

Annual Report

ICAR Research Complex for N.E.H. Region,
Umiam, Meghalaya

वार्षिक - प्रतिवेदन

उत्तर पूर्वी पर्वतीय कृषि अनुसंधान परिसर
उमियम, मेघालय

1999 - 2000



वार्षिक- प्रतिवेदन
ANNUAL REPORT
1999 - 2000



Printed (Bilingual)
Date: 30th September, 2000

(N.S. Verma)
Date: 30th September, 2000

भारतीय कृषि अनुसंधान परिषद
उत्तर पूर्वी पर्वतीय अनुसंधान परिसर
उमियम, मेघालय

ICAR Research Complex for N.E.H. Region
Umroi Road, Umiam-793 103, Meghalaya

Guidance

Dr. N.D. Verma

Editing

: Dr. B.K. Sarma

Dr. Kailash Kumar

Dr. B.P. Bhatt

Shri H.C. Joshi

Dr. Patiram (Coordinating Editor)

*Compiling, Collating &
Editing* : Dr. Patiram

Hindi Translation

: Sri H.C. Joshi



Published by the Director, ICAR Research Complex for NEH Region, Umroi Road, Umiam-793103,
Meghalaya on behalf of the Institute

and

Printed at Modern Offset, Wahthapbroo, Shillong-793002

PREFACE

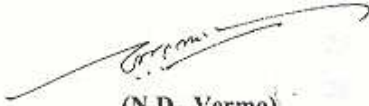
ICAR Research Complex for NEH Region has been striving for improving the productivity of major crops and livestock through research and extension activities. There have been notable achievements that are being made operational by development of technologies to meet the demands of the day.

This annual report has covered the results for the period from April, 1999 to March, 2000. The guidelines set for the preparation of annual report have been adhered to. The research achievements of agriculture including horticultural crops, livestock and fishery are presented.

This institute has made all round progress in terms of development of technologies for consultancy to State Government Departments, award and organising various trainings on agriculture and allied sectors. A good number of research papers were published and presented in national/international seminars and symposia.

The cooperation and support of the scientists, administrative and technical personnel contributing the material for annual report are thankfully acknowledged. The untiring efforts of Dr. B.K. Sharma, Dr. Patiram, Dr. K. Kumar, Dr. B.P. Bhatt and Sri H.C. Joshi in compiling, organising and editing for preparing this report is commendable.

Umiam (Barapani)
Dated, the 30th September, 2000



(N.D. Verma)
Director

CONTENTS

	Page No.
MEGHALAYA	
Executive Summary	i
Introduction	v
Research Achievements	
Weather	1
Rice	3
Maize	8
Pulses	10
Oilseeds	12
Cropping System Research	15
Biofertilizer	16
Fruits	17
Vegetables	20
Spices	21
Floriculture	22
Pasture and Fodder Production	22
Fish	23
Pig	25
Rabbit	28
Cattle	30
Poultry	32
Rodent	34
Ticks	35
Soil and Water Conservation	35
Farm Machinery and Power	36
Agricultural Economics	38
Agricultural Extension	41

			Page No.
Transfer of Technology	...	...	43
Technology Assessed and Transferred	...	...	47
Farming Systems Research	...	...	48
Agroforestry	...	...	53
Publications	...	...	56
Distinguished Visitors	...	...	57
Other Visitors	...	...	58
CENTRES			
Arunachal Pradesh	...	...	59
Manipur	...	...	69
Mizoram	...	...	78
Nagaland	...	...	81
Sikkim	...	...	87
Tripura	...	...	97
Hindi Version	...	...	115

EXECUTIVE SUMMARY

During this years upland RCRT, out of 14 lines RCPL 1-21 gave the highest yield. IR 65258-27-13 and IR 66421-039-2-1 were higher yielders in IURON trial out of 24 selected genotypes. In AICRP trials IET 16487 (RCPL 1-4) and IET 16003 (RCPL 1-28) were higher yielder for two consecutive years. RCPL 1-29 gave higher yield in *jhum* as well as on terrace land as compared to RCPL 1-28 on farmer's field trial. 22 crosses involving promising lines for low land were made and hybrid seed collected. In low land condition, RCPL 1-4 and RCPL 1-87-8 in RCRT, RCPL-179-3P (ST1) and ITA 222 (ST 2) were higher yielder. At higher altitude in normal and late sown condition, Yunlen 12 and Yungen 20 performed well in order. The application of carbofuran @ 1 kg a.i./ha before sowing was effective to control the leaf folder and gundhi bugs. Indigenous method of trapping gundhi bug using dead crabs was more effective to control insect than pummelo or frog stick. The application of 100:80:60 kg NPK/ha alone or in combination with 10t FYM and 20 kg $ZnSO_4$ /ha gave higher yield of rice. Different varieties of rice were screened against gallmidge. The application of 50 kg K_2O /ha in two equal splits (basal and panicle initiation stage) or 1 : 1 ratio of SSP and RP @ 50 kg P_2O_5 /ha along with 5 t FYM/ha gave optimum and maximum yield of rice.

Maize under various co-ordinated trials was evaluated for identification and recommendation of promising cultivars and

other agronomic feature. In RCRCT, MLY and RCM 1-1 was higher yielder among 14 entries and later were much susceptible to cob borer incidence. Seeds of the promising maize variety were produced for testing, evaluation and distribution. RCM 1-3 and RCM 1-1 gave higher yield of baby corn. The highest grain yield of maize was obtained by the application of 100 kg N + 20 kg S + 5t pig manure/ha and similar result was obtained with 20 kg P + 2 t lime + 5 t FYM/ha.

Among pulses, moongbean 99M-39, 99M-57; urdbean 99U-26, 99U-45, 99U-35, 99U-49, 99U-33; pigeonpea AF-239 and rajmash HUR-137 genotypes were found promising as good yielders. Lower number of aphids infestation on pea was noticed in neem and FYM + neem cake treated plots. Lower number of aphids were recorded on Toria and highest on M-37. Popcorn with groundnut (4:2) yielded maximum maize equivalent yield closely followed by popcorn + frenchbean. The application of 80:40:30 kg NPK/ha gave the optimum yield of maize and groundnut intercrop, irrespective of different row ratios.

Bragg variety of soybean gave the highest yield in Initial Varietal Trial and Advanced Varietal Trial. The application of 60 kg P_2O_5 /ha through SSP + RP in 1:1 ratio gave the optimum yield of soybean. Semilooper damage was less in imidachloprid than carbofuran plots and was higher in maize intercropped with soybean than rice. In soybean with rice as intercrop, imidachloprid showed better control

against leaf folder than carbofuran. Application of NPK (20:60:40 kg/ha) + FYM 10 t/ha + Lime @ 2 t/ha produced highest pod yield of groundnut and inoculation of *B. polymyxa* and *P. striate* and application of 30 kg S/ha enhanced the productivity. The insect-pest of soybean was monitored under integrated pest management. The major sunflower pest recorded were pumpkin beetles *E. picauta* spp causing complete defoliation of leaves, followed by *Spodoptera litura*. The lowest number of aphids was recorded on Toria (30.3 aphids/10 plant) and the highest on M-27 (149.7 aphids/10 plants) of mustard cultivar.

Micro propagated different species of *Citrus* performed better than seedling excepting in Khasi mandarin. Softwood grafting of Khasi Mandarin on *C. latipes* during August gave around 80% success. Highest organoleptic score was obtained for the Squash prepared with juice at 40 to 55% TSS of citrus fruits and preserved minor fruits were assessed for processing and preservation. Citrus psylla (*Diaphorina citri* Kew). Incidence was almost nil in *Citrus aurantifolia* and *C. karna* and lowest citrus leaf miner population was noticed in Karna khatta, Pummelo, and East rough lemon. The citrus black aphid population had the significant positive relationship with relative humidity ($r=0.9862$). Monocrotophos @ 0.05% successfully controlled the insect pest.

Different varieties of colocasia and sweet potato were evaluated and application of 100 kg K/ha gave the optimum yield in later. Meghalaya local selection of french bean gave the highest seed yield as compared to other varieties tested. The Nadia ginger registered minimum crude fibre content and maximum in rhizomes of accession 3573.

The diet with 30% protein level gave a maximum increment in body weight of *L.*

rohita fingerlings. Mustard oil cake + rice polish was found to be very effective in enhancing the total biomass production.

A total number of 19 F_1 and 11 F_2 pig generations were produced during the period for their productive and reproductive performance. Better quality of rice polish along with protein performed better for pig growth. Mortality due to gastroenteritis was found to be the main cause of death amongst the piglets. The study on general and specific combining abilities was undertaken by diallel crossing involving Newzealand white (NZW), Soviet chinchilla (SC) and local (L) rabbit. Crossbred rabbits had advantages for body measurements, meat yield traits and nutritive content of meat. The faecal samples revealed *E. coli* to be the most commonly isolated bacterial organism and *E. irresidua*, *E. intestinalis* and *E. stiedae* were major coccidial infestation.

Recurrence of incidence of Black Quarter-like disease in cattle in Manipur Valley was reported in the month of May 1999 inspite of regular vaccination with HS/B.Q. vaccine. Dietary protein utilisation of poultry reduced upto 11% as the level of jack bean treated seed increased from 20 to 40%. The groundnut strawmeal can be fed to a maximum level of 10% to the broiler chicks.

It has been observed that the runoff and soil losses were minimum and maximum from natural vegetation and cultivated bare fallow land use respectively. A lightweight power operated paddy thresher was developed for hilly region. The average biogas production from pig dung was found as 0.044 m³/kg (wetdung) while 0.053 m³/kg in case of rabbit at 1:1 slurry level and 45 days HRT.

Economic analysis of the rice in the North Eastern states was done during the period of 1972-1973 to 1997-1998 in respect of area,

production, productivity and contribution of area to yield. In Mizoram, the analysis of net present value and benefit/cost of agroforestry systems revealed that the net revenue tended to become positive from third year onwards.

Extension division studied the (i) effectiveness of different source of information in adoption of some improved agricultural practices (ii) role performance and knowledge level of tribal women in modern farming (iii) information extension vs. input extension in Meghalaya (iv) factors affecting adoption behaviour of tribal farmers in Meghalaya (v) training need assesment of the tribal farmers in Meghalaya and (vi) Inter-personal communication in technology transfer.

Under institute village linkage programmes, Vijay composite maize yielded 65% more than the local variety MLW, and fertilizer application gave 20% more yields. Indo-American hybrid tomato (Rupali) yielded 57% higher as compared to local variety and application of 80:60:60 kg NPK/ha gave 10% extra yield. Similarly crossbred pig (Hampshire) performed better. During this period six training programmes were conducted in different villages of Meghalaya for vegetable crops. Various training programmes were organised to the farmers of the NEH Region for Transfer of Technology generated at the Institute and feed back for further research and improvement.

In farming System Research, dairy based system (FSW-1) produced sufficient fodder to

maintain two milch cows producing 1590 litres of milk and 9.9 t of manure in nine months. In mixed forest block (FSW-2) Alder (*Alnus nepalensis*), Acacia (*Acacia auriculiformis*), Exbucklandia (*Symingtonia populanea*) and Teeta chap (*Michelia oblonga*) performed well after 16 years of plantation. The growth of orange and lemon was better in FSW-5 and FSW-6. *Pinus kesia* and *Schima wallichii* were the dominant forest species regenerated (FSW-7) after 16 year of protection from biotic interference. No water flow was recorded in FSW-1 and FSW- 8 during the year 1999.

The performance of the MPTs was excellent with survival percent of 70 to 90%, except *P. faclataria*. The *P. faclataria* trees were completely eliminated by an unidentified insect (truck borer) despite its excellent performance (Ht. 13.84 m, and dbh 20cm) up to 8th year. Close planting (2.5 m × 5m) of Khasi Mandarin yielded more than wider spacing (5m × 5m) although former was more affected by insect and disease. Mandarin and guava intercropped rice (RCPI 1-25, RCPL 1-24 and RCPL 1-29) yielded 4.5 to 6.2 t/ha grain. In Som (*Machilus bombycina*) based AFS, broom grass, turmeric and ginger yielded 62 t/ha green biomass (2 t flower) 22.1 and 17.3 t/ha rhizomes, respectively. Indian honeybee species (*Apis cerena indica*) survived well and produced honey while Italian was (*Apis mellifera*) could not perform well. The sprouting of promising clones of *Populus deltoides* was better in polythene mulching (41%).

INTRODUCTION

The ICAR Research Complex for Northeastern Hills (NEH) was established in the year of 1975 with its Head Quarter at Shillong. In 1991 Head Quarter was shifted to Umiam. It is the first institute of its kind set up by ICAR having disciplines of agriculture, horticulture, animal science, fishery and agricultural engineering to cater to the needs of the tribal areas of North Eastern Hills Region including Sikkim. This institute has six centres viz. Basar (Arunachal Pradesh), Imphal (Manipur), Kolasib (Mizoram), Jharanapani (Nagaland), Tadong (Sikkim) and Lembuchera (Tripura). This institute has also in addition six Krishi Vigyan Kendras (KVKs) attached to different centres of the states. There is one Trainers' Training Centre (TTC) at Umiam (Meghalaya) to cater to the needs of the entire NEH region. The research farms of the institute are located at various altitudes from 60-70 m at Lembuchera, 750-800 m (Kolasib, Imphal and Basar), 980-1080 m (Umiam) to 1200-1400 m above msl at Tadong to cater to the needs of different agroclimatic zones of the region.

While locating the research centres, the entire NEH region has been considered as one unit and research centres have also been so located as to represent the varying altitudes and agroclimatic zones of the region. This has helped in rational utilisation of scientists avoiding duplication of work. Further, the total research findings of the institute at different centres can thus be utilised for specific latitudinal range and agroclimatic zones of all the states concerned.

The headquarter of the Institute is located at 25°30'N and 91°15'E near Umiam lake

almost 1.5 km away from the junction of Guwahati-Shillong (GS) road on Umiam road. The site is about 22 km away from Shillong town. The 101 ha farm land has mild to steep slope and flat valleys, which provide suitable site for almost all kinds of agricultural research for hilly topography. Bench terracing on mild slope and contour bunds and half moon terraces on steep hills has been developed for conservation of soil and water. Trenches and earthen dams have been made to harvest the rain-off water. At present, the area under cultivation is around 60 ha.

MANDATE

- (i) To undertake the basic and applied research for delivering technologies based on sustainable farming system for different agroclimatic and socio-economic condition of the region.
- (ii) To improve the productivity of the crops, livestock and fishery.
- (iii) To act as a repository of information on natural resources, different farming and land use systems of the region.
- (iv) To provide training in (a) research methodology and (b) use and application of improved technologies for enhancing agricultural productivity.
- (v) To collaborate with the State Departments for the region and testing and promotion of improved farming and land use technologies.
- (vi) To collaborate with National and International agencies in achieving the above objectives.
- (vii) To provide consultancy.

THRUST AREAS

- To evolve suitable integrated farming systems for the hills of the region to replace *jhuming* (shifting cultivation) for increased productivity.
- Development of feed and fodder's resources including local fodders for different livestock.
- Improvement of citrus plantation to rehabilitate citrus industry.
- To increase the over all productivity of different crops through research in cereals pulses, oil seeds horticultural and other economic crops.
- Animal health coverage and improvement of livestock production system.

STRENGTH AND MAN POWER

The Institute has 15 different disciplines: Plant Breeding, Agronomy, Soil Science, Plant Pathology, Entomology, Agroforestry, Animal Health, Veterinary Parasitology, Animal Nutrition, Animal Production, Fishery, Agricultural Economics and Statistics, Agricultural Engineering, Agricultural Extension and Horticulture. At present there are more than six dozens ongoing research projects in the Institute. The institute, headed by the Director has a total number of 612 (excluding KVKs and TTC) staff in position. The staff position of the Institute is presented below :

Category	Sanctioned	Filled	Vacant
Scientific	192	117	75
Technical	318	248	70
Administrative	154	113	41
Supporting	136	134	2
Total	800*	612	128

* Excluding posts of KVKs and TTC

LIBRARY

The Institute has established sophisticated agricultural research library, which has acquired so far 13,791 books and reports and 7045 back issues of several publications. It has subscribed 42 foreign and 122 Indian journals. The library has been providing quite a good number of services to the scientists and other categories of users visiting the library regularly.

COMPUTER FACILITIES

The institute has started to develop computer used databases of library resources by using CDS/ISIS (ver. 3.01) package received from DST, New Delhi under NISSAT project. It has also started to develop a computerised database on Environmental Degradation in Northeast India by scanning six regional and national newspapers. As library is connected with NICNET, it has been rendering Selective Dissemination of Information Service to its scientists by accessing the International Data Bases available with IASRI, New Delhi regularly, including E-mail services. A well developed computer centre was set up to cater to the needs of scientific and administrative requirement of the institute.

BUDGET

The budget of the institute for the year 1999-2000 is given below :

Budget	(Rs. in lakhs)	
	Allotted	Expenditure
Plan	475.00	472.56
Non-plan	1113.00	1066.04

LINKAGE

The institute is maintaining close link with national and international institutions for conducting its various research programmes. The institute is regularly providing advisory services to the development department of agriculture and 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 publications of the institute. The institute is publishing Annual Report and quarterly newsletter regularly to disseminate its research findings. In addition research bulletins and technical bulletins are also published to transmit its generated information to research scholars and scientists.

MEETING OF RESEARCH ADVISORY COMMITTEE

Research Advisory Committee Meeting of ICAR Research Complex, Umiam was held on 25-26 October 1999, where in Dr. K.G. Tejwani and Dr. P.S. Pathak, A.D.G. (Agron.)

of ICAR, New Delhi were present. Research Projects, proposals and future strategies were discussed at length in the meeting with the scientists of various disciplines.

KISAN MELA ORGANISED

In Kisan Mela organised on 21st August, 1999, Mr. Suchiang, Hon'ble Minister of Agriculture, Govt. of Meghalaya stated that here in Meghalaya I have observed that the modernisation of agriculture is taking place by the sole efforts of the ICAR's scientists. I have been told that the scientists wish to replace the local varieties of rice, maize and groundnut etc for higher production. Local breeds of pig and rabbit have also been replaced to cater to the increasing demand in their respective field.

He further stated that the farmers of this region love to cultivate in a traditional way without considering the other factors like profitability etc. This makes the job a bit difficult for the scientists, as they are to concentrate on so many aspects before recommending any technology to the farmers. He made an appeal to the farmers to come forward and interact with scientists to make them to conduct need based research.



Interface meeting



Research Advisory Committee Meeting

Sh. E.K. Mawlong, Hon'ble Speaker of Meghalaya Legislative Assembly chaired the function and appreciated the efforts of the Institute in bringing out new technologies for the betterment of the farming community of this region.

NATIONAL SEMINAR ON "STRATEGIES FOR AGRICULTURAL RESEARCH"

A three days National Seminar on "Strategies for Agricultural Research in the North East" was organised by ICAR Research Complex, Umiam sponsored by National Academy of Agricultural Sciences (NAAS), New Delhi at the auditorium of St. Anthony's College, Shillong from 10th to 12th November 1999. Dr. N.D. Verma, Director of the institute welcomed the dignitaries by presenting them monuments and bouquet.

Inaugurating the seminar the Governor of Meghalaya his Excellency Sri M.M. Jacob appealed to the scientific community to work with full might for the benefit of farmers. Sri B.B. Lyngdoh, Hon'ble Chief Minister of Meghalaya was the guest of honour on this occasion. In his remarks he emphasised the

need to propagate the latest agricultural technologies to the farmers as Northeast lagged behind in adopting the latest techniques evolved by the scientists in the field of agriculture. Dr. R.S. Paroda, D.G. ICAR in his presidential address stated that ICAR would leave no stone unturned for the benefits of tribal farmers. Sri. M. Suchiang, Hon'ble Agriculture Minister of Meghalaya also expressed his views on this occasion and appealed the farmers of this region to develop close linkage with the scientific community.

There were four technical sessions followed by plenary sessions wherein many lead speakers presented their views in their respective field of specialisation. Poster sessions were also organised and altogether 58 posters were displayed.

UNION MINISTER OF STATE FOR AGRICULTURE AT ICAR COMPLEX

Sh. Hukum Deo Narayan Yadav, Hon'ble Minister of State for Agriculture, Animal Husbandry, Dairy and DARE, Govt. of India visited this complex on 29th March 2000 and laid the foundation stone of Agricultural Technology Information Centre ATIC building.



Governor of Meghalaya His Excellency Sri M.M.Jacob

In his eloquent speech of nearly 1½ hours he cited examples from the mythology to tell the scientific community how this entire region

had visited once upon a time and urges upon them to develop this area in agriculture production. He had a visit to fields and various



Sh. Hukum Deo Narayan Yadav, Hon'ble Minister of State for Agriculture

has an affinity with the rest of the country. Citing the examples from Mahabharata he told that this is the land where our great heroes

divisions of the Complex. He also had a meeting with the staff to acquaint with their problems.

WEATHER

(K.K. Satapathy & D. Daschaudhuri)

Air temperature

The mean monthly maximum temperature varied from 20.7°C in the month of January to 27.7°C in the month of June (Table 1). June was comparatively hotter than other months. Maximum temperature recorded for a day was 32.7°C. Mean monthly minimum temperatures recorded from 7.2°C in January to 20.6°C in July (Table 2).

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 13.8°C in December to 24.1°C in June. Temperature gradually increased from January to April and tended to decline after September and reached around 13.8°C in December

(Table 1). Soil temperature at 30 cm depth also followed the same trend and there was very little difference of temperature in these two depths. Soil temperature was always less than the air temperature.

Rainfall and rainy days

Total rainfall received during 1999 at Barapani was 2091.2 mm distributed over 187 days. Yearly rainfall was 250 mm more than last year and the similar trend was with total number of rainy days. Rain occurred almost every month of the year except February ranging from 5.3 mm in January to 685.4 mm in July. More than 90% of rainfall was received during May to October (Table 1). There were sixteen weeks without any rain. There were 30 rainy days in July and highest amount of rainfall for a single day this year also occurred on 19th July (124.4 mm).

Table 1. Monthly variation of different weather parameters

Monh	Maxt	Mint	Rain	RD	Evp	Rh1	Rh2	SShr	Soil 1	Soil 2	WS	WD	Cloud
Jan	20.7	7.2	5.3	1	66.2	75	49	7.49	14.1	16.4	2.88	142	4
Feb	24.2	10.3	0.0	0	62.4	73	42	6.96	17.0	18.8	3.69	153	4
Mar	26.8	13.5	6.9	2	120.3	67	33	7.39	19.1	20.0	5.71	158	5
Apr	29.1	18.3	25.5	9	145.7	70	45	6.20	23.9	23.7	5.74	165	4
May	26.1	18.3	377.9	28	79.2	86	76	2.95	22.5	23.4	4.17	122	6
June	27.7	20.3	287.4	24	80.8	87	80	2.71	24.1	24.2	3.36	131	5
July	26.6	20.6	685.4	30	64.1	92	78	1.90	23.8	23.8	2.31	94	8
Aug	26.9	20.4	134.8	28	72.5	92	81	2.89	24.0	24.4	2.47	107	7
Sep	26.9	19.6	236.4	26	76.3	88	77	3.42	23.6	23.8	2.32	128	6
Oct	25.4	17.4	264.9	23	69.4	91	76	5.90	21.5	22.3	2.17	115	5
Nov	23.6	13.3	59.8	14	71.2	88	61	7.16	18.6	20.5	2.30	109	5
Dec	20.4	7.8	7.5	2	74.4	58	39	7.32	13.8	17.1	2.56	117	4

Maxt - Maximum Temperature (°C), Mint - Minimum Temperature (°C), Rain - Rainfall (mm), RD - Rainy days, Evp - Evaporation (mm), Rh₁ - Relative Humidity (%) at 0622 hr, Rh₂ - Relative Humidity (%) at 1322 hr, SS_{hr} - Sunshine Hour, Soil 1 - Soil Temperature (°C) at 15 cm depth, Soil 2 - Soil Temperature (°C) at 30 cm depth at 0622 hr, WS - Average Wind Speed(km per hour), WD - Wind Direction (degree) & Cloud - Amount of cloud coverage (octa).

Table 2. Highest and lowest weather parameters for a single day during the Year

Parameters	Highest/Date	Lowest/Date
Maximum temperature (°C)	32.7/16th April	16.2/25th December
Minimum temperature (°C)	22.0/25th July	3.5/11th January
Rainfall (mm)	124.4/19th July	0.0
Evaporation (mm)	8.7/17th April	0.9/18th October
Sunshine hour	9.73/8th December	0.0
Relative humidity 0622 hr (%)	100/18th October	43/12th March
Relative humidity 1322 hr (%)	98/25th August	17/23rd March
Soil temperature (°C) - 15 cm	26.8/29th & 30th April	10.7/11th January
Soil temperature (°C) - 30 cm	27.5/1st May	14.5/11th January, 26th & 27th December
Wind speed (km/hr)	15.51/11th March	0.78/26th August & 1st November

Evaporation

Evaporation was highest in the month of April (120.3 mm) and lowest in January (66.2 mm). Highest evaporation recorded in a single day was 8.7mm on 17th April and lowest (0.9 mm) on 18th October and single weekly highest was 36.9 mm in 17th week (23rd to 29th April) and lowest (11.6 mm) in 42nd week (15th to 21st October). From November to April evaporation was higher than the rainfall and from May to October rainfall exceeded the evaporation.

Wind speed and direction

Mean monthly wind velocity ranged from 2.17 km/hr (October) to 5.74 km/hr (April). During the rainy season wind was blowing at 2 to 5 km/hr. The wind velocity most of the year was south-east direction excepting April, July to August and November to December (southerly and easterly direction).

Relative humidity

Relative humidity at 0622 hr at Barapani was highest in the month of July and August (92%) and lowest in the month of December (58%). From January onwards, there was an

increasing trend upto July and then come down to 58% in the month of December. From June to September i.e. in rainy season relative humidity ranged between 80 to 90%. But 100% relative humidity was recorded on 18th October.

Relative humidity recorded in the evening varied from 33% (March) to 81% (August). Humidity frost showed decreasing trend and started increasing from April upto August with little variation in the month of July. From September onwards it decreased and reached 39% in December. Humidity for a single day was highest (98%) on 25th August and lowest (17%) on 23rd March.

Sunshine hour

The sunshine hour at Barapani ranged from 1.90 hr/day (July) to 7.94 hr/day (January). From June to September it ranged from 1.90 to 3.42 hr/day. From October to May sunshine hour ranged from 2.95 to 7.94 hr/day. Sunshine hours were more than 9 hr/day for 21 days. There were more than 15 days where sunshine were nil, which were mostly in October to January.

RICE

CROP IMPROVEMENT

Twenty-seven trials, 14 in lowland, 8 in upland and 5 in high altitude areas were conducted during the year. A total of 298 germplasms were evaluated in 3 trials. Six farmers' field trials were also conducted with two upland lines i.e. RCPL 1-29 and RCPL 1-28.

UPLAND

(A. Pattanayak & H.S. Gupta)

In the research complex regional trial (RCRT) 14 lines were evaluated and RCPL 1-21 yielded highest (60.68 q/ha). Twenty-four genotypes selected from IURON trial of 1998 were evaluated in a station trial along with 3 advance-breeding lines and 3 checks. IR 65258-27-1-13 and IR 66421-039-2-1 gave higher yield of around 50 q/ha. In AICRIP trials, higher grain yielders were IET 16003 (RCPL 1-28) in AVT-1-U (H), IET 16487 (RCPL 1-24) in IVT-U (H). IET 16003 (RCPL 1-28) gave higher yield in the AVT trial for two consecutive years and was the top ranking line in the All India Co-ordinated trial in 1998. In the IURON trial, CNAX 6187, IR 62761-20, WAB 56-50 and IR 63374-12 were found promising.

Farmers' field trials

Two advanced breeding lines RCPL 1-29 and RCPL 1-28 were tried in farmer's field on two jhum and four terraced uplands in Madan Mawkhar and Mawlansnai Villages of Ri-Bhoi district. The former line gave the higher yield under both conditions.

Hybridization

One hundred and sixty-five F_3 lines from 15 crosses were evaluated under upland condition. Among these 36 promising F_3 individuals were selected for further evaluation in the F_4 generation. Thirty F_1 lines were also raised and used for anther culture. Twenty-two crosses, involving promising lines for lowland, were made and hybrid seeds collected.

INSECT MANAGEMENT

(K.A. Pathak & K. Rajasekhar Rao)

Evaluation of insecticides on pest complex

Leaf folder incidence was significantly lower in fipronil 0.4 G @ 100 g a.i./ha (8.8 damaged leaves/m²), followed by carbofuran 3G @ 1.0 kg a.i./ha (9.6 damaged leaves/m²) and imidachloprid 200 SL @ 2.0 ml/litre (9.8 damaged leaves) treated plots. The control plot recorded the highest incidence of leaf folders (29.4 damaged leaves).

Evaluation of carbofuran granules against pests

Carbonfuran 3G @ 1.0 kg a.i./ha was applied before sowing to study the insect pest incidence along with a control plot. The incidence of leaf folder started from 65 days after sowing (DAS) continued till 115 DAS and the peak period of damage was during 80 DAS to 115 DAS. The gundhi bug incidence was observed from 90 DAS to 105 DAS. The incidence of leaf folder (2.03 leaf folders/sq. m) and gundhi bug (7.80 bugs/sq. m) were low in carbofuran treated plots and

higher in control plots (6.40 leaf folders and 10.79 bugs/sq. m). The grain yield of protected plot was 4.28 t/ha when compared to the control plot (2.06 t/ha). The percent avoidable losses were upto 51.86 due to carbofuran application.

Indigenous methods of trapping gundhi bug

Different locally available materials like acid lime, pummello, dead crabs and dead frog were inserted at the tip of a bamboo stick and such stick were kept in the field @ 1 trap for 6 sq. m. plot. The gundhi bugs were attracted to these materials and congregated on the stick near the tip where 'trap' was inserted. The highest number of the gundhi bugs congregated were more on dead crabs (15-20 bugs/stick) than pummello or frog sticks.

LOWLAND

VARITAL TRIAL

(H.S. Gupta & A. Pattanayak)

In the Research Complex Regional Trial (RCRT) RCPL 1-4 was the highest yielder (57.28 q/ha), followed by RCPL 1-87-8 (56.2 q/ha). In the Station Trial 1 (ST 1) RCPL-179-3 P was the highest yielder (59.39 q/ha). Station Trial 2 (ST 2) was conducted with 14 genotypes selected from IIRON 1998 and ITA 222 gave higher yield (67.85 q/ha). Under the AICRIP, seven trials were conducted. In two trials of aromatic (Basmati) lines, IET 16310 yielded highest (26.15 q/ha) in AVT 1-BT and IET 15830 produced higher (25.46 q/ha) in AVT 2-BT. In the IVT (Slender Grains) IET 16798 (38.64 q/ha) was found promising. From rest of the trials IET 15473 (51.27 q/ha) and IET 16462 (54.25 q/ha) were identified as promising.

CULTURAL PRACTICES

(D.C. Saxena, G.C. Munda, U.K. Hazarika, D.P. Patel & N.P. Singh)

Effect of varying levels of nitrogen, phosphorus and potash on ripening ratio

In the consecutive 4th year also field experiment confirmed the findings of last three years. The applied 100:80:60 kg NPK/ha, $\frac{1}{2}$ at planting and $\frac{1}{2}$ at 18 stage, produced significantly higher grain yield of rice (45.5 q/ha), followed by 60:48:30 kg NPK/ha when N was splitted 2 times i.e., at planting and at P.I. stages, with ripening ratio of around 85.5%. The trend was also similar in harvest index. The application of 60 kg P_2O_5 and 60 kg K_2O /ha gave 6.84 q/ha additional yield over control and 3.76 q/ha extra yield was found with 100 kg N/ha applied along with P and K. The significantly higher straw yield (73.23 q/ha) was obtained with 100:80:60 kg NPK/ha applied whole at planting, followed by splitting of 100 kg N into 3 equal doses at planting, maximum tillering and at P.I. stage (71.03 q/ha).

Studies on yield potential of pre-released variety RCPL-1-87-9

(D.C. Saxena, G.C. Munda, U.K. Hazarika & N.P. Singh)

This was the 3rd year of experimentation to establish the performance of pre released wet land variety RCPL-1-87-8 under the mid hills of Meghalaya. The treatment NPK (100:80:60) kg/ha + FYM @ 10 t/ha + $ZnSO_4$ @ 25 kg/ha produced significantly higher grain yield (56.87 q/ha) and maintained the trend since 1997, followed by 60% of recommended dose of NPK (60:48:36 kg/ha) + FYM 10 t/ha + $ZnSO_4$ @ 25 kg/ha which was at par with 100:80:60 kg NPK + FYM 10 t/ha. The N_{100} ; P_{60} ; K_{40} kg/ha + FYM 10 t/ha or

ZnSO₄ 35 kg/ha or in combination of both produced significantly similar yield of straw ranging from 101.87 to 103.33 q/ha and remained significantly superior to rest of the treatments. At 60% of recommended dose of NPK + 10 t FYM/ha or ZnSO₄ @ 25 kg/ha, harvest index was statistically at par (0.3378 and 0.3399) but differed from the rest of the treatments.

Performance of wetland cultivars under natural/organic farming

(G.C. Munda, U.K. Hazarika, D.C. Saxena & D.P. Patel)

The experiment was repeated to assess the yield stability of six promising cultivars under natural soil fertility conditions. No other cultural operations were done except transplanting of seedlings. Azolla biofertiliser was released to grow as dual cropping @ 200 g/sq m. Among the varieties tested, RCPL-1-87-8 produced maximum yield (31.20 q/ha) followed by DR-92 (28.31 q/ha), H-2850 (28.75 q/ha), Mandri (26.50 q/ha) and H-2686 A (27.00 q/ha).

Integrated nutrient management through organic and inorganic sources

(U.K. Hazarika, G.C. Munda & N.P. Singh)

An experiment was initiated to assess the economic and viable integrated nutrient management approach in increasing yield under low land situation in mid hills consisting 15 integrated nutrient management approaches. The test rice variety was RCPL-1-3. Among all the treatment combinations, optimum yield of rice (38.6 q/ha) was found with 60 kg N + 5 t FYM/ha and was at par with 30 kg N + 25 kg ZnSO₄ + 5 t FYM/ha and 60 kg N + 25 kg ZnSO₄/ha.

INSECT MANAGEMENT

(K.A. Pathak & K. Rajasekhar Rao)

Soil application of insecticides for the management of insect pests

Six varieties were transplanted on 20.7.99 and carbofuran @ 1.0 kg a.i./ha was applied to study its influence on insect pests. Observations revealed lower incidence of insect pests in carbofuran treated plots and higher incidence in control plots. The per cent loss avoided due to lower incidence of insect pests was 41.02% in RCPL 1-87-8 and 31.52% in IR-36.

Comparative efficacy of carbofuran and fipronil on insect pests

Three varieties (DR 92, RCPL 1-30 and Ngoba) were transplanted on 5.8.99 and carbofuran and fipronil were applied in the field as basal dose. Different insect pests were recorded and among the varieties there was no significant difference on incidence. Among the two-insecticides, carbofuran 3G @ 1.0 kg a.i./ha recorded comparatively lower incidence of insect pests than fipronil 0.4G @ 100 gm a.i./ha. Upto 41.66% yield losses could be avoided with the application of carbofuran 3G @ 1.0 kg a.i./ha in Ngoba followed by DR-92 (27.27%) and RCPL 1-3 (26.53%).

Evaluation of new insecticides on pest complex

The insecticides were imposed in the field at 50 days after transplantation (DAT). (-cyfluthrin 2.5 SC @ 12.5 gm a.i./ha plots recorded the lowest leaf folder incidence (0.50 infested leaves/sq.), followed by thiomethoxam 25 WG @ 25 gm. a.i./ha (1.25) chlorpyrifos 10 G @ 1.0 kg a.i./ha (2.0 infested leaves) and carbofuran 3 G @ 1.0 kg a.i. (4.25 infested leaves per sq. m). The lowest incidence of whorl maggot was noticed in the plots that

were treated with chlorpyrifos 10 G @ 1.0 kg a.i./ha (8.0 maggots/sq.), followed by carbofuran 6 G @ 1.0 kg a.i./ha (9.25), (-cyhalothrin 2.5 EC @ 12.5 g a.i./ha (9.50) and carbofuran 3 G @ 1.0 kg a.i./ha (9.5 whorl maggots per sq. m).

Gall midge Biotype (GMBT)

(K.A. Pathak)

Out of 13 varieties received from DRR, Hyderabad for screening against rice gall midge, 5 varieties (W 1263, ARC 6605, Velluthacheera, Agani, and Ptb-10) were found resistant to gall midge at Manipur.

Gall midge screening

Out of 90 varieties received from DRR, Hyderabad, 27 viz.; JGL 2671, 2772, 2813, 336, 3827, 3856, 3858; BPT 1419, CR 705-600-1, JGL 1881, Phalguna, RP 2932-44087, 2932-44089, 3463-44747, 2068-18-3-5, 3463-44774, 4104-44928-40, 4106-45051, 410645053, 410844993, 4111-45847, 4112-46730, 4113-45357, 4117-44925, 4117-46765, 4118-46059, and ARC 5984 showed tolerance gall midge at Manipur.

Screening in plant breeding trials

In the RCRT, maximum leaf folder was found in the RCPL 1-24 with 121-leaf folds/10 hill compared to variety IET 13783 with 111.6 leaf folds/10 hills. WBPH was maximum in RCPL 1-24 and Bali with 6.6/10 hills. Stem borer incidence was less in all varieties. Gundhi bug was maximum on RCPL 1-27 and least in RCPL 1-21.

In the station trial WBPH was maximum in IR 66421-039-2-1-1, and least in the Orizica Sabana -6. Leaf folder was maximum in RCPL-1-88-107 (Bulk) with 136 leaf folds/10 hills compared to variety IR 65261-34-1-b (125.33 leaf folds/10 hills). Stem borer was maximum in Orizica Sabana -6 with 2.33 dead

hearts/10 hills, and gundhi bug in CNAX 2933-60-4-1 compared to RCPL 1-88-107 (B)-1 with 21.33 and 5.0 adults/10 hills respectively. In AVT, IET-15458 had maximum WBPH incidence compared to VL-Dhan 61. VL-Dhan 221 that had lowest dead hearts compared to IET-16056 (3.66/10h). Leaf folders were maximum in IET 15458 and Gundhi bug in VL Dhan 221 (8 numbers/10 hill). In IVT, RCPL 1-27 had lowest WBPH (15.5/10 hills). There was no incidence of stem borer and the population of gundhi bug was also less. Leaf folder was more in HPR-2067 (135/10 hills).

SOIL MANAGEMENT

(B. Majumdar, M.S. Venkatesh, B. Lal & K. Kumar)

Response to split application of K with and without FYM

The grain yield and K content in grain and straw of paddy increased significantly with K and FYM application. The split application of K (Basal + P.I. stage) gave higher yield in comparison to only basal application of K. The highest grain yield (3.25 t/ha) and K content in grain (0.26%) and straw (1.25%) were obtained with the split application of 50 kg K₂O/ha (25 kg K₂O as basal + 25 kg K₂O at P.I. stage) with 5 t FYM/ha compared to its basal application.

Effect of phosphatic fertilisers amended with organic manures on yield and P uptake

A field experiment was conducted during the Kharif 1999 to know the effect of rock phosphate and SSP with or without FYM on yield and nutrient uptake by low land rice. The results revealed that application of SSP and rock phosphate (1:1) @ 50 kg P₂O₅/ha along with FYM @ 5 t/ha produced maximum grain and straw yields (32.33 and 41.67 g/ha,

respectively). The uptake of P was found to be maximum in the treatment which received SSP + RP (75:25) with FYM.

WATER MANGEMENT

(S.K. Gupta)

Studies on water management in lowland transplanted rice

The 5-8 and 3-5 cm depth of submergence gave almost similar yield. Rice cultivar RCPL 1-3 gave 37.0 q/ha grain yield, followed by RCPL 87-8 (35.1 q/ha) and least was with IET 1512 (33.5 q/ha). RCPL 87-8 with shallow submergence (3-5 cm) produced the highest yield (40 q/ha).

HIGH ALTITUDE

(H.S. Gupta & A. Pattanayak)

Eight varieties/lines were tested under normal and late sown conditions in Advance Variety Trial 1. Yunlen12 yielded highest in normal sown (30.80 q/ha) as well as in late (19.71 q/ha). In another AVT (AVT2), highest yield was recorded in 1F8-5-3P-1-5 (25.13 q/ha) in normal sowing and 8F8-3-1P-6-2 (18.11 q/ha) in late sown.

BIOTECHNOLOGY

(H.S. Gupta, A. Pattanayak, Alpna Das, B. Bhattacharjee, A. Kumar & Hari Govind)

Anther culture

Anther response of 6 reciprocal crosses involving 4 upland genotypes viz., RCPL 1-29, RCPL 1-28, IET 13459 and Take were studied. Two anther callusing medium, G_3 and E_{24} were used in the experiment because parental genotypes showed contrasting differences in anther response in these two media.

F_1 - derived anthers from 30 hybrids were cultured and calli produced. These calli are being used for plant regeneration. Callus induction frequency ranged from 16-40% and was highest in the cross IET 13459 × Take in G_3 medium. In general, callus induction frequencies in F_1 -derived anthers were higher than the frequencies observed in parents.

Agrobacterium-mediated transformation of rice

Agrobacterium-mediated transfer of agronomically important gene to Indica and Japonica rice lines were studied. Agrobacterium strain EHA 105 (harboring cryIA(c), hph and gun-gfp fusion genes) was used to transform calli of rice lines Pusa Basmati 1, Basmati 370, RCPL 1-28 and IET-13783.

Mature scutellum-derived calli (3-4 weeks old) were infected by complete immersion in bacterial suspension in AAM medium with 100 (M acetosyringone). These calli were then placed on to the callus induction medium supplemented with 100 (M acetosyringone) for co-cultivation. After 2 days of co-cultivation, calli were washed in 250 mg/l-cefotaxime solution and subculture on fresh medium with cefotaxime (250 mg/l) and hygromycin (50 mg/l). A selection protocol using liquid medium was used. Calli that survived two selections of 15 days each, in hygromycin were transferred to regeneration medium (MS + 3 mg/l kinetin, 0.5 mg/l NAA, 250 mg/l cefotaxime, 50 mg/l hygromycine). Five - to - 10 hygromycin resistant calli from each batch was used for gus-assay. Use of acetosyringone in co-cultivation medium was found to be essential. Molecular analysis of putative transformants are in progress.

