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ANNUAL REPORT 2002-2003



उत्तर पूर्वी पर्वतीय कृषि अनुसंधान परिसर
भारतीय कृषि अनुसंधान परिषद
उमियम - 793 103
मेघालय

ICAR Research Complex for N.E.H. Region
(Indian Council of Agricultural Research)
Umiam - 793 103, Meghalaya

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(Indian Council of Agricultural Research)
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Published by:
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Umroi Road, Umiam-793 103, Meghalaya

Designed and printed by *print21*, Ambikagirinagarpath R.G.Baruah Road, Guwahati 781024, Ph. 2202028

PREFACE

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In the light of globalization of agriculture and allied sector and also increased concern for natural resource conservation, management and utilization, I have the pleasure in presenting the annual report 2002-2003 of the Institute to the scientific community, students, policy makers and farmers.

ICAR Research Complex with its six regional centres is a unique Institute which encompasses all the disciplines of agriculture, horticulture, agricultural engineering, agroforestry, animal and fishery sciences and social sciences. All the works carried out for 365 days by 15 divisions/sections is little difficult to be projected in a report. However, a sincere effort has been made to focus some of the key areas where the institute carried out its research activities during the year 2002-2003. This was also the year when the institute developed its programme for the tenth five year plan with a thrust on organic agriculture, integrated farming system approach both at the institute level and at farmers' field through technology assessment and refinement programme.,


The institute could also contribute significantly to the farming community of the region by way of releasing 4 rice varieties for mid-altitude ecosystem and also one turmeric variety with 6.8-7 % curcumin content, besides establishing one eco-hatchery for large scale production of fish fingerlings. The institute also carried out a number of externally funded projects with focus on benefiting the farming community. TAR programme executed at community/village levels brought in the much needed visibility of the institute in addition to opening up the dimension of partnership and participatory research. The Institute also took up other related programmes on technology transfer through IVLP project for technology backstopping.

In an effort to develop the human resources from within and outside the institute, scientific, technical and administrative staff were deputed for advanced training and PhD students from within the region were accommodated in the institute for pursuing the research work in different areas. The students had affiliation to the regional universities. The year was significant as the institute could take a leap towards the need of 21st century research.

I wish to compliment the members of editorial board for compiling/editing and bringing out the report in the present form, which I am sure would be useful to the readers particularly to have an insight to the hill area research programmes.

I also wish to record my sincere thanks to Dr. J. S. Samra, Deputy Director General (NRM) and Dr. K.R. Solanki, ADG (AF) for their unstinted support and guidance at every step which undoubtedly help the institute to achieve what have been reported in this report.

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(K.M. BUJARBARUAH)
Director

1. EXECUTIVE SUMMARY

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1. EXECUTIVE SUMMARY

During the year under report, Research, Extension and other activities of the Institute were covered through a total of 260 numbers of Institutional Projects, 40 numbers of NATP and 9 numbers of Adhoc & AICRP Projects. Notable achievements were that of the release of 4 rice varieties for mid-altitude ecosystem and one turmeric variety for hill areas.

Several new initiatives were taken up both at the Institute as well as farmers' field. Some of the initiatives were:

- a. Assessment of the developed technology on Integrated Farming System at farmers' field;
- b. Establishment of ATIC for effective service to the farming community;
- c. Round the year Maize Production Programme;
- d. HRD Programme on plant and animal bio-technology;
- e. prototype manufacturing of farm implements;
- f. integrated watershed development programmes;
- g. Initiation of research work on bio-control agents for pest and disease including IPM on vegetables;
- h. PCR and ELISA based animal disease diagnosis programme;
- i. Breeding and production of important fish fingerlings including work on ornamental fishes and
- j. Development of multi-tier agro forestry models etc.

On the specific research on cereal improvement programme, the Institute carried out two AVT, trials and one trial each of IVT, ST, RCRT and IURON. In AVT none of the 18 genotypes tested was better than the Institute developed variety Bhalum-1, which was used as local check under upland rice. However, under IURON trial 3 genotypes were observed to be better yielder than Bhalum-1.

Similarly, 6 trials under RCRT-AR, RCRT-LL, AVT-2-BT, AVT-IEH, IVT-IE and IVT-IM were conducted under low land rain fed condition and the best genotypes were identified for further trials. Under high altitude conditions, the Institute released variety, i.e. NEH Megha Rice-2 continued to be the

best yielder, while RCPL-1-17C, another line pursued by the Institute was found significantly superior in yield to the earlier Institute released variety NEH Megha Rice 1. The Institute also continued its programme on screening of segregating generation under both upland and low land situation. 5 selected population from F_6 and 18 from F_5 under upland were advanced to next generation. Similarly 52 F_2 and 10 F_3 genotypes were advanced to next generations from low land trials.

In rice biotechnology anther culture was used for generating double haploid lines in rice besides molecular screening of transgenic rice plants. Molecular screening was carried out at NRC on Plant Biotechnology. Five plants with single insertion and 2 plants with double insertions were selected for generation advance.

Work on varietal evaluation and testing of both Institute released rice varieties and established varieties from other sources were carried out under upland and low land situation in all the regional centres of the Institute. Breeder Seed Production Programme of the identified varieties was also taken up. Varietal improvement/development programmes were supported by suitable agronomical packages, soil health parameters, disease and pest control measures at various centres.

In maize 377 strains of Kharif Maize and 45 strains of Rabi Maize were evaluated through 17 and 2 trials respectively to identify high yielding and disease resistant strains for early and extra early maturing strains. Suitable strains identified through these trials are indicated in the text. Research was also conducted to increase maize productivity through chain crossing and line x tester crossing method possessing resistant to leaf blight. 38 selected F_1 progenies were advanced to second cycle of selection. In an effort to popularize the identified varieties including Babycorn, Popcorn

and Sweet Corn maize, a total of 150 Front Line Demonstrations were carried out at farmers' field for Vijaya Composit, RCM 1-1; 1-2 and 1-3 and Gujrat Makki 1. Morpho-agronomic characters of maize germplasm were also recorded. Another significant step taken was the production of maize round the year. Through maize/soil interaction/ studies, it was observed that use of higher level of P resulted in reduced uptake of micronutrients, while FYM application increased micronutrient uptake. Similarly liming was observed to have decreased the uptake of Fe, Mn, Cu and Zn by maize grain. Through a field study on control of the major maize pest, Cob-borer, it was found that spraying of 1000 ijs of *Steinernema spp./ml* could kill larvae upto 97.7 % within 72 hours of treatment.

In an effort to improve maize production in jhum field, 13 maize population lines are being developed through inter-varietal crosses in Tripura, besides generation advancement from 2 jhum maize and 3 composite and hybrid segregating trials.

In pulses sector, varietal evaluation and screening of rice bean, moong bean, urd bean, pigeon pea, chick pea, black gram, green gram and horse gram were carried out at the Institute headquarter as well as at its regional centres. Details on the number and type of varieties including the variability observed in some of the local collections are given in the text. In addition to the varietal evaluation programme and development of disease/ pest control measures, the Institute also worked on the development of transgenic for stem and pod borer in pigeon pea.

Oilseed research was mainly centered around soybean, groundnut and rapeseed mustard. In case of soybean F_4 generation crosses were evaluated for rust and frog eye leaf spot disease resistant qualities. In groundnut, JL-24, ICGS-76, TKG-19A, BAU 13, GG13 continued to be recognized as suitable varieties for the region with yield potential ranging from 20.91 q/ha (JL-24) to 31.7 q/ha (BAU 13). It was observed by the Institute over the years that groundnut had very high potentiality for the region. In order to promote its cultivation processing backup for the farmers has now been planned.

Horticultural research was carried out on fruits, vegetables, spices, plantation crops and floriculture

in all the centres. Among fruits, citrus (mandarin and lemon), peach, pineapple, guava, kinnow, kiwi and passion fruits were covered through independent project. For citrus, seedling originated plants were observed to be performing better than micro-propagated plants. As many as 34 germplasm of citrus and 19 of indigenous fruits were conserved. Suitable varieties of peach, guava, pineapple and other fruits were identified. Maximum numbers of leaves per plant and stem diameter in khasi mandarin were recorded in grafted plants. Citrus (Volka Mariana) rootstock disease free planting material were also produced through tissue culture.

Germplasm evaluation with simultaneous attempts on development of suitable varieties was carried out on most of the vegetables grown locally. The tomato varieties developed by the Institute namely Manikhamnu, Manileima and Manithoibi have been recorded to have given excellent yield under All India Coordinated Trials (AICRP).

Cole crops like broccoli were also introduced in the region. Among spices as many as 34 varieties of ginger and 41 of turmeric were screened and their germplasm maintained besides undertaking seed production programme for the Institute released turmeric variety, Megha Turmeric. Other two spices crop namely black pepper and large cardamom were introduced under three and two tier agro forestry system. Among ornamental crops, 33 varieties of gerbera and 49 of gladioli were evaluated for further propagation.

Considering the soil status of the region, soil scientists initiated works on integrated nutrient management for different crops. While application of 60 kg N+ 5t FYM/ha + Azotobacter recorded highest grain yield in upland paddy, highest grain yield in low land paddy was recorded when 60 kg N/ha was applied as 50% basal + 50% at panicle initiation stage. INM (Integrated Nutrient Management) practice followed with NPK+ FYM+ Bio fertilizer + lime in maize-mustard cropping system recorded highest grain yield in both maize and mustard. Through another study attempted towards enhancing soil moisture regime, it was recorded that organic mulches like pine leaf, rice straw, jungle grass, mustard stalk etc. could enhance moisture regime by 16.4 to 20.6 per cent.

Farmers of the region are experiencing heavy agricultural losses in the under story of pine, a dominant forest species of this region due to its deleterious effect on crop growth and productivity. Hence 75% canopy of the natural stand of pine (25 years age) was manipulated for growth of agricultural crops. It was observed that perilla, pigeon pea, sweet potato and rice bean could be intercropped successfully with pine besides ginger, turmeric and colocasia. Ginger gave the yield of 109.44 followed by turmeric 106.67 q/ha in managed stands of pine (*pinus kesiya*).

In a study on integrated agro-aquaculture (IAA), a water-harvesting structure was created over 0.90 ha of marshy land to establish IAA models to increase cropping intensity of the system with five components namely i. fishery cum piggery, ii. fishery cum duckery, iii. fishery cum goatry, iv. fishery cum poultry and v. fishery cum dairy using the stocking density of fish fingerlings as 6000/ha. The experiment is in progress.

An inventory of the edible bamboo species of NEH Region was prepared after surveying 141 market places out of 349 covering 2081 primary and secondary vendors. According to the survey, on an average, 1,978.816, 2188.244, 442.031, 432.634, 441.592 and 201.331 ton of bamboo shoots are harvested annually for consumption and young shoots of *D. hamiltonii* are most preferred followed by *D. giganteus*, *D. sikkimensis*, *M. baccifera*, *D. hookerii* and *B. balcooa* respectively. Consumption of fermented shoots was recorded to be ca. 1,354.7 ton/yr with a highest annual consumption in Arunachal Pradesh, (ca. 872.35 t/yr) followed by Manipur (242.92 t/yr) and Nagaland (126.74t/yr). Nutritive values of some of the commercial edible bamboo species were also estimated and it was found that young edible bamboo shoots are rich in macronutrients, particularly in calcium (1.20-1.86 g/100g), potassium (.021-.027 g/100g), phosphorus (0.54-1.03 g/100g) and magnesium (.041-.046 g/100g) and vitamins.

In order to promote the concept of poly houses low cost poly houses for terraced beds in hills were promoted to grow vegetables crops throughout the year. The poly house was constructed using locally

available bamboo and covering it with 200 Micron UV film costing around Rs. 133.25/m². Capsicum, Tomato, brinjal, french bean, cabbage, cauliflower, pea etc were grown on beds while bitter gourd, bottle gourd and cucumber were taken on risers and it was found that by growing vegetables in poly houses, the farmers can generate a subsidiary income.

In farm machinery sector two short duration and six long duration training programmes on manufacturing and use of improved agricultural implements were organized for the artisans, blacksmiths and small scale manufacturers of the region where 135 manufacturers and state government technicians participated. A total of 39 different types of improved tools and equipments were produced and sold to various agencies and farmers of the region. Two prototypes were taken for feasibility studies to evaluate its adoption while 3 implements and few horticultural tools were taken for front line demonstration to the farmers' field.

Six farming systems (FSW1-FSW6) namely Dairy based farming system, Tree based farming system, Microwatershed, Agro-pastoral system, agri-horti-silvi pastoral system and horticulture based farming system were evaluated. The sensitivity analysis showed that at Rs, 20,000 initial investment amount, the Dairy based system will be financially feasible where IRR, B/C and PBV are positive. The evaluation revealed that in NEH region, where household food security is the major thrust, dairy system can be considered as a supplementary source of family income rather than as a commercial farming.

A sub-watershed under Mawpun village covering an area of 57.17 ha was selected for integrated development as model project under the Upper Shipra watershed under Umsning community development block in Ri-Bhoi district of Meghalaya. While developing micro watershed plan for this watershed attempts were made for developing common enterprises, such as large water bodies for producing fish, plantation crops, forest crops, pasture development etc for generating financial resources for community welfare and eco-development. Local crops varieties were replaced by high yielding varieties of radish, laipatta, French

bean, maize, tomato, brinjal etc. New techniques of crop cultivation practices were adopted for maximum return.

Experiment conducted on organic farming to study the effect of different organic manures and methods of placement in French bean cultivar Naga local (pole type) indicated highest green pod yield (89.03 q/ha) with application of Libra organic manure (5t/ha) in furrows. Furrow and pit placement was found better as compared to broadcasting of organic manures.

In Fishery sector, a very good achievement was noted in the collection and documentation of ornamental fishes of the region besides being successful in producing fingerlings of major carps for the farmers.

In animal husbandry research, works on pig, rabbit, poultry and goat were continued with success. Developed pig and rabbit varieties were

tested at farmers field. Vanaraja poultry was assessed under backyard system. All production programmes were supported by health and nutritional packages. One of the significant achievements was that of standardising PCR technology for faster diagnosis of animal diseases.

Evolved and tested technologies were taken to the farming community through both Institute based project and IVLP. 800 farm families were covered under IVLP. ATIC was used to disseminate information and assist in quality seed supply.

Besides above, a number of NATP and other externally funded projects were implemented with tremendous success. Interface meeting with various state governments were arranged to identify researchable issues as well as to apprise the development departments on evolved technologies for adoption.

2. INTRODUCTION

ICAR Research Complex for NEH Region, a premier Institute in the field of agriculture and allied sector research, development and extension in the tribal and backward areas has completed 27 years of its services not only to the tribal farmers but also to the development departments, NGOs and other stake holder. The Institute was setup in 1975 at Shillong, under the aegis of ICAR, a premier autonomous body for the agricultural and allied sector research in the entire country.

ICAR Complex encompasses all important disciplines of agriculture and allied sciences like crop science, horticulture, animal science, farming systems research, agroforestry, fishery science and agriculture engineering for the overall development of the farmers. The Complex has one centre each in every hill state of the NEH Region located at Lembucherra (Tripura), Kolasib (Mizoram), Imphal (Manipur), Basar (Arunachal Pradesh) and Tadong (Sikkim) with its headquarter at Umiam (Meghalaya). One KVK is also attached to every centre to disseminate the technology generated through research undertaken by the Complex.

The main complex at Umiam is about 22 kilometer from the capital town Shillong and situated just 2 kilometers away from the famous Umiam dyke at Guwahati-Shillong highway. Total area at Umiam Complex is about 101 ha with a mild

to steep slope and flat valleys. At present, the area under cultivation is around 70 ha. Research work on 15 various disciplines is carried out which include Plant Breeding, Agronomy, Soil Science, Plant Pathology, Entomology, Agroforestry, Agricultural Economics and Statistics, Agricultural Engineering, Agricultural Extension, Horticulture, Animal Health, Veterinary Parasitology, Animal Nutrition, Animal Production and Fisheries.

Budget

The budget for the year 2002-2003 is as under
(Rs in lakhs)

Budget	Alloted	Expenditure
Plan	500.00	493.36
Non-Plan	1341.00	1336.44

Human Resource

The staff position during the period under report was as under:

Category	Sanctioned	Filled	Vacant
Scientific	192	127	65
Technical	279	237	42
Administrative	133	120	13
Supporting	122	122	-

Thrust Areas

- To evolve sustainable integrated farming systems for the hills to replace Jhum for increased productivity.
- Restoration of degraded/jhum fallow lands through tree based farming.
- Development of feed and fodders resources including locally available fodders for livestock.
- Improvement of Citrus plantation to rejuvenate the citrus industry.
- To increase the overall productivity of different crops through research in cereals, pulses, oilseeds, horticultural, fisheries and other economical crops.
- Animal health coverage and improvement of livestock production system.

Mandate

- To undertake the basic and applied research for delivering technologies based on sustainable farming system for different agroclimatic and socio-economic condition .
- To improve the productivity of the crops, livestock and fishery.
- To act as repository of information on natural resources, different farming and land use systems.
- To impart training in research methodology and use and application of improved technologies for enhancing agricultural productivity.
- To collaborate with the State Department for agricultural development in the region and testing and promotion of improved farming and land use technologies.
- To collaborate with National and International agencies.
- To provide consultancy.

Library

Nature of Journal	Available
Books and Reports	17,055
Back Issues	11,016
Foreign Journals	67
Indian Journal	140
Hindi Books	1867

Computer facilities

The Institute has a rich computer database of library resources. It also provides computerised database on Environmental Degradation as well as meteorological data. A website has been developed depicting update staff position and important information/publication. Every division and section has been equipped with computer as per their requirements.

Linkages

The institute is regularly providing advisory services to the department of agriculture and other allied sectors. Biennial interface meetings are held at the institute to discuss various problems of agriculture and related matters for research and development with Department of Agriculture, Government of Meghalaya and scientists of various disciplines. The information generated through research is passed on to the farmers through line departments, off farm research, Kissan Mela, front line demonstration of the technologies etc.

IMPORTANT EVENTS

Kisan Samman Week

Kisan Samman Week was celebrated on the occasion of Birth Centenary of Late Ch. Charan Singh, Ex-Prime Minister of India w.e.f 18 - 23 December 2002 at ICAR Research Complex, Umiam, Meghalaya. This programme was inaugurated by the Hon'ble Union Minister of State for Agriculture, Govt. of India, Shri Hukum Deo Narayan Yadav on the 18th of December 2002. More than 1000 farmers attended this programme. During the week many activities related to agriculture, horticulture and livestock were organised. Film show was organised on upland rice cultivation practices, rabbit rearing, mushroom production and



Hon'ble Union Minister of State for Agriculture, Shri Hukum Deo Narayan Yadav at Kissan Samman Week

soil conservation to train the farmers in such aspects. A 'Kisan Quiz' for DD, Shillong was also organised and prizes were distributed. The Kisan Diwas was also celebrated at the regional centres of the Institute.

Secretary, DARE and DG, ICAR visits ICAR Complex

Dr. Panjab Singh, Secretary, DARE, Govt. of India and Director General, Indian Council of Agricultural Research, New Delhi visited ICAR Research Complex for NEH Region, Umiam to review the progress in agriculture and development in the north-eastern region. Hon'ble Minister for Agriculture, Govt. of Meghalaya also attended the meeting as Chief Guest. A number of dignitaries including DDGs from ICAR headquarters, VCs of different Universities and top Officials including Directors of various State Govt. Departments from entire region took part in the deliberations.



Dr. Panjab Singh, Secretary, DARE, and DG, ICAR, New Delhi addressing the delegates

His Excellency, the Governor of Nagaland visits ICAR, Nagaland Centre

His Excellency, the Governor of Nagaland, Shri Shyamal Datta visited Nagaland Centre of ICAR Complex and NRC Mithun on 2nd Nov, 2002. His



His Excellency, the Governor of Nagaland, Shri Shyamal Datta on his visit to Nagaland Centre

views on the visit as recorded in the visitor's book are reproduced as "thanks to ICAR authorities for making my day today. What a lovely surroundings so being professionally managed and run. ICAR has to emerge more robust, bold and pro-active in turning the economy of Nagaland into a thriving one. It can do it and that should be its goal and motivation".

His Excellency, the Governor of Tripura visits ICAR, Centre Tripura

His Excellency, the Governor of Tripura, Lt. General (Retd.) Shri K.M. Seth visited Tripura centre of ICAR Complex for NEH Region on 21st Nov. 2002. Many State Govt. Officials were also present on the occasion. Dr. K. M. Bujarbaruah, the Director of ICAR Complex welcomed the Chief guest and appraised him of the research activities going on at the centre.



Dr. K. M. Bujarbaruah welcoming His Excellency, the Governor of Tripura, Lt. General (Retd.) Shri K.M. Seth

National Symposium

The XXI conference of IAVMI and National Symposium on Prospects and challenges for better livestock and poultry health management employing conventional and molecular approaches was inaugurated by His Excellency, the Governor of Meghalaya, Shri M.M. Jacob on 7th February, 2003 at ICAR Complex, Umiam.



His Excellency, the Governor of Meghalaya, Shri M.M. Jacob inaugurating the National Symposium.

Training Programme on Plasticsulture

A five days training programme on "Plasticsulture Interventions for horticulture and agriculture development in Meghalaya" was organised by the division of Agricultural Engineering of ICAR Complex at Shillong. The programme was inaugurated by Sri W.M.S. Pariat, IAS, Principal Secretary of Agriculture, Govt. of Meghalaya on 29th April, 2002.

Distribution of inputs to farmers

Under Jai Vigyan Project on Household Food and Nutritional Security fee inputs were distributed to farmers with a view to uplift the economic condition of poor farmers. They were provided improved pig husbandry practices and input service like feed, medicine and quality pigs.



Distribution of inputs to farmers

Quinquennial Review Team Visits the Complex

QRT Team comprises of 5 eminent scientists visited the Complex under the Chairmanship of Dr. D. N. Borthakur, Ex-VC, AAU and the founder Director of ICAR Complex for NEH Region. The other members of the team were Dr. Ram Babu, Dr. A. Singh, Dr. A.B. Sarkar, Dr. K.K. Jindal and Dr. Y.P. Sharma, Joint Director (Hqtrs), ICAR Complex, Umiam as member Secretary. The team reviewed the progress of the work done wef 1994-95 to 1999-2000.



Dr. D. N. Borthakur, Chairman QRT addressing the meeting

DDG (NRM) visits ICAR Complex

Dr. J. S. Samra, Deputy Director General (NRM), ICAR, New Delhi visited the Institute on 26th June, 2002 to review the research activities of the Complex. He visited different watersheds developed by the Complex at various places including Mawpun and Umroi of Ribhoi district. He also took a round to different divisions and discussed at length regarding the ongoing projects.



Dr. J. S. Samra, DDG (NRM) visiting horticulture farm at ICAR Complex

3. RESEARCH ACHIEVEMENTS

WEATHER

MEGHALAYA

K.K. Satapathy

Umiam is located at about 1010m height above msl between 91° 55' E longitude and 25° 40' N latitude in state of Meghalaya. The trend of different weather parameters e.g. Air temperature, Soil temperature, Relative humidity, Wind direction, Wind speed, Evaporation, Rainfall, Bright Sunshine Hour etc. recorded daily at 0622 hr, 0830 hr and 1322 hr during year 2002 are as follows;

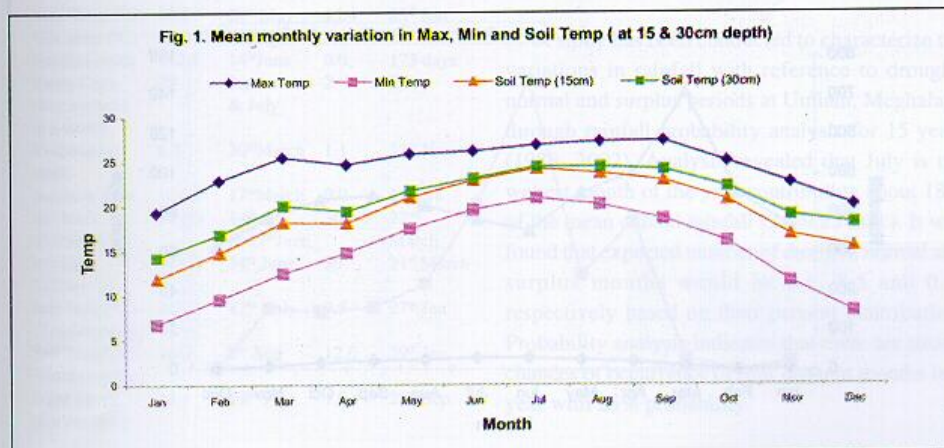
Air Temperature

The mean monthly maximum temperature varied from 19.3°C in the month of January to 27.4°C in the month of September (Fig 1). August was the hottest than the other months. In this month temperature remains in between 23.6 to 30.4°C. Maximum temperature recorded for a single day was highest (30.6°C) on 21st May and lowest (15.4°C) on 29th January. The temperature gradually

increased from January to September (except April) than starts declining till December. Mean monthly minimum temperatures recorded are varied from 5.4°C in the month of January to 20.5°C in the month of July. Mean monthly minimum temperature starts rising from January till Aug and than starts declining and recorded lowest on January. Minimum temperature was highest 22°C on 8th Aug and lowest 2.2°C on 25th January.

Soil Temperature

Soil temperature in the morning at 30 cm depth was slightly higher than that at 15 cm depth and was reverse in the evening. Soil temperature at 15 cm depth varied from 11.9°C in the month of January to 24.2°C in the month of July. After July temperature starts falling till January. Soil temperature at 30 cm depth also followed the same trend. Soil temperature at this depth varied from 14.3°C in the month of January to 24.54°C in the month of Aug. Mean monthly temperature was highest in the month of Aug (26°C). Soil temperature was always less than the Air temperature.



Rainfall & Rainy days

Total rainfall received during 2002 at Umiam was 2516.8 mm distributed over 192 days. Annual rainfall was about 211.8 mm less than last year (2001) and about 117.1mm more than annual average rainfall (2399.7mm)(Fig 2). Total numbers of rainy days were also more than the normal (128 days). Rain occurred almost every month of the year ranging from 1.3 mm in the month of December to 738 mm in the month of June. There were about 173 days in the year without rain. Highest amount of rainfall for a single day were recorded on 24th June (112.7mm).

Evaporation

Evaporation measured by a USA-Class A pan evaporimeter was recorded highest in the month of March (141.3mm) and was lowest in the month of December (62.4mm). During the months of December to March evaporation was higher than the rainfall while from April to November rainfall was higher than evaporation. The total evaporation for this year was 1041.9mm, which is 42.4mm less than the previous year and 12.4mm less than the yearly normal evaporation.

Wind Speed & Direction

Mean monthly wind velocity ranged from 2.5 km/hr in the month of July to 4.9 km/hr in the month

of April. During the rainy season wind speed was in the range of 2 to 5 km/hr. The highest wind speed of 14.4 kmph was recorded on 19th April with 22 days having wind speed more than 5km/hr. The wind velocity was not significantly high to pose problems to any crop throughout the year. Wind throughout the year mostly blown from the southeasterly direction. Except Aug to Oct and November wind blown from the easterly and northeasterly direction respectively.

Relative Humidity

Relative humidity in the morning at Umiam was highest in the month of June (98%) and the lowest in the month of March (36%) (Fig 3). About 37 days humidity was over 95 per cent. Humidity remained low during the month of September, February and April. The lowest humidity for a single day was recorded as 30% on 22nd March.

Sun Shine Hour

The sunshine hour at Barapani ranged from 2.1 hr/day in the month of July to 8.20 hr/day in the month of March. From June to November sun shine hour ranged from 2.1 to 6.6 hr/day. There were about 32 days where sunshine was available for more than 9 hr per day and about 11 days where sky remained overcast through out the day.

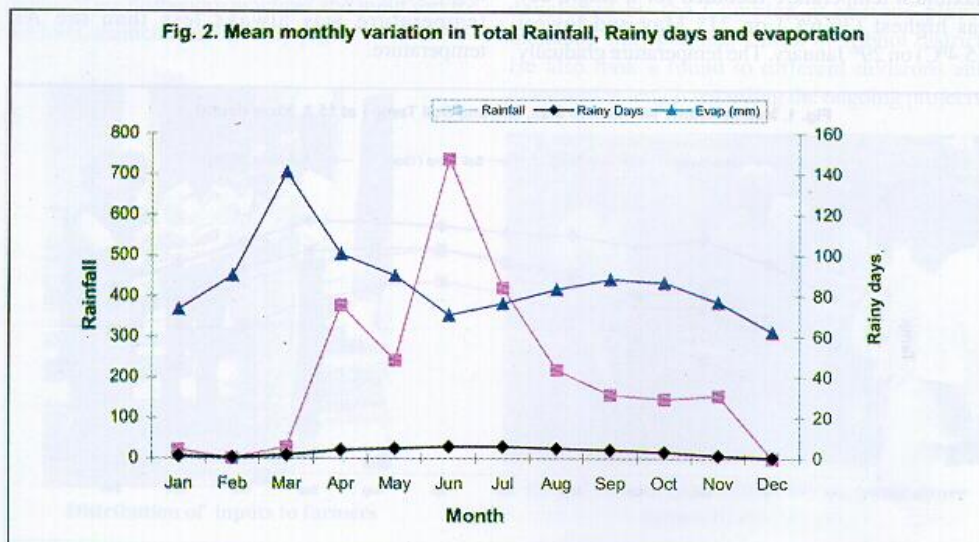


Fig.3 Mean monthly variation in sunshine hours, wind speed, and relative humidity (at 0622 & 1322 Hrs)

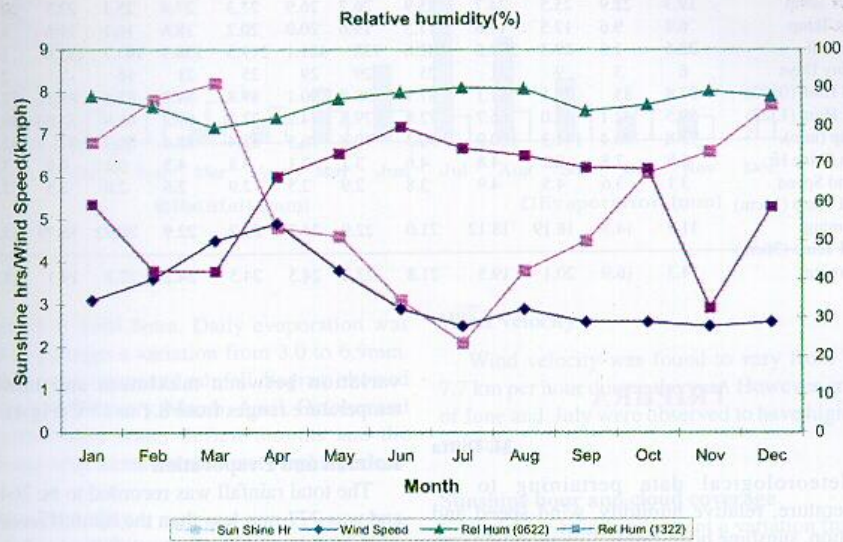


Table 1: Highest and lowest values of weather parameters for a single day.

	Highest	Date	Lowest	Date
Max Temp (°C)	30.6	21 st May	15.4	29 th Jan
Min temp (°C)	22.0	8 th Aug	2.2	25 th Jan
Rainfall (mm)	142.8	14 th June	0.0	173 days
Rainy Days (any amount) in a month	29	June & July	2	Dec
Evaporation (mm)	6.3	30 th March	1.1	13 th Nov
Sunshine hour	10.60	17 th March	0.0	11 days
Rel Hum 0622hr (%)	98 (2)	14 th & 17 th June	36	22 nd March
Rel Hum 1322hr (%)	96 (1)	14 th June	30	21 st March
Soil Temp(°C)-15cm(morning)	26.7	17 th July	9.5	27 th Jan
Soil Temp (°C)-30cm(morning)	26.0	8 th Aug	12.6	29 th Jan
Wind Speed (km per hour)	14.4	19 th Apr	1.0	28 th Sep

Probability analysis of rainfall at Umiam, Meghalaya for crop planning

R. Saha and V.K. Mishra

A study has been conducted to characterize the variations in rainfall with reference to drought, normal and surplus periods at Umiam, Meghalaya through rainfall probability analysis for 15 years (1988- 2002). Analysis revealed that July is the wettest month of the year contributing about 18% of the mean annual rainfall (2439.25 mm.). It was found that expected number of drought, normal and surplus months would be 2.6, 8.5 and 0.9, respectively based on their percent contribution. Probability analysis indicates that there are strong chances of occurrence of four drought months in a year with 25% probability.

Table 2: Monthly normal variation of weather parameters

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Max Temp	19.3	22.9	25.5	24.7	25.9	26.2	26.9	27.3	27.4	25.1	22.7	20.2
Min Temp	6.8	9.6	12.5	14.8	17.5	19.6	20.9	20.2	18.6	16.1	11.6	8.2
Rainfall	22.5	1.6	29.3	379.2	242.6	738	421.1	219.3	158.3	147.7	155.9	1.3
Rainy Days	6	3	9	21	25	29	29	25	21	16	7	2
Rel Hum (0622)	87.8	85	79.5	82.1	87.1	88.8	90.1	89.8	84.0	85.6	89.2	87.8
Rel Hum (1322)	59.5	42.1	42.0	66.7	72.8	79.8	74.2	72.3	69.2	68.9	32.53	58.94
Evap (mm)	73.8	90.4	141.3	100.9	90.3	70.8	76.5	83.4	88.4	86.7	77	62.4
Sun Shine Hr	6.8	7.8	8.2	4.8	4.6	3.1	2.1	3.8	4.5	6.1	6.6	7.7
Wind Speed	3.1	3.6	4.5	4.9	3.8	2.9	2.5	2.9	2.6	2.6	2.5	2.6
Soil Temp (15cm)												
Morning	11.9	14.8	18.19	18.12	21.0	22.9	24.2	23.7	22.9	20.72	16.79	15.5
Soil Temp (30cm)												
Morning	14.3	16.9	20.1	19.5	21.8	23.2	24.5	24.5	24.2	22.3	19.1	18.2

TRIPURA

M. Dutta

Meteorological data pertaining to air temperature, relative humidity, wind speed and direction, sunshine hour, rainfall, evaporation was recorded at Lembucherra.

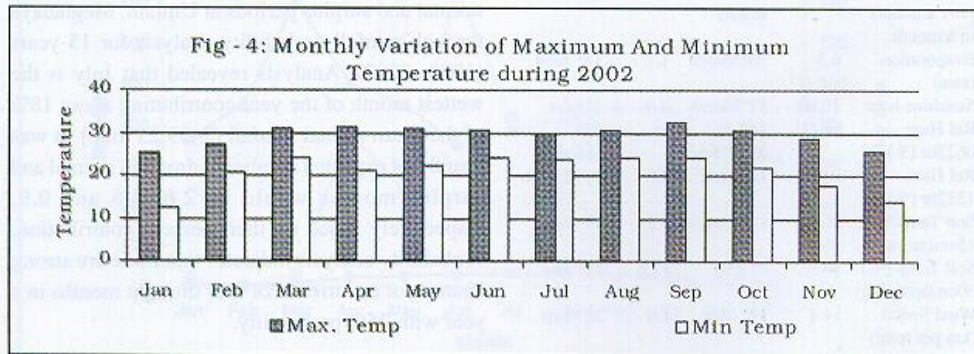
Air Temperature

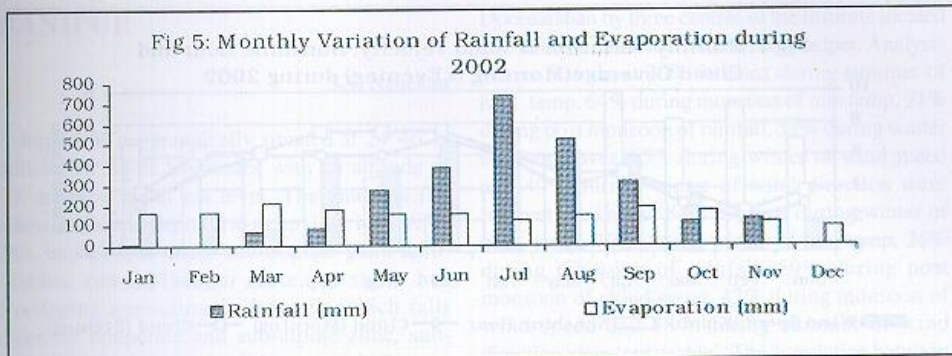
Maximum and minimum temperature from morning to evening was found to vary from 25.3 to 32.4°C and 12.3 to 24.3°C respectively. The highest mean monthly maximum temperature was recorded in September and the lowest mean monthly minimum temperature was recorded in January. The

variation between maximum and minimum temperature ranges from 8.1 to 13°C(Fig 4).

Rainfall and Evaporation

The total rainfall was recorded to be 2644 mm and was 777 mm less than the rainfall received in 2001 which is the highest rainfall recorded in the last 20 years (Fig 5). About 73.9% rainfall was received during the monsoon period (June to September), 9.4% as a post monsoon shower (October to December), 2.9% rainfall in winter i.e. from January to March and 13.7% rainfall in summer season i.e. during April and May. The total rainy days were 138 days. The maximum rainfall (736mm) in a month was recorded during July with 25 rainy days. The total yearly evaporation





amounted to 1884.8mm. Daily evaporation was found to undergo a variation from 3.0 to 6.9mm. Monthly evaporation and rainfall diagram showed that January, February, March, April, October and December were water deficit months and the remaining other months were water surplus periods.

Relative Humidity

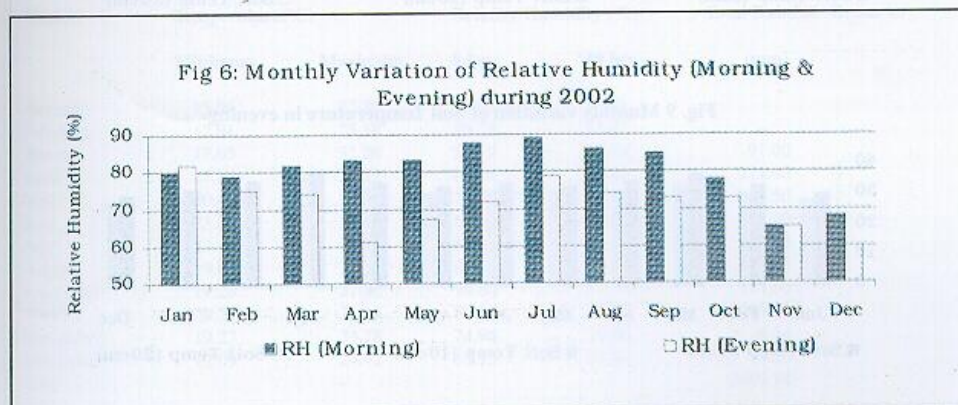
Relative humidity was found to be varying from 65 to 89 per cent and 60 to 82 per cent in the morning and evening respectively. During the monsoon period of June to September relative humidity was observed to be highest in the morning and higher relative humidity was observed in evening during month of January (Fig 6).

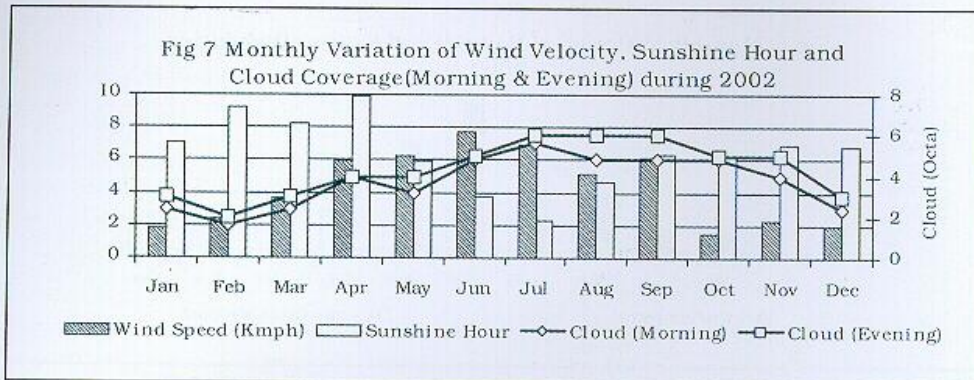
Wind Velocity

Wind velocity was found to vary from 1.5 to 7.7 km per hour during the year. However, months of June and July were observed to have high wind velocity.

Sunshine hour and cloud coverage

Sunshine hours underwent a variation from 2.3 to 9.9 hour per day during the year. On the other hand, cloud cover showed a variation from 3 to 7 and 3 to 6 octa respectively (Fig 7) in the morning and evening. Low sunshine hour were recorded during the month of June to August with higher cloud cover. However, winter and summer months had more sunshine hours.

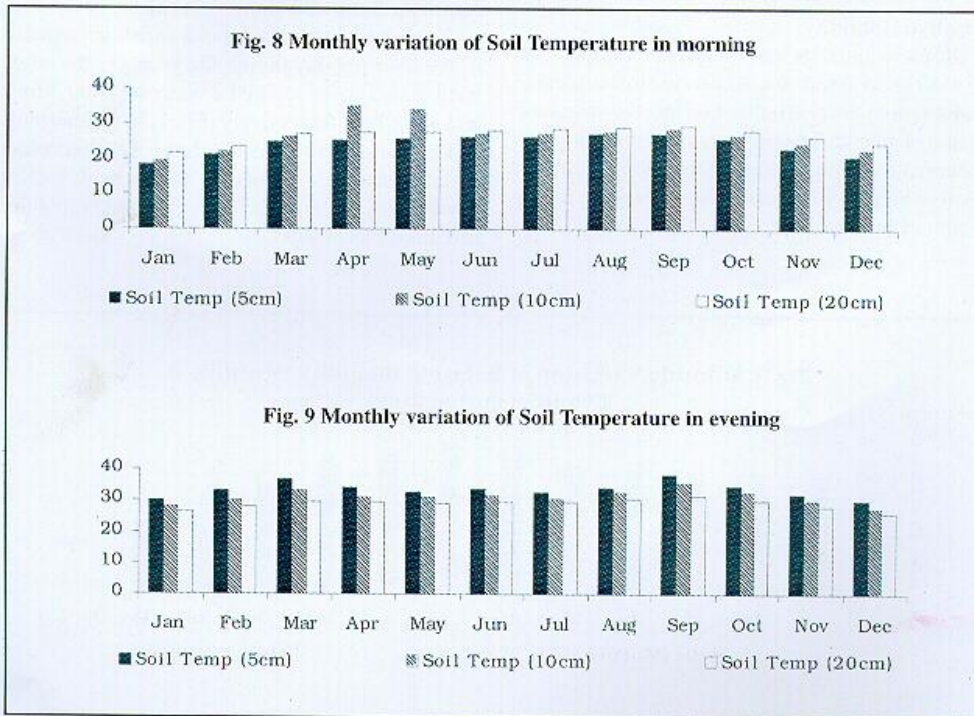




Soil Temperature

Soil Temperature was recorded from 5 to 20cm depth at every 5 cm interval both in the morning and evening. In the morning, average soil temperature at 5, 10 and 15cm depth was observed as 24.3, 26.7 and 26.7°C, respectively (Fig 8).

Similarly, in the afternoon average values of 33.6, 31.3 and 28.9°C was recorded (Fig 9). Soil temperature showed an increasing trend above the depth in the morning but a decreasing trend along the depth in the evening was recorded.



MANIPUR

S.V. Ngachan

Imphal is geographically situated at 24° 46' N latitude, 93° 54' E longitudes with an altitude of 774 m above mean sea level. The land has flat valleys surrounded by mild to steep slope hills. AAS Unit, Imphal falls under sub-tropical plain agro-climatic zone. Manipur state, as such, has overlapping agro-climatic features, which falls under the temperate and sub-alpine zone, sub-tropical plain zone and mild tropical hill zone. Weather data are being recorded daily at the centre and reports on weather are received from Imphal Airport for compilation.

Agrometeorological Advisory Service

K.K. Satapathy, M. Datta & S.V. Ngachan

On the basis of weather forecast received twice in a week from National Centre for Medium Range Weather Forecasting, Department of Science & Technology, Govt of India, New Delhi, advisory bulletins were prepared and disseminated through various media i.e. local dailies, All India Radio and

Doordarshan by three centres of the institute located at Umiam, Lembucherra and Lamphelpet. Analysis shows that about 70% forecast during summer of max. temp, 64% during monsoon of min temp, 91% during post monsoon of rainfall, 51% during winter of cloud cover, 55% during winter of wind speed and 49% during winter of wind direction were 'correct' and about 84% forecast during winter of max. temp, 70% during winter of min temp, 26% during monsoon of rainfall, 59% during post monsoon of cloud cover, 42% during monsoon of wind speed and 68% during summer of wind direction were 'not usable'. The correlation between forecast and observed values were found high in the monsoon season (0.4) followed by pre monsoon (0.3), post monsoon (0.2) and winter (0.2). A set of identified progressive farmers made use of the weather forecasts/agro-advisories prepared by this AAS Unit in planning for their field operations in different districts of the states and their feed back was utilized in preparation of the agro-advisory bulletins.

MIZORAM

N.S. Azad Thakur

The various weather parameters of the Kolasib centre at Mizoram are given in Table 3.

Table 3: Mean monthly weather parameters of ICAR Mizoram Centre, Kolasib (Mizoram) for the year 2002.

Month	Temperature(°C)		Relative Humidity (%)		Total Rainfall (mm)	Remarks
	Minimum	Maximum	8 hrs.	14 hrs.		
January	15.94	22.36	67.03	59.68	-	
February	17.91	25.18	56.75	53.07	-	
March	17.65	32.20	52.19	50.70	91.00	
April	17.86	31.22	67.46	65.40	212.40	
May	20.47	32.93	73.48	72.19	544.50	
June	23.83	31.48	86.40	81.03	335.00	
July	23.14	30.25	83.80	82.29	347.70	
August	19.62	30.83	85.25	85.09	547.60	
September	19.28	31.46	79.60	77.10	114.00	
October	20.77	31.15	80.30	73.03	205.20	
November	19.27	33.78	74.96	75.46	8.24	
December	12.09	24.72	63.13	63.40	4.20	
Total	-	-	-	-	2409.84	

RICE

ARUNACHAL PRADESH

Performance of wetland paddy

S.K. Sarangi and L.C. De

TOX 3093-10-2-32 gave highest yield of 40.63 q ha⁻¹ followed by PSR 88090-30-2-4 (37.5 q ha⁻¹) and DR-92 (36.56 q ha⁻¹), among the 10 varieties tested. The plant height varied from 31.1 cm (RPCL-1-171-3p) to 100.1 cm (*Amru Joha*). Longest panicles (29.0 cm) were produced by PSL 85048-19-3-1P, whereas *Amru Joha* produced shortest panicles of 26.5 cm. The number of ear bearing tillers varied from 9 (RCPL-1-171-3P, *Amru Joha* and RCPL-151-1P) to 13 (PSR 88090-30-1-2-4). Test weight varied from 24.25 g (TOX-3241-221-2-2-3) to 28.63 g (ITA 222). All the varieties matured in 146-148 days except *Amru Joha*, which matured in 158 days.

Evaluation of upland rice varieties

Twelve rice varieties including one local (*Yamuk*) were evaluated for their yield parameters under Basar conditions (Table 3). Results revealed that the longest plant height was recorded in *Yamuk* (83.5cm) and the shortest in WAB 96-1-1 (52.9cm). IR 66421-039-2-1 had longest panicles (24.3cm), but maximum ear bearing tillers was observed in case of TRC-87-251 (6). The test weight of the varieties varied from 22.36 g (TRC-87-251) to 28.78 g (IRAT-216). Highest grain yield was recorded in IR 6008-32 (34.4q ha⁻¹) followed by IR 65907-206-4-B and IR 63380-16 (29.6 q ha⁻¹ each). The local variety *Yamuk* produced lowest grain yield of 10.65 q ha⁻¹. Maturity period of the varieties varied from 112 (IRAT-216 and *Yamuk*) to 133 days (CNAX-2888-B-12-1-1).

MEGHALAYA

Upland rice

A. Pattanayak & A. Annadurai

Six yield trials viz. Advanced Variety Trial 1 & 2 (AVT 1 & AVT 2), Initial Variety Trial (IVT), Station Trial (ST), Research Complex Regional Trial (RCRT) and International Upland Observational Nursery (IURON), were conducted under upland direct sowing conditions. In the AVT 1 & 2, a total of 18 genotypes were tested with Bhalum 1 an Institute developed variety as local check. None of the genotypes was better than Bhalum 1. However, in AVT1, HPR2140 was at par with local check and matured 7 days earlier. In AVT2, RCPL1-39 was at par with the local check. In the IVT, three genotypes viz. VL3967, VL3959 and HPR 2198 yielded higher than RCPL1-29. General yield of the trial was low due to moisture stress at flowering (Table 1).

In the RCRT, 17 genotypes were tested with 3 checks. An exotic genotype IR65907-206-6B was the highest yielder (51.5 q/ha). In the Station Trial with selected genotypes from various trials of previous year, three genotypes viz. YN1353-3, IR71524-44-1-1 (selected from IURON) and IET 16482 (selected from AVT 2) were better yielder than check variety Bhalum 1. In the IURON, three genotypes viz. IR60080-46A, IR70334-14-1-1-1 and IR72768-15-1-1 yielded significantly higher than local check Bhalum 1 (Table 4).

Lowland

A. Annadurai & A. Pattanayak

Six yield trials viz. RCRT-AR (aromatic), RCRT -LL (lowland), AVT2-BT (basmati type), AVT-IEH (intermediate early - hills), IVT - IE (intermediate early), IVT-IM (intermediate maturity), were conducted under rainfed lowland condition.

In the RCRT-AR, two genotypes yielded significantly higher than the best check, Pusa Basmati1 and IET 16332 was the highest yielder (Table 5). Aromatic genotype IET16310 was the

Table 4 : Yield and maturity of promising upland genotypes

Rank	RCRT	IURON	AVT 2	Station Trial	IVT
1	IR65907-206-6B (51.15) 123 days	IR60080-46A (55.45)	Bhalum 1 (42.92) 120 days	YNI1353-3 (37.6) 130 days	VL 3959 (31.23) 106 days
2	Bali (42.63) 142 days	IR70334-14-1-1-1 (51.13)	RCPL1-39 (40.94) 123 days	IR71524-44-1-1 (33.0) 125 days	HPR2198 (25.15) 123 days
3	IURON 2000-414 (42.03) 123	IR72768-15-1-1 (50.27)	RCPL1-35 (38.5) 123 days	IET16482 (26.7) 109 days	VL 3967 (23.83) 106 days
Check 1	Bali (42.63) 142 days	RCPL1-29 (44.75)	Bhalum 1 (42.92) 120 days	Bhalum 1 (22.12) 120 days	Bhalum 1 (21.9) 120 days
Check 2	Bhalum 1 (42.03) 120 days	UPLRI-5 (37.17)	VL Dhan 221 (17.5) 97 days		
CV %	9.7	8.2	11.1	10.8	15.1

Figures in parenthesis are yields in q/ha.

highest yielder (44.59 q/ha) in the AVT2-BT. Both of these genotypes were moderately resistant to blast (score 3-4) compared to the check genotypes, which were susceptible to blast. In the RCRT-LL, RCM-9 was the highest yielder (43.92 q/ha) and was significantly superior to both Ngoba and Lumpnah 1, which were used as checks. In the trials for intermediate to early maturity category (AVT-IEH and IVT-IE) only VL98-3861 (IET 16863 – yield 54.86 q/ha – maturity 120 days) showed yield comparable to Shahsarang 1 (53.3 q/ha, maturity 140 days). Although the genotype matured early, it was susceptible to blast. In the intermediate maturity group (IVT-IM) VL4422 (IET 17639 – yield 53.38 – maturity 125 days) was comparable to Shahsarang1 and matured 15 days earlier than Shahsarang1.

Table 5 : Yield and maturity of promising lowland and aromatic genotypes.

Rank	RCRT – AR	RCRT – LL	AVT2 - BT
1.	IET 16332 (38.86) 146 days	RCM – 9 (43.92) 147 days	IET 16310 (44.59) 130 days
2	IET 16310 (34.96) 146 days	RCPL1-52 (41.1) 146 days	IET 16313 (38.31) 130 days
3	Pusa Basmati 1 (31.24) 135 days	RCPL1-51 (40.86)	IET 15391 (38.20) 136 days
Check 1	Pusa Basmati 1 (31.24) 135 days	Ngoba (40.56) 140 days	Basmati 370 (21.9) 139 days
Check 2	Basmati 370 (28.22) 143 days	Lumpnah 1 (39.30) 140 days	Pusabasmati 1 (12.8) 140 days
CV %	12.3	14.26	11.8

Figures in parenthesis are yields in q/ha.

High altitude

A. Pattanayak

Four yield trials (AVT 1 & AVT 2 with two dates of sowing) and an evaluation trial of germplasm from earlier collections and previously discarded hybrid material were conducted at Upper Shillong. In the AVT 2 at late sowing RCPL1-17C was found to be significantly superior (35.1 q/ha – maturity 154 days) to NEH Megha Rice 2 (31.7 q/ha – maturity 154 days). In other AVTs none of the genotypes was better than the best check variety NEH Megha Rice 2. In the evaluation trial, two genotypes 8F8-10-1P-5-6 and RCPL1-7C (40.7 q/ha and 48.5 q/ha, respectively) were significantly superior to NEH Megha Rice 2 (38.5 q/ha). Yield and maturity of some of the genotypes selected for further evaluation are given in Table 6

Screening of segregating generations

A. Annadurai

Under upland condition 18 populations in F₆ generation and 25 populations in F₅ generation were

screened. Five selected populations from F_6 and 18 populations from F_5 were advanced to next generations. Under lowland condition 255 F_2 genotypes and 69 F_3 populations were grown. Fifty two F_2 single plant selections and 10 F_3 single plant selections were advanced to next generations.

Table 6 : Yield and maturity of some promising cold tolerant genotypes and checks.

Genotype	Yield (q/ha)	Maturity (days)
RCPL1-7C	48.5	151
8F8-10-1P-5-6	40.7	155
RCPL1-5C	39.2	155
RCPL1-8C	33.2	151
Ryllo Red 4	34.2	155
Checks		
NEH Megha Rice 2	38.5	155
RCPL1-10C	36.5	151
NEH Megha Rice 1	34.6	151

Germplasm characterization and evaluation

B.K. Sarma & J.K. Singh

Characterization was done on upland (355 including pre - NATP), and lowland rice (255 including pre -NATP) following the procedure given in Minimal Descriptor of Agri-horticultural crops (part-I) of NBPGR. The design adopted for evaluation was Augmented Randomized Block Design. Wide variability among the materials was observed in all morpho-agronomic characters (Table 7).

Table 7: Germplasm characterization and evaluation of rice varieties

UPLAND RICE	
Character	Range
Flag leaf length	20.9 – 70.1 cm.
Flag leaf breadth	1.12 – 3.24 cm.
Days to 50% flowering	77-124 days
Leaf length	23.2-75.1cm
Leaf width	1.04 -2.08cm
Ear bearing tillers/plant	5-12
Plant height	28 -134cm.
Penicle length	16 - 29cm
Branches of panicle	5.2 – 16.2
Yield/plant	0.7-28.6gm.
100 Seed weight	1.2 – 3.3gm.

LOWLAND RICE

Character	Range
Flag leaf length	19.5-40.6cm.
Flag leaf breadth	0.48-1.98cm.
Leaf length	23.3-55.8cm
Leaf width	0.7-1.8cm
No. of leaf	3.2-5.8
Plant height	73.0-145.7cm.
Penicle length	15.6-26.5cm
Ear bearing tiller	4.0-16.0
Branches of panicle	7.6-13.2
Penicle weight	0.9-5.7gm.
Yield/plant	1.1-20.5gm.

Qualitative characters were recorded on plant vigor, basal leaf sheath colour, leaf colour, leaf pubescence, panicle exertion, panicle type, stigma colour, and seed colour.

BIOTECHNOLOGY

A. Pattanayak, Alpna Das & B. Bhattacharjee

Anther culture for generating doubled haploid lines in rice

A total of 534 doubled haploids were regenerated from 8 crosses. Among these, three doubled haploids viz. DH 18 (from DR92 x IET 16469), DH 235 and DH 239 (from Ngoba x H274-27-21) showed 29 – 33 g/plant yield (compared to 22-25 g/plant yield of best check), 5 – 8.5% higher spikelet fertility and 7 – 10% higher spikelet number than the best check RCPL 1-87-4. Seeds of these genotypes are being multiplied for larger plot trial.

Molecular screening of transgenic rice plants

Molecular screening of putative transgenic plants carrying *CryIA(c)* and *AGP* gene was completed (Fig. 10). The work was carried out at NRCPB. Among the *Cry* gene containing plants, 18 of IR-36 and 10 each of RCPL 1-2C and 1-3C were positive. Number of insertions varied from 1-3. Five plants with single insertions (3 of IR36, 2 of RCPL 1-2C) and two plants with double insertions (of RCPL 1-3C) were selected for generation advance. Further transformation experiments have been initiated for transferring *AGP* gene.

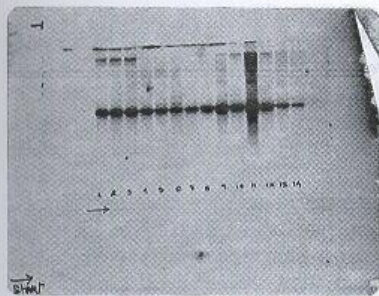


Fig.10 Southern blot analysis of T₂ transgenic rice plants containing CCryIA(c) gene.

Callus and multiple shoot induction in chickpea

a. Somatic Embryogenesis : Three different media were tested for callus induction from cotyledons and leaf explants

- i) MS-based medium with 2,4-D and kinetin
- ii) B₃-based medium with 2,4-D and kinetin
- iii) MS-based medium with B₃ vitamins, kinetin, NAA and IAA.

MS-based medium with 2,4-D (1.25mg/l) and kinetin (0.25 mg/l) induced better response and upto 70% cotyledon explants and 50% leaf explants showed callusing after 30 days in culture. Healthy nodular calli were formed on the cut surface of the explant (Fig. 11). Percent callusing was highest in C-235 (70%) followed by Pusa 72 (63%) and Pusa 1053 (40%). These calli have been transferred to regeneration medium after allowing them to mature in medium containing BAP (Fig. 12 and 13).

b. Multiple Shoot Induction : Surface sterilized and soaked seeds were cut at the middle and the half containing embryo attached to the cotyledons were cultured in tubes containing one of the following medium :

- i) MS medium with 11 M TDZ
- ii) B₃ medium with 3mg/l 2,4-D

Between these two media, MS with 1μM TDZ showed better multiple shoot induction. Induction frequency was highest in C-235 (100%) followed by Pusa 1053 (93.55%).

c. Root Induction : Fifteen-day old shoots (induced by TDZ) were excised from cotyledonary

nodes and transferred to tubes containing MS medium with auxin for root induction. Roots appeared within 10 days of culture in the medium.

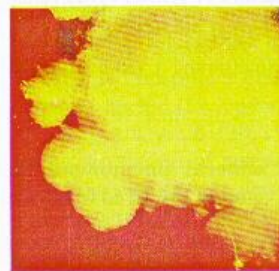


Fig.11 Healthy nodular calli on the cut surface of cotyledon of chickpea cv. C-235



Fig. 12 Cotyledon-derived calli transferred to maturation medium

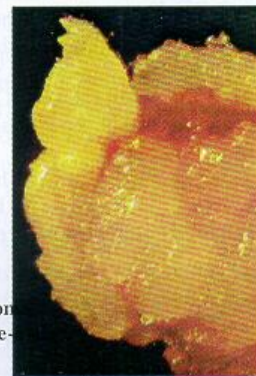


Fig.13 Shoot initiation from hypocotyle-derived calli

Seed multiplication

Seeds of RCPL1-27, RCPL1-29 (50 Kg each), RCPL1-87-8, RCPL1-87-8 (150 Kg each), NEH Megha Rice 1 and NEH Megha Rice2 (200 Kg each) were multiplied.

Variety Release

Four varieties of rice viz. Bhalum 1 (RCPL1-29), Bhalum 2 (RCPL1-27), Lumpnah 1 (RCPL1-87-4) and Shahsarang 1 (RCPL1-87-8) were released.

Rice Agronomy

Effect of low cost mineral amendments on nutritional status of compost prepared from rice straw

N.P. Singh & D.C. Saxena

The experiment comprised of 6 treatments, viz: Chopped straw (CS); CS + Cowdung slurry + Mussoorie rock phosphate (MRP); CS + Cowdung slurry + MRP + Urea; Unchopped straw (UCS); UCS + Cowdung slurry + MRP and UCS + Cowdung slurry + MRP + Urea showed that the mineral amendment had pronounced effect in boosting up the nutritional status of compost. The total N, ammoniacal N, nitrate N, water soluble P and citrate soluble P content of the unamended (ordinary) compost was 0.78%, 0.34%, 18mg/kg, 13mg/kg, 0.031% and 0.221% respectively; the values for the same parameters in mineral-amended rice straw compost was 1.42%, 3.11%, 55mg/kg, 316mg/kg, 0.062% and 0.417% respectively. The mineral amendments narrowed down the C: N ratio of the organic material within a shorter duration of time. On an average, the untreated (unamended) compost showed a C: N ratio of 42:1 at 90 days after start of decomposition, whereas, the mineral amended compost showed a C: N ratio of 13:1 after the same period of decomposition.

Effect of Phospho-Sulpho-Nitro (mineral enriched) compost on the plant nutrient availability and yield of rice

N.P. Singh & D.C. Saxena

The treatments consisted of 6 different types of compost viz; chopped straw (CS); unchopped straw (UCS); CS + slurry cow dung + Mussorie rock

phosphate (MRP); CS + slurry cow dung + MRP + urea; UCS + slurry cow dung + MRP; UCS + slurry cow dung + MRP + urea along with 3 levels of mineral fertilizer @ 100%, 50%, 25% recommended dose of NPK (100:80:40kg NPK/ha) and one control showed marked influence on yield of rice and fertility status of soil. Maximum yield (49.85 q/ha) was obtained from the application of mineral enriched compost @ 10t/ha which was higher than the yield of (44.44q/ha) obtained from application of 100% recommended dose of mineral fertilizer and ordinary compost @ 10 t/ha which produced 40.98 q/ha of grain yield. The residual fertility status of soil after harvest of the rice crop was found to improve due to the application of mineral enriched compost to the crop. A residual fertility status of 421.66kg N, 26.50kg P₂O₅ and 168.33kg K₂O/ha was recorded with mineral enriched compost treatment in comparison to 417.17kg N, 24.86kg P₂O₅ and 165.86kg K₂O/ha under application of 100% recommended dose of mineral fertilizer. The uptake of plant nutrients (125.57kg N, 35.42kg P and 108.15kg K/ha) by the rice crop was higher owing to application of mineral enriched compost than the uptake of 99.58kg N, 28.8kg P and 97.24 kg k/ha obtained due to application of 100% recommended dose of mineral fertilizer.

Response of selected AVT-2-U- (H) upland rice cultures to nitrogen under high and low input management

D.C. Saxena & N.P. Singh

Highest grain yield (29.78q/ha) was recorded with IET-16883 followed by IET-16482 (28.21q/ha) and IET-16876 (20.96q/ha). However, the local check RCPL-1-29 produced higher grain yield (18.8q/ha) as compared to other checks viz; VL Dhan-221 (18.02q/ha) and CH-988 (15.08q/ha). The N application @ 150 per cent of recommended dose produced highest grain yield (22.84q/ha) followed by 100 per cent recommended dose (19.82q/ha) and 50 percent recommended dose (19.65q/ha). Both AVT-2-U (H) IET-16883 and 16482 responded at 150 per cent of recommended dose of nitrogen application.

Response of selected AVT-2-E- (H) lowland rice cultures to nitrogen under high and low input management

Highest grain yield (42.49q/ha) was recorded with IET-16862 followed by Local HYV RCPL-1-87-8 (41.29q/ha) and VL Dhan-81 (34.62q/ha). The lowest yield (19.28q/ha) was recorded with K-39 and this variety was found prone to rat damage. The application of N @ 150 per cent recommended dose produced highest grain yield (35.49q/ha) followed by 50 per cent N/ha of recommended dose (34.05q/ha). However, the variety IET-16862 produced highest grain yield (45.56q/ha) at 50 per cent N/ha and increasing dose of N (100 and 150 per cent recommended dose of N/ha) reduced the grain yield of rice.

Response of NPK on selected rice hybrids under irrigated transplanted conditions

The highest grain yield of paddy (42.90q/ha) was recorded with hybrid rice KHR-2 followed by local HYV RCPL-1-87-8 (42.29q/ha). The national check variety Jaya produced lowest yield (39.57q/ha). In nutrient management levels, $N_{150}P_{80}K_{60}$ produced highest paddy yield (44.90q/ha) followed by $N_{150}P_{80}K_{30}$, which produced 44.26q/ha paddy. Control treatment produced lowest paddy yield (30.20q/ha).

Performance of rice to application of neem cake and growth booster in low land

U.K. Hazarika

Application of 10 q/ha of neem cake and 1.5 kg of crop booster/ha along with 60:40:30 kg NPK/ha produced significantly higher grain yield (33.9 q/ha) under iron affected lowland rice (cv RCPL-1-3) whereas neem cake @ 5 q/ha + 1.5 kg/ha of Crop Booster/ha without NPK produced a grain yield of 30.5 q/ha and NPK @ 60:40:30 kg /ha alone produced rice grain yield of 24.87 q/ha.

Integrated Nutrient Management in low land rice

U.K. Hazarika

Suitable bioorganic sources of nutrients for low land rice (cv DRRH-1) with and without application of nitrogenous fertilizer were assessed. Among the three levels of Nitrogen (N_0 , N_{50} and N_{100}), N_{100} kg/ha recorded maximum grain yield (28.8 q/ha) followed by N_{50} (23.1 q/ha) while N_0 recorded lowest grain yield (20.5 q/ha). Among the bioorganic sources of nutrients, organic compost made from local waste by decomposing paddy straw + FYM charged with MRP, produced highest grain yield (25.5 q/ha), while pig manure and *Azolla* compost @ 10 t/ha each recorded 24.5 and 23.3 q/ha of grain yield/ha respectively.

Integrated nitrogen management in wetland rice

A.S. Panwar & U.K. Hazarika

The study was initiated to study the effect of integrated nitrogen management in wet land rice and to work out optimum nitrogen dose in the presence/ absence of *Azolla* biofertilizers. It was observed that *Azolla* significantly improved grain yield of rice as compared to no *Azolla* treatment. Among the *Azolla* sources, highest yield of 46.52 q/ha was recorded with *Azolla* dual cropping which was 26.82% higher over control.

Yield maximization in low land rice

A.S. Panwar & N.P. Singh

The effect of transplanting date, plant population and nitrogen levels on the maximisation of yield in lowland rice revealed that delaying in transplanting from 1st July to 1st August with an interval of 15 days reduced plant height, number of tillers, number of panicles, panicle length and number of filled grain/ panicle and ultimately yield. Highest yield of rice was recorded with transplanting on 1st July (42.96 q/ha) and lowest with 1st August (34.30 q/ha). Among the plant spacing treatments, highest yield of 41.14 q/ha was recorded with 15 X 10 cm spacing, which was closely followed by the yield (40.19 q/ha) recorded at 20 X 10 cm. It was also

observed that as the planting time delayed, closer spacing recorded highest yield.

Low temperature response to photosynthesis

D.P. Patel and N.P. Singh

The effect of prevailing low temperature on rice leaf photosynthesis during grain filling period indicated significant variations due to varieties and dates of transplanting in terms of plant height (cm), biomass/plant (g), panicle weight (g), grains/panicle, 1000 grain weight (g), panicle length (cm), grain yield (q/ha), stomatal conductance ($\text{m mol/m}^2/\text{s}$). Variety Vivek Dhan 82 showed highest plant height (78.3 cm), biomass/plant (5.3 g), panicle weight (3.1 g), 1000 grain weight (29.3g), panicle length (24 cm) and grain yield (42.1 q/ha).

Photosynthesis rate was found similar in normal as well as in late transplanted conditions. However, a significant reduction in stomatal conductance was observed in late transplanted condition. Variety Vivek Dhan 82 was least influenced by the environmental factors and performed better in normal as well as late transplanted condition compared to the variety RCPL-1-87-8, VL 206 and Thapachini. Highest rate of grain filling was observed in variety Vivek Dhan 82 from 12 to 24 DAA (Days after anthesis) as compared to other varieties and lowest rate was observed in VL Dhan 206. In general, rate of grain filling was higher during 12 to 24 DAA in all the varieties in normal as well as in late conditions.

Use of weed and tree biomass for weed management in rice

Rajesh Kumar, G.C. Munda and A.S. Panwar

Tender vegetative parts of commonly available weed and tree species viz. *Mikania macrantha*, *Ambrosia artemisiifolia*, *Eupatorium adenophorum*, *Ageratum Conyzoides*, *Galinsoga* spp, *Erythrina* spp, *Schima wallichii*, *Pinus kesiya* and mixture of grasses were selected to study their effect on weed growth and yield of wetland rice. Fresh vegetative material was applied one week ahead of transplanting, @ 10 t ha^{-1} . The highest grain yield (4.20 t ha^{-1}) was recorded with application of *Schima*

wallichii followed by hand weeding twice (20 and 40 DAT) (3.70 t ha^{-1}). The lowest yield (2.8 t ha^{-1}) was recorded in weed check. The Weed control efficiency was also highest in *Schima wallichii* biomass treated plot (68.5%) whereas the weed control efficiency in two hand weeded plots was 58.7%.

Integrated Weed Management in direct-seeded upland rice

Rajesh Kumar, Anup Das and U.K. Hazarika

An experiment was initiated during the *Kharif* season 2002 on weed management in direct-seeded upland rice through integrated approach. The treatments included two herbicides, i.e; butachlor and pendimethalin, soil and straw mulching and manual weeding. The first year result shows that application of butachlor @ $1.0 \text{ kg a.i ha}^{-1}$ + straw mulch applied @ 5 t ha^{-1} reduced density and dry matter of weeds and increased grain yield (26.3 q ha^{-1}) which was 34.6% higher than that of unweeded control.

SOIL SCIENCE

UPLAND RICE

Integrated nitrogen (N) management

B. Majumdar, Kailash Kumar, M.S. Venkatesh and Patiram

Three levels of N (0, 30 and 60 kg/ha), 3 levels of biofertilisers (no biofertilisers, *Azotobacter* and *Azospirillum*) and 2 levels of FYM (0 and 5 t/ha) in combinations were taken to study the response of paddy (RCPL-1-29) to integrated N management. The grain yield of paddy increased with increase in N and FYM levels and biofertilizer application. The treatment combination of $60 \text{ kg N} + 5 \text{ t FYM/ha} + \text{Azotobacter}$ registered the highest grain yield (37.95 q/ha) which was 23.2 per cent higher than the yield received with only 60 kg N/ha application followed by a combination of $60 \text{ kg N} + 5 \text{ t FYM/ha} + \text{Azospirillum}$ (36.3 q/ha). The available N content was also more in the plots received *Azotobacter* in comparison to *Azospirillum*.

LOW LAND RICE

Effect of split application of N

B. Majumdar, M.S. Venkatesh,
Kailash Kumar and Patiram

A field experiment was conducted during *kharif* 2002, for 2nd year with 3 levels of N (30, 60 and 90 kg/ha) splitted as basal, 50% basal + 50% active tillering, 50% basal + 50% panicle initiation and 50% active tillering + 50% panicle initiation, 33% basal + 33% active tillering + 33% panicle initiation. The results indicated that grain and straw yields increased up to 60 kg N/ha. The maximum grain (40.30 q/ha) and straw (53.20 q/ha) yields were recorded when 60 kg N/ha was applied as 50% basal + 50% at panicle initiation stage and the grain and straw yields were 21.4 and 18.7 per cent higher respectively over the yields received when 60 kg N/ha was applied as basal.

Virulence of entomopathogenic fungi on rice insect pests

A.N. Shylesha & K. Rajasekhara Rao

Different isolates of *Beauveria bassiana*, *Metarrhizium anisoplae* and *Entomophthora* were collected from soil and also from infected insects. *Entomophthora* was found to be highly virulent on *Cicadulina spectra* (*Cofana spectra*), the white leaf hopper of rice and *M. anisoplae* on soil borne insects. One species of *Entomophthora* was also recorded from maize cob borer larvae. Techniques for mass production of the above entomopathogenic fungi are under progress.

AP CESS FUND PROJECT:

Utilization of indigenous entomopathogenic nematodes (EPNs) for the Management of major insect pests of rice and maize in Meghalaya

A.N. Shylesha, K. Rajasekhara Rao
& K.A. Pathak

Survey for Entomopathogenic nematodes in Meghalaya

Work on the survey of EPNs from different localities of Meghalaya was continued and soil

samples from various pockets of Meghalaya were collected and baited for trapping EPN fauna. A total of 411 samples were baited and in 51 samples, infection of bait insect *G. mellonella* was observed. Samples from Barapani (3 Nos) contained *Steinernema* Sp. and samples from Burnihat, Jorabat, Nongpoh and Weiloi village contained *Heterorhabditids*. Among the 411 samples 15 samples contained the EPNs. The species of *Steinernema* and *Heterorhabditids* were tested for pathogenicity and multiplied for further use. The nematodes from the other were found to be *Aphelencooides*, *Diplogastitids* and *Rhabditids terricola*.

The samples from low altitude were found to contain more EPNs compared to the higher altitudes. Only one sample from the higher altitudes (1500mt) contained *Heterorhabditids*. Most of the soils surveyed was lateritic soils with acidic nature. More than 70% of the soil samples were rich in organic matter and contained various other soil borne insects (Fig 14). The baited larvae succumbed to the fungal infections due to the presence of high load of Entomogenous fungi in the soil. The soils had to be baited for 3 times to get the infection by EPNs or to overcome fungal parasites.



Fig.14 Mermithid from Maize

Survey for EPNs on the insect pests of crops: During the survey various insect pests of rice, Maize, vegetables, fruits and spices were collected from the survey area known to be infected or abnormal. Among them only 2 per cent of the samples brought contained mermithids and others

were found to be either fungal or bacterial infections.

2. Studies on the bio assay of EPNs isolates collected from various parts of Meghalaya on insect pests of Rice

Twenty five well grown healthy larvae *Galleria mellonella* were placed over a wet filter paper containing 250 infective juveniles (ijs)/larva in a petry dish and incubated for 2-3 days at 28°C and 90% R.H. Five such petry plates were maintained and observed for mortality after 24 and 48 hours. The dead larvae were washed in water and surface sterilized in 0.4% hyamine 10X and kept in Whites' trap for the emergence of nematodes. The mortality after 24, 48 and 72 hours of nematode application was recorded. Results indicated that 76.8 per cent of the larvae were killed after 24 hours of exposure and 96.8 % of the larvae were killed after 48 hours of exposure to nematodes. The infected larvae turned brick red and the adult nematodes were visible inside the cadaver after 6-8 days. The ijs emergence started from 10th day of infection.

Similar experiment was carried out using the *Steinernema* sp. (ANS-1) sample and the results indicated that 98.4 per cent of the test insects were killed within 72 hours of exposure to the juveniles. After 24 hours, 58.4 percent of the insects were killed and after 48 hours 93.6 per cent were killed. The juveniles emerged from the dead insects after 10-12 days of infection.

3. Studies on the mortality of rice leaf folder *Cnaphalocrosis medinalis* to *H. indicus* and *Steinernema* sp.

Fully-grown rice leaf folder larvae were collected from the field and the larvae within the folds were kept in petry plates. 10 larvae were kept in each petry plate and infective juveniles of *Steinernema* sp. and *H. indicus* were released @ 250 ijs per larva. The plates were incubated and mortality was recorded at 48 and 72 hours of exposure to nematodes. The results indicated that *H. indicus* was highly virulent and 96 per cent of the leaf folder larvae were killed with in 48 hours of exposure compared to 84 per cent in case of *Steinernema* sp. Complete mortality was observed

after 72 hours of treatment in both the species of nematodes tested. Both the species were highly efficient in bringing about the mortality of leaf folder larvae.