MAIZE

CROP IMPROVEMENT

(H.S. Gupta & D.K. Verma)

Co-ordinated trials

Six trials under AICRP, one each for early and full season maturity to North-east, two numbers each for current cropping and zonal co-ordinated trials for identification and recommendation of promising cultivars and other agronomic features were conducted.

DMR Co-ordinated Trial : NEH - 1 (Old): Out of 12 entries, RCM1-3 topped the rank by giving 38.95 q/ha yield, followed by RCM 1-1 (30.59 q/ha). The yield for other entries ranged between 12.68 q/ha (Navin) to 25.88 q/ha (Pusa Comp).

DMR Co-ordinated Trial : NEH - 2 (Old): In this trial also 12 entries were tested. RCM 1-1 recorded highest yield (36.48 q/ha), followed by RCM 1-3 (24.67 q/ha). The yield for other entries varied from 9.75 q/ha (Ashwini) to 19.74 q/ha (Prabhat).

DMR Co-ordinated Trial : NEH - 1 (New): Among the 15 entries, MLY topped the rank yielding 61.65 q/ha, followed by RCM 1-1 (58.28 q/ha). Renuka gave the lowest yield of 27.90 q/ha.

DMR Co-ordinated Trial : NEH - 2 (New): Out of 8 entries evaluated in this trial, RCM 1-1 yielded highest (54.52 q/ha), followed by MLY (50.7 q/ha). The yield for other entries varied between 20.5 q/ha (Dhawal 510) to 39.3 q/ha (KH 510).

Zonal Co-ordinated Trial No. 101: Out of 16 entries (ZMR-101 to ZMR-116), ZMR-112 topped in the rank with 76.93 q/ha yield, followed by ZMR-113 (71.73 q/ha) and ZMR-16 gave least yield of 40.33 q/ha.

Zonal Co-ordinated Trial No.102 : In this trial 34 entries of ZMR series (201 to 234) were assessed and ZMR-223 yielded highest (103.9q/ha), followed by ZMR-214 (93.1q/ha). The range of yield for other entries was 21.7q/ha (ZMR-224) to 85.2q/ha (ZMR-225).

Research Complex Regional Trial (RCRT)

The trial comprising of 14 entries conducted during Kharif showed that MLY performed the best (64.29 q/ha), followed by RCM 1-1 (63.44 q/ha). The yield range for other entries was 17.96 q/ha for RCM 1-2 (PopCorn) to 52.88 q/ha for N.E. Composite.

Front Line Demonstrations (FLDs)

Thirty FLDs in Ri-Bhoi (24) and East Khasi Hills (6) districts were conducted using Vijaya Comp., RCM 1-2 and RCM 1-1 in collaboration with State Department of Agriculture, Meghalaya. The average yield of demonstration recorded for Vijaya Comp. was 1368 kg/acre and for RCM 1-2, 912 kg/acre; while in East Khasi Hills Vijaya Comp. yielded 1542 kg/acre.

Maintenance and evaluation of germplasm

A total of 77 germplasm were maintained and evaluated. Promising lines possessing characters like higher yield, ear leaf area, better plant type, lodging resistance, tolerance to diseases and pests, earliness, lower ear placement, etc. were identified.

Hybridisation and evaluation of segregating populations

122 F₂, 27 F₃ and 37 F₄ materials were evaluated for various agronomic trials.

Seed multiplication

Breeder seeds of RCM 1-1 (80 kg), RCM 1-2 (60 kg) and RCM 1-3 (120 kg), RCM 1-4 (10 kg), OCM - 2 (60 kg) and Coix (5 kg) were produced by maintaining time and/or distance isolation for further testing, evaluation and distribution.

BABY CORN TRIAL

Two preliminary trials of baby corn with the improved populations of maize viz; RCM 1-1, MLY, MLW, RCM 1-3 and RCM 1-2 were taken. RCM 1-3 gave the highest baby corn yield of 14.60 q/ha, followed by RCM 1-1 (14.62 q/ha).

Intergenic trial

(B.K. Sarma & D.K. Verma)

Three trials viz., Maize+groundnut, Maize + urdbean and Maize + mungbean consisting of three maize (RCM1-1, RCM 1-2 and RCM 1-3), three groundnut (JL-24, ICGS-1 and ICGS-76), two uradbean (UG-218 and PU-19) and two moongbean entries were conducted.

In all the three trials, genetic differences among genotypes were observed for intercropping and characters to breed varieties for intercropping. Groundnut variety JL24 gave more yields under both RCM 1-2 and RCM 1-3. Urad bean genotype PU-19 was a good combination with RCM 1-2, whereas PDM 11 gave better yield with maize genotype.

INSECT MANAGEMENT

(K.A. Pathak & K. Rajasekhar Rao)

Effect of different dates of sowing on the incidence of maize cob borer, *Stenachroia elongella* Wall

Early sown (2-4-99) RCM 1-2 recorded 17.8% of cob damage compared to either RCM 1-1 (3.3%) or local yellow (4.4%). Among the five varieties sown, RCM 1-2 was

found to be susceptible irrespective of date of sowing with a maximum of 65.11% cob damage. Late sowing of maize (24.5.99) attracted cob borer in all the five varieties tested. The number of cob borer larvae was maximum in RCM 1-3 (5/cob) compared to RCM 1-1 (4.41/cob) or 4.07/cob in RCM 1-2. Less weight of cobs was observed in RCM 1-2 (66 g/cob) and more in local yellow (151.5 g/cob fresh weight basis). On dry weight basis, the highest weight of 84.9 g/cob was recorded in RCM 1-1 and the lowest in RCM 1-2. This was attributed to higher incidence of cob borer on RCM 1-2 than all other varieties.

Co-ordinated trials

(K.A. Pathak)

RCRT: Among 14 varieties tested not even a single variety was found to be resistant to cob borer. The damage ranged from 73.3% (RCM 1-2) to 84.43% in MLW. In the all India co-ordinated trial, accession No. ZMR-8 had maximum infestation (77.76%) compared to ZMR-15 (67.76%). In NEH-1 Old trial Kiran was found to be most susceptible with 90% cob damage compared to PSAM-1 with 72% damage. In NEH 2 old trial, Dholi recorded highest infestation of cob borer (88.9%) compared to EH 50617 (76.66%). In NEH 2 New trial, RCM 1-1 recorded highest infestation of 84.5% and lowest was recorded in Navjyot 68.9%. None of the varieties tested in the co-ordinated trials were found to be either tolerant or resistant to cob borer damage. All the varieties registered damage above 65%.

SOIL MANAGEMENT

(B. Majumdar, M.S. Venkatesh, B. Lal & K. Kumar)

Interaction effect of nitrogen, sulphur and pig manure on acid soil

A field experiment was conducted with 3 levels of N (0, 50, 100 kg N/ha), 2 levels of S (0, 20 kg S/ha) and 2 levels of pig manure (0, 5 t/ha) in combinations to evaluate the effect on yield and nutrient uptake by maize (c.v. Vijay). The grain and straw yield of maize increased significantly with the application of N, S and pig manure. The interaction effects of N x S, N x M, S x M and N x S x M were synergistic to increase the grain and straw yield of maize. The highest grain and straw yield were 38.75 and 57.35 q/ha, respectively at N₁₀₀ S₂₀ M₅ (Table 3).

Effect of phosphorus, FYM and lime on yield and P uptake

Field experiment conducted during kharif 1999 revealed that application of 26 kg P + 2 t lime + 5 t FYM/ha gave the highest grain yield (33.57 q/ha) and P uptake by grain (13.87 kg/ha). P use efficiency was more when P fertiliser (SSP) was applied with FYM and lime.

Table 3. Effect of nitrogen, sulphur and pig manure on the grain yield and straw yield (q/ha) of maize

Treatments	Grain yield	Straw yield
T ₁ (N ₀ S ₀ M ₀)	8.02	18.87
T ₂ (N ₀ S ₀ M ₅)	9.17	19.80
T ₃ (N ₀ S ₂₀ M ₀)	12.18	22.52
T ₄ (N ₀ S ₂₀ M ₅)	15.33	28.90
T ₅ (N ₅₀ S ₀ M ₀)	17.64	30.40
T ₆ (N ₅₀ S ₀ M ₅)	19.32	37.25
T ₇ (N ₅₀ S ₂₀ M ₀)	23.80	42.50
T ₈ (N ₅₀ S ₂₀ M ₅)	26.60	47.65
T ₉ (N ₁₀₀ S ₀ M ₀)	20.75	34.80
T ₁₀ (N ₁₀₀ S ₀ M ₅)	23.94	40.15
T ₁₁ (N ₁₀₀ S ₂₀ M ₀)	29.04	45.62
T ₁₂ (N ₁₀₀ S ₂₀ M ₅)	38.75	57.35

C.D. (5%) N S M SN x M S x M N x S x M
 For grain yield 0.30 0.24 0.43 0.42 0.35 0.61

PULSES

CROP IMPROVEMENT

(B.K. Sarma & Gitanjali Sahay)

Mungbean : Two trials [Initial Varietal Trial (IVT) and Advanced Variety Trial (AVT)] were conducted. In IVT, out of 7 entries assessed, 99 M-13 performed well with an yield of 700 kg/ha. In IVT with 22 entries, 99 M-39 yielded highest (789 kg/ha), followed by 99 M-57 (670 kg/ha).

Urdbean : In IVT, 21 genotypes were tested of which 99 U-26 yielded the highest (1137 kg/ha), followed by 99 U-45, 99 U-35, 99 U-49 and 99 U-33, yielding 1130, 1074, 1070 and 1037 kg/ha, respectively.

Pigeon pea : Seven varieties were evaluated under EACT' 99 for yield and yield attributes. Out of 7 varieties evaluated under EACT 99, AF-239 yielded the maximum (1237.0 kg/ha), followed by AF-345 and P-982 (1085 and 1030 kg/ha, respectively).

Rajmash : In a pre Rabi trial comprising of six varieties, HUR-137 was the highest yielder (1482 kg/ha), followed by HUR-120 (1174 kg/ha).

Ricebean : Forty-five germplasm lines were maintained and evaluated for yield. RCRB 1-6 and RCRB 6-10 were multiplied for seed supply.

AGRONOMY

Growth pattern and economic yield in black gram

(D.P. Patel & G.C. Munda)

A field experiment was conducted under rainfed condition of pre-rabi, to study the performance of 5 blackgram cultivars (T-9, PU-19, PDU-1, DPU-88-1 and DPU-88-31) for their growth pattern, grain yield and yield attributes. Variety DPU-88-1 produced significantly taller plants (41.6 cm), followed by PDU-1 (38.1 cm) as compared to other varieties. DPU-88-31 was found to be shortest among the cultivars tested. Root length, flowering and maturity duration were found significantly higher in DPU-88-1, followed by PDU-1. However, DPU-88-31 took minimum period to come into flowering and maturity but remained at par with PU-19. Cultivar T-9 followed by DPU-88-1 and PDU-1 had significantly higher number of pods/plant than PU-19 and DPU-88-31. PDU-1 recorded maximum 1000-grain weight (41.5 g), followed by DPU-88-1 (41.2 g) and was significantly higher as compared to others. PDU-1 produced highest seed yield/plant (9.8g), which was significantly higher, compared to others. Biomass/plant was found to be significantly higher in PDU-1, followed by DPU-88-1 and T-9 than the other varieties. H.I. did not show any significant variation among the varieties tested. Problem of in-situ germination caused by excess rainfall during maturity was not noticed during the year.

Monitoring and biology of pod boring weevil (*Apion clavipes*) in pigeon pea

(K.A. Pathak & K. Rajasekhar Rao)

Apion clavipes was found as the major pest causing pod damage upto 90%. The damage started at pod formation stage, when

the weevil laid eggs (Maximum 3-5 eggs) on the developing pod by inserting the oviposition. Weevil also damage the leaves by making small feeding holes.

Monitoring of insect pests and yield losses in ricebean

(K.A. Pathak & K. Rajasekhar Rao)

The major insect pests recorded were stemfly (12-16% damage) *Ophiomyia phaseoli*, leaf folders *Nacoleia* sps. (5-6%), *Monolepta signata* and *M. basalis* (10-15%) at vegetative stage. At flowering stage the crop was severely damaged by blister beetle, *Mylabris* sps. (15-16 beetles/plant). The pods were found infested by *Apion clavipes* (20% infestation) and stem fly (16% infestation).

Studies on the influence of host plant nutrition on the incidence of insect pests and their natural enemies on pea

(K.A. Pathak & K. Rajasekhar Rao)

A field experiment was conducted to study the influence of different doses of fertilisers and organic manures on the incidence of pea stem fly *Melanogromyza phaseoli* Tryor (Diptera: Agromyzidae). The stemfly incidence decreased with increase in nitrogen rates and was lowest (23-33%) at 45-60-40 kg NPK/ha, the highest damage was observed in FYM treated plots (30.68%) and least in neem cake (18.43%). The lowest number of pupae was noticed on plants that received highest nitrogen (45 kg/ha) compared to without nitrogen (40 pupae/15 plants).

The incidence of green aphids (unparasitized or infected) increased from 60.32% to 86.65%. As the nitrogen doses lower, number of aphid infestation was seen in neem cake and FYM + neem cake plots.

The infection of pea aphid by fungi *Erinium neoaphidis* increased with the fall in

day and night temperatures. Parasitization of *A. pisum* by hymenopteran wasps was also noticed in the field conditions. The parasitization started from last week of November and their activity was static till the end of the crop period. Aphids swelled and their bodies

bulged and the parasites emerged through a circular hole made by them. At least 6-7 parasites were found in each dissected aphid. 30-40% natural parasitization by these wasps and 60-70% infection by fungus were noticed in field conditions.

OIL SEEDS

CROP IMPROVEMENT

(B.K. Sarma & Gitanjali Sahay)

Soybean

In Initial Varietal Trial (IVT), 36 entries were evaluated and No. 32 had the highest yield (2437 kg/ha) followed by 16 and 27 recording yield of 2131, 2086 kg/ha. In Advanced Variety Trial (AVT), 41 varieties were assessed, Bragg gave the highest yield of 4647 kg/ha followed by JS (JH) 89-48, PK 1137, JS (SH) 89-58 and NRC-22 (3770, 3412, 3259 and 3123 kg / ha, respectively).

Forty-three lines including 11 parent lines and 32 F2 hybrids were evaluated for resistance to frog eye leaf spot disease (*Cercospora sojina*). The cross PK-416 X JS (SH) 89-48 yielded highest (45.4 g/plant), followed by cross Bragg X PK-1137 and UGM-52 X KB-117 (43.7, 27.3 and 23.5 g/plant, respectively).

SOIL MANAGEMENT

(B. Majumdar, M.S. Venkatesh, B. Lal & K. Kumar)

Efficiency of phosphatic fertilisers

The grain yield and P content of soybean (cv. Ankur) increased significantly with the application of P and SSP was superior compared to RP. FYM played a significant role

when it was applied with SSP or RP. The highest grain yield (25.55 q/ha) and P content (0.52%) in grain was found when 60 kg P₂O₅/ha was applied through SSP + RP in 1:1 ratio along with 5 t FYM/ha.

INSECT MANAGEMENT

(K.A. Pathak & K. Rajasekhar Rao)

Monitoring and integrated management of insect pests

The integrated practices included treatment of soybean seed with either imidachloprid @ 7.0 g/kg seed or carbofuran 3G @ 250 g/kg seed and intercropping of soybean with either maize or rice to study the influence of these on major insects like leaf folder *Nacoleia vulgalis*, *N. dimenalis* Guenn. and stemfly and other natural enemies occurring in soybean ecosystem. The study showed that leaf folder and stem fly damage was not observed till 8th week after sowing (WAS) and the *N. vulgalis* incidence started from 9th WAS. Whiteflies were present in all the plots (3/plant) from 9th WAS. The leaf folder damage was less in carbofuran seed treated plots than imidachloprid. Semilooper damage was less in imidachloprid than carbofuran, and was high in maize intercropped with soybean than rice. In soybean rice intercrop, imidachloprid showed better control

against leaf folder than carbofuran. The stemfly damage was more in control plots (4 damaged plants/10 plants) than the seed treated. The natural enemies were also active during the first year of study. Spiders were more in rice intercropped with soybean and coccinellids were in maize intercropped with soybean. In soybean the spider activity was very high (20 spiders/10 plants)

GROUNDNUT

CROP IMPROVEMENT

(B.K. Sarma & G. Sahay)

Forty-three bunch and 25 spreading type germplasm were maintained. Five varieties, found promising ICGS 76, JL 24, ICGS-1, ICGS-44 and ICGV 86188 were multiplied. Eleven off types were selected from JL 24 for multiplication.

AGRONOMY

Study on performance of groundnut cultivars under two moisture regimes

(S.K. Gupta)

Variety JL-24 yielded significantly the highest pod yield (21.56 q/ha), followed by TG-3 and TG-26 (20.12 and 17.64 q/ha, respectively) and TG-24 gave lowest yield (15.76 q/ha). The pod yield of plain and ridge methods of sowing differed significantly and later produced higher yield (20.13 q/ha) as compared to former (17.4 q/ha).

Studies on the effect of soil amendments on the pod yield

(G.C. Munda, D.P. Patel, U.K. Hazarika & D.C. Saxena)

As in the previous year, all the treatments showed superiority in respect of pod yield to control. Data on pod yield confirmed the results of the preceding two-year. Application of NPK (20 : 60 : 40 kg/ha), + FYM 10 t/

+ lime @ 2 t/ha produced highest pod yield (32.50 q/ha), followed by NPK (20:60:40 kg/ha) + lime @ 2 t/ha (29.50 q/ha) and FYM 10 t/ha + lime @ 2 t/ha (25.00 q/ha).

Studies on effect of PSM on pod yield

(G.C. Munda, D.P. Patel, D.C. Saxena & U.K. Hazarika)

The application of NPK (20,60 and 40 kg/ha) and phosphate solubiliser produced maximum pod yield (22.50 q/ha) when inoculated with PSM culture IGR-40 followed by *B. polymyxa* (22.00 q/ha) and *P. striata* with 21.80 q/ha. However, culture *B. circulance* along with NPK (20:60:40) produced low yield as compared to NPK alone.

Performance of HPS-II lines

(G.C. Munda, U.K. Hazarika & D.P. Patel)

Performance of five HPS-II groundnut lines (HPS-II- 9701, 9702, 9703, 9704 and 9705) alongwith a check (BAU-13) showed that HPS-II- 9703 produced maximum pod yield (28.92 q/ha), followed by HPS-II- 9704 (26.67 q/ha). BAU-13 gave 13.75-q/ha pod yield.

Performance of varieties under the mid-altitude acid soil

(G.C. Munda & D.P. Patel)

Among 13 cultivars (ICGS-11, ICGS-44, ICGS-76, VRI-2, VRI-3, JL-24, TAG-24, OG-52-1, GIRNAR-1, TG-26, TKG-19A, ICGV-86590 and TRG-24), ICGS-76 (21.00 q/ha), VRI-2 (18.75 q/ha), OG-52-1 (18.75 q/ha) and ICGS-11 (17.42 q/ha) were found promising.

Effect of certain macro and micronutrients on the pod yield

(G.C. Munda & D.P. Patel)

Variety ICGS-76 produced maximum pod yield (32.70 q/ha) with the combined applica-

tion of NPK (20:60:40) kg/ha + zinc sulphate 25 kg/ha + gypsum 25 kg/ha + lime 200 kg/ha + sulphur (elemental) 10 kg/ha, followed by NPK (20:60:40) + sulphur (10 kg) (31.00 q/ha), NPK (20:60:40) kg/ha + zinc sulphate 25 kg/ha (30.50 q/ha) and NPK (20:60:40) kg/ha + gypsum 25 kg/ha (30.00 q/ha). Control crop produced 18.83 q/ha.

Variety HPS-II-9706 produced maximum pod yield (30.67 q/ha) with the application of NPK (20:60:40) kg/ha + zinc sulphate 25 kg/ha + gypsum 25 kg/ha + lime 200 kg/ha + sulphur (elemental) 10 kg/ha, followed by NPK (20:60:40) kg/ha + gypsum 25 kg/ha (27.67 q/ha), NPK (20:60:40) kg/ha + lime 200 kg/ha (26.50 q/ha), and NPK (20:60:40) kg/ha + zinc sulphate 25 kg/ha (26.17 q/ha). Control crop produced 18.00 q/ha.

SOIL MANAGEMENT

(M.S. Venkatesh, B. Majumdar, B. Lal & K. Kumar)

Relative performance of some sulphur sources on the sulphur nutrition

Field investigation on the effect of sources and levels of sulphur on yield and nutrient content of groundnut (cv. ICGS-76) was repeated. The results revealed that sulphur levels significantly increased the mean pod and haulm yield from 21.33 to 29.18 and 34.29 to 43.82 q/ha, respectively. Maximum pod yield of 29.18 q/ha was obtained with the application of 30 kg S/ha. There was significant reduction in pod yield at higher level (45 kg/ha) of S fertilisation. Among the sources, gypsum proved to be better source with respect to yield and yield attributes. N/S ratio was found to be narrowed down with increasing levels of S.

INSECT MANAGEMENT

Monitoring and integrated management of insect pests

(K.A. Pathak & K. Rajasekhar Rao)

The major insect pest *S. litura* Fab. incidence started from fourth week after sowing (WAS) and the seed treatment (ST) plots either of carbofuran or imidachloropid recorded less infestation when compared with no seed treatment plots. Likewise Jassid (*Empoasca kerri*) and flea beetles *Monolepta* and *Chetocnema* species were less in ST plots. The seed was treated with imidachloropid @ 7 g/kg seed and carbofuran 3 G @ 250 g/kg seed, a day before sowing. A maximum of six *S. litura* larvae/10 plants was recorded and the larval population increased to 12 larvae/10 plants by 8 WAS. The infection of *S. litura* larvae by entomogenous fungus *Beauveria* sp. to an extent of 30% was recorded in field conditions. The fungal infection increased with increase in rainfall and relative humidity.

The egg masses of *S. litura* was hardly noticed because of the high predation by coccinellid beetles, spiders and chrysopids. Spiders were found @ 1-2/plant from 4th WAS and the Coccinellids were noticed from 8th WAS. These predators were found devouring on green leafhoppers, *Spodoptera* egg masses, white flies and immature stages of these insects. The neem cake applied plots recorded low incidence of jassids. The sunflower as a trap crop was planted in groundnut but the *S. litura* egg masses were not found because by 8 WAS, both the trap crop and the host crop reached to same height and the *S. litura* moths preferably laid eggs on main host (groundnut). Coccinellid beetles were found more in soybean intercropped groundnut. Spiders and coccinellids found less in non intercropped groundnut. The jassid damage

was also more in non-intercropped groundnut. The jassid attack was severe from 8th WAS. Whiteflies were also present @ 2-3/plant. The flea beetle damage was high in fertilised, non-intercropped plots than in intercropped and neem cake (manurial) plots.

SUNFLOWER

Monitoring of insect pests

(K.A. Pathak & K. Rajasekhar Rao)

The major pest recorded were pumpkin beetles *Epicauta* sps. causing complete defoliation of the leaves. Another insect was *Spodoptera litura*, which damaged the leaves as well as heads of sunflowers. *Helicoverpa armigera*, jassids and aphids were also recorded feeding on flowers, developing seeds and leaves.

MUSTARD

Monitoring of insect pests and natural enemies on different varieties

(K.A. Pathak & K. Rajasekhar Rao)

Aphid infestation started from the 3rd week of January and increased till second week of February. The lowest number of aphids were recorded on Toria (30.3 aphids/10 plants) and the highest on M-37 (149.7 aphids/10 plants). A low incidence of *Pieris rapae* infestation was noticed on Varuna and Gobi Sarson from last week of January. During the winter season, the activity of the coccinellid beetles preying on the soft-bodied insects on mustard was very high. On an average 2.3 to 3.8 beetles were found per plant and their population was more during February than in January.

CROPPING SYSTEM

Performance of cropping systems in rainfed dry terraces of Meghalaya

(G.C. Munda, U.K. Hazarika & D.C. Saxena)

Sixteen treatments of different cropping systems comprising maize, groundnut, soybean, rice and french bean were sown under different row ratios (intensities) to evaluate their suitable cropping pattern. Popcorn with groundnut (4: 2) yielded maximum (96.8 q/ha) maize equivalent yield (MEY) closely followed by popcorn + French bean at 4: 2 row ratio with 91.5 q/ha. Groundnut grown under polythene cover (mulch) also fetched 77.4 q/ha of MEY. Among the sole crops, maize registered 48.8 q/ha, followed by popcorn (30.6, q/ha as 69.7 q/ha of MEY) and groundnut (22.2 q/ha, 66.6 q/ha of MEY).

Rice and soybean proved to be inferior and produced 15.0 q/ha (18.75 q/ha of MEY) and 13.5 q/ha (27.0 q/ha of MEY), respectively. Farmers practice such as mixed cropping with ginger, black gram, maize and vegetable in bun fetched 49.7 q/ha of MEY.

Studies on plant densities and nutrient management on productivity of maize based cropping system

(U.K. Hazarika, G.C. Munda, D.C. Saxena & N.P. Singh)

The experiment consisted of 4 cropping densities with different row ratios (Table 12) and 3 fertiliser levels. Maize (CV. Vijay composite) was sown on May 18 while groundnut (CV. ICGS-76) was sown on May 25, 1999. The yield of sole maize increased

Table 4. Performance of maize based intercropping system at different plant densities and nutrients level

Treatments	Maize yield (q/ha)	Groundnut (q/ha)	M + GN (q/ha)	MEY (q/ha)
Maize (Sole) No NPK	29.2	—	29.2	29.2
Maize (sole) + 80:40:30 NPK3	2.6	—	32.6	32.6
Maize (Sole) + 100:60:40 NPK	34.8	—	34.8	34.8
M + GN (1:1) + No NPK	15.3	16.6	15.3+(41.5)	56.8
M + GN (1:1) + 80:40:30 NPK	15.6	17.8	15.6+(44.5)	60.1
M + GN (1:1) + 100:60:40 NPK	15.8	17.6	15.8+(44.0)	55.8
M + GN (1:2) + No NPK	10.2	14.6	10.2+(36.5)	46.7
M + GN (1:2) + 80:40:30 NPK	12.4	22.1	12.4+(55.2)	67.5
M + GN (1:2) + 100:60:40 NPK	12.9	21.1	12.9+(52.5)	65.4
M + GN (2:2) + No NPK	14.1	17.2	14.1+(43.0)	57.1
M + GN (2:2) + 80:40:30 NPK	16.9	20.4	16.9+(51.0)	67.9
M + GN (2:2) + 100:60:40 NPK	16.3	19.2	16.3+(48.4)	64.3
C.D. (0.05)	4.54			

as the fertiliser levels increased and was optimum at 80:40:30 kg of NPK/ha. The highest and optimum yield of maize and

groundnut was found at the above level of fertiliser application irrespective of different row ratios (table 4).

BIOFERTILIZER

Performance of Azolla to different depth of water levels and P application

(U.K. Hazarika, D.P. Patel, D.C. Saxena & G.C. Munda)

Green Azolla biomass @ 50 g/pond of 9 sq. m area were released for growth and multiplication on 7th June 1999. Harvesting

was done during July 21st, September 27th and November 8th, 1999. The green Azolla yield was highest (17.7 q/ha) at 20 kgP/ha under 15 cm water depth of the pond, followed by 17.1 q/ha at the same water depth with 10 kg P/ha and 16.5 q/ha at 20 kg P/ha under 10 cm water depth.

FRUITS

CITRUS

Growth performance of tissue cultured vs. seedling plants

(Maneesh Mishra & D.S. Yadav)

Experiment laid out during 1996 to evaluate growth performance of different citrus species propagated through tissue culture and seedling revealed that tissue cultured plants attained more height than seedling in all the species tested (Table 5). Stem girth and number of branches were recorded maximum in tissue cultured plants except *C. taiwanica* which showed reverse trend. Tissue cultured plants exhibited bigger canopies than seedling excepting Khasi mandarin.

Soft wood grafting

(D.S. Yadav & Maneesh Mishra)

Soft wood grafting was attempted in Khasi mandarin. 6-month-old shoot tip of Khasi mandarin defoliated 15 days prior to

grafting. The grafting was performed on *C. latipes* rootstocks using cleft or wedge method during August and September months. Around 81% success was achieved by this method.

Processing and preservation of Citrus

(Amit Nath, K.Dinesh Babu & D.S. Yadav)

Fruit beverages were prepared from Khasi mandarin, Karun Jamir, Cleopatra mandarin, Grapefruit, Soh Khyllah and Soh nairiang. The juice was extracted by hand pressing and the juice was analysed for its acidity and total soluble solids (TSS).

Squash was prepared with the juice obtained from different citrus fruits. Highest organoleptic score was obtained for the squash prepared with juice at 40% TSS in Khasi Cleopatra mandarin, 55% TSS in Grape fruit, 55% TSS in Soh Nairiang and 50% TSS in Soh khyllah.

Table 5. Growth performance of tissue cultured and seedling plants of citrus spp.

Citrus spp	Planting material	Plant height (cm)	Girth (cm)	Canopy (cm) EW	No. of NS	Leaf area branches (cm ²)	(cm ²)
<i>Volkameriana</i>	Seed	59.3	5.4	37.6	44.6	7.3	1.8
	TC	115.0	6.6	70.6	63.6	19.3	2.1
Khasi mandarin	Seed	73.6	5.2	30.6	30.0	18.0	2.0
	TC	88.3	6.6	29.0	21.6	15.0	2.3
Assam lemon	Seed	48.3	3.6	26.6	18.0	2.33	2.5
	TC	191.0	11.8	166	166	20.0	2.0
<i>Cleopatra mandarin</i>	Seed	103.0	6.1	40.0	40.0	17.6	2.1
	TC	170.0	9.8	60.0	63.0	18.3	2.2
<i>Taiwanica</i>	Seed	130.0	8.2	81.6	75.0	10.6	1.9
	TC	136.0	6.6	85.0	81.6	8.6	2.2
Troyer citrange	Seed	86.6	4.6	9.3	14.3	8.0	2.3
	TC	120.0	5.4	14.3	21.6	14.0	2.2

* Seed = Seedling, TC = Tissue cultured.

Storage Study

It was observed that Karun jamir squash could be stored for one year with 300-ppm level of potassium metabisulphate (KMS). Khasi mandarin and kinnow mandarin squash could be stored for more than one year with 350 ppm of KMS but colour bleaching was observed.

Processing and preservation of minor fruit products

The preserved minor fruit products were stored at room temperature and organoleptic test was carried out periodically. Aonla candy (70% TSS) stored for one year found acceptable without much change in its texture, flavour and colour. Carambola squash (45% TSS, acidity 3.5%, 300 ppm KMS) found acceptable was after one year of storage. Peach jam (69% TSS, 50% pulp) was acceptable for six months and addition of KMS @ 40 ppm extended acceptability of more than one year at ambient condition of Umiam, Meghalaya. Kagzi lime pickles prepared with common salt @ 1:4 found acceptable for more than one year. In case of Kagzi lime pickles, it was observed that as lime halves turn yellow to brown colour and then to dark brown colour. Flavour and softness also increases as storage period extends beyond three months.

Evaluation of citrus fruits for physico-chemical properties

Fruits of different citrus species were evaluated for physico-chemical characters. Maximum fruit weight was recorded in Karun Jamir (147 g) followed by Taiwanica. Khasi mandarin and Malta fruits were found to be more juicy (35 ml/fruit) with high TSS content (10% and 10.6% respectively). However, highest TSS was recorded in Sikkim Mandarin (10.9%) with lowest acidity (0.525%) and

taiwanica fruits exhibited maximum acidity (5.88%).

Artificial seed production in citrus

(Maneesh Mishra)

An attempt has been made to standardise the method for artificial seed production in Khasi mandarin to conserve the germplasm in vitro. An alginate matrix was prepared by mixing 4 g Sodium Alginate in 100 ml liquid MS medium. Shoot tips/nucellar embryos of Khasi mandarin were mixed with sterile Sodium Alginate and dropped in CaCl_2 (75 m) using a glass dropper and kept on rotary shaker at 75 rpm for 45 minutes. The seeds were then washed three times with sterile distilled water and stored at 24°C, 4°C and 20°C.

INSECT MANAGEMENT

Citrus germplasm evaluation against insect pests

(K. Rajasekhar Rao & K.A. Pathak)

Citrus psylla (*Diaphorina citri* Kuw.)

Observations on the incidence of citrus psylla on the 14 indigenous species of citrus indicated that maximum number of psylla adults were recorded in June and the species Sohjora and Khasi mandarin (*Citrus reticulata*) recorded very high population in the range of 16.66 to 19.33 adults/ventral side of leaf respectively. Kagzi lime (*Citrus aurantifolia*) and Karna khatta (*C. Karna*) recorded zero population throughout the period of study. During July Adajamir, *C. assamensis* and Khasi mandarin showed 22.13 and 18.33 adults/leaf respectively. In all the species there was a continuous decline in psylla population due to very heavy rainfall in the subsequent months of observations (July to September) at Umiam. The gradual reduction in psylla population was noticed from June

to September with increase in the age of second flush and fall in night temperatures. The correlation between psylla incidence and some of the weather parameters showed that there was a positive relationship with minimum temperature ($r = 0.6862$) and relative sunshine hours ($r = 0.8159$).

Citrus leafminer (*Phyllocnistis citrella* St.)

Gradual decrease in leafminer incidence was noticed from June to September 1999 on different species and the species Carrizo citron showed almost zero per cent incidence. The lower incidence was noticed in Karna khatta (11.66%), Pummelo (15.66%), East rough lemon (20.00%). Moderate incidence was observed in Soh Nariange (24.15%), Rough lemon (29.58%), Karun jamir (31.25%), Citrus latipes (33.74%) and Adajamir (34.16%). Sweet lime, Soh jora, Khasi mandarin, Gandharaj citron recorded very high per cent of foliage damage (57.5 - 100%). Correlation between leafminer incidence and phenol content of citrus leaves indicated the existence of a non-significant positive relationship ($r = 0.2364$).

Citrus aphid (*Toxoptera aurantii*)

T. aurantii incidence was not noticed on eight species viz. Adajamir, Karun jamir, Pummelo, Carrizo citron, Citrus latipes, Sweet lime and Karna khatta and lower number of aphid were noticed on East rough lemon, Gandharaj citron and Khasi mandarin (3.50 - 5.41 aphids/leaf). The highest number of citrus black aphid population had the significant positive relationship with relative humidity ($r = 0.9862$) and non significant with minimum temperature ($r = 0.2832$).

Citrus red scale

High incidence of citrus red scale was observed on Soh Nariange and Adajamir

(16.67 and 25.5 scales/leaf). Scales which cause significant damage did not infest remaining all species. The correlation between citrus red scale infestation and minimum temperature was found significantly positive ($r = 0.8483^*$) and very weak with phenols of citrus leaves ($r = 0.1113$).

Citrus mealybug (*Planococcus citri* Risso)

Mealybug did not infest all species of citrus during the period of study except Rough lemon, Adajamir and Gandharaj citron, which recorded 2.25 to 3.83 mealy bugs per leaf. The relationship with sunshine hours was positive and non-significant ($r = 0.7171$ and 0.287 , respectively).

Integrated management of insect pests

(K.A. Pathak & K. Rajasekhar Rao)

Different insecticides viz., monocrotophos @ 0.05%, chlorpyrifos @ 0.05%, endosulfan @ 0.075%, phosphamidon @ 0.05% and dichlorvos @ 0.05% were selected to study their efficacy on the management of leaf miner and mealybug with four replications. The data on insect mortality after 24-hrs, 3 days, 5 days and 7 days spray was recorded, pooled and averaged.

Citrus leafminer (*Phyllocnistra citrella* St.)

The data on per cent larval mortality of leaf miner to different insecticides showed that monocrotophos @ 0.05% was most effective followed by chlorpyrifos, phosphamidon and endosulfan by showing 75.10%, 59.03%, 54.51% and 43.38% larval mortality respectively. Dichlorvos @ 0.05% was least effective.

Citrus mealybug (*P. citri*)

Monocrotophos @ 0.05% successfully controlled the pest when compared to remaining 4 insecticides whereas dichlorvos @ 0.05% was least effective by recording 32.58% larval mortality on micropropagated *P. citri* seedlings.

GUAVA**Evaluation of guava hybrid**

(D.S. Yadav & K. Dinesh Babu)

Eleven guava hybrids developed at this institute are being evaluated for different horticultural traits. Hybrid-2 recorded maximum fruit yield (190 fruits/plant), followed by hybrid-1 (185 fruits/plant). Maximum fruit weight 248 g/fruit was recorded in Hybrid-11. Plant height and stem girth was maximum in Hybrid-2.

VEGETABLES**COLOCASIA**

(D.S. Yadav & Ramesh Kumar Yadav)

Evaluation of genotypes

Six locals of NEH Region and 14 improved varieties were evaluated for yield of corm and cormel characters at Barapani. The yield of local varieties ranged from 33.75 (ML-4) to 79.27 (ML-2) q/ha and in case of improved varieties it was 33.10 (BK Cool 2) to 94.37 (Natal) q/ha.

Initial evaluation trial

Nine varieties (Sonajuli, Mukta keshi, Kadma local, KCA-1, BCC-1, BCC-2, BCC-4, BCC-11 and RNCA-1) were evaluated for their yield, corm and cormel characters with X-23 used as a check. None of the varieties showed better performance than check, which yielded 151.85 q/ha.

SWEET POTATO

(D.S. Yadav, Ramesh Kumar Yadav & K. Dhinesh Babu)

The trial was conducted with 12 varieties in IET. The highest yield was recorded in C-

43 (156.85 q/ha), followed by S-162 (153.75 q/ha) and IB-90-10-20 (142.17 q/ha). The minimum yield was recorded in case of S-107 (38.15 q/ha).

Response to K and FYM application

(B. Majumdar, M.S. Venkatesh, B. Lal & K. Kumar)

The tuber yield increased significantly with the increase in K levels upto 100 kg K₂O/ha but the K content in tuber and straw increased with the increase in K levels. The interaction between K and FYM was significant and the highest tuber yield (22.75 t/ha) and K content in tuber (0.80%) and straw (0.67%) were obtained at 100kg K₂O +5t FYM/ha.

FRENCH BEAN

(D.P. Patel & G.C. Munda)

Growth pattern and economic yield

Among the tested cultivars, Local Purple Pod and Meghalaya Local Selection produced significantly taller plants, followed by Naga

local. Manipuri produced significantly highest root length than other varieties. Meghalaya Local Selection produced significantly highest nodules/plant as compared to other varieties and remained at par with Manipuri. Local Purple Pod took significantly minimum duration to come into flowering than others. Leaf no./plant was found significantly less in Local Purple Pod. Meghalaya Local produced significantly highest pods/plant and lowest was with Local Purple Pod. Significantly highest pod length was observed in Local Purple Pod and lowest in Meghalaya Local. Maximum

seed/pod was recorded in Local Purple Pod followed by Meghalaya Local Selection. Seed yield/plant was found significantly higher in Naga Local. Biomass/plant found significantly higher in Naga Local followed by Meghalaya Local Selection. Highest H.I. was found with Naga Local and Lowest with Local Purple Pod. Meghalaya Local Selection produced highest seed yield as compared to all other varieties. Early vegetative growth of variety Local Purple Pod was found to be faster than all other varieties

SPICE

GINGER

Analysis of ginger rhizomes for crude fibre content

(K. Dhinesh Babu, D.S. Yadav, Anit Nath, Ramesh Kr. Yadav, S.K. Sahoo & B.P.S. Yadav)

Ten collections of ginger rhizomes were evaluated for total crude fibre content. The total crude fibre content of different germplasm varied significantly and ranged from 4.12 to 6.6%. The rhizomes of Nadia registered minimum crude fibre content (4.12%), followed

by Suprabha (4.4%). The maximum crude fibre content of 6.6% was observed in rhizomes of accession 3573.

Monitoring of insect pests of ginger and damage assessment

(K.A. Pathak & K. Rajasekhar Rao)

The major pests recorded were *Dichocrocis punctiferalis* (6-10% shoot damage) at 45 days after planting and *Prodiactes haematicus* (upto 26%) shoot damage. Maximum of 4-6% larvae were found attacked by ichneumonid parasites.

FLORICULTURE

Evaluation of gerbera varieties

(Maneesh Mishra, D.S. Yadav & Ramesh Kumar Yadav)

Twenty varieties of gerbera were evaluated for different morphological traits. It was found that Indukumari, G.S. Lal, Carqna, Divas Memory, Popular and Red Bird stayed longer in the field. However, no significant variation was observed for days taken from bud appearance to burst and bud burst to flower opening. Orange Glem and Nirvana had longest flower stalk. Maximum flower diameter was observed in Red Bird.

Evaluation of micropropagated orchid

(Maneesh Mishra)

Comparative growth performance was made between micropropagated and con-

ventionally propagated plantlets of *Cymbidium* hybrid. Two year old micropropagated plantlets showed more vigour in terms of height and number of leaves over conventionally grown plants of more suckering.

Gladiolus biotechnology

In vitro grown shoots of ten varieties of Gladioli were subculture on MS media supplemented with 120 g sucrose and 10 ppm paclobutrazol. Maximum number of in vitro cormel were produced in Bellariana. Maximum weight of cormel was recorded in Meera (1399 mg) and 'biggest size of cormel was recorded in Local 1.

PASTURE AND FORAGE PRODUCTION

PASTURE AND FORAGE PRODUCTION AND NUTRITIONAL ASSESSMENT

(J.J. Gupta, B.P.S. Yadav, S.K. Sahoo, D. Agrahar Murugkar & S. Doley)

Performance of groundnut fodder in acid soil under sub-tropical condition

The two/three rhizome root of the groundnut (*Arachis hypogaea*) fodder variety of AG-1 was transplanted at a distance of 25 cm from row to row and plant to plant. The regeneration of rhizome roots and canopy coverage in first year was only 40-50%. However, in second year, it was spread in all demarcated area (10 m²) and canopy coverage was around

100% and fodder yield was recorded. The first cut was taken in the month of August and second cut after 90 days gap. The rhizome roots were further spread into 100m² area for production in the subsequent year since growth ceased after 2nd cut.

Varietal trial on fodder and their performance

The root slips of six varieties viz. NB Hybrid-37; Broad leaf PLP-S-1; Rhodes grass; Setaria-92; Kikuyu and Setaria PSS-1 and seed of Parit HGP-2-M-3 were received from AICRP on forage, IGFRI, Jhansi for trials. All six varieties of fodder root slips was sown in

Table 6. Performance of promising grasses

Particulars	Name of promising grasses	NB-Hybrid-37	Broad leaf PLP-S-1 Parit
		HGP-2-M-3	Survivability (%)
At 20 days	100	81	75
At 40 days	100	84	—
At 60 days	100	87	—
Tillering (No.)			
At 20 days	23	8	—
At 40 days	23	13	—
At 60 days	25	13	—
Plant height (cm)			
At 20 days	63	18	—
At 40 days	80	25	—
At 60 days	111	25	17
Fresh fodder yield (t/ha)			
1st cut	56.4	—	—
2nd cut	68.6	21.7	32.5
Total	125.0	21.7	32.5
Av. Dry matter content (%)	14.7	20.0	16.5

different plots (6 m²) at a distance of 50 cm from plant to plant and row to row. The seed of Parit was sown with the seed rate of 100g/40 m². The survivability was very poor except

3 varieties and it was probably due to poor quality of root slip and these fodders were very much liked by goat (Table 6).

FISH

(K. Vinod, A.M.R. Margaret & B.K. Mandal)

Influence of dietary protein levels on the growth of *Labeo rohita* fingerling

The ingredients used in the preparation of diets were wheat flour, rice polish, mustard oil cake and fish meal. The vitamin-mineral mixture (Supplevite-M) @ 1% and a lipid

source, mustard oil @ 2% were added to all the diets. Feed was administered at the rate of 10% of body weight of fishes, once daily.

The diet with 30 % protein level gave a maximum increment in body weight (5.03 g) of *L. rohita* fingerlings, and least with 20% (2.78g). (Table 7).

Table 7. Increment in body weight of *L. rohita* fingerlings fed with diets of different protein levels

Feed (Protein level 20%)	Initial wet weight (g)	Weekly increment in Body weight (g)					Total increment in wt. (g)
		1st	2nd	3rd	4th	5th	
20	6.01	0.47	1.14	0.56	0.30	0.31	2.78
30	5.72	0.51	1.08	0.95	0.83	1.66	5.03
40	5.97	1.05	0.58	1.13	0.36	0.95	4.07
50	5.57	0.97	1.14	1.00	0.33	0.57	4.01

Comparative evaluation of three different oil cakes as feed for the Indian Major Carps

A study was conducted to evaluate the efficacy of three different oil cakes viz., mustard oil cake, groundnut oil cake and soybean oil cake, in combination with rice polish as feed for the Indian Major Carps viz., Catla, Rohu and Mrigal.

Mustard oil cake + rice polish was found to be very effective in enhancing the total biomass production; the total net weight gain being 10035.07 g. The total wet weight gain

were 9838.74 g and 9191.95 g in groundnut oil cake + rice polish and soybean oil cake + rice polish respectively. The length and weight increment of the individual species at different treatments revealed that the performance of Catla was good in MOC + rice polish combination (length increment of 8.19 cm & weight increment of 67.99 g); Rohu in GOC + rice polish combination (length increment of 7.57 cm & weight increment of 52.97 g) and Mrigal in soybean oil cake + rice polish combination (length increment of 4.16 cm and weight increment of 20.67 g) (Table 8).

Table 8. The length and weight increment of Catla, Rohu and Mrigal fed with three different oil cakes

Treatment	Species	Length (cm)			Weight (g)			Initial total biomass (g)	Total biomass After 60 days (g)	Total weight weight gain (g)
		Initial	After 60 days	Increment	Initial	After 60 days	Increment			
Mustard oil cake + rice polish	a) Catla	8.40	16.59	8.19	9.70	77.69	67.99	2390.65	12425.72	10035.07
	b) Rohu	8.52	15.22	6.70	9.65	59.38	49.73			
	c) Mrigal	9.33	12.80	3.47	10.63	29.00	18.37			
Groundnut cake + rice polish	a) Catla	10.30	17.13	6.83	19.57	84.00	64.43	3444.24	13282.98	9838.74
	b) Rohu	8.45	16.02	7.57	10.25	63.22	52.97			
	c) Mrigal	9.45	12.90	3.45	11.50	30.00	18.50			
Soybean oil cake + rice polish	a) Catla	9.69	16.51	6.82	18.97	78.75	59.78	3199.08	12391.03	9191.95
	b) Rohu	8.09	14.88	6.79	9.15	55.12	45.97			
	c) Mrigal	9.01	13.17	4.16	10.00	30.67	20.67			

FIG

Genetic improvement of selected indigenous pig

(Anubrata Das, S. Naskar, J.K. Singh, S.K. Das & S.C. Giri)

The study was undertaken by crossing selected indigenous pig of Meghalaya with

Hampshire. A total of 19 F₁ and 11 F₂ generation were produced during the period for their productive and re-productive performance (Table 9). The average litter size at birth was 6.316 ± 0.552 and 5.364 ± 0.650 for F₁ and F₂ generation, respectively. The

Table 9. Production and reproduction performance of crossbred pig (Hampshire x Khasi Local)

Traits	F ₁	F ₂
Average litter size at birth		
M	3.368 ± 0.413 (19)	7.727 ± 0.469 (11)
F	2.947 ± 0.329 (19)	2.682 ± 0.487 (11)
T	6.316 ± 0.552 (19)	5.364 ± 0.650 (11)
Average litter weight at birth (kg)		
M	2.173 ± 0.469 (11)	2.182 ± 0.369 (11)
F	1.820 ± 0.226 (19)	2.173 ± 0.469 (11)
T	3.924 ± 0.384 (19)	4.345 ± 0.663 (11)
Average individual weight at birth (kg)		
M	0.627 ± 0.028 (19)	0.787 ± 0.055 (11)
F	0.617 ± 0.031 (19)	0.770 ± 0.052 (9)
T	0.620 ± 0.028 (19)	0.791 ± 0.054 (11)
Average litter size at weaning		
M	3.000 ± 0.359 (19)	2.600 ± 0.452 (10)
F	2.824 ± 0.329 (19)	2.300 ± 0.587 (10)
T	5.842 ± 0.454 (19)	4.900 ± 0.674 (10)
Average litter weight at weaning (kg)		
M	16.437 ± 1.984 (19)	14.805 ± 2.265 (10)
F	15.205 ± 1.804 (19)	12.340 ± 2.816 (10)
T	31.642 ± 1.811 (19)	27.145 ± 2.610 (10)
Average individual weight at weaning (kg)		
M	5.774 ± 0.433 (19)	6.216 ± 0.719 (10)
F	5.521 ± 0.311 (18)	5.585 ± 0.342 (8)
T	5.863 ± 0.357 (19)	6.259 ± 0.716 (10)
Pre-weaning growth rate (g/day)		
M	83.980 ± 4.861 (58)	93.750 ± 5.222 (25)
F	82.939 ± 4.441 (54)	97.263 ± 7.474 (24)
T	83.478 ± 3.290 (112)	95.471 ± 4.487 (49)
Average age at first farrowing (day)	430.545 ± 9.660 (11)	
Average maturity weight (kg)	29.364 ± 1.580 (11)	

N.B. Number within the parenthesis indicates the number of observations.

litter size at weaning was 5.842 ± 0.454 and 4.900 ± 0.674 for F_1 and F_2 . The average individual weight at weaning was 5.863 ± 0.357 for F_1 , $6.25g \pm 0.716$ for F_2 generation. The average age at 1st farrowing for F_1 generation was 430.545 ± 9.660 .

Rice polish based feeding system in pigs

(B.P.S. Yadav, J.J. Gupta, S.K. Sahoo, Dipika Agrahar Murungkar & S. Doley)

Experiment was conducted on pigs to study the performance of pigs on rice polish based rations. Test diets were prepared containing 70% rice polish and GNC as source of protein along with (T_3) and without (T_2) 4% fish meal and compared against control ration (T_1). All the diets were iso-nitrogenous and iso-caloric. The diets were offered ad libitum to 12 piglets of 3 months old having 4 piglets in each group. Fortnightly body weight and weekly feed intake were recorded. After 36 days of experimental feeding, a

metabolism trial of 6 days was conducted. Again after 33 days another metabolism trial of 6 days duration was conducted.

Although the animals fed with control ration in 1st phase showed significantly ($P < 0.01$) higher percentage of DM, OM & CP digestibility, N and GE balance in T_1 than T_2 and T_3 , but no significant difference was observed in ADG, FCR, cost per kg gain, DM, N and GE intake (Table 10). In phase - II of the experiment, the animals of control group showed significantly ($P < 0.01$) higher ADG and better FCR than T_2 and T_3 . No significant difference was observed between groups in cost per kg gain and DM, N and GE intake. The animals T_1 and T_2 had significantly higher ($P < 0.01$) DM and OM digestibility than T_3 . No significant difference was observed in CP digestibility and N balance as percentage of N intake. However, animals of T_1 & T_3 showed significantly ($P < 0.05$) higher N balance (g/d) than T_2 . GE

Table 10. Nutrient utilization and growth performance

Particulars	T_1	T_2	T_3
Growth performance			
Av. daily growth (g/d)	419 \pm 58.22	304 \pm 22.05	326 \pm 18.17
FCR	3.99 \pm 0.57	4.68 \pm 2.26	4.93 \pm 0.35
Cost/kg gain (Rs.)	31.96 \pm 4.53	34.51 \pm 2.67	34.55 \pm 2.45
DM intake/100 kg B.wt.	4.96 \pm 0.58	5.66 \pm 0.30	5.91 \pm 0.41
DM intake/W ^{0.75}	120.59 \pm 10.41	132.76 \pm 5.16	137.94 \pm 7.20
Digestibility coefficient			
DM**	69.91 ^a \pm 1.71	54.71 ^b \pm 1.31	56.45 ^b \pm 2.08
OM**	75.57 ^a \pm 1.51	65.31 ^b \pm 1.03	66.82 ^b \pm 1.64
CP**	69.40 ^a \pm 1.61	59.34 ^b \pm 2.17	61.16 ^b \pm 1.13
N balance (g/d)**	36.62 ^a \pm 0.74	30.41 ^b \pm 2.17	32.39 ^b \pm 1.13
N balance as % of Intake**	64.75 ^a \pm 0.98	54.66 ^b \pm 1.60	56.52 ^b \pm 1.23
GE balance (kcal/d)**	6305 ^a \pm 157.7	5329 ^b \pm 203.0	5433 ^b \pm 212.5
GE balance as % of Intake**	74.00 ^a \pm 1.42	63.69 ^b \pm 0.42	64.44 ^b \pm 1.77

** Values in the same row with different superscript differ significantly ($P > 0.01$)

balance (k cal/d) was significantly higher in T_1 than T_2 and T_3 .

Studies on bacteria of public health importance transmitted through meat

(H.V. Murugkar, I. Shakuntala & Ashok Kumar)

A total of 50 pork samples were procured from different slaughtering areas and retailing units in and around Shillong and processed for their bacterial counts. The total viable counts and differential counts of the samples were examined (Table 11).

The mean total viable counts (TVC) of all the pork samples examined was 4.2×10^7 . Highest mean differential counts was observed for *S. aureus* (2.9×10^4 cfu/g) followed by coliforms, faecal streptococci and *B. cereus*.

Presence of these bacteria with high counts emphasised the need for improved quality control measures during pork production, processing and marketing.

Diagnosis and control of piglet mortality

(H.V. Murugkar, I. Shakuntala, Ashok Kumar, B.R. Shome & S. Naskar)

Causes of mortality in piglets upto 12 weeks of age were studied in the Animal Production farm and in the piglets reared by individual private farmers in the villages in Meghalaya. Seasonal variation was observed in the mortality pattern with maximum mortality encountered during the rainy season and peak winter Mortality due to gastro-enteritis was found to be the main cause of deaths amongst the piglets.

Table 11. Total viable Counts and differential counts of beef from various locations in Meghalaya

	T.V.C.	Coliforms	Faecal Streptococci	Staphylococcus sp.	Faecal Streptococci	Salmonella sp.
Barabazar	9.6×10^6	1.94×10^4	1.5×10^2	1.33×10^4	1.33×10^4	4
Laitumkhrach	8.2×10^6	4.7×10^4	7.38×10^2	2.70×10^4	2.10×10^4	2
Upper Shillong	5.7×10^7	1.73×10^4	10.39×10^2	3.49×10^4	3.23×10^4	4
Mawlai	9.3×10^7	1.03×10^4	10.4×10^2	2.74×10^4	2.41×10^4	0
Mean	4.2×10^7	2.34×10^4	7.4×10^2	2.41×10^4	2.27×10^4	8

RABBIT

Studies on the general and specific combining abilities

(Anubrata Das, S.K. Das, S. Naskar, J.K. Singh & S.C. Giri)

The study was undertaken by diallel crossing involving Newzealand White (NZW), Soviet Chincilla (SC) and Local (L) rabbit. The productive performance of six genetic group SC × NZE (SN), SC × L (SL), NZW × SC (NS), NZW × L (NL), L × SC (LS) of rabbits were studied. The litter size at birth was found to be highest 6.14 ± 0.21 in LS and followed by 5.29 ± 0.18 in NS and 5.40 ± 0.19 in SL. The litter size at weaning was highest 5.46 ± 0.8 in NS followed by 5.00 ± 0.23 in LS and 4.83 ± 0.14 in NS group. However, in 90 days the weight was highest 1.72 ± 0.031 kg in SN followed by 1.60 ± 0.03 kg in SL group, respectively. In pure breed, the litter size at weaning was highest 5.27 ± 0.27 in NZW which was lower than the genetically combined group of NS. But the

weight at 90 days was almost similar in crossbred groups and pure breeds except local. When productive and reproductive performances were compared among the pure breeds, it was found that both the exotic breeds were better than local in all the traits. Between the two exotic breeds i.e. SC and NZW, SC was better in respect of litter size at birth (6.19 ± 0.134 vs 6.05 ± 0.24), litter weight at birth 543.75 ± 16.69 g vs 534.21 ± 21.37 g), litter weight at weaning in male (736.00 ± 18.21 g vs 717.00 ± 16.00 g) and litter weight at weaning in female (717.18 ± 16.39 g vs 694.05 ± 19.18 kg). But weight at 90 days was better in NZW (1.732 ± 0.017 for male, 1.716 ± 0.021 kg for female) as compared to SC (1.727 ± 0.013 kg and 1.714 ± 0.018 kg, respectively). Same trend was noticed for weight at 120 days

Under the study of carcass characteristic (Table 12) the dressing percentage was found

Table 12. Carcass trait of different cross breed rabbit

Carcass traits	Breeds					
	SN (SC x NZW)	NS (NZW x SC)	SL (SC x LC)	LS (LC x SC)	NL (NZW x LC)	LN (LC x NZW)
Slaughter weight (kg)	1.691 + 0.06	21.650 + 0.051	1.367 + 0.031	1.471+ 0.062	1.539 + 0.060	1.477+ 0.064
Head weight (g)	154.50 + 5.89	139.00 + 4.38	124.50 + 3.30	131.25 + 4.49	136.75 + 5.04	136.65 + 6.31
Pelt weight (g)	151.25 + 8.17	147.75 + 5.08	114.50 + 3.46	126.25 + 7.15	139.75 + 7.11	143.75 +11.54
Edible offal weight (g)	77.60 + 2.64	78.70 + 2.85	66.70 + 2.24	66.50 + 3.14	61.75 + 2.15	63.50 + 2.54
Carcass weight (g)	795.00 +28.24	790.25 + 2.85	622.75 +17.44	674.75 +39.29	685.25 +31.37	665.50 +36.19
Dressing percent (without head)	51.72 + 0.37	52.71 + 0.54	50.33 + 0.74	50.36 + 1.07	48.42 + 0.64	49.08 + 0.72
Dressing percent (with head)	60.90 + 0.46	61.19 + 0.52	59.76 + 0.62	59.36 + 0.93	57.34 + 0.67	58.34 + 0.77

to be highest in NS (52.71 ± 0.54 without head and 61.19 ± 0.52 with head) and lowest in NL group (48.42 ± 0.64 without head and 57.34 ± 0.67 with head). However, in SN, SL and LS the dressing percentage was almost similar.

Carcass evaluation and acceptability of rabbit meat in the north eastern hill region

Fifty-four rabbits, 6 each of SC x NZW, NZW x L, NZW x SC, SC x L, L x NZW, L x SC crossbred and SC, NZW and L as pure breed were evaluated for carcass traits and nutritive value of meat. Significant breed differences ($P < 0.05$) were seen in all carcass traits studied except giblet percentage and carcass loin width. NZW had the most favourable body composition among all the pure breeds. However, the crossbred rabbits had advantages for body measurements, meat yield traits and nutritive content of meat. Comparisons between rabbit meat and chicken revealed no significant differences ($P < 0.05$) in organoleptic quality and acceptance of meat. However, in respect of appearance, texture, flavour, odour and overall acceptability chicken was slightly better than rabbit meat. The corresponding magnitudes in chicken and rabbit meat were 8.00 ± 0.21 vs 7.80 ± 0.22 ; 7.70 ± 0.26 vs 7.65 ± 0.46 ; 7.60 ± 0.33 vs 7.30 ± 0.54 ; 8.33 ± 0.41 vs 8.16 ± 0.46 and 7.91 ± 0.10 vs 7.55 ± 0.15 , respectively.

Diagnosis and control of bacterial diseases under intensive rabbit rearing system

(I. Shakuntala, H.V. Murugkar, Ashok Kumar, A. Das & B.R. Shome)

Faecal samples from 60 rabbits screened revealed *E. coli* to be the most commonly isolated organism (70%). The other health problems commonly observed in the organized rabbit farm were: posterior paralysis, hock sores, abortion/still births, mucoid enteropathy, corneal opacity associated with blindness, abscesses and injuries.

Studies of parasitic diseases

(Chandan Rajkhowa & Subhasish Bandyopadhyay)

Six hundred and seventy four samples were collected from the rabbit farm during the reported period. Three age groups viz. 0-3 months, 3-6 months and above 6 months were chosen for collection of samples. Faecal samples were examined through standard laboratory techniques and 83 (12.31%) were found to be positive for different coccidial infection. The species identified were *E. irrisidua*, *E. intestinalis*, *E. stiedae*. Three cases (0.45%) of *Passalurus ambiguus* were also detected.

Three hundred and fifty nine skin and ear scrapings were also collected every month for detection of mite infection from the three age group as above. The examined skin scrapings were found in 35 (9.75%) positive for *Psoroptes cuniculi* and *Sarcoptes scabiei* infection. April to July was found to be free from mite infestation.

CATTLE

Studies on partial farm budgeting techniques in relation to control of gastrointestinal parasites of lactating cows

(Chandan Rajkhowa & Subhasish Bandyopadhyay)

Four farmers having 5 lactating animals similar with milk yield records were selected for this study. Faecal samples were collected weekly from 20 lactating animals (5 from each farmer). Samples were examined for GI parasites through standard laboratory techniques. Four groups were made with 5 lactating animals in each group and they were placed under different strategies as follows:

Group A : Animals were suffering from low to medium level of *Strongyle* infection and were put under a strategy of applying mineral mixture @ 25 g/cattle on every alternate day from April to January with monthly anthelmintic treatment (Mebendazole) @ 15 g/animal from April to September.

Group B : Similar to Group A excepting anthelmintic treatment in June, August and October (Mebendazole) at the same

Group C : Similar status as described in Group A and Group B were put under a strategy of applying mineral mixture on every alternate day from April to January.

Group D : This group of 5 animals having similar status as described in Group A and Group B were kept as control.

The maximum profit of Rs. 15820/= was found in group A animals compared to control which was almost 40% more than the B and C groups (Table 13).

Monitoring and surveillance of pasture level concentration

(Chandan Rajkhowa & Subhasish Bandyopadhyay)

The larvae belonging to *Haemonchus*, *Trichostrongylus* and *Nematodirus* were identified as major parasitic larvae. Grass collected during day time after few hours of sunshine and cut above 10 cm of ground had the significantly low level of larval concentration than the grass collected during morning time. Larval concentration was more in

Table 13. Comparison of economic gain of different strategies of control of G.I. parasites in lactating cows

	Group A	Group B	Group C	Group D
Total milk yield (lit.)	4871.33	4749.28	4703.30	4587.70
Total milk cost @ Rs. 12/lit.	58,455.95	56,991.36	56,439.00	55,052.40
Total marginal cost	239.45	226.37	214.30	—
Total marginal profit from April to January in one animal	3,164.10	1,712.59	1,172.30	—
Total marginal profit from April to January in five animals	15,820.00	8,562.95	5,861.50	—

Table 14. Numbers of parasitic nematode larval concentration per kg of dry grass from January to December in medium altitude (below 1000 m above msl)

Month	Nos. of nematode (parasitic) Larvae/kg of dry grass		
	Plain to mild slope	Medium slope	Steep slope
January	15.00	3.63	2.12
February	19.20	4.60	1.90
March	35.00	3.20	2.10
April	462.00	4.30	4.50
May	325.00	7.60	5.30
June	536.00	8.20	6.50
July	462.00	9.20	7.00
August	256.00	10.00	7.00
September	200.00	10.50	3.62
October	98.00	8.25	3.56
November	37.00	6.50	2.90
December	13.50	4.30	2.20

plain and medium slopes than in steep slopes (Table 14).

Recurrence of Black Quarter like disease in cattle in Manipur

Incidence of Black Quarter like disease of cattle in Manipur valley was reported in the month of May 1999, in spite of regular vaccination with HS/B.Q. vaccine. Identifica-

tion of *C. perfringens* as the causative organism on the basis of morphological, biochemical and pathogenically studies gave rise to the suspicion of the re-emergence of the "false black leg disease" earlier reported from the same region. These isolates have been sent to USDA, Ames, IOWA, and USA for further confirmation.

POULTRY

POULTRY NUTRITION AND FEEDING

(J.J. Gupta, B.P.S. Yadav, S.K. Sahoo,
Dipika Agrahar Murugkar & S. Doley)

Performance of chickens on kitchen soda treated jack bean seed with probiotic

An experiment of 28 days duration was conducted on 21 days old *Vencob* broiler chicken to assess the nutritive value of kitchen soda treated (10 g/l solution in 1: 2 w/v ratio for 40 hrs at 80°C) jack bean (*Canavalia ensiformis*) seed. The treated jack bean seed (TJBS) was incorporated to the level of 20 and 40 per cent (D3 and D4) in mach diet and compared against control (D1) diet without TJBS and diet (D2) with 20% raw JBS. All diets were fortified with probiotic Allzyme Vegpro @ 100 g/100 kg and made isoproteic (22%). Total 84 birds were distributed randomly into 12 groups under deep litter system. All the diets were fed in *ad-lib* in triplicate.

The growth rate, feed intake, FCR and feed cost per kg body weight gain were not significant. The treatment of JBS had not significant effect on the yield of giblet and carcass. Although, dietary protein utilisation was reduced up to 10.7% as the level of TJBS increased from 20 to 40 per cent. The serum enzyme (Glutamic oxaloacetic transaminase-GOT and Glutamic pyruvate transaminase-GPT) and cholesterol level were also not influenced due to treatment and level of incorporation of JBS in diet. However, the nutritive value of raw JBS was not improved due to probiotic feeding.

Performance of chickens on groundnut fiber fortified with probiotic

An experiment was conducted on 105 *Vencob* broiler chicks (21 days old) for the period of 28 days to study the effect of probiotic feeding on groundnut fiber based diet. The groundnut straw meal (GNSM) was incorporated at 10 and 20% level with (D₂ and D₄) and without (D₃ and D₅) probiotic, Allzyme Vegpro @ 100 g/100 kg respectively. These four mash diets were tested against control diet (D₁), which was also fortified with probiotic. All diets were made isoproteic (22%) and offered *ad-lib* to chicks distributed randomly into 15 groups.

The chicken fed GNSM either at 10 or 20% level with/without probiotic had similar growth rate and feed intake. However, significant higher growth rate and feed intake was observed in birds fed with 10% level of GNSM. A significant increase of 6% growth rate was recorded due to probiotic feeding at 10% inclusion of GNSM. There was no difference on carcass yield, serum enzyme (GOT/GPT) and total cholesterol level in various groups. However, serum protein, albumin and HDL cholesterol level were higher on GNSM based diet than control. The net dietary utilisation of protein, ether extract, fiber, calcium and phosphorus was higher on control and diet having 10% GNSM than diets having 20% GNSM (Table 15)

Economic of broiler chicken production in the north east India

An experiment was conducted on 40 *Vencob* broiler chicks from 21 day old to

49 days to calculate the economics of production. It was found that broiler production in the North East India is a profitable enterprise

giving profit of Rs. 13.71/bird. So it can be a good source of income to the unemployed youth, farmers and women.

Table 15. Growth performance, carcass yield, nutrient retention and serum enzyme activity in chicken fed with groundnut fiber

Particulars	Treatment Means \pm SE				
	D ₁	D ₂	D ₃	D ₄	D ₅
Growth performance					
Growth rate (g/d)**	42.0 \pm 1.66 ^a	35.5 \pm 0.82 ^b	37.7 \pm 1.26 ^{bc}	30.5 \pm 0.32 ^c	29.8 \pm 0.36 ^c
Feed intake (g/d)*	101 \pm 3.80 ^{ab}	109 \pm 1.21 ^a	08 \pm 0.15 ^b	91 \pm 2.38 ^a	90 \pm 0.69 ^a
FCR*	2.41 \pm 0.01 ^a	3.06 \pm 0.04 ^b	2.87 \pm 0.23 ^b	3.00 \pm 0.11 ^b	3.02 \pm 0.06 ^b
Feed cost/kg Wt. gain (Rs)	24.2 \pm 0.10	28.5 \pm 0.40	27.0 \pm 2.14	26.8 \pm 0.97	27.3 \pm 0.52
Carcass yield (g/kg live weight)					
Giblet	66 \pm 6.00	84 \pm 7.50	83 \pm 0.50	91 \pm 2.50	96 \pm 0.50
Total edible meat	740 \pm 14.80	750 \pm 8.90	750 \pm 5.80	740 \pm 3.30	720 \pm 1.90
Nutrient retention (g/100 g intake)					
Protein**	54.0 \pm 1.16 ^b	47.8 \pm 0.24 ^a	48.5 \pm 0.62 ^a	46.7 \pm 1.28 ^a	46.1 \pm 0.95 ^a
Ether extract**	78.7 \pm 1.09 ^b	81.6 \pm 0.20 ^b	80.2 \pm 0.84 ^b	65.6 \pm 1.00 ^a	65.8 \pm 0.99 ^a
Fiber**	13.2 \pm 0.50 ^{bc}	14.6 \pm 0.67 ^c	15.1 \pm 0.68 ^c	9.3 \pm 0.35 ^a	11. \pm 0.37 ^{ab}
Calcium**	59.0 \pm 1.28 ^c	54.2 \pm 0.69 ^c	54.2 \pm 0.98 ^c	34.5 \pm 0.78 ^a	43.0 \pm 1.67 ^b
Phosphorus**	49.6 \pm 0.40 ^b	48.5 \pm 0.52 ^b	49.6 \pm 1.56 ^b	39.4 \pm 0.42 ^a	4.6 \pm 1.58 ^a
Serum Enzyme/Protein/Cholesterol level					
GOT (μ /ml)	35.0 \pm 1.00	38.5 \pm 3.50	40.5 \pm 0.50	43.5 \pm 1.50	40.5 \pm 0.50
GPT (μ /ml)	7.5 \pm 0.50	9.5 \pm 0.50	7.5 \pm 0.50	7.5 \pm 0.50	8.5 \pm 0.50
Total protein* (g%)	2.5 \pm 0.10 ^a	2.9 \pm 0.07 ^b	2.9 \pm 0.03 ^b	3.0 \pm 0.10 ^b	2.8 \pm 0.11 ^b
Albumin** (g%)	1.5 \pm 0.05 ^a	1.9 \pm 0.13 ^{bc}	2.0 \pm 0.11 ^c	2.0 \pm 0.06 ^c	1.6 \pm 0.04 ^{ab}
Total cholesterol (mg/100 ml)	111 \pm 4.50	119 \pm 6.00	119 \pm 2.50	119 \pm 3.50	113 \pm 3.00
HDL cholesterol* (mg/100 ml)	84 \pm 6.50 ^a	125 \pm 2.50 ^b	109 \pm 6.50 ^b	127 \pm 3.00 ^b	124 \pm 7.00 ^b

Similar superscripts bearing in the row do not differ significantly ($P < 0.05$)* and ($P < 0.01$)**

RODENT

Survey and surveillance

Highest rodent activity on the basis of the live burrow counting method, was between July (78.35% active burrows) and September (68.81% active burrows) and lowest in January (23.81% active burrows).

There was a significant change in the rodent species composition. Earlier, *Rattus nitidus* was a predominant species in fields, but now the population of *Bandicota bengalensis* was increased to 93% (92.61% in 1998 and 93.53% in 1999). *Rattus nitidus* now reduced to 5.64% (5.68% in 1998 and 5.29% in 1999) followed by *Mus* species (1.70% in 1998 and 1.18% in 1999) in fields.

Damage assessment and control

Cumulative damage to lowland and upland rice at grain formation stage was 23%,

and 47%, respectively and maize cobs suffered losses of 6.42% (Racumin 0.0375%). Bait (Racumin 0.0375%) was kept for 1, 2 and 3 days at different locations of burrow opening, resulted in 84.90%, 88.89% and 87.80% reduction in rodent activity, respectively and further damage to crops was stopped. On an average 46.01% poison bait was consumed in one-day treatment (Table 16). Bamboo bait station used for keeping poison baits proved very effective during rainy season.

Efficacy of rodenticide in laboratory

In laboratory 100% killing of *B. bengalensis* was achieved by one day feeding of racumin bait (0.0375%) in choice and no choice feeding experiments within 3-9 days. Bromadiolone 100% kill of rats was achieved after 3 days feeding within 5-14 days.

Table 16. Efficacy of Racumin in fields

Location	Av. consumption (%) after treatment for			% reduction in rodent activity for after treatment for		
	Day	2 Day	3 Day	1 Day	2 Day	3 Day
Rice upland	45.5 ± 1.6	46.3 ± 1.2	44.5 ± 0.8	87.5	90.0	88.9
Rice lowland	47.5 ± 1.0	45.4 ± 1.0	42.7 ± 0.2	88.9	83.3	83.3
Groundnut	47.8 ± 1.4	47.7 ± 0.9	45.1 ± 0.6	66.7	88.9	100.0
Maize	40.3 ± 1.5	49.4 ± 1.0	44.3 ± 0.7	80.0	90.0	88.9
Field godown	49.3 ± 1.6	46.9 ± 0.7	41.8 ± 0.4	90.9	92.3	80.0
Average	46.0 ± 0.8	47.5 ± 0.6	43.6 ± 0.6	84.9	88.9	87.8

TICKS

Isolation, identification and characterisation of tick gut antigen of *Boophilus microplus*

(Subhasish Bandyopadhyay & Chandan Rajkhowa)

Adult matured ticks were collected throughout the year from Barapani areas. To dissect out the gut of the ticks, they were dissected in the laboratory. Gut materials were processed in the laboratory for preparation of antigen. For this guts were triturated and centrifuged @ 2000 rpm for 10

minutes and the supernatant were collected and stored at 0°C. Rabbits were used for this purpose. The antigens were injected along with Freund's adjuvent. Two boosting was done at 10 days interval. Serum was collected after 10 days of second boosting and kept at 0°C. After testing the immunogenicity by immunodiffusion and immunoelectrophoresis test. Two precipitations line and were detected, respectively. Six bands were identified in the characterisation done by SDS-Page.

SOIL AND WATER CONSERVATION

Runoff plot studies for soil erosion - Productivity impact modelling

(D.S. Bundela & K.K. Satapathy)

Eight plots (P1-P8) on 36% convex slope and three (P-9-P11) on 42% concave slope were laid out and were gauged with a newly designed and developed portable hydrologic gauging system. Dominant land uses - uncultivated bare fallow, ginger, raised bed ginger along slope, cultivated bare fallow, maize, paddy, toposequence crops (Upper half maize and lower half paddy) and natural vegetation

on convex slope and paddy, maize and natural vegetation on concave slope were simulated. Ginger was grown very well but maize and paddy crops failed due to poor regeneration of soil fertility and high rate of erosion on hill slopes although fertilisers were applied to paddy crop as per recommended dose. Data on runoff and soil losses were recorded for last two years. From the analysis of data, it has been observed that the runoff and soil losses were minimum and maximum from natural vegetation and cultivated bare fallow land uses, respectively.

FARM MACHINERY AND POWER

Grass cutter assembly of light weight power tiller

(C.S. Sahay & K.K. Satapathy)

In order to reduce the cost of operation of cutting of grasses/bushes, it was decided to perform cutting operation with a device, which could be supported by a lightweight power tiller. This small power tiller used 3 HP petrol start kerosene run engine as a prime mover. A V belt was used to carry the power of the engine to the rotary cutter rotating at 2125 rpm. An idle belt pulley was used as a clutch to engage and disengage the power of rotating cutter. The power tiller had been given a third wheel to balance the machine while operation. The height of third wheel was adjustable resulting in the variation in height of cut of the grasses/bushes. A safety skirt was made using m.s. square angle iron to protect any thing coming beneath the blade and being thrown away during operation.

The performance of machine was observed as follows :

1. Speed of operation = 2 km/h
2. Field capacity in lawn conditions = 0.091 ha/h
3. Field capacity in terraced conditions = 0.083 ha/h
4. Kerosene consumption of the machine = 1.014 l/h
5. Cutting efficiency = 100%
6. Slope of OK cutting = 20%
7. Cost of operation = Rs. 390 per ha

Design and development of motorised wireloop paddy thresher for hilly region

(R.K.P. Singh, S.V. Ghadge & K.K. Satapathy)

The machine consists of a frame, threshing cylinder, blower, prime mover, power transmission unit and a grain shield. Holding paddy bundles against moving cylinder can do threshing of paddy crop and blower helps to throw the broken chaff at some distance away from grain. Detail specification of each component is provided in Table 17.

Thresher was tested at ICAR farm and farmers field during 1998 and 1999 kharif season and its performance was found satisfactory. With respect of grain output capacity (200-225kg /hr) and threshing efficiency (98%).

Orange harvester

(S.V. Ghadge)

Oscillating ring type of manual orange harvester employs single fruit plucking mechanism giving about 300 fruits/man-hour with damage rates of about 10%. This device has a carbon steel circular ring (100-mm in diameter, made of 18-gauge carbon-steel-band-saw blade), which can oscillate into 45° on both sides of its swivel joint on supporting MS rod bracket. The bottom edge is sharpened for cutting fruit stem while pulling down. MS rod threaded mounting stud fits into a long steel handle. It is found that although there exists no definite relationship of work rate with time out, the efficiency of workman goes down in general while working continuously for longer time.

Table 17. Detail specification of motorised wireloop paddy thresher with blower

1. Main components	Threshing cylinder, Blower, Prime mover, Grain shield, Power transmission unit and frame
2. Overall dimension	850 mm x 750 mm x 750 mm (l x b x h)
3. Power requirement	1.5 hp
4. Total weight	50 kg
5. Threshing cylinder	<ul style="list-style-type: none"> * Wireloop type * Cylinder diameter : 300 mm * Cylinder length : 400 mm * Cylinder speed : 450 rpm (7.1 m/s)
6. No of wirepools	<ul style="list-style-type: none"> * 108 (9 loops fitted 40 mm apart in staggered fashion on 12 wooden strips) * wireloop is made of 4 mm diameter iron * height of loops : 40 mm
7. Blower	<ul style="list-style-type: none"> * Centrifugal type * No of blades : 4 * Blower speed : 925 rpm
8. Frame	Made of equal angle iron of 25 mm x 25 mm x 4-mm size
9. Transmission system	Belt and pulley type
10. Manpower requirement	Two persons
11. Prime mover	1.5 hp electric motor or 2-3 hp petrol-cum kerosene engine or light weight power tiller
12. Grain shield	<ul style="list-style-type: none"> * To stop spreading of threshed grain away from thresher * Size:500 mm x 400 mm made of GI sheet
* Angle can be adjusted according to requirement	

Evaluation of management practices for biogas production using animal waste in low temperature areas

(K.N. Agrawal, S.K. Sahoo & C.S. Sahay)

The pilot level studies were conducted with pig dung and rabbit waste at slurry level (dung : water ratio) of 1:1, 1:1.5, 1:2 with head retention time of 45 days and with slurry level of 1:1 with head retention time of 55 days. The average biogas production reduced 37.8% with reduction in average minimum

temperature from 18.0 to 9.3°C. The biogas production from rabbit waste was found more than pig dung. The average biogas production from pig dung was found as 0.044 m³/kg (wetdung) while 0.053 m³/kg in case of rabbit at 1:1 slurry level and 45 days HRT. The fed and digested slurry mass was analyzed for organic matter content and nutrient availability and it was found that the digested slurry contains more available nutrient than initial slurry.

AGRICULTURAL ECONOMICS

Production and productivity analysis of rice in north east India

(S.B. Singh & S.N. Goswami)

Production and productivity analysis of rice in the seven states of North East (NE) India was conducted in order to examine the growth and instability in rice production in the region and also, to investigate the contribution of area and yield to rice production and reasons for low productivity. During the period 1972-73 to 1997-98, the increase in area production and productivity were 0.73, 2.40 and 1.67 per annum, respectively (Table 18). Mizoram experienced the highest growth rate of rice production (4.10%) and productivity (4.40%) the least being Meghalaya (-0.24% and -0.36%). Only Mizoram and Tripura experienced higher growth rates of rice productivity above the national average with

remaining states witnessed lower growth. Contribution of area in increasing rice production was appreciable in Arunachal Pradesh, Meghalaya and Nagaland (63, 80 and 43%, respectively). Average yield was the sole contributing factor in increasing rice production in Manipur, Mizoram and Tripura (80, 139 and 101%, respectively). Area and average yield contributed almost equally in increasing the rice production in Assam (Table 19). On an average, the contribution of average yield in increasing rice production in North-East India was lower (60%) than the all India level (71%). Maximum variation in rice production during the period of study was observed in Mizoram (C.V. 45.17%) and the minimum in Meghalaya (C.V. 8.54%). It reveals that the state with higher growth rate of yield per hectare witnessed higher instability in rice production (Table 20).

Table 18. Compound growth rates of area, production and yield of rice in northeast India (1972-73 to 1997-98)

States	Area	Production	Yield
Arunachal Pradesh	3.26**	4.15**	1.12**
Assam	0.83**	2.35**	1.44**
Manipur	-0.39*	1.77**	2.08**
Meghalaya	0.14	-0.24	-0.36
Mizoram	-0.44	4.10**	4.40**
Nagaland	2.78**	4.04**	1.52**
Tripura	-0.85**	2.22**	3.08**
North East India	0.73**	2.40**	1.61**
All India	0.53*	3.13**	2.58**

* Significant at 5 percent level;

** Significant at 1 per cent level.

Table 19. Percentage contribution of area, average yield and their interaction

States	Area	Yield	Interaction
Arunachal Pradesh	63	21	16
Assam	42	48	10
Manipur	9	80	11
Meghalaya	80	18	2
Mizoram	- 21	139	- 18
Nagaland	43	21	36
Tripura	- 8	101	7
North East India	28	60	12
All India	16	71	

Table 20. Instability in rice production in north east India (1972-73 to 1997-98)

States	Area (,000 hectares)		Production (,000 tonnes)		Yield (kg per hectare)	
	Av.	C.V. (%)	Av.	C.V. (%)	Av.	C.V. (%)
Arunachal Pradesh	97.10	23.74	103.23	28.98	1058.36	11.57
Assam	2831.88	6.58	2638.01	18.60	1114.12	12.73
Manipur	164.18	6.78	282.38	18.16	1716.85	19.63
Meghalaya	105.22	3.56	117.95	8.54	1125.20	8.52
Mizoram	57.57	26.19	56.39	45.47	996.20	37.49
Nagaland	105.36	26.47	107.37	44.49	1012.84	16.64
Tripura	275.36	8.86	400.44	18.25	1458.88	22.37
North East India	3134.57	5.78	3714.32	18.59	1170.60	12.94
All India	40652.68	4.50	60098.2	23.42	1467.15	19.49

Economic analysis of shifting cultivation and agro-forestry practices in Mizoram

(S.N. Goswami & S.B. Singh)

Economic analysis of shifting cultivation (jhuming) and agroforestry practices in Mizoram, north east India, was undertaken using net returns, net present value (NPV) and benefit-cost (B/C) analysis. The agroforestry regime being practiced in the state is basically a agri-horti-silvi system with contour trenching made across the slopes for conserving the soil and water. The inflow of net revenue in agro-forestry systems is shown in Table 21. Net revenue was negative in the first two years Rs.16820 of the project due to non-receipt of revenue from fodder, fruits, timber poles and firewood collection. However, net

revenue tends to become positive from third year onwards. Due to a marginal decrease in labour cost along with proceeds from fodder and firewood. From the fourth year onwards, the fruit trees started yielding Rs. 26800 a year a result of the inclusion of short gestation fruits, viz., papaya, pineapple, citrus and banana. Net revenue become the highest in seventh and fifteenth years due to the harvest of timber poles (teak) in these years. Crops II and I contribute at the same rate under this farming mode, i.e. Rs. 18,900 only. The NPV of shifting cultivation was much lower than that of agroforestry system, in the tune of 15 times. The B/C ratio of 2.94 was in agroforestry compared to 1.21 in shifting cultivation, due to financial soundness of the former regime (Table 22).

Table 21. Net revenue from shifting cultivation (Jhum) and agroforestry practices in Mizoram State

Year	Net present value (NPV)		Net present value (NPV)	
	Jhum	Agroforestry	Jhum	Agroforestry
1	4330	- 12510	3866.07	- 11169.64
2	5700	- 4310	4544.01	- 3435.91
3	5660	28350	4028.68	20178.97
4	—	24630	—	15652.81
5	—	27360	—	15527.80
6	4020	30160	2036.66	15279.99
7	3600	203900	1628.46	92234.01
8	2720	32260	1098.56	13029.27
9	—	63060	—	22740.07
10	2280	32260	734.10	10386.86
11	1240	32260	356.47	9273.98
12	740	63060	189.94	16185.93
13	—	32260	—	7393.16
14	- 680	32260	- 139.14	6601.04
15	- 880	235610	- 160.77	43045.07
	18183.04	272920.41		

Table 22. Benefit cost ratio of shifting cultivation and agroforestry practices in Mizoram state

Year	NPV of gross income		NPV of total cost	
	Jhum	Agroforestry	Jhum	Agroforestry
1	21306.98	16877.70	17440.29	28049.13
2	18044.08	15063.30	13501.18	
3	16091.20	35686.40	12061.28	15201.20
4	-	29065.20	-	13400.52
5	-	25931.40	-	10398.78
6	10768.68	24571.61	8730.54	9298.38
7	9347.36	105135.20	7720.16	12972.40
8	7999.20	18462.80	6900.32	5429.76
9	-	27616.50	-	4851.84
10	6233.92	14714.18	5499.76	4327.68
11	5257.84	13115.90	4901.96	3857.28
12	4080.78	19660.50	3911.32	3454.08
13	-	10465.30	-	3077.76
14	3362.00	9368.50	3501.40	2755.20
15	2964.60	48202.20	3125.64	5085.57
Total	105456.64	413636.69	87293.85	140657.95
B/C ratio	1.21			2.94

AGRICULTURAL EXTENSION

Research, extension and training activities were carried out for bringing out different social aspects responsible for adoption of improved technologies. These technologies were taken into farmers field through different modes of TOT VT, OFR, OFT etc. The farming community was also trained for the development of requisite skill needed for utilising the latest farm technologies.