4. Studies on the infectivity of native strains of EPNs on the Slug caterpillar of rice *Parasa bicolor*

The slug caterpillar, *Parasa bicolor* is a minor insect pest of upland paddy in Meghalaya and occur occasionally (Fig 15). The caterpillars defoliate the rice plants during epidemics. The infectivity of the EPNs collected from Meghalaya were bio-assayed using the final instar larvae of *Parasa bicolor*. Ten fully grown larvae were kept on a petry plate with moist filter paper and rice leaves were provided as feed. 500 ijs per larva of the EPNs were inoculated in to the plates and five replicates were maintained. Observations were made after 24, 48 and 72 hours of incubation. The results indicated that both *Steinernema* and *Heterorhabditids indicus* were highly virulent in killing the slug caterpillar. *H. indicus* was highly efficient in killing the slug caterpillar compared to the *Steinernema* sp. After 48 hours of treatment.



Fig. 15 Slug caterpillar infested by *H. indicus*

5. Virulence of native Entomopathogenic nematodes on root grubs infesting rice crop

White grubs (root grubs) are the major insect pests of upland rice in Meghalaya (Fig 16a to c). Damage due to white grubs exceed 50 per cent if proper control measures are not taken (Fig. 17). The predominant species of root grubs found in the region are the *Leucopholis lepidophora*, *Anomala*

bengalensis and *Melolontha indica*. A mean grub population of 7.23 was observed in an area of 2.5m x 2.5m plots and a maximum population of 12 grubs/one mt row was found during kharif 2003.



Fig. 16a Adult beetle

Fig. 16b White grubs



Fig. 16c Grub infected by *H. indicus*

The grubs were collected from the field and placed in plastic containers with soil and treated with 10 ml nematode suspension containing 500 ijs per ml and incubated at 28°C. The mortality of the grubs were recorded after 48 and 72 hours of inoculation. The results revealed that both *Steinernema* and *Heterorhabditids* were infective and were efficient in bringing about mortality of the grubs. *H. indicus* killed 88 per cent of the larvae with in 48 hours of



Fig. 17 White grub infested Rice plot

exposure and 100 per cent mortality was observed after 72 hours of exposure to nematode. Where as in case of *Steinernema* Sp. 58 per cent of the grubs were killed with in 48 hours of exposure and 98 per cent were killed after 72 hours of exposure. The production of juveniles was very high in case of *H. indicus* compared to *Steinernema* sp. after the 10th day of death of the grubs.

PATHOLOGY

Epidemiology of blast (*Magnaporthe grisea*)

A.K. Singh

At Barapani the leaf blast normally starts in June and attain severity during July-August. Two varieties HR-12 (a susceptible) and RCPL 1-29 (Moderately resistant) were sown at 10 days interval starting from 5th May to 25th June. A significant correlation (Table-8) between rice blast incidence and weather parameters viz. minimum temperature,

Table 8: Correlation coefficients of a linear correlation between rice leaf blast (Disease Index) and meteorological parameters

Variety	Max. Temp.	Min. Temp.	Morning RH	Evening RH	Rainfall	Sunshine Hr.	Rainy Days
At 30 DAS							
HR 12	-0.589**	0.807**	0.772**	0.655**	0.685**	-0.810**	0.787**
RCPL 1-29	-0.530*	0.658**	0.582*	0.648**	0.647**	-0.712**	0.687**
At 45 DAS							
HR 12	-0.078	0.906**	0.842**	-0.076	0.321	-0.685**	0.517*
RCPL 1-29	-0.081	0.845**	0.845**	-0.165	0.190	-0.704**	0.330
Pooled							
HR 12	-0.298	0.844**	0.720**	0.302	0.388*	-0.691**	0.621**
RCPL 1-29	-0.229	0.790**	0.593**	0.194	0.279	-0.644**	0.481**

morning relative humidity, sunshine hours and number of rainy days was found.

Varietal Screening

A.K. Singh

Two hundred sixty six cultures were screened against leaf blast under UBN. Seven cultures under National Screening Nursery including three hybrids (CNB 1253-1-29-22, CNB 1259-5-21, HRI 138 and hybrids(EXPH509, PAC 80007 and KRH 2) were highly resistant. Six cultures under NSN-Hills (VL 94- 3288, HPR 2086, HPR 2088, HPR 2143, VL 4013 and VL 4422) were highly resistant to leaf blast.

MANIPUR

Rice Improvement Project

S.V. Ngachan & Vijai Pal Bhadana

Breeding for high yielding disease resistance quality rice for main kharif

Eleven advanced selected lines from the crosses viz., Prasad/IR-24, BR-1/Leimaphou, along with four checks namely RCM-9 (RC Maniphou-7), RCM-10 (RCC), Leimaphou (SGC) and Prasad (NC) were evaluated under transplanted condition at Lamphelpat farm. Among these lines, MC-17-30-6-12, MC-17-8-16-1, KMC-17-34-2-1-1 and MC-17-8-2-16 were found promising with the yield potential of 26.5, 25.6, 25.1 and 24.3 g/hill, respectively. The above lines also showed mild resistance to diseases and insect pests. The maturity period was 140 days for most of the lines except MC-17-8-2-16.

A preliminary yield trial with eighteen lines selected from the different crosses viz., Prasad/IR-24 (MC-17) 10 lines, Napnang mumei/Basmati-370 (MC-21) 1 line, BR-1/Basmati-370 (MC-23) 1 line, Napnang mumei/KD-2-6-3 (MC-26) 1 line, BR-1/RCM-7 (MC-30) 2 lines, IRAT-109/Basmati-370 (MC-31) 2 lines and Konlong/Basmati-370 (MC-29) 1 line was conducted in transplanted conditions. The lines, MC-30-1-5-6, MC-31-5-5-1, MC-17-3-6-1, MC-17-10-5-3-3 gave yield 29.9, 28.7, 27.5, 25.9 g/hill, respectively and maturity range was 130-145 days.

Regional Co-ordinated trials

Research Complex Regional Trial on Rice (RCRT) was conducted under valley condition at Lamphelpat. The total entries were 15 including four developed by this centre viz., RCM-10, 11, 12 and 9. The entries, RCM-12, RCM-9, RCPL-1-2-30, RCM-10 and TOX-3241-221-2-2-3 were found to be higher yielder with the yield potential of 25.6, 25.5, 25.3, 24.3, 24.2 g/hill respectively. The crop was matured in 130 to 140 days.

Under quality rice RCRT on Aromatic rice, nine entries were evaluated during 2002-03. Among these lines, genotypes IET-16309, IET-16339, IET-16332, IET-16313, IET-16310 were found high yielder and gave 26.3, 25.5, 24.9, 24.7, 23.0 g/hill yield respectively. The genotypes were taking 130-140 days for maturity.

Insecticide Evaluation Trials (IET) (Co-ordinated trial with DRR, Hyderabad)

A.B. Rai

All the insecticidal treatments were superior over control. Among the different treatments applied 10 DAT and subsequent one spray need based, profenofos + cypermethrin (Rocket 44EC) and betacyfluthrin + imidacloprid (confidor ultra 100 EC) were found highly effective than the constituent of combination against major pest complex and registered comparatively higher yield (64.26 and 61.35 q/ha) as against check monocrotophos (58.64 q/ha) and untreated control (48.17 q/ha). It was closely followed by niconicotinoid (group) P 1011120% WDG (61.28 q/ha) and ethiprole 10 SC (61.02 q/ha), imidacloprid 200 SL (60.97/ha and profenofos (60.43).

MIZORAM

Varietal Screening Trials

N.S. Azad Thakur & K. Laxminarayana

RCRT upland varietal screening trial

Thirteen upland varieties, namely WAB- 96-1-1, WAB-5650, IR-63380-16, CT-6942-9-1-2M-1P,

IR-65907-064-1-1B, CNAX-2888-13-12-H, IR-65907-20-4B, IET-13459, IR 65907-203-1B, IRAT-216, RCPL-1-29, IR-66421-0389-2-1-1 and TRC-87-251 were screened for yield attributes. Among the varieties, TRC-87-251 was found to be the best with the grain yield of 36.50 q/ha followed by IR-66421-0389-2-1-1 (26.00 q/ha), CT -6942-9-1-1-2M-1P (25.38 q/ha).

RCRT lowland varietal screening trial

During 2002-03, 15 lowland varieties viz. RCPL-1-87-4, RCPL-1-151-1P, RCPL-1-179-3P, RCPL-1-230, RCM-9, RCM-10, RCM-11, RCM-12, PSL -85045-19-3-1-1, TOX-3093-10-2-3-2, TOX-3241-21-2-2-3, ITA-222, DR-92 and Ngoba were screened. Yield data showed that RCPL-1-179-3P and ITA-222 performed better with the grain yield of 64.00 q/ha each followed by RCPL-1-230 (61 q/ha) and DR-92 (59 q/ha).

AVT upland varietal screening trial

Fifteen upland paddy varieties, namely AVT-2701, AVT-2702, AVT-2703, AVT-2704, AVT-2705, AVT-2706, AVT-2707, AVT-2708, AVT-2709, AVT-2710, AVT-2711, AVT-2712, AVT-2713, AVT-2714 & AVT-2715 were screened. The yield data revealed that the AVT-2712 variety was the best with a grain yield of 42.00 q/ha followed by AVT-2706 (40.16 q/ha) and AVT-2704 (39.50 q/ha). The lowest grain yield (25.00 q/ha) was recorded in case of AVT-2707.

AVT for irrigated medium hills

Ten lowland varieties (AVT-2701, AVT-2702, AVT-2703, AVT-2704, AVT-2705, AVT-2706, AVT-2707, AVT-2708, AVT-2709 and AVT-2710) were screened. It was found that AVT-2708 and AVT-27010 were the best with the yield potential of 57.00 q/ha each followed by AVT-2701 (55.00 q/ha).

Integrated Nutrient Management in Lowland Paddy

K. Laxminarayana

The effect of integrated use of organic manures and inorganic chemical fertilizers on yield performance and nutrient uptake of lowland paddy (cv IET-16465) was studied. The highest grain yield (72.80 q/ha) and straw yield (144.8q/

ha) were recorded with the combined application of optimum dose of NPK (100-60-40 kg N, P₂O₅ and K₂O ha⁻¹) and green manure @ 5t/ha followed by 100% NPK + poultry manure @ 5t/ha (68.72 q/ha and 142.27q/ha). Application of organic manures has shown significant yield response than the recommended dose of NPK. Balanced application of NPK has resulted higher grain yields than the single nutrient application. The results indicated that combined use of organic manures and balanced application of inorganic chemical fertilizers produced highest and sustainable crop yields and maintained the soil fertility status.

Effect of Phosphorous (P) solubilizing micro-organisms on yield performance of paddy

The effect of graded doses of P solubilizing micro-organisms on yield parameters of lowland paddy (cv RCPL1-88-78) was conducted. The highest grain yield (6.28 t/ha) was recorded with the application of 60 kg P₂O₅ ha⁻¹ (5.98 t/ha). It was also found that the grain yield was significantly increased with the application of graded doses of P up to 90 kg P₂O₅ ha⁻¹. Inoculation of P solubilizing microorganisms (bacteria) showed significant response on grain, which might be due to secretion of organic acids that solubilizing the insoluble P fractions in the soil and production of growth promoting hormones.

Effect of blue green algae (BGA) on yield performance of paddy

The effect of graded doses of N along with blue green algae on yield parameters and nutrient uptake of lowland paddy (cv RCPL1-87-4) was conducted during 2002. The treatments include control, 40 kg N ha⁻¹, 80 kg N ha⁻¹, 120 kg N ha⁻¹, BGA, 40 kg N ha⁻¹ + BGA, 80 kg N ha⁻¹ + BGA and 120 kg N ha⁻¹ + BGA. Straw based culture of BGA was mixed with the fine sand and broadcasted in the field after transplantation. The results revealed that the highest grain yield (5.67 t/ha) was recorded with the application of 120 kg N ha⁻¹ + BGA followed by 80 kg N ha⁻¹ + BGA (5.58 t/ha). Inoculation of BGA has shown

marginal yield response due to torrential rainfall and other factors. The results emphasized that application of N fixing bio fertilizer along with externally added limited doses of N enhances crop yields and saves the fertilizer N to an extent of 20-40kg N/ha.

Determination of critical limit for available N in some of the rice soils of Mizoram

A pot culture experiment was conducted during *khari*, 2002 with 35 different rice soils representing from 7 villages of Kolasib District viz., Tuichhahen, Chilui, Saiphai, Chanpuipui, Chemphai, Meidum and Bairabi in order to find out the critical limits for available N by different methods. The soils are acidic in reaction (pH 4.61-5.75), low to high in organic carbon (0.32 – 1.34%), total N (0.0520-0.1624%), low to medium in available N (213-452 kg/ha), P (7.02-21.58 kg/ha) and medium to high in available K (146-388 kg/ha). The trial was laid out in a CRD with 3 levels of N (0, 75 and 150 kg/ha). Five kg of each soil was potted and 21 days old seedlings of paddy (cv IET-16465) were transplanted at 3 hills/pot at equal spacing. A uniform dose of 60 and 40 kg P₂O₅ and K₂O/ha were applied at basal. The grain yield and other yield parameters were recorded at maturity. The results showed that grain yield was ranged from 10.44 to 53.94 g/pot with a mean of 31.94 g/pot and N uptake was ranged from 100.22 to 625.70 mg/pot. Across all the soils, a yield response of 8.63 to 70.03 per cent was observed.

NAGALAND

Paddy varietal trials

A.K. Khan & Anamika Sharma.

Under upland conditions 14 RCRT cultivars were evaluated for yield. Among them IR-65907-206-6B recorded highest grain yield (21.71 q/ha) followed by IR-600-80-32 (21.2 q/ha), CT-942-9-

1-NP (21 q/ha), IR-65907-064-1-1B (20 q/ha) and IR-6333-80-16 (19.6 q/ha).

In lowland, 15 genotypes with Ngoba and DR-92 as checks were evaluated and highest yield was recorded in RCPL-1-68 (62.6 q/ha) followed by RCPL-1-68 (62.4 q/ha), RCM-1 (59.6 q/ha), RCPL-1-65 (56.4 q/ha) and RCPL-1-64 (55.8 q/ha).

Fourteen varieties of paddy consisting local, HYV and aromatic rice were evaluated for physiological and yield attributes. Four varieties viz. Pant-10, RCM-5, Teke and IET-6666 were found to be short duration (100-112 days), seven varieties viz. Bahadur, BPT-5204, Ranjit, Dwarf and tall Mashuri, Kushal and RCM-9 are medium duration (120-135 days) and Joha, UP Special and Sonachur were found to be long duration (> 140 days).

Spacing trial on wonder rice

A.K. Khan & Anamika Sharma

Mean yield of wonder rice was higher (42.96 q/ha) with closer spacing (45x40 cm) followed by 45x60 cm spacing (37.93 q/ha). Lowest yield (23.09 q/ha) was observed with the higher plant-to-plant distance (45x80 cm).

TRIPURA

Rice Improvement Programme

K. Chattopadhyay & K.R. Dhiman

Upland Rice

Three trials were conducted to evaluate their physiological and yield attributes besides their tolerance to drought and leaf blast.

Adaptive Trial

Twenty upland varieties of different origin and 17 local jhum varieties were evaluated. IET-168011 (24.7 q/ha), AR-11 (23 q/ha), TRC-87-251 (23 q/ha) and Annada (21.5 q/ha) performed better than others.

AVT-VE

Twenty entries, including two check varieties, Heera and Aditya and one local check, Rasi, were evaluated on the basis of yield and yield

contributing characters. All lines performed better than Heera (1525 kg/ha). The yield performance of IET-16945 and IET-17509 (2683.3 kg/ha) were better than the others.

Hybridization and selection

F3 generation was raised from the crosses of various upland and jhum (tila) varieties. TRC-2000-36-1-1, a cross between TRC-87-251 (Ngoba/Garomalati) and Bandana was found promising with very high yield (32 q/ha).

Lowland Rice

Three varietal trials of transplanted rice were conducted under shallow or medium shallow water depth situation in *kharif*, 2002. Five lines were selected from varietal crosses among Lowland aromatic lines.

AVT semi deep- water paddy

This All India Coordinated trial comprised 7 entries, 2 regional checks, Sabita and Purnendu and one local check, Puja. The local check puja performed better than all lines with an estimated yield of 54.3 q/ha. The seed yield of IET-17318 was estimated 43.03 q/ha.

RCR trial

Among, 15 lines, ITA-222 (4440 kg/ha) and RCPL-1-151-1P (4160 kg/ha) performed better than others. The mean yield and maturity period of those lines were 3.0 t/ha and 131 days, respectively.

Adaptive trial

Seven genotypes of diverse origin were evaluated. The yield of TRC-229-F-41 (6200 kg/ha), a low land variety, developed at this center, exceeded the yield of Swarna-masuri (MTU-7029) (6000 kg/ha).

Integrated disease management of Rice

T.K. Sengupta

Integrated disease management of rice was conducted in upland situation in *kharif* season. As local varieties, which are grown by the farmers, are susceptible to blast disease, varieties were collected from the farmers of Garomalati, Gaduma, Mamithuru, Kalikhasa, Kechkibadam, and Jolly villages. Pusha 2-21, a susceptible variety, was kept

as control for comparison with other treatments.

Treatment of seeds with carbendazim @ 1 gm/kg effectively reduced the incidence of the blast in nursery. Management practices such as weeding, roguing and other intercultural operations were followed to prevent infection from any alternate and collateral hosts which may spread the blast and brown spot diseases. Spraying carbendazim @ 1g/l three times during their growth period on Pusa 2-21 variety which was susceptible to leaf and neck blast could reduce the infection significantly. The details of lesion size in different local cultivars and the ratings are given in the table 9 and 10.

Table 9 : Evaluation of rice cultivators against leaf blast in upland condition.

Cultivar	Lesion size	Leaf blast
Pusa 2-21	8.00cm	9.00 S
Garomalati	4.00cm	2.5 MR
Gaduma	4.00cm	3.0 MR
Mamitharu	4.00cm	3.2 MR
Jolly	5.00cm	4.0 MR
Kalikhasa	3.80cm	3.9 MR

S – Susceptible, MR – Moderately resistant.

Table 10 : Effect of fungicidal chemicals on blast disease

Name of the fungicide	% leaf blast incidence	% increase in yield
Blitox 50 0.5%	2.1	8.5
Dithane M-45 0.2%	1.5	4.7
Dithane 2-78 0.2%	1.2	10.0
Bavistin 0.05%	0.7	3.4
Control	5.8	-

Evaluation of varieties for resistance to rice blast

46 rice varieties from CRRRI Cuttack were received to evaluate the varieties against blast disease of rice under Tripura condition.

Evaluation of disease reaction based on 0-5 scale.

- No visible symptom (spot) to just pinheader brown colored specks – 1.
- Brown colored circular spots without typical grey center – 2.

c) Circular spots with typical brownish and grey center – 3.

d) Typical spindle shaped spot with grey center and with or without brownish margin.

e) Several spots coalescing together leading to death of ¼ to ½ of the leaf blade – 5.

45 varieties were evaluated against leaf blast and neck blast disease of rice and recorded the minimum incidence of leaf blast, no incidence of leaf blast disease, no infection has been found.

Banded leaf blight disease of Rice

Banded leaf blight disease of rice was recorded in the variety TRC 87251 in upland paddy in kharif season. The treatments include seed treatment with carbendazim @ 1 gm/kg seeds and foliar application with carbendazim @ 1gm/litre of water, blue copper and dithane M-45 as also tested. Carbendazim spraying thrice, one at the seedling stage, second at maximum tillering stage and the third at boot leaf stage successfully controlled the disease and increased the yield.

Improvement of Aromatic lines

Five lines were selected from varietal crosses among lowland aromatic and non-aromatic lines. TRC-02-2-1 (RCPL-87-4/Pyzum) and TRC-02-5-1 (Pyzum /Binni) and TRC-02-4-1 (Basmati-370/RCPL-1-87-4) were found promising with 40 q/ha, 40 q/ha and 30 q/ha, respectively.

Purification of local aromatic line, Kali Khasha

After two cycle of Pure line selection, quality and yield (27 q/ha) improved significantly.

MAIZE

MANIPUR

Maize Improvement

S.V. Ngachan & Vijai Pal Bhadana

Five genotypes of Baby corn obtained from Barapani were evaluated at Langol farm. RCM-1-3 (115.3 g/plant) and RCM-1-1 (96.2 g/plant) were found to be higher yielder. Sixteen entries of maize obtained from IARI, New Delhi were sown on 16.5.02 at Langol farm. Among these entries, Vikram gave highest yield (151.7 g/plant) followed by Deccan-103 (145 g/plant) and Suwan composite (139.9 g/plant).

MEGHALAYA

KHARIF MAIZE

D.K. Verma, B.K. Sarma & K.R. Dhiman

Varietal Adaptability Evaluation

Seventeen trails were conducted to evaluate 377 strains to identify high yielding, disease resistant strains of medium, early and extra early maturity under rainfed condition. Superior strains from different trials are listed in Table 11, Table 12 and Table 13. These trails included 87 RC Strains (18 composites and 59 hybrids) developed at the

Table 11 : Promising entries of maize identified under different maturity groups.

Rank	IET 61 A FSM	IET 61 B FSM	IET 62 A EEM	IET 62 B MM	IET 63 A EM	IET 63 B EM
I	DMR-619 (58.77)	DMR-633 (56.69)	DMR-545 (41.05)	DMR-571 (20.69)	DMR-492 (33.68)	DMR-523 (41.95)
II	DMR-615 (56.10)	DMR-648 (50.49)	DMR-542 (30.71)	DMR-569 (17.15)	DMR-498 (29.81)	DMR-518 (38.98)
III	DMR-629 (54.47)	DMR-659 (49.60)	DMR-550 (26.60)	DMR-572 (15.07)	DMR-494 (26.59)	DMR-524 (30.99)
Trial Mean	41.74	35.03	19.89	9.49	15.83	17.05
Entries	29	29	25	25	29	29
SE±	0.228	0.191	0.819	1.211	0.323	0.441
CD	9.48	4.79	7.48	3.68	4.54	8.49

* Figure in parenthesis indicates grain yield (q/ha)

Institute. In addition, RCBC, RCPC and RCSC strains of specialty corn were evaluated to identify promising materials in baby corn, pop corn and sweet corn respectively.

Development of early and extra early composites

In order to increase maize productivity in rainfed agro-ecosystem of hills, efforts were continued to develop high yielding, short duration, yellow flint hybrids and composites through chain crossing and

Table 12 : Promising entries of maize identified under different maturity groups.

Rank	AET 66 MM	AET 67 EM	AET 68 EEM	AET 69 FSM	AET 70 MM	AET 71 EM	AET 72 EEM	AET 101 E & EEM	AET 102 E & EEM
I	DMR-307 (47.90)	DMR-254 (40.44)	DMR-237 (36.61)	DMR-149 (76.77)	DMR-183 (87.25)	DMR-116 (73.93)	DMR-101 (88.81)	DMR-112 (74.01)	DMR-215 (64.96)
II	DMR-311 (44.88)	DMR-253 (35.71)	DMR-238 (26.17)	DMR-150 (75.64)	DMR-182 (77.95)	DMR-120 (64.96)	DMR-102 (86.44)	DMR-111 (44.07)	DMR-218 (53.15)
III	DMR-309 (39.92)	DMR-252 (32.70)	DMR-236 (20.45)	DMR-147 (73.69)	DMR-185 (64.20)	DMR-118 (63.54)	DMR-103 (84.56)	DMR-102 (41.33)	DMR-212 (24.80)
Trial Mean	27.78	27.26	25.51	74.06	76.51	46.77	86.44	35.14	32.83
Entries	17	8	4	5	5	6	3	13	37
SE±	0.919	1.311	0.908	1.620	0.810	1.871	1.82	0.218	1.810
CD	3.46	3.72	4.42	2.39	3.49	4.44	2.23	9.48	8.44

* Figure in parenthesis indicates grain yield (q/ha)

Table 13 : Promising entries of maize identified under different maturity groups.

Rank	TNK 02	RCRT 2002	RCPC-2002	RCBC-2002 **	RCSC-2002 ***
I	CM-210 (53.15)	Vijaya Composite (69.54)	RCPC-13 (39.83)	RCBC-7 (15.38)	RCSC-11 (9.74 t/ha)
II	CM-104 (49.60)	Gujarat Makki-2 (68.51)	RCPC-75 (36.84)	RCBC-18 (14.37)	RCSC-18 (9.61 t/ha)
III	CM-400 (49.60)	Mahikanchan (43.63)	RCPC-76 (35.11)	RCM-1-3 (13.98)	Madhuri (9.52 t/ha)
Trial Mean	30.23	38.84	23.16	12.87	9.21 t/ha
Entries	15	12	36	21	22
SE±	0.888	0.918	1.18	1.810	0.708
CD	4.49	6.43	2.33	8.44	8.45

* Figure in parenthesis indicates grain yield (q/ha); ** baby corn yield; *** Green cob yield (t/ha)

line x tester methods possessing resistance to *H. turcicum* leaf blight. Broad genetic based HEY Pool reconstituted from 38-selected S_1 progenies were subjected to second cycle of selection for shorter plant height, earliness, higher grain yield and disease resistance. APM-7 and APM-8, advance stage experimental composites, derived from HEY Pool through S_1 /half sib selection was homogenized by selected sib mating. Mild selection pressure for uniformity and other agronomic traits were practiced in RCM-75, and RCM-76, constituted through S_1 selection in enriched Pool during Kharif 2002.

Hybridization and evaluation of segregating populations

Altogether 102 F_2 strains, 122 F_3 strains, 27 F_6 strains, 37 F_8 strains, 8 APM populations and 6 DAPIM (Differential Anthocyanin Pigment) strains were evaluated for various agronomical traits.

Genetic Resources - Evaluation and maintenance

Altogether 77 early yellow inbred lines were evaluated for yield, early leaf area, better plant type, lodging resistance, lower ear placement, tolerance to diseases and pests. Twenty-three desirable advance stage inbred lines have been identified for their use in hybridisation after inbreeding and selection. Besides these new introductions, 72 primitive prolific maize collections available with the institute were evaluated and maintained to conserve the available genetic diversity for prolificacy and other agronomic characters.

Maintenance and seed increase

Nucleus seeds of RCM-75 (12 Kg), RCM-76 (1.5 Kg), RCM 1-1 (12 Kg), RCM 1-2 (8Kg), RCM 1-3 (11 Kg), OCM-2 (4Kg) and Coix (4Kg) were produced by maintaining time and/or distance isolation for further production of breeder seeds during Kharif-2003.

Breeder seeds of RCM 1-1 (118 Kg), RCM 1-2 (38Kg), RCM 1-3 (138 Kg), RCM 1-4 (12 Kg), OCM-2 (14Kg), Coix (6Kg), RCM-75 (21 Kg) and RCM-76 (14 Kg) were produced by maintaining time and/or distance isolation for further production of Breeder Seeds during Kharif-2003.

Varietal demonstrations/ Crop Cafeteria

RCM 1-1, RCM 1-2, RCM 1-3, MLY, MLW, Vijaya Composite, RCM-75, RCM-76, APM-7, APM-8 and Gujarat Makki-2 were grown to demonstrate their production potential.

Front Line Demonstrations under Accelerated Maize Development Programme (AMDP)

**D.K. Verma, B.K. Sarma
& Rajesh Kumar**

Altogether 100 front line demonstrations (FLDs) were conducted in Ri-Bhoi, West Khasi Hills and East Khasi Hills districts using Vijaya Composite, Gujarat Makki-1, RCM 1-1, RCM 1-2 and RCM 1-3 in collaboration with State Department of Agriculture, Meghalaya and Division of Extension of the Institute. The average yield recorded per demonstration was: Vijaya Composite, 1454 Kg/acre; Gujarat Makki-1, 1747 Kg/acre; RCM 1-1, 1438 Kg/acre; RCM 1-2, 1110 Kg/acre and RCM 1-3, 1319 Kg/acre. Twenty three maize meetings were organized, one for each village and one at the Research Farm of the Division where farmers were imparted training on improved maize production techniques

RABI MAIZE

Varietal Adaptability Evaluation

Two trails were conducted to evaluate 45 strains including rabi maize from RAU, Pusa, Bihar to identify high yielding, disease resistant strains for early maturity, cold tolerance and cob yield in winter season/ pre-rabi maize season. Superior strains from the trials are listed in Table 14.

Front Line Demonstrations under Accelerated Maize Development Programme (AMDP)

**D.K. Verma, B.K. Sarma
& Rajesh Kumar**

Altogether 50 front line demonstrations (FLDs) were conducted by using Vijaya Composite, Gujarat Makki-1 and RCM 1-1 in collaboration with State Department of Agriculture, Meghalaya and Division

of Extension, of the Institute. The date of planting at various farmers fields had ranged from 15th August to 18th September. The fertilizers and other inputs were provided to individual farmers in the form of Urea @ 3.5 Kg/acre, SSP @ 7.5 Kg/acre and MOP @ 1.25 Kg/acre. The average yield per demonstration observed for Vijaya Composite was 4648 cobs/acre, Gujarat Makki-1 was 6103 cobs / acre and RCM 1-1 was 6988 cobs /acre. Twenty three maize meetings were organized, one in each village and one at the Research Farm of the Division where farmers were imparted training on improved maize production techniques.

Table 14: Promising entries of rabi maize identified.

Rank	RCRT (RM) – 2002 A	RCRT (RM) – 2002 B
I	Hemant (15.68 t/ha)	Vijaya Composite (12.64 t/ha)
II	Vijaya Composite (14.92 t/ha)	Suwan (11.48 t/ha)
III	Devaki (8.8 t/ha)	APM-11 (7.88 t/ha)
Trial Mean	6.88 t/ha	7.88
Entries	25	20
SE±	0.268	0.388
CD	9.47	9.84

* Figure in parenthesis indicates green cob yield (q/ha)

Germplasm characterization and evaluation

B.K. Sarma & J.K. Singh

Characterization for 183 maize germplasm for 10 characters was carried out following the procedure given in Minimal Descriptor of Agri-horticultural crops (part-I) of NBPGR. The design adopted for evaluation was Augmented Randomized Block Design and data were recorded as per Minimal Descriptor. Wide variability among the materials was observed in all morpho-agronomic characters. The germplasm exhibited wide range of variation in the morpho and agronomic character. (Table 15)

Table 15: Morpho-agronomic characters of maize germplasm.

Character	Range
Days to 50% silking	56 – 90 days
Days to 50% tasseling	51 - 101days
Leaf length	57.9 – 109.6 cm
Leaf width	6.6 –10.8 cm
Ear leaf Area	382.1 – 1183.7 cm ²
Plant height	132.6 – 312.3cm
Ear placement	71.1 – 223.2 cm.
Ear length	4.1 –16.9cm
Ear width	5.1 – 14.0 cm
Kernels/row	10.4 – 38.4
Kernels weight/plant	42.3 – 210.6 g.
100 seed weight	7.3 – 40.4 g.

SOIL SCIENCE

Effect of P levels, FYM and lime on micronutrient uptake by maize and soil available micronutrients

M.S. Venkatesh, Kailash Kumar,
B. Majumdar and Patiram

Application of higher levels of P resulted in reduced uptake of micronutrients. Liming decreased the uptake of Fe, Mn and Cu and Zn by grain. FYM application increased the uptake of micronutrients as well as soil available micronutrients.

ENTOMOLOGY

AP CESS FUND PROJECT:

Entopathogenic Nematodes (EPNs)

A.N. Shylesha, K. Rajasekhara Rao
& Gitanjali Devi

Host searching ability of indigenous entomopathogenic nematodes isolated from soil

The maize cob borer *Stenachroia elongella* is the major insect damaging green cobs. The larvae bore into the cobs and feed on the seeds. The market value of the cob is reduced. The cob borer infested cobs were identified in the field and a spray containing 1000ijs per ml was sprayed on the cobs during the cool hours of the day. The cobs were

harvested after 48, 72 and 96 hours of treatment and the larvae killed due to the infection due to *Steinernema* sp. was observed by removing the husk. The observations showed that 56.8 per cent of the larvae were killed after 48 hours of treatment and 97.7 percent of the larvae were killed after 72 hours of treatment. The results showed that the *Steinernema* sp. can be effectively used against the cob borer larvae under field conditions. The host finding efficiency of *Steinernema* was very high and 100 percent of the larvae present in the cobs were infected after 96 hours of spraying of the cobs.

Utilization of indigenous Entomopathogenic nematodes for the management of maize stem borer

The stem borer infested plants in the maize field were identified and tagged. Ten plants each were selected for application of EPNs. The nematodes were sprayed on the infested plant @2000ijs/ml. Destructive sampling technique was adopted and the plants were harvested after 48 hours, and were split open to know the mortality of the larvae inside. The healthy larvae were allowed inside till 96 hours.

The results indicated that 54.44 per cent and 72.72 per cent of the larvae were killed in the *Steinernema* sp. treated plants after 48 and 72 hours of treatment with EPNs. Where as in the *H. indicus* treated plants 76.6 per cent and 90 per cent of the larvae were killed after 48 and 72 hours of exposure to nematodes. Both the species were found to be highly efficient in bringing about the mortality of the stem borer larvae. However among the two species tested, *H. indicus* was found to be highly virulent even under field conditions. In the control plants maintained no mortality of the larvae were observed.

Progeny production of EPNs *Steinernema* and *Heterorhabditis indicus*

The progeny production or the emergence of infective juveniles from the cadavers was studied under various doses of infective juveniles (ijs). The laboratory reared *Achroea grisella* and *Galleria mellonella* were used as the test insects. Dose ranging from 50 ijs per larvae to 200 ijs per larvae were tested and the larvae which were killed by

EPNs were incubated and the emerging infective juveniles were counted using Haemocytometer. And the results are presented in the Table 16. Maximum infective juveniles were produced in the treatment with 100 ijs / larva using *G. mellonella* (2,38000) the maximum production of ijs was also noticed in 100 ijs/larva treated *A. grisella* (1,45000). Similar results were found in case of *H. indicus* also and 4lakh ijs were produced when 100ijs/larva was used. In case *A. grisella* 2 lakh 60 thousand ijs were produced at the same level of treatment. The higher dose did not increase the production of infective juveniles. This may be due to the more competition for entry in to the host and also survival and production of young ones.

Table 16 : Progeny production *Steinernema* sp., *Heterorhabditis indicus*

Dose(ijs/larva)	<i>Steinernema</i> sp.		<i>Heterorhabditis indicus</i>	
	<i>A. grisella</i>	<i>G. mellonella</i>	<i>A. grisella</i>	<i>G. mellonella</i>
50	68000	1,35000	200000	350000
100	145000	2,38000	260000	430000
150	50000	2,20000	200000	400000
200	20000	1,50000	180000	400000

Production of IJs in different stages of cob borer

Different stages (instars) of the cob borer was treated with *Steinernema* sp. and the infective juveniles production was studied. The results indicated that the production of infective juveniles of EPNs were increased with the increase in the age of the larva and the maximum production was found in the 6th, the last instar larvae (>400000 ijs/larvae)

MIZORAM

Maize Varietal screening trial

N.S. Azad Thakur & K. Laxminarayana

Under varietal evaluation trial, seven varieties viz., MLW, Gujarat Makki, MLY, RCM 1-3, RCM 1-1, Vijay composite and RCM 1-2 were evaluated.

Among these highest grain yield was recorded with RCM -1-1(51.00 q/ha) followed by MLW (50.56 q/ha.).

Baby Corn

N.S. Azad Thakur & K. Laxminarayana

Five varieties viz., MLW, MLY, RCM 1-1, RCM 1-2, and RCM 1-3 were evaluated for their yield potential. Among the varieties, RCM -1-1 was found to be the best with a yield of 48.00 q/ha followed by MLW (42.00 q/ha).

NAGALAND

Maize varietal trial

A.K. Khan

Among the five varieties evaluated for their yield potential, RCM-1-1 found to be best (29.7 q/ha) followed by MLY (29.65 q/ha), MLW (27.37 q/ha), RCM-1-3 (26.16 q/ha) and RCM-1-2 (23.32 q/ha).

SIKKIM

Studies on nitrogen management in Maize for yield maximization

R.K. Avasthe

1. Studies on method of urea application in hybrid maize (ProAgro P-4640)

Three basic methods adopted for urea application @120 kg/ha were broadcast, furrow application and side-band placement as –full dose at the time of sowing, in two splits – half at sowing and half at knee-high stage and three splits – 1/3 at sowing, 1/3 at knee-high stage and 1/3 at tasseling of the hybrid maize. Split, side-band placement produced the highest grain yield (7700 kg/ha) followed by furrow application (6800 kg/ha) and broadcast application produced 6350 kg/ha as compared to no nitrogen control yield of 1360 kg/ha.

2. Studies on integrated nutrient management in hybrid maize (ProAgro P-4640)

Highest grain yield of 6800 kg/ha was recorded in the treatment with Azophos (*Azotobacter* inoculant) seed treatment with 40 kg N through

FYM at sowing and two-split top-dressing of urea – half at knee-high stage and half at tasseling. It was followed by the treatment where 40 kg N was applied through FYM at sowing and two-split top-dressing of urea – half at knee-high stage and half at tasseling that produced a yield of 5900 kg/ha as compared to 1400 kg/ha grain yield in no nitrogen control.

Comparative evaluation of local cultivar and VL Ugal-7 variety of buckwheat and studies for fertilizer dose recommendation

R.K. Avasthe

Grain yield was highest with the combination of N:P:K: applied @ 40:80:40 kg/ha for both VL Ugal-7 and Local Mithe at 803 and 1590 kg/ha respectively as compared to 210 and 400 kg/ha in the corresponding control plots.

TRIPURA

Maize Improvement Programme

K.R. Dhiman & K. Chattopadhyay

Improvement of *Jhum* lines through hybridization

Thirteen maize populations are in the process of development through inter-varietal crosses and generation advancement from two *jhum*-maize lines and three composite and hybrid segregating generation. The average maturity period of the *jhum* lines was 120-125 days with an yield of 20-25 q/ha. Notable improvement was recorded regarding days to maturity (83-90 days), cob size, cob length, 100 seed weight and plant yield (40 –60 q/ha) in these populations. These characters were coupled with the fixing of prolific nature of *jhum*-lines in developing populations.

Screening of maize genotypes and their cross-breeds against sheath blight

S. Biswas & K. Chattopadhyay

Maize varieties like, Prakash, Tarun, Nabin, Jhoom black (JB), Jhoom Red (JR) and Jhoom yellow (JY), and their cross breeds, namely, Prakash

X JY, JY X Prakash, Tarun X JY, JY X Tarun, JB X Prakash, Prakash X JB, Nabin X JY, Nabin X JR, Nabin X JB and JR X JY, were evaluated for their resistance to sheath blight (incited by *Rhizoctonia solani*) during *Kharif* season. Of all the varieties and cross breeds, Prakash, JY and JB, and their cross-breeds showed a certain degree of resistance, while, Nabin and JR, and their cross breeds showed high susceptibility. Other varieties and cross breeds were intermediate in disease reaction.

OILSEEDS

MANIPUR

Integrated nutrient management in Groundnut-Mustard cropping system under rainfed foothills conditions

A.B. Rai & B.B. Panda

Integrated nutrient management in Groundnut

The experiment was carried out with 7 different treatments having organic and inorganic sources of nitrogen in *Kharif* 2001. Among the 7 nutrient treatments, groundnut inoculated with *Rhizobium* and applied with 15 kg N/ha registered highest pod yield (19.44 q/ha) closely followed by the treatment with 30 kg inorganic nitrogen per hectare (19.24 q/ha). However these two treatments were statistically at par with FYM 5 t/ha, FYM 2.5 t/ha + *Rhizobium* and FYM 2.5 t/ha + 15 kg N/ha and produced significantly higher pod over control and Sole *Rhizobium* inoculation. Findings are presented in Table 17.

Table 17 : Effect of different treatments on pod yield of groundnut

Treatments	Pod yield (q/ha)
Control	12.09
Rhizobium	13.87
Rhizobium + 15 kg N/ha	19.44
30 kg N/ha	19.24
FYM 5 t/ha	17.55
FYM 2.5 t/ha + Rhizobium	17.93
FYM 2.5 t/ha + 15 kg N/ha	18.69
SEM ±	1.06
CD (P=0.05)	3.27

Integrated nutrient management in mustard

Eight different treatment combinations of organic and inorganic sources of plant nutrients were applied to mustard and all the treatment combinations significantly increased the seed yield over control (3.44 t/ha). The highest seed yield (10.08 t/ha) and yield attributes were recorded with application of FYM (5 t/ha) + 50% of the recommended NPK dose (15:15:15) + Ammonium Sulphate (20 kg/ha) and it was significantly higher than other treatments but at par with FYM (5 t/ha) + Zinc Sulphate (20 kg/ha).

Development of suitable cropping system for rainfed-foothills of Manipur

Performance of soybean varieties under foothills condition

Among the ten promising soybean varieties tested under foothills conditions of Manipur, the highest yield was registered in MACS-13 (29.3 q/ha) followed by NRC-20 (28.4 q/ha). While these two varieties were at par with JS-335, Pusa 16, Bragg and PK-471 produced significantly higher pod over rest of the varieties. The lowest yield was recorded in PK 262 (13.5 q/ha).

Performance of Groundnut varieties under rainfed foothills condition

Among 14 different varieties of groundnut tested under rainfed foothills condition, ICGV-86590 recorded highest pod yield (24.8 q/ha) followed by ICGS-44 (18.13 q/ha). The variety ICGV-86590 produced significantly higher pod yield compared to other varieties.

Inter-institutional collaborative project on Rapeseed Mustard

Effect of dates of sowing on different varieties of Mustard

The experiment was carried out in a split plot design with two dates of sowing (October 25 and November 9) in main plots and three varieties (SEJ-2, JM-1 and RH-30) in sub plots with 3 replications. All the varieties produced significantly higher seed yield when sown on October 25 over November 9 sowing. There was no significant difference in seed

yield among the varieties when averaged over date of sowing. However, RH-30 recorded highest seed yield (5.81 q/ha) on sowing in October. The variety, SEJ-2 gave highest yield when sown on November 9 while it was lowest yielder on sowing in October.

Evaluation of recently released groundnut varieties and their nutrient efficient lines

Twenty four recently released groundnut varieties were evaluated for their pod yield, nutrient efficiency and leaf spot diseases. Among the 24 varieties, maximum pod yield (23.83 q/ha) was recorded in the variety NRCG-7599 followed by ICGV-86590 (20.07 q/ha) and TG-26 (16.46 q/ha). The highest number of nodules/plant (46) and pods/plant (9.67) were observed in NRCG -7599. But the number of plants affected by leaf spot disease was lowest in NRCG-7599.

Evaluation of different *Rhizobial* strains on groundnut

Mausumi Raychaudhuri & S. Raychaudhuri

The experiment was repeated in association with RBDC, Imphal to assess the efficacy of different *Rhizobial* strains on groundnut with respect to yield attributes. The experiment was carried out at Krishnagiri Farm, Langol Hill in split plot design with three replications. Three groundnut varieties were tested viz., 1) TKG-19A, 2) JL-24 and 3) GG-20. Different *Rhizobial* strains tested were viz., 1) Control, 2) TAL-1000, 3) IGR-6, 4) NC-92 and 5) JCG-48. The experimental soil was taxonomically classified as Ultisol. The soil and plant samples were analysed to study the effect of the *Rhizobial* strains on nutrient uptake and soil characteristic.

The cultivars showed significant difference in pod and haulm yield. JL-24 gave the highest yield over TKG-19A and GG -20 for both pod and straw. IGR-6 and NC-92 strains increased the pod yield significantly over control and TAL-1000. The interaction was significant for both pod and straw yield. The results revealed that all the strains could increase the pod and straw yield of GG-20 cultivars significantly. On the other hand these strains had very insignificant impact on TKG-19A cultivars.

The N and P uptake by the crop showed similar trend as that of their respective yields.

In another set of experiment, 10 groundnut varieties viz., 1) NRCG-6151; 2) PKVG 8, 3) JL-24, 4) NRCG-6450, 5) ICGV 86950, 6) JSP-19, 7) FESG-8, 8) M-13, 9) NRCG-6131, 10) Kadiri 3 were tested with 5 rhizobial treatments 1) Control, 2) T-169, 3) Jcg-48, 4) T-1000 and 5) NC-92 in the field as well as in pots. The experiment was initiated to ascertain the extent of variation in infection/nodulation one strain could impart to different cultivars as well as the extent of variation in response one cultivar shows to different strain. So that the feasibility of recommending cultivar specific strain or validity of such recommendation is ascertained.

The yield attributes viz., no. of nodules, no. of pods, dry nodule wt., root length, shoot length, root wt., shoot wt. etc. per plant were recorded and the results showed characteristic difference among the cultivars and their interaction with different strains. The number of nodules per plant in the field is presented in Table 18.

Table 18 : Total no. of nodules per plant in the field.

Variety	Control	T-169	Jcg-48	T-1000	NC-92
1 NRCG 6151	231.33	141	257.33	194	167.67
2 PKVG 8	77.33	169.67	37.00	187.67	93.33
3 JL-24	65.67	150	137.67	104.33	77.67
4 NRCG 6450	91.33	146.67	89.33	153.33	106.33
5 ICGV 86950	85.67	51.33	129.67	124.33	96.67
6 JSP 19	144	111.33	127.33	161.33	143
7 FESG 8	116.67	140.33	127.33	160	89.67
8 M-13	129.67	97.67	186.33	90	46.67
9 NRCG 6131	124.33	87	135.33	166.33	148
10 Kadiri 3	87.33	75.67	103.67	174	171.33

In the pot experiment, number of secondary root per plant, number of nodules per plant, root length, shoot length, nodulation pattern, their distribution were recorded. The cultivars showed significant difference in secondary root formation (Table 19), nodule formation and their distribution. The nodule weight per plant and biomass production (shoot + root) varied significantly.

Table 19 : Mean no. of secondary root per plant in pot.

Variety	Control	T-169	Jeg-48	T-1000	NC-92
1 NRCG 6151	51	88	43	46	59
2 PKVG 8	43.33	75.33	46.67	64.33	64.7
3 JL-24	7	60.5	15	32.67	38.33
4 NRCG 6450	71.33	64	78.67	59.33	56
5 ICGV 86950	55.33	54.67	39.33	47.67	23
6 JSP 19	60	75.5	62.5	37	49
7 FESG 8	74	76	40.5	86	92
8 M-13	83	27	42.33	44.67	53.5
9 NRCG 6131	56	46	55	76.67	31.5
10 Kadiri 3	56	49.67	19	52.33	54

Inter-institutional collaborative Project on Groundnut

Evaluation of germplasm and advanced breeding lines

Mausumi Raychaudhuri and S. Raychaudhuri

The experiment was repeated with 50 promising germplasm lines of ICG series with two treatments viz., (T₁) Control and (T₂) 50 kg P₂O₅/ha + 2500 kg/ha lime + 10 t/ha FYM with two replications. The experimental soil was clay loam in texture having pH 4.8, organic C 18.6 mg/kg and available P 9.32 mg/kg. The highest pod yield (g/plant) was recorded in ICG 4070 (15.53) followed by ICG 4571 (14.32) and ICG 6487 (14.08). The nodule dry wt, root and shoot dry wt per plant were also recorded. The pod yield increased significantly with T₂ for most of the germplasms tried. The overall pod yields of the germplasms were less compared to that of the previous year.

MEGHALAYA

OILSEED IMPROVEMENT:

G. Sahay

SOYBEAN

Two trials were conducted viz. evaluation of F₄ generation of various crosses and one trial under Darjeeling hills condition (Table 24). F₄ generation evaluation for rust and frog-eye leaf spot (FELS) disease resistance was conducted with 29 hybrid lines. Line DS93-104B x JS80-21 (H₂) was highest

yielding (26.76 q/ha) with disease score 131, 231, 321 for rust and 2 for FEELS, followed by Bragg x DS93-104B (H₃₀) yielding 25.6 q/ha and disease score 131, 232, 323 for rust and 0 for FELS, Pusa 16 x PK416 (H₁₈) yielding 24.00 q/ha and disease score 132, 221, 321 for rust and 2 for FELS, PUSA16 x PK1137 yielding 23.90 q/ha and disease score for rust 121, 221, 321 and 0 for FELS, JS(SH) 89-48 x DS93-104B yielding 23.83 q/ha, disease score for rust 132, 232, 332 and for FELS 3.

Under Darjeeling hill condition 9 varieties were evaluated. Bragg was the top ranking with 25.12 q/ha followed by NRC-24 (19.37 q/ha), NRC – 18 (18.75 q/ha), NRC-19 (11.67 q/ha) and PK1137 (10.0 q/ha), respectively. Average yield of the trial was 12.86 q/ha.

In germplasm maintenance/evaluation, eighty-nine varieties were evaluated. JS (SH) 89 – 48 was top ranking with 31.10 q/ha yield followed by JS (SH) 89 – 2 (26.30 q/ha), JS (SH) 89 – 58 (25.80 q/ha) PK – 1137 (22.20 q/ha) and TAS – 41 (20.80 q/ha). Average trial yield was 13.01 q/ha.

GROUNDNUT

Three trials were conducted viz. Evaluation of selections from JL-24, Screening for Al³⁺ Toxicity Tolerance and Optimum sowing time of promising varieties. A set of germplasm was also maintained.

Six promising varieties of groundnut identified from AVT of previous years were evaluated for two different dates of sowing i.e. 1st week of June and 3rd week of June. Average yield of first date of sowing was 0.79 q/ha. Average yield of 2nd date of sowing was higher i.e. 12.17 q/ha. Confectionery variety, ICGV 86188 was top ranking with 16.51 q/ha yield. In Al³⁺ toxicity tolerance trial, 100 lines were screened out of which ICG – 3241(19.09 q/ha) was top ranking, followed by ICG – 1822 (16.28 q/ha), ICG – 6513 (15.17 q/ha), KG-3073 (14.93 q/ha) and ICG – 7269(14.57 q/ha). Average yield of the trial was 0.69 q/ha.

Sixty eight entries were maintained and evaluated of which NRCG – 1241 was top ranking with 27.75 q/ha yield followed by JL – 24, ICGV/ 88338, NRCG – 3160 and ICGV – 87415, yielding 24.90, 24.80, 22.25 and 22.22 q/ha, respectively. Average yield of the trial was 14.01 q/ha.

Eight selections from JL 24 were evaluated for the third year. On the basis of three years evaluation JL 24/98-6, JL - 24/98 - 8, JL -24/98-7 and JL 24/98-10 were found higher yielder than parent JL-24. Average yield of the trial was 20.91/ha. The per cent yield increase over JL-24 was 25.8%, 25.3%, 15.3% and 12.9%, respectively (Table 20).

Table 20 : Promising varieties of oilseeds from different trials.

Rank	Soybean (G.P)		Soybean (Darjeeling Hills)		Groundnut (G.P)	
	Variety (Kg/ha)	Yield	Variety	Yield (Kg/ha)	Variety	Yield (Kg/ha)
I	JS (SH) 89-48	3110	Bragg	2512	NRCG-1241	2775
II	JS (SH) 89-2	2630	NRC-24	1937	JL-24	2490
III	JS (SH) 89-58	2580	NRC-18	1875	ICGV-88338	2480
IV	C-36	2370	NRC-19	1167	NRCG-3160	2225
V	PK-1137	2220	PK-1137	1000	ICGV-87415	2222
Entries	89		9		68	
Trial mean	1301		1286		1401	
SEM +	1.64		2.81		1.38	
CD(5%)	4.63		5.90		3.91	

SOYBEAN

Oilseeds Germplasm characterization and evaluation

J.K. Singh & A. Pattanayak

Thirty six germplasm were collected from different states of North Eastern Region during 2000-2003 and evaluated for 12 characters and variability found in some important characters studied are given in (Table 21). Variability was also observed in qualitative characters like plant vigour, flower colour, leaf shape, pod colour, seed coat colour, seed shattering and biotice stress susceptibility etc.

Table 21: Variability observed in oilseed germplasm.

Characters	Range
Days to 50% flowering	34 - 76 days
Plant height	16.2 - 70.6 cm.
No. of Primary branches/plant	1.0 - 3.0
No of Secondary branches/plant	1.0 - 4.2
Pods/plant	6.4 -38.0
No. of seeds/pod	1.5 - 3.7
Seed yield/plant	6.3 - 46.2 g
100 seed weight	4.2 - 22.6 g

Studies on the performance of soybean varieties under different planting densities

D.C. Saxena

Field experiment in rainfed uplands was initiated in *kharif* 2002 in mid hill altitude of Meghalaya to study the performance of Soybean varieties under two planting densities. The data on grain yield revealed that the highest yield (10.29q/ha) was recorded with variety RAUS-5 followed by MAUS-71 (9.87q/ha) and MRC-41 (8.85q/ha). The variety Indira soya-9 remained poor yielder (8.64q/ha). In planting densities, highest grain yield (10.08q/ha) was obtained with row-to-row spacing at 45cm followed by 30cm row-to-row spacing (7.49q/ha).

GROUNDNUT

Performance of HPS-II groundnut varieties under mid hills of Meghalaya

D.C. Saxena & N.P. Singh

Field experiment in upland condition was initiated in *kharif* 2002, to study the yield performance of HPS-II lines (HPS-II -9701, HPS-II-9702, HPS-II-9703, HPS-II-9704, HPS-II-9705 and HPS-II-9706) along with the three checks (BAU:13; ICGS-76 and JL-24). The data recorded on pod yield revealed that the highest yield (26.84q/ha) was recorded with the check ICGS-76 followed by HPS-II-9705 (22.95q/ha) and HPS-II-9703 (20.74q/ha).

Effect of organic farming on groundnut production

Field experiment in upland conditions was initiated in *kharif* 2002, to study the effect of different organic sources of nutrients on Groundnut production and to develop techniques for organic farming of Groundnut. The date recorded on pod yield revealed that the application of organic manure @ 10 t/ha (30.66 q/ha) and 30:50:40kg NPK + lime @ 2.5 t/ha (30.92 q/ha) was at par. Seed treatment with PSM and bio-control agent produced 27.59 q/ha pod yield. Use of rabbit slurry produced 22.31q/ha pod yields, which was better than that of pod yield obtained with control treatment (20.18q/ha).

Performance of groundnut to various bioorganic nutrients in mid hill terrace land of Meghalaya

U.K. Hazarika

Groundnut cv GG-20 was sown for the second consecutive year to confirm the yield of this cultivar to various bioorganic sources of nutrients. The trial was initiated with two sources of bioorganic nutrients viz; *Azolla* compost @ 2.5 t/ha and PSM-27 as seed treatment before sowing and applied in presence of 2 levels of P_2O_5 (0 kg, 50 kg/ha) and 2 levels of lime (0 t/ha; 2.5 t/ha). The yield data confirmed the earlier findings that Phosphorus at 50 kg/ha + lime 2.5 t/ha + composted *Azolla* @ 2.5 t/ha produced maximum pod yield (26.9 q/ha) followed by the treatment lime + *Azolla* compost @ 2.5 t/ha each (24.0 q/ha). Among the individual nutrients, maximum pod yield (22.1 q/ha) was obtained due to 50 kg P_2O_5 application/ha, followed by lime at 2.5 t/ha (20.6 q/ha), PSM-27 registered 20.3 q/ha and *Azolla* compost 2.5 t/ha (19.1 q/ha). Control treatment recorded 17.5 q/ha of pod yield in groundnut.

Response of groundnut /cultivars to mulch

A.S. Panwar

With a view to confirm the results obtained during 2001 on the response of groundnut cultivars to mulching, the experiment was continued for the

second year. The data revealed that groundnut cultivar ICGS-76 was the highest yielder (24.51 q/ha) than HPS II-9703 (22.34 q/ha) and K-134 (19.16 q/ha). All the mulch materials significantly increased pod yield of groundnut as compared to no mulch treatments. Maximum growth and yield was recorded with polythene mulch used on flat bed sowing. The pooled analysis of the two years data indicated that polythene mulch on bun sowing was the best treatment (23.85 q/ha) followed by polythene mulch on flat bed sowing (25.30 q/ha). Among the bio-mulch, maximum pod yield was recorded with grass mulch (22.86 q/ha) followed by the pod yield (20.20 q/ha) recorded with *Ambrosia* weed mulch. No mulch treatment produced 16.58 q/ha pod yield of groundnut.

Performance of groundnut to different date of sowing

Rajesh Kumar

Second year experiment on the performance of groundnut to different dates of sowing was conducted during *Kharif* season of 2002, with two groundnut cultivars i.e; ICGS 76 and TKG-19 (A). Sowing was done on six different dates i.e; 15th May, 31st May, 20th June, 10th July, 29th July and 20th August. The highest yield (26.51 q ha⁻¹) was recorded with ICGS 76 when sown on 10th June followed by a yield of 23.73 q ha⁻¹ when the same cultivar sown on 10th July. The lowest yield (7.63 q ha⁻¹) was recorded with cultivar TKG-19 (A) sown on 15th May.

Nutrient Management in Bold Seeded Groundnut

D.P. Patel & N.P. Singh

An experiment was conducted to study the nutrient management in bold seeded groundnut consisting of 8 treatment combinations. ICGS 76 a bold kernel variety was selected for the study. All the treatments showed significant increase in pod yield over control (24.27 q/ha). Highest pod yield (33.02 q/ha) was recorded with the combined application $N_{20}P_{50}K_{100}$ kg/ha + Lime 2.5 t/ha + FYM 10 t/ha.

Evaluation of groundnut cultivars in the acid soils of Meghalaya

An experiment was repeated for the second consecutive year to study the growth parameter and yield performance of 22 varieties including check (JL 24). All the varieties performed better than check variety JL 24 except VRI 4 and DRG 12 in terms of pod yield. Highest pod yield was recorded in BAU 13 (31.7), which was found at par with GSMG 84-1 (30.8), ICGS 76 (29.3), GG 13 (27.8) and TKG 19A (26.1). However check variety (JL 24) produced a pod yield of 9.4 q/ha.

Evaluation of new groundnut varieties in the mid hills of Meghalaya

Twenty-one groundnut varieties were initially evaluated for their yield performance in the acid soils of mid hills of Meghalaya. Some of the varieties found to be promising are NRCG 4659 (18.9 q/ha), NRCG 6820 (17.5 q/ha), NRCG 6450 (16.9 q/ha), VRI 3 (16.8 q/ha) and NRCG 2588 (15.7 q/ha)

SOIL SCIENCE

SOYABEAN

Efficiency of phosphatic fertilizers in acid soil

B. Majumdar & Patiram

The field experiment conducted for fourth year during *kharif* 2002 to study the response of soybean to SSP, rock phosphate (RP) and their mixtures with and without FYM indicated that application of SSP @ 30 or 60 kg P_2O_5 /ha alone or in combination with FYM was superior to application of RP. A treatment combination of 60 kg P_2O_5 /ha applied as SSP + RP (1:1) with 5t FYM/ha recorded highest grain yield (27 q/ha) which was at par with the yield (26.7q/ha) received by the application of 60 kg P_2O_5 /ha as SSP with 5t FYM/ha.

GROUNDNUT

Response to sulphur, boron and FYM in acid soil

M.S. Venkatesh & Kailash Kumar

A field experiment was conducted for 3rd year during *kharif* 2002 to study the effect of levels of sulphur (0, 20 and 40 kg/ha), boron (0, 1.5 and 3.0 kg/ha) and FYM (0 and 5t/ha). Application of S @ 40 kg/ha + B @ 3 kg/ha + FYM @ 5t/ha resulted in 51 % increase in pod yield over control. This treatment also resulted in highest S and B contents in kernels (0.3% and 16 ppm) and the highest available S and B (11.65 and 0.42 ppm), respectively in the post harvest soil.

PATHOLOGY

GROUNDNUT

Satish Chandra & A.K Singh

Management of early leaf spot (ELS) disease

To develop economical control measure for ELS disease an experiment was laid with two varieties and different spray timing and frequency of fungicide. It was found that variety ICGS76 was tolerant to ELS disease. However, the fungicidal mixture (Dithane M-45[®] 0.2% + Bavistin[®] 0.1%) sprayed at 10 days interval starting at 30 days after sowing (DAS) had no significant effect on yield of any of the variety, though there was significant variation in disease index in different treatments.

Effect of stickers on fungicidal control of ELS disease

Due to high rainfall an experiment was planned to find out effect of sticker on increasing efficiency of fungicides like Bavistin (systemic) and Dithane M 45 (protectant) on management of ELS and yield. Two stickers, Apsa 80 and Sandovit were taken for the trial. The experiment was undertaken under two environments. Sandovit followed by Apsa 80 increased efficiency of Bavistin in reducing disease severity though not significantly, but yield was significantly increased in both environments. Both stickers could not effected efficiency of Dithane M 45.

MIZORAM

Integrated Nutrient Management in Groundnut

K. Laxminarayana

A field experiment was conducted during *kharif*, 2002 to study the effect of integrated application of organic and inorganic manures on yield and nutrient uptake of groundnut. The highest yield (21.07 q/ha) was recorded with integrated application of optimum dose of NPK and FYM @ 15t/ha followed by 100% NPK + Poultry manure @ 5t/ha (19.45 q/ha) and 150% NPK (18.70q/ha). The balanced application of NPK has produced highest pod yield in comparison with the application of N alone or NP. Conjunctive use of organic manures and inorganic chemical fertilizers produced highest crop yield and maintains the soil fertility status for longer time.

TRIPURA

Oilseed Improvement Programme

K. Chattopadhyay & K.R. Dhiman

SESAME

TRC-til-1-8-1 (11-12 q/ha), a selection from a cross (BS-5-18-6 (G)- x B-67-) was found promising under rainfed upland condition of Tripura. Seed of this variety was distributed to KVK and farmers.

YELLOW SARSON

Nine lines were sown in the month of October which were selected from different cross combinations on the basis of early ness, pod shape, seed color and seed size. After the selection for five years on the basis of single plant, 2-3 lines were found most promising. TRS-Y-01-5-1-1, a selection from SS-1/SS-2 gave 16.1 q/ha in 90 days with 150 cm plant height and 165 siliqua/plant. TRS-Y-01-2-2-1, another selection from YSK-8501/SS-2 gave 13 q/ha seed yield in 90 days with 130 cm plant height and 145 siliqua/plant. SCRT lines were also being maintained.

SOYBEAN

Twenty two high yielding lines of soybean were evaluated under upland rainfed situation in autumn season, 2002. Due to late sowing (second week of October), average yield of those lines was observed lower (5 q/ha) in comparison to last year's average (7.5 q/ha). The best performer was DS-93-108-13 (7.17 q/ha seed yield).

NATP IN IPNS

Coordinated trial on groundnut

M. Datta

Evaluation of groundnut germplasm

Groundnut germplasm (100 nos) was screened for their tolerance to soil acidity and some of them showed a decline in pod no., pod weight and kernel weight upon liming thus indicating their tolerance to the prevailing soil acidic condition. It is indicated that pod no., pod wt. and kernel wt, on an average showed a decline of 32%, 42% and 39% over control upon liming in groundnut germplasm, respectively.

Long term fertility trial

A fertility trial was conducted with inorganic fertilizer alone or in combination with organics and biofertilizer in groundnut (var. ICGS – 76). The perusal of the productivity indicated that cow dung (10t/ha) in combination with $N_{30}P_{50}K_{40}$ and lime (2.5t/ha) produced the maximum rise in pod no (26.1%), pod weight (33.3%) and kernel weight (30.8%) over control. Farmers practice (20kg P_2O_5 + 37.5 kg K_2O /ha) could produce only 4.3% increase in pod no. but a decline in pod weight and kernel weight was noted.

Productivity evaluation of groundnut varieties

A field trial was conducted with 32 varieties and the productivity parameters indicated that NRCG 5513, CSMG 84-1, NRCG – 6820, ICG 86590, ICGS – 76 and DRG – 12 produced an appreciable increase in pod no. weight and kernel weight as compared to JL – 24 (check). The increase, over JL – 24 was 33 to 122% (pod no.), 60 to 220% (pod wt.) and 33 to 233% (Kernel wt.)

Organic farming in groundnut

A field trial was conducted in groundnut (var. ICGS 76) and productivity parameter as noted at the harvest is presented in Table 22 .

Table 22: Effect of organic socracs on groundnut

Treatment	Pod Yield (q/ha)	Haulm yield (q/ha)
T ₀ - Control	8.96	22.07
T ₁ - N ₃₀ P ₅₀ K ₄₀ + Lime (2.5t/ha)	15.72	36.69
T ₂ - PSM (Bacillus Polymixa) + Rhizobium (TAL 100) + PGPR4 (without fertilizer)	9.6	36.80
T ₃ - Cowdung (10 t/ha)	22.2	39.20
T ₄ - Mustard oil cake (10 t/ha)	15.8	25.9
T ₅ - Compost (10 t/ha)	16.20	24.5
T ₆ - Gliricidia green leaf (10 t/ha)	14.5	20.2
T ₇ - Subabul green leaf (10 t/ha)	12.2	18.5
T ₈ - PSM + Rhizobium + PGPR4 + N ₃₀ P ₅₀ K ₄₀	18.25	24.20
T ₉ - Farmers Practice (P ₂₀ K _{37.5})	11.7	30.20
SE (□)	2.5	5.25
CD (15%)	4.8	9.30

The application of cowdung (10 t/ha) could produce the maximum rise in pod and haulm yield from 8.96 to 22.2 q/ha and 22.07 to 39.20 q/ha, respectively. Fertilizer (N₃₀P₅₀K₄₀) in combination with PSM, *Rhizobium* and PGPR 4 raised the productivity from 8.96 to 18.25 q/ha and 22.07 to 24.20 in pod and haulm yield, respectively. *Gliricidia* leaf, if applied 10t/ha (green leaf) could raise the pod yield from 8.96 to 14.5 q/ha but farmers practice (P₂₀K_{37.5}) could not produce significant increase in pod yield.

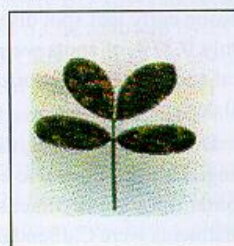
Germplasm screening of groundnut against foliar diseases during kharif season

S. Biswas & M. Datta

One hundred genotypes of groundnut were evaluated for their resistance against early leaf spot (*Cercospora arachidicola*) disease. The genotypes with accession numbers 813, 935, 945, 992, 996, 1001, 1006, 1021, 1026, 1045, 1056, 1057 and 11734 were found to be resistant with disease score ranging between >1 and 3 in 9 point scale . Late leaf spot disease incited by *Phaeoisariopsis personata* was noted to occur at last observation,

i.e. when the plants were 13 weeks of old, and that was only 3.67% out of 2260 spots studied. Application of lime had very little effect in increment or decrement of disease incidence, although, certain varieties, viz. 1026, 1067, 4104, 4467, 4589, and 10465 showed lower disease incidence in lime applied field, while others viz. 1290, 4607, 4636, 4654, 4680, 4706, 6234, 6473, 6491, 11734, 11954, 11959, and 1048 showed higher disease in lime applied field.

In this experiment 24 improved and newly released groundnut varieties were screened for their resistance to leaf spot diseases. The varieties such as CSMG 84-1 and M-13 were found resistant (disease score >1-3), while,



FeESG-8, NRCG-2588 and NRCG-3498 were highly susceptible (>6 to 9) and the rests were recorded as moderately susceptible (>4 to 6) to the disease. Late leaf spot disease with its incidence of 3.48% of total spots was found to appear on the plants of 15 weeks of old and its incidence was increased to 21.09% when the plant age was 18 weeks.

Early leaf spot

Evaluation of fungicides for the control of foliar disease of groundnut under Tripura condition

S. Biswas

During Kharif season, fungicides, like Carbendazim(0.05% a.i.), Ridomil (0.2%), Propiconazole (0.005%), Hexaconazole(0.005%, Copper oxychloride(0.2%), Mancozeb(0.3%), and Kitazim(0.15%), were applied thrice at 15 days interval on the naturally infected field plots. The fungicides was sprayed after 30 days of sowing of ground nut cultivar JL-24. The disease incidence were recorded at 10 days interval after last spray in 9 point scale. It was found that both Carbendazim and Propiconzole were effective to control leaf spot

disease. However, between them, Carbendazim was better. It was found that Hexaconazole, COC and mancozeb were effective to control rust disease upto 10 days of spraying. Further one interesting finding was observed that although both leaf spot and rust appeared in groundnut simultaneously, they are antagonistic to each other. Since, suppression of leaf spot disease by spraying of Carbendazim and Propiconazole enhanced rust incidence significantly over control. Further, during Kharif season early leaf spot disease was most prevalent. Only 9.27% of spots were found to cause by late leaf spot fungus (*Phaeoisariopsis personata*) after 30 days of last spray.

During Rabi season, different combinations of fungicides and furmaric extracts were sprayed in controlling foliar diseases of groundnut. The treatments were Carbendazim + mancozeb (0.05 + 0.2%), Propiconazole + mancozeb (0.005 + 0.2%), Carbendazim + COC (0.05 + 0.2%), Propiconazole + COC (0.005 + 0.2%), Turmeric (acetone extract 0.2%), Turmeric (alcoholic extract 0.2%), Carbendazim (0.05%) and without spray (control). The results revealed that spraying of chemical fungicides both combination and alone (Carbendazim) were equally effective to control leaf spot disease, which mainly caused by late leaf spot fungus (*Phaeoisariopsis personata*). Further, rust disease was not found during the season.

Screening of groundnut cultivars against collar rot disease

T.K. Sengupta

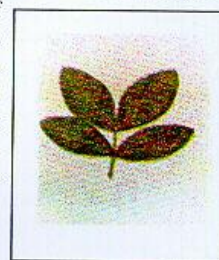
The outbreak of collar rot disease was first noticed in Tripura center. The cultivar showed the symptoms of rotting of the collar portion. Succulent elongated hypocotyl attacked by the pathogen at the soil level causing the death of the seedlings. The hypocotyls was damage by both soil borne inoculum and by the inoculum already infected cotyledons. The hypocotyls develops water soaked and light brown lesions of the cultivars received from ICRISAT (Table 23).

Table 23: Varieties tolerant to the collar rot disease

ICG – 10936	Moderately resistant
ICG – 2716	Moderately resistant
ICG – 10974	Susceptible.
ICG – 11183	Susceptible.

Rust of groundnut

Rust of groundnut (*C.D. Puccinia arachidis*) has been observed in some of the groundnut varieties grown in kharif season. The disease spread severely within short period. Continuous rainfall and lower temperature (28-30°C) might have aggravated the disease. The disease covers the lower surface of the leaves, also form rusty appearance on the upper surface. Carbendazim was sprayed to control the disease, but Carbendazim could not control the disease.



RUST

Mustard

Two major diseases of mustard have been found to occur in Rabi season – (a) Leaf spot – *Alternaria brassicae*, (b) Powery mildew – *Erysiphe cruciferam* quintals per hectare for both carbendazim and copper oxychloride respectively. These two diseases lowered the Mustard yield drastically. Both the varieties were affected. Integrated disease management was adopted. Good seeds chosen were dried properly. Seeds of both the varieties were treated with carbendazim 1gm/kg of seeds. Copper oxychloride and carbendazim @ 3-4 gm/litre of water and @ 1 gm/litre of water was sprayed on the crop respectively. Carbendazim gave the best control, while copper oxychloride sprays gave minimum control. The yield was 600 and 400 quintals per hectare respectively.

Sesamum

Charcoal rot of sesamum (*Macrophomina phaseoli*) was observed in eight varieties of

sesamum. The pathogen attacks mostly at the basal region of the plants. The infected portion rots and characteristically black. Numerous pycnidia and sclerotia were found on the surface of the infected tissues, which looks like black dots. The fungus survives well in the soil as well as on the infected seeds and also on weed hosts. To control the seeds were treated with carbendazim @ 1 gm/kg of seeds.

PULSES

MANIPUR

PULSE IMPROVEMENT PROJECT

S.V. Ngachan, & Vijai Pal Bhadana

CHICKPEA

Two Advanced Varietal Trial viz., AVT₁ and AVT₂ which were obtained from IIPR, Kanpur, were conducted at both Langol hill as well as Lamphelpat farm. Advanced Varietal Trial-1 comprised of 14 genotypes of chickpea. The trial was conducted after harvesting of maize. Among 14 entries, B-34, B-17, B-28, B-50, B-29 performed well with the yield potential of 18.52, 18.37, 18.01, 17.54, 16.6 g/plant.

Similarly, Advance Varietal Trial-2 on chickpea (8 lines) was also taken up at Langol farm. Among the eight entries the lines, B-104, B-102, B-107, B-B-106, were giving yield 22.2, 21.2, 19.6, 18.5 g/ plant respectively.

MEGHALAYA

PULSES IMPROVEMENT

B.K. Sarma & G. Sahay

RICEBEAN

Two varietal trials viz. Research complex Regional Trial (RCRT) and Advanced varietal Trial (AVT) with 8 varieties in each trial, were conducted (Table 24). In RCRT, variety BD-139-1 recorded the highest yield of 14.84 q / ha followed by EC-2074 (14.14 q / ha) and RCRB 6-10 (13.14 q/ ha). In AVT the performance of RBL - 35 was best (7.0 q/ha). Forty nine germplasm were maintained and evaluated of which the high yielding lines were RBS2 (28.31 q/ha), IC187911 (26.18 q/ha), IC 3074 (23.14 q/ha), EC18181 (23.06 q/ha) and EC114077 (19.89 q/ha). Most of the lines were high yielders with average trial yield of 12.59 q/ha.

MUNGBEAN

Four trials viz. two initial varietal trials (IVT), one AVT and another with the materials received from BARC, Mumbai were conducted. However, the yield from all the trials were very poor due to heavy incidence of disease and *in situ* germination due to continuous rain during harvesting time. The yield ranged from 132 to 136 Kg/ ha only.

URADBEAN

Thirty-seven varieties were tested in three different trials viz. IVT, AVT and BARC trials. As in mungbean trials, the varieties failed to produce

Table 24: Promising varieties of pulses from different trials.

Rank	Ricebean (RCRT)		Uradbean (GPE)		Pigeonpea (BARC)	
	Variety	Yield (Kg/ha)	Variety	Yield (Kg/ha)	Variety	Yield (Kg/ha)
I	BD-139-1	1484	VBG 23	1295	BT-20	614
II	EC-2074	1414	RBU-28	1125	TT-44-4-1	414
III	RCRB-6-10 (ch)	1314	99U-40	1093	TT-44-4	410
IV	BRS1-2	1294	99U-43	1067	TAT 93-47	390
V	PRR 9301	1087	99U-27	1009	TT-32	366
Entries	8		37		10	
Trial mean	1144		666		266	
SEM ±	47		-		13	
CD (5%)	102		-		27	

good yield due to continuous rain during maturity. The performance of TU 97-74, 2KU-170 and 2 KU-186 was somewhat better than remaining varieties.

Thirty seven germplasm were evaluated of which VBG 23 recorded the maximum yield (12.95 q/ha) followed by RBU 28, 99U-40, 99U-43 and 99-27 yielding 11.25, 10.93, 10.67 and 10.09 q/ha, respectively.

PIGEON PEA

Ten varieties received from BARC, Mumbai were assessed for their yield performance for the second year. Highest yield was realized from BT-20 (614 Kg / ha) followed by TT- 44-4-1 (414 Kg/ ha). In this trial also, yield was poor due to early harvest to save the crop from grazing.

Pulses Germplasm characterization and evaluation

B.K. Sarma, J.K. Singh & A. Pattanayak

Characterization was done on rice bean (64), green gram (30), blackgram (19), horse gram (08), Pigeonpea (07), following the procedure given in Minimal Descriptor of Agri-horticultural crops (part-I) of NBPGR.