Effectiveness of sources of information in adoption of some improved agricultural practices

(P.P. Pal, N. Prakah, K. Prasad & Rajesh Kumar)

This study was conducted in three hills i.e. Khasi, Garo and Jaintia. From each hill two villages and from each village 25 farmers were again randomly selected. This study revealed that all the three categories of respondents were having low to medium mass media exposure (30-45). The factors behind such low exposure were identified as literacy rate and low profile of education, low socio-economic status, remoteness of the area, non-availability of facility, suitable timing, less attraction in programme, erratic coverage etc. The common information agencies working in the field of agriculture were identified as Radio, TV, Newspaper, Extension persons, Village Dorbar, Distributors etc. The study also revealed that mostly personal cosmopolite (75.54%) and personal locality (60.04%) sources are relied upon than the mass media (41.25%) in respect of adoption of improved agricultural practices.

Role performance and knowledge level of tribal women in modern farming

(B. Bihari, Rajesh Kumar, K. Prasad & P. Sundarambal)

This study was conducted among three tribes of Meghalaya taking 150 farmwomen

as respondents. The study showed that the extent of participation in farm operation among all the tribes was almost equal (60.5% Khasi, 58.9% Jaintia and 59.0% for Garo). The participation in agriculture operation was influenced by age, level of education, size of holding and attitude towards modern agriculture. However, extent of participation in household activities was influenced by outside engagement, social participation and size of family. But the three tribes varied considerably in the knowledge level of agricultural operations. The average knowledge level was found to be 52% among Khasis 38% among Garos and 22% among Jaintias, respectively.

Information extension vs. Input extension in Meghalaya

(B. Bihari, P.P. Pal, N. Prakash & Rajesh Kumar)

This study was conducted in Ri-Bhoi District of Meghalaya to analyse the impact of information extension and input extension as well as to study the impact of the combination of the both. One hundred eighty farmers were randomly selected from 6 villages. The study was conducted in 3 different phases - demonstration, demonstration + input and only input. The adoption level of both the progressive and non-progressive villages was quite high (90% and 70%, respectively) where the combination was tried (Demonstration + input) for adoption of Shimla chilli variety. It was further observed that adoption level had gone up in both the villages (60% and 50%, respectively), where only input was distributed. But adoption level remained very low (23.3% and 3.3%, respectively) where only demonstration was conducted. It was informed that availability of required input was a must in adoption of any improved technology.

Farmers' wisdom in livestock management in Arunachal Pradesh and Meghalaya

(Rajesh Kumar, B. Bihari, P. Sundarambal, P.P. Pal & N. Prakash)

This study was conducted in 2 villages of Arunachal Pradesh (50 respondents) and 2 villages of Meghalaya (50 respondents) in identifying the farmers' wisdom for rearing of livestock. In Arunachal Pradesh, farmers use wire-mesh just below the water level to avoid theft of fish, which can be used for several seasons. At some convenient place they keep one opening to enter inside the pond to check or catch the fish whenever they wish. Leaf of a wild plant locally called as 'HIKRUBU' is fed to the pig and other animals to control endo and ecto parasites. It is fed to the lactating pigs to cure the piglets suffering from endo and ecto parasites. These leaves are also used for controlling itching and healing of wounds in livestock.

In Meghalaya farmers use paste of lime + turmeric + mustard oil at muzzle and hoofs to control FMD in cattle and pigs. They use lime at naval point to discharge the placenta soon. Feeding of raw onion and garlic to fowls for controlling ranikhet disease, use of jair for controlling worms in cattle, FMD control by keeping animal in mud for 24 hours have been found very successful and used by majority of the farmers. Keeping in view the remoteness of the area and lack of improved technologies, these indigenous wisdoms are of great help to the farmers, even though they required refinement and modification.

Factors affecting adoption behaviour of tribal farmers in Meghalaya

(P. Sundarambal, P.P. Pal, N. Prakash, Rajesh Kumar & B. Bihari)

The study was conducted in two villages of Meghalaya to study the factors affecting the adoption behaviour of tribal farmers. It

was observed that the exposure towards latest agricultural technologies was almost nil, followed by lack of education, poor contact with extension agencies, non-availability of inputs and land tenure system.

Training need assessment of the tribal farmers in Meghalaya

(N. Prakash, P. Sundarambal, B. Bihari, Rajesh Kumar & P.P. Pal)

The study was conducted in two villages of Meghalaya with 50 respondents from each village to assess the training needs of farmers in Agriculture and Animal Husbandry. Training needs were prioritised by using average mean score method. In agriculture, nursery preparation in paddy, tomato and chilli, post harvest management in ginger, integrated nutrient management in paddy and maize and integrated pest management, whereas in animal husbandry, breeding feeding and health care of piglets were ranked major training needs of the farmers.

Inter-personal communication in technology transfer

(P.P. Pal, N. Prakash, B. Bihari, P. Sundarambal & Rajesh Kumar)

The study was conducted in one adopted village and two of its neighbouring non-adopted village in Meghalaya where different technologies like paddy varieties (DR-92 & RCPL-1-1), tomato varieties (Vaishali & Rupali), chilli variety (California wonder) crossbred pigs, fish spp. (catla, rohu, mrigal, silver carp, grass carp and common carp) were introduced to 50 farmers in adopted village. After 2 years, study was conducted in two neighbouring non-adopted villages (25 respondents from each village) and it was found that most of the technologies introduced in adopted village were being practised by the majority (53.5%) of the farmers of the non-adopted villages.

TRANSFER OF TECHNOLOGY

MEGHALAYA

(N. Prakash, R. Kumar, P.P. Pal, B. Bihari, P.K. Sharma and G. Upamanya)

Training

The following training programmes were organised for the farmers of NEH region :

Name of training programmes	Date	No. of participants
Rice Production Technology	08.09.99 -10.09.99	9
Mushroom Cultivation	05.08.99- 07.08.99	14
Pig Production Technology	16.04.99-18.04.99	22
Rabbit Production Technology	19.06.99-21.06.99	18
Knitting	15.12.99-17.12.99	30
Poultry	16.07.99-18.07.99	21

Verification trial

VT on paddy, maize, vegetables were conducted to assess the production potential of developed varieties in different adopted villages of Meghalaya.

Crop variety	Yield (q/ha)	Village	No of farm family
Paddy (Massori)	33.25	Mawbri	15
Maize (Vijaya composite)	39.50	Umroi	10
Vegetable			
Tomato (Rupali)	71.10	Mawlasnai	30
Capsicum	75.23	Mawlasnai	15

Visit

Altogether 400 farmers and 210 from different states of NEH region visited the research

farms of the Institute to witness the technology development process during the year.

Field Day

Six field days were organised on paddy, maize, tomato, capsicum, fishery and piggery in different adopted villages where 254 farms were involved.

Kisan Mela

The Kisan Mela was organised (17th August 1999) at the Institute where more than 500 farmers took part. This was organised to help the farmers in getting first hand information about the latest development in agriculture and allied sectors.

Trainers' Training Centre (TTC)

The following training programmes were organised by TTC during 1999-2000.

Name of trainings	Date	No. of participants
Integrated Fish Farming	21.07.99- 24.07.99	5 (M)
Rice Production Technology	08.09.99-10.09.99	9 (7M + 2F)
Rodent Control	26.10.99- 30.10.99	16 (15M + 1F)
Soil Conservation Measures in Hill Agriculture	02.11.99- 06.11.99	5 (M)
Citrus Cultivation	06.12.99- 10.12.99	19 (15M + 4F)
Vegetative Propagation and Grafting of Horticultural Crops	26.2.2000- 2.3.2000	24 (M)

KVK, ARUNACHAL PRADESH**Transfer of technology**

(Vishwakam, T.K. Bag, B. Saloi & J.K. Pandey)

The following training courses conducted for farmers/farm women/school drop outs/school children and rural youths.

Discipline/subject	No. of courses	Participants		
		Male	Female	Total
Crop production	12	56	60	116
Horticulture	22	136	76	212
Animal Science	1	—	7	7
Home Science	17	—	205	205
Total	52	192	348	540
For Inservice (S.S.B. Jawans)	1	9	—	9
Total	53	201	348	549

MIZORAM**Front line demonstration on maize**

(Kamta Prasad)

Front line demonstration (0.4ha/demonstration) was conducted on maize at 25 different locations of Kolasib and adjoining villages with an objective to assess the production constraints of maize cultivation under Participatory Rural Approach. The inputs included seeds of 10 kg. The average yield of 911.6 kg/acre was recorded under FLD, which were around 24 per cent higher than the state average yield (741.6 kg/acre).

Crop	Variety	Farmer (Nos.)	Area (ha)	Av. yield q/ha demonstration	Local	Yield (%) increase
Groundnut	JL-24	19	5.0	18.0	10.0	80%
Soybean	PK-16	16	5.0	15.0	11.0	36
Sesamum	Local	10	3.0	6.5	5.0	11.8
Arhar	UPAS - 120	10	5.0	9.0	NA	NA
Green gram	Pusa baisaki	10	5.0	8.0	NA	NA
Mustard	M-27	50	20.0	7.8	6.0	23.07
Linseed	Neelam	16	4.0	6.0	5.0	16.66
Total	131	47				

Agricultural exhibition cum farmers' fair

Agricultural exhibition cum farmers fair was organised jointly by the ICAR Mizoram Centre, Kolasib, State Department of Agriculture and Minor Irrigation and All Mizo Farmers Union on 1st - 2nd March 2000. About one thousand farmers from Kolasib and nearby villages participated in the exhibition. The Hon'ble Chief Minister of Mizoram, Pu Zoramthanga, Hon'ble Minister of Environment and Forestry, Pu Rualchhina, Director, Department of Agriculture and Minor Irrigation, Govt. of Mizoram and other officials of the state government were present on this occasion.

KVK, NAGALAND

(R.C. Verma, V. Kenny Naleo, H.D. Singh, W.R. Singh, A.K. Kahn, Anamika, S.K. Meitei & P. Venkateswarlu)

The KVK of the centre conducted 60 training programmes covering 1362 farmers (591 male and 771 female), farm women, rural youth, school dropouts and extension functionaries in the disciplines of Agronomy, Horticulture, Animal Science, Home Science, Mushroom.

Front line demonstration

(R.C. Verma, A.K. Kahn, H.D. Singh, Anamika Sharma & P. Venkateswarlu)

FLD programme on oilseeds and pulses were carried out in 4 villages covering 131 beneficiaries in 47 ha area. The details of the crops, varieties, area etc are given below.

FLD on maize

(Naresh Babu, P. Venkataswarlu, A.K. Khan & R.C. Verma)

FLD programme on maize (var. Vijay composite) was carried out and 30 farmers were covered within an area of 12 ha, 0.4 ha/ farmer.

T.V. Show

One show was telecasted by DD-1, New Delhi on 25th Dec '99, regarding activities of the center.

KVK, TRIPURA**Training**

Discipline	ON/OFF Campus	No. of courses	Duration	ST/SC trainee	Male	Female	Total trainees
Agri Engg.	ON	4	1 day	35	30	8	38
Agri Extension	OFF	6	1-2 day(S)	32	92	15	107
Agronomy	ON	2	1 day	14	19	—	19
Total		12		81	141	23	164

Front line demonstration

Front line demonstration of rabi-pulses was implemented in the village - South Chandrapur, North Chandrapur, Indiranagar and Murapura with the help of State Dept. of Agri. - Udaipur and Vivekananda Farmers

Club - Chandrapur. Field pea (Rachana) was demonstrated in 13 ha area involving 150 farmers. The average yield of the variety was 7.9 q/ha which was 46% higher than the local variety.

Extension activities

Activities	No. of Programme	No. of participants	Male	Female	ST/SC
Farmers day	2	70	63	7	24
Field day	2	74	69	5	29

Radio Talk

Fifteen talks were broadcasted by All India Radio, Kohima, Nagaland.

Demonstration

Fruit orchards of different fruits were established. Vegetable crops (summer and winter), livestock unit, poultry unit (100 birds RIR) and rabbit unit were grown and reared. Fish farming unit (both exotic and indigenous) fingerlings were kept besides mushroom demonstration unit. Package of practices was demonstrated to the trainees on crops and animals.

Farm production

Enterprise	No. of Animal/ Trees/area	Quantity of produce	Received Rupees	
Goatry	15 nos.	Kids - 8 nos.	Rs. 2000/-	
Dairy	1 + 3 nos.	Milk - 451.5 lit.	Rs. 3612/-	
Piggery	2 + 4 nos.	Piglet - 13 nos.	Rs. 7800/-	
Orchard	Mango - 150 nos.	Mango - 683 kg	Rs. 8196/-	
		Scion - 724 nos.	Rs. 724/-	
		Mango grafts - 14 nos	Rs. 350/-	
	Guava - 15 nos.	Guava - 344 nos.	Rs. 85/-	
	Sapota - 20 nos.	Sapota - 200 nos.	Rs. 100/-	
	Lemon - 16 nos.	Lemon - 43 nos.	Rs. 21/-	
Vegetables	Mixed	226 kg	Rs. 680/-	
Fodder	Tapioca (1500 sq.m)	1200 kg (approx.)	Rs. Feed to KVK animals	
		Hybrid Napier (200 sq.mt.)	3000 kg (approx.)	(do)
		Dimnath (1000 sq.mt.)	1800 kg (approx.)	(do)

Extension literature prepared

Title	Author	No. of copies
Routine maintenance of Diesel engine, water pump set	T.A. Khan	500
Improved package of practices of Sesamum cultivation	G.P. Kar	400
How to conserve soil and water	G.P. Kar	500
Subabul - a Fodder crop	G.P. Kar	400
Improved method of filed pea cultivation	G.P. Kar	500
Cultivation of Tapioca as Fodder	G.P. Kar	400

TECHNOLOGY ASSESSED AND TRANSFERRED

Institute village linkage programme (IVLP)

Different scientific interventions were tried to assess their potentiality in the existing micro-farming situation of the farmers. The results of some of the interventions showed positive trend with regard to yield potentiality and growth performance. Some of the results obtained so far are furnished below:

Use of composite maize for higher yield

The verification trial of composite maize (Vijay composite) showed good yield potentiality which yield 65% more (39.8 q/ha) than the local variety MLW (24.0 q/ha) in an area of 500 sq. m.

Fertiliser trial in maize

The results of this trial indicated that application of fertiliser yielded more (47.0 q/ha) than without application of fertilisers (39.8 q/ha) in maize variety Vijaya composite.

Hybrid tomato cultivation for higher yield

The results of the verification trial on the cultivation of Indo-American hybrid (Rupali) revealed that the performance of hybrid was far better than the local variety with 57% higher yield.

Fertiliser trial on yield of tomato

The application of balanced fertiliser with organic manure showed higher yield potential of the Indo-American hybrid variety. Yield of hybrid tomato with the application of balanced fertiliser NPK (@ 80:60:60 /ha

was 73.2 q/ha as against 66.25 q/ha of without fertiliser application.

Improvement in body weight of the crossbred pigs

The cross-bred pig (87.5% Hampshire inheritance) indicated better growth performance over the local in existing rearing condition as shown below:

Parameters	Improved	Local
No. of animals	20	20
Average initial body weight at 2 months age	10.15 kg	6.55 kg
Average body weight at 4 months of age	19.75 kg	9.20 kg

The effect of balanced feed on the body weight of improved breed is as under:

Parameters	Balanced	Without balanced
No. of animals	10	10
Average initial body weight at 2 months age	9.85 kg	6.15 kg
Average body weight at 4 months of age	20.50 kg	9.75 kg

Training

During the period altogether six training programmes were conducted in Mawlasnai, Mawtneng, Mawbri, Udem Arka, Umdobyrthih and Mawlasnai for proper nursery bed preparation of tomato, capsicum and other vegetables. A total of sixty-three beneficiaries attended these programmes. Moreover, field days were also organised on tomato and maize in Mawtneng and Mawbri village where more than 250 farmers took part.

FARMING SYSTEM RESEARCH

(N.D. Verma (Project Leader), K.K. Satapathy (Coordinating Leader), S.C. Giri, J.M.S. Tomar, K.N. Agrawal, J.L. Singh, K.K. Dutta, K.A. Pathak, S.K. Das, Margarette, S. Basanta Singh, D.K. Sonowal, I. Sakuntala, B.P.S. Yadav)

Dairy based farming system (FSW₁)

The watershed with the area of 0.94 ha and average slope of 32% was utilised for cultivation of broom and guinea grass on bunds and annual fodder on terraced land. Two milch cow were maintained on the biomass (270.2 q) produced from the watershed, with additional supplement of concentrated feed (27.13 q) and paddy straw (24.35 q). These cows produced 1590 litre of milk and 9.9 t of manure in nine months. The herd was found free from the *Brucella abortus*. However, an acute case of mastitis was noticed and treated with antibiotics. The fodder plantation in the system resulted in no annual water yield and the soil erosion was effectively checked.

Mixed block forest (FSW₂)

Multipurpose tree viz Alder (*Alnus nepalensis*), Acacia (*Acacia auriculiformis*), Exbucklandia (*Symingtonia populanea*) and Teeta chap (*Michelia oblonga*) performed better in 16th year after plantation. The maximum average collar diameter (cd) and diameter at breast height (dbh) were recorded by Exbucklandia (21.08 cm, 17.39 cm), followed by *Acacia auriculiformis* (15.24 cm, 12.01 cm) and reverse for maximum height. (Table 23). Jassids (unidentified) were found to be very severe on alder plants with population of 70-80 adults and nymphs/leaf. The surface flow was recorded as 35.06 mm while base flows remain very low viz. 6.25 mm from the watershed.

Table 23. Growth Performance of Multipurpose Tree Species (MPTS) in Mixed Forest

Species	DBH (cm)		C.D. (cm)		Height (m)	
	Range	Mean	Range	Mean	Range	Mean
<i>Symingtonia populanea</i>	12.4-25.6	17.4	14.8-29.0	21.0	19.2-14.2	13.5
<i>Alnus nepalensis</i>	4.9-14.5	9.8	7.5-19.3	12.8	3.9- 6.8	5.4
<i>Acacia auriculiformis</i>	4.2-21.5	12.0	4.8-27.2	15.2	4.7-25.8	15.8
<i>Michelia oblonga</i>	2.5-17.2	9.8	5.8-24.8	14.0	8.2-14.0	11.5

Silvi-pastoral system for goat production (FSW₃)

The system designed at an average slope of 32% was used to grow annual fodder and grasses. The output of the system was fed to goats for production of meat as source of income for small and marginal farmers. During the period fodder grass, Congo signal was grown. The average production of fodder was

382 q/ha in five cuttings. In this period, six kidding occurred in which 50% were twins and 50% were single kidding. Fourteen adults of goats were fed Congo signal grass twice daily (67% DM) with concentrated feed (33% DM) once. After 10 weeks the average daily weight gain and average daily DM intake was found to be 27.46 g/day and 736 g/day respectively. DM intake per 100 live weight

was found to be 4.66 kg. The performance of goats with guinea grass (*Panicum maximum*) was evaluated by dividing fourteen goats in two groups (GR-1, GR2), GR-1 was given only guinea grass twice daily while GR-2 was given grass (67% DM) with concentrated feed (34% DM). The initial average live weight of GR-1 and GR-2 were 13.65 kg and 13.17 kg, respectively. After 12 weeks with average daily DM intake of 625 g/day and 691 g/day of corresponding groups, the average daily weight gain was found 27.21 g/day and 31.29 g/day in GR-1 and GR-2, respectively. This indicated that performance of goat was better when grass is supplied with concentrated feed rather than grass alone. The surface flow from the micro-watershed was recorded as 26.03 mm while there was no baseflow.

Agro pastoral system (FSW₁)

The system constituted with crops on terraces and fodder on risers. In order to ensure subsidiary source of income, one cow and its followers were maintained on the biomass produced from the system. However, concentrate feed (1.40 t) was supplemented from out side. One case of dystocia with expulsion of dead foetus was reported this year in the cow. The bacteriological examination of uterine and vaginal discharge did not show any photogenic organism, which may have lead to foetal death. Maize (var. RCM 1-3) performed well on upper terraces with an yield of 35.11 q/ha popcorn var. RCM 1-2 yielded (15.16 q/ha), groundnut (14.96 q pod/ha), ginger (65.74 q/ha), and ragi (27.02 q/ha) were grown in rainy season while mustard (3.5 q/ha), rajmash (9.97 q/ha) were cultivated in winter season. The soybean and mustard crops suffered due to late sowing i.e. last week of June and last week of November, respectively. The groundnut was infested with leaf folder *Macoleia vulgaris* (31.1/100 plants)

and grasshopper (33.3/100 plants). In case of ginger stem weevil (*Prodiactes haenaticus*) infestation of 36.7% and stem borer's infestation of 21.1% reduced the yield. Although ragi was free from any major insect-pest, popcorn suffered maximum damaged due to cob borer causing 68.7% infestation at maturity and 94% at harvest. The energy and material flow pattern of the system was assessed for both rainy and winter season. The maximum output - input energy ratio was recorded for groundnut (3.11), followed by ragi (2.36), popcorn (2.09), ginger (1.61), maize (1.82) and rajmash (1.74), respectively. Mustard crop suffered due to late sowing resulted in output - input ratio of merely 0.74. Among the various resources utilised for crop production, highest energy was consumed from chemical fertilisers, followed by seed, human labour, diesel etc. The total energy requirement for crop production of the system was estimated as 6264 MJ while the output energy from grain and chaff were estimated as 10222 and 6375 MJ, respectively.

Broom grass and guinea grass were planted on risers in upper and lower half of watershed. Guinea grass in lower terraces produced 59.8 q/ha/cutting, while its production reduced to half in upper terraces. The average fodder production was 382.459 q/ha with dry matter content of 19%. The milk yield of the system was 2015.2 lit with average yield of 8.2 lit/day/cow.

Agri-horti-silvi-pastoral system (FSW₂)

The watershed area having average slope of 41.77% is divided in three distinct zones of field crop (lower portion) horticulture (middle portion) and pastoral component (upper zones). Maize (25.80 q/ha) groundnut and ginger were grown in rainy season while mustard (2.68 q/ha) and radish were grown in winter season on residual moisture. The

of August (41.8 adults, 4900 nymphs and 810 eggs on 5 twigs/plants). The peak period of mating and egg laying was in 2nd and 3rd week of August and infestation slowly decline and disappeared after October. The surface flow, peak flow base flow and soil loss was nil in the watershed due to good forest litter.

Studies on alternative method of bench terracing

Since 1993, to ensure an effective and low cost technology of bench terracing the experiment is under way to study the various aspects of bench terracing using contour bunds and vegetative barriers as means. Four micro watersheds (Blocks) viz.; Bench terraced (Block A), contour bunded with *Erythrina* plantation (Block B), contour bunded with broom grass (Block C) and contour bunded with vegetation barrier (Block D) were developed. Citrus and pineapple in Block B, peach and orange in Block C and guava and orange in Block D were transplanted.

Maize was grown on terraces with congo signal grass on riser in lower portion of Block, while the same crop suffered in upper portion due to broom grass on risers. During winter season mustard crop grown on residual moisture yielded 3.82 q/ha in upper terraces and 4.22 q/ha in tower terraces. Maize grown in Block C as inter crop of peach and orange plantation could not perform well due to late sowing and insect pest damage. The population of *Chaetocnema* beetle and *Mylocerus* recorded up to 53 beetles/100 plants and 44.4 weevils/100 plants, respectively. Similarly maize grown in Block D as enter crop of orange and guava plantation also suffered from these insects pests due to late sowing. The surface flow and base flow of the watershed was highest i.e. 50.01 and 56.13 mm, respectively.

Hydrological evaluation of different farming systems

Hydrological behaviour of experimental watersheds in terms of total water yield, base flow, surface flow (runoff) and peak flow have been studied and presented in Table 25. Maximum of 106.14 mm flow was recorded from AE-W1, followed by 41.31, 26.03, 19.82, 17.64, 3.37 and 3.19 mm from FS-W2, FS-W4, FS-W6, FS-W7 and FS-W₅, respectively, against the annual rainfall of 2310.2 mm during the year. No flow was recorded from the watershed No. FS-W1 and FS-W8 during the year 1999

Aquaculture

Three micro watersheds namely Farming System Research Pond, Agriculture Engineering pond and Horticulture pond which were quite seasonal were selected to find out the fish production potential. Pond preparation was done at the onset of monsoon. Lining of plastic sheets was done in FSRP pond to control seepage of water. Five species of fish i.e. Catla, Rohu, Mrigal, Grass Carp and Silver carp were introduced to the three micro watersheds at the rate of 6000 fingerlings/ha. Liming, application of cowdung, urea, super phosphate and MOP were being done at the rate of 3000, 180, 540 and 90 kg/ha/yr, respectively. The cowdung used for manuring was collected from the cows of FSRP. Monthly analysis of water sample and fish sample for length and weight were done from each of the micro watersheds. So also water level and temperature were recorded to find out the conducive environment for fish production. In January, fishes from FSRP pond and Horticulture pond were shifted to ICAR fish farm as the water level in these two ponds decreased drastically. Appreciable growth of fishes were observed in Agriculture Engineering pond in comparison to other two ponds

Table 25. Monthly water yield from different experimental watersheds of FSRP (1999)

Months	Total water yield from experimental watersheds									
	Rainfall*1 (mm)	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	5.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	7.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	24.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	377.6	0.00	0.03	0.80	0.00	0.00	0.11	0.00	0.00	0.00
Jun	308.0	0.00	0.34	2.17	2.59	0.00	0.45	0.82	0.00	0.04
Jul	670.2	0.00	17.86	4.45	13.55	2.47	4.11	2.55	0.00	98.01
Aug	349.3	0.00	2.69	1.03	0.00	0.72	3.73	0.00	0.00	1.05
Sep	236.9	0.00	18.25	6.49	9.89	0.00	6.65	0.00	0.00	4.88
Oct	278.3	0.00	1.36	1.68	0.00	0.00	4.77	0.00	0.00	2.16
Nov	44.7	0.00	0.78	1.02	0.00	0.00	0.00	0.00	0.00	0.00
Dec	7.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	2310.2	0.00	41.31	17.64	26.03	3.19	19.82	3.37	0.00	106.14
Max	670.2	0.00	18.25	6.49	13.55	2.47	6.65	2.55	0.00	98.01
Mean	192.5	0.00	3.44	1.47	2.17	0.27	1.65	0.28	0.00	8.85

*1 Rainfall corrected for Hydrological analysis.

due to the presence of aquatic weeds and less CO₂ production.

Agri film lining of FSRP pond

FSRP pond has been further deepened to increase the water storage depth up to 4.00 m and the pond bed lined with Agri film to study the storage pattern of the pond under the lined conditions. The area and storage rating tables of the pond have been re-prepared as per the new shape and capacity of the pond. The total storage capacity of the pond after its reconstruction/deepening/lining has gone up to 6239 m³ for the maximum storage depth of 4.00 m of the pond. The cost of per cum of water storage with agri-film lining has been worked out to be Rs. 44.29.

Economic evaluation

Economic evaluation of three important watershed based farming systems, viz. W₁, W₄ and W₅ was done for the financial year

1999-2000 using farm budgeting technique. The value of inputs and outputs were evaluated using farm price supplied by farm manager office, ICAR Complex for NEH Region, Umiam. The study of input use pattern showed that labour constituted the highest in the total cost in W₅ (67.48%) and W₄ (56.62%), whereas material cost shared 67.48% of the total cost in W₁. It reveals that W₅ and W₄ are economically viable for resource poor farmers and W₁ for economically sound farmers. The analysis of return structure depicted that income from livestock was dominant in all the three watersheds. Thus, out of gross income of these watersheds 95% in W₁, 63.40% in W₄ and 45% in W₅ were derived from livestock alone.

The input-output analysis showed that the input cost was the highest for W₄, followed by W₁ and W₅ (Table 25) per hectare profit was highest for W₄, followed by W₅. Simi-

larly, W4 gave the highest per rupee return of Rs. 1.27, followed by W5 i.e. Rs. 1.16. Surprisingly, there is a loss of Rs. 451.41 in the case of W1 giving an input-output ratio of 0.99. The reason is due to low yield of milk in W5 resulting from prolonged dry period of the cows. The addition of livestock

component in W4 declined the input-output ratio from 1.33 to 1.27. However, there was an increase in profit from Rs. 6600.98 to Rs. 10902.44. It clearly shows that the addition of livestock component thus, improved the income of the farmers besides generating regular employment.

Table 26. Input-output values for different watersheds of farming system research (1999-2000)

Watershed	Input	Output	Profit/loss	Input-Output ratio
FSW-1	38607.11	38152.70	454.41	0.99
FSW-4	20121.46	26722.44	6600.98	1.33
(Without livestock)				
FSW-4	41081.71	51984.15	10902.44	1.27
FSW-5	17605.73	20340.50	2734.77	1.16

FSW-1 = Dairy based farming; FSW-4 = Agro-pastoral system; FSW-5 = Agro-horti-silvi-pastoral system

AGROFORESTRY

Collection and evaluation of multipurpose trees (MPT) suitable for agroforestry systems in Meghalaya

(R. Singh, J.M.S. Tomar & L. K. Misra)

To identify the indigenous and exotic species of MPT for agroforestry, nine multipurpose trees viz. *Alnus nepalensis*, *Parkia roxburghii*, *Prunus cerasoides*, *Michelia oblonga*, *Gmelina arborea*, *Cryptomeria japonica*, *Cupressus torulosa*, *Pinus kesiya* and *Paraserianthes falcataria* were planted in an arboretum. The performance of the MPTS was excellent with survival percent of 70 to 90 except *P. falcataria*. The *P. falcataria* trees were completely eliminated by an unidentified insect (trunk borer) despite its excellent performance (Ht. 13.84-m. dbh 20 cm) up to 8th year. The height, diameter and timber volume production varied significantly among the

species. *Parkia roxburghii* attained maximum height and dbh (26 m, 35.4 cm), followed by *Michelia* (18 m, 31.8 cm), *Gmelina* (17.75 m, 25.6 cm), *Cherry* (16.5 m, 24.1 cm) and *Alder* (17 m, 23.6 cm). The MAI range between 0.95 to 2.2 m for height and 1.7 to 2.95 cm for dbh. The MAI was higher than CAI for both height and dbh.

Development of suitable management practices for agroforestry systems

(R. Singh, L.K. Misra & J.M.S. Tomar)

Horti-agri system

Guava based AFS

The yield of large cardamom (*Amomum subulatum*) was 375 kg/ha under guava plantation and fruit quality and yield of guava was very poor as infected by diseases and insect pests.

Citrus based AFS

Although mandarin fruit yield was lower than that of last year, inter crop performed very well. Turmeric (cv. RCT-1) and Colocasia (cv. eghalaya local) were inter-cropped in both wider (5m x 5m) and closer (2.5 x 5m) spacing of mandarin plants. In the closer spacing, mandarin fruit quality was inferior as compared to wider spacing beside lesser number of fruit/tree but inter-crop performed better in closer spacing. Though total fruit yield/ha was more in closer spacing due to more number of plants and very much affected by insect-pests and diseases.

Assam lemon with chilli

Local chillies were inter-cropped with Assam lemon, which were planted 5m x 5m spacing on terraces on a slope. All lemon plants were pollard/coppiced last year and yielded 10 kg fruits/plant and inter-cropped chillies 16 t/ha.

Horti-agri-pastoral system

One line each of three fodder grasses viz; Broom, Congo and Guinea were transplanted on contour 5m apart in the inter-spacing of mandarin orchard. Turmeric (RCT-1) was planted as inter-crop. The yield of turmeric (15 t/ha) was lower in comparison to other shade/partial shade area. Mandarin recorded an average height and spread of 2.3 m and 0.9 m, respectively after two years of plantation. The total green biomass yield of broom grass was 64 t/ha including flower. The yield of Congo and Guinea were 23 and 30 t/ha, respectively.

In another block four varieties of upland rice viz. RCPL-1-27, RCPL-1-29, RCPL-1-24 and RCPL-1-25 was sown in the month of June with Kinnow mandarin and guava planted 5

m apart on sloppy land. The average height/canopy spread of guava and kinnow were 3.2m/5m and 2.5m/1.5m, respectively. Maximum yield was recorded by RCPL-1-25 (6.2 t/ha), followed by RCPL-1-24 (5.6 t/ha), RCPL-1-29 (5.5 t/ha) and lowest (4.5 t/ha) was with RCPL-1-27. Guava yield was only 15 kg/tree after three years of plantation.

Silvi-agri-pastoral system

Fodder grasses (Congo and Guinea) were planted under silver oak (*Symingtonia populnea*). After five years, silver oak attained an average height of 6.5 m and dbh 6.4 cm. The yield of fodder grasses Congo and Guinea were 25 and 30 t/ha, respectively.

Alder (*Alnus nepalensis*) based agroforestry system

Under this system one row each of turmeric (cv. RCT-1) and colocasia (cv. Meghalaya local) were sown on terraces along with standing crops of Tea on riser and black pepper under the shade of alder tree. Twelve years of observation revealed that alder tree has positive effects on the production of tea. From the month of April to October 6000 kg/ha of green buds could be harvested from the system besides turmeric (18 t/ha), colocasia (17.4 t/ha) and fuel wood (pruned material 8 t/ha). The yield of black pepper (200-g dried/plant) was very poor due to frosting in winter. The Alder recorded an average height, diameter and spread of 22 m, 26.2 cm and 7.5 m, respectively after twelve years.

In another block colocasia (cv. Meghalaya local) was sown with alder tree. Though colocasia crop was heavily infested by fungal disease (*Phytophthora colocasae*), it yielded 18.4 t/ha due to timely control.

Evaluation of sericulture based agroforestry system on sloppy land

(R. Singh, L.K. Misra & J.M.S. Tomar)

Mulberry based AFS

Two sericulture based AFS viz. Sericulture with (i) fruit trees and fodder grasses (ii) field crops were further evaluated. The performance of guava plants was very poor due to heavy infestation of disease and insect-pests. The yield of turmeric yield was 17.5 t/ha, mulberry leaf yield (16.66 t/ha) was good. 150 cm x 60 cm spacing of mulberry plants was found profitable as it balances the return from the unit provided a sequence of leaf harvesting and crop growing.

Som (*Machilus bombycina*) based AFS

Under this system agricultural crops turmeric (cv. RCT-1) and ginger (cv. Nadia) were planted on terraces with standing crop of broom grass on risers with Som plants planted in a spacing of 6m x 4m. After five years Som plants attained an average height, diameter and spread of 6.75m, 10.3cm and 3.05m, respectively. Broom grass was harvested twice as fodder before allowing for flowering. A total yield of 62 t/ha including 2-t/ha flower was obtained from broom grass and yield of turmeric (22.1 t/ha) and ginger (17.3 t/ha) were recorded.

Apiculture in relation to AFS

Two species of honeybee (*Apis cerena indica* and *Apis mellifera*) were introduced in

AF farm to study pollination effect and honey production. The Indian honeybee species (*Apis cerena indica*) has survived well and colony developed fast but the Italian bee (*Apis mellifera*) did not performed well due to natural stresses. Three years of observation revealed that 2-4 kg of honey could be harvested from one Indian bee colony.

Improvement of suitable tree species through selection

(R. Singh, J.M.S. Tomar & L.K. Misra)

12 genotypes of *Alnus nepalensis* with desirable characters for agroforestry system like fast growing, smooth bark, straight bole height, compact canopy and good girth were identified and seeds were sown in nursery for further studies.

Collection and evaluation of poplar (*Populus deltoides*) for agroforestry system in NEH region

(J.M.S. Tomar, R. Singh & L.K. Misra)

Fortythree clones of poplar were collected from FRI Deharadun . under multilocational trial of promising clones of *Populus deltoides* (AICRP on Poplar improvement). The collected cuttings were planted in nursery and mulched with polythene sheet and dry grasses. Preliminary observation revealed that sprouting was better in polythene mulching (41%) than grass mulching (27.83%) and control (25%) after 60 days in nursery.

PUBLICATIONS

- Agrahar, D., Yadav, B.P.S., Gupta, J.J. and Sahoo, S.K. (1999) Nutrient profile and food value of indigenous herbs. *Indian J. Hill Farming* 12 : 114-115.
- Agrahar, D., Yadav, B.P.S., Gupta, J.J. and Das, A. (1999) Job's tears (*Coix lachrymajobi*) in rabbit nutrition. *Pan Amer. Rabbit Sci. News Letter* 4 :13.
- Bhat, P.N., Kumar, S., Singh, A.K. and Chandra, S. (1999) Management of heart leaf diseases complex of banana. *Pestology* 23: 17-17.
- Bhat, P.N., Verma, N.D., Kumar, S. and Chandra, S. (1998) Foliar fungal disease scenario in different farming systems of mid hills. *Indian J. Hill Farming* 11 : 104-107.
- Bhat, P.N., Singh, A.K. and Medhi, R.P. (1999) Reaction of frenchbean (*Phaseolus vulgaris*) cultivars/accessions to rust oathogen *Uromyces appendiculatus*. *Indian J. Agric. Sci.* 69 : 849-850.
- Das, A., Gupta, J.J. and Deka, T.C. (1998) Studies in the dietary protein level in chemical composition of broiler rabbit meat. *Indian J. Hill Farming* 12 : 48-50.
- Das, A., Gupta, J.J. and Deka, T.C. (1999) Effect of dietary protein level on the growth performance of rabbits. *Indian J. Anim. Sci.* 69 : 744-745.
- Gupta, J.J., Sahoo, S.K., Yadav, B.P. S. and Gupta, H.K. (1999) Effect of different vegetable proteins on the utilization of broken rice in broiler production. *Indian J. Poult. Sci.* 34 : 266-269.
- Bihari, B., Kumar, R., Prakash, N., Pal, P.P. & Sundarambal, P. (1998) Assessment of technological requirements in farming operations through use of PRA. *Indian J. Hill Farmg.* 11: 73-76.
- Sundarambal, P., Bihari, B., Pal, P.P., Prakash, N. & Kumar, R. (1999) Different indigenous farming systems of Jaintia Hills - A case study. *Indian J. Hill Farmg.* 12: 128-130.
- Pal, P.P., Sundarambal, P. Bihari, B., Kumar, R. & Prakash, N. (1999) Information seeking behaviour of the tribal farmers of Meghalaya. *Indian J. Hill Farmg.* 12: 124-125.
- Kumar, R., Prakash, N., Pal, P.P., Bihari, B. & Sundarambal, P. (1998) Constraints in dairy farming as perceived by dairy cattle owners of Meghalaya. *Indian J. Hill Farmg.* 11: 55-58.
- Prakash, N., Pal, P.P., Kumar, R., Sundarambal, P. & Bihari, B. (1999) Factors responsible for non-adoption of improved rice varieties among the tribal farmers of Meghalaya. *Indian J. Hill Farmg.* 12: 111-1134.
- Kumar, R., Prakash, N., Naskar, S., Sundarambal, P., Pal, P.P., & Bihari, B. (1999) Adoption of improved dairy management practices by dairy owners of Meghalaya. *Indian J. Hill Farmg.* 12: 47-54.

- Gupta, J.J., Yadav, B.P.S., Gupta, H.K. and Sahoo, S.K. (1999) Use of feeding probiotics in poultry. *Indian Poult. Rev.* 30 : 11-16.
- Gupta, H.K., Gupta, J.J., Yadav, B.P.S. and Sahoo, S.K. (1999) Utilization of Nebaro (*Ficus hookerii*) leaves in rabbits. *Indian J. Anim. Sci.* 69 : 643-644.
- Yadav, B.P.S., Gupta, H.K., Gupta, J.J. (1998) Growth pattern in goats on native pasture of north eastern India. *Range Manag. & Agrof.* 19 : 133-138.

DISTINGUISHED VISITORS

Name	Disignation & address	Date
Dr. R.N. Prasad	ADG (Soil), ICAR, New Delhi	29.5.99
Dr. M.M. Pandey	Projet Coordinator (FIM), CIAE, Bhopal	28.3.99 - 1.4.99
Padma Bhusan Dr. R.S. Paroda	D.G. ICAR, New Delhi	9.11.99
Sh. Hukum Deo Narayan Yadav	Hon'ble Union Minister of State for Agriculture Govt. of India	29.3.1999
Prof. V.L. Chopra	Ex-DG, ICAR, New Delhi	9.12.1999
Dr. K.L. Chadaha	Ex- DDG (Hort.), ICAR, New Delhi	9.12.1999
Dr. Kirti Singh	Ex-Chairman, ASRB, New Delhi	9.12.1999
Dr. J.S. Samra	Director, CSWRI, Dehra Dun	9.12.1999
Dr. G.B. Singh	DDG (NRM) ICAR, New Delhi	9.12.2000
Sh. K.N. Singh	Member of Parliament	9.12.1999
Smt. Singh	Member of Parliament	9.12.1999
Sh. B.B. Lyngdoh	Hon'ble Chief Minister of Meghalaya	7.6.1999
Sh. E.S. Mawlong	Hon'ble Speaker of Meghalaya Legislative Assembly	21.8.1999
Sh. M. Suchiang	Hon'ble Agriculture Minister, Govt. of Meghalaya	21.8.1999
Brigedier H.S. Sirohi	Commanding Officer, 24 Mtn. Brigade	21.8.1999

OTHER VISITORS

Visitors	Date
27 Trainees, SIRD, Meghalaya	9. 4. 99
35 Farmers of Haflong , N.C. Hills, Assam	10. 6. 99
17 Visitors from Assam	15. 5. 99
Visitors from Tura Sangsangiri Deptt. of Agriculture, Govt of Meghalaya	6. 7. 99
Visitors from Soil Conservation Deptt. Byrnihat, Meghalaya	30. 7. 99
35 Progressive farmers from different villages of Meghalaya	11. 8. 99
Yurak Mandal People, Mairang, Meghalaya	5. 11. 99
Trainees of Rural Resource and Training Center, Umran, Meghalaya	19. 11. 99
Army Staff, 25th Mt. Brigade, Umroi Cantt.	27. 11. 99
9 Officers of the Deptt. of Agriculture, Govt of Meghalaya	6. 7. 99
8 Officers of the Soil Conservation Deptt., Govt of Meghalaya	30. 7. 99
NGO (Bosco Reach Out, Mawkyndeng Region, Jaintia Hills	7.1.2000
NIRD Trainees	27.1.2000
NCC Cadets, Imphal	10.2.2000
State Officials, Deptt. of Agriculture, Govt. of Nagaland	16.2.2000
Farmers from Cherrapunji, Meghalaya	1.3.2000
SSB, Manipur, Imphal	4.3.2000
Farmers of Khasi National Academy, Nongstoin	13.3.2000
Students from Shillong Engineering and Management College, Shillong	22.3.2000
Self help Group of Bosco Reach Out, Nongstoin	29.3.2000

Arunachal Pradesh Centre

EXECUTIVE SUMMARY

Among the ten wetland rice varieties tested, RCPL 1-4 gave the highest yield followed by RCPL 1-87-4. Out of 15 tested cultivars/lines under upland condition, IET 15046 yielded the highest grain yield and all were resistant to blast excepting IET 13783. False smut disease of rice was surveyed in different locations of West Siang district.

The application of 30 t/ha pig manure and 60 kg N/ha gave the optimum yield of maize and residual crop of mustard at 45 t/ha pig manure and same dose of nitrogen. March 20 was found optimum date of sowing for maize variety RCM 1-1. The highest severity of rust was found at 90 kg N/ha with 30 t/ha pig manure and was least without fertilizer and manure. Early sown maize showed less rust and higher leaf blight severity. RCM 1-3 and Ganga-2 gave higher grain yield out of 6 varieties tested.

Web blight caused by *Rhizoctonia solani* (<5%), occurred in varieties of soybean PK 416, PK 471, Pusa 16, JSS 335 and Durga.

AIS 1-9706 gave the highest pod yield among the groundnut varieties tested and AL 1-9703 was highly susceptible to leaf spot, rust and wilt.

Twenty-five green gram entries gave the yield from 1 to 1.5 t/ha and 20 entries of black gram yielded 0.5 to 1 t/ha.

Khasi mandarin as scion produced maximum length, sprout thickness, number of brouchers and branches on Tayum rootstock where as Sikkim mandarin performed well on both *Citrus volckemariana* and Tayum. ARL-1 produced more fruits as compared to Assam

lemon. The highest yield of mandarin orange was obtained by the application of 110 kg pig manure, 1 kg N and 650 g K/tree. Sour lime also produced good yield at 60 kg pig manure, 700 g N and 600 g P_2O_5 /tree/year. Twenty seven ppm 2,4-D thrice in a year reduced the fruit drop and gave high yield of orange. The application of 600 ppm NAA produced good root system in Washington Malta. Tayum fruits collected from different places were evaluated for their physico-chemical characters.

Among 5 varieties of Aonla, Kanchan performed well. Growth parameters of different varieties of peach (3), plum (3) almond (4) and one each of walnut, cherry and Chinese gooseberry planted in 1997 were recorded. Thirteen indigenous fruits were collected and planted.

Large cardamom variety Ramla performed better in growth attributes than others and maximum capsule yield was recorded for Sawney. The highest yield of fresh ginger was obtained with application of 30 t pig manure, 100 kg N and 90 kg P_2O_5 /ha. 130 kg N, 90 kg each P_2O_5 and K_2O /ha yielded higher turmeric rhizome.

Out of 50 tree species, 39 established and their economic importance parameters were measured. Studies on *Bauhinia purpurea* + congosignal/guinea grass/golden timothy grass/ broom grass in silvipastoral system, Makueni yielded highest 1189 q/ha green fodder and broom grass could not be harvested during establishment year. Broom grass on drainage channel yielded 164.7 q/1000 m in the second year of establishment. Production of new shoots was found to be highest in *B. vriegata* followed *C. armata* and highest culms/clump in *B. vulgaris* var. *Wamin* followed by *D. asper* out of 28 species. *Phyllostachys*

pubescens did not pick up good growth. Micronutrient analysis of the bamboo shoots showed wide variability for Zn, Cu, Mn, Fe and Co. The maximum amount of mineral accumulation in the biomass was calcium (35.6%) followed by potassium (31.2%), magnesium (14.6%) and phosphorus (10.1%) and micronutrients (8.46%).

INTRODUCTION

Arunachal Pradesh is the largest hill state in the North Eastern Hill region and possesses vast potentiality both in the field of agriculture and animal resources. Research Centre was established at Basar located at 800 m altitude in the West Siang district. The centre has 40.5 ha land at Gori Research Farm and 41.1ha land in KVK Instructional Farm. The Gori farm was developed for the research trials of the centre and Basar farm was developed into KVK farm and its campus. Despite the infrastructural facilities developed, the centre was always in short of scientific manpower. In spite of dearth of scientist, the centre is currently working on crop improvement and plant protection in rice, pulses, groundnut, bamboo, horticulture, and water resource, farming and cropping system and transfer of technology. Due to absence of animal scientist, no work on animal science could be done.

RICE

(T.K. Bag)

Performance of lowland varieties

Among the ten wetland varieties tested, RCPL 1-4 gave significantly highest yield of 44.4 q/ha followed by RCPL 1-87-4 (43.2 q/ha). Yield of MW 10, IET 18-10, IET 6223, VL Dhan 61 and RCPL 1-87-8 ranged from 31.3 - 40.4 q/ha. All the varieties were resistant to blast and leaf scald diseases. VL Dhan 61 were free from leaf scald disease indicating immune to this disease.

Studies on the performance of upland varieties

Out of 15 tested cultivars/lines, IET 15046 yielded the highest grain yield of 34.53 q/ha followed by IET 13459 (33.80 q/ha) and IET 13783 (25.56 q/ha). All the varieties were resistant to blast except IET 13783. RCPL 1-25, IET-13783, RCPL 1-24, RCPL 1-26, RCPL 1-22, RCPL 1-27, RCPL 1-21, IET 15046 and RCPL 1-28 were resistant to leaf scald and Yamuk, Bali (local), RCPL 1-23, RCPL 1-29 and IET 13459 were moderately susceptible to leaf scald. IRAT 144 was highly susceptible to leaf scald.

Survey of false smut of lowland rice in West Siang district

For false smut of rice (*Ustilagenoida virens*) a survey was carried out in different locations and villages of West Siang district in the month of September-October. Highest mean number of affected hills/m² area (2.75) was recorded at Bagra followed by Bame (2.58) and Along (2.00). Highest mean member of panicle affected/m² area also followed this order. False smut disease scoring was the highest in Bame (1.32). Studies also revealed that disease intensity was high in shady, highly fertile and water stagnant fields. Most of the farmers use to grow local lowland rice varieties viz. Lemik, Leli, Mungmai, Kaying in those localities.

MAIZE

Studies on the effect of pig manure and fertilizer nitrogen on maize-mustard sequence

(K.A. Singh)

Over three years of studies on the effect of manure (0, 15, 30 and 45 t/ha) and fertilizer nitrogen (0, 30, 60 and 90 kg N/ha) on maize

(RCM 1-1) - mustard sequence, maize responded significantly upto the application of 30 t/ha pig manure and 60 kg N/ha. The interaction between levels of pig manure and nitrogen was significant. Application of 30 t pig manure and 30 kg N/ha produced the highest grain yield of 38.60 q/ha

Residual effects of manure and fertilizer N on the subsequent mustard crop showed that the highest yield (12.48 q/ha) was recorded when preceding maize was fertilized with a combination of 45 t pig manure and 60 kg N/ha. Residual effects of pig manure were significantly higher upto the highest level of manure application (45 t/ha) and fertilizer nitrogen upto 60 kg N/ha.

Effect of dates of sowing and nitrogen levels

(K.A. Singh)

Over three years of studies, March 20 was found optimum date of sowing for maize variety RCM 1-1. Delaying the sowing beyond 20th March resulted in the reduction of grain yield by 2.92 q/ha upto 15th April and 2.84 q/ha upto 30th April. The crop responded upto 40 kg N/ha. Maize crop sown on 20th March and fertilised with 40 kg N/ha gave the highest grain yield of 29.5 q/ha.

Management of rust and leaf blight

(T.K. Bag)

Out of sixteen treatment combinations of different level of organic manure and fertilizer nitrogen, none resulted in the significant differences on the severity of rust and leaf blight. However, it was remarkably noticed that rust severity was comparatively less than that of leaf blight in all treatment combinations. The lowest rust severity (PDI-474) was recorded in the treatment combination supplied with no organic manure and fertilizer nitrogen, whereas the highest leaf blight severity (PDI-33.27)

was recorded in this treatment combination. The highest rust severity (10.51) was found in the treatment combination supplied with 30 q/ha organic manure and 90 kg N/ha and the lowest leaf blight severity (PDI-20.37) was recorded in this treatment combination.

Effect of date of sowing and nitrogen level on leaf blight and rust

(T.K. Bag)

Among the three dates (30th March, 15th April, 30th April) of sowing, rust severity was the lowest (3.57) in 30th March sown crop and highest (8.88) in 30th April sown crop. On the other hand, leaf blight severity was the highest (24.66) in 30th March sown maize and lowest leaf blight severity was recorded in 30th April sown crop. Maize crop sown early when supplied with no nitrogen/lower dose of nitrogen (80 kg/ha) showed less rust and higher leaf blight severity. Conversely, maize crop sown late with higher dose of nitrogen reacted highly with rust disease and less severely with leaf blight.

Varietal trial

(T.K. Bag)

Among six varieties of maize tested, RCM 1-3 yielded the highest grain yield of 50.09 q/ha followed by Ganga-2 (49.81 q/ha) and RCM 1-1 (48.64 q/ha) and Kanchan (34.18 q/ha). RCM 1-2 and Mizoram local gave 30.40 and 18.77 q/ha grain yield respectively. Mizoram local was highly susceptible to leaf blight (PDI-23.55) followed by Ganga-2 and RCM 1-2. Kanchan and RCM 1-2 were tolerant to the disease.

SOYBEAN

Screening against rust disease

Sixty varieties/lines of soybean were screened against soybean rust (*Phakopsora*

pachyrhizae) under natural condition of disease pressure. The disease did not appear at all in any variety in the disease screening plot under Basar condition. On the other hand web blight caused by *Rhizoctonia solani* were observed in the disease screening plots both in the vegetative and fruit maturity stage. At the time of harvesting due to heavy intermittent rain, the disease severely infected the pods resulting in rotting and decay of soybean seeds. More than 5% web blight incidence occurred in the varieties PK 416, PK 471, Pusa 16, JSS 335 and Durga.

GROUNDNUT

Evaluation of varieties

(T.K. Bag)

Among the varieties, AIS 1-9706 gave the highest pod yield of 17.5 q/ha followed by ICGS 1 (17.0 q/ha) and ICGS 11 (16.0 q/ha). The yield of AIS 1-9708, ICGS 76, ICGS 37, ICGS 5, ICGV 86325 and ICGS 44 ranged from 13.3 to 15.3 q/ha. Maturity of the varieties ranged from 130 to 135 days.

All these varieties were also evaluated against all the prevalent diseases of groundnut. Among them, AIS 1-9705 was highly affected with leaf spot (PDI - 29.16), rust (PDI - 10.16) and root rot and wilt (incidence % - 22.6) resulting in poor pod yield of 4.9 q/ha. AIS 1-9709 and AIS 1-9703 were also affected with all these diseases giving only 8.5 and 9.5 q/ha pod yield respectively.

GREENGRAM AND BLACKGRAM

Studies on the performance of germplasm

(T.K. Bag)

Twenty-five green gram and 20 black gram entries obtained from Indian Institute of

Pulse Research, Kanpur, were evaluated in the Research Farm, Gori under rainfed condition. Yield of green gram ranged from 1.0 to 5.2 q/ha whereas black gram performed comparatively better than green gram. All the 20 entries yielded more than 5 q/ha with a maximum yield of 10.9 q/ha. Majority of the varieties of black gram yielded between 7-9 q/ha.

FRUITS

Citrus

(A.K. Dubey)

Growth behaviour of different species/cultivars in autumn flush

Data were recorded in two months old shoots of different varieties/species of citrus during autumn flush. Observation revealed that *Citrus taiwanica* had highest shoot length (22.73 cm) followed by *Citrus volckemariana* (21.93 cm), Majurica Malta (19.91 cm) and *Citrus latipes* (18.60 cm). Shoot diameter varied from 1.78 mm in Mosambi Australia to 3.44 mm in *Citrus volckemariana*. Leaves were found to be highest in *Citrus zigardio* (11.52) followed by *Citrus volckemariana* and *Citrus taiwanica*. *Citrus karna* had highest fresh wt. of shoot (9.00 g) but highest dry weight was recorded in *Citrus volckemariana* (4.28 g). Leaf area varied from 14.59 cm² in Hill Mandarin to 21.72 cm² in Kingthepe orange.

Rootstocks studies

An experiment was conducted with four varieties of Mandarin orange (Khasi Mandarin, Nagpur santara, Hill Mandarin and Sikkim orange) on different rootstocks (Tayum, *Citrus volckemariana*, Karna khatta and Rough lemon). It was observed that in case of Khasi mandarin as scion maximum sprout length

(35.65 cm), sprout thickness (8.18 cm), number of brouchers (5.50) and number of leaves (62.25) were recorded on Tayum (local) rootstocks after 270 days growth of scion. The shoot length and diameter were lowest with rough lemon but number of branches and number of leaves were found lowest on Karna khatta rootstocks. In Sikkim orange as scion maximum shoot length was recorded (29.75 cm) with *Citrus volckemariana* but number of branches and leaves were found to be highest in Tayum. Hill mandarin as scion had maximum shoot length with Karan khatta (29.53 cm). Performance of Nagpur santara on different rootstocks showed that scion height (18.67 cm), shoot diameter (4.82 m) and number of branches (4.00) were recorded highest with Tayum.

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

An experiment was laid out in 1998 to compare the performance of ARL-1 and Assam lemon. Data showed that Assam lemon had 1.23 m mean plant highest and 2.10 cm trunk diameter in ARL-1. Both varieties started flowering and fruiting in this year. ARL-1 produced 7 fruits/tree as compared 3 fruits in Assam lemon. Fruit weight (239 g), fruit length (10.98 cm) and fruit diameter (6.54 cm) were higher in Assam lemon, but juice/fruit (26.1 ml), number of seed/fruit, TSS (7.60%) and acidity (6.83%) were higher in ARL-1

Effect of pigmanure, nitrogen and potash on mandarin orange

In an integrated nutrient management trial with three levels each of pig manure (0, 70 and 110 kg/tree/year), Nitrogen (0, 750 and 1000 g/tree/year) and Potassium (0, 650 g and 850 g K₂O/tree/year) on mandarin orange was conducted (cv. Khasi mandarin). Plants which

receiving 110 kg pig manure 750 g nitrogen and 650 g K₂O per plant per year gave the maximum fruit yield of 163.00 kg per plant with the highest juice content per fruit (90.10 ml). Percent fruit drop was also the lowest in same fertilizer combinations (19.73%). Fruit weight (181.20 g) and fruit diameter were found to be highest with application of 110 kg pig manure, 1000 g Nitrogen and 650 g K₂O/tree.

Integrated nutrient management of sour lime

Application of 80 kg pig manure, 750 g N and 600g P₂O₅/tree/year in sour lime variety ARL-1 produced the highest fruit yield (750 fruits/tree) with highest fruit weight (64.50 g), juice per fruit (32.43 ml) and size of the fruit (5.26 cm x 4.94 cm).

Effect of plant growth regulators on fruit drop, yield and physico-chemical characters of Khasi Mandarin

Among different treatment lowest fruit drop (16.90%) and highest yield (84.80 kg/tree) were found with spraying of 27 ppm 2, 4-D thrice in a year. Among different concentrations of 2, 4, 5-T, spraying of 17 ppm was found superior to other concentration. However, fruit weight was highest (181.60 g) with spraying of 27 ppm 2, 4, 5-T as compared to all other concentration of GA3 and spraying of 110 ppm was found to be the best.

Effect of NAA on rooting

An experiment was conducted with three concentrations of NAA (200, 400 and 600 ppm) on different varieties of Sweet orange. The application of 600 ppm NAA produced highest number of roots (12.16) but length of root was recorded highest in Washington Malta.

Evaluation

Kinnow

Data were recorded on vegetative growth of Kinnow planted in 1997. The height of the tree varied from 92.35 cm to 1.23 m, diameter of trunk 5.73 to 6.10 cm and maximum spread was recorded 62.3 cm x 42.30 cm.

Assam lemon

The data was recorded on two year old plants. The height varied from 71.0 to 155.5 cm, trunk diameter 5.60 to 8.70 cm. Fruiting was also noticed this year. Highest fruit wt. (300 g), fruit size (11.70 x 7.20 cm), juice per fruit (25.2 ml), acidity (4.80%) and TSS (6.5%) were recorded.

Acid lime

Acid lime variety ARL-1 was evaluated. The highest yield (693 fruits/tree), fruit weight (64.50 g), fruit size (4.97 x 4.69 cm), juice (26.40 ml), TSS (7.70%) and acidity (6.92%) were recorded.

Collection and Evaluation of local germplasm

Tayum fruits were collected from different sites and evaluated for their physicochemical characters. Tayum (kidi) had highest fruit weight (190.50 g) followed by Tayum (Si) and Tayum (Sile). Fruit length, width and peel thickness was highest in Tayum (Si). Number of seed varied from 21.43 in Tayum (sile) to 52.25 in Tayum (kidi). Juice content/fruit was very less in all fruits. Percent acidity was highest (4.76%) in Tayum (kidi).

Aonla

Among the varieties of Aonla (NA-6, NA-7, NA-10, Kanchan and Chakya), Kanchan had highest mean height (1.37 m), which was close to NA-10 (1.35 m). Trunk diameter varied from 1.95 cm in NA-7 to 2.85 cm in Kanchan

Temperate fruits

Three varieties of peaches (Sel-1, TA-170 and Flordasun) and plum (Santarosa, Merry posha, red beaut), four varieties of almond (Druke IXL, Nonperil, Merced), one variety each of walnut, cherry and Chinese goose berry were planted in 1997. Growth of peaches and plums were satisfactory. All the varieties of peaches started flowering and fruiting in this year. The growth of other temperate fruits were not satisfactory although all survived. Among the plum plant height was recorded highest in Santarosa (126.50 cm) but trunk diameter was highest in Meriposha (1.50 cm). Merced variety of almond was more vigorous than others.

Germplasm evaluation of indigenous fruits

Thirteen indigenous fruit trees were collected and planted in the indigenous block. The germplasm includes Kompe, Taglam, Taktir, Tarak, Jalpai, Jamun, Rackchukoye, Tagu Jute, Tagu guchik, Mango (Assam), Kackfruit and Sam kathal. The growth of these fruits after one year was given in Table 1.

SPICES

Evaluation of large cardamom

Comparative data were taken on eight varieties of large cardamom. It was observed that Ramla had highest plant height (191.87 cm) followed by Jaker (191.30 cm), Bebogreen (187.35 cm) and Bebored (182.50 cm). Minimum height was recorded in Ramsey (116.43 cm). Ramla produced highest number of bunch/heap (15). Weight of bunch varied from 33.64 g in Zango golsey to 94.96 g in Bebogreen. Jaker (local) had maximum fruit size (4.42 x 2.72 cm). Fresh and dry weight of 20 capsules was also found to be highest in Jaker (223.70 g, 30.50 g) followed by Bebored, Bebogreen

Table 1. Performance of indigenous fruit trees of Arunachal Pradesh and Assam

Fruit trees	Plant height	Stem diameter	No. of branches	Spread (NS x EW)
Kompe	61.83	0.47	2.00	11.00 x 10.00
Taglam	92.83	1.83	4.50	7.00 x 39.50
Takir	54.10	0.75	4.50	22.50 x 20.55
Tarak	126.00	1.20	5.67	49.00 x 40.70
Jalpai	53.00	1.40	4.00	28.00 x 31.00
Jamun	65.80	1.30	6.33	44.00 x 43.13
Rakchuyok	83.00	1.50	4.00	41.00 x 32.00
Tagu gute	47.17	1.40	2.00	54.00 x 57.20
Tagu guchik	59.13	1.43	2.00	63.30 x 75.30
Mango (Assam)	67.43	1.40	2.00	42.00 x 37.70
Jack fruit(Assam)	65.60	1.10	4.00	30.85 x 31.50
Som Kathal	80.20	1.20	2.00	25.80 x 41.70

and Tali. Sawney variety had highest capsule yield per heap (951.70g) followed by Madhusey (750.50 g). Yield was also highest in Sawney (31.73 q/ha) and Seed/capsule was more in Belak (322.30) followed by Madhusey (84.80) and Ramla (59.20).

Effect of nutrient management of ginger

Application of 30 t pig manure, 100 kg nitrogen and 110 kg P_2O_5 /ha had highest plant height (78.74 cm). Number of suckers/plant was found to be highest with a combination of $F_{30} + N_{140} + P_{90}$ kg/ha. Fresh weight of rhizome was highest (289.10 q/ha) with application of 30 t pig manure, 140 kg nitrogen and 90 kg P_2O_5 /ha accompanied by highest suckers/ plant.

Effect of nitrogen, phosphorus and potash on turmeric

An experiment was conducted with three levels of nitrogen (90, 110 and 130 kg/ha) and two levels each of phosphorus (90 and 110 kg) and Potash (70 and 90 kg/ha) on turmeric

var. PCT-11. The experimental result revealed that application of $N_{130} + P_{90} + K_{70}$ resulted in highest plant height Fresh weight of rhizome and yield/ha and number of suckers was found highest in $N_{130} + P_{90} + K_{90}$ kg.

Studies on effects of doses and time of application of nitrogen on RCT-1

An experiment was conducted with three doses of N (100, 120 and 140 kg N/ha) and three time of application (1) half dose at sowing time and rest half in the month of July, (2) no N at the sowing time, half dose at the time of 1st earthing and rest half in the month of August and (3) one third N at sowing time, 1/3rd in the month of June, 1/3rd dose in the month of September. Data revealed that highest plant height (86.07 cm), number of suckers (5.43/plant), number of finger/ clump (19.20), length of finger (7.33 cm) and fresh weight of rhizome (377.07 g) were found in application of 140 kg N/tree in split doses i.e. 1/3rd at sowing, 1/3rd in the month of June and rest 1/3rd in the month of September.

AGROFORESTRY

(K.A. Singh)

Evaluation and management of tree species of economic importance

In the arboretum 50 tree species were planted during 1997-99. Out of 50, 39 tree species established with a survival of 40 to 100 per cent. 11 tree species, which failed to establish and grow were *Aguillocha agallocha*, *Axardichta indica*, *Acacia auriculiformis*, *Casia siamea*, *Casia fistula*, *Dalbergia sissoo*, *Heavea brasiliensis*, *Leucaena leucocephala*, *Pinus roxburghii*, *Samanea saman* and *Tectona grandis*. Among the 15 tree species established in 1997, *Michelia champaca* attained maximum plant height (295 cm) and basal diameter (6.7 cm) followed by *Altingia excelsa*, *Pinus kesiya*, *Cryptomeria japonica* and Kapur. Among 18 tree species established in 1998, *Acacia mangium* ranked first followed by *Morus laevigata*, *Alnus nepalensis*, *Dubanga orandiflora* and *Symingtonia populanea*. In 1999, six tree species were planted with a survival per cent of 50 to 100%. Among them *Bauhinia purpurea* had maximum plant height (109 cm) followed by *Emblica officinalis*, *Parkia roxburghii* and *Aleurites montana*.

Studies on silvopastoral systems

Studies on *Bauhinia purpurea* + congosignal/guinea grass/golden timothy grass/ broom grass silvipastoral systems showed that guinea grass variety Makueni yielded 1189 q/ha green fodder (4 cuts) and congosignal yielded 370 q/ha (2 cuts). During first year of establishment golden timothy grass gave only one cut of fodder and produced 179 q/ha fresh yield. Broom grass was not harvested during the establishment year. On an average trees attained the height of 154 cm with a basal diameter of 1.96 cm.

Productivity of broom grass on drainage channel

Broom, a high values multipurpose grass produced 164.7 q/1000 m of length of drainage channel. The total fresh biomass consisted of 38.7 q spike for broom, 76.9 q leaves for green fodder during lean period and 49.08 q stem per 1000 m in the second year after establishment.

Effect of tree density on the growth performance of Bola (*Morus laevigata*) and gamhari (*Gmelia arborea*)

A trial was established in 1998 to study the effects of five tree densities (557, 667, 833, 1111 and 1667 plants/ha) in a rectangular geometry. After one year of establishment, *Morus laevigata* plants attained 119.3 ± 13.7 cm height and 1.13 ± 0.13 cm basal diameter. One year old plants did not exhibit effects of tree densities on growth performance. Gamhari (*Gmelia arborea*) was planted at above densities in 1999.

Performance of budded stump of three clones of rubber plant (*Heavea brasiliensis*)

(K.A. Singh, R.P. Singh & D. Chaudhary)

Performance of brown budded stumps of three clones 82/89, PRIM 600 and GT brought from Rubber Board Regional Station, Guwahati was studied during monsoon after failure of winter nursery. In the month of July, these budded plants were planted in polybag and maintained as per the recommendation of Rubber Board. Data on soil temperature and sprouting were recorded during July-January (211 days). The sprouting success was found to be maximum in clone 82/29 (80%) followed by GT 1(65%) and PRIM 600 (44%). In winter nursery trial also clone 82/29 had maximum sprouting success. Sprouting completed in September with onset of winter; leaf

scorching started as the soil temperature dropped below 20-23°C in the month of November. Further, drop in temperature to 15-17°C, leaf defoliated and the stem of sprouts started dying during December. Subsequently, whole plants of three clones died during January at 10-14°C of temperature. Hence, rubber plantation may not be a potential proposition in and around Basar area of West Siang district of Arunachal Pradesh.

Bamboo

(K.A. Singh)

Evaluation of bamboo plant species

Among 28 bamboo plant species established in the bamboosetum, total number of shoots per hectare was highest in *Bambusa variegata* (61.719 shoots/ha) followed by *B. nana* and *B. tulda* in 16th year of establishment. Production of new shoots was highest in *B. variegata* followed by *Chimonobambusa armata*. Among the three bamboo plant species established from seedlings in 1998, *Bambusa vulgaris* var. *Wamin* had 06 culms per clump followed by *Dendrocalamus asper* (02 culms per clump). *Phyllostachys pubescent* did not pick up good growth.

Micronutrients spectrum in the young shoot of bamboo plant species

The nutritional analysis of the edible portion of the bamboo shoots on dry matter basis showed a high variability of micronutrients (Mn, Zn, Fe, Cu and Co). The coefficient of variation was found to be highest for cobalt followed by copper, zinc and iron (42.47%). The range of variability for manganese was 4.0 ppm in *Dendrocalamus giganteus* to 17.6 ppm in *Schizostachyum pergracile*, for iron 5.6 ppm in *Bambusa polymorpha* to 22.7 ppm in *B. variegata*, for zinc 0.6 ppm in *B. variegata* to 3.5 ppm in *S. pergracile*. The copper content was highest

in *B. pallida*, *D. hamiltonii* and *S. pergracile* and cobalt content was highest in *B. variegata* and *D. hamiltonii*.

Effect of clump density on the growth, nutrient profile of biomass in *Bambusa pallida* and its impact on soil properties

In 10th year after establishment, new shoots per clump was highest at a low density of 156 clumps per ha but the total number of shoots per clump continued to be highest at the density of 278 clumps per ha. Consequently number of mature culms harvested per ha was also highest (9305 culms/ha) at this closely spaced (6m x 6m) planting.

Mineral (P, K, Ca, Mg, Cu, Zn, Mn and Fe) accumulation in standing live biomass and floor litter was highest (792.3 kg/ha) at the density of 278 clumps per ha, which reduced with increased spacing of planting. The maximum amount of mineral accumulation in the biomass was calcium (35.6%) followed by potassium (31.2%), magnesium (14.6%) and phosphorus (10.1%). Microelements (Cu, Zn, Mn and Fe) constituted 8.64% of the total mineral accumulation. Among microelements iron constituted 68.2% and manganese 24.7% of the total accumulation. Soil properties remained almost unaffected by various density of planting of *Bambusa pallida* expecting organic carbon, which increased with increasing density.

Performance of chemically (Ethrel and Colchicine) induced variants in *Bambusa pallida*

15 selections were made out of 30 treatments of ethrel and colchicine. In 9th year after establishment, maximum variability was observed in production of new shoots/clump (40%) followed by total number of new shoots/clump and the circumference of the clump.

PUBLICATIONS

- Bag, T.K. (1999) Notes on variation of sclerotial structures of *S. sclerotiorum* (lib) de Bary, incitant of cabbage head rot. *ENVIS Bull.* 7: 7.
- Bag, T, K. (1999) Status of vegetable diseases caused by *S. sclerotiorum* in different land use systems of Arunachal Pradesh, *Environ. Eco.* 18: 88-91.
- Bag, T, K. and Ray, S. (1999) Seasonal incidence of stag beetle, *Prosopocoilus spencei* Hope of Khasi Mandarin. *Sci. Cul.* 65: 385.
- Dubey, A.K. and Singh, K.A. (1999) Large cardamom - A spice crop of India. *Indian Farming* 49: 17-18.
- Singh, K.A. (1999) Effect of nitrogen level on yield, root biomass distribution, nitrogen recovery by forage grasses and changes in soil properties of acid Inceptisol. *Indian J. Agric. Sci.* 69: 551-554.
- Singh, K.A. (1999) Nutrient contents in tree fodder and the leaves of bamboo used during scarcity period in eastern Himalaya. *Indian J. Anim. Nutr.* 16: 178-182.
- Singh, K.A. (1999) Promising forage legumes for low to mid hills of North Eastern Region of India. *Indian Farming* 49: 15-16.
- Singh, K.A. (1999) Response of promising forage grasses to nitrogen. *Indian J. Agron.* 44: 419-423.
- Singh, K.A. (1999) Resource management and productivity enhancement through agroforestry in the eastern hilly agroecosystem of India. *Indian J. Agrof.* 1: 63-72.
- Pathak, P.S. and Singh, K.A. (1999) Sustainable farming systems in the hilly region of India. with special reference to North eastern region. In " Man and Forest " (Ed. Kohli et al.) Pp. 313-346. DNAES, IUFRO, ISTS, Botany Deptt. & Centre for Vocational Studies, Punjab Univ., Chandigarh.

DISTINGUISHED VISITORS

Visitors	Date
Sri Lijum Ronya, Hon'ble Minister for Home & Parliamentary Affairs, Gov. of Arunachal Pradesh	27.4.99
Sri P.M. Nair, Chief Secretary, Govt. of Arunachal Pradesh	25.6.99
Sri Naresh Glow, Hon'ble Minister of for Agriculture, Govt. of Arunachal Pradesh	31.1.2000
Sri Tago Basar, Joint Director, Agriculture, Govt. of Arunachal Pradesh	31.1.2000

Manipur Centre

EXECUTIVE SUMMARY

Ten selected progenies from the cross Prasad x IR 24 and one selected progeny each from the crosses BR-1 ♀ Leimaphou and Napnangmumei ♀ Basmati 370 were tested for yield and other quality traits with 4 checks. The lowest incidence of neck blast, leaf blast and sheath blight was observed in BR-1 ♀ Leimaphou, MC17-8-2-16-2 and MC17-8-2-16. Among six cultures RCM 9 and RCM 10 were found to have similar maturity period as that of Leimaphou, and former gave maximum yield. PL 8/SPS-1 recorded 43% more yield than of the check RCM 5 in RCRT-1. Among 13 AVT upland rice entries of AICRIP, AVT-1705, AVT -1724, AVT-1704, AVT 1714 and AVT-1709 yielded highest in the tune of 3.1-3.3 t/ha grain. PL-1/SPS-4 gave higher yield in 11 Regional Co-ordinated Rice entries. Maximum grain yield was obtained when paddy straw was applied @ 5 t/ha along with NPK.

Samples of rice collected from different valley districts indicated the purity of seed to be 81-84 %. Mustard and soybean seed viability became almost negligible after two year storage under ambient condition. Red-kernel wild rice was found to be genetic contaminant in most of the wetlands and cross breeding by bees is the major problem to maintain the purity of mustard seed.

JS-335 variety of soybean yielded the highest among 7 tested. For indeterminate soybean, wider spacing from seed to seed in row performed better as compared to determinate/ semi determinate. TG-26 gave the highest yield among 13 varieties of groundnut

tested. The highest groundnut pod yield was obtained by applying 50 kg/ha each P and K.

Out of 113 genotypes of groundnut ISK-8917, ISK-8914 and ISK 8909 were severely attacked by collar rot disease. The highest disease incidence was recorded from application of N₁₅, P₃₀ and K₄₅ kg/ha. The disease incidence was lowest in maize + groundnut intercrop. Maximum disease was recorded in June sown groundnut.

The application of lime, *Rhizobium* and phosphorus increased the root length, number of pod/plant, branches, leaves and plant height, yield attributes of groundnut. FYM +B +NPK gave maximum yield of soybean and black gram in rotation.

Better weight gain, digestibility and ECR were observed on fishes fed on ricebean and M.O.C. (1:1) followed by 34.4, 34.4 and 30.2% respectively of M.O.C., *Azolla* and *Alternanthera*. The fingerlings of *Cirrhina mrigala* performed better fed on 10% fish meal, 5% soybean meal and 25% maize flour and produced 72.5% more growth than the control. Animal protein sources were better utilised by the fish than plant protein sources. In composite fish culture, delayed stocking of Indian major carps for 2-5 months helped better production of Pengba without adverse effect on other species. The designed improved fish smoking oven made of 240 litre oil drum showed good performance with efficient fuel energy use.

Among the different species of *Casurina*, *C. equisatifolia* showed better performance in all growth parameters. Under silvi-horti-pas-

toral system *Panicum maximum* and NB-21 gave almost negligible yield due to total suppress by the canopy of both banana and *L. polyantha* and *S. wallichii*. The grasses *P. pedicellatum* and *P. maximum* planted on terrace risers, horticultural crops on bunds and crops in terraces showed that grasses were competing with trees.

INTRODUCTION

Manipur is the eastern most state in the North Eastern Hill Region. It covers an altitudinal range from 51m to almost 2500m above msl. One-tenth of the geographical area of the state is valley and the rest is occupied by hills. The valley's highly fertile area has enormous agricultural potentialities. The research programme of the centre was oriented to fulfil the research requirement of the state in the field of agriculture, horticulture and animal science. At present research farms are above located at Lamphelpat (750-800m,msl). The centre is presently engaged in research on rice, maize, pulses,oilseeds, horticultural crops and fishes. The KVK attached to the centre is undertaking extension activities under transfer of technology programme.

RICE

(A. Anna Durai, S.V. Ngachan,
I. Meghachandra Singh and A.C. Sharma)

Breeding for high yielding, blast resistant and quality rice for main kharif

Ten selected progenies from the cross Prasad × IR 24 and one selected progeny each from the crosses BR-1 × Leimaphou and Napnangmumei × Basmati 370 were tested for yield and other quality traits with 4 checks (RCM 9, RCM 10, Leimaphou and Prasad).

Among the genotypes tested, MC 17-8-2-16 exhibited the highest yield of 4.6 t/ha followed by MC 17-8-2-16-2 (4.2 t/ha). The lowest incidence of neck blast, leaf blast and sheath blight was observed in BR-1 × Leimaphou, MC 17-8-2-16-2 and MC 17-8-2-16.

Variety trials

Among six cultures, RCM 9 and RCM 10 were found to have similar maturity period as that of Leimaphou. With respect to yield, the culture RCM 9 recorded the maximum yield of 4,489 kg/ha. CAUS-1 recorded maximum plant height. No variation was observed for productive tillers/ plant among the new cultures. RCM 9 and RCM 10 exhibited less incidence of neck blast.

In the Research Complex Regional Trial-1 (RCRT1), 11 cultures were evaluated with local check RCM 5. PL 8/SPS-1 recorded the maximum yield of 5.88 t/ha which was 43% more than that of the check RCM 5 (4.05 t/ha) followed by PL 1/SPS-1 which yielded 5.80 t/ha. Other cultures which recorded more than 20 percent yield advantage over the check RCM 5 were PL 5/SPS-1 (5.33 t/ha), PL-8/SPS-2 (5.50 t/ha) and PL 1/SPS-4 (5.10 t/ha). In RCRT-2, RCPL-1-23 recorded the maximum yield of 4.9 t/ha followed by RCPL-1-29 (4.3 t/ha) and RCPL-1-24 (4.3 t/ha).

Upland trials

(Jai Singh, I.M. Singh & K.P. Singh)

Among 13 AVT hill rice entries of AICRIP tested under the rainfed foot hill conditions of Langol, highest grain yield of 3.32 t/ha was obtained from AVT-1705 which did not differ significantly from AVT-1724 (3.24 t/ha), AVT-1704 (3.23), AVT-1714 (3.21) and AVT-1709 (3.11). Out of 11 Regional Co-ordinated Rice entries, PL-1/SPS-4 was found to be the highest yielder (2.55 t/ha) having duration of 116 days fol-

lowed by IET-13783 (2.11 t/ha), IET-13783 (2.54 t/ha) and PL-11/SPS-2 (1.98 t/ha).

Integrated nutrient management in lowland

(Kailash Kumar, Mausumi Raychaudhuri & Jai Singh)

Both grain and straw yield showed similar trend as that of the previous year and increased significantly in all treatment combinations except Phosphatica over the control and N and P uptake by both the grain and straw yields followed the similar pattern of grain and straw yield.

SEED TECHNOLOGY

I.M. Singh, S.V. Ngachan & Jai Singh

Evaluation of seed quality of the farmers

Among 200 rice seed samples collected from the valley districts, only 2% of the samples could confirm the Indian minimum seed certification standards. Highest mean pure seed level of 83.73% was found in Senapati district followed by Churachandpur (83.16%), Chandel (82.78%) and Ukhrul district (81.35%) respectively.

Seed storage

Mustard seeds harvested in rabi 1995-96 and stored under silica desiccated condition could maintain upto 97% germination (cv. M-27) and 52% in cv. Pusa Bold, while storage under ambient spoiled conditions the seeds within two seasons below 1.5% germination.

In Soybean (cv. JS-80-21) seed viability upto 60% could be maintained under desiccated condition for 50 months storage which otherwise could have been completely deteriorated in 20 months under ambient conditions.

Development of techniques and farmers' awareness on scientific own saved seed production

Pure seeds of popular rice cultivar Leimaphou were supplied to 20 selected farmers during 1998 in an effort to find out the feasibility of quality improvement of own saved seed production for re-use. The level of off types present in field were 0.1 to 0.5% which is much below the neighbouring check plots.

Studies on problems in quality seed production and seed multiplication

Seeds were produced for important crops and their problems were identified. In rice, a red-kernel wild rice was found to be a genetic contaminant in most of the wetland plots. In mustard out-crossing through bees were the major problems in maintaining the purity. During the year, 500 kg of different rice varieties, 100 kg of mustard (M-27), and 50 kg of groundnut (different varieties), 50 kg of maize and 20 kg of soybean seed were produced.

OILSEEDS

SOYBEAN

(Jai Singh, I.M. Singh & K.P. Singh)

Performance of varieties under Langol foot hill rainfed conditions

Among the seven promising varieties of soybean tested, JS-335 yielded the highest (2.5 t/ha) with a duration of 116 days followed by NRC-20 (2.37 t/ha) and JS-75-46 (2.37 t/ha), Pusa 16 (2.33 t/ha) and JS-75-46 (2.09 t/ha), respectively. The check variety Bragg and NRC-2 had the longest duration of 126 days.

Effect of plant spacing on different plant types

Closer spacing of 5 x 45 cm was found to be the best in the determinate variety Pusa-16, with a grain yield of 3.64 t/ha. In the semi determinate variety MACS-13, the mid spacing of 10 x 45 cm was best (3.37 t/ha) while in the indeterminate variety JS-335, 15 x 45 cm performed optimum (3.6 t/ha).

Integrated nutrient management

(Kailash Kumar & Mausumi Raychaudhuri)

Maximum grain yield was recorded in Lime + FYM (28.6 q/ha) over control (12.9 q/ha) followed by FYM.

GROUNDNUT

(Jai Singh, I.M. Singh & K.P. Singh)

Among 13 varieties tested, TG-26 was found to be the highest yielder (2.5 t/ha) followed by TG-20 (2.44 t/ha), ICGS-44 (2.1 t/ha), TGS-1 (1.92 t/ha) and ICGS-11 (1.9 t/ha) while the standard check variety JL-24 remained at 1.82 t/ha. TAG-24 had the shortest duration of 102 days similar to that of JL-24 with a yield of 1.59 t/ha.

Integrated nutrient management

(Kailash Kumar, Jai Singh & Mausumi Raychaudhuri)

Pod yield, nodule number and nodule weight/plant increased significantly by liming. *Rhizobium* inoculation without P did not increase the pod yield significantly over control. Nodule weight/plant significantly increased only by *Rhizobium* inoculation either alone or along with 50 kg P₂O₅/ha. Maximum nodule number and nodule weight/plant (215 and 0.157 g respectively) were recorded in P₅₀ + *Rhizobium* treatments followed by *Rhizobium* inoculation (181 and 0.134 g respectively).

Performance of rabi groundnut under polymulch condition

(Sanjeev Kuamr & S.V. Ngachan)

The groundnut variety JL-24 showed higher yield (28 q/ha) under polymulch condition with flat bed system of sowing than other treatments, followed by polymulch with broad-bed-furrow systems in growth & yield attributing characteristics such as plant height, number of leaves, number of pegs, number of pods, and pod weight/plant, and 100 kernel weight and pod yield. Rabi crop took longer (6 months) period than kharif (4 1/2 months) to attain maturity.

DISEASE MANAGEMENT

(B.P. Hazarika)

Screening genotypes for early leaf spot (ELS), late leaf spot (LLS) and other diseases

Out of 103 genotypes, except a few small leaf spots on older leaves, the entries ICGV-88338, ICGV-88342, INS-9115, AIIS-9208 were resistant against ELS disease. The entries, ICGV-88342, AIIS-9208, ICGV-86259, ICGV-87350, ASK-1-8904 were completely free from LLS disease. The entries, ISK-8917, ISK-8914 and ISK-8909 were severely attacked by collar rot disease. Rust disease was absent.