GREEN GRAM

Twenty nine germplasm were collected from Sikkim, Darjeeling district of West Bengal and Assam during 2000- 2002 and evaluated for 18 characters and the extent of variability found in some important quantitative characters are presented in Table 25.

Table 25: Quantitative characters of Green gram germplasm.

Characters	Range
Days to 50% flowering	41-79 days
Plant height	12.5 – 38.6 cm.
Primary branches/plant	1.4 – 5.0
No of clusters/plant	1.6 – 16.8
Pods/clusters	1.6-3.6
No. of seeds/pod	3.0 – 8.6
Pod length	2.8 – 4.1 cm.
Seed yield/plant	2.4 – 14.1 g

A good amount of variability were observed on plant vigour, plant growth habit, leaf color, leaf let shape plant surface, flowering tendency, pod pubescence branching pattern, pod color and biotic susceptibility etc.

BLACK GRAM

Nineteen germplasm were collected from Sikkim, Darjeeling district of West Bengal and Assam during 2000-2002 and evaluated for 19 characters and good variability were found for the Quantitative and Qualitative characters studied are given in Table 26.

Table 26: Some of the characters of black gram germplasm.

Characters	Range
Days to 50% flowering	41- 80 days
Plant height	13.8 – 28.2 cm.
Primary branches/plant	1.6 – 4.2
No of clusters/plant	3.0 – 14.2
Pods/clusters	1.0-2.6
No. of seeds/pod	3.5 – 6.1
Pod length	3.4 – 4.5 cm.
Seed yield/plant	3.0 – 17.3 g

Variability on qualitative characters were observed on plant vigour, plant growth habit, leaf color, leaflet shape, plant surface, flowering tendency, pod pubescence, branching pattern, pod color and biotic susceptibility etc.

HORSE GRAM

Nine germplasm were collected from Sikkim and Assam during 2000-2003 and evaluated for 16 characters and the extent of variability found for the Quantitative characters studied are given in Table 27.

Table 27: Some characters of horse gram germplasm.

Characters	Range
Days to 50% flowering	51- 67 days
Plant height	39.5 – 62.8 cm.
Primary branches/plant	2 – 4
Pods/plant	16.5 – 46.8
Pod length	4.1- 4.9 cm.
No. of seeds/pod	4.1 – 5.7
Seed yield/plant	4.3 –22.3 g
100 seed weight	1.4-2.6 g

Significant variability was also observed in plant vigour, plant growth habit, leaf color, leaf surface, stem colour, flower colour, pod shape, pod surface etc.

SOIL SCIENCE

BLACKGRAM

Response to molybdenum and lime in acid soil

M.S. Venkatesh, Kailash Kumar,
B. Majumdar & Patiram

The effect of liming and levels and methods of molybdenum application on yield and nutrient uptake was studied. The treatments consisted of soil (0, 0.5 and 1 kg/ha), seed soaking (0, 50 and 100g/ha) and foliar (0, 0.01 and 0.02%) application of molybdenum. Soil application of Mo @ 1kg/ha along with lime @ 0.25 LR resulted in maximum grain yield of black gram (13.9 q/ha).

Integrated Pest Management in pulses

A.N. Shylesha, K. Rajasekhara Rao
& K. A. Pathak

PIGEON PEA

Biology of pod boring weevil *Apion clavipes* and its natural biocontrol

The adult weevil lays eggs on the pods they are hemispherical, golden yellow coloured. The black head of the grub is visible on the 3rd day and on the fourth day the eggs hatch and the grub enters into the seeds and starts feeding on the developing grain. Eggs measure 0.8mm x 0.3mm and 10-15 eggs are observed during the peak infestation period. Grubs are white and C shaped with prominent black head. They feed on the grains completely and pupation takes place within the pod. Total larval period is completed in 8-10 days. Pupae are exarate and are found within the pod. Pupal period is for 8 days. The adults emerge by making a hole in the pod.

The adults are black weevils having a good ability of flight. Adult weevils feed on the leaves, young shoot and flower buds. On young leaves they make small holes and in flower buds they

nibble the petals and the flower opening is affected and this will lead to poor pod set. The adult weevils are also found feeding on young pods. In the first generation on the crop when incidence starts there is a long pre-mating period of 12-15 days. As and when flowering starts in pigeon pea the adults start mating and the pre-oviposition period of 5-8 days is observed. Eggs are laid singly on the pods and on an average a female can lay 15 eggs per day and peak egg laying continues for 3-4 days. Males and females are equal in number and adult's longevity ranges from 30-40 days.

Natural enemies

Two hymenopteran parasites have been recorded on this pest feeding on the grubs and one egg parasite has also been observed. The Eulophid parasite lays eggs on the grubs by piercing ovipositor through the pod and or from the entry hole of the grub. The parasite grub feeds as an external parasite and emerge on the 8th day.

Entomogenous fungus *Beauveria bassiana* was tried in laboratory for the management of the adult weevils. Spores of *B. bassiana* when treated @ 10⁹ spores/ml was found to be highly effective killing 90% of the test insects within 3-4 days of treatment and the conidial development was seen on 8th day.

Chemical control of *Apion clavipes*

Different insecticides were used to control the *A. clavipes*. These insecticides were sprayed two times, one at initiation of flowering and the other spray one-month after first spray. Among all the insecticides sprayed decamethrin @ 0.005 % recorded the lowest pod damage (22.33%) followed by carbosulfan 25 DS @ 0.025% (37.66%) and monocrotophos 36 SL @ 0.075% (43.66%). Remaining insecticides, however, did not show any reduction in pod damage were nuvan @ 0.1% (51.33%), endosulfan 35 EC @ 0.15% (57.66%) and cypermethrin 25 EC @ 0.01% (64.66%). Control recorded the highest damage over all the treatments (76%). But when the number of seeds with in each pod was taken into account decamethrin recorded the lowest percent seed damage (8.6%) followed by carbosulfan (17.68) and

monocotophos (19.37%). The highest seed damage was in control (38.65%).

Studies on the behaviour and identification of attractants for luring blister beetle adults damaging pulses, oilseeds and vegetables

K.A. Pathak & A.N. Shylesha

Blister beetles *Mylabris phalerata* (small ones) were the first to emerge during June 3rd week and *M. pustulata* (bigger ones) during 3rd week of August. The activity of these beetles increased when the intensity of the light was more than 8000 Lux. When the intensity of the light was more than 18000 Lux, the beetles migrated from grasses and other pastures to the main crop. The damage by these beetles was severe when the light intensity was between 80,000 to 1,80,000 Lux. Maize + French bean intercrop system attracted more number of blister beetle damage than Maize + Groundnut. This was because of same height of both the crops in the former system. Identification of male/female beetles for the isolation of pheromones could not be done due to the absence of sexual dimorphism.

TRIPURA

Pulses Improvement Programme

K.R. Dhiman & K. Chattopadhyay

BLACK GRAM

Nine high yielding, promising lines, derived from various crosses along with check, B-12-4-4 were sown in autumn season. Some of the identified promising lines were shinning black seeded TRU-99-16 (15.3 q/ha), shinning black seeded TRU-99-4 (16 q/ha), shinning green seeded TRU-99-29 (16 q/ha) and brown seeded TRU-99-14 (12-15 q/ha).

GREEN GRAM

Sufficient amount of genotypic and phenotypic variances were observed among 23 different cross combinations, sown in the month of June, 2002. Thirty eight single plants were selected from them on the basis of higher plant yield, early maturity, large pod length and more seeds/pod. Those lines

were sown in the month of September, 2002 along with local check (UPM-79-12). TM-4 (MH-96-1/BDYR-2) and TM-27 (ML-682/Pant-M-4) were some of the early selections, which gave, estimated yield of 15 q/ha in 65 days and 15.5 q/ha in 72 days, respectively. Twenty-seven plants and single pods from plants were finally selected for generation advancement.

PIGEON PEA

Germplasm evaluation

Twenty five germplasm selected from 100 accessions of North-East India, were evaluated for consecutive 3rd year on the basis of days to 50% flowering, days to 75% maturity, plant height, 100 seed weight, seed/pod, grain colour, flower colour, growth habit, stem colour, extent of branching, *Helicoverpa* pod borer infestation and plot yield. These lines were planted under two separate row spacing (100 cm and 80 cm). A significant difference was noted in respect of yield under those two conditions. One m row spacing was found more suitable than the 80 cm. ICPL-10812 (17.3 q/ha) with 220 days maturity period was observed better than others.

CHICK PEA

ICCV-00107 (6.67 q/ha with moderate resistance to pod borer (scale-4)) was the best performer among 23 semi-short duration lines under International Chickpea screening Nursery (ICRISAT). No line was observed to resistant to *Helicoverpa* pod borer.

Improvement of MULLaRP crops

BLACK GRAM

2KU-8 (1593.33 kg/ha in 83 days) in AVT and 2KU-62 (2090.28 kg/ha in 86 days) in IVT were the best performers among 6 and 19 lines, respectively in autumn season of 2002.

GREEN GRAM

2KM-53 (1284.72 kg/ha in 72 days) in IVT was the best performer among 19 lines in the autumn of 2002.

FIELD PEA

Under the Improvement of MULLaRP crops, IVT-Tall for NHZ on field pea was conducted. The

general mean yield and maturity of the 16 high yielding lines were 11.6 q/ha and 111.4 cm, respectively. FP-2-1 (25 q/ha) and FP-2-9 (22 q/ha) were the best among those lines.

Improvement of Fiber crops

Cotton varietal evaluation

Anjali was the best performer among 14 lines with 23.33 q/ha seed cotton yield in 155 days under the varietal evaluation for introduction of *Hirsutum* cotton in Tripura state.

CROPPING SYSTEMS

MEGHALAYA

AGRONOMY

Integrated nutrient management in maize-mustard cropping system

A.S. Panwar

The experiment comprised of 15 treatments combination in maize-mustard cropping sequence revealed that the growth and yield parameters of

maize varied significantly with the system of manuring and levels of NPK applied. Application of 100 % of the recommended dose of NPK through inorganic sources alone or through inorganic + organic sources, recorded maximum yield (Table 28).

During the rabi season, maximum seed yield of mustard (6.95 q/ha) was recorded in the treatment where 75 % of the recommended dose of NPK through fertilizer + 25 through FYM/Azolla compost applied to maize followed by recommended dose of fertilizer given to mustard.

Total productivity of the maize-mustard system in terms of total maize equivalent yield (MEY) was maximum with substitution of 50 % NPK through FYM and 50 % through inorganic fertilizer followed by 50 % of NPK through inorganic sources to mustard crop.

Integrated Nutrient Management in Maize French bean Cropping Sequence

U.K. Hazarika & D.C. Saxena

Among the 15 integrated nutrient management treatments, maize cv Vijay composite sown under 100% recommended dose of NPK (100:80:50) kg/

Table 28 : Effect of integrated nutrient management on yield of maize and mustards

Treatments	Yield (q/ha)				
	Maize	Mustard	Maize yield (q/ha)	Mustard yield (q/ha)	Total maize equivalent yield (q/ha)
Control	Control	Control	19.80	2.30	24.40
100 % Recommended dose of fertiliser (RIF)	50 % RIF	50 % RIF	33.16	4.50	42.16
75 % RIF	75 % RIF	75 % RIF	25.83	5.20	36.23
75 % RIF + 25 % through FYM	50 % RIF	50 % RIF	35.83	5.45	46.73
50 % RIF + 25 % through FYM	50 % RIF	50 % RIF	27.43	4.80	37.06
50 % RIF + 25 % through FYM	75 % RIF	75 % RIF	27.76	4.65	37.06
75 % RIF + 25 % through FYM	100% RIF	100% RIF	35.10	6.95	49.00
75 % RIF + 25 % through FYM	75 % RIF	75 % RIF	35.43	6.70	48.83
75 % RIF + 25 % through Azolla compost	75 % RIF	75 % RIF	35.23	6.60	48.43
75 % RIF + 25 % through Azolla compost	50 % RIF	50 % RIF	35.93	6.15	48.23
50 % RIF + 25 % through Azolla compost	100 % RIF	100 % RIF	27.06	6.50	40.06
50 % RIF + 25 % through Azolla compost	75 % RIF	75 % RIF	28.90	6.80	41.50
50 % RIF + 50 % through FYM	50 % RIF	50 % RIF	37.33	6.70	50.73
50 % RIF + 50 % through Azolla compost	50 % RIF	50 % RIF	36.26	6.65	49.56
Farmers practice	Farmers practice	Farmers practice	26.20	4.20	34.60
CD (P=0.05)					2.54

ha + FYM 10t/ha recorded maximum grain yield of 32.8 q/ha followed by 31.13 q/ha due to 100% of the recommended levels of NPK + FYM 5t/ha. The grain yield decreased with the decrease in NPK doses from 100% to 25 %. Application of FYM 5 t/ha gave an additional grain yield of 3.3 q/ha over control (21.6 q/ha)

Integrated nutrient management in groundnut-mustard cropping system

A.S. Panwar & Rajesh Kumar

The experiment was designed to study the effect of integrated nutrient management in groundnut and its residual effect on mustard crop. Eight treatments were tested in groundnut while in mustard during rabi season only the recommended dose of nutrients were applied to all the plots. The results of one-year study revealed that application of recommended dose of fertilizer NPK (20:60:40) significantly improved groundnut yield as compared to 10 t FYM or pig manure/ha. Highest pod yield of groundnut was recorded with the application of 10 t FYM/ha + 75 % of the recommended dose of fertiliser, which was however at par with the yield recorded due to application of organic manures in the presence of 50 or 75 % of the recommended dose of fertilisers. (Table 29)

Table 29: Integrated nutrient management in groundnut-mustard cropping sequence

Treatments	Groundnut yield (q/ha)	Mustard yield (q/ha)	Groundnut equivalent yield (q/ha)
Control	19.52	3.75	23.27
RIF (20 : 60 :40)	28.67	5.33	34.00
FYM @ 10 t/ha	26.55	5.50	32.05
Pig manure @ 10 t/ha	25.04	5.65	30.69
FYM @ 10 t/ha + 50 % RIF	31.75	6.00	37.75
FYM @ 10 t/ha + 75 % RIF	32.51	6.25	37.76
Pig manure @ 10 t/ha + 50 % RIF	30.62	6.20	36.82
Pig manure @ 10 t/ha + 75 % RIF	31.75	6.37	38.12
CD (p=0.05)	3.95	0.55	2.32

Yield of mustard was significantly influenced by both the levels of NPK applied to mustard and the system of manuring to the preceding groundnut. Highest mustard yield was recorded with pig manure applied @ 10 t/ha + 75 % of the recommended dose of NPK, which was statistically at par with FYM 10 t/ha + 75 % of the recommended dose of NPK and was superior to rest of the treatments.

SOIL SCIENCE

MAIZE-MUSTARD

Integrated nutrient management

Kailash Kumar & Patiram

Long term experiment on INM for maize-mustard crop sequence consisting of 20 treatment combinations incorporating NPK fertilizer, lime, FYM and biofertilizers was repeated during the year. The grain yield of maize increased significantly by all the fertilizer treatments when applied along with lime and/or FYM over control. The highest yield of maize was recorded in lime + FYM + bio. + NPK (43.6q/ha) over control (8.8q/ha). Similar was the observation for the grain yield of mustard. The maximum grain yield of mustard (600kg/ha) was recorded in lime + FYM + bio. + NPK and was at par with lime + FYM + bio. + 75% NPK (576 kg/ha) as against the control (11kg/ha). Fertilizer doses over 50% caused detrimental effect on the yield of both the crops in the plots receiving no lime or FYM. Exchangeable acidity decreased significantly in the plots receiving lime or lime + FYM while the trend was reverse for exchangeable Ca + Mg. Application of lime, FYM and biofertilizers increased the DTPA extractable Fe, Mn, Zn and Cu in the soil.

MANIPUR

Use of microorganisms/biofertilizers in increasing the productivity of some cropping systems of Manipur

Mausumi Raychaudhuri & S. Raychaudhuri

Use of biofertilizer along with organic manures and intercropping in maize based cropping systems of Manipur hills

Intercropping maize with groundnut and soybean increased the grain yield of maize over control by 15.7 and 25.6 per cent respectively (Table 30). Intercropping with soybean and groundnut was found beneficial in increasing the grain yield of maize over control though not significant. All the treatments in the subplots also increased the grain yield of maize significantly over control. The grain yield increased with FYM @ 5 t/ha + A (A=*Azotobacter* strain (Mac-27) + *Azospirillum* (C2) was used as biofertilizer) by 20.4 per cent and then further increased by 13.8 and 29.1 per cent when coupled with ½ NPK and full NPK respectively. The percent increase was more when maize was intercropped with soybean. Maximum significant grain yield was obtained when FYM @

10 t/ha + *Azotobacter* was coupled with ½ NPK (33.5 q/ha) and became at par with full NPK (36.2 q/ha). The interaction was insignificant. Under controlled condition FYM @ 10 t/ha + A + full dose of NPK could give the maximum grain yield. This yield can be further increased by 19.3 percent by intercropping with soybean and curtailing half dose of NPK.

Mustard was the second crop grown in this system. The grain yield showed residual significance of intercropping. The residual effect of all the sub-treatments showed significant increase in grain yield. The N and P uptake by the grains also showed the similar trend as that of the grain yield. Maximum grain yield was obtained with the residual effect of FYM @ 10 t/ha + A + ½ NPK along with the residual effect of soybean intercropping.

Table 30 : Direct and residual effect of intercropping and treatments on the grain yield (q/ha) of maize-mustard cropping system

Treatments	Sole crop		Intercropping with				Mean	
	Maize (Direct)	Mustard (Residual)	Maize (Direct)	Mustard (Residual)	Maize (Direct)	Mustard (Residual)	Maize (Direct)	Mustard (Residual)
Control	16.4	1.8	22.9 (4.9)	2.0	24.0 (6.6)	3.0	21.1	2.27
½ FYM + <i>Azotobacter</i> + <i>Azospirillum</i> (A)	22.0	3.1	27.5 (6.1)	3.2	26.8 (8.5)	4.3	25.4	3.53
FYM + A	28.0	3.8	30.2 (7.4)	4.1	32.4 (12.0)	5.3	30.2	4.39
½ FYM + A + ½ NPK	23.4	3.7	28.2 (6.7)	3.8	34.9 (10.5)	4.5	28.9	3.98
½ FYM + A + NPK	32.1	4.0	30.4 (7.7)	4.3	35.9 (12.8)	5.0	32.8	4.42
FYM + A + ½ NPK	29.4	4.4	33.5 (9.0)	4.6	37.7 (13.2)	5.5	33.5	4.84
FYM + A + NPK	31.6	4.2	38.9 (9.4)	4.8	38.2 (13.5)	5.1	36.2	4.72
Mean	26.1	3.6	30.2	3.8	32.8	4.7		
CD		Maize (Direct)				Mustard (Residual)		
Intercropping (I)		NS				0.84*		
Treatment (T)		7.34**				0.59**		
I x T		NS				NS		

FYM denotes FYM @ 10 t/ha.
 Figures in parentheses denote yield of intercropped crops. ** and * indicate significance at 1 and 5 % level significantly

Nutrient dynamics of soils under different land uses/cropping systems and management for increased production potential

Mausumi Raychaudhuri & S. Raychaudhuri

Integrated Nutrient Management in groundnut based cropping system

The pod yield increased significantly by all the residual effect of the main treatments except *Rhizobium* inoculation over the control. Maximum pod yield was recorded with Lime + FYM (18.4 q/ha) over control (12.02 q/ha) followed by FYM (17.1 q/ha). Liming + FYM increased the pod yield significantly over *Rhizobium* inoculation (13.7 q/ha). The fertilizer level ½ NPK increased the pod yield significantly over control and became significant with the full dose of NPK. The N and P uptake by the pods showed the similar trend as that of the pod yield. The straw yield increased significantly with lime + FYM over control. The N and P uptake by the straw showed the similar trend as that of the straw yield. Interaction of fertilizers with main treatment was not significant for pod and straw yield (Table 31).

Table 31 : Effect of integrated nutrient management on the grain yield(q/ha) of Groundnut

Main treatment	Fertilizer levels			Mean
	N ₁ P ₁ K ₀	N _{12.5} P ₁₅ K _{12.5}	N ₂₅ P ₂₆ K ₂₅	
Control	9.52	13.98	17.57	13.69
<i>Rhizobium</i>	12.77	17.40	18.67	16.28
Lime @ 500kg/ha	13.79	16.24	19.73	16.59
FYM @ 10 t/ha	16.37	18.27	18.40	17.68
Lime @ 500kg + FYM @ 10 t/ha	17.60	18.23	19.47	18.43
Mean	14.01	16.82	18.77	
P _{0.01}	Main treatment(MT)	Fertilizer(F)	MT x F	
	2.66*	3.27**	NS	

** and * indicate significance at 1 and 5 per cent respectively

Effect on soil characteristics

The soil pH increased from 4.6 to 5.6 with lime and further to 5.9 when combined with FYM. The pH and the K, Ca + Mg content of FYM were the major factors causing an increase in the pH of the soil to which it is applied. Lime by contributing Ca

raises the pH and increase the availability of the plant nutrients. FYM increased the organic matter content in the soil by 26.5 per cent significantly over control (1.33 per cent). The exchangeable K⁺ and available P content also increased significantly by 52 and 78.6 per cent over their respective controls [0.36 cmol (p⁺)/kg and 11.99 ppm]. Lime + FYM was the best treatment found and increased the pH, available P and exchangeable K⁺ to a maximum and increased the yield to 18.4 q/ha.

Micronutrient status under different cropping systems

Three cropping systems viz., 1) maize-mustard, 2) soybean-mustard and 3) black gram-mustard cropping systems were studied for their micronutrient availability in soils under terraced condition. The availability of Fe²⁺ and Mn²⁺ was highest in maize based cropping system (84.56 and 55.34 ppm respectively) followed by soybean (Mn²⁺ availability) and black gram (Fe²⁺ availability) based cropping systems respectively. The availability of Cu²⁺ and Zn²⁺ was highest in soybean based cropping system (2.19 and 7.97 ppm respectively) followed by blackgram and maize based cropping systems.

MIZORAM

CROPPING SYSTEM RESEARCH

N.S. Azad Thakur & K. Laxminarayana

A field trial was laid out in *kharif*, 2002 to study the performance of different cropping systems (Rice sole crop; maize sole; groundnut sole; soybean sole; rice + groundnut, 4:2; rice + soybean,4:2; maize + groundnut, paired rows; maize + soybean, paired rows) in the upland terraces. Mustard was grown as a secondary crop during *rabi* season after harvest of *kharif* crops. Recommended fertilizer doses were applied for all the crops. At maturity the crops were harvested and yield parameters were recorded. The results revealed that highest grain/kernel yields were recorded in sole cropping, where as the economical yields were higher in inter cropping. Maize based cropping systems with legumes showed higher profit than the rice based cropping systems.

TRIPURA

NATP IN IPNS

M. Datta, K.R. Dhiman & N.P. Singh

Manurial effect on the productivity of rice-green gram cropping system.

A field trial was conducted in upland rice (var. TRC-87-251) and green gram (var. UPM-79-4-12) was raised as residual crop. The treatments applied in the experiment were T_0 (control), T_1 (2.5 tonnes cattle manure/ha), T_2 ($T_1 + N_{60}P_{30}K_{30}$), T_3 (5 t CM/ha), T_4 ($T_3 + NPK$), T_5 (10 t CM/ha), T_6 ($T_5 + NPK$), T_7 (15 ton CM/ha), T_8 ($T_7 + NPK$), T_9 (20 ton CM/ha), T_{10} ($T_9 + NPK$), T_{11} (NPK). Data on productivity are presented in Table 32.

Table 32: Effect of organic manure on rice- green gram crop sequence.

Treatment	Rice (q/ha)		Green gram (q/ha)	
	Grain	Dry matter	Pod	Haulm
T_0	17.9	22.3	7.7	11.3
T_1	32.6	37.6	10.3	16.7
T_2	33.5	42.3	10.7	16.3
T_3	33.8	46.2	14.7	16.1
T_4	37.4	59.2	10.5	17.3
T_5	41.1	60.7	12.7	20.3
T_6	39.1	60.2	12.5	21.8
T_7	33.2	46.6	13.6	22.9
T_8	33.7	53.2	11.3	24.6
T_9	32.0	47.0	10.5	17.6
T_{10}	34.7	52.5	14.9	20.2
T_{11}	24.5	36.0	8.2	10.3
SE(?)	3.7	6.2	3.2	4.2
CD(5%)	7.3	12.1	1.2	8.2

The perusal of the data indicated that the application of 5 tonnes cattle manure/ha in combination with recommended NPK doses (60 : 30 : 30) in T_5 produced an increase in rice grain from 17.9 to 41.1 q/ha and dry matter from 22.3 to 60.7 q/ha. In the residual crop of green gram, an

increase in pod and haulm yield were 6.5 to 93.5% and 42.4 to 117.7% over control upon manuring in the crop sequence.

Nutrient uptake after application of cattle manure in cropping systems

Uptake of NPK and Ca both in grain and dry matter was estimated in rice-green gram and rice – field pea cropping systems. The perusal of the data on nutrient uptake indicated that the uptake of nutrients was appreciably raised after manuring. The maximum rise in nitrogen uptake was 2.9 times in rice and 1.7 terms in green gram over control after the application of 10 tonnes cattle manure/ha in combination with NPK (T_6) and alone (T_5), respectively. P-uptake, 2.6 – 4.7 times and Ca-uptake, 2.6-3.1 times over control in rice-green gram cropping sequence.

Nutrient uptake in rice-field pea cropping sequence was estimated upon manuring .It is indicated from the data that NPK and Ca uptake in rice – field pea were raised from 1.6 – 3.5, 1.8 – 2.0, 2.2 – 4.7, 1.6 – 2.3 times over control after manuring. The application of 10 tonnes cattle manure/ha was observed to bring about the maximum rise in nutrient uptake.

Nutrient uptake under the influence of vermicompost and other organic sources

Nutrient uptake in rice- field pea cropping systems was estimated in soils treated with vermicompost and other organic sources. It is indicated that nitrogen was raised 1.3 – 4.4, phosphorus 2.2 – 2.4, potassium 1.6 – 3.9, calcium 1.5 – 4.2 times over control after the application of vermicompost and other organic sources in rice - field pea cropping sequence.

N – USE EFFICIENCY AND N – RECOVERY

Nitrogen use efficiency and recovery in soils treated with vermicompost and other organic sources were estimated and presented in Table 33.

Table 33 : N use, efficiency and recovery in rice - field pea cropping sequence.

Treatment	Rice		Field Pea	
	NUE (kg grain/kgN)	N-recovery (%)	NUE (kg Pod/kgN)	N-recovery (%)
T ₁	6.1	19.8	1.0	1.8
T ₂	2.5	25.5	3.9	0.7
T ₃	10.6	57.0	3.2	0.8
T ₄	17.8	73.0	4.0	—
T ₅	21.3	73.8	0.2	1.8
T ₆	31.6	142.8	—	—
T ₇	22.8	95.2	2.7	2.5
T ₈	18.4	68.3	4.8	2.8
T ₉	14.4	47.7	8.0	3.3
T ₁₀	15.6	51.0	4.3	2.7
T ₁₁	8.2	39.5	4.2	0.7

N-use efficiency and N-recovery was estimated in rice - field pea cropping sequence following the relationship.

$$NUE = \frac{Y_1 - Y_0}{N_{\text{applied}}}$$

Where, Y₁ = grain yield under treatment
Y₀ = grain yield under control

$$N \text{ recovery (\%)} = \frac{N_1 - N_0}{N_{\text{applied}}} \times 100$$

Where N₁ = uptake of nitrogen in rice grain and straw under treatment

N₀ = uptake of nitrogen in rice grain and straw from the control.

The perusal of the data indicates that 30 kg N as cowdung supplemented by ½ NPK (30:15:15) in T₆ could produce maximum NUE (31kg grain/kg N) and N - recovery (142.8%). In residual trial, where field pea was grown, both NUE and N - recovery were strikingly reduced.

Soil test crop response study

It is revealed that N₉₀ P₆₀ K₆₀ produced an increase in grain yield from 14.3 to 38.9 q/ha and

15.6 to 43.3 q/ha under very low and low fertility gradient, respectively. Similar was the rise in straw yield from 20.3 to 56.0 q/ha and 22.5 to 57.3 q/ha, respectively in v. low and low fertility gradient. Under medium and high fertility, N60 P60 K30 and N90 P30 K0 produced an increase in grain yield from 16.2 to 40.7 q/ha and from 12.2 to 38.2 q/ha, respectively. Straw yield was also raised from 24.8 to 42.7 q/ha and 17.6 to 44.10 q/ha under medium and high fertility, respectively.

FARMING SYSTEM RESEARCH

Evaluation of Micro-watershed based Alternative Land Uses in Hill Areas (FSRP)

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Dairy based farming system (FSW₁)

Dairy based farming was evaluated in micro-watershed of 1.39 ha. on 32.02 % hill slope. Annual fodder like maize, rice bean & soyabean was put under terraces & perennial grasses namely guinea on riser and bunds. Two milch crossbred cows with their follower were kept during the year. The intake of different feed competent on fresh & dry matter basis & its price on feeding was calculated & presented in Table-34. The data revealed that major cost of feeding was on concentrate feed which seemed to be highly expensive & needed emphasis to cut down concentrate cost & increase the production of green fodders .

The major input / output statement of W₁ (Table 35) revealed that if the labour charge are deleted considering family labour employed for dairy operation round the year then system seemed to be economically viable.

Table 34: Intake of different feed component on fresh & dry matter and its price on feeding W₁ dairy cows (FSRP)

Feed ingredient	DM (%)	Fresh basis		DM basis		Price basis	
		Total intake (kg)	% of total intake	Total intake (kg)/year	% of total (kg)/year	Cost Rs./ year	Total feed cost (%)
Concentrate	89.00	4225.0	9.5	3760.2	27.2	34391.50	70.4
Green grass	22.29	38519.0	86.4	8585.8	62.1	12711.20	26.0
Paddy straw	80.00	1840.0	4.1	1472.0	10.7	1784.8	3.6
Total		44584.0	100	13818.0	100	48887.50	100

Note :- Calculation was done @ Rs. 8.14 /kg concentrate, Rs. 0.33 / kg green grass and Rs. 0.97/kg of paddy straw

Table 35: Input / output statement of W₁ dairy based farming system of FSRP, ICAR Umiam , Meghalaya for the year 2002 – 2003

Input			
Sl. No.	Particulars	Amount (Rs)	
1.	Cost of concentrate feed	Rs.	35157.00
2.	Paddy Straw	Rs.	1785.00
3.	Vety. Medicine		Nil
4.	Miscellaneous	Rs.	300.00
5.	Labour charge 2.5 man days/ dry @ Rs. 5000.00/month.	Rs.	1,50,000.00
	Total	Rs.	1,87,242.00
Output			
1.	Milk 4225.0 lt. @ Rs. 10.00 / lt.	Rs.	42,250.00
2.	Green fodder 38,519 kg @ Rs. 0.50 / kg	Rs.	12,711.00
3.	Cow dung 3 truck @ Rs. 1500.00 / truck	Rs.	4,500.00
4.	Calves 2 nos.	Rs.	10,000.00
	Total	Rs.	69,461.00

Tree based farming system (FSW₂)

The tree based farming system comprised of *Acacia acuriculiformis* stands. After 19 years of

growth the average height of *Acacia* trees was recorded to be 11.15 m with diameter growth of 0.33 m. The tree canopy was thinned by 25 %, 75% and 100% so as to cultivate the crops in the understorey plots. Data on pruned biomass are given in Table 36. The phytosociology of ground vegetation was also recorded (Table 37). After manipulating the canopy, 2000 suckers of pineapple (var. kew) and 6000 seedlings of large cardamom were planted in the watershed area.

Table 36: Growth performance of *Acacia auriculiformis* along with productivity (dry wt. basis) of pruned biomass (kg/tree)

Parameters	25 % thinning	75 % thinning	100 % thinning
Height, m	8.62±1.19	13.98±2.99	10.86±4.53
Diameter, m	0.58±0.12	0.21±0.17	0.18±0.06
Spacing	3.3 x2.1	3.7x4.8	1.7x2.1
No. of branches removed/tree	2.40±0.55	4.80±2.59	5.8±2.39
Branch biomass	71.13±26.91	93.81±40.55	204.21±60.94
Leaf biomass	1.51±0.95	2.85±1.27	6.06±1.04
Twig dry biomass	0.34±0.21	0.52±0.28	1.61±0.75
Numbers of plants pruned	40	40	101

Table 37: Ground vegetation in under story of *Acacia auriculiformis*

Species	No. of individuals /sq. m.	Phytosociological relationship		
		Frequ-ency	Abund-ance	Density
<i>Eurena lobata</i>	3.67 ±4.61	1.00	4.00	0.43
<i>Lantana Camara</i>	1.67±1.15	1.00	1.67	1.67
<i>Eupatorium odoratum</i>	4.33±4.04	1.00	4.33	4.33
<i>Rubus ellipticus</i>	0.33±0.57	0.33	1.00	0.33
<i>Carex angustifolia</i>	1.00±1.00	0.67	1.50	1.00
<i>Strachytachia spp</i>	3.33±3.51	0.67	10.00	6.67
<i>Imperata cylindrical</i>	12.33±4.93	1.00	12.33	12.33
<i>Dioscorea spp</i>	1.00±1.00	1.00	1.67	1.67
<i>Melastoma affine</i>	1.00±1.00	0.67	1.50	1.00

Microwatershed (W₃)

In this block, 50 seedlings each of *Morus alba*, *Bauhinia variegata* and *Symingtonia populnea* were planted. Data on growth rate are presented in Table 38.

Table 38: Survival and growth performance (±SD) of some forest tree species at W₃ Block

Sl. No.	Tree Species	Survival (%)	Height growth (cm)
1.	<i>Morus alba</i>	80.0	0.90±0.08
2.	<i>Bauhinia variegata</i>	100.0	1.21±0.12
3.	<i>Symingtonia populnea</i>	100.0	0.75±0.07

Agro-pastoral system (FSW₄)

This micro-watershed is of 0.58 ha area having average slope of 32% where efforts were made to maximize the utilization of local resources to meet the food requirement of a family consisting of two adult and three children. The watershed has 0.49 ha. land under terraces, which were used for production of cereal, pulses and oilseed crops under double cropping system and 0.33 ha. land under terrace risers used for production of perennial fodder such as guinea grass. Guinea grasses grown on the terrace risers also stabilized terrace risers besides giving fodder. Guinea grass grown on terrace risers produced 542.5 quintals(q) of green fodder among which 217 q green fodder was fed to cow and heifer

and excess fodder of 325.5 q were fed to the cows of Dairy unit. During the year paddy, maize, ragi, groundnut, ginger and french bean as kharif crop and mustard and french bean as rabi crops were grown on terraces. The yield of paddy (8.5q/ha) grown in lower terraces was very low as the crop was affected by grasses grown on the terrace risers. The yield of maize (10.3q/ha.) grown on upper portion of the terraces was also not satisfactory due to dominance of guinea grasses grown on terrace risers. The yield of groundnut (12.25q/ha) and yield of ginger (46.3q/ha.) was also below the average yield due to higher water retention in terrace, during rainy season. More water retention in the terraces was due to grasses grown on the terrace risers. The yield of french bean green pod (95.80q/ha.) grown in pre rabi season was higher compared to kharif season (16.26q/ha.). In kharif season, french bean yield was very much affected by the attack of insects at flowering stage.

Ragi grown on middle portion of terrace produced 5.18 q/ha grain besides fodder for the cow. Ragi proved to be more competitive with weeds and could be grown under less management condition. Mustard grown after harvest of maize, paddy and ragi on residual soil moisture in the month of October produced 4.33q grain /ha. Details of the crops grown in FSW₄ is given in Table 39.

Table 39 : Crops grown in FSW₄ during the year 2002

Sl. No	Crops	Area	Av.yield (q/ha.)
1.	Paddy	397.6	8.5
2.	Maize	1918.85	10.30
3.	Popcorn	-	-
4.	Ragi	519.4	5.18
5.	Soybean	-	-
6.	Groundnut	1584.4	12.25
7.	Ginger	456.8	46.30
8.	Turnerie	-	-
9.	Mustard	937.9	4.33
10.	Radish	-	-
11.	Rajmash	-	-
12.	Fr.beant(G.pod)	320.6	16.26
12.	Fr.beant(G.pod)	320.6	95.80

One cow and one heifer kept in the watershed as a subsidiary source of income and to utilize the crop by product produced 3106 litre of milk with

average yield of 8.5 litre per day. Total 14 q paddy straw and 22.6 q. concentrate were given as additional feed to the cow. Cow dung, urine, litter (fodder residue) and weed biomass were decomposed in a pit and utilized in terraces for production of field crops and thus reduced the cost of cultivation.

Agri. - horti – silvi pastoral system (FSW₂)

This land use system has 1.03 ha area with 42% hill slope. Agriculture crop put on bottom terrace land, horticulture on middle portion with half moon terrace and silvi-pastoral system on top portion. In middle portion horticulture crops such as Assam lemon, guava, orange were removed and new plantation of orange, assam lemon and guava were done by changing the places of old plantation as the plants became very old and fruiting was very low. The double row plantations of pineapple were done on the contour line as soil and water conservation measures and to get extra income from pineapple without affecting the growth of fruit trees. During the year under report a total of 1000 nos. pineapple, 30 nos. guava, 30 nos. orange and 22 nos. assam lemons were planted. In the bottom, agricultural crops such as french bean, capsicum, brinjal, tomato, ginger and maize as Kharif crops and french bean and radish as rabi crops were grown on terrace land (1-15 terraces having gross area 1200 sq m). French bean, capsicum, brinjal and tomato could not perform very well on bottom portion due to continuous rain. The crop suffered from wilt in tomato, brinjal and capsicum and attack of insects in french bean at flowering stage. The productivity of maize and ginger were 14.5 and 70.0 q/ha, respectively. In rabi seasons radish and french bean were grown on residual soil moisture. Radish grown in 640 sq m area produced 75 kg, radish which was sold @ Rs.2/- per kg (4 nos. each) with 2.3 kg radish seed. While French bean grown on 370 sq m area produced 12 kg seed. Guinea grass grown on terrace risers in bottom portion produced 90.3 q fodder, while Congo signal grass grown in between the inter spaces of horticultural plants in middle portion produced 19.45 q green fodder during kharif season. Broom grass grown on upper portion in between the inter spaces of forest trees

produced 150.5q green fodder for dry winter months.

Horticulture Based Farming System (FSW₆)

This block has been rejuvenated and developed as horticulture dominant horti-silvi culture with bamboo on ridges, fruit trees on mild slopes with pine apple as under storey crop and sole agriculture in terraces at lower end. On an average, 150 seedlings of Assam lemon, 10 of guava and 90 seedlings of bamboo were planted alongwith 5000 pineapple suckers and 5000 large cardamom seedlings. The survival of tree species is indicated in table 40. Among the agricultural crops at lower terraces paddy, rice bean and maize were grown and the productivity was recorded as 11.48, 6.67 and 14.02 q/ha respectively. Radish was cultivated as second crop in same terraces which recorded productivity of 72.85 q/ha.

Table 40: Survival and growth performance(±SD) of some multipurpose tree species at W₆ block

Sl. No.	Tree species	Survival (%)	Height growth (m)	Collar diameter(cm)
1	Assam lemon	70.0±10.0	1.14±0.14	1.78±0.30
2	Guava	80.0±15.5	0.95±0.13	1.44±0.17
3	Bamboo	100.00±0.00	1.12±0.60	2.32±0.46
4	Pineapple	10.00±0.00	-	-

ECONOMICS OF THE FARMING SYSTEM RESEARCH

K.K. Datta, A.K. Tripathi
S.B. Singh & Med Ram Verma

In FSW₁, there is about 1.393 ha area out of which area under forestland is about 0.45 ha and 0.943 ha planned for land use. In the system, 2 milch cows were kept keeping in mind that its fodder requirements will be met from the existing planned land use system and the income from the dairy will help to manage the food security of an household consisting of 6-7 members. The farm budget record showed that major external expenditure incurred for the system is for labour followed by concentrated feed and dry fodder. On an average annual green fodder available from the system is

about 330 q, which is sufficient for the existing cattle. The data from 1987-02 indicated that on an average per day concentrated feed provided in the system was about 9 kg. Per day maintenance cost of the system was worked out in order to get an insight of the income generating capacity in the system. Keeping in view of the fact, cost incurred for concentrate feed and green fodder was about 9/ per kg, dry fodder of Re 1 per kg and Rs 1 per kg in case of green fodder. Based on it, the estimate showed that about 38% of daily expenditure are incurred on concentrated feed and 50 % on green fodder. Labour cost is about 47% in total maintenance cost. Depreciation of animals per day was worked out to be 5 % based on difference in price of animals in the beginning of the stage and during dry period. The difference of amount was divided by the number of inter-calving days so as to arrive at the depreciation of animals per day. Lactations period is considered as 7 based on the information provided by FSRP system. The net cost of maintenance (excluded the initial investment amount for shed cost and on miscellaneous items) of the system per day is worked out to be Rs 215/. Annual average milk available from the system is 4492 liters. In addition to the income from milk, 10% income is added from the system, which is assumed to be generated from sales of FYM, small animals and from green fodder. To meet the brake-even level of cost, the milk price should be Rs.13/ liter whereas existing milk price is Rs10/ liter. As major cost component is on concentrated feed and labour, it is necessary to reduce the concentrated feed cost at least 50% from the existing feed cost. Similarly, the required labour cost (including supervision) can be eliminated from the system since only family labour is used for maintenance of dairy animals. Under such circumstances per liter milk price would be Rs.9.58/.

In order to identify the viability of initial investment amount, sensitivity analysis was carried out. The sensitivity analysis shows that at Rs 20,000 initial investment amount, the system will be financially feasible where IRR, B/C and NPV are

positive (Table 41). The amount of the net present value is sufficient to manage the livelihood of two persons only in the context of existing household consumption expenditure level. Major conclusion arises from the above analysis that under subsistence farming system in NEH region, where households food security is the major thrust, in that system dairy system can be considered as a supplementary source of family income rather than as a commercial farming.

Table 41: Financial analysis of Dairy base System (FS-W₁)

Initial Investment (in Rs.)	Discount rate	Net Present Value (NPV) in Rs.	Benefit – Cost Ratio(B/C) in Rs.	Internal Rate of Returns (IRR) in %
82000	10 %	-27439	0.8140	4
52000	10 %	- 167	0.9986	10
40000	10 %	10742	1.0982	14
20000	10 %	28924	1.3173	25

Hydrological behavior of experimental watersheds

K. K. Satapathy & K. K. Dutta

Hydrological behavior of experimental watersheds in terms of total water yield, base flow, surface flow (runoff) and peak flow have been studied and presented in Table 42 and Fig.18. Monthly rainfall and water yield pattern from different experimental watersheds have been presented in Table. 43. Maximum of 910.68mm flow was recorded from AE-W₁, followed by 442.91mm, 251.80mm, 126.31mm, 45.05 mm and 9.77mm from FS-W₂, FS-W₃, FS-W₄, FS-W₆, and FSW₅ respectively against the annual rainfall of 2516.80 mm during the year. No flow was recorded from the watersheds FS-W₁, FS-W₇, and FS-W₈ during the year 2002.

Table 42: Annual water yield, base flow, surface flow, peak flow, soil loss etc from experimental watersheds of FSRP (2002)

Parameters	Experimental watersheds								
	FS-W ₁	FS-W ₂	FS-W ₃	FS-W ₄	FS-W ₅	FS-W ₆	FS-W ₇	FS-W ₈	AE-W ₁
Surface flow (mm)	Negligible	124.40	143.86	118.7	4.12	32.03	Negligible	Negligible	337.33
Base flow (mm)	0.00	318.51	107.94	7.61	5.65	13.02	0.00	0.00	573.35
Total flow (mm)	Negligible	442.91	251.80	126.31	9.77	45.05	Negligible	Negligible	910.68
Peak flow (mm/hr)	0.00	6.42	1.692	6.627	0.301	4.366	0.00	0.00	5.399
Soil loss (T/Ha)	-	-	-	-	-	-	-	-	-

Table.43: Monthly water yield from different experimental watersheds of FSRP (2002)

Months	Rainfall (mm)	Total Water yield from experimental watersheds								
		FS-W ₁	FS-W ₂	FS-W ₃	FS-W ₄	FS-W ₅	FS-W ₆	FS-W ₇	FS-W ₈	AE-W ₁
Jan	22.5	0	0	0	0	0	0	0	0	0
Feb	1.6	0	0	0	0	0	0	0	0	0
Mar	57.5	0	0	0	0	0	0	0	0	0
Apr	353	0	0	0	0	0	0	0	0	0.16
May	268.2	0	5.97	1.00	85.39	0.19	0.70	0	0	7.24
Jun	741.6	0	211.30	47.96	21.96	9.09	38.94	0	0	435.74
Jul	391.5	0	121.49	98.01	3.04	0.19	2.15	0	0	200.00
Aug	218.4	0	75.16	91.04	0.67	0	0.01	0	0	138.84
Sep	163.9	0	15.57	9.46	0	0	0.04	0	0	60.19
Oct	141.4	0	5.05	2.97	15.25	0.00	2.13	0	0	56.79
Nov	155.9	0	8.01	1.36	0	0	1.08	0	0	11.22
Dec	1.3	0	0.36	0	0	0	0	0	0	0.50
Total	2516.80	0.00	442.91	251.80	126.31	9.47	45.05	0.00	0.00	910.68
Mean	209.7	0.00	36.91	22.89	14.03	1.18	4.10	0.00	0.00	101.19
Max	741.6	0.00	211.30	98.01	85.39	9.09	38.94	0.00	0.00	435.74

⁴³ Rainfall corrected by day for Hydrological analysis

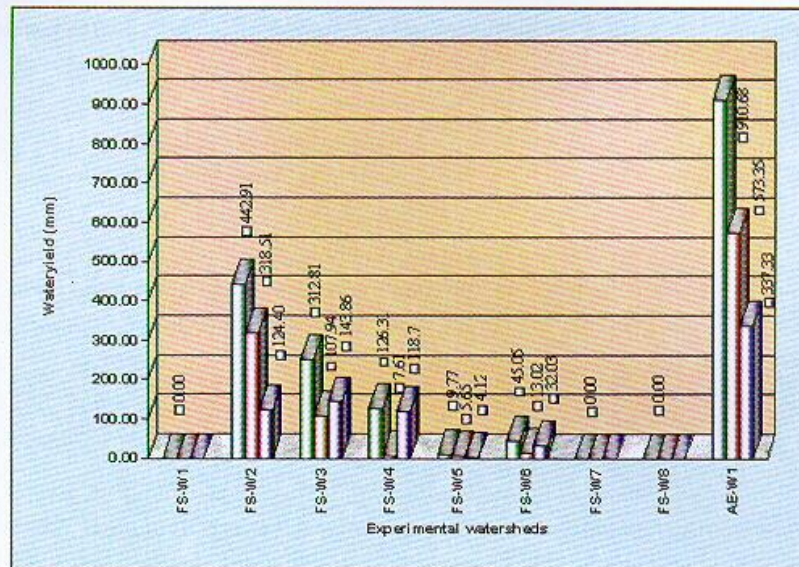


Fig. 18 Micro-watershed Development at Farmer's Field

Micro-watershed Development at farmer's field

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The Upper Shipra watershed comprising an area of 925.64 ha under Umsning community development block in Ri-Bhoi district of Meghalaya was selected as study area by a team of Scientists/ Technical Officers of ICAR. The data related to the watershed was collected through remote sensing and made imagery of the watershed. Ground truthing / verification was done on different aspects i.e. land use/ land cover, soil and slope aspects, geo-hydro-morphology etc and thematic maps were prepared. Based on the information collected from satellite data this watershed was subdivided into six sub-watersheds for identification of critical erosion prone area. For prioritization a sub-watershed under Mawpun village covering an area of 57.17 ha has been selected for integrated development as model project. This village comprising of rolling hill topography was selected for introduction of watershed technology on the integrated farming

system approach. This small watershed provide a unique topographical situation with valley land, steep to very steep slopy land with different crops viz paddy both on wet land and on slopes, ginger in buns on slopes, different vegetable crops, natural pine forest etc. The steep slopes are cultivated and exploited with the traditional agricultural activities of jhuming and bun cultivation and exposing the soil in some places. Forest on high ridges are disturbed and hill tops are becoming barren. In order to restore the damaging action of the natural resources scientific approach such as land shaping, application of soil and water conservation measures in order to control erosion and to augment ground water recharge, providing inputs for seed and fertilizers, introducing proven crop production technologies for agricultural, horticultural and agro forestry aspects was introduced. While developing microwatershed plan for the watershed, attempts have been made for developing common enterprises, such as large water bodies for producing fish, plantation crops, forest crops, pasture development etc. for generating financial resources for community welfare and eco-development.

Local crop varieties were replaced by high yielding varieties of radish, laipatta, French bean, maize, tomato, brinjal etc. In some bun area cut and fill method of terracing were done for settled cultivation. New technique of crop cultivation practices were adopted to get maximum return. Now two crops are raised continuously for the last three years under rainfed condition. The crops found promising in the watershed are French bean (4.545t/ha), laipatta (2.598 t/ha) and brinjal (2.667 t/ha)

In areas with moderate to steep slope where crops cannot be raised horticultural crops such as Khasi mandarin, Assam lemon, Guava, Peach, Plum and mango were transplanted after digging pits of standard size in between contour bunds to utilize the land resources properly. To accelerate the growth of these horticultural plants intercultural operations like jungle cleaning, ring cleaning etc. were carried out from time to time.

The valley region of the watershed is mostly very rich in organic matter content or some time water logged. The waterlogged regions of the watershed were decided to be utilized as farm ponds for pisciculture. Ten such water harvesting tanks/ponds with an area ranging from 0.06 ha to 0.12 ha with 2 m depth were excavated, out of which three were put under composite fish culture. Catla, rohu, mrigal, silver carp, grass carp and common carp were stocked at a density of 8000 fingerlings per hectare. The grass carp and common carp showed a better growth performance when compared to the other species cultured. The average individual weight of fishes after 14 months of culture was catla 350 gm, rohu 200gm, mrigal 150gm, silver carp 250gm, common carp 450gm and grass carp 810gm. The estimated biomass in Pond A was 134.94 kg, Pond B was 119.63 kg and Pond C was 213.27 kg with a cumulative total biomass of 467.84 kg and the FCR obtained was 1.71. The culture is being continued for the second year as the growth of carps is expected to be better in the second year in this region. As the fish production cost is very high due to supplementary fish feed therefore, the livestock production system such as piggery, duckery and poultry were combined with pisciculture. The waster generated through these livestock systems were recycled to farm ponds to serve as food for

fish. For construction of the different sheds locally available materials were utilized (Fig. 19).

Long term effect of different alternative farming systems on phosphorus fractions in an acidic Alfisol of Meghalaya

B. Majumdar & V.K. Mishra

The effect of eight watershed-based farming systems consisting of Live stock farming, forestry, agroforestry, agriculture, agri-horti-silvi-pastoral, horticulture, natural fallow and abandoned jhum land on different forms of phosphorus was studied after 17 years of adoption under rainfed condition on hill slopes of Meghalaya. All the forms of phosphorus except organic P were highest in agriculture land use followed by live stock farming and agri-horti-silvi-pastoral land use and the lowest values of inorganic P was recorded in abandoned jhum land followed by natural fallow. The abandoned jhum land registered highest value of organic P (340 ppm), which was 60.7 per cent of total P while the contribution of organic P to total P was lowest (32.7%) in agriculture land use suggesting higher P mineralization in this system. Among the inorganic fractions of P, the highest value was recorded for Reductant soluble P, followed by Al-P, Fe-P, Occluded-P, Ca-P and Saloid bound P respectively in all the systems except natural fallow and abandoned jhum land. Soil pH, ECEC and base saturation showed significant positive correlation with all forms of P.

Long term effect of different farming systems on micronutrient status in acid soil

M.S. Venkatesh & V.K. Mishra

The effect of eight watershed based land use systems were analysed for micronutrient status after 17 years of adoption under rainfed condition on hill slopes of Meghalaya. Available Fe, Mn, and Cu contents were well above the critical limit in all the land use systems. The farming systems with adequate soil conservation measures and with application of manures and fertilizers (agri-horti-silvipastoral & horticulture) maintained higher level

High yielding varieties on terrace



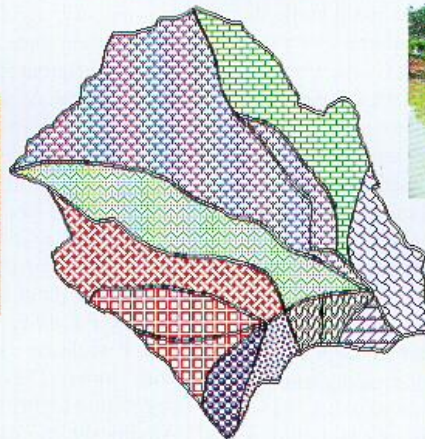
Fish pond



Duckery



Terracing with Grass on Risers



Poly House



LEGEND			
	High yielding variety paddy 4.5 ha		Forest 10 ha
	Forest with paddy 4.5 ha		Water body 1 ha
	High yielding paddy 4.5 ha		High yielding paddy 4.5 ha
	MAIT Model		Forest paddy based agroforestry 4.5 ha
	Reservoir, Mangrove and Forest		Maize and eggplant



Fig. 19 Development Plan and Introduced Technologies in Integrated Farming System at Mawpun Village

of all the micronutrients. Available Zn content was below the critical limit (0.6 ppm) in forestry, agroforestry and natural fallow systems. Available

Zn and Cu contents were significantly and positively correlated with organic carbon and clay content in the soils.

Effect of various land use systems on different forms of potassium in an acidic Alfisol of Meghalaya

M.S. Venkatesh, B. Majumdar,
Kailash Kumar & Patiram

The effect of eight watershed based land use systems consisting of livestock (W_1), forestry (W_2), agro-forestry (W_3), agriculture (W_4), agri-horti-silvi-pastoral (W_5), horticulture (W_6), natural fallow (W_7) and shifting cultivation (W_8) on soil potassium fractions were studied after continuous adoption of different land use systems for 17 years under rainfed condition in hilly terrain of Meghalaya. The farming systems with adequate soil conservation measures and with application of manures and fertilisers (W_5 and W_6) maintained higher levels of water soluble, exchangeable and non-exchangeable forms of K. The shifting cultivation land use recorded least amounts of lattice and total K. There was a maximum increase of 245 per cent in available K over its initial status in horticultural system whereas the maximum increase in total K was recorded in agricultural system.

Farming System Research at Tripura

K.R. Dhiman, N.P. Singh, M. Datta,
S. Biswas, T.K. Sengupta, S.K. Ghosh,
M. Niranjana, B. Santhosh & C. Datt

Geographically, agricultural land in Tripura is comprised of upland, slopy land and lowland. In general, uplands are under traditional agriculture of almost monocropping. Jhum cultivation is generally practised in slopy land. Valley land where irrigation is available, is put to double or triple cropping. Various crops are grown in areas put under farming system research in order to increase, the cropping intensity. The crop productivity scenario is presented in Table 44.

Duck cum Fish Production

An area of 0.1 ha was excavated for water harvesting structure and run off water was accumulated in the pond having ground water source. Water was available throughout the season.

A total of 44 ducks could produce 1252 no. of egg and 20 kg of meat. Fish production was 2750 kg/ha.

Table 44: Crop productivity scenario

	Pre-kharif/ kharif	Autumn	Winter
Crop-variety	1. Rice-TRC-87-251	1. Urd-TRU-99-16 & 17	1. Maize - TRM-3
Date of sowing	17.5.2002	11.09.2002	20.11.02
Maturity	90 days	95 days	112 days
Yield	16 q/ha	9 & 10 q/ha	39 q/ha
Crop-variety	2. Moong-UPM 79-12	2. Groundnut-ICGS-76	2. Toria - SCRT-1-2-4
Date of sowing	10.5.2002	10.9.2002	20.12.02
Maturity	75 days	108 days	88 days
Yield	5.8q/ha	20q/ha	10q/ha
Crop-variety	3. Sesame-TRC-til-1-8	3. Cabbage-70	3. Tomato-Indam & S-22 & Suraksha
Date of sowing	18.5.2002	25.9.2002	31/10, 31/10, 18/12
Maturity	90 days	70 days	90-100 days
Yield	5q/ha	18t/ha	31.8, 8.3, 20.0t/ha
Crop-variety	4. Maize-Prakash & Jhum Yellow	4. Brinjal-Bhola nath	4. Cauliflower-hybrid-50
Date of sowing	25.05.02	28.09.02	16.12.02
Maturity	90 & 110 days	95 days	55 days
Yield	48 & 23 q/ha	7.5 t/ha	6.5t/ha
Crop-variety	5. Black gram TRU-99-12		5. Broccoli-Biju Shital
Date of sowing	11.05.02		31.10.02
Maturity	80 days		77 days
Yield	8q/ha		3.5t/ha
Crop-variety			6. Laipatta-Local
Date of sowing			21.11.02
Maturity			55 days
Yield			380 bundles

Research support in NWDPPRA at Tripura

M. Datta, K.R. Dhiman & N. P. Singh

Cropping Tilla land

In tilla land, various rice based cropping sequence was undertaken and their productivity along with water use efficiency is presented in Table 45.

Table 45: Cropping sequence in tilla land

Cropping sequence	Grain productivity (q/ha)		Water use (mm)		Water use efficiency (Kg/ha-mm)	
	I	II	I	II	I	II
Rice-groundnut (I) (II)	18.52	14.67	992	959	1.86	1.53
Rice - Mung (I) (II)	17.65	5.25	940	320	1.88	1.64
Rice - blackgram (I) (II)	17.45	8.12	950	350	1.83	2.23

Data indicated that rice – groundnut cropping sequence produced the highest productivity as compared to other cropping sequence tested under tilla land condition. Water use of pulse crop varied from 320 to 350 mm but water use of rice and groundnut was of high magnitude (940 – 942 mm). Water use efficiency of upland rice varied from 1.83 to 1.88 kg/ha – mm. The lowest water use efficiency (1.64 kg/ha-mm) was noted in mung.

Water conservation through polythene mulch

In order to increase the water use efficiency, polythene mulch was used in upland and the productivity of various cropping sequence was presented in Table 46.

Data indicated that the use of polythene as mulch could increase the productivity of sesamum, groundnut and blackgram produced as a 2nd crop in the cropping sequence. Similarly water use and its efficiency were also increased with the use of polythene as mulch.

Cassava (var. local) grown as contour cultivation in 3 – 5% slopy area produced 7.3 t/ha and the productivity of turmeric as intercrops with cassava was 12.2 q/ha. Arhar (var. local) produced 2.0 to 4.46 q pod/ha in vegetative barrier. Arhar grown as sole crop produced 18.0 q pod/ha and 7.0 q seed/ha with 38.7% shelling. Sugarcane produced a productivity from 7.26 to 26.80 t/ha under variable fertility level.

Slopy land

In pineapple – Assam lemon land use system, the productivity of pineapple was 11.3 t/ha and the productivity of lemon was 3.87 kg/tree with 20 – 25 lemon/tree. In silviculture system, gamahar (*Gmelina arborea*) showed 51.3cm girth at breast height and 10.87m height after 4 years of planting. Banana (var. sabri) was also planted in half moon terrace in association with gamahar. The productivity of banana in slopy land was 1.3 ton/ha with 2 – 3 kg fruit of sabri variety of banana/tree. The productivity of cavendish was 7 – 12 kg/tree (Fig 20 and 21).

Table 46: Effect of polythene mulch

Cropping sequence	Productivity (pod/seed) q/ha		Water use (mm)		Water use efficiency (kg/ha- mm)		
	I	II	II		II		
		Control	Polythene	Control	Polythene	Control	Polythene
Groundnut – Sesamum	18.23	7.33	9.33	209	212	3.5	4.39
Sesamum – Groundnut	7.5	11.4	16.2	469	470	2.4	3.5
Sesamum – Blackgram	7.5	3.6	4.1	165	167	2.2	2.5



Fig. 20 Pineapple - Assam lemon in sloppy land with hybrid napier as vegetable barrier



Fig. 21 Banana (var. Sabri) in half moon terraces with pineapple as vegetable barrier

Low Land

Vegetable production

Bhindi (var. satdhari) was grown near water harvesting structure and the productivity is presented in Table 47.

Table 47: Productivity of bhindi.

Treatment	Productivity
Control	23.16
NPK	30.09
½ NPK	22.42
½ NPK + cowdung	29.60
Cowdung	54.05
Cowdung + NPK	72.97
Mean	38.72

Data indicated that NPK (120:70:60) in association with cowdung (5t/ha) produced the

maximum yield of bhindi from 23.16 to 72.97 q/ha. Various bhindi hybrids were grown. F₁ hybrid sakshi, F₁ hybrid harishan and hybrid GC 99 produced 59.12, 56.45 and 40.99 q/ha, respectively.

Tomato Indan 1116 produced 16.25 t/ha and cabbage (var. Hybrid 689) produced 13.6 t/ha cowpea (var. Pusa Komol) produced 24.08 q/ha without fertilizer (NPK) but 37.45 q/ pod/ha was produced in the presence of NPK.

Water Yield Behaviour

Water yield behaviour of runoff water was investigated in a pond situated in medium upland without having ground water source. With the help of tarfel lining, the life of water storage was for period of five months from July to November (Fig 22-25).

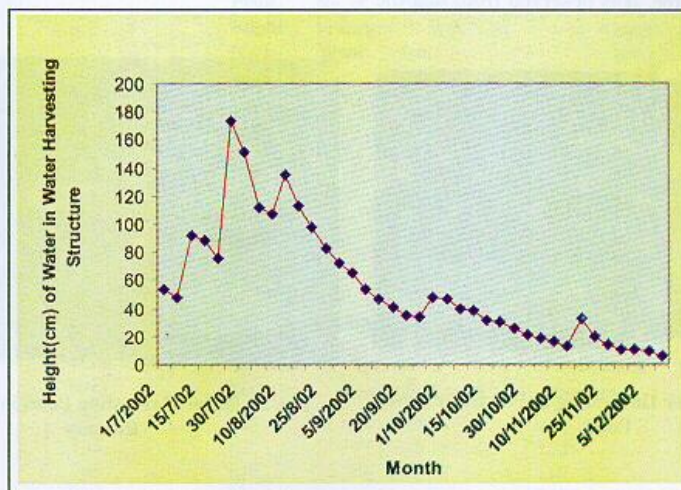


Fig.22 Water Yield Behaviour in Pond Without Ground Water Source

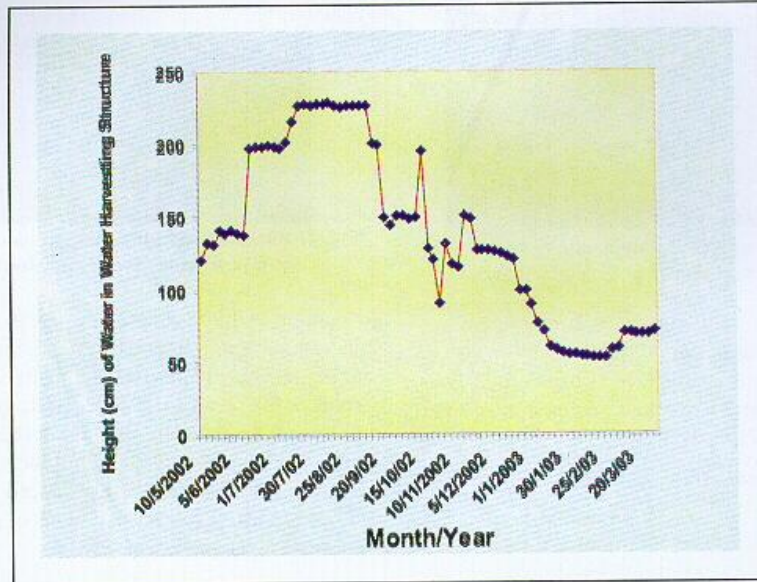


Fig.23 Water Yield Behaviour in Pond With Ground Water Source

Similarly water yield behaviour of runoff water was investigated in a pond situated in low land having ground water source. It is observed from that the

life of water storage was maintained for a period of 11 months from May to March.



Fig. 24 Rain Water Harvesting in Polythene Lined Pond



Fig. 25 Water Harvesting Pond in Lower Hill Reaches

FRUITS

ARUNACHAL PRADESH

CITRUS

L.C. De

Studies on performance of micropropagated and seedling origin plants

A study comprising of 40 numbers of micropropagated citrus plants and 20 numbers of seedling originated plants was carried out. After four years of planting, seedling origin plants were more vigorous than the micropropagated ones. Seedling originated plants attained more plant height (2.32 m) compared to micropropagated /tissue cultured plant (1.82 m). Stem girth (4.88 cm), average numbers of primary branches per plant (3.42) were also higher in seedling originated plants. Whereas, micropropagated /tissue cultured plant recorded maximum canopy spread (90.27 cm x 87.55 cm) than the seedling originated plant. Fruiting for the first time was also recorded in seedling originated

plant with an average of 0.82 fruit per tree, whereas micropropagated plants did not come to bearing even after 4 years.

Studies on compatibility of rootstocks on scion of mandarin orange

Compatibility of four varieties of mandarin orange (Khasi mandarin, Nagpur santra, Hill mandarin and Sikkim orange) on different rootstocks (*Tanyum*, *Citrus volckamariana*, Rough lemon, *Citrus latipes* and Trifoliolate orange) were tested. Details about different growth parameters of these combinations has been given in Table 48.

Growth performance of khasi mandarin under high density planting

Performance of five year old khasi mandarin planted in high density method (2.0m x 2.0m, 2.5m x 2.5m, 2.0m x 3.0m, 4.0m x 4.0m and 5.0m x 5.0m) was evaluated. Maximum plant height (2.52 m) was recorded at closest spacing (2.0m x 2.0m). The closest spacing also showed maximum diameter of stem (5.54 cm), number of primary branches per plant (4.6) and canopy spread (86.4 cm x 103 cm). The data on other density plantings are, mentioned in Table 49.

Table 48: Vegetative growth of mandarin orange on different rootstocks

Treatments	Plant height (cm)	No. of branches plant	Spread (E-W X N-S) (cm)	Dia. of stock (cm)	Dia. of scion (cm)
Khasi mandarin on <i>Tanyum</i>	62.5	6.5	34.70 x 29.00	1.67	1.37
Khasi mandarin on <i>C.volckamariana</i>	51.5	5.5	26.30 x 28.30	1.45	1.10
Khasi mandarin on Trifoliolate orange	91.0	3.0	57.5 x 49.50	2.50	1.60
Sikkim orange on <i>Tanyum</i>	68.25	5.25	24.75 x 24.50	1.62	1.37
Sikkim orange on Rough lemon	73.0	3.5	38.0 x 44.0	2.20	1.45
Hill mandarin on <i>C.latipes</i>	89.0	7.0	26.00x 30.33	2.70	1.80
Hill Mandarin on <i>Tanyum</i>	85.7	5.0	44.67 x 42.33	2.35	1.40
Nagpur santra on <i>C. volckamariana</i>	95.25	5.75	46.25 x 47.00	2.00	1.55
Nagpur santra on <i>Tanyum</i>	72.50	5.5	33.25 x 35.25	1.92	1.72

Table 49: Vegetative growth of Khasi mandarin under high density planting

Treatment	Plant height (cm)	Stem dia. (cm)	Spread N-S x E-W (cm)	No. of primary branches	No. of Fruits/ plant
2.0m x 2.0m	2.52	5.54	86.4 x 103.6	4.6	1.43
2.5m x 2.5m	2.12	4.22	77.5 x 78.25	2.25	0.00
3.0m x 3.0m	2.49	5.30	93.33 x 78.67	2.67	0.00
4.0m x 4.0m	0.91	2.6	35.40 x 42.21	0.97	0.00
5.0m x 5.0m	0.82	2.9	—	0.85	0.00

Growth performance of Kinnow mandarin

Kinnow mandarin was planted in 1996 at an elevation of 660 m asl . After seven years of planting, the trees attained an average height of 2.22 m with diameter of trunk of 5.4 cm. Average number of branches per plant were recorded to be 3.3. The average canopy spread of the tree was 138.1m x 151.40m. Average number of fruits per tree was 10.90 with an average fruit drop of 55.04 per cent. Data were recorded on vegetative growth as well as fruiting and fruit quality of Kinnow mandarin propagated by air layering (Table 50 & 51). Results revealed that the average fruit weight was 130.05 g, fruit diameter of 6.58 cm, fruit length of 5.39 cm, juice content of 58.00 ml/fruit, Total Soluble Solids of 8.50° Brix and 1.048 % acidity.

Table 50: Vegetative growth and fruiting in kinnow mandarin

Av. Plant height (m)	Canopy spread (m) (E-W x N-S)	Av. Dia of trunk (cm)	No of primary branches / tree	Av. No. of fruit / tree	Av. Fruit drop (%)
2.22	138.10 x 151.40	5.4	3.30	10.90	55.04

Table 51: Fruit quality of Kinnow mandarin

Av. Fruit weight (g)	Av. Fruit Dia. (cm)	Av. Fruit length (cm)	Av. No. of juice vesicles	Av. No. of seed per fruit	Juice content (ml/ fruit)	T. S. S/ Brix	Acidity (%)
130.047	6.58	5.39	11.00	16.25	58.00	8.5	2.048

Maintenance of Germplasm of sweet orange, mandarin orange and rootstocks

In the citrus germplasm block, 14 varieties of sweet orange viz., Washington, Valencia Newton, Rubi, Excelier malta, Rubi Blood Red, Whettawar malta, Majurica, Italian Large, Daccus, Mosambi Australia, Para Malta, Vanila, Sohniangriang, and seven varieties of mandarin orange namely Mediterranean, King Theppi, Nagpur Santra, Hill mandarin, Sikkim orange, Wilking orange, *Citrus zigardio* and nine rootstocks viz., *Citrus volckamariana*, Rough lemon, Karna khatta, *Citrus taiwanica*, *C. latipes*, Cleopatra mandarin, Citrange,

Trifoliate orange and Kamla Australia are being maintained.

Comparative performance of acid lime variety ARL-1 and Assam lemon

In the third year after planting, Assam lemon showed better vegetative growth in terms of stem diameter (3.1 cm) and canopy spread (1.48 cm X 1.61 cm), than the acid lime variety ARL-1 with 2.6 cm basal diameter and 1.10 cm x 1.01 cm canopy spread. But improvement of plant height was comparatively higher in Acid Lime (1.38 m) than Assam lemon (1.36 m).

Effect of rejuvenation on vegetative growth of old khasi mandarin

The effect of pruning at different heights on growth, yield and fruit quality of old declining Khasi mandarin was studied. The trees with pruned primary branches produced maximum number of new shoots (283.1) followed by the trees de- topped at 1.5m (105.00) and 1.0m (60.90). Highest length (137cm) of new shoots , however, was recorded for the trees with all primary branches pruned whereas, tree pruned at 1.00 m produced new shoots with maximum proximal diameter of 2.21 cm. Unpruned trees (T_0) had minimum values of all the three growth parameters.

Effect of pruning in rejuvenation of old declining orchard of Acid lime cv. ARL – 1

The effect of pruning at different heights of declining orchard of acid lime (cv. ARL-1), on growth, yield and fruit quality was studied. The trees with pruned primary braches exhibited maximum number of new shoots (46.00) followed by the trees detopped at 1.5m (41.00), 1.0m (30.25) and (13.87), respectively. Highest length (1.46 cm) of new shoots was also recorded in the trees with pruned primary branches followed by the trees pruned at 1.00 m and 0.50 m respectively. Maximum proximal diameter of new shoots (1.36 cm) was obtained on tree with all primary branches pruned. Among pruned trees, trees with all primary branches pruned attained the maximum canopy spread of 1.84 x 1.73m (E-W x N-S). Unpruned trees had minimum values of all the three growth parameters except average plant height and canopy spread.

Studies on survival, vegetative growth and fruiting behavior of 20 years old transplanted khasi mandarin

A study was conducted to explore the possibility of shifting old Khasi mandarin trees from existing site to a new site, by uprooting with maximum primary and secondary root systems and transplanting them in an accommodating large size pits during February 2001. All primary branches were pruned at 103.19 ± 35.89 cm from main trunk to reduce transpirational loss of water. The survival of the transplanted trees was recorded 87 per cent. The mean number of sprouts per tree was 297.3 and average length of one-year-old new shoot was 176.4 cm. The entire new shoot flowered or had fruiting.

Studies on nutrient management in khasi mandarin

An experiment comprising of 24 different combinations of major nutrients viz. nitrogen, phosphorus and potassium and another one on micronutrients viz. Zn, Fe, Mn, and Mg has already been set to evaluate the effect of different levels of N, P, K and micronutrients and their interaction on growth, yield and fruit quality of khasi mandarin so as to give a judicious fertilizer schedule that will help in bringing about more meaningful fertilizer recommendation for West Siang district in particular and Arunachal Pradesh in general. Observations on growth, yield and quality parameters are being taken.

Indigenous citrus Fruits

L.C. De & G. Bagra

Among the local fruits evaluated so far, biggest size of fruit was observed in *Rabab*. The average fruit weight of *Rabab* from 15.00 number of segments was 575.00 g with an average pulp weight of 474.55 g. Maximum number of seeds per fruit (44.75) was obtained from *Elaichi Nimbu* (Rough skin) but juice content per fruit was highest in *Rabab* (151.5 ml). Both *Elaichi Nimbu* (Rough skin) and *Rabab* plants are found to grow in stray conditions. Maximum TSS of 10.2 °Brix and minimum acidity of 1.73 % were observed in

Elaichi Nimbu (Rough skin). *Rabab*, *Elaichi Nimbu* and *Tanyum* are citrus fruit and their juice can be used in squash preparation. *Tader* (a wild litchi) and *Taktir* can also be used in same preparation, though later taste quite sour with highest acidity (6.80 %) among all fruits those have been analysed so far. Empe nut can be eaten raw and also can be preserved as dry fruit after drying. It contains good amount of fat. Jaker is a large Cardamom having sweet taste at ripened stage with an aroma and found to grow in marshy jungles. *Hisir* plant is a tall tree and Deer consumes the fruits in wild but local people use it in chutney preparation. This fruit is liked because of bitter taste with pungent smell.

MANIPUR

Technology Mission for integrated development of Horticulture in NE states including Sikkim (Mini Mission-1)

B. Narsimha Rao, Sunil Kumar, Anjani Kumar Jha and Chandra Deo

Citrus Nursery

Tamenglong district of the Manipur state is famous for Khasi mandarins. To meet the demand of planting material in the state and to conduct the demonstrations in the farmers field, nursery has been raised at Langol Farm of ICAR Research Complex for NEH Region, Manipur Centre, Imphal.

Passion Fruit

Manipur climate is suitable for Passion fruit cultivation. Agrotechniques are to be standardized for this crop under Manipur conditions. There is a growing demand for the planting material of this crop in the state. The variety Kaveri (Hybrid) released by IIHR, Bangalore is reported to be high yielder than the local varieties. The planting material of var. Kaveri from IIHR, Bangalore and other local cultivars of the region are being studied for their performance and to standardize the agro techniques under Manipur conditions.

Kiwi

Kiwi is a new introduction to Manipur. There is a need to evaluate different varieties of kiwi and to

standardize the agro techniques under Manipur conditions. The planting material has been obtained from Sikkim Centre of ICAR Research Complex and planted in the experimental farm of the centre.

Tomato seed production

Manipur centre is having good number of tomato germplasm. Three varieties namely Manikhamnu, Manileima and Manithoibi have already been

released from this centre during the year 2000 and many lines are under pipeline. To demonstrate the latest package of these varieties and to supply the seed material to the farmers and extension agencies, seed production of these varieties have been taken up under KVK. Besides, performance of garlic, onion and pineapple was evaluated and shown in table 52, 53 and 54.