Tikka leaf spot disease incidence and yield performance under NPK application

Variety JL-24 was selected for this study. At 90 DAS the observations on the tikka leaf spot disease incidence were recorded from the second, third and fourth leaves from top of the 10 randomly selected plants from each plot i.e. 30 leaves/plot were selected and assessed on 0-5 scale. The yield data were taken after harvest at maturity. Highest (31%)

disease incidence was recorded from application of $N_{15}P_{30}K_{45}$ kg/ha with the lowest yield of 1636.7 kg/ha.

Effect of intercropping on incidence of tikka leaf spot disease

Groundnut cv. JL-24 was sown as an intercrop with sunflower, maize, soybean and bhindi under rainfed condition to see the effect of incidence of the disease and yield. Disease incidence was lowest in maize + groundnut (31.5%) with pod yield of 1883 kg/ha. The lowest yield was found in sole groundnut or soybean+groundnut (883 kg/ha)

Effect of sowing time on the incidence of tikka leaf spot disease

Disease incidence was minimum in July sown crop (28.86%) followed by May (36.20%). Maximum disease incidence (40%) was recorded in June sown crop. The pod yield was less in May sown crop.

CROPPING SYSTEM

Lime, biofertilizer and phosphorus interaction on groundnut (JL-24) based cropping systems

(M. Raychaudhuri, Kailash Kumar & Sanjeev Kumar)

The root length, number of pods/plant, branches, leaves and plant height (yield attributes) increased with lime, *Rhizobium* and phosphorus and followed the trend of the previous year. The lime - *Rhizobium* interaction for the root length, nodule weight/plant, pod yield, N and P uptake was significant. Liming in furrow @ 0.5 t/ha with *Rhizobium* inoculation gave significantly higher yield (14.6 q/ha) over control (8.9 q/ha). Maximum pod yield 24.3 q/ha was recorded with 1 t lime + *Rhizobium* + 60 kg P_2O_5 /ha. The shelling

percentage increased from 58 to 74 per cent on liming. The second crop, mustard failed due to moisture stress.

The post harvest soil analysis data revealed that the pH, organic C, CEC, exchangeable $Ca^{+2} + Mg^{+2}$ and available P increased to 5.5, 18.80 g/kg, 11.2, 7.8 cmol (P+)/kg⁻¹ and 11.6 ppm, respectively with 1 t lime/ha. Furrow liming, *Rhizobium* and P fertiliser was found beneficial in increasing the pod yield, nutrient uptake and nutrient status of the soil.

Use of biofertilizer along with organic manure in cropping systems of Manipur hills

(M. Raychaudhuri, Kailash Kumar & Sanjeev Kumar)

Application of biofertilizer, organic manure and fertiliser increased the grain yield, N and P uptake of the grains significantly over control. Maize showed similar trend as that of the previous year with the maximum yield of 52.1q/ha at FYM 10 t/ha + B + NPK. Leguminous crops differed from the trend obtained last year. Though FYM + B + NPK gave the maximum yield of soybean and black gram but the maximum significant increase in yield was obtained with FYM @ 10 t/ha + B + 1/2 NPK. The results suggest that for cereals recommended dose of NPK is highly required each year with FYM + B to get maximum production. For soybean and black gram though recommended dose of NPK is required in the first year alongwith FYM + *Rhizobium* but NPK can be reduced to its half dose in the next year for optimum yield of soybean whereas for black gram no fertiliser is required in the next year to get an optimum yield. The N and P uptake by the crops followed the similar trend as that of their respective yields.

The second crop, black gram grown in the Maize - black gram - mustard cropping system gave a maximum yield of 7.6 q/ha with residual effect of FYM + B + NPK. All the treatments showed significant residual effect on the yield of the crops. FYM + B + 1/2 NPK showed the maximum significant residual effect on the crop grown after maize.

FISH

(V.R. Suresh)

Nutritional studies on selected species of cultivable fishes

Ten advanced fingerlings each of *Cyprinus carpio* var. *Communis* were tested for 40 days to determine the suitability of dried *Azolla* and a marshy weed *Alternanthera philazeroides* as ingredients in pelleted feeds. A conventional diet made of ricebean and M.O.C. (1:1) was used as control against four diets of incorporating different levels of *Azolla*, *Alternanthera*, ricebean and M.O.C. The ingredients of each feed were mixed with distilled water, steamed for 15 minutes, cooled and Vitamin and Sodium benzoate were added. These diets were then palletised (1.5 mm dia). The variations in water temperature, pH, dissolved oxygen and alkalinity during the experiment were 27.5 - 28.5°C, 6.8 - 7.5, 7.5 - 8.3 ml/l and 40-60 ppm respectively and were within desirable range for carps. Feeding was done @ 10% of body weight/day. The fishes accepted all the diets, and no mortality was recorded.

Better weight gain, digestibility and FCR were observed in fishes fed on ricebean and M.O.C (1:1) followed by 34.4, 34.4 and 30.2% M.O.C., *Azolla* and *Alternanthera* and 34.6, 32.2, and 32.2% ricebean, *Azolla* and *Alternanthera*, respectively.

Growth response and nutritive value of fish meal and soybean meal incorporated pelleted feed

Experiments were conducted in the laboratory on fingerlings of *Cirrhina mrigala* to determine the efficiency of fish feeds containing fish meal and soybean meal as source of protein, over the conventional feed. Four pelleted feeds were prepared with ingredient combination so as to get approximately 35% protein in each feed and control with ricebran, M.O.C. and other additives. Better weight gain was obtained in different combination fish meal (3.1 ± 0.4 and 3.83 ± 0.7 g) incorporated with 5 and 10% of fishmeal and 10 and 5% of soybean meal. Percentage growth was also high with 10% fishmeal (58.92) followed by 50% (46.04). Digestibility of protein, carbohydrate and lipid was better with former. Although the feed intake did not vary significantly between the treatments (10.02 to 10.88 g dry matter/individual), FCR was better in both ingredients. The experiment revealed that adding 10% fishmeal, 5% soybean meal and 25% maize flour produced 72.5% more growth than the control, and also indicated that feeds containing both plant and animal matter as source of protein produced better growth.

Carp feed containing different animal and plant materials as protein source

Feeding trials were conducted on *Cyprinus carpio*, with nine formulated pelleted feeds, for 60 days, to evaluate different animal and plant materials available locally, as protein source in the feeds. The materials were dried, powdered and passed through 100 micron mesh mixed according to square method to get 38-40% protein in each feed. These were mixed with distilled water, steamed for 15 minutes and after cooling Vitamin mix was

added and pelleted (1.5 mm dia). The protein content of the pellets varied between 38.3 and 40.3%. Feeds containing all animal protein and animal and plant protein produced maximum weight gain (8.19 and 8.42 g, amounting to 0.13 and 0.14 g/day respectively). Multiprotein feeds were better utilised by the fish than those containing single source of protein. Lowest FCR was obtained for feed containing all animal proteins in equal proportion. Source of protein was also found to affect the deposition of protein in muscles, as feeds containing fish meal and slaughterhouse waste produced 68.7 and 65.1% protein in muscles. Feeds containing all animals' matter and that with soybean meal were the most stable in water (1.8% dry matter loss). The results showed that animal protein sources were better utilised by the fish than plant protein sources. Slaughterhouse waste and chicken viscera can be utilised in fish feeds as source of protein along with plant materials, like M.O.C., groundnut waste, soybean waste etc.

Composite fish farming: Food habits and composite culture of a medium carp (*Osteobrama belangeri*) along with major carps

A composite fish culture trial involving *Catla catla*, *Labeo rohita*, *Cirrhina mrigala*, *Osteobrama belangeri* and *Cyprinus carpio* var. *Communis* at a rate of 2:1:1.5:3:1 respectively was taken up with three treatments. In T_1 all the species were stocked simultaneously. Indian major carps were introduced after 2 and 5 months of stocking of *Pengba* and common carp in T_2 and T_3 respectively. Stocking density was @ 8,000/ha, with advanced fingerlings. Without inorganic fertiliser, rice bran and M.O.C. (1:1) @ 5-10% of total body weight/day was given as supplementary feed. Fresh duck weed and *Azolla* @ 10% of

body weight of *Pengba* and common carp was also offered daily after 5 months of their stocking. Stocking was started from August 1998. All the fishes were allowed to grow upto 10 months from the date of stocking. The pH of the pond water varied between 6.0 to 6.5, alkalinity (28 to 42 ppm) and dissolved oxygen between 5.5 to 8 ml/l. The low production of *Pengba* in T_1 is attributed to their inability to compete with Indian major carps for food as early stages of all these thrive predominantly on zooplankton and other fauna. Delayed stocking of Indian major carps for 2-5 months helped better production of *Pengba*, without adverse effect on other species involved in the study.

Improved fish smoking oven: Designing and evaluation

In order to improve the local fish smoking method, a simple, cheap and easy to make oven was made using old oil drum (240 l.). The drum was cut into three sections and at the mouth of the two top sections, metal mesh with hooks were attached. On placing on top of other, with the bottom section for fire, a column could be made. The fishes were hung on the hooks. The sections holding fishes were interchanged periodically to ensure uniform heating. Preliminary testing revealed the following advantages over the local method.

- * Maximum utilisation of smoke and heat, as these did not disperse in the air.
- * Horizontal area needed in relation to number of fish smoked is less (220 fishes of 15 cm T.L./section, i.e. 120 nos/sq.foot) than that of the local method (15-20/sq.foot).
- * Smoke and heat is uniform on all sides of fishes, as they are hung, instead of lying.

- * Smoked fish looked attractive and hold good flavour.
- * No scorch marks on the fishes.
- * Low manual labour.
- * Low fuel consumption.

AGROFORESTRY

(S.V. Ngachan, L.L. Simte, Th. Raghurani Singh & Ramesh Singh)

Collection and evaluation of *Casuarina* species

Three casuarina species viz., *C. cummenggiana* and *C. glanca* collected from the Australia Tree Seed Centre and *C. equisatifolia* collected from the Deputy Conservator of Forest (Genetics), Coimbatore were examined for the 7th year. Maximum plant height (20.63 m) and BHD (12.58 cm) were recorded with *C. equisatifolia* followed by *C. glanca* EC 326191 (16363) 12.50m, 13.4 cm), *C. cunninggiana* EC 326195 (15574) (8.73 m, 7.10 cm) and *C. glanca* EC 325190 (16363) (8.67 m, 8.50 cm), respectively. As compared to other species, *C. equisatifolia* showed significantly better performance in all parameters.

Effect of stump sizes in the growth of *Gmelina arborea*

A trial to study the effect of stump sizes (1.15 cm, 1.30 cm, 1.45 cm and 1.60 cm) on the growth performance of *G. arborea* was established in May 1996. After four years of planting maximum plant growth was recorded (1.45-cm) upto 4.90-m height with basal diameter of 5.43 cm against the mean growth (4.22 m, 4.96 cm). Even after 4 years of planting, there is no effect on plant growth from these four treatments.

Provenance of *Parkia roxburghii*

Out of fifteen provenances collected from five districts of Manipur, four provenances viz., Prov. No. 11, 12, 14 and 15 were damaged by jungle fire. Maximum plant height after 7 years of planting was recorded with Prov. No. 4 (7.93m) with BHD 10.73 cm followed by Prov. No. 3 (7.17m, 9.48 cm) and Prov. No. 7 (7.09 m, 9.30 cm) respectively. Maximum canopy was recorded with Prov. No. 4 followed by Prov. No. 7.

A trial on the effect of stem and root cutting of four years old plants after transplanting was carried out to study the branching, fruiting and growth performances. Maximum plant height was recorded with Prov. No. 12 (5.50 m) followed by Prov. No. 4 (5.02m) and Prov. No. 9 (4.82 m). Whereas maximum B.H.D. (7.53 cm) was recorded with Prov. No. 4 followed by Prov. No. 12 (7.20 cm) and Prov. No. 9 (6.25 cm). After three years of planting there is no significant different in the growth.

Development of suitable management practices for different agroforestry systems

Silvi-horti-pastoral system

Due to increase in height and canopy of all the 9 different tree species, all the terraces were covered with banana (*Musa balbisiana* constitution A BB). About 50% flowering on 18.1.2000 was recorded on the terrace between *P. roxburghii* and *L. polyantha* followed by the terrace between *L. polyantha* and *S. wallichii* where there was less tree canopy. Yields of pastoral crop viz., *Panicum maxicum* and NB-21 were negligible due to total suppression by the canopy of both the banana and trees.

Maximum plant growth after 7 years of planting was recorded with *E. teriticarnis*

(height - 16.93 cm, B.H.D. - 17.18 cm) followed by *E. citriodora* (14.10 m, 15.84 cm), *A. auriculiformis* (12.97 m, 18.32 cm), *P. roxburghii* (10.19 m, 15.14 cm) and *M. azadirneh* (9.88 m, 17.2 cm) respectively. Minimum was recorded with *L. polyantha* (4.75 m, 6.84 cm). After 7 years, fruiting in some plants were recorded with *A. integrifolia* and *Parkia*.

Agri-horti-pastoral system

Agricultural crops viz., groundnut (JL-24), maize (Vijay composite); rice (RCM-5); soybean (PK-472) and red gram (ICPL-87) were cultivated in the terraces, pastoral crops viz., *Panisetum pedicellatum* and *Panicum maxicum* were planted on the terrace risers and horticultural crops viz., orange and pineapple (var. Kew) were also planted on the riser bunds. A field trial in RBD was conducted during *kharif* with recommended doses of fertiliser and spacing. Maize, groundnut, rice, soybean, arhar yields were recorded with groundnut ranging from 1.74 to 2.24 t/ha; maize from 4.63 to 6.53 t/ha; rice from 2.81 to 3.48 t/ha; soybean from 1.92 to 2.97 t/ha and red gram from 1.15 to 2.10 t/ha under rainfed condition.

Fodder yields ranging from 28.66 to 37.35 t/ha and 30.00 to 38.33 t/ha were recorded with *P. pedicellatum* and *P. maxicum* respectively. There were strong competition among horticultural crops viz., Khasi mandarin and pineapple with the fodder crops just like weeds and also taken the maximum fertiliser applied for the horticultural crops. Therefore, yields of the horticultural crops specially pineapple is coming down to negligible. In case of orange, maximum height upto 3.10 m and BHD upto 5.88 cm was recorded with terrace No. 1 followed by 2.91 m and 5.94 cm and 2.19 m and 4.10 cm with terrace No. 2 and 5 against minimum growth in terrace No. 3 (1.65 m 2.84 cm).

PUBLICATION

- Raychaudhari, M. and Sanyal, S.K. (1999) Forms of K and quantity intensity parameters of an acid hill Ultisol limed to different levels. *J. Indian Soc. Soil Sci.* 47: 229-234.
- Raychaudhari, M., Kumar, K. and Ngachan, S.V. (1999) Jaibik kheti aur soybean (Hindi). *Purbottar Parvatya Krishi* 6.

Mizoram Centre

EXECUTIVE SUMMARY

Out of 20 varieties of rice tested under lowland conditions, RCPL-1-88-78, Ngoba, DR-92, RCPL-1-87-4 and RCPL-1-87-8 performed better in order. ZL-1, LT-4 and MP-2 gave highest yield (21-22 q/ha) among the 15 local rice germplasm. Under upland condition, VL-206 and RCPL-1-27 produced highest yield among 13 varieties. It was found that 10:60:40 kg NPK/ha along with 5 t poultry manure/ha gave highest and optimum yield of lowland rice.

Among 10 varieties of maize, RCM-1-3 performed better followed by MLW and RCM-1-1. The first week of April was the best sowing time to get highest kernel yields in 3 maize varieties out of 5 tested.

Out of 10 varieties of groundnut, Girinar-1 performed better followed by ICGS-44 and ICGS-1. The shelling percentage was high in ICGV-87187. Highest pod yield of groundnut was obtained with recommended dose of NPK and either 15 t FYM or 5 t poultry manure/ha. Mustard varieties Rohini, Kranti and PCR-7 in order yielded highest out of 15 tested. Out of same number of soybean varieties, JS-335, NRC-2, PK-472 and Bragg yielded better.

In a ginger evaluation trial, RCT-1 gave highest yield of 579 q/ha fresh rhizome follows by Meghalaya local II (426 q/ha) and Kasturi Tanaka (381 q/ha)

Radish variety Japanese white recorded highest yield followed by Pusa Chetki. Kufri Megha of potato variety gave higher tuber yield as compared to Kufri Jyoti.

Application of 400-300-300 g NPK and 20 kg FYM/tree of guava (Allahabad Safeda) gave average yield of 176 fruits/tree. 13 years old Khasi mandarin could not bear fruits due to attack of citrus die back, trunk borer, twig borer and citrus psylla and nutrient deficiencies.

INTRODUCTION

ICAR Research Complex for N.E.H. Region, Mizoram Centre, Kolasib was established in 1975 to cater to the research needs of the state in the field of agriculture, live-stock and horticulture landuse as an alternative to shifting cultivation. The farm has 32.32 ha land located at an altitude varying between 750-800 m msl. It comprises steep to mild hill slopes between gorges and streams.

WEATHER

The maximum average temperature (30.72°C) was recorded in the month of April and minimum (11.13°C) in January. However, the 16th July was observed as the hottest day of the year with a temperature of 35.0°C and 1st January was the coldest one (9.5°C). The maximum relative humidity (89.29%) was observed in July and the minimum (84.55%) in April. The total annual rainfall recorded during 1999 was 2303.75 mm with a maximum of 461 mm in August and no rainfall in January and February. The highest rainfall (94 mm) recorded in a single day was on 4th September 1999.

RICE

Yield evaluation trials

(N.S. Azad Thakur, Rajesh Kumar & K. Laxminarayana)

Under low land conditions, 20 varieties of paddy viz., RCPL-1-87-8, Jaya, RCPL-6-2, IR-62, RCPL-6-1, RCPL-1-88-115, RCPL-6-5, RCPL-6-7, RCPL-1-88-78, Ngoba, RCPL-1-3, DR-92, RCPL-1-87-4, MC-18-1-46, MC-17-4-23, Basmati, RCPL-1-4, IR-65 and Hariharain were evaluated. Out of these varieties, RCPL-1-88-78, Ngoba, DR-92, RCPL-1-87-4 and RCPL-1-87-8 performed better with an average yield of 61, 53, 52, 50 and 46 q/ha, respectively.

Another set of five early varieties (L-11, L-9, L-55, L-23 and IR-64) were evaluated under lowland conditions and IR-64 was superior with an average yield of 45 q/ha followed by L-11 (21 q/ha).

Out of 15 local germplasm tested, highest yield (22 q/ha) was recorded in ZL-1 followed by LT-4 (21 q/ha) and MP-2 (22 q/ha).

Under upland condition, 13 varieties (VL-206, RCPL-1-28, RCPL-1-27, RCPL-1-24, RCPL-1-23, RCPL-1-22, RCPL-1-25, Bali, RCPL-1-21, RCPL-1-29, IET-15046, RCPL-1-26 and IET-13783) were evaluated. Among these varieties VL-206 (35 q/ha) was the highest yielder followed by RCPL-1-27 (33 q/ha) and RCPL-1-24 (23 q/ha).

Integrated nutrient management

(K. Laxminarayana)

An experiment was conducted in lowland rice (cv. L-11) to study the effect of 50% NPK, 100% NPK (100-60-40 kg NPK/ha), 150% NPK, 100% N, 100% NP, 100%

NPK + 15 t FYM /ha, 100% NPK+5 t poultry manure /ha, 100% NPK + 5 t pig manure/ha, 100% NPK + ZnSO₄ 20 kg/ha and control.

The application of 100% NPK + 5 t poultry manure/ha gave highest grain yield (51.3 q/ha) followed by 100% NPK +5 t pig manure/ha (49.3 q/ha) and 100% NPK +15 t FYM/ha (48.6 q/ha). Application of 100% NPK has recorded highest grain yield as compared to 50% NPK and 150% NPK. Straw yield almost remained constant by the application of fertilizers and manures (11.1-11.9 t/ha). Thus results indicated that integrated use of organic manures and balanced chemical fertilizers sustain the crop yields and maintain the fertility of soil.

MAIZE

(N.S. Azad Thakur & K. Laxminarayana)

Ten varieties of maize (Mahi, Kanchan, RCM-1-3, RCM-1-2, Vijay, RCM-1-1, MLY, MLW, Navin, Gujarat Makki-2 and Megha) were evaluated. The seeds were sown in the last week of April at a spacing of 45x 30cm with fertilizer dose of 100-80-60 kg N, P₂O₅ and K₂O/ha. Among the varieties, RCM-1-3 performed better with an average kernel yield of 39 q/ha followed by MLW (34 q/ha), Vijay (32 q/ha) and RCM-1-1 (26 q/ha), and RCM-1-2 recorded lowest yield (12 q/ha).

Effect of date of sowing on yield

The first week of April was the best for sowing to get highest kernel yield for varieties Ganga (54 q/ha), RCM-1-1 (33 q/ha) and RCM-1-3 (31 q/ha). However, the varieties Navjyot and RCM-1-2 have recorded highest yield (48 and 24 q/ha, respectively) when sown during 3rd week of April.

OILSEEDS

GROUNDNUT

(N.S. Azad Thakur & K. Laxminarayana)

Ten groundnut varieties (Girinar-1, ICGS-65, ICGS-44, ICGS-1, ICGV-86325, ICGV-86590, JL-24, NRCG-1407, NRCG-5953 and ICGV-87187) were screened during *kharif* at a fertilizer dose of 60-40-40 kg N, P₂O₅ and K₂O/ha. Among the varieties, Girinar-1 performed better with a yield of 24.5 q/ha followed by ICGS-65 (23.5 q/ha), ICGS-44 (23.4 q/ha) and ICGS-1 (22.3 q/ha). The other varieties also recorded an average yield of 18-20 q/ha. The variety ICGV-87187 had shown highest shelling percentage (79.5%). The kernels of Girinar-1 were bold, large and higher in test weight (46.5 g).

Integrated nutrient management

(K. Laxminarayana)

An experiment was conducted during *kharif* to study the effect of graded doses of NPK in combination with organic manures on yield performance of groundnut. Highest pod yield (20.4 q/ha) was recorded with the application of 100% NPK +15t FYM /ha and closely followed by 100% NPK + 5 t poultry manure /ha (13.8 q/ha) and 100% NPK+5t pig manure /ha (17.9 q/ha). All other yield attributes showed the same trend in line with pod yield. These results also revealed that combined application of organic manures and inorganic chemical fertilizers enhanced the crop yields and sustain the soil fertility.

Mustard

(N.S. Azad Thakur & K. Laxminarayana)

Fifteen varieties of mustard viz., RH-3159, Vaibhav, PCR-7, Pusa Bahar, Kranti, Bio-902, TM-2, Varuna, TM-4, RH-3, Rohini, RH-819, Sangita, Sharma and Pusa Bala were

evaluated during *rabi* at fertilizer dose of 50-60-60 kg N, P₂O₅ and K₂O/ha. It was observed that the variety Rohini recorded highest yield (19 q/ha) followed by Kranti (16.5 q/ha), PCR-7 (16.0 q/ha) and RH-3 (13.8 q/ha).

Soybean

(N.S. Azad Thakur & K. Laxminarayana)

Out of fifteen varieties of soybean, JS-335 recorded highest yield (12 q/ha) followed by NRC-2 (11.2 q/ha), PK-472 (11 q/ha) and Bragg (10 q/ha). The crop was affected by leaf folders and pod borers and controlled by spraying of Nuvacron @ 1.5 ml/l of water.

SPICES

Turmeric

(N.S. Azad Thakur & K. Laxminarayana)

An evaluation trial was conducted during *kharif* with 8 varieties (Lakadang, PCT-15, Meghalaya local-I, PCT-12, PCT-11, Meghalaya local II, Kasturi Tanaka and RCT -1. Highest yield (fresh weight basis) was recorded in RCT-1 (579 q/ha) followed by Meghalaya local II (426 q/ha) and Kasturi Tanaka (381 q/ha). The variety Lakadang recorded a yield of 310 q/ha with highest curcumin content.

VEGETABLES

(N.S. Azad Thakur & K. Laxminarayana)

Radish

Four varieties of radish viz., Red aush, Chinese pink, Pusa Chetki and Japanese white were grown and Japanese white-recorded highest yield (860 q/ha) followed by Pusa chetki (760 q/ha).

Potato

Kufri Mehga recorded highest tuber yield of 184 q/ha as compared to Kufri Jyoti (148 q/ha).

FRUITS

(N.S. Azad Thakur)

Guava

The saplings of 'Allahabad Safeda' were planted in 1986 and a fertilizer dose of 400-300-300 g N, P₂O₅ and K₂O along with 20 kg FYM per plant were given. An average yield of 176 fruits per plant having a diameter of 6.21 cm and a weight of 121.25 g was recorded.

Citrus

The citrus plants (Khasi Mandarin and Assam Lemon) were planted during 1986. No fruiting was observed due to citrus die back, trunk borer, twig borer and citrus psylla and deficiency of nutrients.

PUBLICATION

- Azad Thakur, N.S. (1999) A eichhetu natna leh rannung laka ven leh enkawl dan. *Huan Eknawltu* 5: 19-21
- Azad Thakur, N.S. & Laxminarayana, K. (1999) Mizoram ek Simhalokan (Hindi). *Purvottar Parvateea Krishi* 6: 51.
- Laxminarayana, K. & Azad Thakur, N.S. (1999) Effect of phosphorus on yield performance of wheat in acidic soils of Mizoram. *J. Hill Res.* 12: 138-140.
- Laxminarayana, K. & Rajagopal, V. (1999) Zinc status of some rice soils of Andhra Pradesh. *Micronutr. News* 13: 2-3.
- Rajesh, K., Prasad, K. & Azad Thakur, N.S. (1999) Tung: an industrial oilseed crop with good prospects of its cultivation in Mizoram. *J. North Eastern Concil* 29: 15-16.

Nagaland Centre**EXECUTIVE SUMMARY**

Out of 14 rice varieties, Heeng, Jeera, K.D. 263, MW-10, hybrid 6111 and 6201 were least susceptible to leaf roller damage. Furadan 3G (carbofuran) was highly effective against stem borer. Insecticides were more effective than indigenous methods in controlling the gundhibug population. Hybrid 6201 was comparatively superior to 6111 with an average yield of 53 q/ha and free from insects and diseases.

Out of 22 varieties of green gram under IVT, MIVT-865, 853, 850, 851, 867 and 848 gave higher yield of about 10-13 q/ha.

M-27 variety of mustard yielded high (15.35 q/ha). Sunflower (var. Morden) performed better in *rabi* than *kharif*.

Application of 300 ppm boron to tomato favoured the higher productivity; cabbage hybrids yielded almost double of the existing varieties.

Azolla @ 10 g/plant along with 20 kg FYM and half of the recommended dose of NPK/tree improved the yield attributing characters of banana. Hand weeding was equally effective to weedicides in controlling the weeds. The application of manures from cow, rabbit and pig fortified with 25% DAP gave

higher yield. Spraying of GA3 at 100 ppm improved physical parameters of papaya fruits. CO 6 of papaya variety gave higher number of fruits/tree out of 4 varieties tested. A small model of kitchen gardening was developed.

Charmil was found cheaper to control the skin treatment of animals. Rabbit ration substituted with 40% banana leaves gave highest productivity. Livefit vet can be used @ 4 kg/ton of feed premix or liquid 40 ml/50 rabbits to check the effect of aflotoxicosis (0.8 ppm) in feed. Ruchmax can be used as a regular tonic for broiler rabbit.

INTRODUCTION

In 1975, when research centre was set up for Nagaland State, two different locations were planned one at Yiesmyong near Mokokchung for taking up problems of high altitude areas and other at Jharanapani for taking up the agricultural problems of lower altitude. Presently the centre is functioning at Jharanapani about 27 km away from Dimapur. Research activities for high altitude areas are now carried out at Pfüterero. The centre is working on rice, maize, oilseeds, plant protection, livestock management and transfer of technology programmes through KVK.

RICE

INTEGRATED PEST MANAGEMENT

(P. Venkateswarlu)

Assessment of leaf roller damage

Out of 14 varieties, leaf roller damage was found to be maximum (13.44 leaves/10 hills) in Dwarf Mashuri followed by Mashuri (12.88) and Sarsa (11.55); whereas Heeng Jeera, Pankaj, K.D. 263, MW-10, hybrid 6111 and 6201 were least susceptible.

Insecticide trial

Nine insecticides were tested against stem borer and leaf roller in variety Dwarf Mashuri. Furadan 3G (*carbofuran*) was highly effective against stem borer followed by marshal 6G (*carbosulfan*) and durmet 20E°C (*chlorpyrifos*), the per cent reduction of damages being 86.45, 82.41 and 75.85 respectively. Leaf roller damage was effectively controlled by Scout 1.8 EC (65.90%). The per cent reduction of leaf damage ranged between 58.07 and 49.72 in other treatments.

Indigenous methods of control

The efficacy of 4 indigenous traditional knowledge techniques (ITKs) over two years of study revealed that insecticides were more effective than indigenous methods in controlling the gundhi bug population and increasing yields. However, a comparison of ITKs indicated that dead frogs (40.55%) followed by crabs (33.96%) with an increase in the yield of rice to the extent of 3.85 and 3.50% attracted more bugs, respectively. Among the insecticides, deltamethrin 0.001% showed the highest per cent reduction of bugs (93.50) with an increase in the yield by 9.85% over control.

Performance of hybrids

(A.K. Khan & P. Venkateswarlu)

Two hybrid varieties of rice (6201 and 6111) obtained from Directorate of Rice Research, Hyderabad were evaluated. Hybrid 6201 was superior to 6111 with an average yield of 53.0 q/ha and free from insects and diseases.

PULSES

(A.K. Khan & P. Venkateswarlu)

Twenty-two varieties of green gram were assessed for the yield and yield attributes in

initial variety trial (IVT). The varieties MIVT-865, 853, 850, 851, 867 and 848 yielded significantly higher than others. The yield of these varieties was between 10-13q/ha.

OILSEEDS

Mustard

(A.K. Khan & P. Venkateswarlu)

Five lines were tested for yield and other characters under rainfed rabi. M-27 yielded highest (15.35 q/ha) followed by TCN 43 (8.39 q/ha).

Sunflower

(A.K. Khan & P. Venkateswarlu)

Sunflower (var. Morden) was superior in rabi with an average plant height of 118.5 cm, head diameter of 24.6 cm and yield of 12.56 q/ha. In kharif, plant height, head diameter and yield were recorded as 103 cm, 20.2 cm and 7.93 q/ha. In rabi, seed formation was proper but, the incidence of tobacco caterpillar, *Spodoptera litura fab* was slightly more than in kharif.

FIBRE CROPS

Cotton

(P. Venkateswarlu & A.K. Khan)

L 389 was evaluated for its performance under foothill conditions. The plant attained an average height of 148 cm with 9 branches and 62 bolls. The average yield was 21.02 q/ha and length of fibre was 3.56 cm. During the crop period, insect pests like jassids and American bollworms were recorded but their population was below economic threshold level.

VEGETABLES

Effect of boron application on tomato

(Naresh Babu)

Two consecutive sprays (one at 30 days of transplanting and the second after fruit set) of boron @ 50, 100, 150, 200, 250 and 300 ppm on var. Pusa Ruby showed that the element had positive effects on height of plant, number of branches, flowering, fruit set and locule number resulting in increased number of fruits/plant and the yield. At 250 and 300 ppm concentrations, yield and TSS were increased, whereas, sugar, ascorbic acid and acidity of fruits reduced.

Performance of hybrid cabbage

(Anamika Sharma)

Two F₁ hybrids (Sudha and Green ball) were assessed for comparison with already existing and improved varieties like Pride of India and Golden Acre. Hybrids were late by 20-25 days and yielded about 416 q/ha with a head size of 1.5 kg, whereas, the existing varieties were early with an average yield of 208.35 q/ha and head size of 0.75 kg. In hybrids, head was very compact and keeping quality was more than normal varieties.

FRUITS

BANANA

(Naresh Babu)

Effect of manures and bio-fertilizers

A field experiment was conducted to study the effect of organic manure (FYM and green manure) and bio-fertilizer (Azolla) with NPK on growth and yield of banana variety Robusta. The study revealed that application of Azolla @ 10 g/plant with 20 kg FYM and half of the recommended doses of NPK (200, 100 and 400 g/plant/year) contributed 22.19,

21.45, 36.82 and 27.35% increase in pseudo stem height, girth, number of functional leaves and leaf area, respectively over control.

Weed management practices

Seven weed management practices viz. hand weeding, mulching with hay, paddy straw, black polythene, inter-cropping of french bean, green gram and spraying glyco phosphate @ 3 ml/lit indicated that more pseudo stem height (141.08 cm) and girth (57.33 cm) were recorded in hand weeding which was at par with mulching and black polythene and these were superior to other treatments. However, number of functional leaves was not influenced though the total leaf production and leaf area showed significant differences among different treatments.

Effect of organic manures on growth and yield

(P.P. Rohilla, K.M. Bujarbaruah & N. Babu)

Different livestock dungs viz. cow (T-1), rabbit (T-2) and pig (T-3) were fortified with 25% DAP by keeping in pits (1 cum.) for 6 months tightly closed and control (T-4). It was found that treatment had a significant ($P < 0.05$) effect on growth and yield of banana, however, chemical composition was not affected. It was evident that manures from cow, rabbit and pig could be fortified (25% DAP) for obtaining higher yields.

PAPAYA

(Naresh Babu)

Effect of plant growth regulators

Spraying of GA3 @ 100 ppm improved the physical parameters of fruits viz.: number of fruits (19.81/plant), length of fruit (30.27 cm), diameter of fruit (27.81 cm), weight of fruit (1237.20 g), pulp content (992.70 g), yield (24.51 kg/plant) and minimized the weight of seeds/fruit (1.29 g). NAA at 100

ppm increased the chemical constituents of fruits, TSS (14.05%), sugar (10.21%) and ascorbic acid (49.13 mg/100g).

Variety trial

Out of 4 varieties of papaya (Coorg Honey Dew, CO2, CO5 and CO6) tested, maximum number of fruits/plant (79.54) was recorded in CO6 and fruit set (56.07%) and weight of individual fruit (2.03 kg) were more in CO5.

Model kitchen garden

(Anamika Sharma, P. Venkateswarlu, H.D. Singh & A.K. Khan)

A small model of kitchen garden (41.0 × 17.5 m area) was developed near farm office to draw the attention of farmers and other visitors. Half of the area was covered under fruit crops and the remaining area under vegetables. Fruit crops like banana, pineapple, papaya, Assam lemon, mango, guava, litchi, jackfruit, arecanut and the vegetable crops like french beans, pea, carrot, turnip, radish, potato, palak, dhania, cabbage, tomato, bhendi, onion, chilli, drumstick, curry leaf and tapioca. During the year 183.50 kg worth of Rs. 1392/- was received from vegetable crops.

PIG

Growth, production and reproduction performance

(P.P. Rohilla, K.M. Bujarbaruah & W.R. Singh)

A survey of 10 villages covering different parts of the state was conducted. Data regarding growth rate and reproductive performance of pigs and poultry were recorded. In pigs, average daily weight gain was 191 g/day, age of maturity was 517 days, litter size at birth was 8.40, litter size at weaning was 6.06 and litter weight was 541 g. Gestation period was

117 days, piglet mortality was 33%. In meat type poultry, average daily weight gain was 128 g/day and marketing age was 13 weeks. Egg type birds started laying at 180 days, number of eggs/per year was 134 and average egg weight was 43.4 g.

CATTLE AND OTHER ANIMALS

Comparative efficacy of Himax and Charmil skin gel therapy in animals

(P.P. Rohilla & W.R. Singh)

A clinical study in cattle for various disorders using Himax and Charmil over 4 years period was reported. Both ointments were found equally effective, safe and economical for skin treatment of animals, however, Charmil was found to be cheaper by (Rs.3.50/10g) than Himax in the market during the year. The trend was similar in pig and rabbit also.

RABBIT

Effect of banana leaves feeding on growth

(P.P. Rohilla & K.M. Bujarbaruah)

Rabbit ration was substituted with 0, 20, 40 and 60% banana leaves on DM basis. Body weight, feed intake, body temperature and respiration rate was recorded individually. Highest growth was recorded in 40% banana leaves and minimum average DM intake in 60% banana leaves and control groups.

Therapeutic efficacy of livfit vet against aflatoxicosis

(P.P. Rohilla, G. Singh & K.M. Bujarbaruah)

Therapeutic efficacy of livfit premix and liquid was evaluated against aflatoxicosis in rabbits fed on naturally contaminated (0.8 ppm) feed. There was significant ($P < 0.05$)

variation from healthy controls with regard to live body weight, relative weight of liver, kidney and biochemical traits. It was concluded that livfit vet can be used @ 4 kg/t of feed premix or liquid @ 40 ml/50 rabbits to check the effect of aflatoxicosis (0.8 ppm) in feed.

Addition of Ruchamax in ration

(P.P. Rohilla & K.M. Bujarbaruah)

Thirty rabbits (NZW & SC) aged 40-45 days were divided into 3 equal groups. Ruchamax was added @ 0.2% (T-2) and 0.4% (T-3), while the first group was kept as control (T-1). Based on the present study Ruchamax may be used economically as a regular tonic for broiler rabbits for highest growth.

PUBLICATION

Babu, N. & Verma, R.C. (1999) Vaiganik Vidhi Apani, Subji Utpadan Badhain. *Poorvuttar Purvatiya Krishi* (Hindi). 6 : 29-39.

Rohilla, P.P., Bujarbaruah, & Singh, G.P. (1999) Effect of different fertilizers on growth of napier. *Indian Farming* 49: 20 -21.

Rohilla, P.P. & Verma, S. (1999) Note on milk production performance of Jersey crossbreds in foothills of Nagaland. *Indian J. Anim. Prod. Mgmt.* 14 : 65 -67.

Rohilla, P.P. & Bujarbaruah, K.M. (1999) Effect of fortified organic manure on production of beans (*Phaseolus vulgaris*). *Indian farming* 49 : 6-8

Rohilla, P.P. & Bujarbaruah, K.M. (1999) Effect of *Morus alba* feeding on growth and physiology of rabbits. *Intern. J. Ani Sci.* 15: 9-11.

Rohilla, P.P. & Bujarbaruah, K.M. (1999) Effect of subabul (*Leucaena leucocephala*) feeding on growth and physiology of rabbits. *J.Hill Res.*12: 135-137.

Rohilla, P.P, Bujarbaruah, K.M, Singh G.P & Kumar, M. (1999) Haematological and

biochemical studies on pure and cross-bred rabbits. *Indian J. Anim. Sci.* 70: 60-62

Rohilla, P.P, Bujarbaruah, K.M, Singh G.P & Kumar, M. (1999) Indigenous technical knowledge used for animals treatment in foothills of Nagaland. *Indian J.Hill Farming* 12: 121-123.

DISTINGUISHED VISITORS

Name	Designation & Address	Date of visit
Dr. Kirti Singh	Chairman, ASRB, New Delhi	09-05-1999
Dr. K. Pradhan	Vice Chancellor, RAU, Bikaner	09-05-1999
Dr. Kannayan	Dean, Agri. Tamilnadu Agri. Univ.	09-05-1999
Shri. Apok Jamir	Hon'ble M.P, Nagaland	26-07-1999
Shri. J.P. Negi	IAS, Executive Director, National Horticulture Board, New Delhi	30-10-1999
Dr. (Mrs) Mitra	Deputy Director, National Horticulture Board, New Delhi	30-10-1999
Dr. K. Chuba Ao	Director (Hort), Govt of Nagaland	30-10-1999
Shri Rokonicha	Minister, Wasteland Development, Govt. of Nagaland, Kohima.	26-01-2000
Dr. Arun Verma	ADG (A.N. & P), ICAR, New Delhi	15-02-2000
Dr. S.S. Baghel	Vice Chancellor, C.A.U, Imphal	29-04-1999

Sikkim Centre

EXECUTIVE SUMMARY

In maize, crossing was made in all possible combinations excluding reciprocal and 41 cross cobs obtained for further advancement. 41 cross cobs hybrid and 30 inbreds were maintained. In advancement of F_3 inter-varietal crosses, NE Comp \times RCM 1-1 gave highest yield followed by RCM 1-2 \times Line 9681 and RCM 1-1 \times Renuka. In yield evaluation of Zonal Co-ordinated trial, ZMR 101 and ZMR-113 yielded maximum.

The black gram varieties, RCU-6-12, KU-92-1 and TAU-9406 gave maximum yield (7 q/ha) out of 25 tested. Among the 78 lines of rajmash/frenchbean, PR-84-78, UPF-627 and Gheu semi/Butter bean gave maximum pod yield in the decreasing order. Crosses were made to evaluate the subsequent generation segregation for different traits.

Twenty single plant selections were made from F_2 generation crosses bred in half diallel fashion involving 6 promising varieties/lines of yellow sarson. Twenty five single plant selections from F_2 generation of brown sarson cross bred lines were evaluated. Pusa Bold, Pusa Bahar and TM-2 gave, in order, maximum yield out of 15 Indian mustard varieties. The mustard crop sown on 25 September at row spacing of 45 cm resulted in higher yield. The yield of soybean increased significantly up to 40 kg N/ha.

The leaf extract of *Oxyspora paniculata* and *Macaranga iculatadentr* in vitro inhibited the growth of *P. aphanidermatum* and *Pythium* sp. by 94 and 100% respectively. *Trichoderma harzianum*, *T. koningii* and two strains of *T.*

viride had the inhibitory effect on rhizome rot pathogens of ginger.

The survey of livestock diseases reflected that the most important problems were digestive disorder and parasitic conditions. A total of 36 bacterial pathogens were isolated from cervical mucus samples of bovine cows. The specific causes of the death of most German Angora rabbits were systematic infection and pneumonia and non-specific were injury and ureamia. The sex ratio of the kidding of Sikkim local goats for male and female were 1:0.8. The most important causes of mortality were pneumonia and enteritis.

The cabbage waste can be used as rabbit feed. The intake and digestion of mixed jungle grasses were maximum during the month of August when fed to local goats. The Barhar leaves supplemented and mixed with jungle grass indicated that DM intake increased with increasing levels of supplementation without change in eating behaviour. From chemical composition, it was found that broom grass and hybrid napier were most fibrous.