Table 52 : Performance of Garlic accessions (Mean values)

Acc. No.	Height of the plant (cm)	No. of leaves/ plant	Weight of the bulb (g)	No. of cloves/ bulb	Weight of 50 cloves (g)	Diameter			Waxy ness A;Waxy B:Mod. Waxy C;Less Waxy	Erectness A;Erect B:Mod. Erect C;Leaves falldown	Market-able bulbs/ m ²	Yield / plot (m ²) (g)
						Equatorial (cm)	Polar (cm)	Neck (cm)				
55	34.8	7.4	10.4	16.0	26.0	2.79	2.29	0.37	A	A	65	676.0
61	31.6	6.2	11.5	15.0	29.0	3.02	2.43	0.31	C	A	31	356.5
174	36.1	7.1	9.7	15.0	22.0	2.67	2.41	0.32	B	A	64	620.8
200	30.1	5.4	6.1	11.2	27.0	3.05	2.79	0.30	B	B	10	61.0
263	28.0	5.2	5.2	9.1	39.5	2.22	2.46	0.27	B	A	34	176.8
303	51.0	8.3	18.0	13.6	52.0	3.59	2.67	0.42	B	A	63	252.0
316	41.6	8.2	15.0	14.5	41.5	3.69	3.93	0.39	B	A	38	570.0
321	56.8	9.6	21.2	11.4	86.0	3.54	3.14	0.61	B	A	64	1356.8
475	60.3	10.4	39.0	16.8	104.0	4.56	3.70	0.85	B	A	65	2535.0
MGR2	47.2	9.2	9.4	12.0	48.0	2.86	2.49	0.34	B	A	61	573.4
MGR3	32.0	8.2	2.9	13.0	12.0	2.11	1.89	0.26	B	A	62	179.8
MGR4	44.0	6.1	9.8	14.0	29.5	2.65	2.25	0.28	B	A	63	617.4
MGR5	44.2	7.4	13.2	7.8	80.0	2.98	2.79	0.40	B	A	60	818.4

Table 53 : Effect of date of planting and nitrogen application on the yield and quality of Onion under Manipur conditions

Treatments	Height of the plant (cm)	No. of leaves/ plant	Number of Marketable bulbs/plot	Number of Unmarketable bulbs/plot	Weight of bulb (g)	Girth of the bulb (mm)	Yield /plot (6m ²) (kg)	Yield/ha (q)
D ₁ N ₁	54.05	10.05	218	82	91.05	59.86	19.49	324.83
D ₁ N ₂	53.15	10.57	225	75	77.30	58.55	17.23	287.16
D ₁ N ₃	52.52	9.90	231	69	75.65	55.55	18.41	306.83
D ₂ N ₁	25.54	8.00	85	215	32.70	38.85	1.76	29.33
D ₂ N ₂	24.62	7.50	76	224	26.77	37.12	1.54	25.66
D ₂ N ₃	26.85	8.02	87	213	19.82	35.04	2.00	33.33
D ₃ N ₁	24.05	8.60	40	260	21.42	33.55	0.79	13.08
D ₃ N ₂	20.59	7.30	53	247	19.12	30.65	0.88	14.58
D ₃ N ₃	24.77	9.20	47	253	19.75	32.07	0.65	10.75

Table 54 : Mean data for high density planting in pineapple var. Kew

Spacing (cm ²)	Plant height (cm)	Number of leaves/plant	Length of leaves (cm)	Breadth of leaves (cm)	Days to flower initiation	Days for maturity	Fruit weight (kg)	Fruit length (cm)	Fruit girth (cm)	TSS (°Brix)
25x40x120	99.75	36.83	89.50	6.20	522.0	613.5	1.54	18.2	41.69	15.53
30x60x90	104.54	38.20	94.61	6.13	467.0	617.1	1.39	17.23	41.23	16.83
25x45x90	101.20	36.75	91.13	6.67	512.5	628.8	1.16	17.25	39.60	15.98
25x35x90	103.50	37.27	95.54	6.23	467.0	618.0	1.50	17.17	41.19	17.48
25x50x80	100.78	41.18	89.66	6.13	467.0	620.5	1.40	17.35	40.95	16.19
25x35x75	102.06	39.52	92.00	6.30	467.0	634.6	1.29	16.75	39.38	15.31

MEGHALAYA

Evaluation of growth parameters of Khasi mandarin

A.K. Dubey & D.S. Yadav

Nucellar seedling, micropropagated and budded plants of Khasi mandarin were evaluated for growth characters. The maximum plant height (60.75 cm) and leaf area (9.15 cm²) was recorded in nucellar seedlings. However, maximum number of leaves per plant (38.20) and stem diameter (1.24 mm) has been recorded in grafted plants of Khasi mandarin on *Citrus volkamariana* rootstock as given in Table 55.

Evaluation of growth parameters of lemons

Three lemon varieties namely Assam Lemon Long, Assam Lemon Round and Kachai Lemon were evaluated for growth characters. The maximum plant height (52.52 cm) and leaf area (10.60 cm²) were found in Assam Lemon Long, while the maximum stem diameter (0.97 cm) and leaves/plant (65) in Assam Lemon Round.

CITRUS

K. Rajasekhara Rao & K.A. Pathak

Isolation of pheromone from citrus trunk borer *Monohammus versteegi*

Citrus trunk borer adults were collected in large numbers and the sexes were separated. The bodies of the beetles were finely grinded with hexane and

allowed for 24 hours. The contents were filtered and the extract was evaporated till a brownish liquid was obtained. This yielded a volatile substance. The unidentified volatile substance was isolated from the female trunk borer, which successfully attracted the opposite sex both in lab (95% attraction) and field (75% attraction) conditions.

Table 55 : Comparative performance of nucellar seedling, micropropagated and budded plants of Khasi mandarin

Treatments	Plant height (cm)	No. of leaves / plant	Stem diameter (mm)	Primary Leaf branch/ area	plant (cm ²)
Nucellar seedling	60.75	34.40	1.02	2.40	9.15
Micro propagated	33.48	13.60	0.81	1.20	8.14
<i>Citrus volkamariana</i> X Khasi mandarin	57.78	38.20	1.24	2.80	6.67
<i>Citrus letipes</i> X Khasi mandarin	34.16	19.20	1.17	3.00	6.36
<i>Citrus taiwanica</i> X Khasi mandarin	38.25	21.00	0.75	1.80	6.96
<i>Citrus reshni</i> X Khasi mandarin	23.95	11.50	0.73	3.00	6.61
SEm (±)	6.29	4.46	0.13	-	0.29
CD at 5%	18.35	13.02	0.37	NS	0.83

Laboratory studies on the attraction of unidentified substance to trunk borer adults

M. versteegi adults were attracted towards the pheromone source within 10 minutes when the substance was kept at a distance of 3m. The unidentified substance resulted in arresting the

borers to feed on citrus branches and attracted towards the substance leaving the citrus branches. The substance had created a change in the behaviour of the beetle population in field, i.e., a barking/cracking sound was noticed within 5 minutes indicated that the substance was having a pheromone property. The substance attracted the males continuously for 5-6 days in laboratory conditions.

Management of Citrus trunk borer

Management of the trunk borer with different IPM tactics was taken up at ICAR farm. The orchards showed 30-40% recovery (growth) with good flush. Shaking of the plants for a week when the fruits are of pea size, resulted in good collection of beetles. The method was very easy and further their collection from April 3rd week to May 2nd week has resulted in reduction in oviposition by females because males emerge first during the season.

ENTOMOPATHOGENIC NEMATODES

A.N. Shylesha, K. Rajasekhara Rao
& K.A. Pathak

Bioassay of entomopathogenic nematodes on citrus trunk borer

Entomopathogenic nematodes were bioassayed on grubs of citrus trunk borer *Monohammus versteegi*, citrus butterfly larvae (*Papilio domoleus*) and root grubs *Halotrichia*, and other insect pests viz. *Dioscorea* leaf eating saw fly larvae, *Haplosynx chalybaeus* (Taro corm borer) in lab conditions. *Steinernema carpocapse* was found to be highly virulent against all these test insects.

GUAVA

ARUNACHAL PRADESH

Performance of two improved varieties of guava at different spacing

L.C. De

In general, Allahabad Safeda showed better growth in terms of plant height, basal diameter and canopy spread than L-49. Closer spacing improved plant height and canopy spread in Allahabad Safeda. Number of fruits/tree was maximum (87) with

closer spacing (3mx4m) in L-49, whereas the same observed with wider spacing (4mx4m) in Allahabad Safeda (81). Highest yield /tree was recorded in Allahabad Safeda (14.2 Kg/tree) with wider spacing followed by L-49 with closer spacing.

MEGHALAYA

Evaluation of guava hybrids

K.D. Babu & D.S. Yadav

Out of nine guava hybrids evaluated for their growth and yield performance, Hybrid-7 recorded the highest fruit weight (153.14 g) and the highest TSS (11.50 %). However, the Hybrid-3 recorded the highest no. of fruits/tree (254.20) and highest acidity (0.51 %). The Hybrid-3 recorded the highest yield (36.93 kg/tree).

BANANA

ARUNACHAL PRADESH

Performance of different varieties of banana

L.C. De

Out of 30 genotypes of banana, nine cultivars came into bearing. Among nine varieties, Pakte (Local) had maximum plant height (3.75), stem girth (70 cm), heavy male flower (930 g), bunch wt (17.8 kg) and bigger size of fingers (18.0 cm), dia 250 g and pulp wt (165 g). No. of sterile flowers was found least with Jeera banana (20) and maximum with Vannan (55), Chini Champa had highest no. fingers/bunch (17) and bunch length (58cm).

NAGALAND

Collection, evaluation and development of suitable agro-techniques for banana and papaya under foot- hills of Nagaland

Naresh Babu

Influence of split application of nitrogen on banana cv. Jahajee

The height (214.63 cm) and girth of pseudostem (59.95 cm), number of fingers/ bunch (76.32) and bunch weight (26.51 kg) were significantly superior

under 240g N/ plant applied in 4 splits i.e.2, 4,6, 8 months after planting. Split application of nitrogen hastened flower initiation and fruit maturity by 16-29 days and 9- 13 days respectively. Nitrogen application has no significant influence on TSS and ascorbic acid contents though significant improvements in total sugar, acidity and sugar/ acid ratio were observed at 180g in 4 split doses.

Influence of different orchard floor management practices on nutrient content of banana leaves

Leaf nutrient levels were significantly influenced by different orchard floor management practices. The herbicide (glyphosate, 3ml/ lit. of water) treatment significantly increased the leaf N content (2.61%) followed by green manuring with cowpea (2.595). However, these treatments were statistically at par with paddy straw mulching. Paddy straw mulch recorded highest P and K contents (0.20 and 3.79% respectively), followed by herbicide and black polythene mulch, which were statistically at par with each other. Intercropping with French bean treatment resulted in the lowest Ca and Mg contents of banana leaf.

Collection and evaluation of local banana germplasms

Naresh Babu, C. Rajkhowa & S.D. Rao

Evaluation of local and improved varieties of banana under foothills of Nagaland

Thirty genotypes of banana comprising 12 local varieties and 18 improved ones were collected from different parts of Nagaland and adjoining areas of Assam during 2002 and the same were planted in the Institute's farm for their evaluation. Among these genotypes 'Ghaspani' (Local) had highest pseudostem height (245.01 cm) followed by 'Manohar' (241.40 cm), 'Ranga kol', 'Malbhog tall' and 'Kaskol'. The girth of pseudostem was recorded highest in 'Kaskol' (61.00cm) followed by 'Jahajee', 'Robusta', 'Jati kol', 'Chinichampa', 'Bhimkol' and 'Dimapur' (local). 'Robusta' produced highest length of leaf (118.40cm) followed by 'Manohar', whereas 'Bhimkol' had maximum breadth (61.20cm) of leaf followed by 'Kaskol' (54.34cm) and 'Jatikol'.

LITCHI

TRIPURA

TECHNOLOGY MISSION

M.Sankaran, Jaiprakash & S.Biswas

Seven high yielding varieties of litchi, namely Chess II, Sahi, China, Swarnarupa, Early Bedana, Late Bedana and Purabi, have been introduced from ICAR Research Complex, Ranchi. The plants are in establishing stage. Two leaf diseases, Anthracnose (*Colletotrichum gloeosporioides*) and blight (*Botryodiplodia theobromae*), were found to affect young plants severely. The diseases were controlled by foliar spray of carbendazim and mancozeb mixtures. Tila land with gentle (g₁₀) slope are suitable for litchi cultivation to obtain 14.66 to 17.87 kg / plant fruit yields from 15 years old plant.

PASSION FRUIT

MANIPUR

Application of plastics in Agriculture and Horticultural Crops in Manipur

B. Narsimha Rao & Anjani Kumar Jha

Effect of Drip irrigation on the yield and quality of different varieties of Passion fruit (*Passiflora edulis*)

Passion fruit plants were transplanted during the second fortnight of Sept.2002 by utilizing the monsoon rains for better establishment and the drip system was installed by the onset of dry spell in Dec.2002. The experiment was laid out in a Split Plot Design with three replications and the treatment involving drip irrigation at different time interval, mulching with different materials over two varieties.

The experiment is under progress. Observations are being recorded for further analysis and presentation.

Effect of drip irrigation and nitrogen application on the yield and quality of Passion fruit

This experiment has been taken up as an inter crop under the partial shade of *Parkia roxburghii*

with a view to study the effect of partial shade and drip irrigation on Passion fruit. The experiment was laid out in a Split Plot Design with three replications and the treatments are as follows. The drip irrigation was applied during the dry spells at different intervals.

The flowering and fruiting has already been started and recording of observations is under progress. The preliminary observations indicated that the flowering and fruiting is early under partial shade of *Parkia* than in the open field.

PEACH

ARUNACHAL PRADESH

Performance of peach varieties at lower hills of Arunachal Pradesh

L.C. De

Among three varieties of peaches, Sharbati showed highest growth and bearing. It attained a height of 4.10 metres, maximum basal diameter of 6.63 cm and canopy spread (356.0 cm x 367.0 cm) and produced highest number of fruits per plant (1149) followed by Floridasun and T.A 170. Average weight of single fresh fruit was recorded maximum in T. A. 170 (41g) followed by Sharbati (34.2g) and Floridasun (25g).

MEGHALAYA

Evaluation of peach varieties

K.D. Babu

Three varieties of peach viz. Flordasan, TA-170 and Shan-e-Punjab were evaluated for their growth and yield attributing characters. The highest leaf: fruit ratio (6.66) was recorded in Flordasan variety while maximum no. of fruit/tree (245.2) and the highest fruit weight (56.09) were noted in variety Shane-e-Punjab. The variety Shane-e-Punjab also recorded the highest fruit yield/tree (13.75 kg).

PINEAPPLE

MANIPUR

Evaluation of Sub tropical, temperate and indigenous fruit crops

B. Narsimha Rao, Sunil Kumar,
& Anjani Kumar Jha

Effect of high density planting on the yield and quality of pineapple

Various systems of planting in hill slopes including farmers practices were evaluated to come up with optimum plant density in pineapple var. Kew. Best spacing treatment was 25x35x90 cm³, which yielded fruits weighing on an average 1.5 kg each with highest TSS (17.48) and length of leaves (95.54 cm). Spacing did not affect maturity much. Highest fruit girth (41.69 cm) and fruit length (18.20 cm) was recorded with a spacing of 25x40x120 cm³, while maximum number of leaves per plant (41.18) was obtained with 25x50x80 cm³ spacing.

MEGHALAYA

Standardization of pineapple RTS

A. Nath & N. Rai

Eleven different concentrations (*viz.* 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 percentages) of pineapple (Kew) juice were added and final TSS of 23% was maintained by adding desired quantities of sugar. The highest score was recorded in juice concentration 30% while lowest was recorded in juice concentration 0% and 100% respectively in terms of sensory attributes.

TRIPURA

TECHNOLOGY MISSION

M. Sankaran, Jaiprakash & S. Biswas

Double row system of cultivation method for 'Queen' and 'Kew' varieties has been introduced for pineapple.

VEGETABLES

ARUNACHAL PRADESH

Performance of different vegetable crops

L.C De

Research work on various vegetable crops was undertaken during the period under report and the performance of different vegetable crops is given in Table 56.

MANIPUR

Nutrient Management in Tomato

Mausumi Raychaudhuri & S. Raychaudhuri

The experiment is initiated this year in a split plot design with (1) Poultry manure @ 10 t/ha, 2)

Lime @ 500 kg/ha and 3) Control in the main plot and 4 levels of NPK in the sub plots viz., 1) Control, 2) 1/2 NPK, 3) NPK and 2 NPK. NPK refers to and kg of N, P₂O₅ and K₂O/ha. The experiment was carried out in the valley (Lamphelpat Farm) after harvesting of paddy. The experimental soil was acidic in reaction with pH 4.8, organic carbon 6.31%, exch. Ca²⁺ + Mg²⁺ as 11.1 cmol (p⁺) kg⁻¹ and available P as 46 ppm.

The treatments viz., poultry manure @ 10 t/ha increased the yield significantly over control. The fertilizer level also increased the yield significantly. The interaction was also found significant too. Under controlled situation the yield increase was linear with fertilizer (r²=0.9346). Gradually the slope declines with lime (r²=0.7445) and absolutely flattened with poultry manure (r²=0.0007). The results depict that fertilizer application can be nullified if poultry manure @ 10 t/ha is being used. The maximum yield of 305.09 q/ha was obtained with Poultry manure @ 10 t/ha + NPK (Table 57).

Table 56: Performance of different vegetable crops

Name of vegetable	Variety	Best time of planting	Duration (days)	Size (Breadth x length)cm	Yield
Cabbage	Pride of India	Oct-January	90-120	36	33t/ha
Radish	Pusa Himani	Oct-January	60-75	3 x 60	330g/root
Radish	RRWT	Oct-January	50-60	8	172.2g/root
Knolkhol	White Vienna	Oct-December	50-60	9.2	408g/stem
Cauliflower	Pusa Himjyoti	Oct-November	62-65	29	510g/curd
Sprouting Broccoli	KTS-1	Oct-January	90-100	20-25	250-350g/curd
Brussels Sprouts	Hild's Ideal	Oct-January	100-110	2-2.5	50-120 sprouts /stalk
French bean	Arunachal Local	Feb-May, Aug-Sept	60	14-15	200-300g/plant
Ridge gourd	Tripura Local	April-May	80-90	3.5 x 30	181g/fruit
	Harbhajan	April-May	53	17 (length)	14 fruits/plant
	7-Dhari	April-May	52	15 (length)	12 fruits/plant
	Parvani Kranti x 7-Dhari	April-May	52	19(length)	10 fruits/plant
Bhindi	Parvani Kranti x Harbhajan	April-May	51	15(length)	13 fruits/plant
	Parvani Kranti	April-May	54	16(length)	13 fruits/plant
	Parvani Kranti x Hibiscus rosa sinensis	April-May	55	18(length)	16 fruits/plant

Table 57: Nutrient Management in Tomato with lime, poultry manure and different fertilizer levels

	O NPK	½ NPK	NPK	2 NPK	Mean
Control	134.5	209.6	221.4	276.5	210.5
Lime @ 500 kg/ha	132.8	179.4	174.9	190.8	169.5
PM @ 10 t/ha	244.7	262.3	305.1	228.2	260.1
Mean	170.7	217.1	233.8	231.8	
C.D.	Main treatment (Tr)		Fertilizer levels (F)		Tr x F
	50.42*		48.07**		60.78*

Improvement of vegetable crops and development of suitable agro-techniques including plant protection

B. Narsimha Rao & Chandra Deo

Crop Improvement in Tomato

Seventy six breeding lines of F_5 , F_6 , F_7 and advance generation lines were grown during *rabi* season after rice crop with uniform package of practices. Selection has been done based on their superior performance. Seeds of the superior lines were collected for further evaluation and advancement of generations. Ten selections were identified for Advance Varietal Trial both in the farmers field and research farm.

Improvement of Brinjal

Seven promising bacterial wilt resistant selections were grown during *kharif* season under foothill conditions of Manipur. Seeds have been collected from the superior plants for further evaluation and selection.

Evaluation of Garlic accessions under Manipur conditions

As part of ongoing project thirteen garlic accessions obtained from the NRC Onion and Garlic (Including local collections) were evaluated for their growth, bulb and yield performance under Manipur conditions. Highest plant height (60.3cm) and number of leaves(10.4) were recorded in Acc. 475

and the lowest plant height (28cm) and number of leaves(5.2) in Acc.263. Similarly, maximum weight of bulb (39g), cloves per bulb (16.8) and equatorial diameter (4.56cm) were observed in Acc.475 and the minimum weight of the bulb (2.9g) and equatorial diameter (2.11cm) were recorded in Acc.MGR3. The bulb yield per hectare was highest in Acc.475 (237.9q) and the lowest in Acc.200 (6.1q).The overall performance of Acc.475 is promising.

Agro-techniques for Onion in Manipur

In order to standardize the date of planting and nitrogen application for onion yield and quality assessment under Manipur condition an experiment was laid out during *rabi* season of 2002-03. The onion variety Nasik Red was grown in horticulture block of Lamphelpat farm with three different dates of transplanting (D_1 -17th Dec.2002; D_2 -2nd Jan.2003 and D_3 -17th Jan.2003) and three different levels of nitrogen dose (75, 100 and 125 Kg /ha) applied in two equal splits- basal and 30 days after transplanting, whole P and K was applied basally. Among the various dates of planting, D_1 days of transplanting showed marked difference. For the traits studied (height of the plant, number of leaves/ plant, marketable bulbs/plot, weight and size of the bulb and yield) D_1 transplanting gave best result irrespective of N dose. However, TSS of onion was higher in case D_2 and D_3 . This might be due to dilution effect of bigger bulbs and more number of marketable bulbs produced in D_1 . Effect of nitrogen level was over shadowed by date of transplanting. Treatment D_1N_1 was found to be the best.

NAGALAND

Collection and Evaluation of Solanaceous vegetables for Yield and Quality

Naresh Babu

Influence of organic manures on growth and yield of tomato (*Lycopersicon esculentum* L.)

A field experiment consisting five organic manure treatments viz. FYM @ 20t/ ha, Green

manure @ 20 t/ha, *Azospirillum* @ 25 kg/ha, poultry dropping @ 5t/ha and FYM@ 20 t/ha + NPK @100: 60: 60 kg/ha and three tomato varieties ('Shakti', 'Pusa Ruby' and 'H S - 101') was conducted to study the response of organic manures on yield of tomato. Significantly higher maximum fruit diameter (4.79 cm), fruit weight (73.39 g) and yield (322.67 q/ha) were recorded in 'Shakti' than Pusa Ruby and H.S. 101. Significant improvement in plant height (123.36 cm), fruit length (5.27 cm), diameter (5.10 cm) and yield 329.26 q/ha) was also noticed with the application of FYM+ NPK. The studies have conclusively indicated that FYM @ 20t/ha +NPK @ 100:60:60 kg/ha is ideal fertilizer dose for obtaining higher yield in tomato under foothill conditions of Nagaland.

Effect of different time of transplanting and system of cultivation on tomato

The effect of date of transplanting (2nd, 3rd week of August, 2nd week of September and 3rd week of September) with four methods of cultivation viz., plain bed, plain bed with staking, raised bed and raised bed with staking was studied. Significantly higher yield was recorded when the transplanting was done in second and third week of August (317.49 and 304.67 q/ha respectively). Raised bed with staking recorded higher yield (326.17q/ha) as compared to plain bed (237.12 q/ha).

MEGHALAYA

TOMATO

Evaluation of tomato varieties

D. S. Yadav & N. Rai

Nine bacterial wilt tolerant tomato varieties namely BT-2, BT-1, BT-117-5-3-1, BT-12, BT-10, Arka Abha, Shakti, KT-10 and KT-15 were evaluated for yield and yield attributing characters. Maximum yield was recorded in BT-117-5-3-1 (288.75 q/ha) followed by Shakti (277.68q/ha) & Arka Abha (277.50 q/ha).

Evaluation of tomato varieties under polyhouse

N. Rai & D. S. Yadav

Fourteen varieties of tomato namely BT-117-5-3-1, Sel-3, KT-10, BT-10, Arka Alok, SEL-2, Sel-1, Arka Abha, KT-15, H-24, Shakti, Tura Local, BT-12 and Sikkim Local were evaluated in polyhouse. The maximum number of fruits (31) were reported in Sikkim Local. However the maximum fruit weight (61.16 g) was found in Arka Alok followed by BT-117-5-3-1 (49.89 g). Maximum yield was noted in BT-117-5-3-1 (342 q/ha) followed by BT-12 (302.40 q/ha) and BT-10 (294 q/ha).

Breeding for disease resistance in tomato

D.S. Yadav & N. Rai

Twenty lines of tomato were selected as tolerant to bacterial wilt and blight disease among 150 segregating lines. The yield performance of twenty selected lines was also better.

Generation advancement and evaluation in tomato

D.S. Yadav and N. Rai

Generations of F₃ (25), F₄ (25) F₅ (9) & F₆ (5) F₇ (16) progenies of tomato were evaluated and individual plant selection was made. Seeds of all the lines were collected for further generation advancement and evaluation.

BRINJAL

Evaluation of Brinjal varieties

N. Rai & D.S. Yadav

Twenty-four varieties of brinjal were grown in rainy season in open conditions, the varieties CH-157-6-4-1 (353 q/ha), JC-4 (335 q/ha) and JC-2 (225 q/ha) were found to be high yielders as well as tolerant to bacterial wilt.

Evaluation of brinjal hybrids

One hundred and fifty F₁ hybrids of brinjal were developed in diallel mating design as well as general crossing and evaluated for yield attributing

characters. Out of which few hybrids performed superior to national check Pusa Hybrid-5 (long) and Pusa Hybrid-6 (round) for yield and yield contributing characters as given in Table 58 .

Evaluation of brinjal under open condition

Five brinjal varieties namely CHBR-2, RCMB-7, JC-1, RCMB-10 and RCMB-1D were evaluated under open condition. The maximum yield was recorded in CHBR-2 (361.66 q/ha) followed by RCMB-7 (329.55 q/ha) and JC-1 (322.44 q/ha).

Table 58: Growth and yield parameters of brinjal hybrids

Crosses	Plant height (cm)	No. of branches	Fruit weight (g)	Fruit shape	Yield (q/ha)
RCMB-3 X					
RCMB-60	100.25	8.12	135.73	Long	515.77
RCMB-3 X					
BB-64	102.12	7.67	75.58	Long	478.66
RCMB-1 X					
BB-64	66.82	5.33	112.61	Long	460.44
BB-40X					
BB-64	64.75	5.00	115.00	Oblong	429.77
RCMB-10 X					
RCMB-1	72.53	6.67	95.64	Long	414.44
RCMB-10 X					
RCMB-4	75.03	8.00	110.87	Long	412.44
BB-46 X					
BB-40	60.60	4.00	107.67	Oblong	411.55
BB-46 X					
BB-60	81.30	6.00	108.47	Oblong	406.88
RCMB-9 X					
BB-60	63.65	6.00	90.41	Oblong	387.77
RCMB-7 X					
BB-46	61.50	5.33	74.41	Long	378.66
Pusa Hybrid-5	64.55	5.25	149.38	Long	418.67
Pusa Hybrid-6	65.40	5.80	215.78	Round	478.33

CAPSICUM

Evaluation of Capsicum Hybrids and varieties in polyhouse

Seven hybrids of capsicum namely Indame-3, Mahabharat, My-6801, Arun F, Bharat, Alankar and Anupam and one open pollinated variety California Wonder were evaluated for yield and yield attributing traits. Maximum fruit yield was

recorded in hybrid Indame-3 (250.30 q/ha) followed by Mahabharat (236.70 q/ha) and Hybrid-6801 (223.70 q/ha). Highest weight of individual fruit (156.25 g) was found in Mahabharat 156.25 g whereas maximum number of fruits (14) was noted in Anupam.

Effect of different packaging materials on shelf-life of capsicum

A. Nath

Maximum shelf-life of 16 days (at 22 + 2 C and 85% RH) was achieved when fruits were packed in cloth bag treated with $KMnO_4$ (1000 ppm) with minimum weight loss (16.70%) while minimum shelf-life was recorded in Low density polyethylene (LDPE) 100 gauge; LDPE 100 gauge perforated; LDPE 150 gauge; LDPE 150 gauge perforated(2 mm in dia, 4 nos.) up to 10 days only at 22 + 2 C and 85% RH.

IMPROVEMENT OF COLE CROPS

N. Rai & D.S. Yadav

CAULIFLOWER

Evaluation of cauliflower varieties/hybrids

Four open pollinated varieties namely ES-67, Kartiki, SKAU-CF-9, SKAU-CF-9-2 and five hybrids of cauliflower namely Summer Queen, 55 days, Amazing were evaluated in open condition during winter 2002. Among four varieties SKAU-CF-9 performed better with average yield of 240q/ha followed by SKAU-CF-9-2 (186.75q/ha). Among the hybrids maximum yield was recorded in Amazing (286.75q/ha) followed by 55 days (230 q/ha).

CABBAGE

Evaluation of cabbage varieties/hybrids

Four hybrids of cabbage namely Simran, Mahima, Bahar and Green Challenger and one open pollinated variety Golden Acre were evaluated in winter 2002. The large head size (16.39 cm) and highest individual head weight (1100g) was

recorded in Hybrid Bahar followed by Simran (288.33 q/ha) and Green Challenger (279.33q/ha). The maximum yield (320 q/ha) was recorded in hybrid Bahar.

BROCCOLI

Evaluation of broccoli hybrids

Two hybrids of broccoli namely Lucky F₁ and Fiesta F₁ and one open pollinated variety KT-S-T were evaluated in winter of 2002. The maximum yield was recorded in hybrid Fiesta (265 q/ha). It was also observed that broccoli could be an important crop among the cole crops in respect to cold hardiness and it was found suitable for cultivation in Meghalaya.

IMPROVEMENT OF TUBER AND RHIZOMATOUS CROPS

COLOCASIA

Evaluation trial on colocasia

Twenty nine genotypes of colocasia were evaluated for their growth and yield attributing characteristics. Among the genotypes, ML-1 recorded the highest yield of 265.6 q/ha followed by Meghalaya Collection (196.9 q/ha) and ML-9 (191.5 q/ha). Although the yield performance of genotype BCC-2 was comparatively lower than the other high yielding genotypes but it was resistant to bacterial leaf blight disease than the other genotypes.

SWEET POTATO

Evaluation trial on sweet potato

Thirteen varieties of sweet potato were evaluated for their growth and yield contributing characteristics. Among the different varieties, the highest tuber length (19.25 cm) was recorded in the variety 18-90-12-29, while the highest tuber diameter (8.16 cm) was noted in CIP-440/27. The highest yield was recorded by Sonipat-2 (489.0 q/ha) followed by H-620 (436.0 q/ha) and Co-3 (391.5 q/ha).

IMPROVEMENT OF LEGUME VEGETABLES

INDIAN BEAN / DOLICHOS BEAN

Eighty germplasm lines were collected from NEH Region and Tribal areas of Chhattisgarh and evaluated under terrace land condition. Nine promising lines were identified on the basis of yield and pod characteristics. The highest pod length was recorded in RCDL-97 (15 cm) followed by RCDL-111 (14.02 cm). The highest weight of 10 pods was recorded in RCDL-111 (120.67 g). The highest yield was recorded in RCDL-112 (2.998 kg/plant) followed by RCDL-90 (1.340 kg/plant).

FRENCH BEAN

Collection and evaluation of French bean (pole type)

Forty-five lines were collected from different parts of NEH and Chattisgarh and evaluated for yield and yield attributing characteristics. The highest pod length was recorded in line RCFB-1310 (16.16 cm), however the weight of 10 pods was highest in RCFB-36 (120 g). The highest yield (1.239 kg/plant) was recorded with RCFB-35 followed by RCFB-22 (1.108 kg/plant).

Organic Farming in French bean

D.P. Patel

The effect of different organic manures and its methods of placement on the crop growth pattern, green pod yield and seed yield of French bean cultivar Naga local (pole type). Highest green pod yield (89.03 q/ha) was recorded with application of Libra organic manure (5t/ha) in furrows which was significantly higher as compared to all other organic manures and method of organic manure application. Lowest green pod yield was recorded with Ekta organic manure (5t/ha). Furrow placement and pit placement of organic manures was found better as compared to mixing (broadcasting) of organic manures in whole plot. Furrow placement gave highest green pod yield (62.11 q/ha) followed by pit placement (60.98 q/ha) whereas mixing in whole plot produced only

34.07 quintals green pod/ha. Germination found to be poor in pit placement as well as furrow placement of Ekta (5 t/ha) followed by Libra (5 t/ha) organic manure (Table 59).

Performance of Rajmash cultivars in mid hills of Meghalaya

D.P. Patel

Green pod purpose

Five bush type cultivars of French bean (Arka Komal, IVR FB -1, MFB-2, MFB-3 and MFB-1) were evaluated to study the growth pattern and green pod yield during pre-rabi season. Variety Arka Komal gave highest green pod yield (150.6 q/ha) followed by MFB-1 (110.4 q/ha) and MFB-3 (102.00 q/ha). Pod length was found maximum in Arka Komal (16.1 cm) and minimum in MFB -1 (13.7 cm). Seed yield was also recorded highest in Arka Komal (13.79 q/ha) followed by MFB-1(11.8 q/ha).

Seed yield purpose

Eight cultivars of Rajmash (HUR 15, HUR 150, HUR 137, BHUR 168, HUR 138, HUR 139, PDR 14 and VL 63) were evaluated to study their growth pattern and seed yield during pre-rabi season. VL 63, HUR 138, HUR 139 and HUR 150 varieties found to be promising with seed yield ranging 12-16 q/ha. VL 63 was found dwarf and earliest in maturity whereas BHUR 168 and PDR 14 took long-time and produced taller plants.

Table 59: Effect of organic manures on green pod yield of French bean

Organic manures	Methods of placement			Mean
	Furrow	Pit	Broadcasting	
FYM (10 t/ha)	61.33	44.41	31.25	45.67
Rabit Manure (10 t/ha)	50.58	68.50	32.08	50.39
Libra (5 t/ha)	89.03	79.08	49.58	72.57
Ekta (5 t/ha)	48.83	32.58	34.67	38.69
Libra (2.5 t/ha + Neem shield (1.0 t/ha)	60.75	80.33	22.75	54.61
Mean	62.11	60.98	34.07	

CD (P=0.05): Organic manures =14.23,
Methods of placement=11.02, Interaction=NS

SIKKIM

VEGETABLE IMPROVEMENT

Varietal evaluation of Okra

Ramesh Singh & Ashok Kumar

Maximum yield (178.4 q/ha), maximum number of fruits per plant (10.00) and maximum weight per fruit (25.36 g) was recorded in VRO-5 out of four bhindi varieties evaluated.

Varietal evaluation of Brinjal against bacterial wilt

All the 17 varieties of brinjal evaluated, showed tolerance to bacterial wilt with differences in yields parameters. Highest yield (659.18 q/ha and 2.47 kg/plant) was recorded in JC-4, highest number of branches /plant (10.13) in RCMB-9 and the highest number of fruits/plant (23.0) in RCMB-4.

Evaluation of brinjal varieties suitable for poly-house cultivation

Ramesh Singh & Ashok Kumar

Maximum number of fruits/plant was recorded in RCMB-4 (13.50) and number of seeds per fruit in JC-4 (525). Highest yield was obtained in RCMB -4 (11.47 kg/plant) whereas minimum in RCMB -9 (1.05 kg/plant). JC-2 showed early flowering (17 days) and BB-40 (41 days) showed late flowering in poly-house conditions.

Varietal evaluation of bean

Out of 46 varieties of bean evaluated for yield parameters, variety French Bean White was superior in yield (247.50 q/ha). Maximum fruit width (3.02 cm) and plant height (311cm) was recorded in Wing Bean White. Maximum yield/plant (11.70 kg/plant) was recorded in Sikkim Local-18. Variety Wing Bean White was found superior for yield 947.50 q/ha) of all the varieties evaluated at Sikkim.

TRIPURA

TECHNOLOGY MISSION

M. Sankaran, Jaiprakash & S. Biswas

TOMATO

Out of eight varieties tested, Selection-1, Selection-3, RCHLTE and Arka Abha were found to be promising. Variety RCHLTE took lesser days to first flower (37.50 days after planting) as compared to Selection-3 (64.50 days after planting). The performance of Arka Abha was better with the yield of 39.31 ton/ha in comparison with Selectio-2 (4.99 ton/ha.).

BRINJAL

Evaluation was carried out with six varieties. The varieties such as TRB-4, Singnath, TRB-2, and TRB-9 were found to be promising. The minimum fruit weight was recorded in TRB-4 (200.12 g/fruit). TRB-9 gave high yield (7.92 ton/ha) as compared to a local variety (3.8 ton/ha).

BHINDI

Varieties such as Harbajan, Parbhani kranti x Hibiscus, Bharka and Kaveri selection were found promising. The variety Kaveri has shown 0% incidence of *YVM*. The highest yield was recorded in Bharka and Parbhani kranti x Hibiscus, 10.88 and 10.66 ton/ha respectively.

BROCCOLI

Broccoli was cultivated in winter season and found that it produced 37.33 q/h harvested vegetable in the season under Tripura condition

NATP in IPNS in Vegetables

M. Datta

The effect of various sources of organic matter on mineralisation rate of organics in bhindi-tomato cropping sequence on upland condition was studied. The effect of different organics sources on growth and yield of bhindi and tomato crops in the sequence were in the order FYM @ 10 tonnes/ha, recommended doses of NPK, FYM @ 5 tonnes/ha.

However among the organics *Gliricidia* leaf or grain legume straw are cheaper and locally available as compared to FYM.

Another experiment was conducted on variable slope situation in bench terrace (22-23% slope). The performance was best with middle terrace followed by lower terrace. Among the various treatment T₃ i.e. first crop with *gliricidia* leaf followed by second crop with chhan showed good result.

The same set of treatments were tested on three more slopes. It was seen that higher growth and yield were recorded under lower slope (5.8%) as compared to higher slope (13.6%). Application of leaf mulches in both the crops i.e. bhindi (kharif) and brinjal (Rabi) recorded better yield of the crops as compared to mulching in the second crop alone.

Application of 100% P as MRP + *gliricidia* leaf @ 4 tonnes/ha + PSB recorded highest yield of rice and rock phosphate application 30 days before sowing was most efficient than rock phosphate application 15 days before sowing.

Screening of tomato varieties against wilt disease

S. Biswas

Eight tomato varieties viz. Selection 1, Selection 2, Selection 3, Arka Abha, Hyderabad, Bankura local, and Tripura local, were screened during winter crop season against wilt disease. Arka Abha had good field resistance to wilt caused by *Ralstonia solanacearum* (*Pseudomonas solanacearium*) giving highest yield. Two viral diseases, namely, leaf curl and mosaic, were noted in the field during the season with high percentage of infection, particularly the former one.

Screening of brinjal varieties against wilt

S. Biswas

Eight varieties of brinjal viz. PPC, TRB-4, TRB-9, Singhnath, TRB-5, TRB-2, Hyderabad and local, were screened against wilt disease. The data revealed that wilt was not severe in all the varieties except Hyderabad where its incidence was 50%. The percent disease incidence in other varieties was remained between 0 and 6.25%.

Disease management of Brinjal wilt and Tomato wilt

In winter season farmers grow brinjal and tomato in vast areas of Lembucherra, Mohanpur, Fatikcherra in uplands situation. These two crops are cash crops. But these crops suffers everywhere and enormous loss has been recorded due to Bacterial wilt and Fussarial wilt *Pseudomonas solanalearum* of brinjal wilt and *Fusarium solani* for tomato wilt. Around 50-60% of crops die due to these two diseases.

To reduce the wilting of the plants, crop rotation programme has been taken up before transplanting of Brinjal and tomato seedlings in Rabi season. In Kharif season, maize, Amaranthus and Marigold were sown and the plants were grown upto maturity. Root exudates of Maize, Amaranthus and Marigold have the capacity to inhibit the growth of *Pseudomonas* and *Fusarium* sp. After the harvest of Maize, Amaranthus and Marigold, the tomato and brinjal seedlings were sown in plots where previous crops were grown in winter season. Both tomato and Brinjal were locally collected and susceptible to wilt diseases. Brinjal growth was good and only 10% plants died. But tomato started wilting after one month of planting. 40% plants dies due to bacterial wilt. Yield of Brinjal was also good. Apart from Maize, *Amaranthus* and Marigold more crops will be included which seems to have fungistatic activity.

SPICES

MANIPUR

Integrated disease management

S.V. Ngachan

Evaluation of biocides against soft rot of ginger

Aqueous extract of plant materials (*Cuscutta* sp., *Juglans* sp. (Dry), *Artemesia* sp., *Myrica* sp., *Crysanthemum* sp., *Lantana camera* sp., Marigold (*Tagetes* sp.), Tulsi (*Ocimum sanctum*) and *Spilanthus ocmella*) at three different doses were used as seed treatment (soaked for 6 hours before planting) of ginger rhizomes in the month of April.

Their field bio-efficacy against soft rot with untreated control were compared in the farmers field in germination, foliar growth stages (June, August). Among the plant species *Artemesia* sp. showed effective results with 98% germination followed by *Cuscutta* sp. (45%). However, infection in the month of July reappears. The remaining botanicals could not show any effect on germination as well as in the growing stages of ginger. Against sclerotium foot rot of cucumber, the above plant species were tested for their efficacy as fresh leaf mulch. The results obtained in the farmer's field showed that *Artemesia* sp. and Marigold (*Tagetes* sp.) were comparatively performing better against aphids, mealy bugs and mosaic virus than foot rot.

MEGHALAYA

Improvement of Ginger and Turmeric

R.K. Yadav, N. Rai and D.S. Yadav

Maintenance of different varieties of ginger and turmeric

Thirty four varieties of ginger and forty one varieties of turmeric were maintained.

Marketing of Ginger in Ri-Bhoi District:

A.K. Tripathi, Med Ram Verma, S.B. Singh & K.K. Datta

A study was conducted to estimate the price spread and share of producer and market intermediaries in consumer's rupee in different channels of ginger product. Selected markets of Umroi, Umsning and Nongpoh were identified as study area. Depending upon the farmer's information from where the products come, Umroi Madan and Umroi Umdobyrthih villages in Umroi Block and Shopdok and Umtrou villages in Umsning Block were selected as study area. These are the main ginger growing villages in Ribhoi district. PRA technique was used to know the marketable surplus. About 188 farmers were participated consisted of four villages. The magnitude of marketable surplus varies between 47 to 75%. About 4 per cent of the product spoil and about 30 percent kept for seed. About 70 per cent

of the farmers sold their produce within a month after harvest in order to meet their cash requirements.

About 79% of the marketing cost goes to the intermediaries and rest is for actual marketing cost. In the actual marketing cost maximum amount goes as transportation (66%) cost. Among the intermediaries, wholesalers' share is about 53%, followed by village traders (15%) and producers' share in consumers' one rupee is about 21%.

MIZORAM

TURMERIC

N.S. Azad Thakur & K. Laximarayana

Varietal screening trial

An evaluation trial was conducted during kharif 2002 with nine prominent varieties of turmeric namely, Baktawng local, PDT-8, Meghalaya local-II, RCT-I, PCT-11, PCT-12, Lakadang, Kasturi Tanaka, Meghalaya local II. Highest yield (fresh weight basis) of turmeric was recorded in RCT-I (440.625 q/ha) followed by PCT-11 (414.575 q/ha) and Meghalaya local I (328.79 q/ha). However, the lowest yield was recorded in Baktawng local (216.6 q/ha).

SIKKIM

Improvement of production & productivity of rhizomatous crops

Ramesh Singh & Ashok Kumar

Varietal evaluation of turmeric

Out 18 varieties of turmeric evaluated for their morphological and yield performance, variety Pratibha was found superior in yield and rhizome fresh weight (348.89 q/ha and 422.13 g/plant, respectively) followed by ACC no. 96 (331.56 q/ha & 405.33 g/plant, respectively).

Impact of different tree leaf mulching on the productivity and improvement of ginger

An experiment on ginger variety Bhasa was carried out to observe the effect of different tree

leaf mulching consisted of Chilaune (*Schima wallachi*), utis (*Alnus nepalensis*), Banmara (*Eupatorium cannabinum*), Dhokare (*Datura futeosa*) and Tite Pati (*Artemisia vulgaris*) for productivity improvement. Maximum plant height (61.65 cm), number of leaves per plant (17), leaf length (22 cm), rhizome width (3.85 cm) and weight of mother rhizome (128.33 gm) was found in Banmara leaf mulching. Whereas the maximum yield (788 q/ha) was obtained in Utis mulching. Maximum fresh rhizome weight (678.50 g) was found in Dhokare mulching. Maximum yield in Utis mulching was due to greater sized mother rhizome. Maximum rhizome length & width was found in Dhokare mulching (6.69 cm) and Banmara mulching (3.85 cm) respectively.

Effect of rhizome weight, method of sowing and intercropping on the production of ginger

Maximum plant height (67.46 cm) was recorded in 75 gm rhizome weight + double row spacing + French bean intercropping. The highest fresh weight of rhizome (844.66 g/plant) and the highest total yield (761.12 q/ha) was recorded in 50 gm rhizome weight + single row + French bean.

TRIPURA

TECHNOLOGY MISSION

M. Sankaran, Jaiprakash & S. Biswas

BLACK PEPPER

Five high yielding varieties of black pepper, namely, Pourmami, Sreekana, Subhakana, Panchami and Paniyur - 1, have been introduced from Horticulture Research Centre, Govt. of Tripura, Nagicheria. The plants are in establishing stage. For nursery raising of black pepper, trench method has been followed in shed provided by straw ('Chhan') instead of polythene as followed in conventional method. A leaf let preparation with details of package of practices of black pepper is under progress.

AGROFORESTRY

Restoration of degraded lands through agroforestry Models

Twenty one ha of degraded land (13 ha in farmers' field and 08 ha in Institutional farm) has been taken up for restoration through various agroforestry models and details of each agroforestry system (AFS) has been mentioned below:

Soil fertility status

B.P. Bhatt and K. Laxmi Narayan

Soil samples have been collected from different depths along the slopes and the composite samples of each depth was analyzed to know the initial soil fertility status. The soils have been found poor particularly in organic carbon and available nitrogen. The details of the fertility status have been shown in table 60.

Table 60 : Soil fertility status of degraded land

Soil depth (cm)	Organic carbon (%)	Soil pH	Available N (Kg/ha)	Available K (Kg/ha)	Available P (Kg/ha)	Ca ⁺⁺ (mg/100g)	Mg ⁺⁺ (mg/100g)
0-20	1.57	5.24	100.35	436.29	0.50	0.86	0.94
20-40	1.17	5.04	150.53	455.89	0.34	0.51	0.67
40-60	1.05	5.73	50.18	461.50	0.28	0.53	0.61

Agri-horticulture AFS

B.P. Bhatt & J.M.S. Tomar

Khasi mandarin (*Citrus reticulata*), Assam lemon (*Citrus lemon*), pear (*Pyrus communis*), jackfruit (*Artocarpus lakoocha*), Kinnow mandarin, wild apricot (*Prunus armeniaca*), Peach (*Prunus persica*), guava (*Psidium guajava*), tree bean (*Parkia roxburghii*) and *Myrica* sp. have been planted under agrihorticulture AFS. The survival and growth performance of tree species has been given in table 61.

Table 61 : Survival and growth performance of fruit tree-crops

S. No.	Plant species	Survival %	Height growth (m)
1	<i>Citrus reticulata</i>	70.0±15.5	0.45±0.10
2	<i>Citrus lemon</i>	50.0±10.0	0.40±0.12
3	<i>Pyrus communis</i>	60.0±15.5	1.10±0.23
4	<i>Artocarpus lakoocha</i>	50.0±20.5	0.90±0.10
5	Kinnow mandarin	90.0±5.0	0.67±0.09
6	<i>Prunus armeniaca</i>	80.0±10.0	1.10±0.14
7	<i>Prunus persica</i>	50.0±25.0	1.20±0.11
8	<i>Psidium guajava</i>	70.0±10.5	0.54±0.07
9	<i>Parkia roxburghii</i>	60.0±10.0	0.56±0.05
10	<i>Myrica</i> sp.	65.0±10.2	0.50±0.07

Agri-silviculture AFS

B.P. Bhatt and K.M. Bujarbaruah

In agri-silviculture system, 26 various multipurpose trees including edible bamboo species have been planted and their survival and growth has been shown in Table 62.

Crop productivity in agrihorti and agrisilvi AFS

B.P. Bhatt, A. Pattanayak, D.K. Verma, & J.M.S. Tomar

Various location specific agricultural crops have been intercropped with tree-crops and the crop productivity has been shown in Table 63.

Crop productivity in managed stand of *Pinus kesiya*

B.P. Bhatt

Pine is one of the most dominant forest species of the region which forms unclassed as well as classed forests of the region. Farmers of the region are experiencing heavy agricultural losses in the understorey of pine, hence voicing concern about its deleterious effect on crop growth and

Table 62 : Survival and growth performance of various MPTs

S. No.	Plant species	Survival %	Height growth (m)
1	<i>Agathis australis</i>	80.0±10.4	0.50±0.09
2	<i>Anthocephalus indicus</i>	95.0±2.5	1.50±0.20
3	<i>Albizia lebbek</i>	70.0±10.0	0.80±0.10
4	<i>A. stipitata</i>	100.0±0.00	0.67±0.11
5	<i>Bambusa balcooa</i>	50.0±10.5	NA
6	<i>Bambusa bambos</i>	50.0±10.0	0.70±0.06
7	<i>B. cacharensis</i>	20.0±10.0	NA
8	<i>B. niagra</i>	70.0±10.0	0.56±0.06
9	<i>B. pallida</i>	70.0±10.0	NA
10	<i>B. ventricosa</i>	70.0±12.5	0.60±0.05
11	<i>Bauhinia variegata</i>	80.0±10.0	0.90±0.10
12	<i>Chukrasia tabularis</i>	68.0±12.5	0.80±0.12
13	<i>Dendrocalamus hamiltonii</i>	75.0±10.5	NA
14	<i>D. longispathus</i>	50.0±10.0	NA
15	<i>Dendrocalamus strictus</i>	80.0±10.0	NA
16	<i>Ficus glomerata</i>	100.0±0.0	0.90±0.09
17	<i>Ficus retusa</i>	80.0±10.0	0.80±0.07
18	<i>Gigantochloa macrostachya</i>	60.0±10.0	NA
19	<i>Gmelina arborea</i>	70.0±15.0	1.00±0.15
20	<i>Syningtonia populnea</i>	60.0±12.5	0.45±0.06
21	<i>Melocanna baccifera</i>	70.0±12.5	NA
22	<i>Mesua ferrea</i>	50.0±20.0	0.34±0.04
23	<i>Michelia champaca</i>	60.0±20.0	0.30±0.03
24	<i>Morus alba</i>	100.0±0.0	1.45±0.25
25	<i>Phyllostachys bambusoides</i>	50.0±10.0	NA
26	<i>Saffilaria arboricola</i>	50.0±15.0	0.50±0.04

NA denotes Not applicable as rhizomes were planted

productivity. Hence natural stand of pine (age 25 years approx.) was selected and 75% canopy was manipulated for growth of agricultural crops. It has been observed that perilla, pigeon pea, sweet potato and rice bean could be intercropped successfully with pine besides ginger, turmeric and colocasia. The crop productivity has been given in table 64.

Table 63 : Crop productivity in agrisilvi and agrihorti AFS

S. No.	Food crops	Crop yield (q/ha)	Green/dry biomass yield (q/ha)
1	Maize	14.27±0.23	NA
2	Mustard (M 27)	6.70±0.54	NA
3	Turmeric	166.67±1.12	NA
4	Ginger 169.	44±1.50	NA
5	Upland paddy	31.0±1.12	183.33±5.67
6	Ragi	10.44±0.78	70.34±2.12
7	Rice bean	6.56±0.34	45.23±0.23
8	Colocasia	210.0±12.34	NA
9	Groundnut		
	ICGV 86311	17.33±0.45	NA
	86252	16.40±0.32	NA
	86326	18.84±0.12	NA
	86335	15.67±0.56	NA
	86259	17.40±0.23	NA
	87291	18.26±0.23	NA
10	Soybean		
	Black soybean-	4.11±0.56	4.81±0.67
	Soybean MAW 98-2	9.32±0.45	7.05±0.56

Table 64 : Crops productivity in managed stands of pine (*Pinus kesiya*)

S. No.	Food crops	Crop yield (q/ha)
1	Perilla	2.81±0.67
2	Pigeon pea	8.64±0.34
3	Turmeric	106.67±0.83
4	Ginger	109.44±1.50
5	Rice bean	3.33±0.24
6	Colocasia	150.0±8.34
7	Sweet potato	60.0±1.23

Studies on intensive integrated farming system

B.P. Bhatt, Mrs. Rajeswari Shome, S.K. Majhi, Y.P. Sharma & K.M. Bujarbaruah

Studies on integrated agro-aquaculture (IAA)

About 2.3 ha of marshy land of the Institutional land was selected and water harvesting structures were created over 0.90 ha, to establish integrated agro-aquaculture (IAA) models on the one hand and to increase the cropping intensity by recycling of water into the system particularly during the lean

period. After creating small ponds over 0.90 ha, rest of the marshy land, i.e., 1.4 ha area was restored for cultivation of high value crops. The components of IAA include (i) fishery cum piggery, (ii) fishery cum duckery, (iii) fishery cum goatry, (iv) fishery cum poultry and (v) fishery cum dairy. The stock density of fish fingerlings was 6000/ha. Composite fish culture was practiced in a ratio of 2.0:2.0:1.5:2.0:1.0:1.5, respectively, to catla, silver carp, rohu, grass carp, mrigal and common carp. In one of the ponds, concentrate feed is being given, whereas, one pond has been kept as control where neither the concentrate feed nor any integration was done. However, lime was added to reduce the acidity. Since most of the units were developed in last part of the report under preparation hence the data is yet to be taken. However, the data for other integrated units has been shown in table 65.

Table 65 : Fish productivity with integrated farming system

S. No.	Unit established	Stocking density	Fish production (q/ha)
1	Piggery cum fishery	33 pigs/ha	16.03
2	Duckery cum fishery	250 birds/ha	18.53
3	Control pond	Nil	8.10

The average growth in each system was recorded highest for silver carp (206.7-585.3 g/fish), followed by common carp, mrigal and catla, respectively. The average body weight gain was recorded to be 340.24 and 4.27 g/day, respectively, for pig and ducks. On average, pig dung was applied @ 35.32 ton/ha. Similarly, droppings were added @ 7.42 ton/ha (Table 66).

Table 66 : Growth performance of pigs and ducks in integrated farming system

S. No.	Livestock/duck	Initial weight*	Final weight after 12 month of rearing
1	Duck (Assam local)*	0.875 (kg/bird)	2.10 (kg/bird)
2	Pig**	9.00 (kg/piglet)	112.0 (kg/pig)

*Four month old ducklings were reared
**Two month old piglets were reared

Crop productivity under integrated farming system

After rehabilitating the 1.4 ha of marshy area, various crops have been raised and their productivity has been shown in table 67.

Table 67 : Crop productivity under integrated farming system

S. No.	Crops	Grain/pod yield (q/ha)	Biomass yield (q/ha)
1	French bean (containter)	69.45	NA
2	Low land paddy (RCPL1-87-8)	38.60	71.24
3	Maize	14.27	86.45
4	Mustard (M 27)	8.34	NA

Growth performance and economic analysis for broiler chicks under integrated farming system

Broiler chicks are being reared in integrated system. During the period under report, 04 batches (each consisted of 100 chicks) each for 46 to 50 days. On average, the birds gained the body weight of 1.77 kg per bird after 50 days of rearing compared to 4.0 g initial weight. The mortality percentage was 20.75%. Cost-benefit analysis have also been worked out and on average, the net income was recorded to be Rs. 13,955.00 from four batches of broilers. Details of the cost-benefit has been shown in table 68.

Introduction of potential medicinal plants in AFS

Y.P. Sharma & B.P. Bhatt

Putranjiva roxburghii, *Cinnamomum camphora*, *C. zeylanicum*, *Phyllanthus embelica* and *Taxus baccata* as a tree species and medicinal herbs- *Alpinia galanga* and *Curcuma caesia* are being cultivated into the system. Survival for tree species ranged from 40.0-80.0%, whereas, the productivity of *Alpinia galanga* and *Curcuma caesia* was recorded to be 121.3 and 156.6 q/ha, respectively.

Studies on edible bamboo species of NEH Region

B.P. Bhatt and K.M. Bujarbaruah

(i) Survey for edible bamboo species

(a) Young shoot consumption

On average, out of 349 market places, 141 markets covering 2081 primary and secondary vendors were surveyed and interviewed to understand the major edible bamboo species, their consumption pattern and cost-benefit analysis of tender bamboo shoots. *Bambusa balcooa* Roxb., *B. polymorpha* Munro in Trans., *B. tulda* Roxb., *Dendrocalamus giganteus* Munro in Trans., *D. hamiltonii* Nees et. Arn, *D. longispathus* Kurz, *D. membranaceus* Munro in Trans., *D. sikkimensis* Gamble, *Melocanna baccifera* (Roxb.) Kurz, *Phyllostachys bambusoides* Sieb., *Schizostachyum dullooa* Gamble, *Teinostachyum wightii* Beddome and two unidentified spp.- *Chingwa* and *Khupri* have been found commercial edible bamboo species in tribal states of NEH. These edible species are also cultivated in home gardens besides their occurrence in forests.

Edible shoots are harvested from first week of June to third week of September every year for

consumption. However, market days for its sale varied from state to state and even from place to place within the state, with average value of 84.13, 83.78, 52.65, 80.71, 76.43 and 41.63 days/yr, respectively, in Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. On average, 1,978.816, 2,188.244, 442.031, 432.634, 441.592 and 201.331 ton of bamboo shoots are harvested annually, accordingly in the same states for consumption. Among various species, young shoots of *D. hamiltonii* are harvested and consumed maximum (ca. 1,858.702 ton/yr), followed by *D. giganteus* (ca. 1,094.00 ton/yr), *D. sikkimensis* (ca. 1,079.20 ton/yr), *M. baccifera* (ca. 647.160 ton/yr), *D. hookerii* (ca. 325.740 ton/yr) and *B. balcooa* (ca. 272.470 ton/yr), respectively, irrespective of states surveyed. Genus *Dendrocalamus* contributed 76.85% of the total requirements of bamboo shoots in the region.

So far diversity of edible species was concerned, a maximum of eight species have been observed as commercial edible species for Manipur, followed by Tripura (06 spp.), and Arunachal Pradesh and Nagaland (5 spp. in both the states). Among species, *D. hamiltonii* and *M. baccifera* have frequent range of distribution as young shoots of these species are

Table 68 : Cost-benefit analysis for broiler chick rearing under integrated farming system

Inputs (Rs)		Output (Rs)		Net Income (Rs)
Cost of birds	- 6500.00	I st batch	- 195.5 Kg	Rs. 13,955.00
Electricity	- 1728.40	II nd batch	- 170.0 Kg	
House	- 1804.00	III rd batch	- 162.7 Kg	
Feed (starter)	- 2168.00	IV th batch	- 52.34 Kg	
Feed (Finisher)	- 9270.00	Total wt.	= 580.54 kg @Rs	
Drinkers	- 233.00	65/- kg	= 37,735.10	
Electric Bulbs	- 280.00			
Gunny bags	- 48.00			
Reflector	- 150.00	Through dropping 20 bags	@ 20 /each = 400.00	
Saw dust	- 132.00			
Total	Rs. 38, 135.10			
Carrying transplantation etc.	- 890.00			
Rearing cos (2 hr/day for 132 days)	- 1650.00			
	24,180.40			

sold almost in all the states. Significant ($P = 0.05$) variations have been recorded for shoot length, basal diameter of young shoots and shoot weight among species. However, shoot length and basal diameter was recorded highest to *D. giganteus* and lowest to *T. wightii*, respectively. Shoot weight was recorded highest to *D. giganteus* (1.83 kg/shoot) and lowest to *S. dullooa* (0.048 kg/shoot).

(b) Fermented bamboo consumption

On average, out of 297 market places, 118 markets covering 1200 primary and secondary vendors were surveyed and interviewed to understand the consumption pattern of fermented bamboo products. The consumption of fermented shoots for the region was recorded to be ca. 1,354.70 ton/yr. Among various states, per day as well as annual consumption of fermented bamboo shoots was highest (ca. 872.35 ton/yr) in Arunachal Pradesh, followed by Manipur (242.92 ton/yr) and Nagaland (126.74 ton/yr). Thus, 64.39% of total consumption was noticed only in Arunachal Pradesh. Minimum consumption (1.97%) was, however, noticed for Sikkim. Fermented products are sold as slice fermented, crushed fermented, fermented dry, fermented whole shoot, roasted whole shoot in the region except Sikkim, where the bamboo shoots are sold in boiled form. Bamboo squash is also sold on the commercial scale in Nagaland state. The market days for various products vary among states; however, it is sold for considerably longer period in Arunachal Pradesh and for a minimum period in Sikkim. Since mixture of the species is used for making fermented products, it was not possible to record the fermented shoot consumption at species level. The consumption was highest for crushed fermented shoots in Arunachal Pradesh (ca. 573.4 ton/yr). Whereas, in Manipur mixed fermented product showed the highest consumption. Crushed fermented product, followed by slice fermented products in Nagaland is consumed to a great extent compared to other products.

(ii) Nutritive values of some commercial edible bamboo species

Out of 25 edible bamboo species identified for the region, 11 species- *Bambusa balcooa* Roxb., *B.*

nutans Wall. ex Munro, *B. tulda* Roxb., *Dendrocalamus giganteus* Munro in Trans., *D. hamiltonii* Nees et. Arn, *D. hookerii* Munro in Trans., *D. longispathus* Kurz, *D. sikkimensis* Gamble, *Melocanna baccifera* (Roxb.) Kurz, *Phyllostachys bambusoides* Sieb. and Zucc. and *Teinostachyum wightii* Beddome has been found as potential edible species, which are sold in the markets by primary or secondary vendors and used, as fresh, fermented or roasted. These edible species are also cultivated in home gardens besides their occurrence in forests. This paper reports the nutritive values on some major edible bamboo species of the region.

For different species, food energy ranged from 14.64-16.90 MJ/kg and ash content from 2.07-3.72%. For different species, crude fibre content ranged between 23.05-35.47%, and the fat between 0.62-1.03%, and the carbohydrate from 4.48-5.19%. Among various species, the protein content was determined high in *Dendrocalamus hamiltonii*, *Phyllostachys bambusoides*, *Teinostachyum wightii* and *Bambusa balcooa*. Young edible bamboo shoots were also found rich in macronutrients, particularly in calcium with a range of 1.20-1.86 g/100g. The potassium content ranged from 0.021-0.027 g/100g, phosphorus from 0.54-1.03 g/100g, and the magnesium varied from 0.041-0.046 g/100g. Edible shoots were also rich in vitamins. Among species, the ascorbic acid ranged from 3.03-12.88 mg/100g, tryptophan from 0.39-1.70 g/16 g N, and the methionine from 0.26-0.77 g/16 g N. HCN content was also available in edible shoots, however, the range varied from 0.009-0.020%. The study shows that *Dendrocalamus* spp, *Melocanna baccifera* and *Phyllostachys bambusoides* needs to be included in various afforestation programmes in the region where shifting cultivation has already caused serious environmental degradation. It will serve the twin purpose of restoration of degraded lands and production of edible shoots for consumption of various ethnic groups of the region. Besides, these potential species could be recommended for commercial cultivation owing to their multifarious nature.

Production Potential of Agri-horticulture AFS

J.M.S. Tomar

Tree growth, crop yield and cost benefit analysis of guava (*Psidium guajava* cv. Allahabad safeda), Assam lemon (*Citrus lemon* cv. Local) and Peach (*Prunus persica* cv. TA170) intercropped with three upland rice varieties has been analysed. It has been recorded that upland rice varieties could be incorporated successfully with peach, guava and Assam lemon (Table 69).

Table 69 : Tree growth and crop yield (qt/ha) under agrihorticulture AFS

Characteristics /traits	Tree-crop			
	Guava	Assam lemon	Peach	Control
<i>Tree growth</i>				
Density (plants/ha)	400	400	400	
Plant height(m)	4.53 ± 0.43	2.55 ± 0.31	5.55 ± 0.88	
DBH (cm)	8.05 ± 0.92	-	7.06 ± 0.32	
Collar diameter(cm)	10.1 ± 4.05	3.52	11.03 ± 1.67	
Canopy spread(m)	4.26 ± 0.81	2.6 ± 0.23	5.42 ± 1.01	
Fruit yield (qt/ha)	64.44±1.39	27.61±.79	58.11±4.01	
<i>Grain yield of different rice varieties (qt/ha)</i>				
RCPL-1-24	24.42 ± 3.96	23.92 ± 4.77	27.55 ± 3.97	30.22 ± 1.08
RCPL-1-28	21.17 ± 2.88	20.02 ± 2.96	25.75 ± 2.86	27.88 ± 2.22
RCPL-1-29	28.16 ± 0.57	25.45 ± 1.03	30.58 ± 3.34	35.68 ± 0.95

Performance of pineapple in horti-silviculture AFS

In an area of 20-40% slope, pineapple (cv.kew) was planted (@ 40,000suckers/ ha) in combination with *Mechilus bombycina*, *Grewillea robusta* and *Acacia auriculiformis*. After one year of plantation, maximum survival and growth of pine apple was recorded in *G. robusta*. (Fig. 26)

Evaluation of Multipurpose tree species (MPTs) for AFS

J.M.S. Tomar & B.P. Bhatt

Six indigenous and exotic MPTs viz. *Alnus nepalensis*, *Parkia roxburghii*, *Symingtonia*

populnea, *Prunus cerasoides*, *Michelia oblonga* and *Gmelina arborea* were planted with a density of 416 plants/ ha. After 14 years of growth maximum height was attained by *M. oblonga* followed by *P. roxburghii*. While maximum DBH were recorded by *G. arborea*, followed by *P. roxburghii*. The growth behaviour of trees has been shown in table 70.

Table 70: Growth attribute of some multipurpose tree species after 14 years of plantation

Sl. Tree species No.	Height (m)	DBH (cm)	Crown spread (m)
1 <i>Alnus nepalensis</i>	18.41±4.19	25.25±4.12	7.27±0.84
2 <i>Parkia roxburghii</i>	21.15 ±5.69	27.76±8.71	9.00±2.49
3 <i>Symingtonia populnea</i>	13.66 ±1.72	27.08±2.69	6.56±0.95
4 <i>Prunus cerasoides</i>	12.00 ±1.68	21.02±2.83	6.70±0.82
5 <i>Michelia oblonga</i>	23.91±6.69	26.76±6.66	6.86±1.73
6 <i>Gmelina arborea</i>	18.0 ±1.92	29.84±6.19	7.53±1.11

Evaluation of suitable *Populus deltoids* clones for AFS

J.M.S. Tomar

Ten promising clones were selected out of 43 clones of *Populus deltoids* on the basis of their survival and growth performance in the nursery condition. PIP-115, PIP-117, PIP-118, PIP-119, PIP-121, PIP-203, PIP-204, PIP-207, PIP-209 has been found best in growth performance (Table 71)

Table 71 : Growth performance of Promising clones of *P. deltoids*

Name of clone	At the time of planting		Increment after 6 months of planting	
	Height (m)	CD (cm)	Height (m)	CD (cm)
PIP-115	2.00	2.40	0.24	1.03
PIP-117	2.47	2.20	0.57	0.76
PIP-118	1.91	1.70	0.35	0.43
PIP-119	2.07	1.78	0.43	0.46
PIP-121	2.36	2.47	0.83	0.42
PIP-203	2.57	2.14	1.61	1.32
PIP-204	2.15	1.76	0.95	1.48
PIP-207	2.28	2.00	1.60	1.58
PIP-208	2.22	2.12	1.38	1.83
PIP-209	2.51	1.84	0.27	1.21

Performance of multistoried AFS

J.M.S. Tomar & B.P. Bhatt

This system consists of different components viz. tea, alder, black pepper and turmeric. The turmeric were sown in the terrace along with tea on the risers. The yield potential has been given in table 72.

Table 72 : Performance of Alder yield of tea and intercrops under multistoried AFS

Components	Growth	Yield
Average height (m)	23.45	
Average collar diameter (cm)	30.66	
Average DBH (cm)	26.98	
Crown spread	7.04	
Tea (Fresh buds)		6.5 t/ha
Turmeric		17.5 t/ha
Black pepper (dried)		124 g/plant

Long term effects of agro-forestry systems on soil hydro-physical behaviour

R. Saha, V.K. Mishra & Patiram

Different agro-forestry systems (AFS) viz. *Arboretum*, Khasi mandarin, Assam lemon, Multistoried AFS (Alder + tea + black pepper), Silvi-horti-pastoral (Alder + pineapple + fodder) and natural forest, developed during 1987-1988, were evaluated to study the long term effects on soil physical properties. The soils were mostly clay to silty clay in texture and acidic in reaction. Bulk density of the soils under various systems varied between 0.91 and 1.24 Mg m⁻³. Macro and micro aggregate percentage and mean weight diameter (MWD) were recorded in the order: Natural forest > Multistoried AFS > Silvi-horti-pastoral > *Arboretum* > Khasi mandarin > Assam lemon. The maximum reduction in transmission pores (>50µm) by 46 % in khasi mandarin as compared to that of natural forest indicated that the downward movement of water is restricted and facilitating the

runoff, might be due to disintegration of soil aggregates. The low values of hydraulic conductivity under Khasi mandarin, *Arboretum* and Assam lemon systems in comparison to natural forest, could be ascribed to high degree of soil dispersion. On the basis of investigated parameters, multistoried AFS appeared to be the most sustainable and resource conserving in hilly agro-ecosystems of Meghalaya.

Biomass productivity of MPTS in Tripura

M. Datta & K.R. Dhiman

Multipurpose tree species(MPTS) suitable for humid subtropical region were planted in RBD with eight replication in 1987. MPTS are divided into three groups on the basis of spacing adopted in the planting geometry. The tree species planted in 2 m X 2 m spacing were i. *Acacia auriculiformis* ii. *Moras alva* iii. *Leucaena leucocephala* iv. *Dalbergia sisoo*. The tree species planted in 3 m X 3 m spacing were i. *Gliricidia maculata*, ii. *Azadirachta indica* iii. *Michelia champaca* iv. *Eucalyptus hybrid*. And the tree species planted in 4 m x 4 m spacing were i. *Tectona grandis* ii. *Gmelina arborea* iii. *Samania saman* iv. *Albizia lebbeck*. *Acacia auriculiformis* were clearfelled and boundary plantation were only maintained.

Growth characteristics

Growth characteristics of MPTS are recorded in the arboretum are reported in Table 73.

Data indicated that *Eucalyptus hybrid* attained a maximum height (18.3 m) followed by *Gmelina arborea*(14.1 m), *Albizia lebbeck* (13.1 m), *Michelia champaca* (12.9 m), *Samania saman* (12.5 m), *Tectona grandis* (12.4 m) etc. *Moras alva* was of the lowest height 17.5 m. Basal girth and girth at GBH of MPTS were found to vary from 43.5 to 96.8 cm and 32.9 to 75.9 cm, respectively. *Gmelina arborea* showed the maximum girth and the lowest was recorded by *Moras alva*. *Eucalyptus hybrid*, *Gmelina arborea*, *Samania saman*, *Michelia champaca*, *Albizia lebbeck* and *Tectona gandis* produced comparatively high timber value, resin form 10.9 to 25.8 m³ x 10⁻²/tree.

Table 73 : Mean growth characteristics and timber volume of old MPTS

MPTS	Height (m)	BG (cm)	GBH (cm)	Timber volume (m ³ x 10 ⁻² tree ⁻¹)	Total Timber volume (m ³ ha ⁻¹)
<i>Leucaena leucocephala</i>	11.4	45.4	41.2	5.2	134
<i>Gliricidia maculata</i>	8.8	48.1	40.4	3.8	27.5
<i>Samania saman</i>	12.5	85.3	70.5	16.5	133.1
<i>Michelia champaca</i>	12.9	82.9	63.6	13.8	176.7
<i>Tectona grandis</i>	12.4	79.3	57.7	10.9	55.4
<i>Eucalyptus hybrid</i>	18.3	92.8	72.9	25.8	223.2
<i>Azadirachta indica</i>	6.9	45.7	41.1	3.2	35.2
<i>Gmelina arborea</i>	14.1	96.8	75.9	21.6	132.4
<i>Albizia lebbeck</i>	13.1	80.2	64.9	14.6	160.6
<i>Dalbergia sisoo</i>	10.3	55.0	45.9	5.8	161.4
<i>Morus alba</i>	7.5	43.5	32.9	2.2	30.2
Mean	11.6	68.6	55.18	11.2	115.4
CV %	26.63	29.19	26.46	67.68	55.74

Fuel wood productivity

Data on the fuel wood productivity after 50 % pruning in MPTS indicated that *Michelia champaca* produced the maximum fuel wood 94.57 q/ha and the least was produced by *Eucalyptus hybrid* (13 q/ha). Even after 50 % pruning, light available under the tree canopy was only 15.9 % as compared to

the open space in *Gmelina arborea*, but *Tectona grandis* showed the maximum availability of light (92.5 %).

Crop Productivity

Upland rice, pineapple, turmeric and ginger were grown as intercrops and their productivity is presented in Table 74.

Table 74 : Productivity of intercrops

MPTS	Upland rice (ton/ha)	Pineapple (ton/ha)	Turmeric (ton/ha)	Ginger (ton/ha)
(2 m x 2 m Spacing)				
<i>Acacia auriculiformis</i>	6.06	7.95	-	-
<i>Leucaena leucocephala</i>	-	10.0	12.76	-
<i>Dalbergia sisoo</i>	-	10.3	9.4	-
<i>Morus alba</i>	-	6.3	5.0	-
(3 m x 3 m Spacing)				
<i>Gliricidia maculata</i>	4.1	6.5	-	-
<i>Azadirachta indica</i>	6.3	11.6	-	-
<i>Michelia champaca</i>	5.8	4.3	-	-
<i>Eucalyptus hybrid</i>	4.4	15.5	-	-
(4 m x 4 m Spacing)				
<i>Tectona grandis</i>	-	8.5	-	0.92
<i>Gmelina arborea</i>	-	8.3	-	0.78
<i>Samania saman</i>	-	16.5	-	1.4
<i>Albizia lebbeck</i>	-	11.5	-	0.574
No Tree	18.2	8.2	7.4	2.25



Fig. 26: Pineapple production in silvi – horti system

Data indicated that the productivity of upland rice in agri-silvi system varied from 4.1 to 6.3 q/ha thus revealing a decline of 67.4 to 77.5 % compared to grain yield of upland rice produced in open space. This is mainly due to low light intensity and intense tree crop competition for nutrients in the Agro-forestry system. On the other hand maximum pine apple productivity was noted under *Leucaena leucocephala* (10.0 tonnes fruits/ha) in 2 m x 2 m spacing, under *Eucalyptus hybrid* (15.5 tonnes fruits/ha) in 3 m x 3 m spacing and under *Samania saman* (16.5 tonnes fruits/ha) in 4 m x 4 m spacing. This productivity showed an increase of 21.9 to 101.2 % over the productivity of pineapple (8.2 tonnes/ha) in open space. Black pepper which was grown in a three tier system with *Michelia champaca* –pineapple and *Azadirachta indica*-pineapple combination showed a productivity of 294 g/plant (wet), 80 g/plant (dry), 355 g/plant (wet) and 107 g/plant (dry) respectively.

Turmeric which was grown in Silvi-horti system in 2 m X 2 m spacing under went a variation from 5.0 to 12.76 tonnes/ha (net plot basis) and an increase of 27.0 to 72.4 % over the rhizome yield of turmeric produced in open space was recorded in *Leucaena leucocephala* and *Dalbergia sisso*. On the other hand, *Moras alva* showed a decline in yield of 32.4 % as compared to open space. Ginger which was grown in Silvi-horti system in 4 m X 4 m spacing varied from 0.57 to 1.4 ton/ha thus producing a decline of 37.8 to 74.6 % over rhizome yield in open space.

Bamboo Resources

Bamboo exists in hill ranges and catchment areas particularly in moist locality along the gorges of hills, springs and river banks in Tripura. The species normally found are Muli (*Malocanna bambusoides*), Mirtinga (*Bambusa tulda*), Yai (*Bambusa pallida*), Makal (*Bambusa nutan*), Dolu (*Teinostachyum dullooa*) and Rupai (*Dendrocalamus longispathus*). Total bamboo forest as recorded in Tripura is 938 km² covering 8.94 % of the total geographical area. The demand per capita is 42.7 numbers and considering the total uses the overall demand per annum counts out to be 117.9 million units. The

supply of the availability of bamboo is 142.6 million units per annum, thus indicating the absence of any deficit in bamboo. The growth of some bamboo species planted in 1994 in the arboratum is recorded and presented in Table 75.

The perusal of the data on the growth of bamboo species showed that Pechi (*B. cacharensis*) attained a maximum height (10.07 m) and Muli showed the least height (5.80 m). Maximum girth (22.57 cm) was noted in Mirtinga (*B. tulda*) and Muli (*M. bambusoides*) showed the least girth (10.28 cm). Makal (*B. nutan*) showed the maximum internode distance of 24.64 cm and the lowest internode distance 6.9 cm was noted in Konkiss.

Table 75 : Growth of the bamboo species

Bamboo species	Height (m)	Girth (cm)	Internode distance (cm)
Nol barak (<i>D. hamiltonii</i>)	9.08	18.75	19.91
Pechi (<i>B. cacharensis</i>)	10.07	19.46	20.75
Muli (<i>M. bambusoides</i>)	5.80	10.28	19.34
Mirtinga (<i>B. tulda</i>)	8.40	22.57	24.01
Konkiss (<i>B. nana</i>)	9.9	11.77	6.9
Makal (<i>B. nutan</i>)	9.95	18.41	24.64
Yai (<i>B. pallida</i>)	7.95	15.31	18.98
Mean	8.74	16.65	19.21
CV(%)	16.37	24.50	28.26

Physico chemical properties, Erodibility and Nutrient availability

Soils under different toposequence

Soil physico chemical properties, erodibility indices and nutrient availability in upland, slopy land and low land were estimated. Soils were found acidic in nature and the soil pH is found to vary from 4.3 to 5.3, 5.2 to 5.4 and 5.0 to 5.5 in soils of upland, slopy land and low land respectively. Organic carbon varying from 1.87 to 7.66 g/kg underwent a fall down the soil profile. Soils of lowland are observed to contain more organic carbon as compared to soils developed in upper toposequence. Water holding capacity varied from 32.5 to 40.2 kg/kg, 31.7 to 51.6 kg/kg and 22.7 to

39.2 kg/kg in soils of upland, slopy land and lowland respectively. The data on mechanical analysis indicated that soil texture varied from sandy clay to clay in upland and sandy clay loam to clay both in slopy land and low lands. Migration of clay was noticed in upland soils down the profile. Available nitrogen concomitantly underwent a decline from 808 to 155 kg/ha, 770 to 341 kg/ha, 845 to 239 kg/ha down the soil profile in upland, slopy land and low land toposquence respectively. Thus indicating the variation of N status from high to low. Available phosphorus, on the other hand underwent a variation from 9.80 to 18.52 kg/ha. Thus indicating medium to low availability. Available phosphorus varied from low to medium in upland and medium to high potash availability was noticed in slopy land and low land. Available Fe, Mn, and Zn was estimated. Available Fe in upland underwent a decline from 40.89 to 7.91 mg/kg down the profile. In slopy land and lowland, the variation of available Fe was 22.90 to 25.45 mg/kg and 31.67 to 65.66 mg/kg respectively. This indicates high accumulation of Fe in low land compared to overlying soils. Similar was the trend noticed in available Mn. The values of available Fe and Mn are found to be higher than the respective critical limits, thus indicating adequacy in Fe and Mn availability. Available Zn underwent a variation from 0.15 to 1.19 mg/kg in upland and in slopy land and in lowland the variation was from 0.90 to 1.90 mg/kg and 0.63 to 2.32 mg/kg, respectively. This indicates high availability of Zn in slopy and low land.

Among the various erodibility indices, Clay ratio was found to vary from 0.78 to 1.97. The lower the ratio, the more will be the clay accumulation. The silt-clay ratio was found to vary from 0.06 to 0.81. Lower the ratio more will be clay accumulation compare to silt particles. Suspension percentage was found to vary from 2.0 to 11.0 in the soils. The greater the value, the more easily the soil could be eroded. Thus high suspension percentage in surface soil of slopy land indicated the erosive nature. Clay-available water ratio underwent a variation from 0.53 to 1.89. The higher the ratio the more would be the relative permeability of soil for water, thus reducing the possibility of soil erosion by run-off

water. The dispersion and erosion ratio inconsistently varied down the soil profile. Soils having dispersion ratio more than 10 were generally erosive in nature.

Soils of shifting cultivation

Physico chemical properties as estimated in soils in Dhalai were estimated. Soil pH varied from 4.1 to 5.3, thus indicating the presence of moderately high acidity. Organic carbon varied from 3.19 to 26.0 g/kg, thus indicating the variation from low to high. Water holding capacity varied from 14.4 to 47.4 kg/kg. Soil texture determined through mechanical analysis varied from sandy clay loam to loam. Nutrient availability of soils collected from shifting cultivation site and the data presented in Table 5. Available nitrogen was found to vary from 808 to 932 kg/ha, thus indicating high status. On the other hand available phosphorus underwent a variation from medium to high status. Available potassium was mostly in medium status. As the soils were collected from first year of shifting cultivation soils were observed to contain an appreciable amount of nutrient availability due to nutrient turnover and accumulation in slash and burn system of shifting cultivation. Available Fe, Mn and Zn were also found to be adequate in the soils under study.

Among the various erodibility indices, clay ratio was found to vary from 0.19 to 3.17. This indicates the variability in the clay accumulation in the soils under study. Silt clay ratio, on the other hand varied from 0.09 to 1.17. Suspension percentage was found to vary from 3 to 12. Some soils could easily be eroded and as indicated by high suspension percentage. The high clay-available water ratio (1.11 to 2.47) indicates high relative permeability of soil for water and thus reduction in the possibility of soil reduction by run-off water. The dispersion ratio was found to vary from 8.01 to 18.52, thereby indicating that the soils having high dispersion ratio (>10) were susceptible to erosion. Erosion ratio in some soils were also of high magnitude (17.5 to 24.92) and such soils are observed to be highly erodable.

SOIL AND WATER MANAGEMENT

Integrated N management of Upland Rice

B. Majumdar

An experiment was conducted during *kharif* 2002, for 2nd consecutive year with 3 levels of N (0, 30 and 60 kg/ha), 3 levels of biofertilizers (no biofertilizer, *Azotobacter* and *Azospirillum*) and 2 levels of FYM (0 and 5t/ha) in combinations to study the response of paddy (RCPL-1-29) to integrated N management. The grain yield of paddy increased with increase in N and FYM levels and biofertilizer application. The treatment combination of 60 kg N + 5t FYM/ha + *Azotobacter* registered the highest grain yield (37.95q/ha) followed by a combination of 60 kg N + 5t FYM/ha + *Azospirillum* (36.3 q/ha). The available N content was recorded more in the plots received *Azotobacter* compared to *Azospirillum*.

Effect of split application of N in Low Land Rice

B. Majumdar & Kailash Kumar

A field experiment was conducted during *kharif* 2002, for 2nd year with 3 levels of N (30, 60 and 90 kg/ha) splitted as basal; 50% basal + 50% active tillering, 50% basal + 50% panicle initiation, and 50% active tillering + 50% panicle initiation, 33% basal + 33% active tillering + 33% panicle initiation. The results indicated that grain and straw yields increased up to 60 kg N/ha. The maximum grain (40.30 q/ha) and straw (53.20 q/ha) yields were recorded when 60 kg N/ha was applied as 50% basal + 50% at panicle initiation stage and the grain and straw yields were 21.4 and 18.7 per cent higher, respectively, over the yields received when 60 kg N/ha was applied as basal.

Effect of P levels, FYM and lime on micronutrient uptake by maize and soil available micronutrients in Maize

M.S. Venkatesh

A field experiment was conducted for 2 consecutive years during 1999 and 2000 to study the effect of P levels, FYM and lime on yield and P uptake by maize. During this year (2002-03) the grain and soil samples were analysed for micronutrient status to find out the effect of applied P, lime and FYM on micronutrient content. Application of higher levels of P resulted in reduced uptake of micronutrients. Liming decreased the uptake of Fe, Mn and Cu and Zn by grain. FYM application increased the uptake of micronutrients as well as soil available micronutrients.

Integrated nutrient management for Maize-Mustard Crop Rotation

Kailash Kumar & Patiram

Long term experiment on INM for maize-mustard crop sequence consisting of 20 treatment combinations incorporating NPK fertilizer, lime, FYM and biofertilizers was repeated during the year. The grain yield of maize increased significantly by all the fertilizer treatments when applied along with lime and/or FYM over control. The highest yield of maize was recorded in lime + FYM + bio fertilizer + NPK (43.6q/ha) over control (8.8q/ha). Similar was the observation for the grain yield of mustard. The maximum grain yield of mustard (6.0 q/ha) was recorded in lime + FYM + bio fertilizer + NPK and was at par with lime + FYM + bio fertilizer + 75% NPK (5.76 q/ha). Control plot has significantly low productivity. Exchangeable acidity decreased significantly in the plots receiving lime or lime + FYM while the trend was reverse for exchangeable Ca + Mg. Application of lime, FYM and biofertilizers increased the DTPA extractable Fe, Mn, Zn and Cu into the soil.

Efficiency of phosphatic fertilizers in Soybean

B. Majumdar & Patiram

The field experiment conducted for fourth year during *kharif* 2002 to study the response of soybean

to SSP, rock phosphate (RP) and their mixtures with and without FYM indicated that application of SSP @ 30 or 60 kg P_2O_5 /ha alone or in combination with FYM was superior to application of RP. A treatment combination of 60 kg P_2O_5 /ha applied as SSP + RP (1:1) with 5t FYM/ha recorded highest grain yield (27 q/ha) which was at par with the yield (26.7q/ha) received by the application of 60 kg P_2O_5 /ha as SSP with 5t FYM/ha.

Response to sulphur, boron and FYM in Groundnut

M.S. Venkatesh, B. Majumdar,
Kailash Kumar & Patiram

A field experiment was conducted for 3rd year during kharif 2002 to study the effect of levels of sulphur (0, 20 and 40 kg/ha), boron (0, 1.5 and 3.0 kg/ha) and FYM (0 and 5t/ha) in groundnut productivity. Application of S @ 40 kg/ha + B @ 3 kg/ha + FYM @ 5t/ha resulted in 51 % increase in pod yield over control. This treatment also resulted in highest S and B contents in kernels (0.3% and 16 ppm respectively and the highest available S and B (11.65 and 0.42 ppm respectively) in the post harvest soil.

Response to molybdenum and lime in Black gram

A field experiment was conducted during kharif 2002 to study the effect of liming and levels and methods of molybdenum application on yield and nutrient uptake. The treatments consisted of soil (0, 0.5 and 1 kg/ha), seed soaking (0, 50 and 100g/ha) and foliar (0, 0.01 and 0.02%) application of molybdenum. Soil application of Mo @ 1kg/ha along with lime @ 0.25 LR resulted in maximum grain yield of black gram (13.9 q/ha).

Status of micronutrients in different land use systems of Meghalaya

Surface soil samples from Ri-bhoi district of Meghalaya under various land use systems viz., bun

cultivation, terrace, natural forest and valley land were analysed for available and total micronutrient status (Table 76). Burning under bun cultivation resulted in decrease of available Fe, Zn and Cu whereas, available Mn increased to about four fold. Total micronutrients also increased after burning and a maximum increase of 44 per cent was recorded in total Mn. The level of available and total micronutrients after 3 years of bun cultivation was almost similar to their initial status. Highest amount of available forms of Fe, Zn and Cu and least amount of available Mn were noticed in valley land. Organic carbon content was positively correlated with available Zn and Cu.

Effect of different land use systems on P fractions and forms of acidity in acid soil of Meghalaya

Distribution pattern of different forms of phosphorus and acidity were studied in surface soil samples collected from important land use systems viz., bun cultivation, terrace cultivated land and natural forest on hill slopes and paddy field of valley land of Ri-bhoi district, Meghalaya. Total, exchangeable and pH dependent acidities decreased after closed burning of plant biomass under bun farming, maximum decrease (87%) being recorded in exchangeable acidity, but the values of acidities after two years of bun cultivation were in the same range to their initial values. Valley land showed the lowest, while soils under terrace land recorded the highest values of all kinds of acidity. Closed burning under bun cultivation resulted manifold increase in Ca-P and Saloid-P and 38.3 per cent increase in Fe-P while Al-P decreased by more than 9 times. Among other systems, terrace land registered higher values of different forms of P followed by natural forest and valley land. The dominant forms of inorganic P were Fe-P, reductant soluble P and occluded-P (97 %) and existed in the order of reductant soluble P > occluded P > Fe-P under various land use systems on sloppy lands while in case of valley land, the magnitude was in the order of Fe-P > reductant soluble P > occluded P.

Effect of tillage and organics on rice (*Oryza sativa*) production, water loss and physico-chemical behaviour of soil

V.K. Mishra

Field experiment was initiated in *kharif* 2000 on a highly permeable foot hill sandy clay loam soil (Typic Hapludalf) of Meghalaya to evaluate the effect of tillage practices (T_0 -no tillage; T_1 - puddling with spade; T_2 -power tiller cultivator with cage wheel and T_3 -*deshi* plough) and organics (M_0 -no organics; M_1 -mixed jungle grass; M_2 - *Ambrossia sp* and M_3 -FYM) on rice production. After three years of experimentation, the rate of water loss, mean weight diameter, transmission

pores reduced significantly under puddled conditions compared to no tillage plots. The magnitudes of reduction in these properties were maximum under T_2 plots followed by T_1 and T_3 . The grain yield was observed in order of T_2 (36.8 q/ha) > T_1 (34.5q/ha) > T_3 32.4q/ha) > T_0 (30.6q/ha). Among the different sources of organics, FYM application was very much effective for crop production and maintenance of soil health, however *Ambrossia sp.* was also found a promising weed as green manure and increased the grain yield by 16.2%, water holding capacity by 23.8 %, organic carbon by 13.4 % and reduced the puddling index by 16 % and bulk density by 11.1% compared to no organic plots.

Table 76 : Effect of various land use systems on available micronutrient status (mg kg⁻¹) of soils

Land use systems	Slope portion	Fe		Mn		Zn		Cu	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bun 1 st year (Before burning)	Top	18.3-30.7	21.7	3.2-11.6	7.4	0.52-1.57	1.02	0.44-1.58	0.85
	Middle	12.4-32.4	27.6	3.1-9.1	4.8	0.59-1.38	1.00	0.32-1.10	0.65
	Bottom	11.5-30.8	19.3	4.0-8.0	5.5	0.36-1.14	0.86	0.36-1.11	0.55
	Mean		22.9		5.9		0.96		0.68
Bun 1 st year (After burning)	Top	6.9-26.8	21.1	16.7-36.6	26.0	0.43-1.49	0.68	0.27-1.13	0.46
	Middle	20.5-34.9	23.4	20.9-27.6	25.4	0.38-0.80	0.55	0.40-1.50	0.85
	Bottom	9.5-35.1	12.9	8.6-39.3	25.3	0.32-1.01	0.63	0.28-0.86	0.47
	Mean		19.1		25.5		0.62		0.59
Bun 2 nd year	Top	10.7-34.5	21.4	10.8-15.3	12.9	0.41-1.27	0.84	0.22-1.46	0.63
	Middle	12.8-33.3	20.0	3.7-9.7	7.6	0.48-0.98	0.64	0.24-1.59	0.61
	Bottom	11.6-31.8	20.7	3.3-11.8	7.8	0.48-1.56	0.81	0.25-1.41	0.59
	Mean		20.7		9.4		0.76		0.61
Bun 3 rd year	Top	29.5-34.6	32.0	8.8-10.9	9.9	0.34-1.16	0.82	0.39-1.74	0.89
	Middle	14.0-32.5	20.0	3.7-13.6	8.0	0.50-1.76	0.87	0.44-0.75	0.59
	Bottom	15.3-34.2	27.2	3.9-6.8	4.9	0.34-1.16	0.82	0.28-0.53	0.47
	Mean		26.7		7.6		0.84		0.65
Terrace	Top	15.0-31.5	25.6	5.9-9.1	7.5	0.69-0.70	0.69	0.20-0.53	0.40
	Middle	11.6-33.4	19.1	5.2-8.6	7.3	0.48-0.61	0.54	0.24-0.48	0.33
	Bottom	15.0-34.7	23.3	5.9-9.4	7.6	0.37-1.00	0.70	0.26-0.79	0.51
	Mean		22.6		7.4		0.64		0.43
Natural forest	Top	20.9-38.5	34.7	8.5-13.5	11.4	0.46-0.62	0.52	0.57-0.66	0.62
	Middle	25.5-38.6	31.7	3.9-7.9	5.3	0.50-0.68	0.58	0.40-0.58	0.49
	Bottom	20.9-30.2	26.9	3.8-8.1	6.6	0.41-0.60	0.54	0.26-0.41	0.39
	Mean		31.1		7.8		0.55		0.50
Valley land		39.7-41.5	40.2	2.2-6.4	4.2	0.93-1.36	1.15	0.48-1.18	1.04

Each value is a mean of 6 samples

Effect of *bun* system of cultivation on physico-chemical behaviour of soil and crop production under terrace condition

V.K. Mishra

The experiment was started in 2001 on the basis of indigenous *bun* systems of Meghalaya. In second year, under different *bun* systems the ginger yield was recorded in the order of alternate year of burnt and grass *bun* (265 q/ha) > FYM- *bun* (228 q/ha) > grass *bun* (205 q/ha) > close burnt *bun* (182 q/ha) > open burnt *bun* (166 q/ha) > ridge (115 q/ha) > plain system (85 q/ha). It was interesting to note that the ginger yield was reduced 26 to 50 per cent in second year and maximum reduction was observed in close burnt *bun* and flat system. The continuous burning also reduced the organic carbon content and available nutrients in comparison to the initial status of soil. However, the magnitude of reduction was minimum in alternate year of burnt and grass *bun*. The hydraulic behaviour like hydraulic conductivity increased by 57.2 per cent and water holding capacity reduced by 14.5 per cent in close burnt *bun* over the flat system indicating that the burning might be helpful in creating good drainage system in crop root zone.

Effect of different sources of organic mulches on soil water and thermal regime and crop production under maize-mustard cropping sequence

V.K. Mishra & Ritesh Saha

Effect of different sources of organic mulches viz. pine leaf, rice straw, jungal grass, and mustard stalk on soil water and thermal regime and maize crop production and its residual effect under mustard crop was studied. Application of organic mulch enhanced the profile soil moisture regime (0-75cm) by 16.4 to 20.6 % after maize harvest over the control plots. Among the different source of mulches, maximum maize grain yield (42.6 q/ha) was recorded in jungal grass treated plots. It is interesting to note that the application of pine leaf as mulch material significantly reduced the grain yield production over the control plots. The residual effect of mulches was enhanced the seed germination percentage due to presence of more soil

moisture and consequently increased the mustard grain yield. The maximum 5.2 and minimum 3.6 q/ha yield was observed in jungal grass and no mulch plots, respectively. The application of pine leaf did not show any significant effect on grain yield of mustard over the control.

Effect of raised : sunken bed system on rice and French bean production

V.K. Mishra & Ritesh Saha

Raised : Sunken bed system of cultivation was used to increase crop productivity, cropping intensity and *in situ* rain water conservation. Six raised : sunken bed width ratio viz. 1:1, 1:1.5, 1:2, 1:2.5, 1:3 and 1:3.5 in 6 m long plots and compared with control plots with ratio of 0:1 and 1:0 for sunken and raised bed respectively. The width of all the raised beds was 1m. French bean was cultivated in raised beds and rice in the sunken beds. It was observed that the average water submergence depth in sunken plots varied from 1.11 to 2.97 cm. The rice yield in sunken plot increased by 16 – 28% over the control (Table 77). The moisture content on raised bed under different types of raised: sunken beds was higher in all the layers of soil than control. At 0- 7.5 cm soil depth, the moisture content on raised beds varied between 32.31 and 38.4 % and in control by 31.6 %. The raised and sunken bed system reduced green pod yield of French bean by 11.2 to 27.9 % over the control plots.

Hydrological Behaviour studies of Micro-watershed in Hills

K.K. Satapathy & R.K. Singh

Annual rainfall was recorded to be 1543.1mm with maximum daily rainfall of 116.0 mm . Maximum I_{30} of 130.0mm /hr and Annual EI_{30} of 244.52 have been observed. Total flow varied from 4.47 to 60.87% of rainfall in the watersheds. Surface flow ranged from 0.45 to 7.70%, while subsurface flow ranged from 2.59 to 57.80% of rainfall. Soil loss was also monitored in all the watersheds, and recorded minimum of 0.25 t/ha in WSS3 and maximum of 62.31 t/ha where no interventions are imposed and serves as a control watershed.

Agronomic interventions have been done in WS₂, WSS₁ and WSS₂. Bean, maize and ground nut has been demonstrated along with maize + ground nut intercropping. Local variety of rice was transplanted in sloppy upland of 2.0m contour intervals and the average yield was recorded to be 20.85 q/ha.

Table 77 : Effect of raised: sunken bed ratio on rice and French bean production

Raised : Sunken bed Width Ratio	Rice yield (q/ha)		French bean green pod (q/ha)
	Grain	Straw	
0:1 (Control for sunken bed)	28.2	41.6	—
1:0 (Control for raised bed)	—	—	118.2
1:10	27.5	42.5	84.4
1:1.5	32.6	58.3	88.5
1:20	33.4	59.2	94.0
1:2.5	35.8	65.0	110.2
1:30	36.2	66.2	102.7
1:35	34.6	60.4	105.3

Soil hydro-physical behaviour and recovery pattern under Jhum cultivation

V.K. Mishra & R. Saha

A study has been undertaken on the changes in soil hydro-physical behaviour and recovery pattern of hill eco-system under *Jhum* cultivation. The sample sites were selected at four different phases

of *jhum* cultivation on the basis of land use factor considering the ratio of cropping and fallow periods i.e. phase I (>10 years), phase II (5-10 years), phase III (2-5 years) and phase IV (<2 years). One site was also selected in conserve forest area for comparative study ensuring the similar slope condition (15 to 20%) and soil type (*Typic Hapludalf*). The study revealed that the land use factor of phase IV and III categories caused severe depletion in organic carbon, clay content and deterioration in structural behaviour and pore geometry of soil, which led to low availability of nutrients to the plants. The minimum erodibility factor (0.08) and dispersion ratio (0.112) were observed in conserve forest followed by phase I, II, III and IV. The value of saturated hydraulic conductivity of soil was the highest in conserve forest and the lowest in phase IV, whereas reverse trend was recorded for unsaturated hydraulic conductivity and diffusivity of soil. The soil moisture tension (y) corresponding to volumetric moisture content (q) relationship showed slow rate of moisture release pattern at any suction with decrease in land use factor. Thus the results suggest that the land use factor of phase IV and III resulted into poor hydro-physical behaviour and low level of soil fertility.

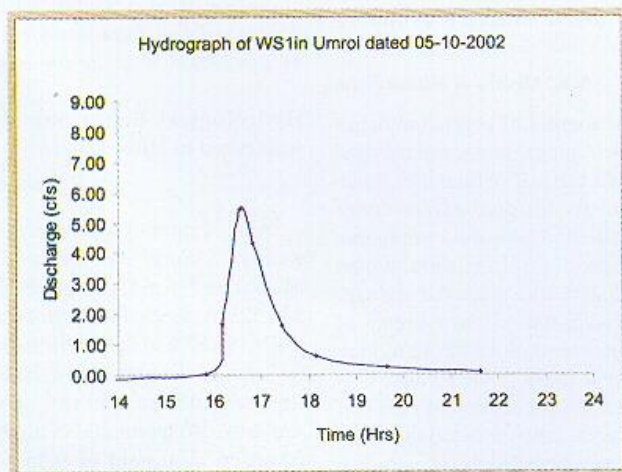


Fig. 27 Hydrograph of WS₁ due to rainfall 15.30 hrs to 17.30 hrs, total amount 30.00 mm @ 15.00 mm/hr.

WEED MANAGEMENT

Weedflora of *Kharif* crops in Meghalaya

Rajesh Kumar & U.K. Hazarika

Weed survey was conducted during rainy seasons of 2002 in the Ri-Bhoi district of Meghalaya. A total of 41, 24, 38, 47, 61 and 27 prominent weed species were recorded in upland rice, lowland rice, maize, ginger, pineapple and Khasi Mandarin with a density of 233, 163, 289, 328, 451 and 301 species m⁻² respectively. In case of upland rice and maize, *Galinsoga ciliata* (Raffin.) Blake, was the most dominating weed accounting for 29.5 and 19.4 % of total weed population respectively, whereas, in case of lowland rice it was *Rotala indica* (Wild.) accounting for 38.2 % of total population. For ginger, pineapple and Khasi Mandarin the dominating weeds were *Borreria hispida* L. (22.8%), *Digitaria ciliaris* (Retz) Koel. (14.1%) and *Galinsoga ciliata* (Raffin.) Blake. (13.5%), respectively.

Use of weed and tree biomass for weed management in rice

Rajesh Kumar, G.C. Munda & A.S. Panwar

An experiment was conducted during *Kharif* 2002 using tender vegetative parts of commonly available weed and tree species to study their effect on weed growth and yield of wetland rice. The species selected were *Mikania macrantha*, *Ambrosia artemisiifolia*, *Eupatorium adenophorum*, *Ageratum conyzoides*, *Galinsoga* spp., *Erythrina* spp., *Schima wallichii*, *Pinus kesiya* and mixture of grasses. The fresh vegetative material were applied one week ahead of transplanting, @ 10 t ha⁻¹. The other treatments were Butachlor 1.5 kg ai ha⁻¹, two hand weeding (20 and 40 DAT) along with weedy check. The highest grain yield (4.20 t ha⁻¹) was recorded with application of *Schima wallichii* followed by hand weeding twice treatment (3.70 t ha⁻¹). The lowest yield (2.8 t ha⁻¹)

was recorded in weed check. The Weed control efficiency was also highest in *Schima wallichii* biomass treated plot (68.5%) whereas, in twice hand weeded treatment the weed control efficiency was 58.7%.

Weed Management in direct seeded rice through spatial diversification

Rajesh Kumar, D.P. Patel & A.S. Panwar

An experiment was conducted during year 2002 to study weed management in rice through spatial diversification. The treatments consisted of sole rice and rice based intercrops taking three legumes viz; groundnut, soybean and blackgram (2:1 ratio). Three weed management methods viz; hand weeding twice (20 and 40 DAS), one mechanical weeding (20 DAS) and pre-emergence application of Pedimethalin (1.5 kg a.i ha⁻¹) with weedy check were included in the trial. The experimental results revealed that the intercropping system significantly reduced weed number and total weed biomass as compared to sole crop of rice. Among the intercrops, rice + groundnut with two hand weeding was effective in checking weed population and the rice equivalent yield was also maximum in the same treatment. However, the sole crop of rice with two-hand weeding recorded the highest weed control efficiency.

Integrated weed management in direct-seeded upland rice

Rajesh Kumar, Anup Das & U.K. Hazarika

An experiment was initiated during the *Kharif* season 2002 on weed management in direct-seeded upland rice through integrated approach. The treatments included two herbicides, i.e; Butachlor and Pendimethalin, soil and straw mulching and manual weeding. The first year result shows that application of Butachlor @ 1.0 kg a.i ha⁻¹ + straw mulching applied @ 5t ha⁻¹, reduced density and dry matter of weeds and increased grain yield (26.3 q ha⁻¹) which was 34.6% higher than that of unweeded control.

HOUSEHOLD PRODUCTION SYSTEMS

MUSHROOM

MEGHALAYA

Button mushroom

Satish Chandra & A.K. Singh

Testing of different strains of *Agaricus bisporus*

Four strains i.e. AG, CM11, CM12 and CM13 were evaluated. Long method compost was prepared (1.9% nitrogen at the time of spawning, 88kg/ m² bulk density at 18 cm depth). During spawn run, which took one month, the minimum temperature was 12.5 °C and maximum was 24.9 °C. The RH was 77%. Pinheads were seen eight days after casing. Clusters of a weed fungus *Coprinus* sp. were seen inside all the bags (score2) on 28.02.03 and on the surface of casing on 15.03.03 in one bag (score3).

Chemical pasteurization of long method compost Due to unfavorable temperature during fruiting, crop recorded poor yield. The strain AG gave highest (298g) followed by CM13 (75g), CM11 (66g) and CM12 (40g) per 10kg compost.

Four treatments (T1-T4) along with control (T5) were tested to see their effect on fungal count and yield of mushroom. Fungal count was noted on Rose Bengal Agar medium at 6days after plating (DAP).

Least fungal count (6.6x10³/g) was recorded in T3 (bavistin @ 0.5g/10kg compost). The highest count (1.36x10⁵) was observed in T2 (DDVP 3ml + Bavistin 0.5g /10kg compost). T1 and T2 showed much higher count than control. Data are shown in table 78.

Effect of dipping treatment in EDTA solution on the quality and shelf life of button mushroom.

In a study at room temperature (20-27°C) it was found that mushrooms kept well up to two days and spoiled on 3rd day. There was no difference between 75,125 and 200ppm EDTA doses tested.

Storage studies at refrigerated temperature (6°C) indicated 16 days shelf life without any visible deterioration in colour and texture in strain AG, CM11, 12 and 13. There was no difference between different concentrations of EDTA.

Table 78 : Effect of various treatments on fungal counts/g in compost at 6 DAP on Rose Bengal medium

Treatment	Fungal counts/g of compost
T1: Formalin+Bavistin (15ml+0.5g/10kg compost)	1.35x10 ⁵
T2: DDVP+ Bavistin (3ml+0.5g/10kg compost)	1.36x10 ⁵
T3: Bavistin (0.5g/10kg compost)	6.60x10 ³
T4: Formalin+ DDVP (15ml+3ml/10kg compost)	1.44x10 ⁴
T5: Control (water spray)	1.88x10 ⁴

LSD (p=0.05) 5.73x10²

Oyster mushrooms

Effect of substrate treatment and supplement on yield of oyster mushroom

Oyster mushroom [*Pleurotus ostreatus* (Jacq.) Fr.] strain x was grown on paddy straw with and without rice bran supplement. Two methods of substrate treatment i.e. hot water treatment (HWT) at 80°C for 20 min and chemical sterilization treatment (CST) were tested. CST consisted of soaking chopped straw in a solution of carbendazim 75ppm + formalin 500ppm for 18 hrs. Poly bag method of cultivation was used with five replications. The experiment was laid out in randomized factorial design in an improvised green house. Spawning was done @3% on wet wt. basis. Each bag contained 6kg of wet treated straw. The bags were spawned on 21 Dec.02. It took 19 days to complete spawn run. The first harvesting was done on 17 Jan.03 and last on 5 April 03.

The result (Table 79) indicated that addition of 5% rice bran increased the yield by 40%. There was no significant difference between substrate treatment methods indicating that either method may be used. Absence of interaction showed that rice bran was equally beneficial in CST and HWT treated straw for increasing yield.

Table 79 : Yield of *Postreatus* as affected by substrate treatment methods and supplement

Supplement	Substrate treatment method		
	HWT	CST	Average
Rice bran @5%	2231	2246	2238.5 a
Without rice bran	1382	1293	1337.5 b
Average	1806.5	1769.5	

Means followed by a different letter are significantly different by LSD test (p=0.05)

NAGALAND

Mushroom Production

The popularity of mushroom cultivation in the state is increasing day by day. Six training programmes were conducted in different corners of the state in which 234 participants i.e. 52 males and 182 females were taught about the cultivation of edible mushrooms by using the locally available materials.

SERICULTURE

MANIPUR

Management of Castor for Rearing Eri Silkworm (ROPS-4)

A.B. Rai

Evaluation of different Eco-races of Eri silkworm for their performance on castor varieties (Summer & winter, 2002 to 2003)

The castor varieties namely Local red, DCH-177, Local green and 48-1 sown at ICAR Farm, Langol were used to study the performance of the Eri silkworm during summer and winter 2002-2003. The same race of Eri silkworm was used to test the performance.

Consumption indices of Eri silkworm

(i) **Consumption Index (CI):** The consumption index (CI) for total larval instar vary when compared summer crop and winter crop rearing. During the first crop rearing maximum consumption index was recorded with 48-1 (0.48) and minimum

in local red and local green (0.41) while in second crop the maximum consumption index was recorded with local red (0.39) and minimum in 48-1 (0.31).

(ii) **Approximate digestibility (A.D.):** The approximate digestibility for both the crop remain the same when fed on defferent varieties of castor leaves. The maximum percentage for the total larval instar was recorded in local green (83.30 & 73.25) and minimum with 48-1 (80.13 & 70.06) percent for both summer and winter crop.

(iii) **Growth rate:**The growth rate increased in succeeding larval stages in both first and second crop rearing. In the first crop rearing the maximum growth rate was recorded with local red (0.44) and minimum with 48-1 (0.36). Whereas in second crop rearing, the maximum growth rate was recorded with local red and local green (0.40) and minimum with 48-1 (0.32).

(iv) **Efficiency of conversion of ingested food (ECI)%:** The efficiency of conversion of ingested food (ECI %) did not vary much for both the crop. The highest ECI for total larval instar for both the crops was recorded with local red (17.38 & 15.28)% followed by DCH-177(17.25 & 14.39)% and minimum with 48-1(14.80) in first crop and local green(13.62) in second cropping.

(v) **Efficiency of conversion of digested food (ECD)%:** Similar trends were observed in both the crops. The highest ECD for both the crop was observed with DCH-177 (21.49 & 19.29) followed by local red (21.45 & 18.31), local green (18.70 & 16.47) and lowest with 48-1 (18.47 & 15.28) respectively in first and second cropping

Rearing Parameters

(i) **Larval duration:** The larval duration varies between first and second cropping. During the first crop rearing it took 19 to 20 days to finished the cocooning. But in second crop rearing the larval duration prolonged due to low temperature and took 35 days to complete the cocooning.

(ii) **Mature larval weight (g/10 larvae):**The highest mature larval weight (g/10 larvae) was recorded with local red (61.11 & 58.20 g) and minimum with 48-1(50.90g) in first crop but DCH-177 (52.46g) in second crop.

(iii) **Larval mortality (%)**: There was a wide variation in terms of larval mortality percentage. The rate of larval mortality was very high in second crop as compared to first crop. This might be due to low temperature during the second cropping period. The highest larval mortality in the first crop was recorded with 48-1 (5.33%) and lowest on local red and DCH-177 (4.00% in both variety) whereas in second crop it was recorded highest with DCH-177 (60%) and lowest on local red (40%).

(iv) **Effective rate of rearing (ERR %)** In both the crops maximum effective rate of rearing (ERR) was recorded with local red (96.00 & 50.83) and the lowest was observed in 48-1 (84.00) in first crop but in second crop it was recorded on DCH-177 (36.67).

Cocoon Parameters

In the first crop rearing maximum cocoon weight, shell weight, shell ratio and silk productivity was recorded with DCH-177 (26.7, 3.5, 13.14 & 0.071) and minimum with 48-1 (25.2, 2.6, 10.33 & 0.052). Whereas in second crop rearing, the maximum was recorded with local green (24.08, 2.50, 10.52 & 0.0071) and minimum with local red (20.06, 1.90, 9.47 & 0.0054).

Grainage Parameters

In the first crop rearing, the highest pupae wt. (g/10 pupae) was recorded with DCH-177 (23.5) and lowest on local red (21.7) where in second crop the highest was recorded with local green (20.40) followed by DCH-177 (19.63), 48-1 (19.03) and minimum with local red (18.90). As regards to the rate of pupation the maximum pupation rate was recorded with local red (96.00%) and minimum with 48-1 (84.00%) in the first crop while in second it was recorded with DCH-177 (72.00%) and minimum on local green (63.00%). The pupal duration also varies in both the cropping; it takes 13 to 14 days in first and 15 to 16 days in second crop rearing respectively.

The rate of moth emergence is very low as compare to the previous rearing. The highest rate of moth emergence is recorded with local red

(94.26%) and lowest on DCH-177 (82.86%) in the first crop where in the second crop rearing the highest rate recorded with DCH-177 (7.04%) and minimum on local green (5.83%). The fecundity (egg/laying) was maximum on DCH-177 (360 & 103) for both the crop and the minimum was observed on local red (322.67) during the first crop and 48-1 (69) in second crop. Table 5. The hatching of the eggs could not take place after the second crop as the temperature decreases with fall of winter.

Thus, from the results it is known that the first crop rearing (August to October, 2002) showed better result than the second crop rearing (October to December 2002). Also it was observed that the local variety (local red) was found more suitable for feeding and more productive than other varieties. The cocoons and eggs stored under refrigerator for different days revealed that cocoon could be stored for moth without affecting the adult emergence.

Determination of foliar constituents of Castor varieties

The data on ash content (%) present in the leaves of castor varieties revealed that in general younger the plant, the higher was the ash present in leaf. Thereafter it declined gradually until 120 DAS but increased a bit coinciding with maturity of the crop at 135 DAS. The highest percentage of ash content was recorded with DCH-177 during all the periods of observations which varied from 7.50 (120 DAS) to 10.68 % (45 DAS) (Table 6). Almost similar pattern was recorded with crude protein. The highest crude protein was recorded with DCH-177 (25.73%) followed by Local red (24.15%), Local green (23.63%) and 48-1 (23.28%). The minimum was recorded with DCH-32 (22.23%) followed by Jyoti (22.73%). As regards to leaf moisture, DCH-177 recorded the highest (83.85%) closely followed by 48-1 (83.17%). The minimum leaf moisture was recorded with local green (80.02%) followed by DCH-32 (80.68%), local red (81.38%) and Jyoti (82.46%). The mean leaf yield was maximum with DCH-177 (4.44 t/ha) followed by Local red (3.65 t/ha), Jyoti (3.73 t/ha), 48-1 (3.55 t/ha), Local green (3.49 t/ha) and DCH-32 (2.60 t/ha).

On Farm Adoptive Research

Evaluation of castor varieties for leaf yield

Four promising varieties viz., Local red (non powdery), DCH-177, Local green and 48-1 were grown under foot hill condition (rainfed) in experimental fields adopting two different practices i.e. improved and farmer's practices. At Langol, all the four varieties were sown and evaluated for their leaf yield in two season (kharif and rabi) while in Game village only two varieties namely Local red and DCH-177 were taken for evaluation during kharif season.

Location 1: Langol

Plant height (cm): Kharif season is observed to be more favourable than Rabi season with regard to height of the castor plant. Local red (164.20 cm) followed by Local green (132.00 cm) under improved practice (IP) recorded the highest in Kharif and Local red (134.80 cm) followed by DCH-177 (132.20 cm) in Rabi. For all the varieties improved practice gives better plant height than farmers' practice.

Number of leaves/plant: There is no wide variation between the two cropping seasons in terms of leaves number per plant. While it ranges from 7.6 (Local red) to 9.2 (48-1) in Rabi, it is between 8.8 (DCH-177) to 10.2 (48-1) in Kharif under improved practice. The maximum number of leaves per plant was observed during the period from 105 DAS to 120 DAS and the least in the initial and later stages.

Leaf area (cm²): The leaf area was maximum during 105 DAS for all the 4 varieties and declined gradually thereafter in both Kharif and Rabi seasons. Among the four varieties Local green (9763.52 cm²) exhibit the largest leaf area followed by 48-1 variety (7292.57 cm²) under improved practice. The greatest area variation between the two practices was also observed in these two varieties. Leaf area in Kharif season was observed to be almost the double of leaf area in Rabi season.

Leaf area Index (LAI): Local green with 0.81 LAI followed by 48-1 with 0.66 LAI recorded the maximum leaf area index in Kharif under improved practice, while Local green (0.56) followed by

Local red (0.48) recorded the maximum LAI in Rabi season under improved practice. DCH-177 variety exhibits the least LAI in both the seasons, (0.41 in Rabi & 0.58 in Kharif).

Leaf yield (g/plant): The fresh leaf yield in both the seasons (Kharif & Rabi) was recorded highest with Local green 189.80 g/plant Kharif and 139.80 g/plant in Rabi under improved practice. While the least leaf yield was observed with DCH-177 in Kharif and Local red in Rabi. Here too, seasonal comparison shows that Kharif season is more favourable for leaf yield than the Rabi season for all the 4 varieties. It is also observed that for all the varieties maximum leaf yield occurs when the castor crop attains 90 DAS to 105 DAS and it declines from 120 DAS onward.

Leaf yield (kg/ha): The highest leaf yield per hectare in both the seasons (Kharif and Rabi) was also observed with Local green under improved practice (4686.35kg/ha) and farmers' practice (3965.37 kg/ha) in Kharif, and in Rabi Local green with 3451.80 kg/ha under improved practice and 3036.99 kg/ha under farmers' practice (FP). It is known from the given data in Table 6 that Kharif season is more suitable for castor leaf production than the Rabi season for all the four varieties. Local red with 4207.34 kg/ha in Kharif under improved practice comes second in terms of leaf yield. DCH-177 under improved practice gives the poorest performance with just 2513.55 kg/ha in Kharif and Local red with 2340.70 kg/ha in Rabi.

Location 2 : Game village

Two promising varieties viz., Local red and DCH-177 was taken for evaluation at Game village, which shows the crop itself is performed better under improved practices than farmer's practices.

Plant height: Between the two varieties, Local red recorded 160.20 cm and DCH-177 110.60 cm under improved practice and they were 148.20 cm and 97.20 cm respectively, under farmers' practice.

Number of leaves/plant: With regard to number of leaves per plant, both the varieties exhibit similar result with their leaf number ranging from 8.40 to 9.40 in improved practice as well as farmers practice

although improved practice shows lightly more number of leaves on an average. Leaf area (cm²/plant). The Local red under farmers' practice gives better result than Local red under improved practice. Local red leaf area however is double to that of DCH-177 in both the practices.

Leaf area index (LAI): There is minimal index gap between the two varieties in both the practices, the data ranging between 0.51 and 0.60 under improved practice, and 0.54 and 0.59 under farmers practice.

Leaf yield (g/plant): In terms of leaf yield Table 5. indicates that Local red yielded about 50% higher than DCH-177 in both the practices and result under improved practice is more impressive than the result

under farmers' practice as it is the case of other parameters.

Leaf yield (kg/ha): The leaf yield was recorded higher with indigenous varieties than exotic. The highest yield was recorded at 105 DAS in both varieties as well as practices. Local red produced (5061.65 and 4320.92) and DCH-177 (4074.10 and 3703.65). The overall average leaf yield of Local red was 3718.46 and 3232.57 and DCH-177 was recorded to 2380.24 and 2153.05 kg/ha under improved and farmer's practices.

Thus, from the above discussion it may be stated that *Kharif* season is more favourable for castor leaf production than *Rabi* season. Also, improved practice is found to be more productive than the farmers' practice in terms of all the plant parameters (Table 80).

Table 80 : Cost of cultivation of castor per hectare and Eri cocoon production

(A) Improved Practices (IP)		
1. Land preparation	:	Rs. 1,200.00
2. Fertilizer application (NPK @ 60:40:20 kg/ha)	:	Rs. 1,400.00
3. Seed cost (5 kg/ha) @ Rs. 150/kg.	:	Rs. 750.00
4. Sowing cost (15 man days @ Rs. 60/-)	:	Rs. 900.00
5. First Intercultural operation (30 man days @ Rs. 60/-)	:	Rs. 1,800.00
6. Second Intercultural operation (30 man days @ Rs. 60/-)	:	Rs. 1,800.00
7. Leaf harvesting including nipping of terminal buds (40 + 20 man days @ Rs. 60/-).	:	Rs. 3,600.00
		Rs.11,538.00
(B) Farmer's practices (FP).		
(Cost of improved practices - fertilizer application + terminal bud nipping.	:	Rs. 8,850.00
(C) Worm rearing & cocoon production (70 man days @ Rs. 60/-)		
	:	Rs. 4,200.00
(D) Total expenditure including cost of castor cultivation and worm rearing.		
1. Improved practices : (Rs.11,538 + 4,200)	:	Rs.15,738.00
2. Farmer's practice : (Rs. 8,850 + 4,200)	:	Rs.13,050.00

Urea = @ Rs. 5.40/kg, Murate of Potash = @ Rs. 6.20/kg, SSP - @ Rs. 5.30/kg,
DAP- @ Rs. 10.80/kg.

FARM TOOLS AND MACHINERY

Anthropometric Database of Agricultural Workers of Meghalaya

R.K.P. Singh, K.N. Agrawal & K.K. Satapathy

Seventy two different body dimensions related to farm machinery design has been collected for 578 subjects i.e. 272 female and 306 male agricultural workers from Ri-Bhoi, East Khasi Hills, Jaintia Hills, West Khasi Hills and West Garo Hills district of Meghalaya to develop anthropometric data base. Study was also conducted to assess the drudgery perceived, gender involvement and time spent in various farm activities for cultivation of paddy, maize, ginger and potato crops in Meghalaya state. The ergonomical evaluation of the selected traditional and improved Farm tools and machinery was also done.



Fig. 28 Assessment of Ergonomical Problems of Traditional Tools

Plastics in Manufacturing of Agricultural Implements

K.N. Agrawal & S. V. Ghadge

The transportation of implements on hills becomes a major problem since mostly implements are carried manually on slopes up to the field. Due to this weight of implement becomes very

important. As it has been a proven fact that maximum acceptable work load (MAWL) decreases non-linearly with the increase in ground slope. The use of plastics for manufacturing of various implements/machinery parts without affecting its working efficiency and strength as an alternative to conventional metals has been started under the AICRP Project on APA at this centre. The various parts of some of the popular tools and implements such as outer cover of maize sheller, metering mechanisms of seed drill, fenders, pedal etc in pedal paddy thresher have been identified to be replaced with their plastic alternates. The replacement of outer cover of tubular maize sheller reduces its weight by 50.5% and 35.3 % reduction in workload on the agricultural workers. Experiments carried out on male and female agricultural workers of Meghalaya suggests about 17 and 2.5 per cent reduction in HR and OCR of the subjects during the maize shelling task by using plastic maize sheller over the conventional metallic maize sheller. However, the cost of the maize sheller noticed an increase of 12.5 % over the conventional maize sheller.



Fig 29 Modified Maize Sheller with Plastic Outer Cover

Computer Aided Manufacturing of Improved tools and Machinery

R.K.P. Singh

Dies and fixtures for the fabrication of wheel hand hoe, wheel hand hoe seed drill, octagonal maize sheller, tubular maize sheller and groundnut decorticator were developed and characterization for requirement of raw material, standard

components and production processes of nine improved implements namely motorized wireloop paddy thresher, pedal paddy thresher, groundnut decorticator, wheel hand hoe, wheel hand hoe seed drill, hand winnower (Fig 2), tubular maize sheller, octagonal maize sheller, and fruit harvesters were completed. Production manual for the batch production of nine prototypes namely Tubular Maize Sheller, Octagonal Maize Sheller, Fruit Harvesters, Wheel Hand Hoe, Groundnut Decorticator, Hand Winnower, Pedal Paddy Thresher, Motorized Wireloop Paddy Thresher and Wheel Hand Hoe Seed Drill have been brought out.

Training of Local Artisans and Prototype Multiplication of Farm Implements

R.K.P. Singh

Two short-duration and six long duration training programme on Manufacturing and Use of Improved Agricultural Implements were organized for the artisans, blacksmiths and small scale manufacturer of Assam, Manipur, Meghalaya, Nagaland, Sikkim and Tripura states in which 135 manufacturers and state government technicians were imparted training about fabrication of improved tools and implements like maize sheller, hand fork, garden rake, grass slashers, and wheel hand hoe, etc. Fabrication of 20 numbers Motorized Wireloop Paddy Thresher, 100 numbers of Manual Fruit Harvesters, 250 numbers of PAU Wheel Hoe Seed Drill, 255 numbers of PAU Wheel Hand Hoe, 2000 numbers of Maize Shellers, 50 numbers of Groundnut Decorticator, 100 numbers of Pedal

Paddy Thresher and 05 numbers of Hand Winnower were completed.

Commercialization of Farm Tools

C.S. Sahay, K.N. Agrawal,
& K.K. Satapathy

A total of 39 different types of improved tools and equipments were produced and sold to various agencies and farmers of the region. Different state departments, universities, and research stations have shown keen interest and happened to be the major buyers of these implements. Apart from these, four to five local manufacturers are identified and encouraged to fabricate these implements and its components. Initially the scheme was started with twenty seven identified prototypes for multiplication and supply. Based upon the demand received from the various agencies, the number of items was raised to thirty nine during this year considering other on-farm requirements.

Prototype Feasibility Testing and Front Line Demonstration

K.N. Agrawal & R.K.P. Singh

Two prototypes were taken for feasibility studies to evaluate its adoption while 3 implements and few horticultural tools were taken for front line demonstration to farmers' field. The feasibility studies were conducted both at research farm and farmers field. The area covered and feed back received from such studies are shown in Table 81.



Fig.30 Training of Artisans in Implements Manufacturing

Table 81 : Area covered and feed back from feasibility studies and front line demonstration of farm tools and equipments

Sl. No.	Equipment	Area/No. of Demonstrations	Farmer's Feed Back/Remark
1.	IIT Puddler	0.45 ha	➤ Good in working in valley land fields. Can be taken for front line demonstration at farmer's field.
2.	Self Propelled Paddy Transplanter	0.10 ha	➤ Needs improvements before taking to farmer's field.
Front Line Demonstration			
1.	Vertical Conveyor Reaper	0.35 ha	➤ Very high working efficiency compared to manual harvesting
2.	Tree Pruner	6	➤ Difficult to be taken in smaller terraces and wet fields. · Can be Propagated among farmers having orchards · It reduces the risk of climbing on trees · Cost has to be reduced
3.	Horticultural Tools	12	· Needs more demonstration
4.	Motorized Wireloop thresher	50 h	· Reduces the drudgery of operations of weeding etc · Good at work needs large scale demonstration.

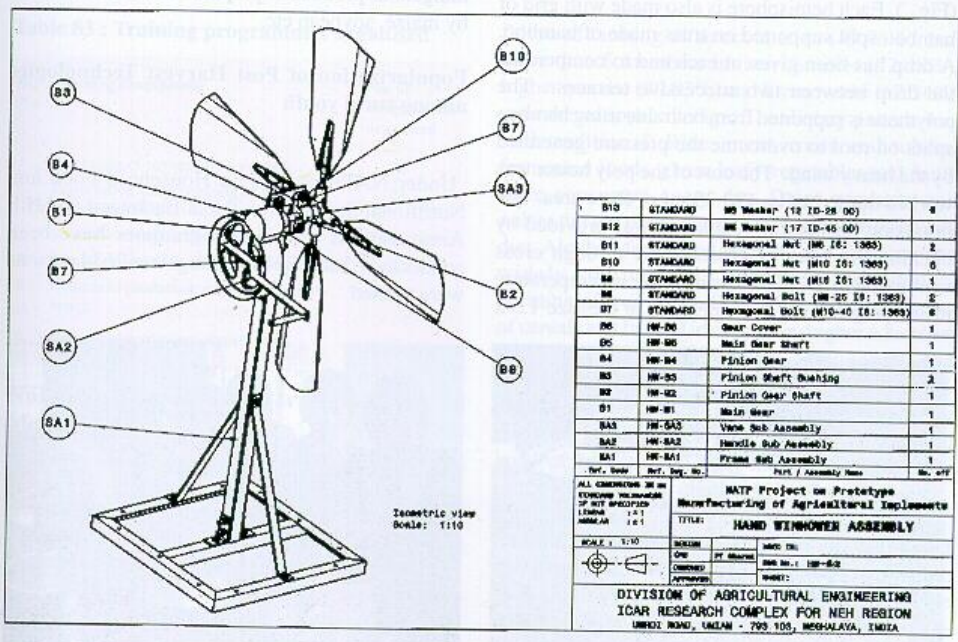


Fig.31 Manufacturing Drawing of Hand Winnower (Assembled)

AGRICULTURAL STRUCTURES & POST HARVEST TECHNOLOGY

Low Cost Poly House for Terraced Beds in hills

K.N. Agrawal, R.K. Singh & K.K. Satapathy

A low cost poly house for bench terrace has been promoted by Agricultural Engineering division. The total covered area of the constructed green house is 161.8 m² covering three bench terraces at a vertical interval of 1.2 m. The structure has been made with the help of bamboo and covering is done using 200 micron UV film. The basic structure was made by using the net of split bamboos with a grid of 9 x 12". The roof of the green house was made in the form of three hemispheres in such a manner that height of the roof from ground remains constant (Fig.). Each hemisphere is also made with grid of bamboo split supported on truss made of bamboo. A drop has been given at each end to compensate the drop between two successive terraces. The polythene is supported from both side using bamboo splits on roof to overcome the pressure generated by the heavy wind. The cost of the poly house was worked out to be Rs. 133.25/m² of floor area. The provision for natural ventilation was provided by opening the sides of green house through cross ventilation to avoid excess increase in temperature inside poly house. Two openings of the size 1.5 x



Fig 32 Low cost green house made for terraced land at Umiam

2.0 m were kept for natural ventilation. The construction of poly house on the terrace lead to increase in cultivable area by 19 % in form of risers which can be utilized for forage grass or creeper vegetables. The crops grown and their performance and cost benefit are given in Table 82 .

Traditional Post Harvest Technologies in NEH Region

R.K.P. Singh & K.N. Agrawal

Documentation of traditional method of post harvest technology and food processing techniques in Meghalaya, Nagaland, Manipur, Mizoram and Sikkim states has been done. The indigenous methods of processing of food grains as , rice, maize, soy bean etc; horticultural produce like turmeric and ginger; animal products such as fishes, pork etc. were surveyed. It was found that almost in all the state of NEH region, majority of the indigenous products is prepared from rice followed by maize, soybean etc.

Popularization of Post Harvest Technologies among rural youth

Under NATP project on Household Food and Nutritional Security for Tribal Backward and Hill Areas various training programmes have been conducted (Table 83) and altogether 2634 persons were trained.



Fig 33 : Training provided to woman in preparation of Soy products

Table 82 : Crops grown in low cost green house and their benefits

Sl. No.	Crop	Month of Planting	Area Under crop (m2)	Input Cost (Rs.)	Yield (Kg)	Market Rate (Rs./kg)	Benefit (Rs.)
A. Crop on Beds							
1.	Capsicum	May	32.31	219	26	32/-	631
2.	Tomato	April	32.31	230	24	20/-	250
3.	Brinjal	May	35.0	210	38	16/-	398
4.	French Bean	June(1 st week)	19.38	85	12	16/-	107
5.	Cabbage	July	62.70	278	63	12/-	478
6.	Cauliflower	August	32.31	80	22	12/-	184
7.	Pea	December	32.31	105	23	16/-	263
8.	French Bean	January	35.0	80	25	16/-	320
9.	Tomato	March	62.70	115	35	16/-	445
B. Crop on Risers							
10.	Bitter Gourd	June	10.16	12	9.2	20/-	172
11.	Bottle Gourd	June	20.23	35	35	16/-	525
12.	Cucumber	July	10.16	25	12	20/-	205
13.	Bitter Gourd	November	10.16	10	4.6	20/-	82
14.	Cucumber	February	30.31	24	26	12/-	288
Total							4338

Table 83 : Training programmes organised

Sl. No.	Training Programme	No. of Programmes organized
1.	Processing of soybean for food uses	70
2.	Preservation and processing of fruits and vegetables	20
3.	Scientific storage of food grains	03
4.	Manufacturing of food grains storage bins	02
5.	Household production and processing of honey	03
6.	Household production of mushroom	04

Nutritional profiles of tribal women in Meghalaya

D.A. Murugker, B.P.S. Yadav & P.P. Pal

Assessments of the existing, food consumption pattern, and food taboos and special foods consumed by tribal women.

About 1850 respondents from 325 families were selected using stratified random sampling from thirteen villages in Ri-Bhoi district of Meghalaya to study their nutritional profile. Socio-economic parameters revealed that the majority of tribals those

followed farming as an occupation (49.96%), had more than 5 members in their families (72.48%), higher income (49.83%) and literacy rate (67.34%) over the national average. The dietary pattern was still traditional. Rice, meat, roots and tubers, fermented foods, green leafy vegetables and fruits were consumed every day. Dairy products and pulses did not play a significant part in the everyday diet. Alcohol, fermented betel nut and tobacco were widely consumed by both men and women. Farming played a significant role in consumption of cereals and fruits. Urbanization, higher education and income significantly influenced the consumption of non-traditional foods such as dairy products, roots and tubers. The results of the study therefore indicated that an increase in income and level of education did not mean a proportionate improvement in the quality of food consumed.

Evaluation of the nutritional content of the diet and assessment of deficiencies (if any) in the diet.

A significant difference ($P < 0.5$) was seen in the consumption of nutrients between low and high-income groups in the three physiological states studied. The consumption of protein (g/d) was higher than the Recommended Dietary Allowance

(RDA) in both income groups for Non Pregnant Non Lactating (NPNL) women, in the high-income group for pregnant women and lower than the RDA in both income groups for lactating women. Energy (Kcal/d) and carotene levels ($\mu\text{g/d}$) were lesser than the RDA in all the groups except pregnant women under the high-income group. The consumption of calcium (mg/d) was lower than the RDA in all the groups studied. Adequate amounts of iron rich foods (mg/d) above the RDA was observed only in NPNL women under the high-income group. However, the consumption of vitamin C (mg/d) was adequate in all the groups except in lactating women under both income groups.

Mapping of unconventional foods and assessing their nutritional quality

Using rapid rural appraisal technique, the plant foods and cooked foods were identified. The plant foods were then botanically identified at the National Bureau of Plant Genetic Resources (NBPGR), Shillong. They were also photographed for their documentation. A total of 71 raw, cooked and fermented foods were identified. The proximate principles like dry matter, protein, fat, ash, fibre and minerals like calcium and phosphorus were estimated.

FEED AND FODDER

MEGHALAYA

Fodder Production

J.J. Gupta

Broom (*Thysanolaena maxima*): The broom nursery was developed 5 years back in 200m² area with a total of 140 plants. The nursery was further increased 3 years back in additional 200m² area adjacent to old one with 140 plants. The data of fodder, flowers and sticks were recorded and presented in Table 84. The fodder obtained from 1h area of 3 year old plants is sufficient to meet dry matter requirement of one cattle unit. However, dry

matter requirements of 2 cattle units can be fulfilled from 1h area of 5 years old plants. In addition to this, dry broom sticks (9.11 – 13.77 t/h) were obtained for fuel use and flowers (1.56 – 2.36 t/h) as a subsidiary source of income.

Table 84. Fodder and flower yield from broom

Particulars	3 Years Old Plants	5 Years Old Plants
Fodder Yield from Leaf (t/h)		
Fresh	7.70±0.91	16.60±3.58
Dry	2.86±0.33	6.18±1.33
Dry Sticks Yield (t/h)	9.11±1.09	13.77±2.87
Dry Flower Yield (t/h)	1.56	2.36

Soybean (*Glycine max* Merr.): The soybean (MAUS-98-2) seed @ 40 Kg/h was sown in 100m² area after enriching the soil with lime (0.50 t/h) and FYM (10 t/h) 30 days in advance. The fodder yield after 75 days in first cut was obtained 28.12±0.62 t/h with 16.58% dry matter. The second cut of fodder was taken after 30 days gap of first cut and yield recorded 16.50±1.50 t/h with 21.19% dry matter. The soybean fodder has good palatability in rabbits and contain high amount of protein 18-19% on dry matter basis that could be good for livestock feeding.

Rice Bean (*Vigna umbellata*): Eighteen genotypes of rice bean were procured from Plant Breeding Division, ICAR Research Complex for NEH Region, Umiam and sown in 36 plots having 6m² area each after enriching the soil with lime (0.50 t/h) and FYM (10 t/h) 30 days in advance to study the fodder production. The seed was sown @ 17.80±0.51 Kg/h with the distance of 30 cm row to row and 15 cm plant to plant. The fodder yield was recorded after 85 days of sowing. The fodder quality was also assessed. Total nine genotypes (EC-18155; RCRB-1-3; BRS-1-2; RBS-110; EC-2074; PRR-9301; RCRB-6-10; EC-1667 and BD-139-1) were found good in terms of fodder and nutrient yields (Table 85).

Table 85 : Fodder and nutrient yields from different genotypes of rice bean

Genotypes	Fodder Yield (t/h)	Dry Fodder Yield (t/h)	Proteins Yield (t/h)	Fibre Yield (t/h)	Minerals Yield (t/h)
IC-15668	16.67	3.38	0.48	1.04	0.26
RCRB-1-5	18.33	2.81	0.44	0.81	0.24
EC-18155*	22.50	3.86	0.58	1.28	0.31
RBS-2	22.00	3.50	0.46	1.22	0.31
BRS-2	21.67	3.51	0.57	1.01	0.23
RBL-6	12.50	2.10	0.35	0.60	0.17
RCRB-1-3*	25.00	4.04	0.59	1.13	0.38
PRR-9402	10.33	1.74	0.21	0.55	0.14
C x M-12P-2	11.67	2.08	0.30	0.70	0.15
BRS-1-2*	25.00	4.13	0.64	1.22	0.33
RBS-110*	25.83	4.37	0.64	1.30	0.31
EC-2074*	28.33	5.02	0.70	1.59	0.44
PRR-9301*	25.83	4.74	0.63	1.47	0.38
RCRB-6-10*	21.67	4.04	0.66	1.19	0.30
EC-1667*	23.33	4.03	0.60	1.30	0.28
BD-139-1*	23.33	4.13	0.66	1.13	0.32
RBL-52	14.17	2.68	0.44	0.86	0.21
EC-114077	15.83	2.34	0.36	0.77	0.22
Av. ± SE	20.22±1.29	3.47±0.23	0.52±0.03	1.06±0.07	0.28±0.02

* Genotypes nearer to average values and shows good performance

The contribution of non-soluble fibre, soluble carbohydrates, proteins and minerals fractions in total dry matter yield (3.47 t/h) are 31, 46, 15 and 8 per cents, respectively with 0.26 t/h digestible crude protein. Thus, data indicated that rice bean fodder is of excellent quality and dry matter and nutrients obtained from rice bean fodder of 1h area is sufficient to meet the nutrient requirements of one lactating crossbred cow for one year.

TRIPURA

Development of feeds and fodders and their nutritional revaluation

Chander Datt

Feeds and fodders development

Scarcity of feeds and fodders is the prime constraint in animal production in the state. Hence, there is a need to increase the feed resource base, which can be achieved by cultivating the fodder

crops, identifying newer feed resources, nutritional evaluation and by other technologies as well. Cultivation of fodder crops is more important in order to improve productivity of ruminant animals. Therefore, different crops like maize, sorghum, grasses (napier hybrid, guinea grass, thin napier, paragrass and broom grass), cowpea, rice bean, chinese cabbage and oat were grown in order to provide green fodder. Horticultural / vegetable wastes / agricultural residues were also utilised as feeds. In addition to 15 types of feeds including cultivated fodders (leguminous and non-leguminous) horticultural / vegetable by product / agricultural residues analysed for proximate principles in the previous year, few more were analysed for the same. This included leguminous fodders (*Clitoria ternatea* and *Sesbania aculeata*), horticultural/ vegetable wastes (tapioca leaves, jackfruit waste, jackfruit seeds, banana leaves and litchi seeds), agricultural residues (Arhar pod and groundnut haulms). Agricultural weeds and fodder trees also play an important role in the nutrition of the animals. Four types of dicot weeds and 6 species of fodder tree leaves were subjected to chemical analysis (proximate composition and cell wall constituents) and *in vitro* digestibility studies in addition to 44 species of locally available feeds subjected to such type of evaluation in the preceding years.

A survey work on feeds and feeding management prevailing in the State is under progress.

Variation in the nutritional characteristics of some local feed stuffs.

Chander Datt & K. Chattopadhyaya

Twenty four varieties / strains of paddy straw, 10 varieties / crosses of maize fodder collected from plant Breeding Division of the centre and leaves of 7 species of bamboo collected from elsewhere were evaluated for their nutritional characteristics.

Proximate Composition : The CP content among different paddy straw cultivars / strains varied from 3.66 to 6.47 per cent while CF content ranged from 26.43 to 33.44 per cent. Among the maize varieties

/ crosses the CP level ranged from 7.29 to 9.80 per cent and the range for CF content was found to be from 22.09 to 28.07. Bamboo leaves of different species contained CP ranging from 10.09 to 15.18 per cent, while the amount of CF varied from 21.81 to 28.76 per cent.

Cell wall constituents :The NDF, ADF, hemicellulose, cellulose and lignin concentration range was found to be 64.33 – 79.89, 40.39 – 53.52, 22.03 – 32.57, 28.95 – 40.36 and 4.10 – 5.97 per cent, respectively among different types of paddy straws. The corresponding values for different maize varieties / crosses were : 53.10 – 64.53, 30.23 – 38.75, 17.49 – 25.91, 22.29 – 33.69 and 2.92 – 4.73 per cent. Among the bamboo species, the respective values were : 69.69 – 74.54, 39.20 – 46.59, 27.23 – 35.24, 28.73 – 35.23 and 4.22 – 6.86 per cent.

In vitro digestibility: *In vitro* drymatter digestibility (IVDMD) ranged from 37.85 to 54.78 per cent in case of paddy straw, 56.83 to 65.87 per cent in case of green maize and from 34.98 to 43.45 per cent for different species of bamboo leaves. List of the local feed resources and their chemical composition is given in Table 86 and 87.

Table 86 : List of the local feed resources evaluated for their forage quality.

Types of feed	Varieties / strains / species
1. Paddy straw (n = 24)	TRC-87-251, C-10, RCM-9, Ngoba RCPL-1-84-4, RCPL-1-2-30, RCPL-1-151-151, RCPL-1-179-3P, SPR-880 90-30-1-2-4, SDR-880 90-30-12-4, Pyzum white, RCM-10, RCM-11, TRC-02-2, RCM-12, NDR-97, NDR-359, SPL-850.48-19-3-1-1, TOX-3241, TOX-3093 -10-2-3-2, RCPL-1-3-1-2-30, Pyzum Red, Binni and Kali Khasa.
2. Maize Green : (n = 10)	Naveen, Jhum Black, Jhum Black x Naveen, Jhum Yellow, Jhum Red, Jhum Red x Naveen, Prakash x Jhum Red, Prakash, Prakash x Jhum Black and Jhum Yellow x Naveen.
3. Bamboo Leaves : (n = 7)	<i>Bambusa plicata</i> , <i>B. nana</i> , <i>B. nutan</i> , <i>B. Cacharensis</i> , <i>Dendrocalamus hamiltonii</i> , <i>D. sikkimensis</i> and <i>M. bambusoids</i>

Table 87. Chemical composition (per cent on DM basis) and *in vitro* digestibility values (mean ± ISE) of different types of feed resources of Tripura.

Parameter	Type of feed		
	Paddy Straw (n = 24)	Maize green (n = 10)	Bamboo leaves (n = 7)
A. Proximate Composition			
OM	85.69 ± 0.38	89.31 ± 0.42	83.89 ± 0.66
CP	4.71 ± 0.18	8.57 ± 0.28	12.42 ± 0.69
EE	1.22 ± 0.02	1.31 ± 0.07	1.39 ± 0.07
CF	29.51 ± 0.44	25.53 ± 0.55	25.28 ± 0.78
NFE	49.75 ± 0.53	53.90 ± 0.66	44.04 ± 0.83
Total Ash	14.81 ± 0.38	10.69 ± 0.42	16.11 ± 0.66
B. As per Van Soest method of fibre analysis			
Cell Contents	27.43 ± 1.10	40.99 ± 1.09	26.99 ± 0.58
NDF	72.57 ± 1.10	59.01 ± 1.09	73.01 ± 0.58
ADF	46.34 ± 0.72	36.18 ± 1.02	41.61 ± 1.51
Hemicellulose	26.30 ± 0.58	22.83 ± 1.04	31.40 ± 1.13
Cellulose	33.69 ± 0.65	27.67 ± 1.15	32.15 ± 0.99
Lignin	5.23 ± 0.09	3.66 ± 0.20	5.59 ± 0.43
C. <i>In vitro</i> digestibility (Per cent)			
IVDMD	45.91 ± 1.10	60.37 ± 1.07	39.09 ± 1.08
IVOMD	47.63 ± 1.08	62.49 ± 1.09	41.69 ± 1.18

Status of essential minerals in the feed stuffs of Tripura.

Chander Datt

Mineral elements play a variety of roles in animal body, the deficiency, excess or imbalances of which is likely to cause a range of disturbances. The local feedstuffs are the main sources of minerals for animals. Hence, these were analysed for their mineral contents in order to determine their status in terms of macro (Ca and P) and micro (Fe, Cu, Zn and Mn) elements. These feeds included cultivated fodders (non-leguminous : maize, oat, sorghum, napier hybrid, guinea grass, thin napier, paragrass and broom grass; leguminous; cowpea, rice bean, *Clitoria* and *Sesbania aculeata*), horticultural / vegetable by-products (leaves of cabbage, sweet potato, radish, tapioca and banana; jackfruit waste, seeds of jackfruit and litchi and tapioca meal) and agricultural residues (paddy straw, GN haulms and arhar pods).

The other feed resources analysed for essential minerals elements were agricultural weeds (grassy weeds : n=13, dicot weeds : n=21) and fodder tree leaves (n=20) as presented in Table 88 . The data on their mineral composition have been presented in Table 89. In general, cultivated leguminous fodders contained more of Ca, Fe, Cu and Mn. Ca

& P ratio was the widest (7.71 : 1) for fodder tree species as compared to other feed stuffs.

Tannin content in tree leaves

The tannin content in 20 different species of fodder tree leaves ranged from 0.85 to 8.11 per cent on DM basis.

Table 88 : List of local fodder sources analysed for their mineral contents.

Grass species	Non-grass species	Fodder trees
1. <i>Panicum sp.</i>	1. <i>Mimosa pudica</i>	1. <i>Artocarpus heterophyllus</i>
2. <i>Imperata cylindrica</i>	2. <i>A. Spinosus</i>	2. <i>Erythrina indica</i>
3. <i>Digitaria sp.</i>	3. <i>Enhydra fluctuans</i>	3. <i>Ficus hispida</i>
4. <i>Commelina benghalensis</i>	4. <i>Alteranthera sessilis</i>	4. <i>Leucaena leucocephala</i>
5. <i>Paspalum notatum</i>	5. <i>Acalypha indica</i>	5. <i>Gmelina arborea</i>
6. <i>Cynodon dactylon</i>	6. <i>Oxalis Corniculata</i>	6. <i>Albizzia lebbeck</i>
7. <i>Eleusine indica</i>	7. <i>Leucas aspera</i>	7. <i>Bambusa sp.</i>
8. <i>Dactyloctenium aegyptium</i>	8. <i>Phyalis minima</i>	8. <i>Gliricidia sp.</i>
9. <i>Setaria glauca</i>	9. <i>Phyllanthus niruri</i>	9. <i>Grewia sp.</i>
10. <i>Echinochloa colonum</i>	10. <i>Centella asiatica</i>	10. <i>Moringa oleifera</i>
11. <i>Leptochloa filiformis</i>	11. <i>Portulaca oleracea</i>	11. <i>Acacia auriculiformis</i>
12. <i>Cyperus sp.</i>	12. <i>Mikania scandens</i>	12. <i>Zizyphus sp.</i>
13. <i>Sachharum munja</i>	13. <i>Chenopodium album</i>	13. <i>Morus sp.</i>
	14. <i>Boerrahavia duffusa</i>	14. <i>Ficus religiosa</i>
	15. <i>Amaranthus viridis</i>	15. <i>Bauhinia variegata</i>
	16. <i>Euphorbia hirta</i>	16. <i>Cassia simea</i>
	17. <i>Gyandropsis sp.</i>	17. <i>Dalbergia sissoo</i>
	18. <i>Solanum torvum</i>	18. <i>Samanea saman</i>
	19. <i>Corchorus acutangulus</i>	19. <i>Bombax ceiba</i>
	20. <i>Latuca sativa</i>	20. <i>Shorea robusta</i>
	21. <i>Eichhornia crassipes</i>	

Table 89 : List of cultivated fodders, horticulture / veg. by-products and agricultural residues analysed for their mineral content.

Catagory of feed	Name
a. Cultivated fodders	
1. Non-leguminous	Maize, oat, sorghum, napier hybrid, guinea grass, thin napier, para grass, broom grass.
2. Leguminous	Cowpea, rice bean, Clitoria, <i>Sesbania aculeata</i> .
b. Hort. / veg. by-products	Leaves of cabbage, sweet potato, radish, tapioca and banana, jackfruit waste, tapioca meal, seeds of jackfruit and litchi.
c. Agricultural residues	Paddy straw, groundnut haulms, arhar pods.

DAIRY FARMING

MEGHALAYA

Performance of crossbred cows and calves in farm condition

B.P.S. Yadav

The productive and reproductive performance of Holstein –Friesian and Jersey crossbred cows were studied in small herds of dairy farm. The cows were offered concentrate feed comprising of maize, wheat bran & mustard oil cake fortified with mineral mixture and common salt and green grasses in rainy season and paddy straw during winter season as roughage feed. The average productive and reproductive performances of cows and input/output of farming during the year are presented in Table 90 & 91 respectively. The studies indicated that dairy farming seems to be sustainable in NE Hills.

Table 90 : Productive and reproductive performance of dairy animals

Parameters	Mean ± SE
Lactation yield (Litre)	2871.83 ± 491.64 (6)
Lactation length (Days)	330.5±14.09 (6)
Dry period (Days)	65.33±10.42 (6)
Highest lactation yield (Litre/lactation)	4336.5
Highest Peak yield (Litre/day) Cow no. 10	21.5
Birth weight of calves (Kg)	
Female	26.25±2.5 (2)
Male	34.5±0.5 (4)
Gestation length (Days)	273.47±1.91 (6)
Calving interval (Days)	411.00±11.26 (6)
Growth rate in calves (g/d)	332.6±47.63

Figure in parentheses indicated numbers of animals on observation

Epidemiological studies on cattle parasites

S. Bandyopadhyay & P. Devi

Faecal samples of 326 cattle were collected from various Government farms of Meghalaya. Out of these, 135 (41.41 per cent) were found to be positive for various parasites.

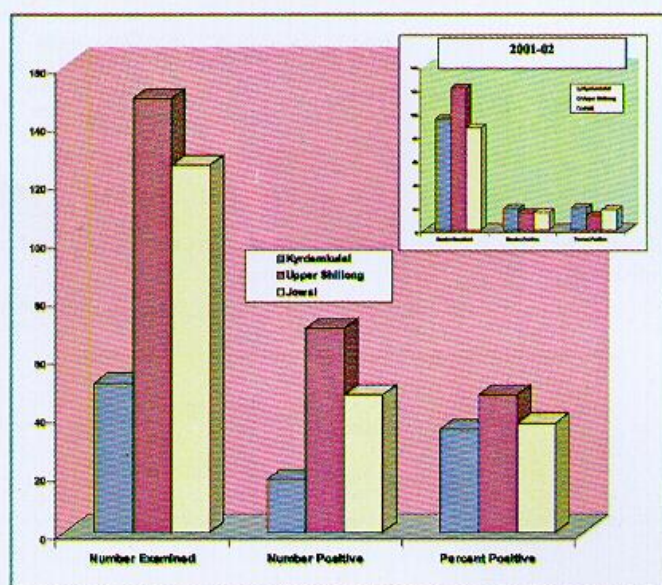


Fig. 34 Place wise incidence of Gastrointestinal parasites in Cattle during the year 2003-2004

From Figure , it has been observed that the per cent of positive animals (cattle) are more in Kyrdemkulai (18.947%) and Jowai (17.241%) than the Upper Shillong (12.40%). This might be due to location of Upper Shillong farm at a higher elevation than the other two farms. It might also be due to better care and maintainance of hygiene in Upper Shillong farm.