INTRODUCTION

The Sikkim centre of the Complex is located at Tadong, 5 km away from Gangtok at an altitude of 1200 to 1400 m msl. The Government of Sikkim handed over 21.5 ha land in 1976. The farm was properly developed for facilitating research on all the potential crops and livestock. The research findings have been transferred to the farmers by the scientists through KVK attached to the centre under transfer of technology programme.

MAIZE

(J. Meher)

Hybridisation

A crossing programme was initiated among 5 white kernel cultivars viz. RCM 1-3, Sikkim Local white, MLW, NLD white and Gujarat Makki-1 with different desired traits. Crossing was made in all possible combinations excluding reciprocal and obtained 38 cross cobs for further advancement.

Development of hybrids and maintenance of inbreds

Development of single cross hybrid among 9 diverse inbreds was initiated by making crosses in all possible combinations excluding reciprocal to know their hybrid performance over the existing popular cultivars and obtained 41 cross cobs for further testing. Also maintenance of inbreds by setting was done in 30 inbreds.

Yield evaluation and advancement of F_3 inter-varietal crosses

Thirty-five promising intervarietal crosses made during 1997 were advanced for getting more desirable recombinants and more proportion of economic alleles. NE Comp \times RCM 1-1 gave highest yield of 64.3 q/ha followed by RCM 1-2 \times line 9681 (56.8 q/ha) and RCM 1-1 \times Renuka (54.6 q/ha). The duration for maturity was 110.2, 112 and 98 days, respectively for these crosses. Ten-percent best cobs from each cross were constituted to make the composites.

Yield evaluation of Zonal Co-ordinated Trial No. 101

Medium maturity hybrids/composites

A yield evaluation trial consisting of 16 hybrids/composites received from VPKAS,

Almora was conducted. There was a wide variation in yield level ranging from 8.4 to 38.45 q/ha but the standard check gave highest yield of 42.4 q/ha. The best performer line were ZMR-101 yielding 38.46 q/ha followed by ZMR-113 (36.4 q/ha) and ZMR-112 (30.8 q/ha). The maturity duration ranged from 96 to 106 days and ZMR-113 had the longest duration.

PULSES

(J. Meher & Sanjeev Kumar)

Black gram

Twenty-five varieties/lines were evaluated during *khari*. The mean yield of these lines ranged from 3.43 to 7.10 q/ha. The maximum yield was obtained in RCU-6-12 followed by KU-92-1 and TAU-9406 with 6.9 and 6.75 q/ha, respectively. Maturity duration ranged from 86 to 98 days. NDU-94-1 and KU-304 were the shortest duration varieties (86 days) where as Local Pahelodal and RCU-6-15 were longest duration varieties (97 and 98 days respectively). Among other yield attributes pod/plant ranged from 7.0 to 45.6, pod length from 3.98 to 5.11 cm and seeds/pod from 5.06 to 8.5.

Rajmash/Frenchbean

Out of seventy-eight lines of germplasm were maintained, PR-84-78, UPF-627 and Gheu semi/Butter bean gave maximum fresh pod yield of 27.8, 24.7, and 21.3 q/ha, respectively. Highest number of pods/plant was obtained from UPF-227 (23.4) followed by Singtame beans (20.1) and UPF-68 (19.6). The longest pod was recorded in UPF-68 (13.6 cm) followed by Singtem beans (11.8 cm). Maximum seeds were obtained from line 84-78 (10.3) followed by UPF-627 (9.6).

Hybridisation

In order to make the three land races (Gheu semi, Singtem Local and Montula) having long duration but good quality, determinate in habit with shorter duration, an intervarietal hybridisation programme was initiated involving UPF-679, UPF-627, UPF-227, UPF-740, UPF-68, Pusa Parvati, EC-324992, EC-316020, Contender, IC-204102, EC-316037 and EC-324995 as line and above three land races as tests. Crosses were made and 157 cross-pods were harvested to be evaluated in subsequent generation for segregation of various traits.

OILSEEDS

Yield evaluation of *Brassica campestris* var. *Yellow sarson* through Bulk pedigree method

(J. Meher)

Twenty single plant selections was made from F_2 generation crosses bred in half diallel fashion involving six promising varieties/lines viz. SS-1, SS-2, SS-3, YSC-68, YSU-8501 and YSP-842. They were evaluated for their performance at 3 locations along with standard check SS-1. These lines were selected based on the visual performance at late flowering, late reproduction and final seed yield/plant. The yield of these selected lines varied from 10.0 q/ha in [V-9/(Yse-68 x YSP-842) x YSP-842] to 19.3 q/ha. The maturity period varied from 121 days in [V-4/(Yse-68 x SS-3)] to 135 days in [V-1/(YSP-842 x YSK-8501)]. In the above trial 7 lines out yielded the standard check SS-1 (15.2 q/ha). The overall seed yield was poor due to damage during harvesting because of heavy rainfall. Highest yield was recorded in V-11/YSP-842 x SS-3 (19.3 q/ha) followed by V-6/SS-3 x SS-2 (18.4 q/ha) and V-10/YSP-842 x SS-3 (17.7 q/ha).

Among other yield traits V-5 had maximum pods/plant of 150.25, V-16 had highest pod length of 5.42 cm and V-18 had maximum of 17.6 seeds/pod.

Yellow sarson

A bulk was constituted by selecting 5% best promising plants based on morphophysiological uniformity from each of 15 crosses made earlier involving 6 varieties in half diallel design. Some of which were separated in early segregating generation and maintained as 21 lines. These bulks were evaluated for their performance in a replicated trial. The yield of these bulks ranged from 6.5 to 23.66 q/ha and maturity duration from 114 to 125 days. About 6 bulks outyielded the standard check SS-1. Bulk constituted from SS-3 x SS-2 gave maximum yield of 23.7 q/ha followed by SS-3 x SS-1 (23.53 q/ha) and SS-1 x SS-2 (22.75 q/ha). Among important yield attributes YSP-842 x SS-3 had highest number of pods/plant (160.4), YSP-842 x SS-1 (b) had longest siliqua (5.39 cm) and SS-1 x SS-2 had maximum number of seeds/siliqua (17.73).

Brown sarson

Twenty-five single plant selections were made from F_2 generation of crosses made earlier among 6 promising lines viz. SS-1, SS-2, SS-3, YSC-68, YSK-8-501 and YSP-842 in half diallel design. These lines were evaluated for their performance in a replicated trial against standard check SS-2 with a yield of 20.8 q/ha. The yield of these lines ranged from 14.3 q/ha in V7 to 26.8 q/ha in V-23 and maturity duration from 127 to 140 days. Among these, 7 lines out yielded the standard check.

Among important yield attributes V-18 had maximum number of pods/plant (191.6),

V-2 highest pod length (5.6 cm) and SS-2 highest number of seed/pod (20.3).

Twenty bulks were constituted from 15 crosses bred earlier in half diallel fashion from F₂ generation involving 5% best plants having uniformity in morphophysiological characters. With standard check SS-2, yield of various bulks ranged from 15.0 to 25.4 q/ha. Nine bulks outyielded the standard check. The highest yield was recorded in YSP-842 x SS-1 (a) (25.4 q/ha) followed by SS-1 x SS-2 (24.6 q/ha) and YSP-842 x YSK-8501 (24.5 q/ha).

Maintenance of germplasms

Forty lines of toria, yellow sarson, brown sarson and Indian mustard were maintained.

Indian mustard

Fifteen varieties were evaluated. Pusa bold produced highest yield of 18.5 q/ha followed by Pusa Bahar (17.2 q/ha) and TM-2 (16.6 q/ha). The yield ranged from 6.8 to 18.5 q/ha. The shortest duration variety was the TM-4 maturing in 155 days.

Performance of rainfed mustard influenced by dates of sowing and row spacing

(Jasjit Kaur & Sanjeev Kumar)

Mustard var. Pusa Bold was grown in field with five dates of sowing viz. 25 Sept., 5 Oct., 15 Oct. and 4 Nov. at 30 cm, 45 cm and 60 cm row-row spacing. Among all the dates of sowing and row spacing, mustard crop sown on 25 Sept. at 45 cm row spacing resulted in higher yield (22.7 q/ha) but was found at par with 5 Oct. sowing at 30 cm row spacing.

SOYBEAN

Effect of bio-fertiliser on productivity

(Sanjeev Kumar, Jasjit Kaur & Patiram)

Soybean variety PK-486 was inoculated with *Brady Rhizobium* strain along with different levels of nitrogen. The treatment N₄₀P₈₀K₆₀ + *Rhizobium* resulted in significantly higher number of pods/plant, pod weight/plant, 100 grain weight, pod and kernel yield per ha over all the treatments but was at par with treatment N₄₀P₈₀K₆₀ in respect of number of branches/plant and weight of pods/plant. *Rhizobium* inoculation had added about 12.3 kg more nitrogen/ha in soil over uninoculated plots. After the harvest of soybean, mustard variety Pusa Bahar was grown in the same plots with different nitrogen levels and mulch treatments. The yield, number of pods/plant and oil content from N₄₀P₈₀K₆₀ + *Rhizobium* was 1878 kg/ha, 51.2 and 18.9% respectively.

VEGETABLES

Management of important diseases

(Narayana Bhat M.)

Hexaconazole, tilt and RIL F004 were effective in managing rust, angular leaf spot and pod anthracnose disease. Steam sterilised and antibiotic treated cold water extracts of 37 plant species were evaluated at 20% against *Pythium aphanidermatum*, *Oxyspora paniculata* and gave maximum inhibition (94.4%) in both the methods and was significantly superior to others. In pot culture experiment among the seven selected extracts, *Artemisia nilagirica* and *Eupatorium adenophorum* were significantly superior to others in reducing the pre emergence damping off, though not comparable with ridomyl.

SPICES

Biological control of important diseases of ginger

(Narayana Bhat M.)

Leaf extracts were tested in vitro against *P. aphanidermatum* and *Pythium* sp., the casual agents of soft rot of ginger. *Oxyspora paniculata* gave inhibition upto 94.4 % against *P. aphanidermatum* while *Macaranga denticulata* evinced complete inhibition of *Pythium* sp. in both the methods of steam sterilisation and antibiotic treatment. Nine and 12 extracts showed more than 50% inhibition against the two species respectively while 27 and 22 extracts showed minimum % inhibition.

None of the 45 plant species tested exhibited 100 % inhibition against *Fusarium moniliforme*, *F. oxysporum* and *F. solani* the casual agents of dry rot of ginger. Only *Schima wallichii* showed more than 50 % inhibition against *F. moniliforme* (66.7%), *F. solani* (50 %) and *F. oxysporum* (50 %). *Eupatorium adenophorum* exhibited 53.7% inhibition against *F. oxysporum*. Fourteen species inhibited none of the pathogen.

Two strain of *Trichoderma viride*, one each of *T. harzianum* and *T. koningii* were found inhibitory against rhizome rot pathogens in vitro by dual culture methods by overgrowing the pathogens.

AGROFORESTRY

Collection and evaluation of multipurpose trees

(Matber Singh)

Alnus nepalensis attained maximum height of 26.72 m followed by *Prunus cerasoides*

(16.9 m), *Terminalia myriocarpa* (15.31 m) and *Evodia fraxinifolia* (13.54 m) while the least height was recorded in *Albizia procera* (4.2 m). Basal girth and girth at breast height (GBH) in multipurpose tree species varied from 17.2 to 88.01 cm and 12.25 to 70.61 cm respectively. Maximum basal girth and GBH was recorded in *Ficus elevata* whereas *Albizia procera* showed minimum basal girth and GBH (Table 1).

CATTLE

Survey of diseases

(R. Chandra & H.D. Karmakar)

In spite of the existing facilities, the latest available records show that the livestock population in the state has suffered from various infectious or non-infectious diseases during 1996-97 numbering 39022. The most important problems were digestive disorders (30.16%) and parasitic conditions (25.26%). Significantly high incidence of skin diseases (8.45%), reproductive disorders (7.36%) and respiratory disorders (7.13%), were also observed. The infectious diseases including FMD, BQ and H.S. together account for 2.92% cases. Various deficiency diseases (3.16%), metabolic diseases (2.05%) and poisoning (1.14%) were also observed. High number of surgical conditions (5.65%) and other diseases (6.70%) including mastitis, haematuria, ephemeral fever and cancer/tumour were also significant problems of livestock farming in Sikkim.

Studies on bacterial pathogens associated with reproductive disorders

Samples were collected from different parts of the state during 1998-2000 and investigated for bacterial pathogens associated with reproductive disorder in bovine cows.

Table 1. Vegetative characteristics of different MPTs

Name of species	Basal girth (cm)	Girth at breast ht. (cm)	Height (m)
<i>Alnus nepalensis</i>	88.01	70.61	26.72
<i>Ficus hookerii</i>	59.65	37.78	05.95
<i>Leucaena leucocaphala</i>	29.32	20.10	06.27
<i>Ficus iedevata</i>	88.78	82.43	06.98
<i>Ficus infectoria</i>	39.67	29.71	06.63
<i>Ficus nemoralis</i>	32.00	23.00	05.57
<i>Pinus petula</i>	77.70	57.80	10.34
<i>Michelia valutina</i>	38.90	22.44	06.06
<i>Evodia fraxinifolia</i>	69.10	54.73	13.54
<i>Terminalia myrtocarpa</i>	66.94	55.10	15.31
<i>Schima wallichii</i>	59.38	43.07	09.17
<i>Saurauvia nepalensis</i>	36.50	25.68	04.56
<i>Prunus cerasoides</i>	81.34	68.33	16.90
<i>Brassiopsis mitis</i>	52.40	39.07	04.65
<i>Grewia optiva</i>	21.80	14.50	04.80
<i>Albizia procera</i>	17.20	12.25	04.20
<i>Litsea polyantha</i>	55.85	48.23	10.35
<i>Erythrina arborescens</i>	58.40	42.80	08.45
<i>Artocarpus lakoocha</i>	27.50	20.10	04.80
<i>Ficus bengalensis</i>	61.60	48.08	07.21

All the samples including, 75 cervical mucus from repeat breeders, pieces of placenta from 9 cases of abortion, and 150 each of milk and blood serum samples from suspected cows for brucellosis were examined in the laboratory. A total of 36 bacterial pathogens including, 10 *Staphylococcus aureus*, 7 *E. coli*, 4 *Proteus* sp., 4 *Bacillus* sp., 3 *Salmonella* sp., 3 *Corynebacterium pyogenes*, 2 *Streptococcus pyogenes*, 2 *Klebsiella* sp. and 1 *Enterobacter* sp., have been isolated from cervical mucus samples. From aborted foetal placentas, 5 *Brucella*

abortus, 2 *Corynebacterium pyogenes* and 1 each of *E. coli* and *Salmonella* sp. were isolated. Twelve per cent of the milk and sera samples were found to be positive for brucella antibodies. Out of 18 milk samples which were found to be positive in 'Milk Ring Test', the corresponding sera were also positive in 'Rose Bengal Plate Test' and 'Standard Tube Agglutination Test'. The antibody titres of the brucella positive sera were 1:40 for 11, 1:80 for 5 and 1:160 for the other 2 numbers of samples as observed by 'Standard Tube Agglutination Test'.

RABBIT

Health status at farm

(R. Chandra, H.D. Karmakar & K.C. Mishra)

A flock of German Angora rabbit was maintained. Initially all the animals were screened for enterobacterial pathogens and gastrointestinal parasites. Various disease conditions were treated with available drugs and laboratory investigations were carried out with antemortem and post-mortem specimens. During the period (1998-2000), a total of 23 rabbits died. The most significant specific causes of death were systemic infection and pneumonia, while for non-specific causes the most important were injury and ureamia. Laboratory investigation with post-mortem specimens resulted in isolation and identification of 10 bacterial pathogens, including 5 *Staphylococcus aureus*, 2 *Streptococcus pneumoniae*, 2 *Pastesrella multocida* and 1 *Clostridium tetani*.

Pre weaning mortality

(Ramesh Chandra, H.D. Karmakar & K. C. Mishra)

Pre weaning mortality was 21.05% out of 114 young born in 24 litters the pre weaning mortality was highest in the month of March (7.89%) followed by December and November (7.02% & 3.51%), respectively

Productive and reproductive performance

(Ramesh Chandra, H.D. Karmakar & K.C. Mishra)

The performance of Angora rabbits was recorded during the year and presented in Table 2.

Table 2. Productive performance of Angora rabbit

Parameters	Mean and SE
Litter size at birth	4.75 ± 0.21
Litter wt. at birth (g)	229.38 ± 8.0
Individual wt. at birth (g)	48.29 ± 0.87
Litter size at weaning	4.45 ± 0.12
Litter wt. at weaning (g)	2252.50 ± 12.0
Individual wt at weaning (g)	506.18 ± 14.67
Wt. at 90 days (g)	1520.51 ± 45.52
Wt. at 120 days (g)	1892.31 ± 47.04
Wt. at 180 days (g)	2452.26 ± 28.03
Gestation period (days)	30.9 ± 0.26
No. of service/conception	1.86
Conception rate (%)	89.0
Av. wool production (g/ shearing)	118.36 ± 2.49
Av. staple length of wool (cm)	10.84 ± 0.23
Diameter of wool (μ)	9.65 ± 0.36

GOAT

Performance of Sikkim local goats

(Ramesh Chandra, H.D. Karmakar & K.C. Mishra)

A total of 5 kidding were obtained from Sikkim local goats with single and twinning incidence of 20% and 80% respectively. The sex ratio was record as 1.0, 1:1 and 1:0.8 for single, twinning and overall kidding, respectively. Data on growth rate of the kids from birth to 8 month of age was also recorded during the year. The male kids were heavier than their female counterparts at all the stages of growth from birth to 8 month of age.

Selection for twinning and triplet production traits

(R. Chandra, H.D. Karmakar & K.C. Mishra)

A flock of Sikkim local goat was maintained in 'Goat Research Unit' of ICAR,

Tadong for this investigation. The animals have under gone initial screening for entero bacterial pathogens and gastro intestinal parasites. Various disease conditions have been treated with available drugs, and laboratory investigation has been carried out with antemortem and post-mortem specimens. A total of 19 animals died during the reported period (1998-2000). The most important specific causes of mortality were pneumonia and enteritis. Laboratory investigation with post-mortem specimens has resulted in isolation and identification of eight bacterial pathogens, including 4 *Pasteurella multocida*, 2 *Escherichia coli*, one each of *Staphylococcus aureus* and *Mycoplasma mycoides*.

FEED AND FODDERS

Nutritional evaluation of cabbage waste in rabbit

(Debasis De, Asit Das & Ramesh Chandra)

Six adult Soviet Chinchilla rabbit were taken to evaluate nutritive value of cabbage waste. Fifty per cent of dry matter (DM) requirement of rabbit was met through concentrates mixture (maize 45 part, mustard cake 40 part, wheat brawn 12 part, mineral mixture 2.5 part, and common salt 0.5 part). Rest of the DM requirement was met through cabbage waste. After a preliminary feeding of 38 days and digestibility trial of 7 days, there was body weight gain of rabbit @ 9.43 g/d during trial period which showed the potential of cabbage waste as rabbit feed which otherwise is thrown away and causes disposal problem.

Seasonal variation in nutritive value of mixed jungle grass for Sikkim local goats

(Asit Das & Debasis De)

Three digestibility trials were conducted during the months of August, December and April. During each period 4 Sikkim local goats (Av. body wt. 19 ± 1.8 kg) were stalled with mixed jungle grass ad lib. After a preliminary feeding period of 14 days, a digestibility trial of 5 days collection period was conducted during each period (Table 3). The intake and digestion of nutrients were maximum during the month of August, followed by December and April.

Nutritive value of Barhar leaves for oats

(Asit Das & Debasis De)

Four adults Sikkim local goats (Average body weight 20.25 ± 1.50 kg) were stalled on Barhar (*Artocarpus lakoocha*) leave ad lib. After a preliminary feeding of 14 days, a digestion trial of 7 days collection was conducted. DM consumption was 4.61 ± 0.11 % of body weight indicating that barhar leaves were highly palatable.

Effect of Barhar leaves supplementation of mixed jungle grass on intake, digestion and eating behaviour of Sikkim local goats

(Asit Das & Debasis De)

An experiment was conducted to study the effect of barhar leaves supplementation on intake, digestion and eating behaviour in Sikkim local goats fed on mixed jungle grass based diet. 4 Sikkim local does (Av. b.wt. 18.7 ± 1.14 kg) were randomly distributed in an experiment based on 4 x 4 latin square design comprising 4 treatments, 4 animals and 4 periods (Dec. - Feb), each comprising of

Table 3. Seasonal variation in nutritive value of mixed jungle grass for goats

Parameter	August	December	April
DM intake (g/d)	569 ± 7.9	517 ± 8.4	495 ± 18.43
Digestibility (%)			
DM	59.56 ± 2.02	52.19 ± 1.96	47.71 ± 2.84
OM	63.48 ± 2.82	53.48 ± 1.43	49.32 ± 2.76
CP	70.37 ± 0.53	57.32 ± 1.36	49.48 ± 4.45

Table 4. Effect of barhar leaves supplementation on intake, digestion and eating behaviour in goats fed mixed jungle grass based diet

Parameter	Dietary treatments				SEM
	I	II	III	IV	
Feed consumption (g/d)					
Jungle grass*	517a	525a	512a	469b	23.2
Barhar leaves	—	120	239	351	—
Total**	517a	645b	751c	320d	18.43
Digestibility of nutrients (%)					
DM*	52.19a	61.96b	60.78b	59.34b	1.18
OM*	53.42a	63.59b	64.62b	64.37b	1.43
CP*	57.31a	62.54b	67.87b	69.45b	1.36
Parameter	Dietary treatments				SEM
	I	II	III	IV	
Plane of nutrition (g/d)					
DOM I*	242a	363b	429c	467c	17.52
DCP I**	19.33a	33.30b	43.80c	52.42d	1.41
Time spent (min/d)					
Eating	236	225	278	239	17.4
Ruminating	527	580	586	561	19.9
Idling		677	635	576	640 22.3

a, b, c values bearing different superscript differ significantly.

* P < 0.05 ** P < 0.01

21 days of which 14 days was adaptation period and 7 days was collection period. The four dietary treatments were mixed jungle grass ad.lib. (I) supplemented with either 15 (II), 30 (III) or 45 (IV) % of barhar leaves. The results are presented in table 4.

The results of the trial indicated that DM intake increased with increased level of supplementation without any significant change in eating behaviour. Digestibility of nutrients increased only upto 15% level of supplementation beyond which there was no further improvement. Though there was a linear increase in DCP intake with increased level

of barhar leaves in the diet, DOM I increased only upto 30% level of supplementation.

Chemical composition of some fodders performing well under Sikkim condition

(Asit Das, Debasis De & Matber Singh)

Samples were analysed for crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF), hemicellulose, cellulose and lignin. which are presented in Table 5.

CP content was highest in Dallis (*Dactylis glomarata*) followed by dhutesars (*Setaria palmifolia*), Nandi (*Setaria sphacelata*), broom

Table 5. Chemical composition (% DM) of fodders

Sample	CP	NDF	ADF	Hemicellulose	Cellulose	Lignin
BN 82048	5.25 ± 0.51	69.37 ± 1.32	41.34 ± 0.73	28.02 ± 0.97	24.99 ± 0.83	6.80 ± 0.69
NB 21	4.96 ± 0.29	67.85 ± 2.25	40.87 ± 3.04	26.98 ± 0.90	27.37 ± 0.19	5.15 ± 1.14
Dhutesaro	7.29 ± 0.39	60.91 ± 1.15	34.72 ± 3.04	26.64 ± 1.44	23.83 ± 2.18	3.82 ± 0.37
Nandi	7.15 ± 0.38	61.59 ± 1.43	34.31 ± 2.49	27.29 ± 0.66	22.65 ± 0.57	4.35 ± 0.37
Guatamala	5.69 ± 0.44	63.89 ± 2.30	35.95 ± 1.82	27.94 ± 1.42	22.14 ± 2.33	5.65 ± 0.41
Dallis	8.02 ± 0.14	65.54 ± 1.72	37.95 ± 0.22	27.64 ± 1.75	25.93 ± 0.94	5.41 ± 0.41

grass (*Thysanolaena maxima*), Guatemala (*Tripiscum laxum*), Hybrid napier BN 82048 and NB 21. Lignin content was highest in broom grass followed by hybrid napiers, guatamala, dallis and was lowest in dhutesaro and nandi setaria; similar trend was also observed in NDF and ADF content. From the chemical composition it is evident that broom grass and hybrid napier are most fibrous.

PUBLICATION

Kumar, S. and Kumar, A. (1999) Production potential of various Spanish and Virginia groundnut (*Arachis hypogaea* L.) cultivars in mid-western plains of Uttar Pradesh. *Indian J. Agric. Sci.* 69 : 519-520.

Tripura Centre

EXECUTIVE SUMMARY

Out of 14 rice lines, TRC-87-251 performed the best and was partially tolerant to leaf blast. The application of 20 t vermicompost/ha increased the grain yield by 82% over control. Weed free rice plots gave the maximum production followed by weedicides Butachlor and Pretilachlor. Among the 8 crop sequences, sesamum-rice gave the highest rice equivalent yield followed by rice-blackgram and greengram-rice.

Among the tested fungicides, carbendazim proved best to control the blast and brown spot diseases.

In early maturing trial on maize, Prakash gave the highest yield and Hrasha performed well in medium maturity.

RBL-52 and Pahelo/UG varieties of ricebean and blackgram performed best among tested lines/cultivars. The mulching of straw, Chan and polythene gave significantly higher grain yield of blackgram as compared to control. The 45 cm row spacing and mulching gave the maximum yield of greengram. The application of phosphorus and *Rhizobium* increased the grain yield of blackgram and field pea.

All tested groundnut germplasm showed the tolerance to soil acidity. The application of phosphorus, lime and phosphate solubilizing bacteria together gave the maximum yield of groundnut. Out of 30 lines of groundnut tested, ICG-10936, ICG-10932, ICG-10943 and ICG-11183 were tolerant to early and late leaf spot diseases. The grain yield of mustard increased significantly at 25 kg N/ha and *Azotobacter* application. Among the 44

lines of selection and crosses of mustard, (SCRT-1-1)-1 gave the maximum yield followed by (SCRT-1-1)-1 and (SCRT-1-1)-5. Soybean varieties, VLS-45 produced maximum grain yield followed by MAUS-45 and Uam-52.

The growth attributing characters of gladiolus improved maximum by the application of 25 ppm 2, 4-D and early sprouting of cormels occurred with 0.2% of K_2SO_4 followed by hot water treatment and continuous wetting in running water. Big cormels (2.5-3.5 cm diameter) gave long floral spikes. The bud initiation was earliest in August planting of chrysanthemum and minimum in October planting.

In Okra, out of 19 crosses, Parvati Kranti \times 7-Dhari, Parvati Kranti \times *Hibiscus rosa sinensis*, Parvati Kranti \times Harbhajan showed 99% resistance to yellow vein mosaic virus in F_6 generation and former two recorded maximum weight of individual fruit. The tomato seed treated with latex of plumeria, croton and Indian rubber produced the maximum weight of fruits/plant.

Under agroforestry arboretum, growth parameters and fuel wood productivity of different MPTS were measured. On 50% pruning of MPTS, the maximum fuel wood productivity was recorded *G. arborea*, *S. saman* and *T. grandis*. Productivity of turmeric and pineapple was also evaluated under different trees. Among the bamboo species, Makal attained the maximum height and least was with Muli. Silvi-forage system had the positive effect of soil health.

A community land under Lembucherra Gaon Panchayat was selected to implement

the NWDPRP programme. An upland farming system is being developed at the research centre.

Acclimatisation of artificial feed was tested and found successful in 11 species of ornamental fishes. Three new species of copepod parasites of fishes were recorded.

INTRODUCTION

Tripura centre of ICAR Research Complex located at Lembucherra, about 14 km away from Agartala, has been functioning since 1976. Due to the presence of subtropical and humid climate, a number of *kharif* crops are grown in Tripura. Cropping intensity is very high in low land locally known as "lungas" while upland covering 60% of total geographical area possess a low cropping intensity. The centre is presently engaged in research on rice, oilseeds, pulses, vegetables, flowers, cattle, goat, rabbits, pigs, fishery, agroforestry and farming system. The research findings have been transferred to the farmers through KVK situated at Birchandra Manu in South Tripura.

WEATHER

(M. Datta, P. Chowdhury & K.R. Dhiman)

Agrometeorological data as recorded in Lembucherra are as follows:

Air temperature : Maximum and minimum temperature varied from 26.5 to 35.1°C and 12.1 to 24.6°C respectively. The variation between the maximum and minimum temperature was from 7.4 to 14.8°C.

Relative humidity : Humidity in air varied from 78.4 to 87.8% and 19 to 66% in the morning and afternoon respectively. Winter months showed reduction in humidity as compared to that in summer and *kharif* season.

Wind velocity : Wind velocity underwent a variation from 1.70 to 7.60 km/hr. Months from April to August recorded high wind velocity.

Sunshine : Sunshine on an average underwent a variation from 3.8 to 8.2 hours/day. In the months from July to September, low sunshine was recorded.

Pan evaporation : Daily evaporation varied from 2.7 to 4.3 mm/day and the total evaporation was 1176.4 mm.

Rainfall : Total rainfall was 2527.7 mm and rainy days were 119. Pre *kharif* rainfall in this year was very low (42.2 mm) thus delaying the sowing of rainfed crops. Rainfall distribution graph showed the presence of highest (596.3 mm) rainfall in July. There was no rainfall in Nov. and Dec. when the total evaporation was 198.1 mm thus leading to stress in soils.

Validity of weather forecast : Weather forecast as received from the NCMRWF, Department of Science and Technology, Govt. of India was translated in the form of agro-advisory bulletins (49 nos.) which were published in the local newspaper and broadcast through TV and Radio station. Forecast accuracy (ACC) was the highest in winter months. *Kharif* months showed the existence of highest bias probability of detection and threat score. Correct rainfall forecast varied from 18.4 to 95.6% from pre-*kharif* to *rabi* season. But usable forecast was only 4.6% in pre-*kharif* months. Usable maximum and minimum temperature underwent a variation from 23.3 to 25.0% and 16.6 to 36.0% respectively. Vary low (3.9 to 4.6%) unusable temperature was forecast in *kharif* months.

Soil temperature : Soil temperature was recorded at 5 to 30 cm depths both in the morning and afternoon. Soil temperature in the morning was lower than that of the

afternoon. With rise in depth, soil temperature showed an increasing trend in the morning and a decreasing trend in the afternoon. Irrespective of depth, soil temperature gradually increased from January to May followed by a drop and then showed a constant trend again followed by a drop from October onwards.

RICE

(K. Chattopadhyay & K.R. Dhiman)

UPLAND

Varietal trial

Out of 14 lines evaluated, TRC-87-251 (27.9 q/ha), Joli (15.1 q/ha) and Chingri Joli (13.5 q/ha) performed better than other local lines. TRC-87-251, Mycassa and Chingrijoli were found partially tolerant to leaf blast.

Effect of vermicompost (vc) on rice productivity, soil properties and nutrient uptake

Productivity : A field trial was conducted in upland rice (var. TRC-87-251) with various doses of vermicompost (vc) prepared from waste material using earthworm (*Perionyx excavatus*).

Results indicated that the application of 10 t vermicompost/ha + NPK and 20t vc/ha + NPK produced significant increase in dry matter from 1.39 to 3.43 g/plant and 4.09 to 6.30 g/plant at tillering and flowering stages of rice respectively. Maximum grain yield from 23.39 to 42.49 q/ha (81.7 % increase over control) was recorded after application of 20 t vc/ha. Vermicompost when applied @ 5 t/ha in combination with NPK and 10 t/ha produced 62.2% and 69.3% increase in grain yield. Significant increase in straw yield from 43.2 to 56.5% over control was observed after

the application of vermicompost. The effect of 5 to 15 t vc/ha in increasing both grain and straw yield was at par. But supplementation of NPK in 5 t vc/ha was required to have significant increase in rice production.

Soil properties : Consumptive water use and its use efficiency showed wide variation from 313 to 375 mm and 6.79 to 12.72 kg/ha-mm. The application of 15 t vc/ha in T₇ produced the highest water use efficiency although all the values of water use efficiency were observed to be higher than that recorded in control (Table 1).

Mean weight diameter as index of soil aggregates increased as compared to control in all the treatments. The maximum reduction in soil aggregates from 0.74 to 0.55 was noted after the application of 10 t vc/ha in T₅. Available nitrogen substantially increased from 472 to 805 kg/ha after 10 t vc/ha in T₅. Potassium availability was, on the other hand, raised in all except T₅.

Nutrient uptake: N uptake in grain and straw varied from 24.3 to 67.6 kg/ha and 26.8 to 89.6 kg/ha respectively after the application of vermicompost. Maximum N uptake in grain and straw was recorded in T₇ and T₆ after the application of 15 t and 10 t vc/ha respectively. Similar increase in K-uptake from 2.5 to 7.0 kg/ha was noted in grain in T₇. But inconsistent change with 60% coefficient of variation in P uptake in straw was noted though a maximum increase was recorded in T₆. Potassium uptake in grain and straw was observed to vary from 5.12 to 9.44 kg/ha and 17.61 to 36.14 kg/ha respectively. Here maximum increase in K uptake was noted in T₄ after the application of 5 t vc/ha + NPK. Ca uptake in grain and straw underwent a variation from 1.1 to 1.6 and 3.5 to 11.6 kg/

Table 1. Changes in soil physico-chemical properties after vermicompost and fertiliser application

Treatments	Water use (mm)	Water use efficiency (kg/ha-mm)	Soil aggregates (MWD)	Available nutrients (kg/ha)	
				N	K
T ₀ (control)	344	6.79	0.74	472	35.52
T ₁ (2.5 t)	336	8.70	1.47	564	39.96
T ₂ (T ₁ + NPK)	357	7.92	1.24	403	37.74
T ₃ (5.0 t)	343	9.04	0.66	345	42.18
T ₄ (T ₃ + NPK)	348	10.90	0.60	552	42.18
T ₅ (10.0 t)	313	12.65	0.55	805	31.08
T ₆ (T ₅ + NPK)	343	11.55	0.59	402	48.84
T ₇ (15.0 t)	334	12.72	0.62	578	39.96
T ₈ (T ₇ + NPK)	353	10.56	0.68	598	46.62
T ₉ (20.0 t)	367	9.40	0.73	414	39.96
T ₁₀ (T ₉ + NPK)	363	9.83	0.72	425	46.62
T ₁₁ (NPK)	375	6.89	0.65	495	39.96
Mean	348	9.74	0.77	499	40.88
CV (%)	4.6	19.8	35.3	23.6	11.6

ha respectively. Maximum increase in Ca-uptake in grain was noted in 5 t vc/ha + NPK in T₄ whereas 20 t vc/ha + NPK in T₁₀ showed a striking increase in Ca uptake in straw.

Effect of time of nitrogen application and weed control methods on yield

(S. Mitra & D.P. Patel)

Among the three nitrogen treatments, N₂ recorded maximum number of panicles/m², filled spikelets (%) and paddy yield (Table 2). However, N₁ and N₃ treatments were at par regarding their effect on yield attributing character, paddy yield and weed dry matter.

Maximum and minimum values of paddy yield was observed in two control treatments i.e., weed free (W₆) and weedy check (W₅). Among the four weed treatments tested for

comparison, W₃- butachlor (pre-emergence) @ 2 kg ai/ha + 1 hand weeding at 40 DAS and W₄ pretilachlor (PE) @ 2 kg ai/ha + 1 hand weeding at 40 DAS and weed free treatment recorded significantly higher yield over the rest (Table 2). Almost similar trend was observed in panicles/m² and filled spikelets (%) while the effect was non-significant in 1000 grain weight. Regarding weed dry matter, minimum value was observed with W₃ and W₄ (keeping apart weed free control).

Investigation of diseases

(T.K. Sengupta)

Six local varieties and one high yielding variety of paddy were tested in upland situation. Mamithuru, Kalikhasa and Kachkibadam were moderately susceptible to blast and brown spot diseases. Among the fungicides tried to

Table 2. Effect of time of N application and weed control methods on yield attribute and yield of rice and dry matter of weed at harvest

Treatments	Plant parameters				
	Panicles/m ²	Filled spikelet (%)	1000 grain wt. (g)	Paddy yield (q/ha)	Weed dry matter at 60 DAS transformed value (g/m ²)
Nitrogen					
N ₀	190.9	74.5	23.7	28.8	6.2
N ₂	201.5	80.1	26.0	32.0	4.3
N ₃	193.7	76.9	24.9	29.1	7.1
SEm±	2.49	1.52	0.75	0.54	0.41
CD (P=0.05)	7.2	4.4	NS	1.5	1.2
Weed Control					
W ₁	206.7	76.2	24.5	33.9	4.2
W ₂	200.3	75.8	24.1	30.4	5.1
W ₃	219.9	79.1	25.2	34.3	3.8
W ₄	216.7	80.6	25.4	34.6	3.9
W ₅	99.4	68.4	22.9	9.6	17.4
W ₆	229.1	83.2	27.2	36.9	0.7
SEm±	9.34	2.15	1.06	0.94	0.57
CD (P=0.05)	27.0	6.2	NS	2.7	1.6

N₀ = 0 basal + 50% AT + 50% PI; N₂ = 25% basal + 50% AT + 25% PI;

N₃ = 50% basal + 25% AT + 25% PI.

W₁ = 2 HW at 20 & 40 DAS; W₂ = Chan (*Saccharum sp.*) mulch; W₃ = Butachlor (PE) + 1 HW (40 DAS);

W₄ = Pretilachlor (PE) + 1 HW (40 DAS); W₅ = Weedy check; W₆ = Weed free control.

control the blast and brown spot diseases carbendazim proved to be the best followed by Copper oxychloride.

Resistance to blast

Thirty-six varieties were evaluated against blast disease on 0 - 5 scale. Out of 36 varieties, 9 lines scored 1 (no visible symptom); 13 lines scored 2 (brown coloured circular spots); 11 lines scored 3 (circular spots with typical symptom) and 3 lines scored 4 (typical symptom of blast).

MAIZE

Maize co-ordinated trial

(K.R. Dhiman & K. Chattopadhyay)

Four varietal trials were conducted during *kharif*. These include 65 varieties/lines under maize co-ordinated trial for NEH and Regional Centre trial. Prakash gave the highest yield of 52.9 q/ha in early maturing trial with an average of 80,000 cobs/ha. In medium maturity trial, Harsha was the best performer with 33.8 q/ha kernel yield. Line 4217 produced 49.45 q/ha which was highest and

followed by 4218 (42.6 q/ha) and 4216 (42.4 q/ha) in EVT. Megha and RCM 1-3 (white) gave almost similar yield (39 q/ha) in Regional Varietal Trial.

CROPPING SYSTEM RESEARCH

Relative performances of rice based cropping systems on rainfed uplands

(S. Mitra, M. Datta & B.K. Bhattacharya)

The present investigation was carried out to study the relative performances of 8 rice based cropping sequences under rainfed upland situation and their effect on soil. Among the eight different sequences tested, sesamum-rice recorded highest (68.4 q/ha) rice equivalent yield followed by rice-blackgram (63.2 q/ha) and greengram-rice (60.3 q/ha), respectively. Maximum net return was obtained from sesamum-rice (Rs. 19,136/ha) followed by greengram-rice (Rs. 16,517/ha) and rice-blackgram (Rs. 16,257/ha) while jute-rice fetched lowest net return (Rs. 4735/ha). The water use efficiency was maximum with sesamum-rice (8.55 kg/ha-mm) while jute-rice system recorded minimum water use efficiency (4.45 kg/ha-mm). Rice-blackgram (7.31 kg/ha-mm), greengram-rice (7.10 kg/ha-mm) and maize-rice (7.10 kg/ha-mm) also recorded fairly high water use efficiency. Maximum decrease in bulk density (BD) value in 0 - 30 cm soil depth was obtained in rice-blackgram (25.5%) and greengram-rice (25.6%) sequences followed by rice-cowpea (23.4%) and rice-ricebean (23.9%) systems. While rice-groundnut and sesamum-rice recorded 18-22% change in BD value, maize-rice and jute-rice sequences recorded 10-12% decrease in BD value. Considering all the parameters under study, sesamum-rice, rice-blackgram and rice-greengram sequences were found to be highly suitable for cultivation on rainfed uplands of Tripura.

Comparative efficacy of organic amendments on availability of nutrients

(M. Datta & B.K. Bhattacharjee)

In the field trial, organic amendments i.e. vermicompost, cattle manure and *Glyricidia maculata* leaf were used in upland rice-cowpea cropping sequence. Organic carbon was raised from 7.65 to 10.17 and 8.24 to 9.57 g/kg in direct and residual experiment after application of organic amendments. The trend in increase in organic carbon was of the following order: Cattle manure > Vermicompost > *Glyricidia* leaf. Available nitrogen and phosphorus raised from medium to high and potassium from low to medium.

Nutrient uptake : Maximum rise in N uptake from 10.91 to 31.02 kg/ha in rice grain and 49.68 to 64.35 kg/ha in field pea seed were noted after the application of cattle manure and *Glyricidia* leaf in combination with NPK (30:15:15) respectively. K uptake increased from 2.69 to 5.84 in rice and 5.28 to 8.46 kg/ha in field pea after the application of cattle manure in combination with 1/2 and 1/4th of the recommended NPK (60:30:30), respectively. Marginal increases in P and Ca uptake was noted in both rice and field pea.

PULSES

(K.R. Dhiman & K. Chattopadhyay)

Yield trial

Ricebean

Among 31 varieties, RBL-52 gave the best performance with an estimated seed yield of 9.6 q/ha, followed by BD-139-1 (9.3 q/ha) and BRS-1-2 (9.2 q/ha). Average maturity period of these varieties was recorded as 80-85 days.

Black gram

Three lines namely T9, B-12-4-4, B-3-8-8 and six cross combination (Pahelo/U-5,

Pahelo/UG-218, B-3-8-8/DU-1, B-12-4-4/DU-1, Pahelo/AMP-36, UG-218/Pahelo) were raised in autumn on residual moisture after harvesting of maize crop. Average yield of all lines and crosses was 9 q/ha. All crosses out yielded the check variety T_9 (7.2 q/ha). Highest yield was recorded in Pahelo/UG 218 (10 q/ha). Seeds from different cross combination were classified according to the colour and shininess. 22 selection lines from hybrid were developed which varied widely from Viridis type to Mungo type.