Seroprevalence of parasitic infection in cattle through ELISA

S. Bandyopadhyay & P. Devi

Serum samples from cattle were collected from different areas of Meghalaya. The antigens were partially purified using chromatographic techniques through FPLC system (Fig 35).

Table 91 : Input /output statement and revenue receipt of dairy farming

Period		From 01.01.2002 to 31.12.2002	
Herd	Strength		
	Initial	No. of cows	7
		No. of male calves	4
		No. of female calves	4
		Total	15
	Final	No. of cows	10
		No. of heifers	2
		No. of male calves	2
		No. of female calves	2
		Total	16
Details of input / output items			
INPUTS:			
		Expenditure	
		Amount (Rupees)	(% Distribution)
Feed (Concentrate)	Rs. 2,34,897.00		61.80
Paddy straw	Rs. 35,845.00		9.43
Vety. Med. Semen & LN ₂	Rs. 3,275.00		0.86
Fire wood & buckets, utensil rope and other Miscellaneous	Rs. 14,800.00		3.90
Labour charge	Rs. 91,250.00		24.01
	Total Rs. 3,80,067.00		100
OUTPUT			
Sale of product			
		Money receipt	
		Amount in Rs.	(% Dstribution)
Milk (@ Rs.10/- per lit.)	Rs. 2,93,500.00		65.39
Sale of Paneer	Rs. 2,560.00		0.57
Sale of male calf 6 Nos.	Rs. 9,800.00		2.18
Cow dung (16 trucks)@ Rs.1500/-/Truck	Rs. 24,000.00		5.35
Product obtained in kinds			
Heifers 3 nos. converted into cows @Rs. 15,000/- each	Rs. 1,05,000.00		
2 no. of male calves @ Rs. 2,000/- each	Rs. 4,000.00		26.25
2 no. of female calf @ Rs. 6,000/- each	Rs. 10,000.00		
	Total Rs. 4,48,860.00		100
Revenue deposited to office Rs. 3,29,860.00 (Rupees three lakh twenty-nine thousand eight hundred sixty) only.			

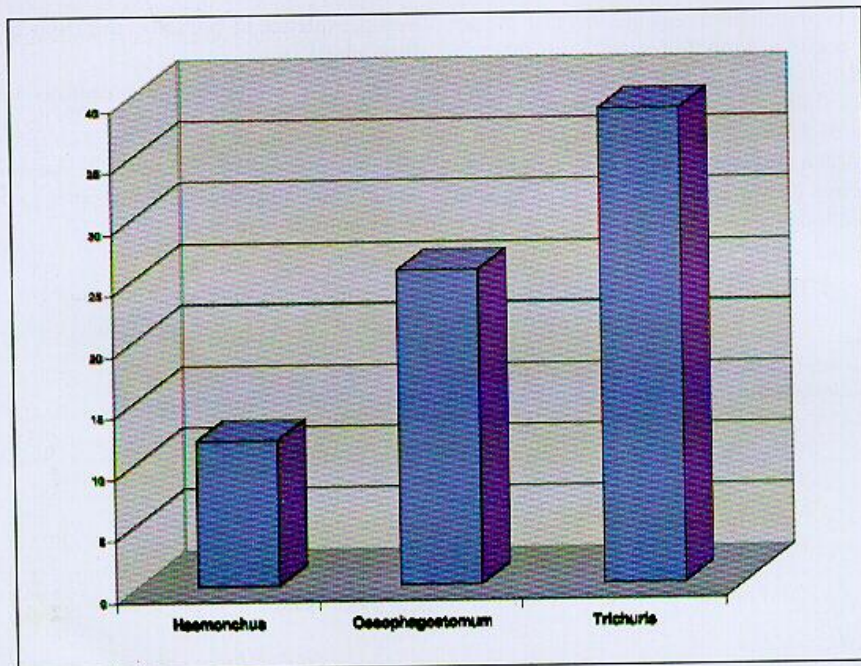


Fig. 35 Seroprevalence of gastrointestinal Parasitic infection through indirect ELISA

TRIPURA

Management of Cattle

Chander Datt & S.K. Ghosh

Twenty crossbreed cattle comprising of different age groups were maintained at the livestock farm. During the rainy season, when availability of green fodder was sufficient, the animals were allowed to graze for 6-7 hours a day. Concentrate mixture and cultivated green fodders (leguminous and non-leguminous) were also supplemented in order to meet the nutrient requirement. November to April being the scarcity period in terms of availability of green fodders, the animals were mostly stall-fed. The ration supplied during this period was mainly paddy straw supplemented with concentrate mixture and green fodders including cultivated fodders (maize, cowpea, chinese cabbage) and tree leaves.

Due care was taken for the good health of the animals. The animals were vaccinated against FMD HS and BQ. Regular deworming schedule was followed for the prevention of endoparasitic infestation. Tick infestation was controlled using Butox® (deltamethrion) during the months of March – April and July – September.

The average gestation period was 276 days. Out of 5 calvings obtained, one was the rare case of twin birth. A cow aged about 13 years gave birth to two females calves. The surprising fact was that the second calf was born about 80 hours after the birth of first calf. Firstly, twinning in cattle is a rare phenomenon. Secondly, even if it happens the time gap between two births is few hours rather than such a long one. The calf born second was slightly heavier as compared to first one (16.0 vs 15.5 kg). Yet another interesting point is that the said cow herself was born as twin and has given birth to twin calves once earlier also.

ANIMAL SCIENCES

PIG

MEGHALAYA

Genetic improvement of selected indigenous pig by crossing with Hampshire.

Anubrata Das, S. Naskar,
G. Kadirvel & S.K. Das

Reproductive Performance of crossbred pig:

Various reproductive parameters of two crossbreds (Khasi Local x Hampshire) with 50 % (CB-50%) and 75 % (CB-75%) exotic Hampshire inheritance level were studied and compared. Result presented in table 92 indicates the higher age at puberty; conception, first farrowing and less inter-farrowing interval in CB-75% than CB-50%. But the difference was not statistically significant ($P < 0.05$).

Table 92 : Comparative Reproductive Characters of Two Crossbred (Mean \pm S.E)

Sl	Reproductive characters	CB-50%	CB-75%
1	Average age at Puberty (days)	266.38 \pm 25.86 (25)	276.66 \pm 21.19 (15)
2	Average age at Conception (days)	308.85 \pm 26.92 (25)	328.00 \pm 31.41 (15)
3	Average age at first farrowing (days)	424.25 \pm 25.95 (25)	442.166 \pm 31.52 (15)
4	Av. Inter- farrowing intervals (days)	215.46 \pm 16.42 (25)	208.42 \pm 18.74 (15)

Whereas, all the litter traits of these two crossbred were compared on the basis of first parity information. Result (Table 93) indicated that average litter size (LSB), litter weight (LWB) and individual litter weight at birth (ILWB), litter size at weaning (LSW) and weaning percentage (WP) was higher in CB-75% but the difference was not significant. But other characters like individual weight at weaning (ILWW) and litter weight at weaning (LWW) was significantly ($P < 0.05$) higher

in CB-75% than CB-50%. These may be due to better milk production and good mothering ability of CB-75%.

Table 93 : Comparison of different first parity reproductive parameters. (Mean \pm S.E)

Sl	Parameters	CB-50%	CB-75%
1	Av. Litter size at birth (LSB)	6.06 \pm 0.42 (17)	6.33 \pm 0.69 (15)
2	Av. Litter weight at birth (kg) (LWB)	5.472 \pm 0.44 (17)	5.720 \pm 0.98 (15)
3	Av. Ind. Litter weight at birth (kg) (ILWB)	0.883 \pm 0.34	0.904 \pm 0.16
4	Av. Litter size at weaning (LSW)	5.625 \pm 0.48 ^a (17)	6.33 \pm 0.68 ^b (15)
5	Litter weight at weaning (LWW)	36.039 \pm 3.61 ^a (17)	51.610 \pm 14.487 ^b (15)
6	Ind. Litter weight at weaning (kg) (ILWW)	6.407 \pm 0.44 ^a	8.153 \pm 0.85 ^b
7	Average weaning percentage (WP)	92.82 \pm 4.47	100%

Different super script indicates significant difference ($P < 0.05$)
Number in parenthesis indicates the number of farrowing.
Number in parenthesis indicates the number of sows in each breed.

Litter traits of different parities:

Data of different litter parameters of different parities of CB 50% was recorded, analyzed and presented in table 94. The average litter size at birth was increased with the increase in parity. The highest litter size was found 8.28 \pm 0.42 in 3rd parity and decreasing trend was noticed thereafter. Exactly similar trend was found in litter weight at birth and individual litter weight at birth. Maximum litter size at weaning was found at 4th parity and then started declining. Whereas, highest litter weight at weaning and individual weight at weaning was found in 5th and 6th parity, respectively. Average weaning percentage varied precisely from 85 to 96 per cent

Relationship among different litter traits:

Correlation among different reproductive characteristics were also calculated and presented in table-4. Litter size at birth (LSW) was positively and significantly correlated with litter weight at birth (LWB). Same trait is also positively correlated with individual litter weight at birth (ILWB), litter size at weaning (LSW) and litter weight at weaning (LWW) and negatively with individual litter weight

at weaning (ILWW) and weaning percentage (WP). LWB is positively correlated with ILWB, LSW, and LWW and negatively correlated with ILWW and WP, respectively. ILWB has also positive correlation with LSW, LWW and WP and negative correlation with ILWW. In case of LSW, it is positively and significantly ($P < 0.05$) correlated with LWW but it shows only negative correlation with ILWW and positive correlation with WP (Table 95).

All India Network Programme on Gastrointestinal Parasitism Epidemiological studies on Pig parasites

S. Bandyopadhyay

Faecal samples of 195 pigs were collected from various Government farms of Meghalaya. Out of these, 83 (42.56 per cent) were found to be positive for various parasites (Fig 36).

Table 94 : Production and Reproduction Performance of different parities of CB- 50%.

Sl No	Parameters	Different Parities						
		1	2	3	4	5	6	(overall)
1	Av. Litter Size at Birth	6.06 ± 0.42 (17)	8.19 ± 0.42 (17)	8.28 ± 0.42 (17)	8.25 ± 0.42 (17)	7.66 ± 0.69 (8)	6.0 ± 0.95 (5)	7.33 ± 0.72
2	Av. Litter wt at birth (kg)	5.472 ± 0.44 (17)	7.215 ± 0.44	8.075 ± 0.44	7.452 ± 0.44	7.208 ± 0.44	5.505 ± 0.75	6.866 ± 0.65
3	Av. Ind. Litter wt at birth (kg)	0.883 ± 0.34	0.881 ± 0.34	0.975 ± 0.34	0.902 ± 0.34	0.957 ± 0.40	0.916 ± 0.50	0.919 ± 0.035
4	Av. Litter size at weaning	5.625 ± 0.48 (17)	6.875 ± 0.48	6.925 ± 0.48	7.13 ± 0.48	6.83 ± 0.56	5.75 ± 0.66	6.52 ± 0.58
5	Av. Litter wt. at weaning (kg)	36.039 ± 3.61 (17)	44.646 ± 3.61	48.946 ± 3.61	56.320 ± 0.44	62.615 ± 6.93	57.32 ± 3.90	50.981 ± 4.96
6	Ind. Litter wt. at weaning (kg)	6.407 ± 0.44	6.494 ± 0.44	7.068 ± 0.44	7.899 ± 0.44	8.655 ± 0.65	10.04 ± 0.64	7.761 ± 0.54
7	Av. weaning percentage	92.82 ± 4.47	84.608 ± 4.47	84.597 ± 4.47	87.898 ± 4.47	89.17 ± 4.47	95.83 ± 4.25	89.15 ± 4.50

Table 95 : Correlation among different reproductive characters in crossbred pigs (CB-50 %).

Sl	Parameters	LSB	LWB	ILWB	LSW	LWW	ILWW
1	Av litter size at birth (LSB)	1.000					
2	Av litter weight at birth (kg) (LWB)	0.807*	1.000				
3	Av. Individual litter weight at birth (kg) (ILWB)	0.141	0.179	1.000			
4	Av. litter size at weaning (LSW)	0.661	0.599	0.197	1.000		
5	Av. litter weight at weaning (kg) (LWW)	0.412	0.352	0.074	0.729*	1.000	
6	Av. individual litter weight at weaning (kg) (ILWW)	-0.269	-0.266	-0.069	-0.155	0.476	1.000
7	Av. weaning percentage (WP)	-0.185	-0.054	0.095	0.536	0.510	0.025

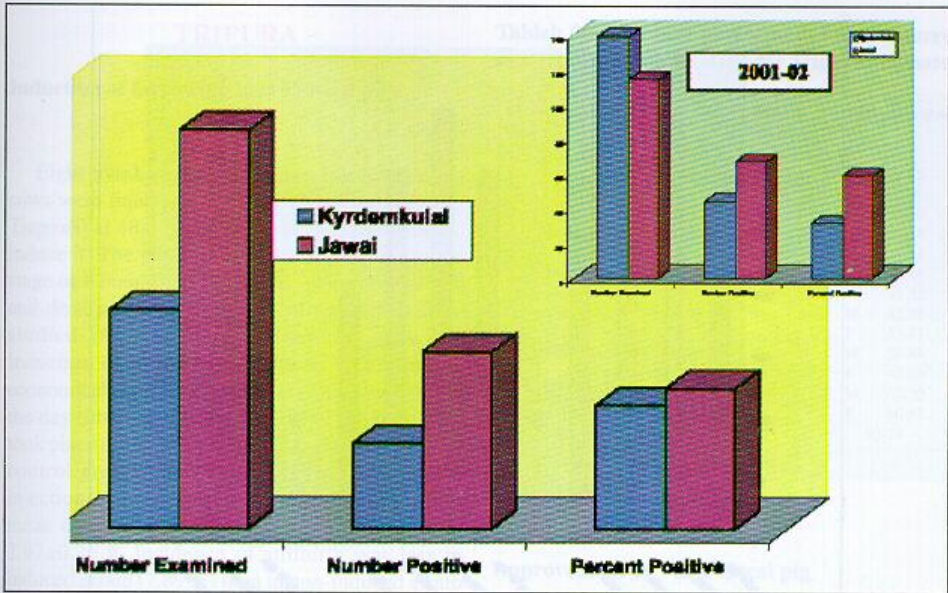


Fig.36 Place wise incidence of Gastrointestinal Parasites of Pig in Meghalaya during the year 2002-2003

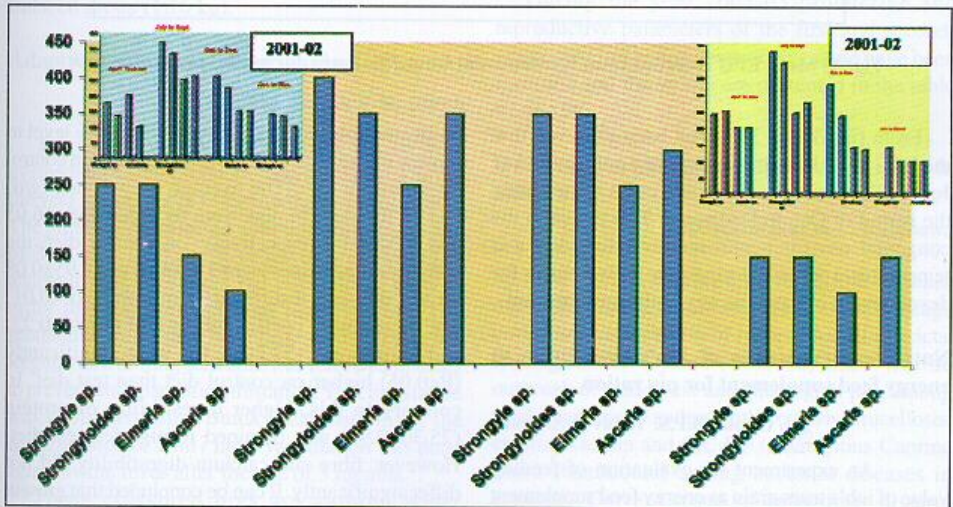


Fig. 37 Mean Egg per Gram (EPG) recorded from Jowai Govt. Pig Farm year 2002-2003

From Figure 36, it was observed that the parasitic infection in pig from Jowai farm (58.77%) is higher than the farm located in Kyrdemkulai (31.65%).

This is due to the better managerial practices observed in Kyrdemkulai farm.

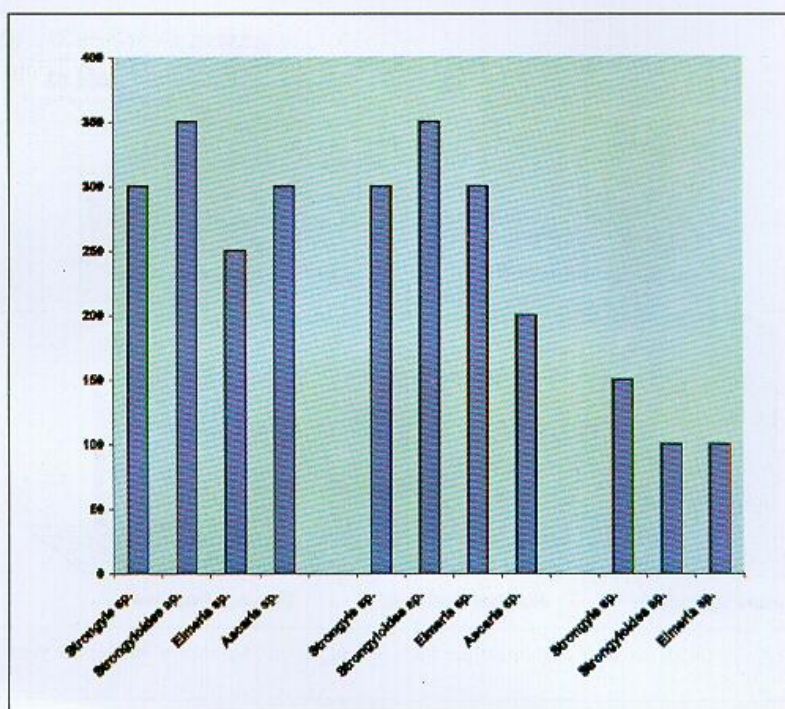


Fig. 38 Mean EPG recorded from Kyrdemkulai Govt. Pig Farm during the year 2002-2003

From fig 37 and 38, it has been observed that the EPG level is higher in pig during the period of July to September and in some cases even during the period of Oct. to December. This is due to the congenial environmental factors (Humidity and temperature) prevails during June to September for development of parasitic egg in the environment

Nutritional evaluation of Job's tears grain as energy feed supplement for pig ration

J.J. Gupta, B.P.S. Yadav & S. Doley

An experiment for evaluation of feeding value of job's tears grain as energy feed supplement was conducted for 42 days duration on twelve crossbred (Hampshire x Local) female pigs of 170 days age having average body weight 39 ± 0.67 Kg. The test diet was prepared by incorporating ground

corticated Job's tears grain (CJTG) at 60% level to replace maize 40% and rice polish 20% as in control conventional diet. The average growth rate (g/d) and FCR values in pigs were recorded 458 ± 16.05 and 4.04 ± 0.04 respectively. on control diet, the corresponding values were 370 ± 4.63 and 4.95 ± 0.08 on test diet and it differed significantly ($P < 0.01$) The digestibility coefficients of DM (69.86 ± 0.22) and phosphorus (52.29 ± 1.15) were significantly ($P < 0.05$) higher on control diet than test diet. In contrary to this, higher digestibility of protein (75.30 ± 0.99) was obtained in pigs fed test diet. However, fibre and calcium digestibility did not differ significantly. It can be concluded that growth performance and nutrient digestibility in finisher pigs fed CJTG at 60% level are within acceptable range. Thus, Job's tears grain can be used as energy feed supplement in place of maize.

TRIPURA

Induction of farrowing in crossbred pigs

S.K.Ghosh

Eight numbers of Hampshire x Local crossbred sows were injected with 5 ml Iliren® (0.750 mg Tiaprost) at 48 h before the expected farrowing to induce it. The parameters like duration of second stage of labour, time of farrowing, number of live and dead piglets and weight of the piglets were studied and compared to normal farrowing. Induction of farrowing proved to be useful and economical because the farrowing took place during the day time only. Whereas most of the farrowing took place during the night time in the non-induced control group. The interval between the Iliren injection and farrowing was 28.95 ± 2.27 h. The mean duration of second stage of farrowing was 2.97 ± 0.26 h. Incidence of stillbirth was less in induced group (7.89 %) than in non-induced group (15%). The mean birth weight was slightly less (1.03 kg) in induced group than that of the non-induced group (1.16 kg).

Adaptive trial on crossbred pigs in Tripura.

Chander Datt & S. K. Ghosh

The crossbred pigs (Hampshire x Local) were evaluated for their production performance. During the year under report 14 farrowings were obtained. The piglets were injected with Imferon® at the age of 3, 7 and 14 days in order to prevent piglet anaemia. The pigs were fed on standard diets in order to meet their nutrient requirements. The production traits have been presented in Table 96. Regular deworming schedule was followed in order to prevent endoparasitic infestation. Tick infestation was controlled using Butox (deltamethrin) at the concentration of 2 ml / litre. Vaccination was done against swine fever after the age of 3 months.

These crossbred pigs are gaining wider acceptance among the local farmers. In order to popularise this breed, piglets of both the sexes were sold to the local people. For the same purpose, the local farmers were provided with the facility of natural service from the boars of the centre.

Table 96 : Average performance of crossbred pigs (Hampshire x local) under Tripura climate.

Sl. No.	Character	Average value
1.	Litter size at birth (Nos)	7.20
2.	Litter size at weaning (Nos)	5.90
3.	Gestation period (Days)	111.50
4.	Individual wt. (kg) at wk 0 (birth)	M 1.17 F 1.14
5.	Individual wt (kg) at wk 8 (weaning)	M 11.18 F 11.53
6.	Individual wt (kg) at wk 16	M 32.58 F 33.41
7.	Individual wt (kg) at wk 24	M 50.84 F 47.25
8.	Individual wt (kg) at wk 32	M 62.70 F 60.42
9.	Dressing percent	69.74

NAGALAND

Improvement of Naga Local pig

C. Rajkhowa & M. Karunakaran

During the year 2002-03 productive and reproductive parameters of the first and second-generation indigenous pigs of Nagaland have been recorded and the values are presented in the table 97 and 98.

Outbreak of infectious microbial diseases in animals

H.D. Karmakar & C. Rajkhowa

Retrospective survey of infectious disease outbreaks in Nagaland has been carried out through collection and analysis of records for all districts. During last five years (1997-02) there was no outbreak of rinderpest and sheep/goat pox among viral diseases and anthrax, tuberculosis, brucellosis, enterotoxaemia and C.C.P.P (Contagious Caprine Pluro Pneumonia) among bacterial diseases in animals. Current trend of infectious disease outbreaks during this period has shown a total of 737 outbreaks of swine fever, 612 outbreaks of FMD covering five years each and 1 outbreak of rabies covering one year, with large number of animals affected and casualties due to these

Table 97 : Comparative growth performance of indigenous pigs of Nagaland at different ages

Parameters	First generation				Second generation			
	Male		Female		Male		Female	
	No.	Mean±SE	No.	Mean±SE	No.	Mean±SE	No.	Mean±SE
Birth weight (kg)	36	0.50±0.15	39	0.53± 0.02	20	0.556 ± 0.02	17	0.57 ± 0.04
Weight at weaning (kg)	35	4.18±0.25	39	4.89± 0.23	18	3.925 ±0.72	17	3.75 ±0.80
Weight at 90 days (kg)	35	6.09± 0.25	39	6.96 ±0.30	18	6.35± 0.29	17	6.90±0.34
Weight at 120 days (kg)	32	7.71± 0.28	39	9.44± 0.42	12	9.03 ±0.04	8	9.38±0.45
Weight at 150 days (kg)	31	9.80 ± 0.34	31	11.76±0.55	3	9.96 ± 1.57	2	12.03±1.62
Weight at 180 days (kg)	30	12.07± 0.40	26	14.36±3.05	—	—	—	—
Weight > 10 months(kg)	23	22.46±1.33	21	33.86±2.85	—	—	—	—

diseases. In poultry 15 outbreaks of ranikhet disease were observed covering 3 years and 1 outbreak of fowl pox covering one year. Among bacterial diseases 8 outbreaks of hemorrhagic septicemia covering two years and 2 outbreaks of black quarter covering one year were recorded with large number of animals affected and casualties during the reported period.

Nature and distribution of the infectious disease outbreaks has shown swine fever with the highest average number of outbreaks per year (147.4 ± 4.17), number of animals affected per year (10988.8 ± 37.10) and number of animals died per year (1281.2 ± 13.58) followed by the values for FMD, H.S., B.Q. and rabies among livestock diseases. In poultry ranikhet disease was with the highest average number of out breaks per year (3 ± 0.94), number of birds affected per year (253.2 ± 8.30) and number of birds died per year (55 ± 9.13) followed by fowl pox. However, mortality rate in livestock diseases were 100% in rabies, 11.66% in swine fever, 3.23% in H.S., 2.32% in FMD and 1% in B.Q., while poultry mortality rates were 25% in fowl pox and 21.72% in ranikhet disease. During the reported period outbreaks of swine fever and FMD were widely spreaded in six districts each, while H.S. and fowl pox in two districts each and BQ, rabies and fowl pox in one district each out of 8 districts in this state.

Table 98: Comparative study on the reproductive traits in indigenous pigs of Nagaland

Parameters	Parent stock		First generation	
	Nos. of Observation	Mean±SE	Nos. of Observation	Mean±SE
Litter size at birth	25	5.96±0.28	32	6.59±0.24
Litter size at weaning	20	4.06±0.35	27	4.27±0.46
Litter weight at birth	25	4.30±0.32	32	4.38±0.28
Litter weight at weaning	20	16.53±1.05	27	18.16±1.16
Age at puberty	20	176.42±3.43	34	160.31±2.72
Age at first farrowing	18	290.56±6.58	30	267.46±3.58
Gestation period	25	114.28±1.53	39	113.18±0.03

Immunostimulation in Farm Anima

H.D. Karmakar

Preparation of immunostimulator from *Mycobacterium phlei* was under progress during the reported period. *M. phlei* (IVRI-strain) was cultivated in 2% glycerinated nutrient broth at 37°C for 15 days. Dilipidation of *M. phlei* has been completed for two batches of harvest. For this purpose moist cell mass of *M. phlei* was extracted

in Soxhlet apparatus consecutively with acetone, ethanol, chloroform and chloroform-methanol (87:13, V/V) for 15 hrs each and finally harvested with ether. The yield of dilipidated dry mass was 24.05% of the moist cell mass of *M. phlei*

MIZORAM

Adoption of pig rearing practices

N.S. Azad Thakur

Breeding practices

Rearing of crossbred pig is practiced only to a little extent to Sikkim, followed by Mizoram and Meghalaya. But heat detection and symptoms identification are done by majority of the farmers in all the states. However, the same trend could not be observed in the case of age at first service, though the farmers of Arunachal Pradesh (80.00%) and Nagaland (70.00%) are quite aware of it. Regarding other practices like maintaining male for breeding purpose, breeding of female piglet in subsequent heat and treatment of unconceived sow, a good number of farmers from these states are following these practices. The pooled data of all these practices show that maintenance of male for breeding purpose is quite uncommon. There has been a wide gap in perception regarding 'sow furrowed twice in a year', 'average litter size at birth' and 'average litter size at weaning' This may be due to the fact that totally non-descript nature of local pigs are reared in the state for which uniformity in these aspects are quite unlikely. Moreover, the farmers of these state are getting very less number of piglets at furrowing time and the mortality rate between furrowing and weaning is also quite high. This needs immediate improvement of management practices to help farmers getting proper benefit.

Feeding practices

The farmers of the state are quite concerned with the feeding of the pigs. Though scavenging is allowed but one definite ration is provided in the evening by a good number of farmers. Most interestingly stall-feeding for pigs was a common one being is practiced by 82 per cent of the farmers.

Similarly, all the farmers under the study provide additional feed in any time of the day. Regarding quantity of concentrate, majority of the farmers (74.00%) provides more than 2 Kg of concentrate.

Healthcare practices

The majority of farmers in this state treat their sick animals & deworm them periodically. The healthcare practices in general are traditional in nature and hardly the pigs were taken to Veterinary Hospitals for treatment. Data presents the most alarming condition in respect of healthcare practices. It seems that healthcare system is somewhat uncommon/unattended in the rural areas of the state. Deworming is the only healthcare practice followed by the farmers which is done through indigenous method only by feeding some local herbs or leaves of trees.

Housing management

Construction of sheds for pigs is a very common practice in the state followed by 80-92 per cent of the farmers. Cleaning of pig-shed and construction of *pucca* and wooden floor is not that much common. Water facility is hardly provided. The housing facility available in the study area is the construction of a set of barrier of bamboo or local timbers and it is hardly covered to save the animals from rain or excessive cold.

Piglet care and other management practices

Farmers take adequate care in deworming and castration of piglets. But another important aspect-removal of naval cord and application of any antiseptic lotion is almost neglected by them. This leads to high mortality and morbidity among the piglets. Weaning is also a neglected practice of the farmers

Categorization of the tribal farmers according to their extent of adoption of pig rearing practices

The data revealed that majority of the tribal farmers were having low levels of adoption in respect of all the areas of breeding (80.00%), feeding (93.00%), health care (97.50%) and housing (71.50%). (Table 99)

Table 99 : Extent of Adoption of Pig Rearing Practices by Tribal

Sl.No.	Category	Breeding N=400		Feeding N=400		Health care N=400		Housing N=400	
		F	P	F	P	F	P	F	P
1.	Low	320	80.00	372	93.00	390	97.50	286	71.50
2.	Medium	53	13.25	20	5.00	10	2.5	162	40.50
3.	High	27	6.75	8	2.00	0	0.00	48	12.00

Reasons for following traditional practices

Preference to local pigs for pork production has been the most important factor in spite of the better performance in growth of the improved breed. Reasons to follow the traditional practices is absence of healthcare facilities as indicated by 90.80 percent of the farmers. The other important factors are susceptibility to diseases, inadequate transport facility, lack of knowledge, non-availability of the suitable breed in the local market, etc. (Table 100)

Table 100 : Factors responsible for traditional pig rearing practices N=250

Sl. No.	Reasons	Frequency	Percentage	Rank
1.	Non availability of suitable breed in local market	192	76.80	VI
2.	Cost of breed	152	60.80	X
3.	Susceptibility of improved breeds to diseases.	201	80.40	III
4.	Non availability of feed	156	62.40	IX
5.	Absence of healthcare facilities	227	90.80	II
6.	Lack of training	167	66.80	VIII
7.	Lack of knowledge about better management practices	198	79.20	V
8.	Weak communication system	186	74.40	VII
9.	Transport	200	80.00	IV
10.	Taste preference	243	97.20	I

Association between selected socio-economic variables and management practices (Adoption):

Traditional practices depend mainly on the socio economic profile of the farmers and more the farmers are exposed, greater is the chance to follow improved rearing practices. The following table (Table 101) indicates the association between selected socio economic variables and management

practices followed by the farmers. The 'r' value indicates a very uncommon association. Generally it is believed the more sound is the economic profile higher is the possibility for the improvement. But it is observed from the table that hardly any socio-economic variable has exerted influence on improved rearing practices.

With the traditional pig rearing practices, it may be stated that improvement in management practices is very difficult with the existing condition. However, only livestock possession has significant and positive influence on all the management aspects. Land holding and annual income have been found positively and significantly related to housing which indicates that economic condition and land possession are coming on the way for better pigshed construction ('r' value 0.2757 and 0.4131 respectively). The pooled correlation value, however, indicates that except in livestock possession the other socio economic variables are negatively significant. This may be due to lack of interest and will power to improve the existing condition.

Constraints:

Breeding management constraints perceived by the tribal farmers

It was found that non availability of good boar was a major limiting factor followed by piglet mortality (68.00%) and third important constraint was difficulty in heat detection (60.00%)

Feeding management constraints perceived by the tribal farmers

Major constraints under feeding management in order of severity were high cost of feed (I rank;

Table 101: Association between selected socio-economic variables and management practices

SL. No.	Variables	'r' value				
		Breeding	Feeding	Healthcare	Housing	Pooled
1.	Age	-0.1518	0.0245	-0.0691	0.0809	-0.1187
2.	Family size	-0.2558	0.0517	-0.2870	0.1362	-0.2329*
3.	Education	-0.2227	0.0447	-0.4676**	0.1815	-0.2429*
4.	Land holding	-0.3125*	0.1960	-0.1457	0.4131*	-0.1394*
5.	Livestock possession	0.2836*	0.3337*	0.2972*	0.3230*	0.1454*
6.	Annual income	-0.2655	-0.4107**	-0.0880	0.2757*	-0.2681**
7.	Social participation	-0.2223	-0.2428	-0.1664	0.1652	-0.2466**

* Significant at 5% level ** significant at 1% level

67.00%), followed by lack of knowledge about balanced feeding (II rank; 66.00%) and non-availability of good quality feed materials (III rank; 59.24%)

Health care constraints perceived by the farmers

Main constraints under healthcare were difficulty in identifying disease symptoms in early stage, veterinary hospital are located at distant place, in proper care of piglets, lack of knowledge about vaccination scheduled, insufficient veterinary hospital and dispensaries, high cost of medicine and lack of staff in Veterinary hospitals.

Marketing constraints perceived by the farmers

Major constraints under this head were price of produce is not remunerative, lack of accessibility to market, existence of malpractice's, lack of processing facility, non availability of cooperative marketing, exploitation by middle man and transportation.

Economical constraints encountered by the farmers

Economical constraints include high cost of feed, lack of credit facility, non availability of credit, Less profitability and Inadequate credit facility.

NATP-JAI VIGYAN PROJECT

N.S. Azad Thakur

A mission mode project was launched in Sept. 2000 at this Centre to uplift the socio-economic conditions of the farmers.

Integrated Piggery Development

The selected beneficiaries and breeder farmers were provided 3 (2 Females + 1 Male) and 8 (6

Females + 2 Males) pre vaccinated White Yorkshire breed of piglets, respectively along with feed and medicine. In the year under report, 9 farmers have returned a total No of 24 piglets, which were redistributed to other 9 selected farmers in Kolasib & Aizawl districts. The distributed piglets are being monitored regularly for growth rate, mortality, furrowing and other management practices of the piglets. The parasitic, skin, respiratory diseases and urinary tract infection were observed in some of the distributed piglets.

RABBIT

MEGHALAYA

Performance of crossbred rabbits

Anubrata Das, S.K. Das, S. Naskar & G. Kadervil

Productive and reproductive performances of different crossbred rabbits produced through a 3x3 diallel crossing involving Soviet Chinchilla (SC), Newzealand White (NZW) and Meghalaya local (ML) rabbits were studied to find out the best possible combination.

The analysis of data revealed that highest litter size at birth (7.20), litter size at weaning (5.62) litter weight at birth (342.00g) was found in SN (SC x NZW). However individual litter weight at birth was highest (55.10) in SL (SCx ML). In male litter

weight at weaning was highest in LS (ML x SC), but weaning weight in female and overall weight were highest in SN. Highest live weight in male, female, overall at 90,120 and 150 days were recorded in SN, however highest 60 days weight was observed in SL. Highest growth in post weaning period and in 90 days period from birth to marketing was found to be 20.46 and 17.12 gram per day in SN (Table 102).

Table 102 : Productive and reproductive performance of half bred rabbits

Sl Traits No	Genetic Group			
	SN (SC x NZW)	NS (NZW x SC)	SL (SC x ML)	LS (ML x SC)
1 Litter size at birth	7.20±0.33	6.50±0.27	5.85±0.25	6.00±0.29
2 Litter weight at birth (g)	342.00±8.27	337.00±8.95	322.31±9.69	325.56±3.00
3 Individual litter weight at birth (g)	47.50±5.12	51.85±4.61	55.10±3.87	54.26±5.63
4 Litter size at weaning	5.62±0.22	5.50±0.37	5.30±0.21	5.29±0.30
5 Wt at 42 days				
M(g)	595.00	577.88	532.86	603.16
F	616.67	583.04	610.83	596.11
O	605.84	580.46	571.85	599.64
6 Wt at 60 days				
M(g)	925.00	863.75	913.93	901.58
F	995.22	935.22	1036.67	881.67
O	960.11	899.49	975.30	891.63
7 Wt at 90 days				
M(g)	1586.67	1425.94	1541.43	1462.11
F	1589.56	1487.83	1511.25	1442.78
O	1588.12	1456.89	1526.34	1452.45
8 Wt at 120days				
M(g)	2026.36	1935.00	1971.79	1866.11
F	2055.65	2026.96	2017.50	1942.67
O	2041.01	1980.98	1994.65	1904.39
9 Wt at 150days				
M(g)	2209.03	2184.69	2185.00	2136.11
F	2241.90	2238.33	2159.58	2170.00
O	2225.47	2211.51	2172.29	2153.06
10 ADG from birth to 90 days (g / d)	17.12	15.61	16.35	15.54
11 ADG from 42 to 90 days (g / d)	20.46	18.26	19.89	17.77

Organoleptic properties and consumption pattern of rabbit meat

S.K. Das & Anubrata Das

Organoleptic properties and consumption pattern of rabbit meat based on 121 consumers were studied. It was found that 47.62% consumers reported flavour of meat as **good**, whereas 47.62 % reported taste of rabbit meat as **very good**. Most of the respondents (57.14 %) found colour of meat white. Maximum consumers reported that juiciness and tenderness (90.48 per cent) of meat was **medium** (89.95 %). Most of the consumers (57.14 %) delineated that they take rabbit meat **thrice a week**. Rabbit meat consumed per week per head was in the range of **100-200g**, which was as per 38.10 % consumers.

Microenvironment of rabbit house

Microenvironment of rabbit house was recorded regularly in the morning. The average maximum temperature, minimum temperature, air temperature and RH in 2002-03 was found to be 26.63 ± 1.05 ° C, 16.69 ± 1.79 ° C, 24.11 ± 1.09 ° C and 72.88± 1.45 per cent. Highest maximum (30.32 ° C), minimum (25.63 ° C) and air temperature (29.03 ° C) were recorded in the month September and highest RH was found in the month July (79.50 %). The range of air temperature was 29.03 ° C to 17.10 ° C. Range of RH was 79.50 to 62.17 %. Multiple regression analysis was done to find the effect of air temperature and relative humidity on average daily gain, dry matter intake and fed conversion ratio. It was found that average daily gain; dry matter intake and fed conversion ratio were negatively correlated with both air temperature and relative humidity. More incidences of diseases were found during rainy season, which was in correlation with the highest ambient temperature and RH during rainy season.

Improvement of Broiler Rabbit for meat in Eastern Himalayas

S.K. Das & G. Kadervil

One hundred and ninety seven rabbits consisting of 100 Soviet Chinchilla (SC) and 97 New Zealand White (NZW) were studied during the year 2002-03. Rabbits were kept in low cost thatch housing system in group. They were fed 50% concentrate pelleted feed and rest DM was supplied through congosignal grass. The composition of feed was maize crust 40 %, wheat bran 22 %, groundnut cake 25 %, fishmeal 5 %, molasses 5 %, vitamin and mineral mixture 2.5 %, common salt 0.5 %. Weaning was practiced at the age of one month and slaughtering was done at the age of four to five months. Average weaning weight in NZW at one month of age was found to be 526.58 and 610.94g in 2nd and 3^{re} generation with an improvement of 16.02 %. Improvement was reduced gradually in subsequent ages i.e. 2m, 3m, 4m and 5m. Average daily gain was found to be 16.66 g/d in second generation and 16.80 g/d in third generation crops with an improvement of only 0.84 %. However in SC rabbit improvements of 4.80, 5.57, 1.00, 0.85, 0.81 and 0.78 % were observed in third generation crops over second generation crops at 1m, 2m, 3m, 4m, 5m and 6m live weight respectively. Average daily gain was found to be 17.24 and 17.09 g/d in second generation and third generation progenies.

In NZW improvements were observed in second generation crops over first generation in almost all the traits i.e. litter size at birth (6.27%), litter weight at birth (3.20%), litter size at weaning (22.90%), litter weight at weaning (26.97%) and interkindling period (38.79%). The average value for all the traits in NZW was 5.76, 312.42g, 4.38, 2093g, 1.79 and 101 days. However, in SC rabbit no improvement was found in second-generation crops over the first generation. It indicates that reproductive performance of first-generation was better than that of second-generation except in interkindling period where minor improvement was seen in second generation over first generation. The average figures for litter size at birth (LSB), litter wt at birth (LWB), litter size at weaning, litter wt at weaning, service per conception (SPC) and inter kindling period

(IKP) in SC were 5.79, 316.10g, 3.94, 1859.24g, 1.74 and 83.21 days respectively. When NZW and SC were compared, it was found that SC was better than NZW in respect of LSB, LWB, SPC and IKP.

Rabbit Nutrition and Feeding

Roughage based feeding system for rabbit production:

J.J. Gupta & B.P.S. Yadav

An experiment was conducted on 24 numbers of New Zealand white rabbits (970±53.36 g) equal sex ratio (50±5 days old) for a period of 50 days to evaluate the roughage based feeding system for economic production. All rabbits were distributed into 4 treatment groups and kept in individual iron cages. The concentrate mash ration of 19% protein level was prepared and fed in *ad-libitum* once in the morning hours. However, mash ration was wet in water in the ratio of 1:1 (w/v) and made in to ball before feeding. The rabbits of all four groups were provided fresh roughages viz. T₁: Congosignal, T₂: Rice bean, T₃: Soybean and T₄: Job's tear through cut and carry methods in *ad-libitum* during evening hours. The performance (growth rate, feed intake and FCR) of rabbits was recorded. Nutrient digestibility coefficients (Table 103). revealed that rabbits achieved significantly (P<0.01) higher growth rate of 17.70±2.16 and 15.38±0.73 g/d on soybean and rice bean fodder respectively than congosignal (7.92±0.81) and job's tears (8.63±0.96) fodder and it saved 60 and 51 per cents concentrate feed. Most of the nutrients also showed better digestibility coefficients on rice bean and soybean fodder. It is concluded that almost 50% concentrate feed can be saved from rabbit ration by feeding of rice bean or soybean fodder.

Adaptive trial on broiler rabbit in Tripura

S.K.Ghosh

Two breeds of broiler rabbit viz. NZW and SC were introduced during 1997-98 under the project "Adaptive trial on broiler rabbit in Tripura". The animals were kept in individual cages made by galvanised wire (size : 50-60 cm x 35-40 cm). Commercial pellets and green fodder (25-30 : 70-

Table 103 : Growth performance and nutrient digestibility in New Zealand White rabbits

Particulars	Treatment Means \pm SE				\pm CD
	T ₁ : Congosignal	T ₂ : Rice Bean	T ₃ : Soybean	T ₄ : Job's Tears	
Growth Performance:					
Growth Rate (g/d)	7.92 ^a \pm 0.81	15.38 ^b \pm 0.73	17.70 ^b \pm 2.16	8.63 ^a \pm 0.96	5.24**
DM Intake (g/d) Concentrate	47.67 ^b \pm 0.80	43.83 ^{ab} \pm 1.42	41.33 ^a \pm 1.02	42.50 ^a \pm 0.72	4.14**
Roughage	32.50 ^a \pm 3.23	45.67 ^b \pm 1.65	62.50 ^b \pm 2.88	25.83 ^a \pm 2.71	10.80**
Total	80.17 ^b \pm 3.20	89.50 ^b \pm 1.69	103.83 ^b \pm 2.07	68.33 ^a \pm 2.28	9.55**
Fibre Intake Ratio (%)	40.00 ^a \pm 2.41	51.00 ^b \pm 1.39	60.00 ^b \pm 1.59	37.33 ^a \pm 2.84	8.61**
FCR on Total DM Intake	10.62 ^b \pm 1.13	5.86 ^a \pm 0.20	6.31 ^a \pm 0.75	8.46 ^{ab} \pm 1.02	3.44**
FCR on Concentrate Intake	6.33 ^b \pm 0.64	2.87 ^a \pm 0.12	2.56 ^a \pm 0.36	5.21 ^b \pm 0.53	1.85**
Nutrient Digestibility (%):					
Dry Matter	65.42 ^b \pm 2.18	68.02 ^b \pm 1.65	65.98 ^b \pm 1.70	50.88 ^a \pm 2.52	8.45**
Protein	71.04 ^b \pm 0.88	76.80 ^b \pm 1.34	74.26 ^b \pm 1.14	65.62 ^a \pm 1.31	4.89**
Fibre	11.07 ^a \pm 0.46	28.87 ^b \pm 0.62	29.61 ^b \pm 1.39	9.64 ^a \pm 0.58	3.50**
Ether Extract	60.08 ^a \pm 1.24	49.38 ^b \pm 1.39	39.95 ^b \pm 1.08	45.14 ^b \pm 0.80	4.75**
Calcium	37.33 ^b \pm 1.69	43.41 ^b \pm 2.06	47.14 ^b \pm 1.14	29.10 ^a \pm 1.12	6.52**
Phosphorus	47.37 ^b \pm 1.80	40.14 ^a \pm 2.50	38.47 ^a \pm 1.73	22.76 ^a \pm 1.52	7.95**

75) were used as their feed. The green fodder included leaves of mulberry, cauliflower, cabbage, cowpea, maize, radish, turnip, carrot and grasses like dubgrass, napier etc. During the period under report 65 kindlings were recorded in both the breeds. When productive and reproductive performance were compared between the two breeds, it was observed that both the breeds performed equally well. No significant differences were observed between the two breeds in respect of their litter size at birth, litter weight at birth, litter size at weaning, litter weight at weaning and individual weight at 90 days of age.

Induction of kindling by PGF_{2a} and its effect on reproductive and productive traits in broiler rabbit

S.K. Ghosh

This study was designed with an objective to reduce the cost of production of rabbit by reducing the pregnancy period without any effect on production. Two breeds of broiler rabbit viz. New Zealand White (NZW) and Soviet Chinchilla (SC) were included in this study. Thirty induced kindling (13 NZW and 17 SC) and equal number of normal

kindling (14 NZW and 16 SC) were studied for this experiment. In the treatment group, pregnant does were given 0.1 ml of Iliren® (0.015 mg Tiaprost) intramuscularly on 26th day of pregnancy. The equal amount of normal saline was also injected to the control group of animal. The gestation periods were recorded as 28.06 \pm 0.35 and 30.36 \pm 0.33 days for treatment and control groups, respectively. Litter size at birth (No.), individual weight at birth (g) and litter size at weaning (No.) were found to be 6.01 \pm 0.52 and 6.16 \pm 0.39, 50.12 \pm 0.28 and 48.97 \pm 0.36, 5.25 \pm 0.41 and 5.16 \pm 0.29 in treatment and control group, respectively. Individual weight at weaning (g) and at d 90 (day of slaughter) (kg) were observed to be 687.46 \pm 4.14 and 1.88 \pm 0.07, respectively in treatment group and the corresponding values were recorded in the control group were 693.76 \pm 4.30 and 1.89 \pm 0.08, respectively. No significant differences were observed between the two groups in respect of their different reproductive and productive traits though the gestation period was reduced by around 48 hours in treatment group. Therefore, it can be concluded that induction of kindling would be a successful programme in broiler rabbit production unit.

Studies on productive and reproductive performance of crossbred rabbit

S.K. Ghosh

In order to improve the productivity crossbreeding programme between NZW and SC was undertaken from the last year and their productive performance was studied only in first generation (F1). Twenty two (10 NZW male and 12 SC male) crossbreeding were performed and their productive performance was recorded (Table 104)

Table 104 : Productive and reproductive performance of crossbred rabbit

Trait	NZW Male	SC Male
Gestation period (day)	30.32 ± 0.38	30.19±0.40
Litter size at birth (No.)	6.45±0.40	6.20±0.10
Individual wt. at birth (g)	55.16±1.14	53.20±1.28
Litter size at weaning (No.)	5.50±0.70	5.39±0.38
Individual wt. at weaning (kg)		
M -	0.850±0.03	0.88±0.06
F -	0.810±0.05	0.83±0.04
Individual wt. at 90 days of age (kg)		
M -	2.02± 0.08	2.00±0.09
F -	1.98±0.06	1.94±0.07

GOAT

MEGHALAYA

Epidemiological Investigation of parasites through autopsy Examination of Goat slaughtered in Meghalaya

S. Bandyopadhyay

A total of 29 number of stomach and intestine of goat were collected from local unorganised slaughter places located in Shillong. The goats were brought from various places located in different altitudes of Meghalaya. Out of 29 viscera following parasites were recovered and identified

1. *Oesophagostomum radiatum* (48.27%)
2. *O. venulosum* (37.93%)
3. *Haemonchus sp.*(in abomasum) (51.72%)

4. *Haemonchus sp.*(in reticulum) (41.37%)
5. *Trichuris ovis* (41.37%)
6. *Bunostomum sp.* (31.03%)
7. *Moniezia benedeni* and *M. expansa* (31.03%)

Effect of concentrate feeding on carcass quality of local goats

B.P.S. Yadav S. Doley & J.J. Gupta

Thirteen local male goats of 9-10 kg body weight were procured, castrated and conditioned for 15 days before experiments. They were divided into two groups; on body weight basis with group average of 9.42 ± 0.15 and 9.67 ± 0.25 Kg. Randomly one group of goats was provided with concentrate mixture of 16 % CP @ 100 g /head / day in addition to grazing, whereas another group was kept only on grazing. After six months of feeding experiment, the goats were slaughtered as per the standard procedure. The dressing percentage, moisture and crude protein contents in meat were estimated for carcass evaluation. The moisture and crude protein contents were little higher in carcass of goats kept on grazing, whereas dressing percentage was little higher in group I where concentrate was supplemented but differences were not significant. The result indicated that feeding of concentrate mixture to local goats did not show any significant effect on carcass quality specially on dressing percentage, moisture and crude protein content.

POULTRY

MEGHALAYA

Poultry Nutrition and Feeding

Effect of phytase enzyme supplementation on level of rice polish utilization in broiler chicken ration:

J.J. Gupta, S. Doley & B.P.S. Yadav

An experiment of 28 days duration was conducted on 21 days old Vencob strain broiler chicks to study the feeding value of rice polish at various levels of inclusion in ration with enzyme phytase. Total 162 birds were distributed into 27

groups with 6 birds in each under deep litter system. The experiment was conducted in factorial design of CRD with 3 levels of rice polish (15, 30 and 45Kg/100Kg of feed) and 3 levels of phytase enzyme, (0, 10 and 20 g/100Kg of feed). The diets were made isonitrogenous (21% crude Protein) with the help of GNC, Soya meal and fishmeal. The feed and water were provided to birds in *ad-libitum*. Feed conversion ratio (FCR) and feed cost per Kg body weight gain was calculated on the basis of growth & feed consumption of birds (Table 105). The results revealed that as the level of rice polish increased the growth rate reduced. However, there was not any significant difference in the performance of chicken fed rice polish at 15 % or 30% levels. The supplementation of enzyme phytase did not improve the feeding value of rice polish in broiler chicken ration. Thus, rice polish can be fed to a maximum level of 30% to broiler chicken even without supplementation of phytase enzyme.

Table 105 : Performance of broiler chicks fed rice polish based ration with phytase enzyme

Treatments	Performance ± SE		FCR	Feed Cost (Rs.) Per Kg Gain (g/d)
	Growth Rate	Feed Intake (g/d)		
T1: (RP, 15; P, 0)	45.20 ^b ± 2.52	138 ± 1.11	3.07 ^a ± 0.18	30.02 ^a ± 1.79
T2: (RP, 15; P,10)	46.74 ^b ± 1.66	134 ± 2.16	2.93 ^a ± 0.03	28.92 ^a ± 0.32
T3: (RP, 15; P,20)	47.42 ^b ± 1.49	137 ± 2.16	2.89 ^a ± 0.14	28.70 ^a ± 1.38
T4: (RP, 30; P, 0)	44.17 ^a ± 1.19	139 ± 0.81	3.14 ^a ± 0.09	30.18 ^a ± 0.89
T5: (RP, 30; P,10)	45.32 ^b ± 0.77	141 ± 1.71	3.12 ^a ± 0.08	30.14 ^a ± 0.81
T6: (RP, 30; P,20)	42.15 ^b ± 1.71	135 ± 3.85	3.20 ^a ± 0.04	31.17 ^a ± 0.38
T7: (RP, 45; P, 0)	34.79 ^a ± 1.27	135 ± 3.20	3.88 ^b ± 0.11	36.47 ^b ± 1.03
T8: (RP, 45; P,10)	33.36 ^a ± 0.66	133 ± 3.31	3.98 ^b ± 0.09	37.72 ^b ± 0.82
T9: (RP, 45; P,20)	33.55 ^a ± 1.24	135 ± 3.97	4.03 ^b ± 0.10	38.45 ^b ± 0.99
LSD±	6.04**	NS	0.43**	4.19**

RP: Level of Rice Polish inclusion in diet (Kg/100Kg); P: level of Phytase Inclusion in diet (g/100Kg) ** Level of significance at 1%

Effect of different brooding systems on subsequent performance in broiler chicks:

S. Doley, J.J. Gupta & B.P.S. Yadav

Two experiments were conducted in the month of May-June and Nov.-Dec. 2002 to study the different brooding systems and its subsequent affect on the performances of broiler chicks under sub-tropical conditions at mid altitude of Meghalaya. Unsexed, day-old Vencob strain broiler chicks were brooded separately in two groups for 21 days. The chicks of group-I was provided electric Hoover whereas, chicks in group-II was provided only charcoal angithi and a zero watt electric bulb during night hours for light purpose on standard feeding of practice. The body weight of chicks was recorded at 0, 21, and 49 days of age. The cumulative feed intakes during different period and mortality were also recorded and feed conversion ratio (FCR) was calculated. The performance of chickens brooded in different brooding system are presented in Table 106.

Table 106 : Impact of various brooding system on boiler chicken performance

Particulars	Group Value		
	T ₁ : Electric Hoover May-June	T ₂ : Charcoal Angithi May-June	Nov.-Dec.
Body Weights (g)			
21 ^a Days	450.00±8.28	464.69 ± 8.48	377.00±10.59
49 ^a Days	1769.32±29.85	1890.00±24.60	1600.28±82.65
Feed Intake (g/d)			
0-21 days	50.17±0.60	49.13±0.50	3556±1.83
21-49 days	126.64±1.47	126.93±0.15	137.79±1.11
Mortality (%)			
0-4 days	0	0	0
4-21 days	0	0	2
21-49 days	3.92	3.92	3.5
0-49 days	3.92	3.92	5.5
Growth rate (g/d)			
0-21 days	24.03±0.64	25.71±0.91	16.37±0.57
21-49 days	47.17±1.10	51.07±1.55	43.67±2.34
0-49 days	35.41±0.66	37.94±0.82	31.97±1.45
Feed conversion Ratio (FCR)			
0-21 days	2.16±0.07	2.01±0.04	2.17±0.08
21-49 days	2.69±0.04	2.49±0.07	3.16±0.13
0-49 days	2.55±0.03	2.38±0.05	2.94±0.90
Brooding Cost (Rs./Bird) 0-21 days			
	31.12	32.12	-

The result revealed that Day-old chicks could even be brooded with the help of charcoal Angithi only and an arrangement of light during night hours for better post brooding performance in rainy as well as winter season too in remote villages of northeastern region where electric is not available.

NATIONAL AGRICULTURE TECHNOLOGY PROJECT

Diagnostic survey on rural poultry in Meghalaya

J.J. Gupta, S. Doley & B.P.S. Yadav

A diagnostic survey with objectives:

- i. To record the present poultry production status;
- ii. To record feeding, breeding and health cover aspects;
- iii. To identify constrains faced in marketing of egg/meat was started.

Total 14 villages were selected from all 7 districts of Meghalaya to achieve above targets with the help of Animal Husbandry & Veterinary Department, Govt. of Meghalaya. Total 25 farmers from each identified village were selected as the target groups and informations collected as per approved questionnaires through participatory discussion method. The different feed samples fed to poultry were also collected for nutritional analysis during visits. The following salient informations are recorded.

- On an average 15.85 birds per family are reared by tribal people of Meghalaya and majority of farmers are not satisfied with their present stock of desi type.
- On an average 47.41 eggs per hen per annum are obtained from desi bird and sold at an average rate of Rs. 2.90 per egg.
- The survey indicates that 97.71% farmers are interested to keep improved rural poultry breed of dual purposes suitable to their agro-climatic conditions. However, 99.71%

farmers need subsidy on poultry feed whereas 47.14% farmers need loan and 77.71% farmers only need training for upliftment of rural poultry production through improved way of management practices.

Most of the poultry owners offer self produced cereal grains and kitchen waste to their desi bird and in daytime allow for scavenging. But those farmers who keep broiler chicken provide commercial compound mash feed to their birds.

The farmers never spent money on veterinary medicine even on broiler chicken. They procure medicine only from Govt. agencies. The average mortality of 19.75 per cent is reported and major diseases recorded during survey are Coccidiosis, Salmonellosis, RD, CRD, MD and Fowl Pox.

AICRP on Poultry Improvement (Rural Poultry Production)

M. Niranjan & S.K. Ghosh

During the present year evaluation of dual purpose germplasm viz. Vanaraja and Giriraja was continued from previous year both at farm and farmers level. Data regarding to various parameters are presented in Table 107.

Giriraja showed better body weight than Vanaraja at all ages both at farm and farmers house. Age at sexual maturity was less in Vanaraja. Egg production upto weeks of age was more in Vanaraja at both locations than Giriraja. Mortality due to predotous was upto 40% at farmers house due to heavy body weight. The farmers could sell these birds @ Rs.90/- per kg live weight when they are around 2-2.25 kg due to their coloured feathers.

Evaluation of Gramapriya

An egg type backyard variety is under progress. Twelve hundred hatching eggs were procured from Project Directorate on Poultry, Hyderabad and incubated in the institute hatchery. Hatching data is presented in Table 108.

Table: 107 : Comparison of two breeds of poultry birds.

Parameter	Vanaraja		Giriraja		
	Farm	Farmer	Farm	Farmer	
20 week body weight (g)					
	M	2581.64 ± 51.44	2318.92 ± 83.02	2782.94 ± 42.46	2661.76 ± 62.68
	F	2055.94 ± 33.15	1913.47 ± 46.27	2243.09 ± 56.41	2134.17 ± 72.16
40 week body weight (g)					
	M	3721.25 ± 51.90	3373.27 ± 46.23	4274.67 ± 63.62	3986.43 ± 62.17
	F	2710.36 ± 48.86	2432.46 ± 56.73	3258.63 ± 77.45	2896.38 ± 42.63
Age at first egg (Days)	151.00	181.23	162.00	190.62	
Egg number upto 40-weeks of age.	38.13	29.64	32.63	23.74	
Egg weight at 40 week of age (g)	61.53 ± 0.18	-	64.83 ± 0.28	-	
Feed consumption per day between 19-20 weeks of age(g)	128.87 ± 11.62	-	142.99 ± 18.16	-	
Feed consumption per day between 39-40 weeks of age(g)	223.05 ± 14.13	-	254.50 ± 12.63	-	

Table 108 : Hatching performance of Gramapriya

Variety	No. of eggs set	No. of fertile eggs	No. of chicks hatched	Fertility (%)	Hatching (%)
Gramapriya	1088	884	704	81.25	64.71 79.97

Evaluation of Guinea fowl under Tripura climate

M. Niranjan

Pearl variety of guinea fowl (*Numida meleagris*) was evaluated during the current year. Fertility was

77.65 per cent and hatchability on fertile eggs set was 87.59 per cent. Birth weight (23.67 g), 4 week (189.54g), 8 week (536.23g), 12 week (847.18g), 16 week (1103.63g) and 20 week (1236.78g) body weight was recorded. The egg production during laying cycle (April to September) was 92.67 eggs. Egg weight was 40.17 g.

NATP-JAI VIGYAN PROJECT

N.S. Azad Thakur

A mission mode project was launched in Sept. 2000 at this Centre to uplift the socio-economic conditions of the farmers.

Backyard Poultry Production

A total No of 1260 eggs of 'Vanaraja' were procured in 3 batches from the Project Directorate on Poultry, Hyderabad, hatched at State Govt. Hatchery and day old chicks were reared at this Centre up to 6 weeks of age and distributed to the selected beneficiaries of Kolasib district. A total no. of 320 birds were distributed to 32 selected beneficiaries in different villages of Kolasib district. The distributed birds are constantly monitored for the survival, mortality, laying performance, etc.

Jai Vigyan Household Food and Nutritional Security for Tribal, Backward and Hilly Areas on Poultry Production (MM III)

S.V. Ngachan & A. Suresh Kr. Meitei,

Under this NATP Project eggs from Project Directorate on Poultry, Hyderabad were obtained and chicks were produced and distributed among the farmers. Out of 10,290 fertile eggs, only 3760 healthy chicks were produced after accounting for the losses in transit and hatching during the year, 2002-2003. Out of the last consignment of 1260 fertile eggs, 896 eggs were incubated for production of Vanaraja chicks. The percent hatchability on total egg set ranged moderately from 42.0 to 64.29 % for all the six batches of eggs set during the year (Table 109).

Table 109 : Chicks Production at the Centre

Sl. No.	Eggs requisitioned	Eggs set no.	Broken (%)	Hatch ability %	Chicks produced (No.)
1	2100	1507	28.2	48.2	724
2	1470	1094	25.7	55.0	602
3	1470	983	33.1	42.0	413
4	1470	1084	26.3	47.1	511
5	1470	1126	33.0	64.3	724
6	2100	1835	12.6	43.0	786
	10,290	7629	26.5	49.0	3760

All the chicks produced were raised up to the age of six weeks and the average body weight was 601 g with a feed efficiency of 2.16. The mortality has been around 13.34% up to the age of six weeks. On an average females weighed 2450 g at the point of lay and at the same age the male weighed 3180 g. The range of bodyweight was for females between 1700 g to 3200 g and in males 2600g to 3700 g at different location of rearing. The females matured between 156 to 178 days of age with an average age of 167 days. During the first month of lay egg production was 9.6 per month. The average body weight at twenty weeks of age for the birds reared in the Open and the Semi-open systems was 2360 g and 2520 g respectively, the average body weight of females and males was 2580 g and 3150 g respectively at forty weeks of age. At seventy two weeks of age, the average body weight of females and males was 3430 g and 4350 g respectively. The sexual maturity of Vanaraja pullets was 167(av.) days produced 32 to 36 eggs in initial 100 days production period. The average weight of first egg laid and at seventy two weeks was 40 gram and 62 g respectively. The laying potential of the hens was recorded , 140 to 170 eggs per hen/year and the percent of hatchability on fertilized egg set under farm condition was found between 72 to 91. The survivability under farm condition was recorded at 87% (110).

This Centre continued to distribute chicks from its nursery after rearing them for 6 weeks under controlled conditions. During the reported year, 2041 grown up Vanaraja chicks were distributed in

nine districts of Manipur, however, the last consignment was under progress (Table 111).

Table 110 : Performance of Vanaraja birds in farmers' unit

Particulars	Vanaraja	
	Male	Female
Av. b. wt (g)		
at 20 wks.	2750	2240
at 40 wks	3150	2580
at 72 wks	4350	3790
Av. Egg production at 72 wks. (No./wk)	4	
Av. Egg weight (g)		
1 st egg		40
at 40 wks		58
at 72 wks		58
Av. Sexual maturity (days)		167

Table 111 : Distribution of Vanaraja Chicks from Nursery to households in different districts of Manipur

Districts	7th batch	8th batch	9th batch	10 th batch	11th batch	12 th batch
Bishnupur	10	30	-	-	-	Under progress
Chandel	160	100	-	-	-	
Churachandpur	16	25	26	35	75	
Imphal West	70	44	66	103	60	
Imphal East	23	20	46	36	47	
Senapati	95	50	-	45	30	
Tamenglong	30	-	-	-	-	
Thoubal	12	-	16	75	55	
Ukhrul	148	110	130	28	225	
Total	564	379	284	322	492	

Mortality statement

During the brooding period, to note the overall incidence of various problems, code of diseases, and mortality percentage have been shown below. Mortality rate was found to be highest in batch no. 8 with 33.0% where as lowest was reported in batch no. 11th with 2.3 at the 4th week of age (Table 112).

Diseases/Code

A. Respiratory diseases	B. Digestive disorders
C. Reproductive problems	D. Nervous diseases
E. Non-specific diseases	F. Weakness
G. Accidents	H. Specific diseases
I. Urinary diseases.	J. Others.

Table 112 : Mortality Statement

Code	7th	8th	9th	10th	11th
A	23	27		12	
B					
C					
D					
E	27	29	2	14	10
F	10		6	8	
G	42	64	38	17	8
H	20	72		10	2
I					
J	13	8		12	
Total (no)	135	200	2	73	20
Mortality(%)	18.7	33.2	11.6	14.28	2.27

Socio-economic Impact assessment

Further, the performance of Vanaraja chicks at farmers' location under free range and semi range systems of rearing is being assessed for evaluation of impact of poultry farming. Thus, Information on socio-economic impact was collected from 240 beneficiaries and analyzed. Types of rearing were categorized into 2 systems (Open and Semi-open systems) covering 140 in the Open system and 100, Semi-open system.

Occupation

Occupations	Open system	Semi-open system
Agriculture	48	16
Poultry business	22	8
Service	27	32
Small business	13	5
Labour	21	22
Other	9	17

Educational Level of the beneficiary

Level	Open system	Semi-open system
Primary	2	-
High school	21	3
Secondary class	53	21
College	23	24
Other	41	52

Locations of the practice

Locations	Open system	Semi-open system
Rural	83	15
Peri-urban	37	46
Urban	20	39

Category of farming practices

Type of rearing	No. of beneficiaries	Av. Sex ratio (M: F)
-----------------	----------------------	----------------------

Open System	140	1:3
Semi-open system	100	1:7

Period of operation

Duration of rearing	Open system	Semi-open system
In weeks	62.0	56.4

Mortality (7 weeks onward)

Mortality	Open system	Semi-open system
(%)	(up-to 62 weeks.)	(56.4 weeks.)
	20	1.1
	21	

Average Egg Production / bird

	Open system	Semi-open system
(during 62 wks life span)	196 eggs	156 eggs
(during 56.4 wks life span)		

Total Costs, Total returns and profit per bird

System	Total Costs	Total returns	Profit per bird
Open	Rs.203.21	Rs.592.17	Rs.388.95/ bird/62 wks.
Semi-open	Rs.467.79	Rs.594	Rs.126.21/ bird/65.4

Profit per Year per bird

Open	Rs.324.59
Semi-open	Rs.113.15

Profit per month per bird

Open	Rs.27.05
Semi-open	Rs.9.43

Input - Output Ratio

Open	1.00 : 2.91
Semi-open	1.00 : 1.27

The items of costs include purchase of price of birds. Feeds, medicines, mortality etc. and the output values as eggs, culled birds/ male birds disposed off, consumption of eggs and meat during the reared

periods. It may be stated that the awareness among the sample beneficiaries of the qualitative standard of Vanaraja strain and the economic implications in an encouraging trend for the acceptance as a layer bird for rural poultry at household level. Vanaraja birds have been continued to distribute to the farmers along with a suitable package of practices for improving the rural poultry production using an improved breed as a profitable venture. The price of Vanaraja chicken eggs for hatching purpose cost Rs. 5.00 to Rs.10.00 per unit, on live weight, Rs. 75.00 to Rs. 85.00 per kg was offered. Farmers produced own chicks at their level for replacement of the stock.

Vanaraja chick production Under Natural Condition

Farmers in the rural areas regarded Vanaraja birds as a good layer as such eggs produced by the farmers incubated the hatching eggs using local hens for production/propagation of next generation chicks. The chicks are maintained under traditional system of rearing with the mother hens. Percent hatchability ranges from 61.5 to 83.3 in which 10 to 16 fertile eggs were set of incubation i.e. per local broody hen. The weight of the day old chicks was in the range of 42 to 46 g which is extremely good size even under the controlled conditions of hatching. Vanaraja chicks produced by the progressive farmers are sold at the rate of Rs. 18 per day old chick and the RD F1- strain vaccinated day old chicks are sold at the rate of Rs. 20.00.

Records of broodiness of Vanaraja hens were collected from 3 beneficiaries. The farmers stopped the habit by withdrawing eggs from the birds.

One beneficiary from Ukhrul district has managed force incubation of Vanaraja hen by keeping in a basket and allowed to sit on eggs as the farmer had no alternative. They, thus multiply the chicks at the household level (113).

Chick Production under Artificial Incubation system

Progressive farmers from Imphal East and West districts brought fertile eggs produced at households and incubated every week under artificial incubation

at state Govt. farms.. In this way multiplication and dispersion have been in a continuous process.

Table 113 : Chick production using Local hens in Hills and Rural areas

Total eggs set (No.)	Chicks hatched (No.)	Hatchability on total eggs set (%)	District falls
188 (14)	129	69.0	Churachandpur, Imphal East, Imphal West, Bishnupur, Thoubal, Senapati & Ukhrul

Values in the brackets indicate the no. of parameters

From the available records in state Veterinary Hatchery , it had been seen that the percent hatchability was to be highest in the month of June 2002 with 81.7% and the lowest in November with 44.3%. Totality of 14,921 fertile eggs from those farmers were brought and incubated at the state farms. Out of that 8,326 chicks were hatched out with overall percentage of hatchability, 58.8%. Now, it may be mentioned that the hatchability of Vanaraja produce at household level gives very impressive results and the dispersion, as well as, multiplication process among the farmers indicates that Vanaraja bird is accepted as a profitable poultry bird for backyard poultry farming by the local farmers.

One beneficiary from Ukhrul district has managed force incubation of Vanaraja hen by keeping in a basket and allowed to sit on eggs. They, thus multiply the chicks at the household level.

Demands of such chicks are very high. Chicks were dispersed in all the districts for raising as productive birds. Average weight of 3.5 kg in male and 3.2 kg in female (adults) are recorded in farmer's unit with minimum feeding consisting of rice bran (75%), cooked rice (waste), broken rice/maize, weeds (ad.libitum), plantain tree/leaves, leaves of cabbage/ cauliflower, etc. Field snail is given, as main calcium source during laying period and it is available readily in the state at a low cost price throughout the year.

Feeds, feeding system and management

Management of birds are basically in traditional /backyard systems and birds are penned inside

during night time. Birds are allowed to search themselves for feeds available in and around homestead, gardens, fields, crop-harvested areas. Birds are provided households-wastes, food grains, and other crop-byproducts with little supplement of home-prepared feeds during the growing period. The foodstuffs used by the farmers are mentioned below. When, the reaches laying stages, farmers used to give FIELD SNAILS as major calcium source. Most of the farmers in the plain provided 75% rice bran and available green leaves ad-libitum. Though, some farmers used to give rice bran with little quantity of readymade feed in city areas (Table 114).

Table 114 : Feed -stuffs used in the farmers' units

Items	Observations/Remarks
Rice bran	Rs. 2-5 /kg
Wheat bran	Rs. 6.50/kg
Broken rice/maize	Rs. 8-10/kg.
Leaves of cabbage, cauliflower	Rs. 2-3/kg
Field snail	Rs. 2/kg.
<i>Altenanthera phelloxenoide</i> (weed)	Available year round
Wild palak leaves	Available September to June
Plantain leaves, plaints (cut)	When available in rural areas
Readymade feeds	Rs. 15/kg.

In general, farmers provided the feed ingredients available at households in a ratio mentioned below

Grower (7 - 22 weeks)	Layer Feeds
Maize -	28 kg 36 kg
Rice bran -	60 kg 35 kg
Conc.	12 kg 9 kg
Min. mixture	500 g 500 g (sometimes)

Vanaraja birds seem to consume efficiently a wide variety of stuffs and endow with better capability of utilization feed ingredients of higher content of fibre.

Preference towards the Vanaraja birds

The progressive farmers in and around the urban and peri-urban areas prefer to rear Vanaraja as a meat bird and came to the centre for chicks. Demands of the farmers could not be arranged by the unit due to technical problems, however it will

be fulfilled in the near future. The imported commercial broiler breed strains and other colored birds of meat type strains cost Rs. 15/- to 18/- per day old chick in the local market / dealers. In case of the Vanaraja which are produced locally cost about Rs.20.00 per chick at hatchery door. It is evident from the reports which were maintained at hatcheries. Demand is in upward trends which may be due adaptation in the agro-climatic condition and high resistant to the fatal diseases as Ranikhet, IBD etc, Farmers have a choice of the stair as a layer which can survive and produce economically in the local condition.

Records on reproductive performance (Preliminary)

Farmers maintained birds and produced hatching eggs. From there chicks were produced and those birds had attained maturity age. Performance of the birds are mentioned in Table 115.

Table 115 : Production records of Vanaraja (III-generation)

Items	Observations/Remarks
Age at 1 st egg (days)	167 (56)
Egg weight (1 st laid egg), g.	46.0 (55)
Egg colour	Brown colour
Weight at maturity (female), kg.	2.80 (36)
Weight at 24 th wk. (male), kg	3.20 (25)
Weight of chicks on 70 th day (g)	45.0 (46)

Values in the brackets indicate the no. of parameters

Eggs produced in farmers unit have a good shell texture, size is bigger and heavier 18-20 g than that of local eggs. Colour of the egg is brown and more attractive than that of local one. Average chick weight produced by the farmers using natural incubation has found to be 44 g and chick produced from the third generation have almost same average weight that of the mothers (more numbers of parameters are to be recorded later on.). It indicates from the available information that the local farmers are utilizing the Vanaraja (germplasm) for consumption in the form of eggs and meat or earning income in a small way.

FISH

Fish Biodiversity of North Eastern India

B.K. Mahapatra, K. Vinod & B.K. Mandal

North Eastern Hill states of India have diversified aquatic resources endowed with a rich variety of ichthyofauna which are yet to be exploited. In the present updated inventory of the NEH States, a total of 274 fish species have been included which belongs to 114 genera under 37 families and 10 orders. The fish fauna of NEH region constitutes as much as 34 % of those reported and recorded freshwater fishes (806 species) of India. Out of 274 fish species, almost all fish species are treated as food fish (99.27%) followed by ornamental fish (91.24%), cultivable fish (17.52%) and sport fish (3.28%).

Native Ornamental Loaches of NEH States and their Conservation

Loaches form an important group of Indian Ornamental Fish having good demand due to their small size, bright bands, blotches, colouration, peaceful nature, hardiness and compatibility. The North Eastern Hill States are the home of as many as 45 loach species which belonged to 15 genera under 2 families. Among the 45 potential loaches 10 species are already popular among the traders and hobbyists both locally and globally by specific trade name. Although the trade is not organized, the fishes are collected from the natural habitat by local fish collectors and are sent to Kolkata by some traders. All the loaches are becoming vulnerable in NEH region due to degradation of water bodies, pollution, poisoning, over fishing of broods and juveniles. The conservation status of the 45 species are Critically Endangered - 2 (4.4%), Endangered - 11 (24.44%), Vulnerable - 11 (24.44%), Low Risk - near threatened - 05 (11.11%), Data deficit - 01 (2.22%) and Not evaluated - 15 (33.33%).

Incorporation of some terrestrial weeds as feed in pond culture of carps

K. Vinod, B.K. Mahapatra & B.K. Mandal

The three common local weeds viz., *Vernonia anthelmentica*, *Bidens pilosa* and *Ageratum conyzoides* have been incorporated as feed for grass carp in the composite fish culture system of which *V. anthelmentica* was found to have a better acceptance and the growth of grass carp was significantly high when compared to the pond where *A. conyzoides* and *B. pilosa* were given.

Broodstock maintenance of some carp species

B.K. Mahapatra, K. Vinod & B.K. Mandal

In *Labeo rohita*, both males and females were found to mature in 2+ year age. In the case of mrigal and red rohu, males were found to mature in 1+ year age whereas the females in 2+ year age. The males of chocolate mahseer *Neolissocheilus hexagonolepis* were found to attain sexual maturity above 130 mm while the females above 250 mm length, when they attain 1+ and 2+ year age respectively.

Growth Studies of stocked Indian Major Carps and their impact on fisheries in Umiam reservoir, Meghalaya

K. Vinod, B.K. Mahapatra & B.K. Mandal

Umiam reservoir, the largest in Meghalaya was primarily developed for hydro-electric power generation. Although there is no organised fishery in this reservoir, the common carp, *Cyprinus carpio* stocked in early 1970's, forms the mainstay of fishery. In July 1999, about 2,50,000 numbers of fish fingerlings of Indian Major Carps were stocked by the Department of Fisheries, Govt. of Meghalaya with a view to enhance the yield. The growth performance of catla, rohu, mrigal and calbasu were promising. Highest growth rate was observed in catla which registered 1.5 kg in 1+ year, 6.0 kg in 2+ year, 9.5 kg in 3+ year and 12.0 kg in 4+ year of stocking. A growth rate of 0.6 kg, 1.9 kg, 3.1 kg and 4.3 kg was recorded in the case of rohu after 1,

2, 3 and 4+ year of stocking respectively. The growth of mrigal was comparatively less which attained 0.45 kg in 1+ year, 1.5 kg in 2+ year, 2.25 kg in 3+ year and 2.9 kg in 4+ year of stocking. A growth rate of 0.65 kg, 1.9 kg, 2.8 kg and 3.5 kg was recorded in 1, 2, 3 and 4+ year of stocking respectively in calbasu. The studies on fish catch and species composition at Lad Umsaw market indicated a substantial contribution of the stocked Indian Major Carps ranging from 7.45% to 67.77%. The yield of the reservoir was calculated (June 2000 to May 2001) and was found to be 97.87 kg ha⁻¹ yr⁻¹. The stocking of fish fingerlings is therefore a prime need in Umiam reservoir for fish yield optimisation. Proper stocking and harvesting schedules, selection of the right species mix for stocking and employing appropriate gears would certainly help in the improvement of fishery in Umiam reservoir.

ANIMAL HEALTH AND DISEASES

Detection of *Salmonella* virulence genes by PCR.

H.V. Murugkar, H. Rahman, Ashok Kumar, B.R. Shome, and Rajeswari Shome

The occurrence of different virulence genes viz Pef, Sef and SopE was studied in a total of 95 isolates belonging to *S. Typhimurium* (51), *S. Enteritidis* (36), *S. Bareilly* (3), and *S. Paratyphi B* (5) serovars by polymerase chain reaction (PCR) assay, using their specific primers. The *sopE* gene was found to be present in only 36 of the 95 isolates, all of which belonged to *S. Enteritidis* serovar. It was found to be absent in all the *S. Typhimurium*, *S. Paratyphi B* and *S. Bareilly* isolates. The gene was found to be present only among the *S. Enteritidis* isolates and appeared to be serovar specific. The phenotypic expression of the gene was detected with the help of dot-ELISA using anti-SopE serum. It was detected in 31 out of the 36 *S. Enteritidis* isolates and was negative for rest of the

S. Enteritidis and all the *S. Typhimurium*, *S. Paratyphi B* and *S. Bareilly* isolates studied.

The *sef* gene, detected by the presence of a 1103 bp product, was found to be present in only 36 of the 95 isolates, all of which belonged to *S. Enteritidis* serovar. It was found to be absent in all the *S. Typhimurium*, *S. Paratyphi B* and *S. Bareilly* isolates. *sef* was found to be present only among the *S. Enteritidis* isolates as it is serovar specific. The *pef* gene, detected by the presence of a 700 bp PCR product was found to be present in 85 of the 95 isolates. Forty-nine out of 51 *S. Typhimurium* strains showed the presence of this gene. Thirty-one of the 36 *S. Enteritidis* strains and all the five *S. Paratyphi B* isolates were also positive for *pef* gene. All the *S. Bareilly* isolates were negative for the gene.

Occurrence of *Campylobacter jejuni* in livestock and poultry:

Ashok Kumar & H.V. Murugkar

A total of 102 faecal samples of animal and poultry origin comprising goat (28), cattle (21), poultry (43) and duck (10) were processed for isolation of thermophilic *Campylobacter* species. Of these, 14 isolates of *Campylobacter* were recovered from poultry samples (32.56%). On the basis of hippurate hydrolysis test, all the isolates were found to be *C. jejuni*. Further characterization of the isolates at subspecies level, revealed that only 2 *C. jejuni* hydrolyzed DNA. None of the isolates were positive for rapid hydrogen sulphide (H₂S) test. Thus, the results of biotyping showed that out of 14 *C. jejuni*, 12 (85.71%) belonged to biotype I, and 2 (14.28%) to biotype II. The study indicated that necessary measures need to be adopted to minimize the *Campylobacter* infection in poultry so as to reduce the potential threat to human health in the region.

Presence of bacterial pathogens of zoonotic importance in livestock products:

A total of 24 beef and 36 pork samples were processed for isolation of *Salmonella* sp. and *E. coli*.

Nine *Salmonella* isolates consisting of three serovars, *S. Enteritidis* (3), *S. Paratyphi B* (2) and *S. Typhimurium* (4) were recovered from the samples, while *E. coli* could be isolated from all the 48 samples tested.

A total of 136 samples comprising of beef (36), pork (36), mutton (12), poultry meat (34) and cow milk (18) samples were collected and processed for isolation of *Aeromonas* sp., thermophilic *Campylobacter* and *Listeria monocytogenes*. Seven beef and 8 poultry samples were found positive for *Campylobacter* sp. Nine beef, 6 pork, 3 mutton and 4 cow milk samples were positive for *Listeria* sp. Five beef and eight poultry samples revealed the presence of *Aeromonas hydrophila*. Out of 22 *Listeria* isolates, only 14 could be characterized as *L. monocytogenes*. Amongst 15 *Campylobacter*, 14 were *C. jejuni* and only one was *C. coli*. The study indicated the need for better quality control for livestock products to minimize the potential threat to human health in the region.

Detection of *stx* gene in *Salmonella* serovars isolated from livestock products

H.V. Murugkar & Ashok Kumar

Presence of *stx* gene in salmonella serovars isolated from beef and pork being sold at retailers' level was studied. Seventeen *Salmonella* isolates consisting of three serovars, *S. Typhimurium* (9), *S. Enteritidis* (5) and *S. Paratyphi B* (3) isolated from beef and pork were subjected to PCR for the detection of *stx* gene with the known primer. The gene could be detected from all the isolates irrespective of its source of isolation. *In-vitro* expression of the enterotoxin gene was studied with the help of dot-ELISA using a standard anti-enterotoxin serum. Fifteen of the 17 cultures were positive for the enterotoxin production.

Rapid identification of *Listeria monocytogenes* in marketed meat by PCR assay:

Ashok Kumar, B.R. Shome, H.V. Murugkar, Rajeswari Shome & H. Rahman

A multiplex PCR (mPCR) assay specific for *L. monocytogenes* was standardized based on genes encoding hemolysin (*hlyA*) and invasion associated

protein (*iap*) genes. Mutton and beef samples from the retail outlets in and around Shillong, Meghalaya were collected and processed using UVM modified *Listeria* enrichment broth and PALCAM medium agar plates. The enrichment broth culture and the representative colonies from the agar plates suspected to be *Listeria* were screened directly for the presence of *hlyA* and *iap* genes with their specific primers by a single tube mPCR using intact bacterial cells. Five (3 from mutton and 2 from beef) out of eight suspected cultures were found to be positive for *hlyA* and *iap* with the specific amplification of 234 bp and 131 bp fragment from *hlyA* and *iap* genes, respectively (Fig.40). The cultures positive for the two genes were further confirmed bacteriologically to be *L. monocytogenes*. Other 3 suspected cultures when examined bacteriologically were found to belong to other species of *Listeria*. The mPCR method takes 8 hr for the enrichment as well as detection of *L. monocytogenes* directly from intact cell avoiding prior isolation of genomic DNA from bacterial cells

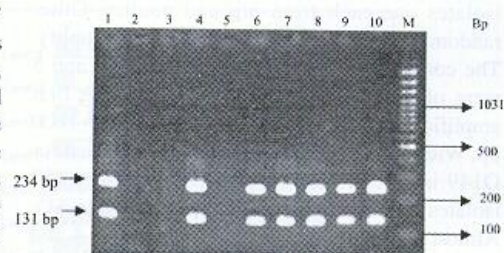


Fig. 40 Detection of Listeriolysin O (*hly A*) and invasive associated protein (*iap*) genes of *L. monocytogenes* in raw meat by multiplex polymerase chain reaction. Lane 1-5 suspected cultures, lane 6-10 standard cultures and lane M is the marker (Gene Ruler Cat No.SM0323, MBI Fermentus)

RAPD analysis of *Escherichia coli* O157 and O149 strains isolated from pig and poultry in Meghalaya

B.R. Shome, Rajeswari Shome, H. Rahman, Ashok Kumar & H.V. Murugkar

Amongst bacterial enteropathogens, *E. coli* infection has been a threat to the livestock industry including poultry. The pathogenesis and concurrent infection caused by various *E. coli* strains in different age groups is quite intriguing, especially in view of the multiplicity of the serogroups. Out of 118 strains of *E. coli* isolated from diarrhoeal cases, the six pathogenic isolates belonging to serogroup O157 (2 - poultry origin) and O149 (3 - pig origin and 1 - poultry origin) were analyzed for comparative genome analysis using randomly amplified polymorphic DNA (RAPD) profile.

Twenty number of 10 mer synthetic oligodeoxyribonucleotides (Kit G, Operon Technologies Inc, USA) were used. Of the 20 primers, opg-3, 4, 5 gave reproducible and scorable amplicon profiles for two O157 and two O149 isolates originated from poultry and pigs, respectively. However, opg- 7 and 8 gave positive results additionally for two more *E. coli* O149 isolates one each from pig and poultry. Other random oligonucleotides primers did not amplify. The comparative amplicons with opg-3, 4 and 5 were obtained after reamplification of the first amplification products, in the range of 350 to 1600 bp. With opg-3, 100% similarity was observed for O149 isolates from pig whereas the two O157 isolates exhibited only 70 % similarity(Fig.41). Almost similar trend was observed for opg-4 and opg-5. The amplicons with opg-7 and 8 were in the range of 500-1100 bp. With opg- 7, all the three O149 isolates of pig and poultry origin were clustered in one genotype(Fig.3). Though more than 50% similarity was observed in case of O157 strains, the striking difference between the strains was also evident. For opg-8, all the four O149 strains from different geographical locations and source of isolation were clustered in one genotype and both the O157 isolates were clustered in another genotype showing more than 90%. The results showed the importance of genotyping in the

epidemiological studies of *E. coli* in the region. However, more work is required and especially, significance of O149 isolates need to be ascertained for developing control measures.

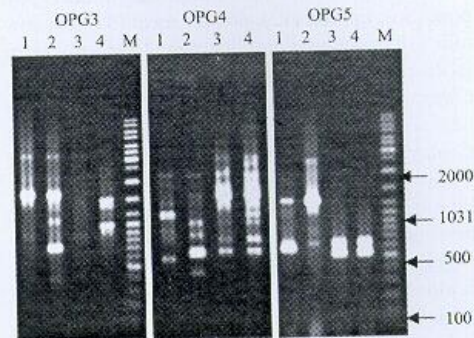


Fig. 41: RAPD analysis of selected *Escherichia coli* O157 and O149 strains isolated from pig and poultry in Meghalaya.

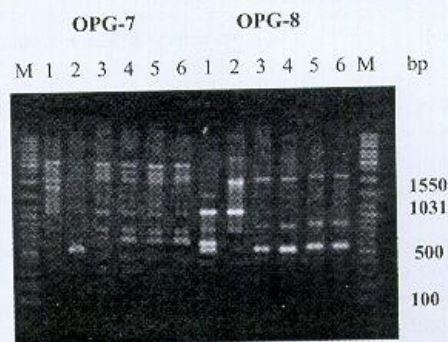


Fig. 42 : RAPD-PCR profile of *Escherichia coli* strains isolated from pigs and poultry

Genotyping of *Salmonella* isolated from animals and poultry by plasmid profiling and randomly amplified polymorphic DNA

As phenotype is not always a true representation of genotype, consideration of antigenic makeup of bacteria alone is not enough to design an effective

polyvalent vaccine. Therefore, the need for genotyping arises. A total of 14 *Salmonella* isolates belonging to *S. Typhimurium* 4,5: i :1,2 (9) and *S. Enteritidis* 1,9,12:gm (5) were studied Plasmid profiling and RAPD analysis. The isolates were clustered into 5 genotypes (3-5-1, 3-2)(Fig. 43) according to plasmid profile. Interestingly, RAPD – PCR fingerprints obtained with random primer OPG-8 and OPG-10 (Kit G, Operon Technologies, USA) also clustered into 5 genotypes (3-5-1, 3-2). The results of these clustering using ID AAB Software based on RAPD fingerprints were 100 % congruent to each other. There was no commonality in clustering of any isolates between the subtypes.

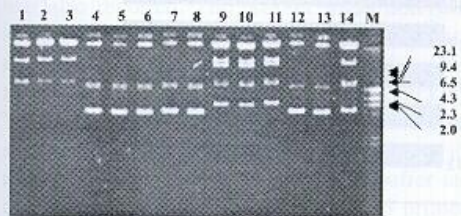


Fig.43 Plasmid profile of *Salmonella* isolated from Poultry and Pigs. Lane 1-8 *S. Typhimurium* and Lane 9-14 *S. Enteritidis* isolates.

Nine *S. Typhimurium* and 5 *S. Enteritidis* isolates were clustered into 3 and 2 unique genotypes, respectively as evident by the dendrogram analysis of the results obtained by both the methods (Fig. 44 & Fig. 45). These findings give enough clues for selection of isolates required for future works in vaccine development.

Detection of Shiga toxin genes (*stx1*, *stx2*) and enterohemolysin toxin gene (*hlyA*) in *Escherichia coli* strains isolated from pig and poultry by Polymerase Chain Reaction

Escherichia coli strains have been reported to possess a battery of virulence determinants, which contribute to its pathogenicity. In piglets, *E. coli* strains producing Shiga like toxins cause severe enterotoxaemia, which is also known as edema disease. In addition, enterohaemolysin (*hlyA*) is a plasmid coded virulence factor and is always attributed to high pathogenicity of *E. coli* strains. Keeping in view that the PCR is a fast and reliable method for the identification of virulence determinants in field isolates, 118 *E. coli* isolates

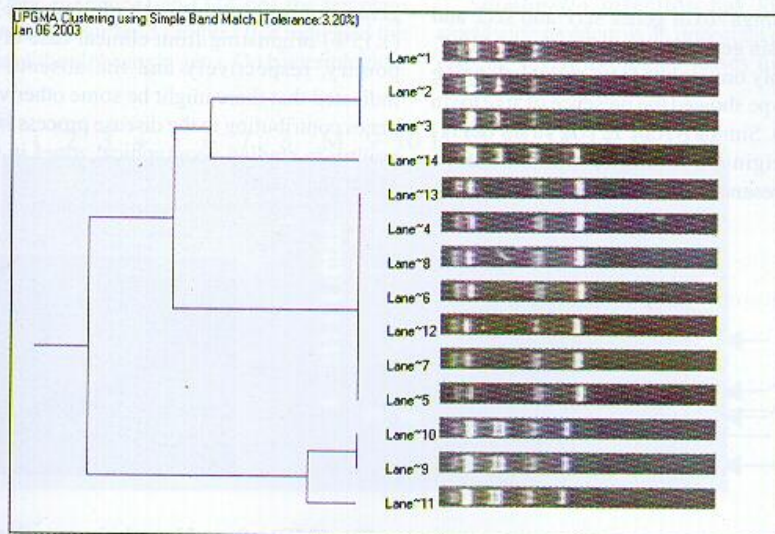


Fig. 44 Dendrogram based on Plasmid profile of *Salmonella* isolated from Poultry and Pigs.

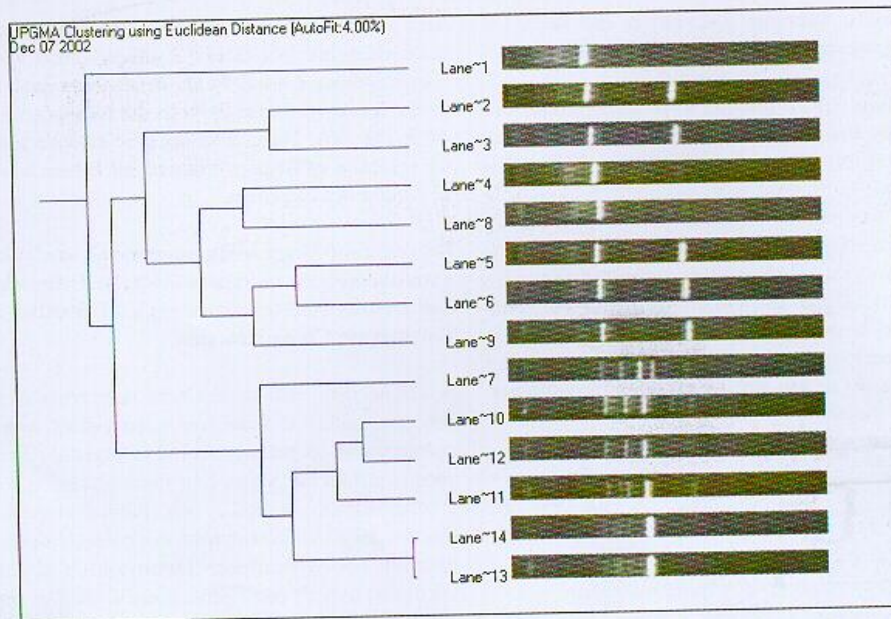


Fig. 45 Profile similarity of *Salmonella* by the RAPD analysis of *opg 8* series based on the UPGMA clustering base on the euclidean distance.

(31 from piglet diarrhoea and 87 from cases of colibacillosis in poultry) were screened for the detection of Shiga toxin genes *stx1* and *stx2* and enterohemolysin gene *hlyA* by PCR. Out of 118 *E. coli* strains, only one isolate from piglet belonging to O141 serotype showed the presence of *stx2* toxin gene (Fig. 46). Similarly, one *E. coli* strain (E111) of poultry origin belonging to O108 serotype showed the presence of *hlyA* toxin gene (Fig. 47).

Interestingly, none of the isolates revealed the presence of *stx1* gene. The presence of *stx2* and *hlyA* gene in only one strain each of 31(3.22%) and 87 (1.15%) originating from clinical case of pig and poultry, respectively and the absence of *stx1* indicated that there might be some other virulence genes contributing to the disease process in pig and poultry in studied geographical zones in the state of Meghalaya.

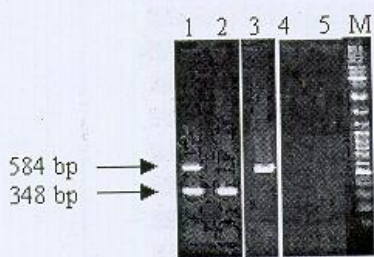


Fig. 46 Detection of Shiga toxin gene (*stx 1* & *stx 2*) in *E. coli* strains isolated from pig in Meghalaya.

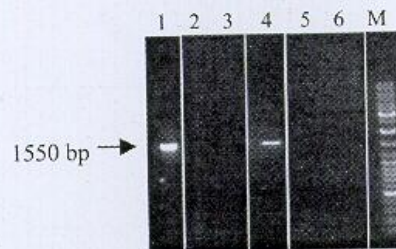


Fig. 47 Detection of hemolysin gene (*hly A*) in *E. coli* isolates from poultry in NEH Region.

Diagnosis of atypical blackleg from clinical samples by polymerase chain reaction (PCR)

Incidence of black quarter like disease (atypical blackleg) in cattle of Manipur vaccinated with classical *Clostridium chauvoei* vaccine, reported during early to mid eighties was controlled by the use of bacterin/toxoid developed using the clinical isolates of pathogenic *Clostridium perfringens* Type A. Earlier, reemergence of atypical blackleg and identification of causative agent based on bacteriological, pathogenicity test, typing of the isolates by toxin and antitoxin assay and PCR assay (in collaboration with University of Arizona, USA) was also reported. The present study described standardization of rapid PCR based diagnostic method using directly the clinical material obtained from cattle suffering from atypical blackleg. Template DNA was prepared by boiling the supernatant for 10 min obtained after triturating the affected muscle sample in extraction buffer and centrifugation. Multiplex PCR using 6 primers specific for the major toxins of *C. perfringens* namely, *cpa* (alpha toxin), *cpb* (beta toxin), *cpb-2* (beta-2 toxin), *etx* (enterotoxin), *cpaA* (iota A) and *cpe* (epsilon). Among all the primers, only primer specific for *cpa* amplified (324 bp) the template DNA in all the four field samples that indicated the presence of the alpha toxin gene. On bacteriological

examination, from more than 95% of cases Gram +ve, anaerobic rod shaped organisms were isolated. The anaerobic bacilli were highly proteolytic, hemolytic, DNase, lecithinase and gelatin liquefaction positive. Based on cultural, biochemical, and biological assays the isolates were identified as *Cl. perfringens* Type A. In multiplex PCR analysis for *cpa*, *cpb*, *etx*, *iA*, *cpe*, and *cpb2*, 11 isolates were found to be only *cpa* toxin gene positive (Fig. 48). None of the cultures were positive for *C. chauvoei* either bacteriologically or by PCR using *C. chauvoei* specific primer. RAPD analysis further confirmed the homogeneity among *Cl. perfringens* Type A isolated from Atypical Blackleg. The presence of the gene in the sample and RAPD results amply suggested that the disease was caused by *C. perfringens* Type A and therefore, a refined vaccine other than traditional vaccine against black quarter, need to be developed to protect the cattle of Manipur from atypical blackleg disease.

Detection of the *stn*, *pef A* and *sef C* genes in *Salmonella* isolates from animals and poultry by multiplex PCR

Salmonella infection has always been a worldwide problem as an important enteropathogen causing severe economic losses to livestock and

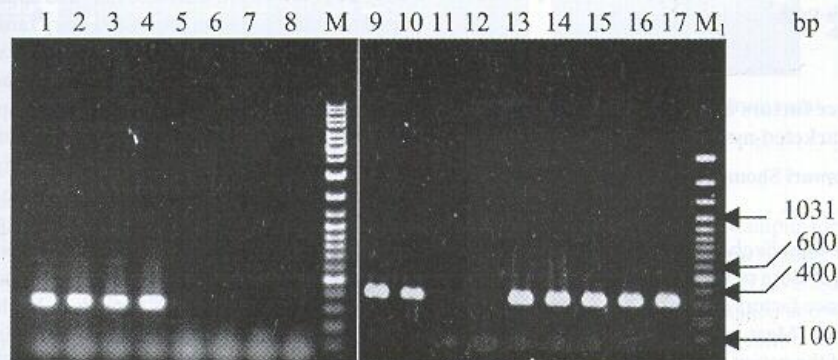


Fig. 48 Detection of alpha toxin (α toxin) gene among the anaerobic bacteria isolated from clinical case of Atypical Blackleg in cattle of Manipur

poultry. A total of 23 *Salmonella* were isolated from animals and birds. Out of which, 13 isolate were *S. Typhimurium* (pig-5, mice-6 and poultry-2) and 10 were *S. Enteritidis* (mice-4, rabbit-1 and poultry-5). Multiplex PCR was standardized using specific primers for *stn*, *pef A* and *sef C* genes. Highly specific amplicons of 617, 700 and 1103 bp were obtained for *stn*, *pef A* and *sef C*, respectively (Fig.49). All the 23 isolates were found positive for *stn* gene. Six out of 13 *S. Typhimurium* and 4 out of 10 *S. Enteritidis* were positive for *pef A*. Five out of 10 *S. Enteritidis* were positive for *sef C*. Amongst *S. Typhimurium*, 6 isolates were positive for both *stn* and *pef A*. As regard to *S. Enteritidis*, 5 isolates were containing all the three genes studied and rest were positive only for *stn*.

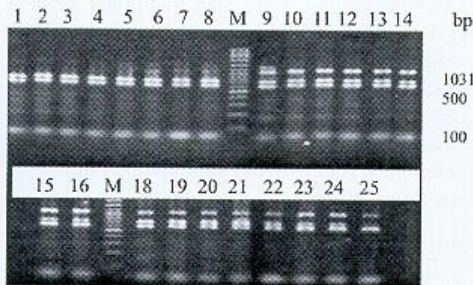


Fig. 49 Detection of the *stn*, *pef* and *sef* genes in *Salmonella* isolates from animals and poultry by multiplex PCR

Virulence factors in *Escherichia coli* isolates from marketed meat in Meghalaya

Rajeswari Shome, B.R. Shome, H.V. Murugkar, Ashok Kumar & H. Rahman

Although *Escherichia coli* forms a part of normal gut flora of man and animals, the presence of virulence factors makes the organism potentially pathogenic. Meat and meat products are found to be one of the potent sources of the infection in case of unsanitary and unhygienic slaughtering of animals and further food processing chain. Out of

a total of 53 samples comprising beef (28), pork (15) and mutton (10) processed, *E. coli* were present in 18 (64.28%), 14 (93.33%), and 10 (100%) samples from beef, pork, and mutton, respectively. Thirty two isolates were screened further for the presence of some of the fimbrial antigens by slide agglutination test. Twenty-five isolates (beef- 9, pork- 7 and mutton- 9) were found to harbour F 17 fimbrial antigen. Similarly, 16 isolates (beef - 8, pork -1 and mutton -7) were positive for K 99. Only two *E. coli* (O 108 & O 8) isolates from beef were positive for K 88 and F6 respectively. All the isolates were negative for F 41 fimbriae and haemolysin. Only one isolate originating from beef was positive for Congo red binding test indicating its invasiveness. Only two, one each from mutton and beef origin had both *stx1* and *stx2* and *hly* (Table 116). The presence of such *E. coli* with virulence factors in the food chain reemphasizes the need for special caution in meat production process.

Rapid detection of non-O157 Shiga toxin producing *Escherichia coli* (STEC) in faecal samples in an organized dairy farm

Shiga toxin producing *Escherichia coli* other than O157 of varying pathogenicity have been found in the faecal flora of wide variety of animals, however, the most important source of infection for human is the cattle. In the present study, faecal samples (n=36) from diarrheic (23) and apparently healthy cattle (13) in an organized dairy farm were processed directly for shiga toxin (*stx*) and enterohaemolysin (*hly*) genes of *E. coli* by polymerase chain reaction using their specific primers. Two samples were positive for both *stx 1* and *stx 2* genes; as well as for *hly* gene (Fig. 50). Interestingly, both the samples were from cattle suffering from diarrhoea. On further screening, none of the samples was found to be positive for *rfb O 157* gene indicating that the samples were positive for non-O 157 STEC. This appears to be the first report of the occurrence of non-O157 STEC in dairy cattle from the region. The study clearly emphasizes the public health concern to the dairy workers and dairy products consumers in the region.

Table 116 : Virulence determinants of *Escherichia coli* isolated from foods of animal origin

Serotypes with source	Anti-F					Anti O157:H7	Congo red	Target genes				
	F17	F6	F41	F4 (K88)	F5 (K99)			<i>stx1</i> & <i>stx2</i>	<i>stx1</i>	<i>stx2</i>	<i>hly</i>	<i>rfb O157</i>
1. Pork												
O25 (6)	-	-	-	-	-	+(1)	-	-	-	-	-	+(1)
O110 (3)	+(1)	-	-	-	-	+(2)	-	-	-	-	-	+(2)
O113 (1)	+	-	-	-	+	+	-	-	-	-	-	+
O153 (3)	+	-	-	-	-	+	-	-	-	-	-	+(1)
2. Beef												
O8 (1)	+	+	-	-	-	-	-	+	+	+	-	-
O11 (1)	-	-	-	-	-	-	-	-	-	-	-	-
O37 (1)	-	-	-	-	-	-	+	-	-	-	-	-
O63 (2)	+(1)	-	-	-	+(1)	+	-	-	-	-	-	-
O82 (3)	+	-	-	-	+(2)	-	-	-	-	-	-	-
O101 (1)	+	-	-	-	+	-	-	-	-	-	-	-
O110 (1)	+	-	-	+	+	+	-	-	-	-	-	-
UT (2)	+(1)	-	-	-	+(1)	+(1)	-	-	-	-	-	-
3. Mutton												
O8 (1)	+	-	-	-	+	+	-	-	-	-	-	-
O11 (3)	+	-	-	-	-	+	-	-	-	-	-	-
O20 (1)	+	-	-	-	+	+	-	+	+	+	-	-
UT (2)	+(1)	-	-	-	+	+	-	-	-	-	-	-

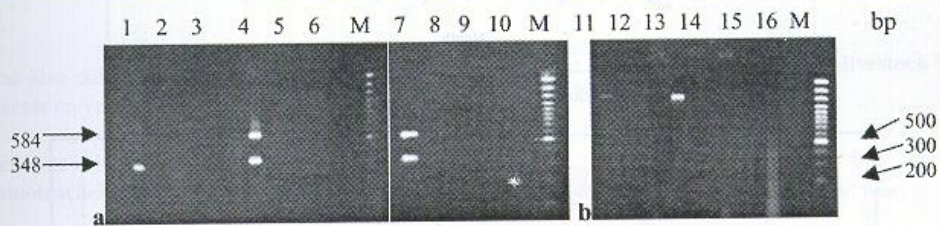


Fig. 50 a: *E. coli stx1* and *stx2* from meat samples pure culture; b: *E. coli hly* from meat samples pure culture

Weather based (Agrometeorological) Data from North-Eastern Region:

H. Rahman, B.R. Shome, Ashok Kumar, H.V. Murugkar & Rajeswari Shome

Agrometeorological data for Meghalaya state from two different locations, namely, Shillong and Cherrapunji for 10 years (from 1992 to 2002); Mizoram for 10 years (1992 to 2002) from one centre (Aizawl); Tripura for 10 years (1992 to 2002)

from one centre (Agartala) ; Manipur for 7 years (1996 to 2002) and Nagaland for 6 years (1997 to 2002) were collected. Monthly average of the requisite parameters was calculated and wherever required the requisite classification as per the intensity of individual parameters was also computed. The processed data is now being arranged as per the requirement of the EPITRACK software developed by PD_ADMAS.

Retrospective trends of important diseases in various states of North-Eastern Region:

Month wise disease incidence/prevalence data for all the seven districts of Meghalaya collected for 13 years (1990-2002, Fig. 51) from the State Department was analyzed. The Foot and Mouth disease, Haemorrhagic Septicemia, Swine fever and Ranikhet Disease were found to be prevalent throughout the year, however, for FMD, most

outbreaks were observed during the months of April-May-June and in the months of July-Aug. For Haemorrhagic Septicemia, most outbreaks were during the months of March - mid June and during mid-Aug to mid Oct. For Swine fever, most of the outbreaks occurred during the months of mid-Jan to mid-March. For Ranikhet Disease, the outbreaks were uniformly distributed throughout the year. Similarly data from Mizoram (three years, Fig. 52), Tripura (one year) and Manipur (six years, Fig. 53)

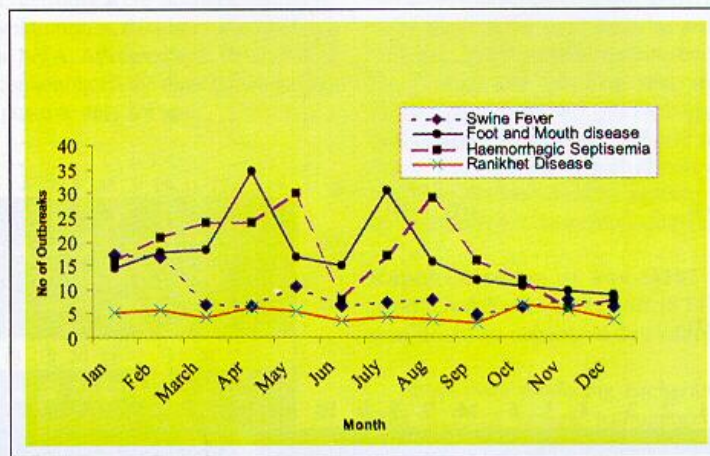


Fig. 51 Major livestock and poultry diseases of Meghalaya (1991 to 2002)

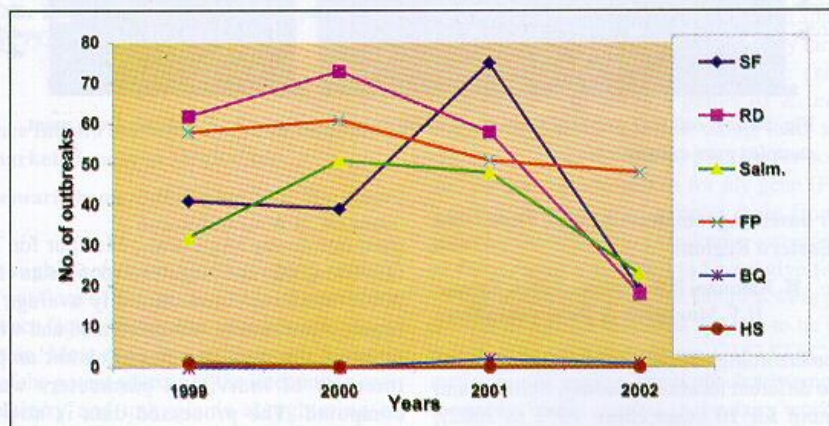


Fig. 52 Major disease outbreak in Mizoram

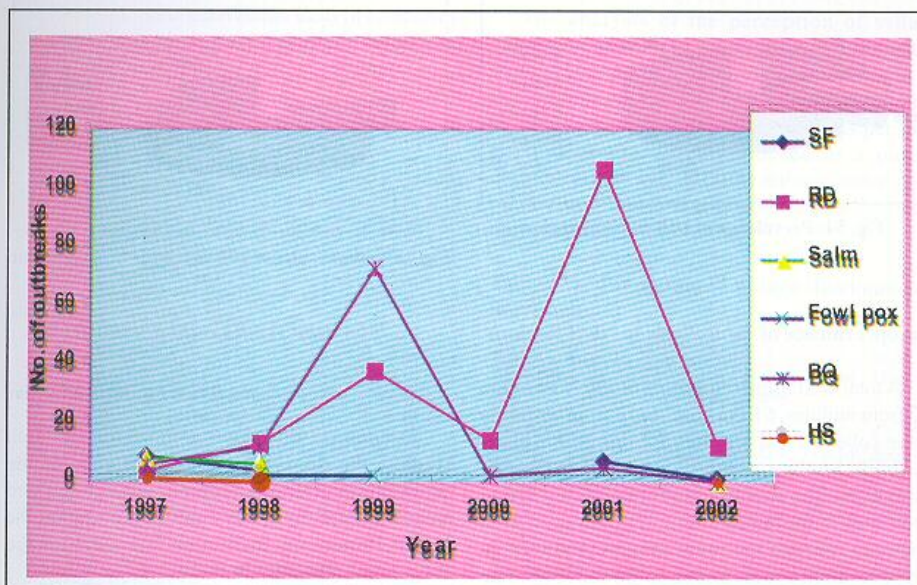


Fig. 53 Major disease outbreaks in Manipur

was also collected and analyzed for the major disease prevalence pattern in the region.

Seroprevalence of infectious bovine rhinotracheitis (IBR) in NEH Region:

A total of 431 sera comprising 317 from cattle, 72 from mithuns, 38 from goats and 4 from buffaloes were collected and screened for infectious bovine rhinotracheitis (IBR) using A-B ELISA Kit obtained from PD_ADMAS, Bangalore. The prevalence of IBR was found to be high in the region (Table 117). It varied from state to state and species of animals. The average seroprevalence was found to be 25% (Table.117 Fig 54). The prevalence was very high in Mizoram (51.85%). This may be due to the fact that all the animals tested from the state were with one or the other reproductive disorder.

Table 117 : Seroprevalence of IBR in livestock species in NEH Region.

State	Animal species				Total No. Tested/ +ve
	Cattle No. Tested/ +ve	Buffalo No. Tested/ +ve	Goats No. Tested/ +ve	Mithuns No. Tested/ +ve	
Meghalaya	220/41 (18.64)	NT	38/13 (34.21)	NT	258/54 (20.93)
Mizoram	77/42 (54.55)	4/0	NT	NT	81/42 (51.85)
Nagaland	NT	NT	NT	72/9 (12.50)	72/9 (12.50)
Manipur	20/4 (20.00)	NT	NT	NT	20/4 (20.00)
Total	317/87 (27.00)	4/0 (0.00)	38/13 (34.21)	72/9 (12.50)	431/109 (25.00)

Figures in parentheses indicate percentag

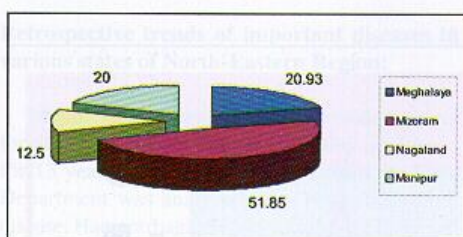


Fig. 54: Prevalence of IBR in NEH region

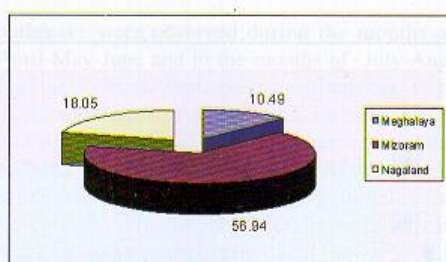


Fig. 55: Seroprevalence of Brucellosis in NEH region

Seroprevalence of brucellosis in NEH Region:

A total of 315 sera comprising of 233 from cattle, 72 from mithuns, 6 from goats and 4 from buffaloes were collected and screened for brucellosis using A-B ELISA Kits obtained from PD_ADMAS, Bangalore. The prevalence of brucellosis is found to be high in the region (Table 118). It varied from a state to state and species of animals. The average seroprevalence was found to be 22.53%. The prevalence was very high in Mizoram state (56.94%, Fig.55). This may be due to the fact that all the animals tested from the state were with one or other reproductive disorder.

Table 118 : Seroprevalence of Brucellosis in livestock species in NEH Region.

State	Animal species				Total No.
	Cattle No.	Buffalo No.	Goats No.	Mithuns No.	
Meghalaya	156/16 (10.25)	NT	6/1 (16.00)	NA	162/17 (10.49)
Mizoram	77/40 (51.94)	4/1 (25.00)	NT	NA	81/41 (56.94)
Nagaland	NT	NT	NT	72/13 (18.05)	72/13 (18.05)
Total	233/56 (24.03)	4/1 (25.00)	6/1 (16.00)	72/13 (18.05)	315/71 (22.53)

Figures in parentheses indicate percentage

TECHNOLOGY TRANSFER

N. Prakash, P.P. Pal & Rajesh Kumar

Besides conducting a number of research studies, the division was also engaged to the development of human resources, taking developed technologies in the farmers' field and managing the NATP Project on Institution Village Linkage Programme (IVLP).

Involvement of village durbars in participatory communication for rural development of Meghalaya

This study was conducted to assess the role of village durbars (Durbar Shnongs) in community development, find out the present mode of communication in durbar system and to know the perception of the villagers about durbar system in respect of participatory mode of communication. This study was conducted in 10 randomly selected villages from Ri-Bhoi district involving 250 villagers and 20 durbar heads & secretaries as the sample.

To understand the involvement of villagers in community development programmes taken up by the village durbars, nine areas were identified and the participation of the villagers was found out by personal interview method (Table 119)

With regard to perception of the villagers about participatory method of communication in the durbar system it was observed that in most of the cases the villagers were consulted (Table 120) though the villagers (70.00%) observed that

decisions were not taken on the basis of consensus. In other aspects also a good majority of the farmers expressed the same view.

Table 119 : Involvement of villagers in community development programme.

S. Areas No.	Participation of the villagers	
	Frequency	Percentage
N=250		
1. Social Forestry	72	28.80
2. Upliftment of communication facility	145	58.00
3. Drinking water facility	235	94.00
4. Educational facilities	107	42.80
5. Health improvement programme	166	66.40
6. Rural electrification programme	175	70.00
7. Transportation facilities	214	85.60
8. Creation of Marketing facility	134	53.60
9. Other social activities like sports, cultural programmes, etc.	218	87.20

Table 120 : Perception of villagers.

Sl. Areas of Development No. Programme	Villagers Consulted			
	Always	Frequently	Rarely	Never
N=250				
1. General body meeting is called before implementing and development programme.	150 (60.00)	15 (6.00)	10 (4.00)	75 (30.00)
2. Villager's consent is sought in implementing any specific programme.	110 (44.00)	5 (2.00)	20 (8.00)	115 (46.00)
3. Use of natural resources is done by consensus only.	170 (68.00)	10 (4.00)	15 (6.00)	55 (22.00)
4. Individual problem is given as importance as the community problem.	90 (36.00)	5 (2.00)	20 (8.00)	135 (54.00)
5. Community problem are solved with the involvement of the villagers	190 (76.00)	20 (8.00)	5.00 (2.00)	35 (14.00)
6. Exchange of ideas about development of the village takes place in Durbar meeting	70 (28.00)	20 (8.00)	5 (2.00)	15 (6.00)
7. Villagers are allowed to share their ideas openly in all the meeting	210 (84.00)	20 (8.00)	5 (2.00)	15 (6.00)
8. Decisions are taken in the basis of consensus only	50 (20.00)	10 (4.00)	15 (6.00)	175 (70.00)

The analysis of the perception of village headmen and secretaries regarding participatory method of communication revealed that almost all the respondents (60.00 %) were 'strongly agreed' to 'agreed' (30.00 %) on this aspect. As per their perception the durbars worked as a purely democratic system (100.00 %) and any central govt. scheme was launched only after discussing in the durbar system (70.00 %) etc.

Table 121 : Perception of Village Headman and Secretaries

S. Areas No.	Strongly Agree	Agree	Disagree
			N=20
1. The central Govt. Schemes are implemented after detailed discussion in the durbar only.	16 (80.00)	4 (20.00)	0 (0.00)
2. NGO's are allowed to work in the village after obtaining permission from the durbar with the meeting of villagers.	14 (70.00)	5 (25.00)	1 (5.00)
3. Agricultural based programmes launched by research organisations and others are allowed after obtaining consent of the villagers.	9 (45.00)	10 (50.00)	1 (5.00)
4. The villagers are always taken into confidence before launching any community development project.	18 (90.00)	2 (10.00)	0 (0.00)
5. Villagers participation is always ensured before taking up any village developmental programme.	12 (60.00)	6 (30.00)	2 (10.00)
6. The villagers are allowed to express their acceptance or rejection for any developmental programme	17 (85.00)	3 (15.00)	0 (0.00)
7. The durbars work as purely democratic system.	20 (100.00)	0 (0.00)	0 (0.00)
8. The help of the outsiders is sought after obtaining the permission from the common villagers.	5 (25.00)	15 (75.00)	0 (0.00)

The existing communication system of the Durbar Shnongs of Meghalaya though not purely a participatory one in letter and spirit, a great deal of flexibility is exercised by the Durbars. However, it will not be fair to compare this system with that of ideal participatory communication as this system has certain limitations being an elected body. Still the way these Durbars are involving the common

villagers in all community development aspects needs to be highlighted and followed by other such organizations.

Role of tribal women in organic vegetable cultivation in Meghalaya

R. Kumar, P.P. Pal & N. Prakash

Vegetable cultivation in Meghalaya is the domain of tribal women only. In general, though the bulk of the cultivation practices in agriculture are carried out by the women folk, this participation/ involvement in vegetable cultivation is almost 100 per cent. Moreover, vegetable cultivation does not include any chemical fertilizers, plant protection chemicals etc. As a result, women can easily manage their fields, which is in the vicinity of their residence and only small-scale cultivation practices practised in the state. A study was conducted in 4 randomly selected villages of Meghalaya taking 160 tribal farmers to assess the role of tribal women in organic vegetable cultivation.

Table 122 : Involvement of farmers in vegetable cultivation (Activity Wise)

Activities	N=160					
	Male		Female		Joint	
	F	P	F	P	F	P
1. Land preparation	24	15.00	108	67.50	28	17.50
2. Carrying of FYM	25	15.00	122	76.25	13	8.12
3. Collection of seeds	17	10.63	130	81.25	13	8.12
4. Nursery preparation	6	3.75	138	86.25	16	10.00
5. Transplanting	1	0.62	145	90.60	14	8.75
6. Weeding	6	3.75	136	85.00	18	11.25
7. Earthing up	11	6.88	88	55.00	61	38.13
8. Watering	15	9.37	112	70.00	33	20.62
9. Disease and pest management	7	4.37	136	85.00	17	10.62
10. Harvesting	4	2.50	156	97.50	0	0.00
11. Carrying and selling of produce	2	1.25	158	98.75	0	0.00

It was observed that almost all the activities pertaining to organic vegetable cultivation were carried out by women only. The assistance of male was observed only in land preparation and carrying of FYM (15 per cent each). In other activities, the involvement of male farmers was almost negligible.

A knowledge test was also conducted among the tribal women to assess their knowledge level in organic vegetable cultivation. It was observed that majority of the tribal women (53.75%) did not have adequate knowledge in organic vegetable cultivation. Only 20 per cent of women had adequate knowledge about proper cultivation practices, compost preparation and disease management etc.

The problems related to organic vegetable cultivation as revealed by the tribal farmers were high cost of compost (95.00%), transportation problem (95.00%); non-availability of quality FYM (87.50%), lack of alternative to quality FYM (78.75%) etc. (Table 123).

Table 123 : Problems related to Organic Vegetable Cultivation

Problems	N=160	
	Frequency	Percentage
1. Non availability of quality FYM	140	87.50
2. Quality seed	102	63.75
3. Regulated Market	90	56.5
4. Transportation	78	48.75
5. Seed production facility	82	51.25
6. Compost making facility	107	66.87
7. No other alternative to quality FYM	126	78.75
8. Cost of compost is very high	152	95.00
9. Transportation of compost	152	95.00
10. Lack of knowledge and exposure	75	46.88
11. Disease and insect problem in local variety increases	84	52.50

The improvement in the existing low profile organic vegetable cultivation greatly depends upon providing adequate skill and knowledge about overall cultivation practices. This must be supplemented with basic facility like making of quality compost, easy availability of FYM, seed production facility and regulated market in the near by areas. This will not only help the tribal women to get the remunerative price from the produce but also influence the male to involve themselves to a greater degree for the overall development in socio-economic condition of the tribal families.

Communication source utilization behaviour of the tribal farmers of Meghalaya in agriculture

P. Pal, N. Prakash & R. Kumar

In spite of having a large number of communication sources and channels, the farmers perceived only a few credible sources of information. This information source credibility is decided by the degree of trustworthiness and expertness accorded to a source by its respondents at a given time. In Meghalaya, a number of communication sources of channels are active to provide various information to the tribal farmers in respect of agriculture. Hence a study was conducted to identify different sources and channels engaged in transmitting knowledge to the farmers about agricultural practices.

This study was conducted among the three tribes of Meghalaya – Khasi, Jaintia and Garo taking 50 farmers from each to make the sample size 150. The farmers were selected based on the criteria like age, land holding, occupation and social interaction. The improved agricultural practices considered for the study were adoption of any improved variety, fertilizer application, adoption of plant protection measures and use of improved tools and implements.

It was observed that personal localite and personal cosmopolite sources were the major sources of information utilised by the farmers in all the improved practices except in farm tools and implements where other sources were consulted.

The impact study of different sources revealed that in case of variety personal cosmopolite sources were ranked as the most influential one by (22 %) of the respondents followed by fertilizer application (15.33%) and plant protection measures (12.6%). Personal localite source was observed to have highest influence in fertilizer application (78.00%) and plant protection measures (66.00%) and found influential in the case of variety (11.33%). Other sources were found influential only in farm tools and implements (55.33%). The reasons delineated by the respondents for preference of different sources where accessibility, detailed information, scope for future reference, scope for detailed discussion, information and input supply etc.

Though the respondents did attach high degree of reliability and creditability on mass media it was the least preferred source in case of information acquisition by the farmers.

Farmer – scientist interaction for improved vegetable cultivation - An experience of Meghalaya

The vegetable production scenario of the state is not very bright though favourable climate for vegetable cultivation exists in the state. Unfortunately the vegetable cultivation has remained as the household practice only and no effort has so far been made to make it a commercial venture. Through IVLP, the farmers have been

Table 124 : Sources of information utilized by the respondents

Improved farm Practices	Sources of Information											
	Personal Cosmopolite			Personal Localite			Mass Media			Other Sources		
	K	J	G	K	J	G	K	J	G	K	J	G
Improved variety	14	12	7	29	17	37	4	11	2	3	10	4
	(28.00)	(24.00)	(14.00)	(58.00)	(34.00)	(74.00)	(8.00)	(22.00)	(4.00)	(6.00)	(20.00)	(8.00)
Fertilizer application	8	1	14	39	32	46	0	2	0	3	5	0
	(16.00)	(2.00)	(28.00)	(78.00)	(64.00)	(92.00)	(0.00)	(4.00)	(0.00)	(6.00)	(10.00)	(0.00)
PPM	13	6	0	21	35	43	3	0	0	13	9	7
	(26.00)	(12.00)	(0.00)	(42.00)	(70.00)	(86.00)	(6.00)	(0.00)	(0.00)	(26.00)	(18.00)	(14.00)
Farm Tools	0	0	0	22	16	29	0	0	0	28	34	21
	(0.00)	(0.00)	(0.00)	(44.00)	(32.00)	(58.00)	(0.00)	(0.00)	(0.00)	(56.00)	(74.00)	(42.00)

constantly interacted and motivated to go for commercial cultivation of tomato and capsicum for a period of seven years. Finally sixty farmers who have sizable valley land and assured irrigation facility were selected for this venture. The land holding of the farmer varied from one acre to two acres and the land was utilised for both *Kharif* and *Rabi* season. The farmers were provided with Indo-American hybrids seeds pre tested in the research field along with chemical fertilizer and plant protection chemicals and five sprayers for application of plant protection chemical.

The total cultivation process of all the farmers in both the seasons was monitored by a team of scientists, starting from nursery raising to selling of produce. The package of practices for tomato and capsicum cultivation was followed as per the recommendation of the concerned division of ICAR Research Complex only. The average yield recorded for three consecutive years (1998-2001) is presented in Table 125.

Table 125 : Yield of different vegetable at farmers' field

Year	Season	Name of variety	Average Yield (Kg/ha)
1998	Kharif	Rupali (Hybrid tomato)	262
-do-	Rabi	Vaishali (-do-)	341
-do-	Kharif	California (capsicum)	134
-do-	Rabi	-do-	186
1999	Kharif	Rupali (Hybrid tomato)	243
-do-	Rabi	Vaishali (-do-)	302
-do-	Kharif	California (capsicum)	95
-do-	Rabi	-do-	197
2000	Kharif	Rupali	289
-do-	Rabi	Vaishali	362
-do-	Kharif	California (capsicum)	153
-do-	Rabi	-do-	178

The yield recorded for three consecutive years clearly indicated that commercial vegetable cultivation, particularly of tomato and capsicum is very much possible in this part of the state. As tomato and capsicum have got market price throughout the year, the farmers could fetch a handsome profit out of these two vegetables. However, due to lack of transport and storage facility, the farmers neither could dispose off the total produce nor preserve for future selling which

has prevented the farmers, from earning the expected remuneration.

Institution Village Linkage Programme (IVLP)

**K.M. Bujarbaruah, N. Prakash, P.P. Pal,
R. Kumar, S. Naskar & K. Vinod**

ICAR Research Complex for NEH Region has been implementing a pilot project on Institution Village Linkage Programme in 13 selected villages of Ri-Bhoi District, Meghalaya since 1996. This project has been included into NATP from 1999 onwards. In this project 1000 farm families have been adopted for their overall development in agriculture, livestock, horticulture, mushroom cultivation, vegetable production, pisciculture and related aspects. Another important aspect covered under this project is the drudgery reduction in agricultural operations especially for the women farmers.

For enhancing rice productivity, four ICAR developed varieties namely, RCPL-1-28, RCPL-1-29, RCPL-1-87-8 and RCPL-1-87-4 were cultivated covering nearly 7 hectares of lowland and upland. Similarly, RCM-1-1, RCM-1-2 and RCM-1-3 varieties of maize of this Institute have covered 5 hectares of land. The seeds of hybrid tomato and capsicum have been introduced among the selected farmers for commercial vegetable cultivation, which has been immensely popular among the farmers. The preventive measures taken up against soft rot disease of ginger has helped the farmers to get quality produce.

In the livestock sector, so far 200 piglet of improved breed (87.5% Hampshire Inheritance) were distributed among the farmers to increase pork productivity as well as to replace the local low productive pigs. The farmers were also trained in management practices and vaccination schedule. Concentrated feed was also provided for gaining faster growth. Rabbitry, which is comparatively a new venture has also been taken up under this project and so far 40 pairs of rabbits have been distributed among the farmers along with feed and housing technology.

In fish production, ten farmers were identified and they were trained in scientific fish culture

practices. The pre-stocking, stocking and post-stocking management practices were demonstrated to the beneficiaries.

Mushroom spawn has been distributed among the selected unemployed youth to help them start their own venture for additional income generation.

Improved agricultural tools and implements suitable for hill agriculture like long handled weeder, maize sheller, grass cutter, hoe etc have also been provided to the farmers for reducing drudgery, specially for the women farmers. Moreover, pedal paddy thresher, knapsack sprayer have also been given to the farmers for its use on community basis.

In the initial stage of this project saplings of citrus and guava have also been distributed to the farmers, which are about to bear fruits in the farmers field.

For the successful implementation of this project, altogether 7 On and Off campus training programme for the practising farmers have been conducted within this year. Moreover, the farmers have been taken to Assam and Delhi to help them understand the benefit of modern cultivation and livestock management practices.

Table 126 : Adaptability Assessment of RCPL-1-28 and RCPL-1-29 in the farmers' field (Upland)

Parameters	RCPL-1-28	RCPL-1-29	Local variety (Maniphou)
Area (Sq.m)	200	200	200
Germination percentage	93	94	96
Plant height (cm.)	92	93	95
No. of hills/sq.m.	24	24	18
No. of tillers/hill	12	13	9
No. of grains/panicle	171	173	82
1000 grain wt. (gm)	24.23	24.41	22.29
Yield (Kg/ha) Max.	3313	3389	2341
Min.	2312	2439	1786
Avg.	2772	2856	2113
Cost- Benefit ratio	1:2.3	1:2.4	-

The performance of these varieties was compared to the local variety to help the farmers understand the potentiality of the introduced varieties. At the same time, the adaptability of these varieties was measured against certain parameters like germination percentage, plant height, no. of hills/sq.m. etc. The difference in yield, which is

presented in the table, has helped the farmers to replace the local variety with that of improved one.

Table 127 : Performance assessment of improved varieties of rice (RCPL-1-3 and DR- 92) in lowland condition

Parameters	RCPL-1-3	DR-92	Local variety (Lakang)
Area (Sq.m)	200	200	200
Germination percentage	94	96	86
Survivability Percentage	92	95	82
Plant height (cm.)	52	53	59
No. of hills/Sq.m	24	27	19
No. of tillers/hill	11	15	7
No. of grains/panicle	156	169	84
1000 grain wt. (gm)	25.12	26.93	22.8
Yield (Kg/ha)			
Max.	3641	3719	2519
Min.	2639	2714	1838
Avg.	3113	3123	2208
Cost- Benefit ratio	1:2.2	1:2.2	-

The data clearly showed the better performance of the introduced varieties. It was observed that both the varieties (RCPL-1-3 and DR-92) performed well in respect of number of grains/panicle, 1000-grain weight and yield. The yield of the crop clearly shows that the introduced varieties could adapt the local condition very well.

Table 128 : Performance assessment of improved variety of maize in the farmers' field

Parameters	RCM-1-1	RCM-1-2	RCM-1-3	MLY
Area(Sq.m.)	500	500	500	500
Plant height (cm.)	205	171	213	236
Cob length (cm.)	18.1	15	16.3	13.7
Cob girth (cm.)	7.19	7.02	8.59	5.33
No. of cobs/plant	1	1	1	1-2
Av. Yield (Kg/ha)	3900-4100	3000-3100	4000-4200	1700-1800
Cost- Benefit ratio	1:6.5	1:3.0	1:6.6	-

Verification Trial was taken up to assess the production potentiality of RCM-1-1 RCM-1-2 and RCM-1-3 as well as to increase the overall production of maize as settled cultivation. It was observed that the introduced varieties could well adapt the farmers condition and the yield was recorded as high as 4000-4200 Kg/ha whereas the yield of local variety, MLY, was only 1700-1800 Kg/ha.

Table 129 : Performance assessment of hybrid variety of tomato in the existing micro farming situation during the Kharif season

Parameters	Var. Gotia	Var.Suraksha	Var. Khasi Local
Area Sq.m	400	400	400
Germination Percentage	80	78	74
No. of fruits/plot	29	34	12
Fruit size (girth)	7.3 cm	7.9 cm	4.2 cm
Average weight/ fruit	53 gm	57 gm	39 gm
Yield (kg/ha)	32200	31600	8700
Cost - Benefit ratio	1:6.5	1:6.6	-

Gotia and Suraksha were introduced considering the better performance of the varieties in the farmers field. The results obtained so far has indicated that the introduced varieties could perform better in respect of fruit size, average weight of the fruit, thinner pulp and average yield.

Table 130 : Performance of high yielding variety of capsicum in the existing micro farming situation during Kharif season

Parameters	Variety (California Wonder)	Local Variety	Cost-Benefit ratio
Area(Sq.m.)	400	400	1:7.0
No. of fruits/ plot	27	19	
Av. Weight /fruit (gm)	66	37	
Survivability percentage after Transplanting	93	87	
Yield (kg/ha)	16900	9300	

This intervention gave better results when the variety was judged against parameters like number of fruits/plant, average fruit weight and the yield. Though the local variety has shown a better survival percentage after transplanting in the field the same trend has not been observed in other aspects. Due to bad weather condition and without use of any input, this variety performed well in the farmers' field.

It was revealed that production performance of Large Black was better than crossbred under village condition. But crossbred were more adoptive than Large Black pig, which is reflected through mortality. It was also found that the mortality per cent was higher in the case of LB as compare to CB.

Table 131 : Performance Assessment of two breed of pigs under traditional system of rearing

Parameters	Large Black (LB)	Crossbred (75% Hampshire Inheritance)
Initial body weight (Kg)	10.95 ± 0.98 (10)	9.62 ± 0.85 (10)
Average body weight at 6 months of age (Kg)	23.71 ± 1.02 (9)	19.45 ± 0.75 (10)
Average body weight at 8 months of age (Kg)	30.25 ± 1.35 (8)	27.35 ± 1.15 (9)
Average body weight at 1 year of age (Kg)	48.68 ± 2.55 (7)	42.92 ± 3.16 (9)
Average daily body weight gain (g/day)	150.92 ± 12.56 (7)	133.20 ± 18.62 (9)
Cost- Benefit ratio	1:1.2	1:1.1

On Farm Trial on "Assessment of standardized ration on growth and performance of pig"

Table 132 : Production performance of crossbred pig

Production traits	Type of feeding system	
	With 50% balanced ration	Without balanced ration
Initial body weight (Kg)	9.26 ± 1.15 (10)	9.19 ± 1.26 (10)
Avg. body weight at 4 months (Kg)	12.61 ± 1.96 ^a	11.74 ± 1.65 ^a
Avg. body weight at 5 months (Kg)	16.56 ± 2.75 ^a	14.18 ± 1.77 ^b
Avg. body weight at 6 months (Kg)	20.13 ± 2.91 ^a	16.88 ± 1.92 ^b
Avg. body weight at 7 months (Kg)	24.65 ± 4.16 ^a	20.48 ± 2.36 ^b
Avg. body weight at 8 months (Kg)	29.64 ± 4.18 ^a	23.94 ± 3.75 ^b
Avg. body weight at 9 months (Kg)	33.78 ± 5.15 ^a	27.57 ± 4.57 ^b
Avg. body weight at 1 year (Kg)	49.98 ± 6.29 ^a	36.54 ± 4.12 ^b
Avg. daily body weight gain (g/day)	150.81 ± 8.14 ^a	101.29 ± 9.63 ^b
Mortality (%)	10	10
Cost- Benefit ratio	1:2.1	1:1.6

Results indicate that mean body weight at different ages differ significantly (PCO.05) between two groups with a similar management and housing system. Similarly, average daily body weight gain (g/day) also differs significantly (PCO.01) between two feeding groups. Mortality rate was also higher in traditional feeding system. So it may be mentioned here that with the feeding of 50 percent

balanced ration, significantly more productivity can be achieved.

S-8: On Farm Trial on “Assessment of performance of broiler rabbit breed in micro farming situation”

Table 133 : Production and reproduction performance of Rabbit in adopted village under IVLP

Traits	New Zealand White	Soviet Chinchilla
1. Litter Size at birth	5.26 ± 0.41	5.48 ± 0.56
2. Litter weight at birth (g)	326.62± 19.73	348.63 ± 35.91
3. Individual litter weight at birth (g)	62.09 ± 3.37	63.62 ± 2.19
4. Litter size at weaning	2.92 ± 0.95	3.06 ± 0.86
5. Litter weight at weaning (g)	1783.84 ± 42.65	1947.68 ± 37.86
6. Individual Litter weight at weaning	610.57 ± 32.25	635.97 ± 28.15
7. Average weight at 90 days (g)	1565.28 ± 45.15	1672.68 ± 38.46
8. Average weight at 180days(g)	2524.45 ± 62.92	2766.28 ± 75.25
9. Average daily post weaning body weight gain (g/day)	10.65 ± 2.85	12.15 ± 2.35
Cost- Benefit ratio	1:1.6	1:1.6

The results revealed that the Soviet Chinchilla breed performed little better than New Zealand White breed of broiler rabbit in over all production as well as reproduction parameters.

S-9: Composite pisciculture in the IVLP adopted villages

Table 134 : Growth of fishes in 14 months of culture

Sl. No.	Species	Average initial weight (gm)	Average final weight (gm)
1.	Catla	14.15	410.56
2.	Rohu	6.60	300.20
3.	Mrigal	4.07	253.75
4.	Silver carp	6.10	350.00
5.	Grass carp	2.91	815.00
6.	Common carp	9.53	525.30
7.	Gonius	27.58	225.75

Certain constraints were observed among the farmers in practising composite fish culture with management practices in total. Some farmers were

feeding the fishes as long as the feed was supplied to them and subsequently feeding was discontinued by them. Also, some farmers were not following the application of lime and cow dung as per the recommended schedule. All these factors directly reflected on the production.

NAGALAND
Socio-economic and personal characteristics of leaders and non-leaders

S.S. Gadge

The study was conducted in Teneiyphye-1 and Ngwala villages of Nagaland. Traditional leaders were found in the upper age group. The finding focused the importance of G.B.(Gaon Burah) in the progress of the Naga villages. It was found that all the leaders belonged to medium annual income group. Non-leaders in majority were found in low-income group (< Rs. 10,000). Majority of the leaders in different leadership patterns owned farm size between 1.1 to 2.5 ha. Majority of the leaders belonged to high socio-economic status, while the maximum numbers of non-leaders were found in medium socio-economic status. Majority of leaders were found in high degree of scientific orientation. Majority of non-leaders (62.12%) were found in medium degree of scientific orientation. About 82.41 per cent of leaders were found in high degree of mass media participation. All the political and functional leaders were having high degree of social participation. About 73 per cent of traditional leaders were found having high social participation. The percentage of leaders having high information source use pattern was 86%. The non-leaders having high information source use pattern were only 19%. Majority of leaders (93.20%) had high level of extension contact, while the maximum number of non-leaders had low to medium level of extension contact.

Gap between role expectation and role performances of leaders in village developmental work

S.S. Gadge

The research work was conducted in Teneiyphye-1 and Ngwala villages of Nagaland to find out the

gap between role expectation and role performances of leaders in village developmental work. The minimum gap (1%) between the role expectations and role performances of the leaders was found related to rising of funds. Out of total 150 respondents, 80 respondents expected their leaders to give emphasis on the improvement of economic and social condition of the resource poor. But only 46 respondents said that their leaders were performing this role. The highest gap (41%) was found when leadership role of making simple, easy and affordable technological solutions was concerned. While considering negative roles of leadership, the maximum gap found was regarding 'Securing advantages of governmental help for self-development with profit motive, i.e. (26%)'. The average gap found related to negative role performances and people's expectations from their leaders was (9%).

TRAINERS' TRAINING CENTRE

The Trainers' Training Centre (TTC) of ICAR Research Complex for NEH Region, Umiam is

engaged in planning, organizing and conducting training courses for refreshing the knowledge and upgrading the skills of the scientists/trainers of Krishi Vigyan Kendra's (KVK's), the field functionaries of the State Departments of Agriculture, Horticulture, Soil & Water Conservation, Animal Sciences, Fisheries etc. including NGO's in the North Eastern Region of India. The TTC conducted need-based quality training programmes during 2002-2003 (Table 135:).

All the 86 participants have been benefited immensely from the above need-based and quality training programmes conducted by TTC where State Govt. officials (40), ICAR staff (35) along with KVK Scientists/ In charges (11) were trained. Participants from Meghalaya (76), Assam (6), Tripura (1), Manipur (1), Sikkim (1), and Arunachal Pradesh (1) have attended the trainings. The participants belonged to different categories including Scheduled Tribes (56) Scheduled Caste (2), OBC (5), and General Category (23).

Table 135 : Training Programme conducted in TTC during the period 01.04.2002 to 31.03.2003

Sl. No	Training Programme	Period	No. of Participants			Sponsoring State	Remarks
			M	F	T		
1.	Plasticulture Interventions for Horticulture & Agriculture Development in Meghalaya	29 th Apr. to 3 rd May, 02	15	21	36	Meghalaya	Trg. programme conducted under 1 AICRP (Agril. Egg) and in collaboration with Meghalaya Small Farmers Agri-business Consortium, Shillong.
2.	Rabbit Production Technology	20 – 24 Aug., 02.	5	6	11	Meghalaya	
3.	Poultry Production Technology	19 – 22 Nov., 02.	12	3	15	Meghalaya	
4.	Rural godown scheme for KVK Scientists/Incharges of NEH Region	12 Dec.,02.	24	-	24	Meghalaya, Assam, Tripura, Manipur, Sikkim	Collaborated training programme with NIAM Jaipur
Total			56	30	86		

M – Male; F – Female; T – Total

RODENTS

All India Network Project on Rodent Control

K.A. Pathak & D. Kumar

Survey and surveillance

The regular survey conducted on rodents showed the occurrence of *Bandicota bengalensis*, *Rattus nititidus* in fields and adjoining areas and *B. bengalensis*, *Rattus rattus* and *Mus musculus* in houses, stores, godowns. *Bandicota bengalensis* is recorded as predominant species. Highest rodent activities were recorded during July to September and least during December-February. Upland areas harboured maximum number of active burrows.

Damage assessment and control operations in various crops

Rodent damage in paddy, maize and groundnut was recorded at various locations. Cumulative damage to the tune of 2.63 and 1.92 %, at vegetative stage, was recorded in lowland and upland rice, respectively. The damage increased to 7.34 and 5.03 % at grain formation stage. Early maturing varieties suffered higher losses (up to 9.16%). Two treatments, at 15 days interval, with rodenticides (racumin, bromadiolone and zinc phosphide) proved effective and very less damage was observed at maturity. Maize cobs suffered losses of 5.86 % that was reduced to 1.79% after treatment with different rodenticides. Groundnut crop was damaged up to 6.79% at pod formation stage. (table 136)

Table 136 : Damage assessment and control

Locations	Damage %		
	Vegetative stage	Grain formation stage**	Maturity
Rice lowland	2.63	7.34	1.85
Rice upland	1.92	5.03	1.07
Maize	-	5.86	1.79
Groundnut	4.33	6.79	-

** Treatment with different rodenticide baits

Efficacy of rodenticides (Table 137 & 138)

Fields: Treatment of Rodent burrows in upland areas, having paddy, maize and groundnut, with fresh bait of racumin (0.0375%) prepared from racumin tracking powder for one day resulted in 79.00% reduction in active burrows. In these fields damage was considerably low after treatment. Average consumption of racumin bait, when used on bait stations, was 39.25% and 42.63 in 1 and 2 days treatments, respectively in fields.

Zinc phosphide 2% bait, kept in bait stations (made up of bamboos) was consumed to the tune of 29% and rodent activities were reduced significantly in paddy fields. Bamboo bait stations proved very effective during rainy seasons for keeping the poisons baits in the fields.

Table 137: Burrow treatment with rodenticides

Rodenticides	No. of active burrows treated	No. of active burrows after 7 days of treatment	% reduction in active burrows
Racumin bait (0.0375%)			
Rice fields	70	14	80.00
Maize fields	44	10	77.27
Groundnut fields	37	8	78.37
Animal farm	113	20	82.30
Zinc phosphide (2%)			
Rice fields	25	4	84.00
Uncultivated upland area	51	9	82.35

Animal farms: Rodent activities were recorded high in animal farm because of the storage of various kind of feed used for rabbits and pigs. Rabbit feed and pig feed were used as bait material for control of *Bandicota bengalensis*. Fresh bait of racumin by using animal feed as bait material was found very effective. In one-day and two days treatment consumption recorded was 45.30 - 50.00% (av. 47.65) and 42.85 - 52.71% (av. 47.78), respectively, at different locations and effective control was achieved within 10 days of treatment.

Treatment of rodent burrows with racumin tracking powder was found very effective. One-day treatment of RTP resulted in 82% reduction of active burrows.

Houses, shops & Godowns: *Bandicota bengalensis* and *Mus musculus* were recorded as predominant species. Use of anticoagulants (Racumin and Bromadiolone) proved effective in controlling these species. Racumin was found more effective than bromadiolone against *B. Bengalensis*. Average consumption of racumin bait recorded was 34.71 – 41.36% and 35.29 – 43.26% in 1 and two days treatment, respectively. Effective control of rodents with anticoagulants was achieved within 10-12 days with 1 day treatment of racumin and 2 day treatment of bromadiolone. Zinc phosphide (2%) bait was found very effective in controlling rodent

population with an average consumption of 17.00-20.00% in one day treatment. But, its use was not recommended in urban areas and animal farms because of hazards posed to the non-target organisms.

Evaluation of new rodenticide (racumin paste) in Laboratory:

Evaluation of Racumin paste was conducted under laboratory conditions against *B. bengalensis*. In 'No choice' test, 100% kill of experimental animal was achieved within 3-10 days after one day feeding and within 3-9 days in 2 and 3 days treatment. In 'choice test' one day feeding resulted in 90% kill, while 100% kill in 2 and 3 days treatments.

Table 138: Effect of different rodenticides exposed on bait stations

Locations /Rodenticides	1 day treatment		2 day treatment	
	No. of bait stations	Av. Bait consumed (%)	No. of bait stations	Av. Bait consumed (%)
Fields				
Racumin bait (0.0375%)	105	39.25	50	42.63
Zinc phosphide (2%)	60	29.00	-	-
Animal farm				
Animal feed based racumin bait (0.0375%)	42	47.65	20	47.78
Shops				
Racumin bait (0.0375%)	115	34.71	40	35.29
Houses				
Racumin bait (0.0375%)	160	41.36	30	43.46
Bromadiolone (0.005%)	50	33.00	15	35.21
Zinc phosphide (2%)	40	18.50	-	-

4. DISTINGUISHED VISITORS

Sl. No.	Name	Designation and Address	Date of Visit
1	Dr. Kirti Singh	Ex-Chairman, ASRB, New Delhi	1st May 2002
2	Shri Satpal Singh Verma,	IMC nominee by ICAR New Delhi	9 th May 2002
3	Dr. B.S. Hansra	ADG (AE), ICAR, New Delhi	21 st May, 2002
4	Dr. J.S. Samra	DDG (NRM), ICAR, Krishi Bhawan	26 th June, 2002
5	Dr. Akshayabher Singh	Professor, W T C, IARI, New Delhi	1 st & 2 nd July, 2002
6	Prof. V.P. Mahajan	Professor, Member of QRT.	30 th June to 3 rd July, 2002.
7	Shri Shyamal Dutta	His Excellency the Governor of Nagaland	2 nd Nov, 2002
8	Shri K.M. Seth Lt.Gen. (Retd.)	His Excellency the Governor of Tripura	21 st Nov., 2002
9	Shri R.K. Vaish, IAS	Principal Secretary & Commissioner, Deptt. Of Fisheries, Govt. of Tripura	28 th Nov., 2002
10	Shri Ashutosh Jindal	DM & Collector, West Tripura, Agartala	1 st Dec., 2002
11	Colonel Anil Nakra, SM(Retd.)	Executive Pilot, Pawan Hans Helicopters Ltd, New Delhi	4 th Jan., 2003
12	Colonel P.P. Sharma, YSM (Retd.)	Executive Pilot, Pawan Hans Helicopters Ltd, Safdarjang Airport, New Delhi-3	4 th Jan., 2003
13	Dr. R.S. Misra,	Principal Scientist, Regional Centre (TCR), BBSR	24 th Jan., 2003
14	Shri G.S. Raju	Director, SIPARD, A.D. Nagar, Agartala	7 th Feb., 2003
15	Shri K.J. Benny, CSC along with 27 farmers	Director, ASHA Damdania, Tripura West	10 th Feb., 2003
16	Sri Tarun Kapoor, IAS	Director (P), SJVN	21 st Feb., 2003

5. PUBLICATIONS

Research Articles:

- Majumdar, B., Venkatesh, M.S., Kailash Kumar and Patiram (2002) Effect of levels of potassium and FYM on yield and uptake of nutrients by sweet potato and different forms of K in an acid Alfisol of Meghalaya. *Journal of Potassium Research*, 18 (Accepted for publication).
- Majumdar, B., Venkatesh, M.S., Kailash Kumar and Patiram (2002) Effect of nitrogen, sulphur and pig manure application on yield, nutrient uptake and quality parameters of maize-mustard crop rotation and residual nutrient build up in an acidic Alfisol of Meghalaya. *Journal of Hill Research*, 15(2): 63-70.
- Majumdar, B., Venkatesh, M.S. and Kailash Kumar (2002) Effect of nitrogen and farm yard manure on yield and nutrient uptake of turmeric (*Curcuma longa* L.) and different forms of inorganic N build up in an acidic Alfisol of Meghalaya. *Indian Journal of Agricultural Sciences*, 72(9): 528-531.
- Venkatesh M.S., Majumdar, B., Kailash Kumar and Patiram (2002) Effect of Phosphorus, FYM and lime on yield, P uptake and forms of soil acidity in *Typic Hapludalf* of Meghalaya. *Journal of the Indian Society of Soil Science*, 50 (3): 254-258.
- Venkatesh M.S., Majumdar, B., Kailash Kumar and Patiram (2003) Status of micronutrient cations under various land use systems of Meghalaya. *Journal of the Indian Society of Soil Science*, 51 (1): 60-64.
- Venkatesh M.S., Majumdar, B., Lal, B. and Kailash Kumar (2002) Relative performance of sulphur sources on sulphur nutrition of groundnut in acid Alfisol of Meghalaya. *Indian Journal of Agricultural Sciences*, 72 (4): 216-219.
- Singh, A.K. and Narayana Bhat M 2002. Control of frenchbean rust through fungicides and a nem based formulation. *Indian Phytopath* 55 (2): 241-243.
- Prasad M.Santa Lakshmi, Prasad M. Srinivas, Sharma Y.P. and Singh A.K. 2002. Management of brown spot disease of rice, *Indian Journal of Hill Farmg.* 15(1): 15-17
- Prasad M.Srinivas, Prasad M.S.Lakhmi, Singh A.K. and Sharma Y.P. 2001. Effect of containers and fungicidal application on the storage of Khasi Mandarins. *Indian Journal of Hill Farmg* 14(1): 56-62
- Sharma Y.P, Singh A.K., Prasad M.Srinivas Prasad and Prasad M.S.Lakshmi 2001. Itrogenic effect of citrus management with systemic fungicides *Indian Journal of Hill Farmg.* 14(1): 78-83
- Prasad M.S. and Prasad M.S.Lakshmi .Singh A.K and Sharma Y.P. 2001. Reaction of citrus germplasm to different fungal diseases in Meghalaya *Indian Journal of Hill Farmg* 14(1): 113-116
- Chandra, S., Singh, A.K., Sharma, Y.P. and Prasad M.S.Lakshmi 2003. Bamboo dust: A substrate for growing oyster mushrooms (*Pleurotus* Spp.) pp. 275-277 In Proc. Approches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem (Eds: B.P.Bhatt, K.M.Bujarbaruah, Y.P.Sharma and Patiram) ICAR Research Complex for NEH Region, Umiam, Meghalaya
- Prasad, M.S., Prasad M.S.Lakshmi, Singh, A.K. and Sharma, Y.P. 2003. Diseases of rice and their management in NEH Region. pp. 267-274 In Proc. Approches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem (Eds: B.P.Bhatt, K.M.Bujarbaruah, Y.P.Sharma and Patiram) ICAR Research Complex for NEH Region, Umiam, Meghalaya
- Verma, D.K. and Sarma, B.K. (2003) Metroglyph analysis of maize inbreds in Northeast India. *J Assam Science Society, December, 2003* (In press).
- Verma, D.K; Thakur, R; Singh, N.K and Mishra, S.B. (2002). Heritability and genetic advance studies in F_2 population, F_1 population, parents and Pooled population of intra indica crosses of rice grown under late sown condition. *Mysore J Agril Sci* 36(3): 222-230.
- Sahay Gitanjali; Verma, D.K; Durai, A. Anna and Sarma, B.K. 2002. Bhartiya Krishi Anusandhan Parishad Padap Prajnan Prabhag ka Uttar Purvi Parikshetra Ke liye Kismen ke Vikas mein yogdan. *Jigyasa* (In Hindi). September: 33-42.
- Rajesh Kumar, Pal P.P., Prasad K. and Prakash N. 2002. Modernizing Tribal Piggery: A delineated Approach (*Research Bulletin No- 47*).
- Pal P.P., Kumar Rajesh, Bankey Bahari, Prakash N and Parsad K., 2002. Percolation of Improved Agricultural Technologies in Meghalaya villages, *Mysore J. Agril. Scientist*, 36: 162- 164.
- Prasad K., Burman B.D. and Kumar Rajesh, 2002. A problem solving approach of Agricultural Extn. for Development: A guide to the Extn. workers. *Zoram Loneitu*, 44 (2): 39-42
- Babu Naresh, P. Venkateswurtu and R. C. Verma (2001). Performance of selected brinjal lines in Nagaland. *Indian J. Hill Farm.* 14 (2): 29- 33
- Babu Naresh and Anamika Sharma. Effect of Integrated Nutrient Management on Productivity of Banana and soil Properties. Abstract published in "Global Conference on Banana and Plantain" from 28- 31 October 2002 at Bangalore. pp 126.
- Karmakar, H.D.(2003). Antibiogram of bacterial pathogen isolated from repeat breeder cows in Sikkim. No PP-47, in the 'XXI Conference of IAVMI' on 7th to 9th Feb, '03 in

- ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Karmakar, H.D. (2003) Bacterial pathogens isolated from cervical mucus of repeat breeder bovine cows in Sikkim. No. PP-48, in 'XXI Conference of IAVMT' on 7th to 9th Feb.'03 in ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Karmakar, H.D. (2003) Bacteriological study of abortion in bovine cows in Sikkim. No. PP-50 in 'XXI Conference of IAVMT' on 7th to 9th Feb.'03 in ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Dey, D.; Das, A and Karmakar, H.D.(2002). Mycotoxin in feeds and its detoxification to improve production performance of livestock. *Indian Dairy Man*. 54(S)35-4
- Singh, S.P., Sharma, S.K., Sharma Anamika and Sharma A. (2003) Evaluation of various extraction methods for estimation of Potassium content in Plant materials of different field crops of Nagaland. *Advances in Plant Sciences* 16(1) 131-136.
- Sharma, A.; Sharma Anamika and Sharma, S.K. (2002). The scope of improving the existing system of Poultry farming. *Bioved*. 13 (1,2): 147-150.
- Sharma, A; Lal, R.C.; Sharma, Anamika; Sharma, S.K. & Singh, J.(2002) -"Factor productivity and real cost of production of major cereals and non-cereals crops in India". 2nd International Agronomy Congress on Balancing Food and Environmental Security - A continuing challenge, IARI, New Delhi, November 26 to 30. PP. 16-17.
- Sharma, A; Lal, R.C.; Sharma, Anamika; Singh, J & Sharma, S.K. (2003) -"To study the problem faced by the farmers for Adoption of improved Maize cultivation practices in Hills". 5th Indian Agricultural Scientists and Farmer's Congress". Vigyan Parisad, University of Allahabad, Allahabad, February 15 & 16. PP. 13-14.
- Sharma, A; Sharma, Anamika & Sharma, S.K. (2002) - "Alternate cropping system of Nagaland in North East region of India". *Nature & biosphere*. Vol.No. 7(3). December. PP.13-16.
- Sharma, S.K.; Singh S.P.; Sharma Anamika and Sharma A. (2003). Status of Available Nitrogen, Phosphorus, Potassium and Physio-chemical characteristics of Acidic soils of North East Region with special reference to Nagaland State. *Journal of Interacademia*. Vol. 7(1): 123-126.
- Sharma, Anamika and Sharma, S. K. (2003). Scoring technique for rose evaluation. *Journal of Ornamental Horticulture*, New Series. Vol. 6 (1): 50-54.
- Babu, K. D., S. Yadav, M. S. Prasad and Y. P. Sharma (2002). Pre harvest fruit drop in Khasi mandarin (*C. reticulata* Blanco). *Crop Res.*23 (2): 308-312.
- Dubey, A.K., A. Nath, R.K. Patel, K.D. Babu and D. S. Yadav (2002). Standardization of maturity indices of kinnow under Meghalaya condition. *Progressive Horticulture*, 34(1): 119-122.
- Mishra, M., I.P. Singh, S. Govind and D.S. Yadav (2002). Effect of triacetonol on micropropagation of certain citrus species. *Indian J. Citriculture*, 1(1): 28-31
- N. Rai, D.S. Yadav and R.K. Yadav (2002). Standardization of paclobutrazol a. concentrations in vegetable crops. *Veg Sci*. 29: 149-53.
- Babu, Dinesh K. and D. S. Yadav (2002). Screening guava hybrids for yield and quality traits. *South Indian Horticulture*, 50 (1-3): 190-194
- Babu, Dinesh K. and D. S. Yadav (2002). Effect of Dichlorophenoxy acetic acid on yield and quality of Khasi mandarin (*C. reticulata* Blanco). *South Indian Horticulture*, 50(1-3): 31-35.
- A.K.Tripathi, N. Nayak, S.S.K Das: Economics of Groundnut Production under frontline demonstration. in Agricultural Extension Review volume, Nov - 2002.
- A.K.Tripathi, S.B.Singh & K.K.Datta: Constraints and Prospects of slow growing crops, viz. Maize Pulse and oilseeds in North Eastern Region in India (Abstract) Published in Indian Journal of Agricultural Economics Volume - 57, No- 3 July - Sept 2003 page 379 - 380.
- Datta, K.K, C. de Jong and Singh, O.P (2002). Feasibility of subsurface drainage for salinity control in the trans-Gangetic region of India, Irrigation and Drainage. Vol 51, No 4 (Wiley & Sons ltd publication), pp275-292.
- Datta, K.K & C. de Jong (2002) Adverse effect of waterlogging and soil salinity on crop and land productivity in northwest region of Haryana, India, *Agricultural Water Management*, Vol 57, No 3, pp223-238.
- Datta, K. K. (2003) Farmer's Participation in Sub-surface Drainage Project: Experience from Haryana, in Institutional Change in Indian Agriculture, In: Pal, Suresh, Mruthyunja, Joshi, P.K. and Raka Saxena. (Eds.) Institutional Change in Indian Agriculture, National Centre for Agricultural Economics and Policy Research, pp 255-264
- Datta, K.K and Singh, S.B (2003) Analysis of traditional agricultural Practices of NEH Region, In: Bhatt,B.P, Bujarbaruah, K.M, Sharma, Y.P and Patiram. (Eds.) Approaches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem, ICAR Research complex for NEH Region, Pp 283-290.
- S.B.Singh, Datta,K.K and Nagachan, S.V (2003) Economic Analysis of Shifting Cultivation. In: Bhatt,B.P, Bujarbaruah, K.M, Sharma, Y.P and Patiram. (Eds.) Approaches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem, ICAR Research complex for NEH Region, pp 323-330.
- Gupta, J.J., Doley, S. and Yadav, B.P.S. 2001. Performance of broiler chicks under different types of management practices. *Indian J. Hill Farming*, 14 (2): 120-122.
- Gupta, J.J., Yadav, B.P.S. and Hore, D.K. 2002. Production potential of buckwheat grain and its feeding value for poultry in northeast India. *Fagopyrum*, 19:101-104.
- D. Agrahar - Murugkar., P. P. Pal and B. P. S. Yadav, 2002. Dietary pattern and food consumption pattern of the tribals of Meghalaya and its relation with socio- economic factors. *Ind.J.Nutr.Dietet.* (In press).

- Agrahar-Murugkar, D., AND Pal, P.P. (2003). Intake of Nutrients and Food sources of nutrients among the Khasi tribal women of India. *Nutrition: The International Journal of Applied and Basic Nutritional Sciences* (In press).
- De, L.C and K.R.Dhinan (2002) : Growth , flowering and corm production of gladiolus as influenced by grades,season and chemicals". *The Horticultural Journal*, 15(2): 69-74
- De, L.C, B. K. Bhattacharjee and K. R. Dhinan (2002): Effect of biomulches on growth and flowering of Chrysanthemum CV. " Yellow Anemone " under Tripura condition. *Progressive Horticulture*. (Press)
- Agrahar-Murugkar, D., AND Pal, P.P. (2003). Intake of Nutrients and Food sources of and its feeding value for poultry in northeast India. *Fagopyrum*, 19:101-104.
- Babu Naresh, P. Venkateswarlu and R. C. Verma (2001). Performance of selected brinjal lines in Nagaland. *Indian J. Hill Farm*. 14 (2): 29- 33
- Baghel, S.S., Singh, S.B. and Singh, I.M. (2002) The WTO and Policy Obligations for Agriculture in North Eastern States (full paper), *Proceedings of 27th Convention of Indian Agricultural Universities Association*, organized by Indian Agricultural Universities Association and A.N.G. Ranga Agricultural University, Hyderabad: 361-376.
- D. Agrahar-Murugkar, P.P.Pal and .P.S.Yadav,2002.Dietary pattern and food consumption pattern of the tribals of Meghalaya and its relation with socio- economic factors. *Ind.J.Nutr.Dietet*. (In press).
- Das,K.S., Tomar,O.S. ,Das, N.,Bist, G.S. and Ghosh,S.K. (2003). Effect of steaming-up period on subsequent reproduction in primiparous crossbred dairy cows. *The Indian Journal of Animal Sciences*.73(3) : 294-295.
- Datta, K.K. and Singh, S.B. (2003) Analysis of traditional Agricultural Practices of NEH Region (full paper). *Proceedings of National Seminar on Approaches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem*, organized by Indian Association of Hill Farming & ICAR Complex for NEH Region Umiam, Meghalaya (in press).
- Dey, D.; Das, A and Karmakar, H.D.(2002). Mycotoxin in feeds and its detoxification different types of management practices. *Indian J. Hill Farming*,14 (2): 120-122. existing system of Poultry farming. *Bioved*. 13 (1,2): 147-150.
- Gupta, J.J., Yadav, B.P.S. and Hore, D.K. 2002. Production potential of buckwheat grain *Journal of Ornamental Horticulture*, New Series. Vol. 6 (1): 50-54.
- Madhav,M.S.,Rao,B.N.,Singh,S. and Deka,P.C. 2002. invitro Production of Virus free citrus (*Citrus reticulata* Blnaco cv. Khasimandarin) plantlets. *International Journal of Tropical Agriculture*—Accepted for publication.
- Madhav,M.S.,Rao,B.N.,Singh,S. and Deka,P.C. 2002.Nucellar embryo genesis and artificial seed production in *Citrus reticulata* Blnaco cv. Khasimandarin. *Indian J. Plant Physiology*- Accepted for publication
- Mausumi Raychaudhuri and Kailash Kumar. 2002. Direct and residual effect of lime on the soil characteristics, yield and nutrient uptake of maize (*zea mays*) and soybean (*Glycine max*) in an acid hill soil of Manipur. *Indian Journal of Agricultural Sciences*. 72 (2) : 67-9.
- Mausumi Raychaudhuri and Kailash Kumar.(2001) Response of maize to potassium under different levels of lime in an acid hill Ultisol of Manipur. *Annals of Agricultural Research* (communicated and acknowledged vide letter No. ISAS/823 dt.22/11/2001).
- Mausumi Raychaudhuri, Kailash Kumar, Raychaudhuri, S. and Sanjeev Kumar. 2002. Efficiency of *Rhizobium* with liming in furrows in groundnut. In *Microbial Biotechnology for Crop Production-Past Present and Future Perspectives*. (Yadav, A. K., Raychaudhuri, S. and Talukdar, N. C. Eds.) (In Press).
- Mausumi Raychaudhuri, Ngachan, S. V., Raychaudhuri, S and Singh, A. L. 2003. Yield responses of groundnut (*Arachis hypogaea*) to dual inoculation and liming of an acid hill Ultisol of Manipur. *Indian Journal of Agricultural Sciences*. 73 (2) (In Press)
- Mausumi Raychaudhuri, Kailash Kumar and Raychaudhuri, S. 2002 Role of Manures and biofertilisers in alleviating legume-Rhizobium symbiosis constraints to crop production. In *Proceedings of Recent Advances in Life Sciences* Ed. Yadava, P. S., Manipur University, Imphal. pp. 148-150
- Narsimha Rao,B. and Venkata Rao,P. 2002. Heterosis in ridge gourd (*Luffa acutangula* (Roxb.)L.). *Journal of Research ANGRAU*. 30(1):11-8
- Narsimha Rao,B., Venkata Rao,P. and Reddy,Y.N. 2002. Genetic studies in Ridge gourd (*Luffa acutangula* (Roxb.)L.). *South Indian Horticulture*. 50(1-3):233-7
- Ngachan, S. V., Yadav, A. K., Raychaudhuri, S., K. Lokeswar Singh, L. Ingobi Singh, Th. Raghupati Singh and Sharma, B. K. 2002. Rhizobium application in groundnut in the farmers field. In : *Microbial Biotechnology for Crop Production- Past Present and Future Perspective*. SPURIT, New Delhi. (In press)
- Pal P.P., Kumar Rajesh, Bankey Bahari, Prakash N and Parsad K., 2002. Percolation of Improved Agricultural Technologies in Meghalaya villages, Mysore J. Agril. Scientist, 36: 162- 164
- Pal P.P., Kumar Rajesh, Bankey Bahari, Prakash N and Parsad K., 2002. Percolation of Improved Agricultural Technologies in Meghalaya villages, Mysore J. Agril. Scientist, 36: 162- 164
- Prasad K., Burman B.D. and Kumar Rajesh, 2002. A problem solving approach of Agricultural Extn. for Development: A guide to the Extn. workers. *Zoram Loneitu*, 44 (2): 39-42
- Prasad K., Burman B.D. and Kumar Rajesh, 2002. A problem solving approach of Agricultural Extn. for Development: A guide to the Extn. workers. *Zoram Loneitu*, 44 (2): 39-42
- Rajesh Kumar, Pal P.P., Prasad K. and Prakash N. 2002. Modernizing Tribal Piggery: A delineated Approach (Research Bulletin No- 47).
- Rajesh Kumar, Pal P.P., Prasad K. and Prakash N. 2002. Modernizing Tribal Piggery: A delineated Approach (Research Bulletin No- 47).

- Singh, K. P., Mausumi Raychaudhuri, and Munda, G. C. (2002). Nitrogen economy in groundnut through *Rhizobium* in acid hill soils of Manipur. In *Microbial Biotechnology for Crop Production - Past Present and Future Perspectives*. Yadav, A. K., Raychaudhuri, S. and Talukdar, N. C. Eds.) (In Press).
- Singh, S.B. and Datta, K.K. (2003) Economics of Shifting Cultivation in Manipur (full paper), Proceedings of National Seminar on Approaches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem, organized by Indian Association of Hill Farming & ICAR Complex for NEH Region Umiam, Meghalaya (in press).
- Singh, S.B., Datta, K.K., and Ngachan, S.V. (2002) Adoption of Agroforestry Technology in Mizoram – an Economic Analysis. *Agricultural Economics Research Review* (revised version communicated ; Ref. No. ABRR:234 dated 12/5/2003.)
- Singh, S.B., Mishra, L.K. and Datta, K.K. (2002) Financial analysis of Selected Agro-Horticulture systems in Meghalaya, *Journal of Hill Research* (Ref.No. JHR:800/2002 dated 11/11/02)
- Singh, S.B., Singh, R.P. and Datta, K.K. (2002). Shifting Cultivation and Its Sustainability in India's North-Eastern Hill Agriculture. *Agricultural Situation in India: Vol. LVIII(10):467-472*
- Sunil Kumar, K. 2002. Variability of *Mangifera* species in Manipur. (In) *Proceedings on Recent advances in life sciences* (P.S. Yadav, Edited), Manipur University, Imphal - 157-9
- Tripathi, A.K., Singh, S.B. and Datta, K.K. (2002) Constraints and prospects of Slow Growing Crops, viz. Maize, Pulses and Oilseeds in North Eastern region in India *Indian Journal of Agricultural Economics* 57(3):379-380.
- Yadav, A. K. and Raychaudhuri, S. 2002. Recent advances in phylogeny and taxonomy of rhizobia. *Biofertiliser Newsletter* 10(2) :26-30.
- Ghosh, S.K. Persistent penile frenulum in a boar and its management- a case report. Communicated to : *The Indian Journal of Animal Reproduction*.
- Niranjan, M. and Chander Datt. 2003. Egg quality traits of khaki Campbell and desi ducks. *Indian J. Poultry Science*. (Submitted).
- Book chapter**
- Majumdar, B. (2002) Soil and land use survey and land capability classification. *Integrated watershed management for sustainable development*. (Eds: K.K. Satapathy and K.K. Dutta) pp. 27-30.
- Venkatesh M.S. (2002) Biofertilizers In: *Integrated watershed management for sustainable development*. (Eds: K.K. Satapathy and K.K. Dutta) pp. 213-215.
- Patiram (2002) Soil fertility management. In: *Integrated watershed management for sustainable development*. (Eds: K.K. Satapathy and K.K. Dutta) pp. 121-126.
- Singh, A.K. and Chandra, S. 2002. Mushroom Cultivation. Pages 227-230 in *Integrated Watershed Management for Sustainable Development* (Eds. K.K. Satapathy and K.K. Dutta). ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Chandra, S. Singh, A.K. 2003. Use of Plastics in Mushroom Cultivation in NEH region. Pages 183-190 in *Plasticulture Intervention for Agriculture Development in North Eastern Region* (Eds. K.K. Satapathy and Ashwini Kumar). ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Verma, D.K; Pattanayak, A and Dhiman, K.R. (2003) Boro rice production system in northeastern India: A Research Perspective. *Book Chapter. In Boro Rice., Proc. NSM-2K. Eds.: Singh, Mahub Hossain and R.Thakur., IIRI-India Office, New Delhi. pp. 157-166.*
- Verma, D.K. 2002 Population Improvement for the Development of hybrids, composite and synthetic varieties of maize. *Book Chapter. In Approaches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem*. Eds. Bhatt, B.P.; Bujarbaruah, K.M.; Sharma, Y.P. and Patiram pp.219-232
- Durai, A. Anna; Pattanayak, A; Verma, D.K; Sahay, Gitanjali and Sarma, B.K. (2002) Introduction of Exotic Rice Varieties in rainfed Lowlands of Meghalaya . *Book Chapter. In Approaches for Increasing Agricultural Productivity in Hill and Mountain Ecosystem*. Eds. Bhatt, B.P.; Bujarbaruah, K.M.; Sharma, Y.P. and Patiram pp.237-241
- Verma, D.K.; Sarma, B.K and Gupta, H.S (2002) Stability analysis in baby corn in the mid hills of Meghalaya. *Book Chapter. In Adv. Maize Prodn. Tech. & Quality Impvt., Proc. NSM-2K. Ed.: C.P.Awasthi, Indian Soc. Agril. Biochemists- P.C., 2002: pp. 44-47*
- Verma, D.K. and Singh, N.K. (2002) Agro-informatics and its strategic role in Agricultural Research. In *Fundamentals of Bioinformatics*. Ed Irfan Ali Khan and Atiya Khanum, Ukaaz Publications, Hyderabad, India. Pp.110-177
- Mandal, S.S; Akhtar, S.A; Pandey, A; Verma, D.K; and Sinha, N.K. (2002) Plant Biotechnology in modelling of biopharmaceuticals for cancer. *Book Chapter. In Role of Biotechnology in Medicinal and Aromatic Plants Vol VI. Special Volume on Diseases. (Ed) Irfan A Khan and Atiya Khanum, Ukaaz Publications, Hyderabad, India*
- Bhattacharjee, S.K and L.C.De (2003)"Dahlia" In: *Advances in Floriculture*. (Communicated)
- De, L.C and S.K, Bhattacharjee (2003):" Post harvest management of cut flowers and Loose flowers". In: *Advances in Floriculture"*. (Communicated)
- Gupta, J.J. 2002. Non-conventional feed resources for poultry production in Arunachal Pradesh. In *Resource management perspective of Arunachal agriculture*. Ed. K.A. Singh, Published by ICAR Res. Complex for NEH Region, Arunachal Pradesh Centre, Basar- 791101, India, pp. 139-146.
- Gupta, J.J. 2002. Household production system: Broiler and egg production. In *Integrated watershed management for sustainable development* Eds. K.K. Satapathy and K.K. Dutta, Published by ICAR Res. Complex for NEH Region, Umiam, Meghalaya, pp. 263-265.

- Datta, K.K., Singh, S.B. and Tripathy, A.K. (2002) Evaluation of Watershed Management Programmes and Project Cost Analysis In Satapathy and Dutta (eds) Integrated Watershed Management for Sustainable Development, ICAR Research Complex for NEH Region, Umiam (Meghalaya):323-328.
- Goswami, S.N., Sarma, B.K. and Singh, S.B. (2002) Food Security of North East India, for Twenty First Century. In Datta Ray, B. (eds), *Agenda for North East India*, Concept Publishing Company, New Delhi: 31-45.
- Gupta, J.J. 2002. Household production system: Broiler and egg production. In *Integrated watershed management for sustainable development* Eds. K.K. Satapathy and K.K. Dutta, Published by ICAR Res. Complex for NEH Region, Umiam, Meghalaya, pp. 263-265.
- Gupta, J.J. 2002. Non-conventional feed resources for poultry production in Arunachal Pradesh. In *Resource management perspective of Arunachal agriculture*. Ed. K.A. Singh, Published by ICAR Res. Complex for NEH Region, Arunachal Pradesh Centre, Basar- 791101, India, pp. 139-146.
- present and future perspectives. In : *Microbial Biotechnology for Crop Production- Past Present and Future Perspective* Eds. Yadav, A. K., Raychaudhuri, S. and Talukdar, N. C. Society for Promotion of Utilization and Resources Technology, New Delhi. (In press)
 - reference to taxonomy and phylogeny of diazotrophs. In : *Microbial Biotechnology for Crop Production- Past Present and Future Perspective* Eds. Yadav, A. K., Raychaudhuri, S. and Talukdar, N. C. Society for Promotion of Utilization and Resources Technology, New Delhi. (In press)
- S. B. Singh (2002) Economic Aspect of Floriculture In Lyndem, B. (eds) *Floriculture*, Centre for Distance Education, NEHU, Shillong: 65-70.
- Singh, S.B., Datta, K.K. and Singh, Kh.B. (2002), Determinants of Production and Instability of Rice in North-Eastern State of India. In Datta Ray, B. (eds) *Agenda for North East India*, Concept Publishing Company, New Delhi: 40-46.
- Yadav, A. K. and Raychaudhuri, S. 2002. Biofertilisers in integrated plant nutrient supply system . A practical approach. In : *Integrated Nutrient Supply Management Systems*. Ed. N. P. Singh, Concept Publishers, New Delhi, p. 107-123.
- BOOKS**
- Bhattacharjee, S.K and L.C.De (2003):" Advanced Commercial Floriculture ". Published by Pointer Publishers. (2 sets vols)PP-686., Jaipur, Rajasthan
- De, L.C and S.K.Bhattacharjee (2003):" Post harvest management Flowers and Ornamental crops. Pointer Publisher, Jaipur, Rajasthan. (Communicated)
- Bhattacharjee, S.K and L.C.De (2003):" Medical herbs and Flowers ". Pointer Publisher: Pointer, Jaipur , and Rajasthan. (Communicated)
- Yadav, A. K., Raychaudhuri, S. and Talukdar, N. C. Eds *Microbial Biotechnology for Crop Production- Past Present and Future Perspective*. Society for Promotion of Utilization and Resources Technology, New Delhi. (In press)
- Papers for Poster Session in 5th Agricultural Science Congress (April 4- 7, 2001), Guwahati and 5th Biennial Conference of Animal Nutrition Association of India held at W.B. Univ. Anim. Fishery sciences, Kolkata from 20 – 22 nov. 2002.**
- Yadav, B.P.S., Sahoo, S.K. and Gupta, J.J. Performance of growing pigs on deoiled rice polish based ration.
- Gupta, J.J., Yadav, B.P.S. and Doley, S. Job's tears (*Coix lachryma jobi*) grain as energy feed supplement for pig ration.
- Gupta, J.J., Yadav, B.P.S. and Hore, D.K. Production potential of buckwheat grain and its feeding value for poultry in XXI Conference of IAVMI held at ICAR Res. Complex for NEH Region, Umiam, Meghalaya from 7-9 Feb.2003.
- Gupta, J.J. Doley, S. and Yadav, B.P.S. Incidence of diseases in rural poultry of Meghalaya in the 9th Asian Congress of Nutrition from 23rd Feb to 27th Feb 2002, New Delhi.
- D. Agrahar- Murugkar, P.P. Pal and B.K. Das Effect of socio economic status on the food consumption pattern of the tribals of Meghalaya.
- Research Papers Presented in Seminar / Symposium / Conference etc.**
- Dr. N. Rai, Sr. Scientist, Division of Horticulture, ICAR Research Complex for NEH Region, Umiam, Meghalaya attended training on "Advances in vegetable production" held at Indian Institute of Vegetable Research, Varanasi from 3-23 December, 2002
- Dr. D. S. Yadav, PS & Head, Division of Horticulture, ICAR Research Complex for NEH Region, Umiam, Meghalaya attended Regional seminar on Turmeric held at Shillong on 28th November, 2002.
- Verma, D.K. and Sarma, B.K. (2002) *Correlation Study in Baby Corn (Zea mays L) in the mid hills of Meghalaya (Abstr)*. Proc of the International Conf on Vegetables on "Vegetables for Sustainable Food and Nutritional security in the New Millennium" at Dr. Prem Nath Agricultural Science Foundation, Bangalore, India during 11-14, November, 2002.
- De, L.C., A.K Dubey and M.Rai (2002): Evaluation of local and improved varieties of banana at low altitude of Arunachal Pradesh . Abstracted in proceedings on " Global Conference on Banana and Plantain " held at Bangalore from 28-31 October 2002.
- Soybean Genotypes Evaluation in Mid-altitude of Meghalaya. Gitanjali Sahay and B.K. Sarma. Paper for poster session of National Seminar on Approaches for Increasing Agricultural productivity in Hill and Mountain Ecosystem from October 18 – 20, 2000.

- Performance of Pigeon Pea (*Cajanus cajan*) varieties in Meghalaya. G. Sahay and B.K. Sarma.
- Ghosh, S.K. and Das, Asit. Studies on behavioral and physical signs of estrus in Black Bengal goat.
- Ghosh, S.K., Datt, Chander, Das, Asit and Niranjana, M. Studies on productive and reproductive performance of New Zealand White and Soviet Chinchilla rabbits
- Ghosh, S.K. Induction of kindling by PGF₂α and its effect on reproductive and productive traits in broiler rabbit.
- Ghosh, S.K., Yadav, M.C., Meur, S.K., Sharma, B. Kumar, S. and Uma Shankar. Effects of vitrification using different cryoprotectants on the morphological abnormality of *in vitro* matured buffalo oocytes.
- Ghosh, S.K., Yadav, M.C., Meur, S.K., Sharma, B. Kumar, S. and Uma Shankar. Studies on post-thaw livability of vitrified *in vitro* matured buffalo oocytes using trypan blue. Abstracts No. 1-5 were published in XVIII Annual Convention and National Symposium on "Reproductive Technologies for augmentation of fertility in livestock" at IVRI, Izatnagar from November 14-16, 2002.
- Ghosh, S.K., Yadav, M.C., Meur, S.K., Sharma, B. Kumar, S. Cryopreservation of *in vitro* matured buffalo oocytes by vitrification.
- Ghosh, S.K., Yadav, M.C., Meur, S.K., Sharma, B. Kumar, S. A study on *in vitro* maturation and *in vitro* fertilization of follicular oocytes from buffalo (*Bubalus bubalis*). Abstract No. 6 & 7 were presented and published in 9th International Congress on Biotechnology in Animal Reproduction at Tamilnadu Vety. and Animal Science University, Chennai from December 2-4, 2002.
- Chander Datt and Niranjana, M. Cell wall composition of tree leaves used as fodder for ruminants in Tripura. In Proc.: 'Seminar on Grassland and Fodder Development' held at IGFR, Jhansi (U.P.) from Oct 30 to Nov 1, 2002.
- Babu Naresh and Anamika Sharma. Effect of Integrated Nutrient Management on Productivity of Banana and soil Properties. Abstract published in "Global Conference on Banana and Plantain"- from 28- 31 October 2002 at Bangalore. pp 126.
- Karmakar, H.D. (2003). Antibio gram of bacterial pathogen isolated from repeat breeder cows in Sikkim. No PP-47, in the 'XXI Conference of IAVMI' on 7th to 9th Feb.'03 in ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Karmakar, H.D. (2003) Bacterial pathogens isolated from cervical mucus of repeat breeder bovine cows in Sikkim. No. PP-48, in 'XXI Conference of IAVMI' on 7th to 9th Feb.'03 in ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Karmakar, H.D. (2003) Bacteriological study of abortion in bovine cows in Sikkim. No. PP-50 in 'XXI Conference of IAVMI' on 7th to 9th Feb.'03 in ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- Sharma, A; Lal, R.C.; Sharma, Anamika; Sharma, S.K. & Singh, J. (2002) --"Factor productivity and real cost of production of major cereals and non-cereals crops in India". "2nd International Agronomy Congress on Balancing Food and Environmental Security – A continuing challenge, IARI, New Delhi, November 26 to 30. PP. 16-17.
- Sharma, A; Lal, R.C.; Sharma, Anamika; Singh, J & Sharma, S.K. (2003) --"To study the problem faced by the farmers for Adoption of improved Maize cultivation practices in Hills". 5th Indian Agricultural Scientists and Farmer's Congress". Vigyan Parisad, University of Allahabad, Allahabad, February 15 & 16. PP. 13-14.
- B. Narsimha Rao, and K. Sunil Kumar, attended 'Awareness campaign cum workshop of Technology Mission' from 16-18th May, 2002 at State Guest House, Imphal Organized by State Department of Horticulture and Soil Conservation, Manipur.
- B. Narsimha Rao and S. Raychaudhuri, participated as resource persons in the Two days workshop cum Exhibition on 'Organic farming and Vermiculture for sustainable Agriculture' organized by SDDC, Senapati at Mini Stadium Senapati and delivered the guest lecture on "Vermiculture and Vermicompost- Problems and prospects in Manipur" on 24th Jan. 2003.
- M. Raychaudhuri, B. Narsimha Rao, S. Raychaudhuri, and V.R. Suresh, participated in the workshop organized by the G.B. Pant Institute of Himalayan Environment and Development, North East unit, Itanagar and RRL, Manipur Centre, Imphal for identifying the issues and activities on 'Integrating culture and sustainable Natural Resource Management Challenges in the North Eastern India' and presented the views of the group on Conservation of Biodiversity and Deforestation and Land Rehabilitation on 2nd Jan. 2003
- S. Raychaudhuri, attended 'Sixth Agricultural Science Congress', NAAS, Bhopal, 10-12 Feb. 2003 and presented an article entitled 'Evaluation of different rhizobial strains on groundnut in an acid hill soil'.
- S. Raychaudhuri, attended the '1st North Eastern Regional workshop on production and quality control of biofertilizers' held at Guwahati University, Guwahati on 26-27th Feb'2003 organised jointly by Regional Biofertiliser Development center, GOI and North East Biotechnological Association, Guwahati.
- Singh, S.B. and Ngachan, S.V., attended Problems and Prospects of Shifting Cultivation in Manipur State, (invited paper) 'Workshop on Population, Food Production and Environment of Manipur', 28th July, 2002, Department of Agricultural Economics, College of Agriculture, Central Agricultural University, Imphal.
- V. R. Suresh, attended workshop on 'Sustainable fisheries development in Loktak Lake' 8-10 March, 2003 organized by L.D.A. & W.I. South Asia, New Delhi at Imphal.

Popular Articles

- N. Rai, D.S. Yadav, A. Nath and R.K. Yadav (2002). Chow-chow: A poorman vegetable for north-eastern hills region. *Indian Farming*. 52(9): 18-20.
- Yadav, R. K. , Yadav, D. S., Rai, N. and Patel, K. K. 2002. Vaigyanik dhang se khira ki kheti. *Vishwa Krishi Sanchar* 4(4): 47-49.

- Bujarbaruah, K.M and Chander Datt 2002 Agroforestry for higher animal production in North-Eastern Hill Region. Theme paper. In Proc. Seminar on Grassland and Fodder Development held at IGFRI, Jhansi, Uttar Pradesh, from Oct 30 to Nov 1, 2002.
- Biswas, S., Das, S.K., Das, N.K. and Das, D. (2002). Effect of seasonal variation and host genotypes on diseases of mulberry in Darjeeling. *Indian Phytopath.*, 55(1) : 30-33.
- Biswas, S., Das, D., Chattopadhyay, S., Das, S.K. and Mandal, K. (2002). Root mealy bug (*Paraputo* sp) of mulberry in Darjeeling hills – its severity, biology and control. *Sericologia*, 42(1) : 39-48.
- Verma, D.K. B.K. 2003. Rabi Makka, Uttar Purvi Parvatiya Kshetron ke liye vandan: Ek Paridrishya. Purvanjali (Hindi). October, 2003 pp13.
- Verma, D.K. and Sarma, B.K. 2002. Potential of baby corn in north eastern region. *Indian Farmers' Digest*. April, 2002 pp20-21.
- Mausumi Raychaudhuri 2002. Nutrient Management of acid soils of Manipur. *Indian Farming*. 52 (6), 13-5.
- Narsimha Rao, B. and Harishu Kumar, P. 2002. Improved package of Practices for higher yields in Cashew (In Telugu). *Swarna Sedyam*. Feb. 2002: 32-5.
- Singh, S.B., Datta, K.K. and Singh, K.B. (2002) Nature and Causes of Forest Resources Degradation in NEH states, *Journal of North Eastern Council*, 22 (3):44-49
- Sunil Kumar, K., Suresh, V.R., Ngachan, S.V. and Raghmani Singh, Th. 2002. Tree bean: a potential multipurpose tree. *Indian Horticulture*. 47(3):10-1.
- S. Raychaudhuri Collaborated with RBDC, M/O Agriculture, GOI, as expert in 5 weeks training programme on "Production and Quality Control of Biofertilisers" with theoretical and practical courses at RBDC, Imphal during 26.11.03 to 13.12.03 for the technical officers from State Agriculture Dept., Meghalaya.

Talks Delivered

- B. N. Rao, delivered lecture on "Scope and Production of Vermicompost" in a training programme organized by the Regional Biofertilizer Development Centre, Imphal to the extension staff of the state Department of Agriculture on 13th June, 2002.
- B. N. Rao, delivered lecture on "Scope of Development of Horticulture in Manipur" in a training programme organized by KVK to the farmers on 15th May, 2002 at ICAR Research Complex for NEH Region, Manipur Centre, Imphal
- B. N. Rao, delivered lecture on (i) Organic farming in Horticulture (ii) Problems and prospects of Horticulture in Manipur in a training programme organized by the Regional Biofertilizer Development Centre, Imphal to the extension officers of state Department of Agriculture on 9th Aug, 2002.
- B. N. Rao, delivered lecture on "Latest package of Practices for Passion Fruit and Pineapple" in a training programme organized by the KVK and State department of Horticulture and Soil Conservation, Imphal at ICAR to the farmers of Imphal East District on 26th Aug, 2002.
- B. N. Rao, delivered lecture on "Vermiculture and Vermicompost- Problems and prospects in Manipur" in a workshop on Organic farming and Vermiculture for sustainable Agriculture organized by the SDDC, Senapati, Manipur on 24th Jan. 2003.
- B. N. Rao, delivered lecture on the eve of World food day organized by the KVK, ICAR, Imphal on "Prospects of Passion fruit cultivation in Manipur" on 16th Oct. 2002.
- B. N. Rao, delivered two guest lectures on 3rd and 4th Dec. 2002 (i) "Problems and Prospects of Passion fruit Cultivation" (ii) "Problems important insect pests on fruits and vegetables and their control measures" in the training programme organized by the KVK, ICAR, Imphal at Purul, Senapati District, Manipur.
- Mausumi Raychaudhuri, delivered lecture on "Response of biofertilizers in different cropping systems of Manipur" on 12-06-2002 in an orientation course on biofertilizers and organic farming for State level officers of department of agriculture conducted by Regional Biofertilizer Centre, Manipur, Imphal.
- Mausumi Raychaudhuri, delivered lecture on "Response of biofertilizers in different Horticultural crops" on 08-08-2002 in a two day training course for State level officers of department of horticulture conducted by Regional Biofertilizer Centre, Manipur, Imphal.
- S. Raychaudhuri, delivered lecture on "Azotobacter and Azospirillum Biofertilizer in non-legume crops" in two days 'Orientation Course on Biofertilizers and Organic Farming' organized by Regional Biofertilizer Development Centre, M/O Agriculture, GOI, Imphal on 12-13 June, at Mantripukhri, Imphal. Participants were senior level State Govt. Officers (Agriculture) like SDAOs, SMSs, ADOs, Deputy Directors.
- S. Raychaudhuri, delivered lecture on the topic "Application methodology and precautions on biofertilizer use" in "Two days Extension Training Programme on Promotion of Use of Biofertilizers" organized by Regional Biofertilizer Development Centre, M/O Agriculture, GOI, Imphal on 8-9 August, 2002 at Mantripukhri, Imphal.
- S. Raychaudhuri, delivered lecture on "Azotobacter and Azospirillum in Horticultural crops" in 'Two days Extension Training Programme on Promotion of Use of Biofertilizers' organized by Regional Biofertilizer Development Centre, M/O Agriculture, GOI, Imphal on 8-9 August, 2002 at Mantripukhri, Imphal. Participants were officers from State Horticultural Department from all parts of Manipur.
- S. Raychaudhuri, delivered lecture on "Different methods of composting" in 'Two days Orientation Course on Biofertilizer and Organic Farming' organized by Regional Biofertilizer Development Centre, M/O Agriculture, GOI, Imphal on 12-13 June, at Mantripukhri, Imphal.
- S. Raychaudhuri, delivered lecture on "Organic farming for sustainable Agriculture" in two days exhibition cum workshop on "Vermiculture and Organic farming for Sustainable Agriculture" organized by Senapati Hill District Development Council (SDDC) on 23-24 January, 2002 at Senapati. Participants were NGOs, social workers, farmers and students.
- S. Raychaudhuri, delivered lecture on "Use of biofertilizer for higher crop productivity" in farmer's training programme organized by Regional Biofertiliser Development Centre, M/O Agriculture, GOI, Imphal on 8.3.2002 at Imphal. Participants were social workers and farmers.

6. LIST OF SCIENTISTS AND TECHNICAL OFFICERS

Director

Dr. K. M. Bujarbaruah

Meghalaya (Headquarters)

Joint Director (H. Q.)

Dr. Y. P. Sharma

Agronomy

Scientific

Dr. G. C. Munda, PS
Dr. D. C. Saxena, SS
Dr. A. S. Panwar, SS
Dr. U.K. Hazarika, SS
Dr. D. P. Patel, Scientist (SS)
Dr. Rajesh Kumar, Scientist

Technical

Sri Rajen Srivastava, Technical Officer (T-5)
Sri Avinash Chandra, Trg. Asst. (T-5)

Agricultural Economics and Statistics

Scientific

Dr. K. K. Dutta, PS
Dr. A. K. Tripathy, SS

Technical

Sri Ratan Kumar Das, Tech. Officer

Agricultural Extension

Scientific

Dr. Narendra Prakash, SS
Dr. Rajesh Kumar, Scientist (SS)
Sri P. P. Pal, Scientist

Technical Officer

Sri P.K. Sarmah, T-7 (Sr. Trg. Asstt.)
Sri P. Nath, Tech. Officer(Photographer)

Agricultural Engineering

Scientific

Dr. K.K. Satapathy, PS
Sri K.N.Agrawal, Scientist-SS
Sri C. S.Sahay, Scientist-SS
Dr. A. K. Mishra, Scientist-SS till 31.10.2002
Sri D. S. Bundela, Scientist on study leave
Sri R. K. Singh, Scientist on study leave
Sri S.V. Ghadge, Scientist on study leave
Sri R. K. P. Singh, Scientist
Dr. U. S. Saikia, Scientist since 06.03.2003

Technical

Sri K. K. Dutta, Sr. Trg. Asstt. (T-7)
Sri J.K. Bharali, Manager OM Cell (T-7)
Sri V. Dkhar, Tech. Asst. (T-6)
Sri A. V. Rynjah, Tech. Officer (T-5)
Sri Chakra Borah, Fitter (T-4)
Sri. C. Adhikari, Tech. Officer (T-5), ARIS Cell

Farming System Project

Technical

Sri J. L. Singh, Trg. Asst. (T-6)

Agroforestry

Scientific

Dr. B. P. Bhatt, SS
Sri J. M. S. Tomar, Scientist

Technical

Sri L. K. Mishra, Tech. Officer (T-5)

Animal Nutrition

Scientific

Dr. B. P.S. Yadav, PS
Dr. J. J. Gupta, SS
Smt. Dipika Murugkar, Scientist
Dr. S. Doley, Scientist

Animal Reproduction

Scientific

Dr. S.C. Saxena, PS
Dr. R.K. Bardoloi, PS
Dr. Anubrata Das, PS
Dr. S. K. Das, Scientist, SS
Dr. S. Naskar, Scientist, SS
Dr. G. Kadirvel, Scientist

Technical

Sri H. H. Bareh, Tech. Officer(T-5)

Entomology

Scientific

Dr. K. A. Pathak, PS
Dr. A. N. Shylesh, SS
Dr. K. R. Rao, Scientist

Technical

Sri M. C. Sharmah, Tech. Officer(T-5)

Fishery

Scientific

Dr. B. K. Mandal, PS
Dr. B. K. Mahapatra, SS
Dr. K. Vinod, Scientist

Technical

Sri P. Nayak, Tech. Officer(T-5)
Sri Rakesh Kumar, Tech. Officer(T-5)

Horticulture

Scientific

Dr. D.S. Yadav, PS
Dr.N. Rai, SS
Dr. A. K. Dubey, Scientist
Sri Amit Nath, Scientist(FST)
Sri K. Dinesh Babu(on study leave)
Shri R. K. Yadav

Technical

Sri Debbruta Paul, Tech. Officer(T-5)

Plant Breeding

Scientific

Dr. K. R. Dhiman, PS

Dr. B. K. Sharma, PS till 31.10.02

Dr. A. Pattnayak, Scientist (SG)
Smt. G. Sahay, Scientist
Dr. D. K. Verma, Scientist
Ms. Alpana Das, Scientist
Sri Annaduarai, Scientist
Smt. Promila Devi, Scientist

Plant Pathology

Scientific

Dr. A. K. Singh, PS
Dr. Satish Chandra, PS

Soil Science

Scientific

Dr. Patiram, PS
Dr. Kailash Kumar, SS
Dr. Babulal, SS
Dr. V. K. Mishra, SS
Dr. B. Majumdar, Scientist
Dr. K. Lakshmi Narayana, Scientist
Dr. M. S. Venkatesh, Scientist
Dr. R. Saha, Scientist

Vety. Parasitology

Scientific

Dr. S. Bandyopadhyaya, SS

Vety. Public Health

Scientific

Dr. H. Rahman, PS
Dr. Ashok Kumar, SS
Dr. B. R. Shome, SS
Dr.(Mrs) R. Shome, Scientist-SS
Dr. H. V. Murugkar, Scientist-SS
Dr. I. Shakuntala, Scientist(on study leave)

Administrative Section

Smt. M. J. Kharmawphalang, Adm. Officer
Sri. G. Sinha, Asst. Adm. Officer
Sri A. C. Deb, Asstt. Finance & Accounts Officer I/C
Smt. June Dkhar, Asst. Adm. Officer
Shri B. K. Das, Asst. Adm. Officer
Smt. D. S. Dkhar, Asst. Adm. Officer
Sri H. S. Chakrabarty, Asst. Adm. Officer

Instrumentation Cell

Sri A. K. Acharjee, Instrumentation(T-6)
Sri M. Kharpuli, Tech. Officer(T-5)

Hindi Cell

Sri H. C. Joshi, Dy. Director (O.L.)

General Farm Management

Dr. N. R. Roy, Sr. Farm Manager (T-9)
Shri G. P. Singh, Trg. Asstt.(T-6)
Shri D. Medhi, Farm Manager(T-8) (posted in ZC-III)

Estate and Security

Shri S.K. Biswas, Draftsman (T-5)

Technical Cell

Shri Ajit Khound, Tech. Officer (T-6)
Smt. P. Purkayastha, Tech. Officer(T-5)

Library

Sri M. D. Siyem, Tech. Officer (T-6)
Sri Gulab Prasad, Tech. Officer(T-5)

Manipur Centre

Joint Director

Dr. S. V. Nangchan

Scientific

Dr.A. B. Rai, SS (Ento)
Dr. (Mrs.) Mausami Roy Choudhury, SS
Dr. B. Narsimha Rao, SS(Hort.)
Sri I. M. Singh, Scientist(Agro/Seed Tech) on
deputation to CAU, Imphal
Dr. S. B. Singh, Scientist(Agril. Econ)
Dr. K. Sunil Kumar, Scientist(Hort)

Technical

Sri L.L. Sinite, Tec. Officer(T-5)
Sri Raghupati Singh, Tech. Officer(T-5)
Sri K. Lokeswar Singh, Incharge KVK

Administrative

Sri K. Jongou, Asst. Adm. Officer
Smt G. A. I. Devi, Asst. Adm. Officer

Tripura Centre

Joint Director

Dr. K. R. Dhiman upto 20.11.2002
Dr. N. P. Singh from 20.11.2002

Scientific

Dr. M. Dutta, PS(Soil Sc.)
Dr. T. K. Sengupta, Scientist(SS)(Pl. Path)
Dr. L. C. De, Scientist(Hort)
Dr.S. Mitra, Scientist(Agro)
Dr. K. Chattopadhyaya, Scientist(PB)
Dr.C. Dutt, Scientist(AN)
Dr. S. K. Ghosh, Scientist(An. Reproduction)
Dr. M. Niranjana, Scientist(Poultry Science)
Dr. B. Santosh, Scientist(Fishery)

Technical

Dr. Asit Chakraborty, Farm Manager(Poultry) (T-6)
Sri J.K. Pandey, Tech.Officer(T-5)
Shri Achyut Roy, Tech. Officer(T-5)
Shri Shanbhu Deb, Tech. Officer (Livestock)
Sh. T.A. Khan, Trg. Asstt. (T-5) (posted at HQ)
Sh. G.P. Kar, Trg. Asstt. (T-5) (posted at HQ)
Sh. J.L. Singh, Trg. Asstt. (T-6) (posted at HQ)
Sh. P. K. Sarmah, Sr. Trg. Asstt. (T-7) (posted at HQ)

Administrative

Sri M. P. Rajak, Asst. Adm. Officer

Sikkim Centre

Joint Director

Dr. L.S. Srivastava

Scientific

Dr. K.P. Singh, SS (Agro)
Dr. R. K. Awasthe, SS (Soil Sc.)
Dr. Ramesh Singh, SS (Hort) & I/C KVK
Dr. Asit Das, Scientist (AN)
Dr. Debasis De, Scientist (AN)
Dr. Ramesh Chandra, Scientist (An. Reproduction)
Dr.R. K. Jangra, Scientist (Hort)
Dr. Matvar Singh, Scientist (AF)

Technical

Sri S.B. Singh, Farm Manager(T-8)
Sri B.K. Mishra, Farm Manager(T-6)

Administrative

Sri D. Joseph, Asst. Adm. Officer

Nagaland Centre

Joint Director

Dr. C. Rajkhowa from 15.03.2002

Scientific

Dr. Naresh Babu, Scientist(Hort)
Dr. H. D. Karamkar, Scientist(Vety. Parasitology)
Sri. S S Ghadge, Scientist(Ag. Extn.)

Administrative

Sri H. S. Nongbri, Asst. Adm. Officer

Mizoram Centre

Joint Director

Dr. N.S. Azad Thakur up to 30.12.2002
Dr. K. A. Pathak from 30.12.2002

Scientific

Dr. Kamta Prasad Scientist(Agril Extn.)

Technical

Sri Bikram Debrma, Tech. Officer

Administrative

Sri S. K. Das Biswas, Asst. Adm. Officer

Arunachal Pradesh Centre

Joint Director I/C

Dr. L. C. De from 28.1.2002

Administrative

Sri D. C. Bhuyna, Asst. Adm. Officer

KVK, Manipur,

Sri K. Lokeshwar Singh, Trg. Associate(T-7)

Mrs. R. Jasumati Devi, T-7

Smt. S. K. Rama Trg. Asst. (T-6)

Sri L. Ingobi Sing, Trg. Asst(T-6)

Smt. Ng. Santombi Devi, Trg. Asst.(T-6)

Sri. Kh. Hera Singh, Trg. Asst. (T-6)

Sri G. P. Kabui, Trg. Asst.(T-6)

Smt. A. R. Devi, Trg. Asst. (T-5)

KVK, Nagaland

Sri D. K. Sonowal, Trg. Associate (Posted at TTC, Umiam)

Sri R.C. Verma, Trg. Assoc.

Sr. W. Ranen Singh, Trg. Assoc.

Smt. V. Kenny Naleo, Trg. Assoc.

Sri. A. K. Khan, Trg. Assoc

Sr. R. K. Tarat, Trg. Assoc. Posted at ZC, Umiam

Dr. (Mrs.) Anamika Sharma, Trg. Assoc.

Dr. S. K. Meiti, Trg. Asst. posted at Umiam

Smt. Ng. Sanatombi Devi, trg. Asst. posted at Manipur

KVK, Arunachal Pradesh

Sri Vishwakam, Trg. Assoc. T-8

Sri K. K. Dutta, posted at Umiam

Shri Jyoti Borah, Trg. Assoc., T-6

Shri Bharati Saloi, Trg. Assoc. T-5

KVK, Tura, Meghalaya

Mr. Jyoti Bora, Trg. Assoc, T-6

7. सारांश

प्रतिवेदित अवधि के दौरान संस्थानीय परियोजनाओं, राष्ट्रीय कृषि अनुसंधान परियोजनाओं, एवं तदर्थ व अखिल भारतीय समन्वित परियोजनाओं के तहत क्रमशः 260, 40 तथा 9 अनुसंधान, प्रसार तथा अन्य गतिविधियां आयोजित की गईं।

इस दौरान कई नये वैज्ञानिकों ने कार्यभार ग्रहण किया तथा संस्थान स्तर तथा किसानों के खेतों पर कई विषयों पर नई पहल की भी शुरुवात की गई जो इस प्रकार हैं।

क. किसानों के खेतों पर एकीकृत खेती पद्धति पर विकसित तकनीक का मूल्यांकन, ख. फार्मिंग कम्युनिटी को अच्छी सेवा प्रदान करने के लिए एटिक कृषि तकनीक सूचना केंद्र की स्थापना, ग. वर्ष भर मक्के का उत्पादन, घ. पादप एवं पशु जैव प्रौद्योगिकी पर गानव संसाधन विकास कार्यक्रम, च. फार्म उपकरणों के प्रोटोटाइप निर्माण एवं एकीकृत जलसंभर विकास कार्यक्रम इत्यादि, छ. कीट एवं व्याधि नियंत्रण तथा शाकवर्गीय फसलों के समन्वित व्याधि प्रबंधन हेतु जैव नियंत्रण पर अनुसंधान कार्य की पहल, ज. पीसीआर तथा एलिसा पर आधारित पशु व्याधि समाधान कार्यक्रम, झ. प्रमुख मत्स्य बीज उत्पादन तथा शोभाकारी नछलियों का प्रजनन तथा उत्पादन एवं य. बहु आयामी कृषि वानिधी माडलों को विकसित करना।

प्रतिवेदित अवधि के दौरान खाद्यान्न फसलों पर विशिष्ट अनुसंधान किया गया तथा फसल सुधार कार्यक्रम के अन्तर्गत संस्थान में धान पर AVT के दो परीक्षण और IV, ST, IRCT और IURON के अन्तर्गत प्रत्येक पर एक एक परीक्षण किये गए। AVT के 18 जीनरूपों के परीक्षण में किसी भी जीनोटाइप को संस्थान द्वारा विकसित Bhalum1 से बेहतर नहीं पाया गया मालूम 1 किस्म को अपलैंड में लोकल चेक के रूप में लगाया गया था हालांकि IURON परीक्षण के अन्तर्गत 3 जीनोटाइप को उपज की दृष्टि से मालुम-1 से बेहतर देखा गया।

वर्षापोषित निम्न भूमि में उपज पर प्रभाव देखने के लिए धान पर 8 परीक्षण किये गए जिनमें आरसीआरटी-सुगंधित धान, आरसीआरटी-निम्न भूमि, एवीटी-2-बासमती टाइप, एवीटी-मध्यम अगेती पहाड़ी, आइवीटी-मध्यम अगेती और आइवीटी-मध्यम परिपक्वता वाली किस्में सम्मिलित हैं इनसे प्राप्त अच्छे जीनोटाइप को भविष्य के परीक्षणों में सम्मिलित करने के लिए चिह्नित किया गया। अति उँचाई वाले स्थानों के लिए संस्थान द्वारा विमोचित किस्म मेघा राइस-2 को पुनः अच्छी उपज वाली किस्म पाया गया, जबकि संस्थान द्वारा आरसीपीएल-1-17सी को संस्थान द्वारा पूर्व विकसित एनइएच मेघा राइस-1 से बेहतर उपज वाला पाया गया। संस्थान द्वारा उपरिभूमि व निचली भूमि दोनों के लिए प्रयोज्य के पृथक्कीकरण (screening of segregating generation) को जारी

रखा गया है। उपरिभूमि के धान हेतु एफ₂ की 5 और एफ₃ की 18 पापुलेशन का अगले जेनरेशन के लिए चयन किया गया। इसी प्रकार निचली भूमि के धान हेतु एफ₂ के 52 और एफ₃ के 10 जीनप्रतिरूपों का अगली पीढ़ी के लिए चयन किया गया।

जैवतकनीकी कार्यक्रम के अन्तर्गत धान की डबल हैप्लॉयड लाइन्स के संवर्द्धन के लिए एंथर कल्चर तकनीक का प्रयोग किया गया तथा ट्रांसजेनिक धान के पौधों की आपेक्षक स्क्रीनिंग भी की गई। मॉलीकुलर स्क्रीनिंग का कार्य एनआरसी ऑन बॉयोटेक्नालॉजी में संपादित किया गया जिसमें सिंगल इनसर्सन के पॉच और डबल इनसर्सन के दो पौधे अगली पीढ़ी के लिए चयनित किये गए।

संस्थान द्वारा विमोचित अपलैंड तथा लोलेंड धान की किस्मों तथा अन्य स्रोतों से प्राप्त धान की स्थापित किस्मों के वैरायटल मूल्यांकन और परीक्षण का कार्य संस्थान तथा इसके केंद्रों पर किया गया तथा चिह्नित किस्मों के ब्रीडर सीड तैयार करने के कार्यक्रम भी चलाए गए।

मकई में अगेती व अति-अगेती पकने वाली, अति उपज देने वाली तथा रोग प्रतिरोधी मकई की किस्मों की पहचान के लिए खरीफ मकई के 377 और रबि मकई के 45 स्ट्रेन्स (विभेदों) के क्रमशः 17 और 2 ट्रायल किये गए तथा इन परीक्षणों में जो विभेद या स्ट्रेन उपयुक्त पाये गए उनका विवरण रिपोर्ट में दिया गया है। मकई उत्पादन बढ़ाने के लिए चैन कासिंग एंड लाइन X लीफटेस्टर कासिंग विधि का इस्तेमाल करते हुए ऐसी किस्मों को विकसित करने पर अनुसंधान किया गया जिनमें लीफ ब्लाइट प्रतिरोधी गुण सम्मिलित हों। एफ₂ की 38 चयनों को द्वितीय चक्र के परीक्षण हेतु चिह्नित किया गया। मकई की चिह्नित उपयुक्त किस्मों को लोकप्रिय बनाने के लिए किसानों के खेतों में बेबीकॉर्न, पॉप कॉर्न तथा स्वीट कॉर्न मेज पर 150 अग्र पंक्ति निर्देशन फ्रंट लाइन डिमॉन्स्ट्रेशन आयोजित किये गये जिनमें विजया कम्पोजिट, आरसीएम 1-1, 1-2 व 1-3 तथा गुजरात मक्की 1 किस्मों को सम्मिलित किया गया।

मकई के जननद्रव्यों के मार्फो-एग्रोनॉमिक लक्षणों को भी रिकार्ड किया गया तथा वर्ष भर मक्के की प्राप्ति के लिए वर्ष भर मक्का (Maize round the year) कार्यक्रम चलाया गया। मकई व मक्का अन्तर्सम्बन्ध अध्ययन में पाया गया कि फास्फोरस का अनुप्रयोग स्तर बढ़ाने पर सूक्ष्मपोषक तत्वों के उद्ग्रहण में कमी आई जबकि एफवाईएम के अनुप्रयोग से सूक्ष्मपोषक तत्वों के उद्ग्रहण में वृद्धि देखी गई। इसी प्रकार चूने के अनुप्रयोग द्वारा लौह, मैग्नीशियम, तांबा और जिंक के अपटेक में कमी देखी गई। मकई के प्रमुख कीटों में कॉब बोरेर के नियंत्रण के लिए स्टेनरनिमा (Steinernema spp.) कीटनाशक को 1000 आईजेएस प्रति मिलीलीटर की दर से

छिड़काव करने पर उपचार के 72 घंटों के भीतर कॉब बोरेर के लार्वा की 97.7 प्रतिशत तक रोकथाम की जा सकती है।

झूम खेतों में मक्के का उत्पादन बढ़ाने के लिए अन्तर्प्रजाति-संकरण (Inter-varietal crosses) तथा जेनरेशन एडवान्समेंट को अपनाते हुए त्रिपुरा में दो झूम लैंड तथा तीन कंपोजिट व हाइब्रिड सेग्रीगेटिंग जेनरेशन के अन्तर्गत मक्के की 13 पापुलेशन को विकसित किया गया।

दलहनी फसलों में राइसबीन, मूंगबीन, उर्दबीन, पिजन पी, चिक पी, ब्लैक ग्राम, ग्रीन ग्राम तथा हॉर्स ग्राम की विभिन्न प्रजातियों के विकास और स्क्रीनिंग पर संस्थान मुख्यालय तथा इसके केंद्रों पर अनुसंधान कार्य किया गया। इस सन्बन्ध में किस्मों का प्रकार तथा संख्या तथा स्थानीय चयनों का विस्तार से वर्णन रिपोर्ट में दिया गया है।

दलहनी फसलों की विभिन्न किस्मों के मूल्यांकन के साथ ही कीट एवं व्याधि रहित किस्मों के विकास के साथ ही चिक पी तथा पिजन पी में स्टेन व पॉड बोरेर की रोकथाम हेतु ट्रांसजेनिक किस्मों के विकास पर भी कार्य किया गया।

तिलहनी फसलों में प्रमुख रूप से सोयाबीन, मूंगफली और रेपसीड सरसों पर ही अधिकतर शोध कार्य सम्पादित किया गया। सोयाबीन में चौथी पीढ़ी से प्राप्त संकर किस्मों को फाग आई लीफ स्पॉट तथा रस्ट के प्रति मूल्यांकन किया गया। मूंगफली की JL-24, VHD-76, YKH-19A, BAU 13 तथा GG13 किस्मों को उपज की दृष्टि से इस पूरे क्षेत्र के लिए उपयुक्त किस्में पाया गया जिनसे प्राप्त उपज 20.91 (JL-24) से 31.7 (BAU13) कुन्तल प्रति हेक्टेयर के बीच पाई गई। इस संस्थान के पिछले कई वर्षों के अनुसंधान से यह स्पष्ट है कि इस क्षेत्र में मूंगफली के उत्पादन की अपार संभावनाएं विद्यमान हैं अतः इसकी खेती को बढ़ाने के लिए इसके प्रसंस्करण की योजना पर अमल किया जा रहा है।

औद्योगिक फसलों के तहत संस्थान के सभी केंद्रों पर फलों, सब्जियों, मसालों, रोपण फसलों तथा पुष्प वर्गीय फसलों पर अनुसंधान कार्य किया गया। फलों में नींबू वर्गीय (मैडेरेन व लेमन), आड़ू, अनन्नास, अमरुद, किन्ना, किवी तथा पैशन फ्रुट पर अलग अलग स्वतंत्र परियोजनाओं के अन्तर्गत शोध कार्य किया गया। सिट्रस में यह पाया गया कि बीजू पौधों से बनाये गये पौधे सूक्ष्म प्रवर्धन विधि से तैयार पौधों की अपेक्षा अधिक अच्छा प्रदर्शन कर रहे हैं। इस अवधि के दौरान सिट्रस के 34 तथा अन्य देशीय फलों के 19 जननद्रव्यों का संरक्षण किया गया। इसके साथ ही आड़ू, अमरुद, अनन्नास तथा अन्य फलों की उपयुक्त प्रजातियों को चिह्नित किया गया। खासी मैडेरेन के ग्राफ्टेड पौधों में प्रति पौधा तना मोटाई तथा पत्तियों की संख्या सर्वाधिक पाई गई। नींबू (*Volka mariana*) में टिशू कल्चर तकनीक द्वारा रोग मुक्त पादप सामग्री का उत्पादन किया गया।

इस अवधि के दौरान स्थानीय रूप से उपलब्ध शाक वर्गीय उपयुक्त प्रजातियों का विकास एवं उनके जननद्रव्य का भी मूल्यांकन किया गया। संस्थान द्वारा विकसित टमाटर की तीन किस्मों मनीखामनु, मनीलेड्मा तथा मनीथोड्बा को अखिल भारतीय समन्वित अनुसंधान योजना के अन्तर्गत सर्वाधिक उपज देने वाली किस्में पाया गया।

कोल फसलों में पहली बार ब्रोकोली का इस क्षेत्र में प्रवेश किया गया। मसाले वाली किस्मों के अन्तर्गत अदरक की 34 और हल्दी की 41 किस्मों की स्क्रीनिंग की गई और उनके जननद्रव्य का उचित रखरखाव किया गया। इसके साथ ही संस्थान द्वारा विमोचित हल्दी की किस्म मेघा टरमेरिक-1 के बीज उत्पादन कार्यक्रम प्रारम्भ किया गया। काली मिर्च और बड़ी इलायची को कृषि वानिकी की थ्री टियर व टू टियर पद्धति के अन्तर्गत सम्मिलित किया गया। शोभाकारी फसलों में जरबेरा की 33 व ग्लेडिओलस की 49 किस्मों का मूल्यांकन कर उनका संवर्द्धन किया गया।

इस पूरे क्षेत्र की नूदा संरचना को ध्यान में रखते हुए नूदा वैज्ञानिकों ने विभिन्न फसलों हेतु समन्वित पोषण प्रबंधन (Integrated nutrient management) पर अनुसंधान कार्य किया। नूदा प्रबंधन पर किये गये शोध कार्यों में पाया गया कि उपरिभूमि धान में 60 किलो नत्रजन + 5 टन कम्पोस्ट खाद एफवाईएम प्रति हेक्टेयर + एजोटोबेक्टर के अनुप्रयोग द्वारा सर्वाधिक उपज मिली जबकि निचलीभूमि के धान में सर्वाधिक उपज 60 किलोग्राम नत्रजन प्रति हेक्टेयर का 50 प्रतिशत प्रारम्भ में बेसल डोज तथा 50 प्रतिशत बालियां निकलने पर अनुप्रयुक्त करने पर प्राप्त हुई। समन्वित पोषण प्रबंधन (Integrated nutrient management) के अन्तर्गत मकई-सरसों सस्य पद्धति में NPK+ FYM + biofertilizer + lime के अनुप्रयोग द्वारा मकई व सरसों दोनों में ही सर्वाधिक उपज दर्ज की गई। नूदा नमी को बनाये रखने के एक परीक्षण में देखा गया कि चीड़ की पत्तियों (पाइन लीफ), धान का पुवाल (राइस स्ट्रॉ) जंगली घास व सरसों के डंढल आदि को मल्ल के रूप में प्रयोग करने से नूदा नमी को 20.6 से 60.4 प्रतिशत तक बढ़ाया जा सका।

इस क्षेत्र के प्रमुख जंगली वृक्ष चीड़ की छाया में उगाई जाने वाले फसलों में उत्पादकता एवं फसल वृद्धि दोनों में ही नुकसान पाया जा रहा है अतः प्राकृतिक रूप से उगे 25 वर्ष के चीड़ के पेड़ों के 75 प्रतिशत कैनोपी को छांट कर उनके नीचे खाद्यान्न फसलें उगाने पर पाया गया कि इन वृक्षों के नीचे पेरिला, अरहर, शकरकंद तथा राइस बीन को अदरक, हल्दी और कोलोकेशिया के साथ साथ सफलता पूर्वक उगाया जा सकता है। इस प्रकार से कैनोपी छांटे गए चीड़ वृक्षों के नीचे उगाए गए अदरक से प्रति हेक्टेयर 109.44 कुन्तल उपज प्राप्त की गई जबकि दूसरे स्थान पर हल्दी से प्राप्त उपज 106.67 कुन्तल थी।

एकीकृत एग्रो एक्वाकल्चर पर किये गए एक अध्ययन में दलहली भूमि पर 0.90 हेक्टेयर में एक जल संग्रहण संरचना का निर्माण किया गया ताकि एकीकृत एग्रो एक्वाकल्चर मॉडल बनाकर उसमें मछली एवं सुअर पालन, मछली एवं बत्तख पालन, मछली एवं बकरी पालन, मछली एवं मुर्गी पालन तथा मछली के साथ साथ डेयरी पशुओं को भी सम्मिलित किया जा सके। यह प्रयोग अभी जारी है।

पूर्वोत्तर क्षेत्र का सर्वेक्षण करने के पश्चात खाने योग्य बांस प्रजातियों की एक इन्वेंटरी बनाई गई जिसमें प्राथमिक एवं द्वितीयक वैडरों को सम्मिलित करते हुए 349 में से 141 बाजारों का सर्वेक्षण किया गया तथा पाया गया कि बांस के मुलायम प्रशोहों की वार्षिक

खपत कमरा: 1978.816, 2188.244, 442.031, 432.634, 441.592 और 201.331 टन प्रतिवर्ष है तथा खाये जाने वाले बांस प्ररोहों में यहां डी. हैमिल्टन सर्वाधिक उपयोग में लाया जाता है जबकि इस कम में अन्य प्रजातियां डी जाइगेटियस, डी सिकिमैसिस, एम. बेसीफेरा तथा बी. बालकुआ कमरा: खाने, के काम में लाये जाते हैं।

किण्वीकृत बांस के प्ररोहों (फर्मेन्टेड शूट्स) की वार्षिक खपत 1354.7 टन प्रतिवर्ष पाई गई और अरुणाचल प्रदेश में इनकी सर्वाधिक खपत देखी गई (872.35) जबकि इस कम में मणिपुर (242-92) तथा नगालैंड (126.74) का स्थान क्रमशः दूसरे तथा तीसरे स्थान पर पाया गया।

खाने योग्य बांस प्रजातियों में कैल्शियम, पोटेशियम, फॉस्फोरस, मैग्नीशियम जैसे पोषक तत्व प्रचुर मात्रा में पाए गए साथ ही इन्हें विटामिन युक्त भी पाया गया।

पहाड़ी भूभाग में वर्ष भर सब्जी उगाने के लिए कम लागत वाले पॉली हाउसों को बनाकर इनमें विभिन्न प्रकार की सब्जियां उगाकर देखा गया। पाली हाउसों की लागत में कमी लाने के लिए इन्हें स्थानीय रूप में उपलब्ध बांस तथा 200 माइक्रॉन की यूवी फिल्म की मदद से तैयार किया गया जिसमें 133.25 रुपया प्रति वर्ग मीटर की लागत आई। इन पॉली हाउसों में शिमला मिर्च, टमाटर, बैंगन, फ्रेंचबीन, पातगोभी, फूलगोभी, मटर आदि सब्जियां क्यारियों में उगाई गई जबकि मेड़ों पर तराई, लौकी तथा कद्दू जैसी सब्जियां उगाई गई और यह पाया गया कि पॉली हाउसों में सब्जी पैदा कर किसान अतिरिक्त आय कमा सकते हैं।

फार्म मशीनरी के तहत इस क्षेत्र के कामगारों, लोहारों तथा लघु स्तर पर कृषि यंत्रों के निमाताओं को विकसित कृषि यंत्रों के निर्माण तथा उनके प्रयोग संबंधित कम अवधि के दो और दीर्घ अवधि के 6 प्रशिक्षण कार्यक्रम चलाये गए जिसमें राज्य सरकार के तकनीशियनों सहित 135 निमाताओं ने सहभागिता निभाई। इस अवधि के दौरान 39 प्रकार के विभिन्न विकसित यंत्रों तथा उपकरणों का निर्माण किया गया तथा उन्हें इस क्षेत्र की विभिन्न एंजिनियों तथा किसानों को बेचा गया। दो यंत्रों के प्रोटोटाइप के मूल्यांकन के लिए उन्हें परखा जा रहा है जबकि 3 यंत्रों तथा बागवानी संबंधित कुछ यंत्रों को किसानों के खेतों में अग्र पंक्ति निदर्शन हेतु ले जाया गया।

संस्थान में पहले से स्थापित 6 प्रकार के कृषि पद्धतियों का मूल्यांकन किया गया जिसमें डेयरी, वृक्ष, माइक्रोवाटर शैंड, एगो पेस्टोरल, एगो हार्टि सिल्वी पेस्टोरल तथा बागवानी पर आधारित कृषि पद्धतियां सम्मिलित हैं। मूल्यांकन में पाया गया कि 20,000 रुपये के प्रारंभिक निवेश कर डेयरी आधारित कृषि पद्धति को परेल् खाद्यान्न सुरक्षा की दृष्टि से लाभकारी पाया गया।

मेघालय के रिभोई जिले के मापुन गांव में अपर शिप्रा जल संग्रहण क्षेत्र के अन्तर्गत 57.17 हेक्टेयर में एक उप जलसंग्रहण क्षेत्र

का चयन कर उसे एक मॉडल के रूप में विकसित किया जा रहा है ताकि अधिक पानी वाले स्थानों पर मछली पालन, रोपण फसलें, वानिकी वृक्ष और चारागाह विकसित कर आर्थिक संसाधन जुटाये जा सकें। यहां पर अभी तक स्थानीय रूप से उगाई जा रही फसलों के बदले में अति उपज देने वाली मूली, लाइपत्ता, फ्रेंच बीन, मकई, टमाटर, बैंगन आदि से प्रस्थापित किया गया और उनके उत्पादन हेतु नई तकनीक किसानों को बताई गई ताकि वे इससे अधिक लाभ प्राप्त कर सकें।

इस सम्पूर्ण क्षेत्र में जैविक खेती को बढ़ावा देने के लिए फ्रेंच बीन की एक किस्म नगा लोकल (पोल टाइप) पर विभिन्न प्रकार के जैविक खादों तथा उनके प्रयुक्त करने के तरीकों पर एक प्रयोग किया गया और इसमें लिंब्रा जैविक खाद के प्रयोग (5 टन प्रति हेक्टेयर) के प्रयोग द्वारा सर्वाधिक फलियां मिलीं (89.03 कुन्तल प्रति हेक्टेयर) और नालियों व गड़दों (फरो एंड पिट) में खाद डालने को सामान्य रूप से जैविक खाद छिड़कने, ब्रांडकास्टिंग गढ़ की तुलना में अधिक अच्छा पाया गया।

मत्स्य पालन के अन्तर्गत इस सम्पूर्ण क्षेत्र की शोभाकारी मछलियों (ornamental fishes) के संग्रहण एवं उनको सूचीबद्ध करने का उल्लेखनीय कार्य किया गया और साथ ही मेजर कार्प की फिंगरलिग्स को किसानों में वितरित करने के लिए उनका उत्पादन किया गया।

पशुपालन के अन्तर्गत सुअर, खरगोश, मुर्गी तथा बकरियों पर पहले से चल रहे अनुसंधान कार्य को जारी रखा गया तथा इस संस्थान में विकसित सुअर व खरगोशों की नस्लों को किसानों के खेत पर परखा गया। मुर्गीपालन में बनराजा को घरों के पिछवाड़े (बैकयार्ड सिस्टम) पालने पर उससे मिलने वाले लाग का आंकलन किया गया। इन सभी प्रजनन एवं उत्पादन कार्यक्रमों में स्वास्थ्य एवं पोषण पैकेज का ध्यान रखा गया। प्रतिवेदित अवधि के दौरान पशु रोग निदान के लिए पीसीआर तकनीक नामक त्वरित निदान पद्धति का विकास विशेष उपलब्धि रही।

उपरोक्त कार्यों के अतिरिक्त बड़ी संख्या में राष्ट्रीय कृषि तकनीकी परियोजना तथा वाह्य वित्त पोषित परियोजनाओं पर कार्य किया जा रहा है तथा उन्हें सफलता पूर्वक चलाया जा रहा है। क्षेत्र की विभिन्न राज्य सरकारों के साथ इंटर फेस बैठकों का भी आयोजन किया गया ताकि अनुसंधान से जनित तकनीकी को उनके साथ मिलकर किसानों तक पहुंचाया जा सके और उनकी जरूरत के मुताबिक अनुसंधान कार्य आगे के लिए हाथ में लिये जा सकें।

कृषि प्रसार के तहत संस्थान में विकसित एवं जांची गई तकनीकों को कई परियोजनाओं तथा आईवीएलपी के माध्यम से किसानों तक ले जाया गया। आईवीएलपी के अन्तर्गत 800 फार्म परिवारों को सम्मिलित करते हुए उन्हें उन्नत तकनीक का ज्ञान दिया गया तथा एटिक (कृषि तकनीक सूचना केन्द्र) के माध्यम से उन्हें गुणवत्ता वाले बीज प्रदान करने में सहायता दी गई।