Effect of mulching and row spacing on growth and yield of *kharif* blackgram and weed growth

All the three mulches, viz. straw, Chan and polythene recorded significantly higher seed and straw yield of the crops as compared to control (4.6 & 7.6 q/ha). Seed yield of blackgram in Chan mulch (6.3 q/ha) was on par with polymulch (7.2 q/ha) and straw yield did not differ. Mulching resulted into significant reduction in weed dry matter over control (102.2 g/m²) with polymulch recording the minimum value (48.6 g/m²). Among the three-row spacing tested, 35 cm spacing recorded significantly higher seed yield of the crop (7.2 q/ha). Higher row spacing i.e., 45 cm increased number of pods/plant (21.2) and 1000-grain weight (37.9 g) as compared to 25 cm spacing. There was no significant variation in weed dry matter yield between 25 and 35-cm row spacing but 45 cm spacing recorded significantly higher weed.

Greengram

Integrated weed management

The 45 cm row spacing recorded significantly higher seed yield (5.5 q/ha) and 25 cm spacing reduced the weed dry matter significantly (5.8 g/m²) as compared to 45 cm row spacing. Application of mulch resulted signifi-

cant increase in pods/plant (13.3); seeds/pod (7.8) and seed yield (5.1 q/ha) and significantly reduced the weed dry matter (6.5 g/m²) as compared to control. All the weed control treatments recorded significantly higher number of pods/plant, seeds/pod and seed yield of the crop over control. Application of butachlor (pre emergence) and one handweeding resulted in maximum seed yield (5.9 q/ha) which was on par with two hand weeding (15 & 35 DAS) treatment (5.0 q/ha) indicating savings of one manual weeding. Almost similar trend was observed in case of pods/plant and seeds/pod. All the treatments recorded significantly lower weed dry matter as compared to control with butachlor (PE) + 1 hand weeding at 35 DAS showing lowest value of weed dry matter (5.0 g/m²).

Growth and yield of *kharif* blackgram as influenced by organic matter and phosphorus

(B.K. Bhattacharya)

The experiment was conducted to study the effect of organic matter (poultry manure), *Rhizobium* and phosphorus on growth and yield of *kharif* blackgram (var. T_9). Seed yield of blackgram increased significantly with application of phosphorus and was maximum with 50 kg P₂O₅/ha (9.8 q/ha). It was also observed that application of *Rhizobium* resulted in significantly higher seed yield of the crop (7.6 q/ha) as compared to control. Organic matter (poultry manure) when applied in soil resulted into 1.3 fold increase in seed yield of the crop over control (7.2 q/ha).

FIELD PEA

Growth and yield as influenced by phosphorus, *Rhizobium* and phosphate solubilising bacteria

The experiment was carried out to determine the effect of phosphorus, *Rhizobium*

and phosphate solubilising bacteria (PSB) on growth and yield of pea (var. Rachna). Application of P resulted in significant increase in seed yield over control (7.9 q/ha) and maximum yield was obtained with 50 kg P₂O₅/ha (11.7 q/ha). *Rhizobium* (seed inoculation) recorded significantly higher seed yield (10.4 q/ha) than control (9.1 q/ha). Pea seed when inoculated with PSB resulted 1.7 times higher yield as compared to control (8.9 q/ha).

OILSEEDS

Integrated nutrient management

A field trial was conducted in groundnut (var. ICGS-76) with two levels of lime (0, 2.5 t/ha), phosphorus (0, 50 kg P₂O₅/ha) and inoculation with *Rhizobium* (IGR 40) and phosphate solubilizing bacteria (*Bacillus polymixa*).

There was maximum augmentation in pod and seed weight from 9.98 to 16.05 and 5.32 to 10.95 g/plant respectively after combined application of lime, phosphate and PSB. Similar was the trend in pod and haulm yield from 8.47 to 17.04 and 18.09 to 33.90 q/ha respectively and was at par with lime and PSB application.

Yield trial

(K. Chattopadhyay & K.R. Dhiman)

12 lines from ICRISAT and one local check variety JL 24 were sown at end of May. Average yield performance was very poor (5.4 q/ha). Among all the lines, the performance of ICG 10964 was best (13.75 q/ha) followed by ICG 10974 (11.75 q/ha) and ICG 11183 (8.75 q/ha).

Investigation on diseases

(T.K. Sengupta & Satish Chandra)

Thirty lines were screened for early leaf spot (ELS) and late leaf spot (LLS) on 0-9

scale. The score ranged in ELS between 2.2 to 3.2 indicating less ELS incidence while LLS score ranged from 4.8 - 8.2 indicating more incidences.

The cultivars ICG-10936, ICG-10932, ICG 10974, ICG 10943 and ICG-11183 were tolerant. ICG-4995, ICG-7320, ICG-7887 and ICG-2716 were susceptible to collar rot while ICG 799, 221, 4995, 7895, 1703, 1705 and ICGS 76 were susceptible to rust.

MUSTARD

Effect of *Azotobacter* and nitrogen on growth and yield

The field trial data revealed that application of nitrogen increased beyond 25 kg/ha seed yield of mustard significantly over control (6.5 q/ha). Successive increase in N dose there after resulted into significant increase in seed yield of the crop up to 75 kg N/ha (11.1 q/ha). Application of *Azotobacter* increased mustard yield by 1 q/ha over control (8.9 q/ha) and the increase was significant.

Yield trial

44 lines (selection and crosses) were evaluated in winter season (sown on 6.11.99). Average grain yield was 6 q/ha. (SCRT-1-1)-2 out yielded other entries with 19.8 q/ha grain yield followed by (SCRT-1-1) -1 (15 q/ha) and (SCRT-1-1) -5 (14.8 q/ha) with an average of 90 days maturity period. Among the crosses, Ysc-68/ss-2 (a) performed better than others with grain yield of 7.2 q/ha did.

Investigation of diseases

(T.K. Sengupta)

Screening 12 mustard varieties against powdery mildew indicated disease index ranged from 2.0 (RH 30, PCR7, M27 and Rohini) to 7.5 (Varuna) while all 8 sesamum varieties were found susceptible to charcoal rot disease.

Soybean*(K. Chattopadhyay & K.R. Dhiman)*

Out of 34 varieties sown in *kharif* VLS-45 produced highest seed yield of 20 q/ha, followed by MAUS-45 (18.3 q/ha), Uam-52 (15.7 q/ha) and TPS-41 (15.4 q/ha). Average varietal yield was 11 q/ha.

WHEAT**Productivity of wheat as influenced by organic matter, nitrogen and *Azotobacter***

The application of organic matter @ 5 t/ha recorded significantly higher grain yield of wheat (24.7 q/ha) over control (21.9 q/ha). Similarly *Azotobacter* resulted into 1.1 times higher grain yield over control (22.6 q/ha) and the increase was found to be significant. The grain yield of wheat was also found to increase significantly with successive increase in fertiliser nitrogen dose upto 80 kg N/ha (24.8 q/ha).

FLORICULTURE*(L.C. De & K.R. Dhiman)***Influence of growth regulating chemicals on flowering of gladiolus**

Among different growth regulation chemicals, 2, 4-D (25 ppm) showed maximum improvement on plant height (130 cm) early flower bud initiation (46 days), number of florets and spike (15), spike length (95.6 cm), diameter of corms (5.2 cm), average weight of corms (31.20 g) and weight of cormels (17.97 g) per plant, although beneficial effect was also recorded with 2, 4-D (5 ppm), 2, 4-D (10 ppm) and B9 (500 ppm) over control.

Effect of different physical and chemical treatments on dormancy of cormels of gladiolus

Treatment with K_2SO_4 (0.2% solution) showed early sprouting of cormels (13 days) followed by hot water treatment and continuous wetting in running water. Maximum rate of germination (33.6%) was recorded with freezing for one month in refrigerator. Maximum improvement on plant height was observed with continuous wetting in running water and IAA (100 ppm) for 24 hours. Larger size cormels were harvested with NAA (100 ppm) (4.3 cm diameter) followed by IAA (100 ppm) (3.7 cm) and freezing for one month (3.06 cm).

Growth and flowering of gladiolus as effected by cormel size

Among different grades, cormels of 0.5 - 1.0 cm and 1.0 - 1.5 cm diameter produced only three to four leaves and cormels of 2.5 - 3.5 cm diameters without flowers. Cormels of 2.0 - 2.5 cm diameter produced flower spike of 65 cm length with 4 florets each 7.5 cm in diameter. Big cormels (2.5 - 3.5 cm diameter) gave long floral spikes of 75 cm and with 7 florets borne on them.

Growth and flowering of chrysanthemum as affected by different dates of planting

Bud initiation was earliest in cv. 'Yellow Anemone' (26 days) followed by 'Yellow Pompon' planted on 15th October whereas late (91 days) in 'Chandrama' followed by 'Bajoria Red' and 'KS-19' when planted on 15th August. Maximum plant height (64 cm) was recorded with the cv. 'KS-19' planted on 15th August and minimum (14 cm) with 'Yellow Anemone' planted on 30th October. Cultivar 'Yellow Pompon' produced highest number of branches (154) followed by 'Yellow Anemone' (142) planted 15th August and

lowest number of branches (3) in 'Chandrama' when planted on 15th October. Number of flowers produced per plant was found maximum (424) with cv. 'Yellow Pompon' when planted on 15th August whereas the same variety yielded only 55 flowers per plant when planted on 30th October. Flower diameter was measured maximum (10.0 cm) with cv. 'Chandrama' planted on 15th August and minimum (2.1 cm) in 'Yellow Pompon' planted at the same time. The variety 'KS-19' produced good size (7.5 to 9.0 cm) flowers when planted between 15th to 30th September. Weight of flowers for all genotypes was in rising trend planted starting from 15th August to 30th September. Among five genotypes, 'Chandrama' was found long lasting ranging from 10.3 days when planted on 15th October to 160 days when planted in 15th August. Other genotypes in descending order were 'Bajoria Red', 'KS-19', 'Yellow Anemone' and 'Yellow Pompon' all planted on 15th August. Spray length was obtained highest (56.3 cm) in 'KS-19' followed by 'Bajoria Red' (50.6 cm) planted on 15th August and minimum with 'Yellow Pompon' (9.0 cm) when planted on 30th October. The above genotypes showed same trend in spray girth also.

VEGETABLES

(L.C. De, K. R. Dhiman & K. Chattopadhyay)

Evaluation of summer vegetables

In Okra, out of nineteen crosses, three namely Parvani Kranti × *Hibiscus rosasinensis*, Parvani Kranti × Harbhajan and Parvani Kranti × 7-Dhari showed 99% resistance to yellow vein mosaic virus in F₆ generation. The cross Parvani Kranti × *Hibiscus rosa sinensis* attained maximum height

(122.6 cm), showed early fruit setting (57 days) highest number of fruits upto 40 per plant and longer fruits (20.6 cm) followed by Parvani Kranti × Harbhajan and Parvani Kranti × 7-Dhari. Individual fruit weight was recorded maximum (13.6 g) with the cross Parvani Kranti × 7-Dhari and Parvani Kranti × *Hibiscus rosa sinensis*.

Yield and quality of tomato var. RCHLTE-3' as affected by seed treatment

Seeds were treated with latex of locally available plants mainly croton, Indian rubber plant, jackfruit, papaya, pedilanthus, plumeria and sown in the nursery bed alongwith untreated control. Plants grown from seeds treated with latex of papaya, jackfruit and plumeria showed minimum incidence of mosaic diseases whereas plants developed from rubber plant and croton latex treated seeds had minimum incidence of wilting. All the treatments showed improvement of vegetative parameters over control. Among the treatments, Pedilanthus gave late fruiting of tomato. Average number and weight of fruits per plant were maximum (52 and 890 g, respectively) with plumeria followed by croton and Indian rubber plant.

AGROFORESTRY

(M. Datta & K.R. Dhiman)

Growth parameters of MPTS

Basal girth (BG), girth at breast height (GBH) and height of MPTS as recorded for multipurpose tree species. *E. hybrid* attained the maximum height (19.77 m) followed by *G. arborea* (12.67 m), *T. grandis* (10.61 m), *A. lebbek* (10.20 m) and *M. champaca* (9.44 m) etc. *M. alba* showed the least height and

girth at years planting in the arboretum. *G. arborea* showed the maximum basal girth (93.68 cm) and girth at breast height (77.10 cm). *E. hybrid* produced the maximum timber volume (0.30 m³) followed by *G. arborea* (0.29 m³), *S. saman* (0.17 m³), *A. lebbek* (0.15 m³) and *T. grandis* (0.12 m³) etc.

Fuelwood productivity

Acacia auriculiformis was felled at 12 years after planting. Fuelwood productivity was 502 t/ha with 72.8 t branch/ha and 59.7 t green leaf/ha. On an average 2.01 q fuelwood could be produced from each *Acacia* tree species. On 50% pruning of MPTS, the maximum fuelwood productivity was recorded from *G. arborea* (71.48 q/ha) followed by *S. saman* (68 q/ha), *T. grandis* (60.59 q/ha), *A. lebbek* (52.29 q/ha), *M. champaca* (49.52 q/ha), *E. hybrid* (47.98 q/ha), *A. indica* (36.39 q/ha), *M. alba* (34.61 q/ha), *L. leucocephala* (27.96 q/ha) and *D. sisso* (25.39 q/ha).

Silvi-horti system

Maximum pineapple production was noted under *S. saman* followed by *L. leucovephela*, *D. sisso*, *G. arborea*, *A. lebbek*, *A. indica* etc. Under *G. arborea* and *E. hybrid* an appreciable production of turmeric was noted. Other tree species showed poor turmeric productivity.

Growth of Assam lemon

Assam lemon was also planted in association with *A. auriculiformis* and *T. grandis* and its growth characteristics in respect of height and diameter were more in former.

Growth of bamboo species

Among the 7 bamboo species planted in 1994, Makal (*B. nutan*) attained the maximum height (13.25 m) and Muli (*B. pallida*) showed the least height (7.86 m). Nal Barak

(*D. hamiltonii*) attained the maximum girth (22.33 cm) and Mritinga (*D. sikkimensis*) showed the maximum internode distance of 35.10 cm. Muli and Konkiss (*B. nana*) were of the least girth (11.84 cm) and internode distance (5.28 cm) respectively.

Changes in soil fertility in silvi-forage system

In silvi-forage system, cowpea was grown as forage component and changes in soil fertility were recorded. Data on changes in soil fertility in silvi-forage system indicated a decline in exchangeable acidity in soils of *A. indica*, *M. alba*, *G. arborea*, *G. maculata* and *A. lebbek* as compared to soils of sole cowpea. Soils of tree-cowpea association, on an average, showed higher organic carbon, available nitrogen and potassium as compared to soils of sole cowpea. Soils under some tree species showed appreciably high exchangeable cations and available phosphorus.

Changes in soil moisture under tree crop association

Soil moisture retentivity showed that soils of pineapple and turmeric contained high moisture varying from 67.12 to 86.50 mm and 64.09 to 111.70 mm respectively. But low soil moisture was noted in soils of tree species without any crop. Soils of cowpea showed an average value of 56.6 mm with 4.3% coefficient of variation.

FARMING SYSTEM RESEARCH

RESEARCH SUPPORT IN NWDPPRA

(*M. Datta, B.K. Bhattacharya & K.R. Dhiman*)

A community land under Lembucherra goan panchayat (0.982 ha) in Tripura was selected for implementation of NWDPPRA programme. Before the adoption of

conservative measures in the site, annual soil and nutrient losses were estimated.

Farming systems suitable for lands of different capability classes were identified and implemented.

Arable cropping system - W1 (3-5% slope)

- i) Rice (upland) based cropping system.
- ii) Inter cropping of local arhar and ginger (1:2) along the contour lines.
- iii) Local arhar on bunds.

A compost pit was made and crop residues along with weed biomass were allowed to undergo decomposition in the presence of raw cowdung. The productivity of rice (var. TRC-87-251) was maximum with 60:30:30: kg NPK and 5 t compost/ha. A rise in production efficiency from 10.9 to 24.1 kg/day/ha was noted with SYI (sustainability yield index) varying from 28.8 to 88.1%.

Local arhar planted on the bunds as soil conservation measures produced 525 g pod and 315 g seed/tree. Arhar on pruning produced 898 g dry stalk/tree used as fuel wood.

Table 3. Crop productivity potential in valley land

Crops	Productivity (t/ha)	Production efficiency (kg/day/ha)	Land utilization (%)	Sustainability yield index (%)
Upland rice	1.50	13.3	32.1	40.0
Sugarcane	9.77	32.6	82.2	8.6
Ridge gourd	5.80	55.2	28.8	58.8
Bitter gourd	3.40	32.4	28.8	28.3
Colocasia	7.50	50.0	41.1	25.0
Cassava	26.14	108.9	66.8	80.7
CV (%)	89.9	61.8	44.2	58.8

In contour farming with arhar and ginger, 14.07 q pod/ha with 60.1 shelling per cent was obtained.

Cropping on slopes (> 15%) - W₂

In the upper reaches of the hill slopes, cassava was planted on the ridges and hybrid napier in the furrow (2:1) for soil conservation. In the conservative row, 16.7 t cassava/ha and 22.5 t green fodder (hybrid napier)/ha were produced. Pineapple - Assam lemon land use system was adopted on the hill slopes. Mulching was done to control the weed biomass and increase the water use.

Without mulch, the weed biomass was the highest (2.25 kg/m²) followed by polythene mulch (0.43 kg/m²) and Chan grass mulch (0.36 kg/m²). Straw mulching produced an appreciable increase in fruit yield from 4.65 to 9.81 t/ha and water use efficiency from 13.9 to 28.5 kg/ha-mm.

Valley land cropping - W₃

Number of crops were grown in valley land and the productivity potential of the crops is presented in table 3.

Groundnut was also grown to find out the effect of mulching on water use efficiency.

Acacia leaves produced the highest water use efficiency (3.46 kg/ha-mm) followed by paddy stubble (3.14 kg/ha-mm) and polythene (3.22 kg/ha mm). Sugarcane and colocasia showed 15.3 and 7.09 kg/ha-mm water use efficiency respectively.

Agri-horti-silvi system - W₄

In the sloppy land, mango (var. Amrapalli) and gamari (*Gmelina arborea*) were the tree components. *Gmelina arborea* on an average attained a height of 1.61 m and a diameter of 28.17 mm. Intercrop maize gave 20.54 q green cob/ha with 3.24 kg/ha-mm water use efficiency. Hybrid napier and turmeric were planted as vegetative measures for control of soil erosion. The productivity of napier was 29.1 tonnes green fodder/ha with 79.7 kg/day/ha production efficiency and 24.3% sustainability yield index.

Horticulture land use and water harvesting pond - W₅

In undulated eroded land (Ve) around the water harvesting pond (0.043 ha m), fruit tree based cropping system with papaya, banana and guava was adopted. The water harvesting pond had "tarfel" lining in the sidewall to control seepage loss in addition to brick plast floor to check water percolation loss. The total cost involved in the preparation of water harvesting pond was Rs. 117/m³. The storage hydrograph showed that storage life of the pond was 230 days in the presence of tarfel lining. Without tarfel lining, the storage life of the pond was only 91 days. The seepage loss with tarfel linning was strikingly minimised from 21 to 8 mm/day.

From the hydrological water balance, it was found that the runoff collected in the pond contributed highest proportion of inflow (67.9%) to the pond and the proportion of

interflow was the least (1.6%) due to tarfel lining used on side walls of the harvesting pond. Excess runoff taken as overflow component of outflow from the pond contributed highest proportion (87.2%) to the pond outflow. The ratio of total runoff flowing to pond (including overflow) and runoff collected in the pond was found to be 2.27 suggesting that the pond size could be increased with the tarfel lining by two times in order to store the entire runoff water.

Vegetable production - W₆

A field trial was conducted on bhindi with the application of organic manure and phosphate solubilizing bacteria (PSB). Data indicated increase in bhindi production from 40.69 to 54.33 q/ha and WUE from 4.86 to 6.42 kg/ha mm after the application of cattle manure and PSB. Sustainability yield index was also raised from 38.1 to 56.2%.

DEVELOPMENT OF MODEL SYSTEM AT RESEACH FARM

(K.R. Dhiman, M. Datta, T.K. Sengupta, L.C. De, B.K. Bhattacharya, S. Mitra, M. Niranjan, B. Santosh, C. Datt & K. Chattopadyaya)

The system included arable cropping of upland with rainfed rice, rice + mung, rice + sesamum, maize and maize + rice in the summer season. Two varieties of rice viz. Vandana and TRC-87-251 was grown. TRC-87-251 out yielded Vandana and tall growing habit of Vandana was prone to lodging. Rice + mung intercropping system was more economic than the yield of 2.5 t/ha of TRC-87-251 under pure rice crop. Sesamum variety Krishna produced 11.5 q/ha grain yield. After the harvest of summer crop in August, second crop groundnut, urd and mung has produced grain yield of 22.5, 8.5 and 8.2 q/ha, respec-

tively in autumn season exclusively with residual moisture.

Another side of hill top was planted with papaya, lemon, mango and anar. The interspaces were planted with sweet potato.

Sloppy lands were planted with high-density pineapple planting across the slope. In addition to handsome produce, it worked as a very effective conservation crop. The risers, path sides and groves not suitable for any crop were dibbled with arhar seeds of local selections.

Freshly cut soil of lowest point for water harvesting cum fishery pond was conserved with planting of grass species viz. thin napier, napier hybrid and broom grass. The small terraces and strips along the pond sides were utilised for tapioca, cucurbits, Indian beans, tomato, brinjal, chillies, cabbage and ornamental like tuberose. The valley land was utilised for the cultivation of radish, sugar cane and sweet potato. It was found that two CIP cultures of sweet potato has a production potential of more than 1000 q/ha.

CATTLE

(Chander Datt & M. Niranjana)

A small number of cross-bred cattle were maintained at the livestock farm under semi intensive type of rearing system. During rainy season, the availability of green fodder/vegetation was in ample quantities and the animals were allowed to graze for 6-7 ha a day. In the evening concentrate mixture and some green fodder was supplemented depending on the physiological stage viz. growth, pregnancy or lactation. During the lean period (November to April) the animals under stall-fed conditions fed mainly on paddy straw supplemented with concentrate mixture and some quantity of green fodder based on body weight and the level of production.

In lieu of the facilities for artificial insemination, natural service was practised. The average gestation period was 286 d. During the year 1999 a total of 5 calvings were obtained from June to December (four male and one female).

Vaccination against FMD was done in all the animals in the month of February. The tick infestation during March-April and July-September was successfully controlled using Butox

Table 4. Productive traits of two breeds of rabbit

Parameter	New Zealand White	Soviet Chinchilla
Gestation period (d)	30.92 ± 0.26	30.94 ± 0.21
Litter size at birth (No.)	6.34 ± 0.63	6.13 ± 0.54
Litter wt. at birth (g)	331.51 ± 25.80	318.20 ± 24.48
Litter size at weaning (No.)	4.79 ± 0.32	4.83 ± 0.25
Litter wt. at weaning (kg)	3.34 ± 0.06	3.47 ± 0.09
Individual wt. at weaning (kg)		
Male	0.619 ± 0.04	0.625 ± 0.06
Female	0.594 ± 0.04	0.576 ± 0.05
Individual wt. at 90 d of age (kg)		
Male	1.433 ± 0.03	1.433 ± 0.06
Female	1.393 ± 0.03	1.386 ± 0.04

(Deltamethrin) at a concentration of 2 ml per litre water. Regular deworming was done for preventing the occurrence of endoparasitic infestation.

RABBIT

Two breeds of meat type rabbit viz. New Zealand White and Soviet Chinchila introduced at the centre during 1997-98 were evaluated for their production traits. The animals were fed on commercial pellets and green fodder. The green fodder included cowpea, leaves of radish, turnip, carrot, cabbage, mulberry, *leucaena* and grasses like Bermuda grass, Napier grass etc. Their production traits were equally well under Tripura conditions (Table 4).

POULTRY

Evaluation and improvement of broiler lines

(M. Niranjan)

Two broiler lines viz. H line and C line were selected and reproduced during the year 1999-2000. The average 6th week body weights were 1190 and 1160 g and at 8th week were 1665 and 1605 g respectively. The feed conversion ratio, measured up to 8 weeks was 2.48 and 2.56 and percent mortality was 6.9 and 7.2, respectively.

Effect of egg weight on subsequent performance in broiler breeders

Fertility remained unaffected by egg size and hatchability decreased with increase in egg weight. Correlation between egg weight and body weight at all ages was positive. Body weight at 6th week was significantly ($P < 0.01$) lower in < 60 g eggs and was highest in eggs weight of 65-70 g. Feed efficiency was not affected by eggs weight.

Evaluation of index selection in White Leghorns

(M. Niranjan)

During the current year, two white leghorn lines i.e. IWH and IWI were selected for genetic improvement of part period egg production. The production traits like egg number upto 280 days of age, egg weight at 40 weeks of age, age at sexual maturity, body weight at 20th and 40th weeks of age were measured in both the lines.

GUINEA FOWL: A boon for back yard rearing

During the current year Guinea fowl (*Numida meleagris*) have been introduced at ICAR Research Complex, Tripura Centre. Sixty eggs of two varieties of G. Fowl (Pearl and Leavander) were purchased from Central Avian Research Institute, Izatnagar. The fertility was 60% and hatchability of fertile eggs set was 92.8%. The birds are under evaluation for further production traits.

WILD SOTTI: A new non-conventional poultry feed ingredient

Wild sotti (*Canaan reeves*) is a rhizome occurring abundantly on upland of Tripura at the onset of rainy season as a weed, is not extensively used for human/animal consumption. It contains about 12-15% crude protein and 65 to 70% nitrogen free extract (NFE) can be tried as energy supplement in poultry feed.

Wild sotti rhizome were collected from local forest and planted in experimental plots during May. On harvesting during December, it yielded 14.5 t/ha of under ground biomass. The Economic (edible part) yield was 10.5 t/ha.

FISH

Ornamental fish resources of Tripura

(B. Santhosh)

49 species were collected and identified up to the species level. The data regarding the morphometric characters and feeding habits were recorded for 18 species. Acclimatisation and acceptance of artificial feed were verified and found successful in 11 species. Confined breeding was found successful in three species of loaches.

Introduction of the Pearl-spot (*Etroplus suratensis* Bloch) in Tripura

(B. Santhosh)

Two hundred fishes were collected from Chilka lake and brought to fresh water in the laboratory condition, 25% survival was obtained. After acclimatisation, the fishes were stocked in an open pond for brood stock purpose.

Copepod parasites of fishes of Tripura

(B. Santhosh)

A detailed parasitological examination of 20 species of fishes revealed that 8 species of fishes were infected by 4 species of copepod parasites. The parasites were dissected and a detailed study revealed that the parasites belonged to the family Ergasilidae (Poecilostomatoidea). Three species are found new to science and the fourth species was *Neoergasilus japonicus*.

SOIL AND WATER CONSERVATION

(B.K. Bhattacharya, M. Datta & S. Mitra)

Different soil amendments such as cowdung manure (M_1), poultry manure (M_2),

Gliricidia maculata leaf (M_3), lentil bran (M_4), lentil waste (M_5), sewage waste (M_6) and compost prepared from crop residues (M_7) were applied to the soil one month before bhindi sowing (12.5.99) @ 5 t/ha on air dry weight basis. Substantially, higher yield and water use efficiency were obtained in case of *Gliricidia* leaf manure (85.0 t/ha), lentil bran (82.3 t/ha) and compost (84.0 t/ha). The increase in mean yield and water use-efficiency was in the order of $M_0 < M_1 = M_5 < M_6 < M_2 < M_4 < M_7 < M_3$.

Different amendments such as: clay mix (T_1), Jalashakti (T_2), poultry manure (T_3), groundnut husk (T_4), coir waste (T_5) and leaf manure (T_6) of *Gliricidia maculata* were applied to the soil @ 2%, 1 kg, 5 t/ha, 5 t/ha and 5 t/ha respectively before sowing direct seeded pre-kharif rice in upland soils. The mean grain yield was significantly higher in all the soil amendments (1.56 to 2.29 t/ha) as compared to control (1.33 t/ha). Clay mix (T_1) showing the highest yield was followed by T_3 , T_2 , T_4 , T_5 and T_6 . The water use efficiency was also higher in all the soil amendments (4.46 to 6.17 kg/ha - mm) as compared to control (4.37 kg/ha - mm).

FODDER

(Chander Datt, K.R. Dhiman & M. Niranjan)

In order to provide a part of total nutrient requirement through green fodder to cattle round the year, an area of approximately 1.5 acre has been brought under cultivation. On the top portion of the land (Tilla land) maize and sorghum fodder crops were raised. Napier grass (*Pennisetum purepureum*) and thin Napier grass (*Pennisetum polystachyon*) was established on the terraces while rice bean or cowpea either singly or in combination with maize fodder were grown on the lower portion (Lunga). Sorghum variety PC-9 and Napier

hybrid (NB-21) brought from Forage section of NDRI-Karnal were introduced for the first time at Tripura Centre. A good growth performance of grasses (Napier hybrid and thin Napier) was observed during rainy season. Fodder tree leaves can play an important role in overall feeding of ruminants during lean (winter) period. A number of fodder tree species viz. *Leucaena leucocephala*, *Ficus hookeri*, *Gmelina*, *Bambusa* sp., *Acacia auriculiformis*, *Gliricidia maculata*, *Erythrina indica*, *Morus* sp. hold good promise as potential feed resources, the samples (leaves) were collected for nutrient analysis. *Leucaena leucocephala* saplings were planted in an area of about 200 m² in order to meet a part of protein requirement of cattle and rabbits at the centre.

PUBLICATION

- Das A and S.K. Ghosh. (1999). Effect of concentrate supplementation on intake, digestion and milk production in crossbred cows grazing in native pasture of Tripura. *Indian J. Anim. Nutr.* 16: 238-239.
- Das, Asit, L. C. De, S. K. Ghosh and K. R. Dhiman (1999) Jack bean: a potential legume for livestock and poultry. *Indian Farmers Digest* 32: 16-18.
- De, L. C. and S.K. Bhattacharjee (1999) Effect of different chemicals for tight bud opening of rose cv. 'Super Star' at different stages of maturity. *Ann. Agril. Res.* 206-211.
- L.C. De, Asit Das, K.R. Dhiman and S. K. Ghosh (1999) Potential of agri-horti-pastoral crops for the improvement of shifting cultivation. *Indian Farmers Digest* 32: 19-21.
- De, L.C., S.D. Wahi and S.K. Bhattacharjee (1999) A post harvest study of genetic divergence in cut roses. *Indian J. Gen.* 59: 351-356.
- Mitra, S., B. K. Bhattacharjee, M. Datta and S. Banik (1999) Effect of variety, rock phosphate and phosphate solubilizing bacteria on growth and yield of greengram in acid soils of Tripura. *Environ. Ecol.* 17: 926-930.
- Mitra, S. and A.K. Pal (1999) Water use and productivity of summer sesame and influenced by irrigation and nitrogen. *J. Indian Soc. Soil Sci.* 47: 400-404.
- Vinze, Mukesh and Chander, Datt (1999) Veterinary drug residues in animal products. A cause of concern for human health. *Milcow* July: 10-15.

Seminars/symposia attended

- Dhiman, K.R., L.C. De and M. Datta (1999) Utilization of natural resources and eco-friendly development of Tripura. Proceedings of International Conference on Managing Natural Resources for Sustainable Agricultural Production in the 21st Century, Vol 3 : 1008-1010, New Delhi.
- Datta M. and K.R. Dhiman (1999) Agroforestry: A sustainable Research Approach for utilisation of uplands of Tripura. Proceedings of International Conference on Managing Natural Resources for Sustainable Agricultural Production in the 21st Century, Vol. 3: 1008-1010, New Delhi.
- Mitra, S., B. K. Bhattacharjee, M. Datta and K.R. Dhiman (1999) Relative performance of rice (*Oryza saliva*) based cropping systems on rainfed uplands of Tripura. Proceedings of International Conference on Managing Natural Re-

sources for Sustainable Agricultural Production in the 21st Century, New Delhi from 14-18th Feb, 2000.

Datt, chander and A. Chhabra (1999) Effect of supplementation of inorganic and organic forms of selenium on rumen microbial population in cattle and buffaloes. Proceedings of IX Annual Nutrition Conference held at Acharya N.G. Ranga Agri. Univ. Rajendranagar, Hyderabad, A.P. from 2 to 4 December, 1999.

Datt, Chander and A. Chhabra (1999) Effect of high level selenium supplementation

on feed intake and nutrient utilization in cattle and buffaloes fed on paddy straw based diets. Proceedings of IX Annual Nutrition Conference held at Acharya N.G. Ranga Agri. Univ. Rajendranagar, Hyderabad, A.P. from 2 to 4 December, 1999.

Mitra, S., S. Singh, S. K. Bandyopadhyay and C. S. Singh (1999) The effect of irrigation, nitrogen and biofertilizer on nutrient uptake and yield of wheat. Proceeding of 1st Regional Conference in Biofertilizer held at Guhawati from 22-23 Jan, 1999.

प्राक्कथन

भारतीय कृषि अनुसंधान परिषद का उत्तर पूर्वी पर्वतीय परिसर इस संपूर्ण क्षेत्र की प्रमुख खाद्यान्न फसलों व पशुधन पर अनुसंधान एवं प्रसार द्वारा लगातार उन्नति के लिए प्रयासरत है। समय की मांग के अनुरूप शोध द्वारा प्राप्त नई तकनीकों एवं उपलब्धियों को किसानों तक पहुंचाना संस्थान का प्रथम उद्देश्य है।

प्रस्तुत वार्षिक प्रतिवेदन में अप्रैल 99 से मार्च 2000 तक के शोध परिणामों को प्रस्तुत किया जा रहा है तथा इस संबंध में वार्षिक प्रतिवेदन हेतु निर्दिष्ट दिशा निर्देशों का अनुपालन किया गया है। औद्योगिक फसलों, पशुधन तथा मत्स्य पालन सहित कृषि में प्राप्त अनुसंधान उपलब्धियों को इसमें समाविष्ट किया गया है।

राज्य सरकार के विभागों को तकनीकी ज्ञान, सूचना एवं सलाह देना, कृषि एवं सम्बद्ध

क्षेत्र में विभिन्न प्रकार के प्रशिक्षण आयोजन करने से अवाहक प्राप्त करने तक संस्थान ने चतुर्दिक प्रगति की है। प्रतिवेदित अवधि के दौरान काफी संख्या में शोध पत्र प्रकाशित किए गए तथा राष्ट्रीय/अंतरराष्ट्रीय सेमिनारों में उनका प्रस्तुतीकरण किया गया।

इस प्रतिवेदन को तैयार करने में सहयोग देने के लिए सभी वैज्ञानिकों, तकनीकी तथा प्रशासन कर्मियों को धन्यवाद ज्ञापित करते हुए सामग्री संकलन, संगठन, एवं संपादन में डॉ. पातीराम, डॉ. बी. के. शर्मा, डॉ. कैलाश कुमार, डॉ. बी.पी. भट्ट एवं श्री एच. सी. जोशी का योगदान एवं हिंदी रूपान्तरण में श्री एच. सी. जोशी का योगदान सराहनीय रहा है।

नरेन्द्र देव वर्मा

नरेन्द्र देव वर्मा

निदेशक

उमियम (मेघालय)

दिनांक 30 सितम्बर, 2000

परिचय

भारतीय कृषि अनुसंधान परिषद के उत्तर पूर्वी पर्वतीय अनुसंधान परिसर की स्थापना वर्ष 1975 में हुई जिसका मुख्यालय प्रारंभ में शिलांग में था जिसे वर्ष 1991 में उमियम (बड़ापानी) ले आया गया जहां परिसर का मुख्य अनुसंधान फार्म स्थित है। भारतीय कृषि अनुसंधान परिषद द्वारा सिक्किम सहित संपूर्ण पूर्वोत्तर पर्वतीय क्षेत्र स्थापित यह एक ऐसा शोध संस्थान है हेतु जहां पर, कृषि, बागवानी, पशु विज्ञान, मत्स्य पालन एवं कृषि अभियांत्रिकी पर शोध कार्य करने के साथ साथ कृषि विज्ञान केन्द्रों द्वारा विकसित तकनीक को किसानों तक पहुँचाने का कार्य भी संपादित किया जा रहा है ताकि पूर्वोत्तर क्षेत्र की कृषि समस्याओं को समग्र रूप समझ कर यहां की अनुसंधान आवश्यकताओं की पूर्ति की जा सके। इस संस्थान के 6 केन्द्र पूर्वोत्तर के विभिन्न राज्यों में खोले गए हैं जो कि बसार (अरुणाचल प्रदेश), इंफाल (मणिपुर), कोलासिब (मिजोरम), झरनापानी (नागालैंड), टडॉंग (सिक्किम) तथा लेम्बूचेरा (त्रिपुरा) में स्थित हैं। इसके अतिरिक्त विभिन्न अनुसंधान केन्द्रों से समबद्ध कृषि विज्ञान केन्द्र भी तकनीकी प्रचार व प्रसार में सतत संलग्न हैं। समस्त पूर्वोत्तर पर्वतीय राज्यों की अनुसंधान आवश्यकताओं की पूर्ति के लिए उमियम (मेघालय) में एक प्रशिक्षक - प्रशिक्षण केन्द्र की स्थापना की गई है। विभिन्न कृषि जलवायवीय खंडों की कृषि समस्याओं व जरूरतों को जानकर उनका निदान खोजने के उद्देश्य के तहत इस संस्थान के केन्द्रों को अलग अलग उँचाइयों पर स्थापित किया गया है जिसमें उमियम (बड़ापानी)

समुद्र सतह से 980 से 1080 मीटर की ऊँचाई पर स्थित है तो झरनापानी 500 से 550 मीटर की ऊँचाई पर। त्रिपुरा का लेम्बूचेरा स्थित फार्म 60 से 70 मीटर ऊँचाई पर स्थित है तो सिक्किम का टडॉंग स्थित फार्म 1200 से लेकर 1499 मीटर तक की ऊँचाई पर है। बसार (अरुणाचल), कोलासिब व इंफाल स्थित फार्म 750 से लेकर 800 मीटर तक की ऊँचाई पर अवस्थित हैं।

अनुसंधान केन्द्रों की स्थापना संपूर्ण पूर्वोत्तर पर्वतीय क्षेत्र को एक इकाई मानकर की गई है और केन्द्रों की स्थापना करते वक्त यह ध्यान रखा गया है कि इस संपूर्ण क्षेत्र के कृषि-जलवायवीय खण्डों तथा विभिन्न ऊँचाई पर स्थित भू-स्थलों को उचित प्रतिनिधित्व मिल सके और वैज्ञानिकों को दोहरे कार्य से बचाकर गहन अनुसंधान के लिए उनका विवेकपूर्ण उपयोग किया जा सके। साथ ही संस्थान द्वारा सभी पूर्वोत्तर पर्वतीय राज्यों हेतु विशिष्ट ऊँचाई व भूस्थलाकृति पर आधारित शोध उपलब्धियों का समुचित प्रयोग किया जा सके।

उमियम स्थित मुख्यालय 25° 30' उत्तर तथा 91° 51' पूर्व पर गुवाहाटी-शिलांग व उमरोई रोड के संगम पर स्थित उमियम डाइक से लगभग 1.5 कि. मी. की दूरी पर स्थित है। शिलांग शहर से इस स्थान की दूरी लगभग 22 कि.मी. है। 101 हेक्टेयर क्षेत्रफल वाली इस जगह की भू-स्थलाकृति कहीं पर मध्यम से तीव्र ढलान वाली तो कहीं पर सपाट घाटीयुक्त है जो कि सभी प्रकार की पहाड़ी भू-स्थलाकृति का प्रतिनिधित्व करती है। इन पहाड़ियों पर मृदा एवं जल संरक्षण

के लिए अनेक प्रकार के उपाय किए गए हैं जिनमें मध्यम ढलान वाली भूमि पर बैंच टैरेस, तीव्र ढलान वाली पहाड़ियों पर कंटूर बडिंग तथा अर्ध-चंद्राकार वेदिकाएं बनाई गई हैं। वर्षा के पानी को कृषि कार्य के लिए उपयोग में लाने के लिए मिट्टी के बांध तथा ट्रेंचेज बनाई गई हैं। वर्तमान में खेती के अंतर्गत 60 हेक्टेयर भूमि का उपयोग किया जा रहा है।

प्रमुख उद्देश्य

1. इस क्षेत्र के विभिन्न कृषि-जलवायवीय खंडों तथा आर्थिक-समाजिक स्थितियों में स्थाई खेती पद्धतियों पर आधारित तकनीक विकसित करने हेतु मूल तथा प्रयुक्त शोध कार्य करना।
2. खाद्यान्न फसलों, पशुधन तथा मत्स्य पालन के क्षेत्र में उत्पादकता बढ़ाना।
3. क्षेत्र के प्राकृतिक संसाधनों तथा विभिन्न खेती एवं भू-उपयोग प्रणालियों से संबंधित आंकड़ों के संग्रहणालय के रूप में कार्य करना।
4. अनुसंधान विधियों तथा कृषि उत्पादकता बढ़ाने हेतु विकसित तकनीकों के उपयोग एवं अनुप्रयोग के बारे में प्रशिक्षण प्रदान करना।
5. राज्य सरकार के विभागों के साथ सहयोग करना तथा विकसित खेती व भू-उपयोग तकनीकों को बढ़ाना तथा उनका परीक्षण करना।
6. उपरोक्त उद्देश्यों की प्राप्ति के लिए राष्ट्रीय तथा अंतरराष्ट्रीय संस्थाओं से सहयोग करना।
7. कृषि से संबंधित सलाह व सूचनाएं प्रदान करना।

विशिष्ट क्षेत्र

- अधिक उत्पादकता प्राप्त करने हेतु झूम खेती का प्रतिस्थापन तथा पर्वतीय इलाकों हेतु उपयुक्त एकीकृत खेती-पद्धति का विकास।
- स्थानीय रूप से उपलब्ध चारे को शामिल करते हुए पशुओं के लिए आहार व चारे का विकास।
- निंबुकुल के वृक्षों में सुधार लाना ताकि इसे फिर से पुनर्स्थापित किया जा सके।
- खाद्यान्न फसलों, दालों, तिलहनों, बागवानी तथा अन्य महत्वपूर्ण फसलों पर अनुसंधान करके उनकी कुल उत्पादकता बढ़ाना।
- पशुओं की उचित देखभाल तथा पशु उत्पादन प्रणाली में सुधार लाना।

संस्थान में 15 विषयों पर अनुसंधान कार्य किया जा रहा है तथा वर्तमान में 72 से अधिक शोध परियोजनाएं पादप प्रजनन, सस्य विज्ञान, मृदा विज्ञान, पादप रोग विज्ञान, कीट विज्ञान, पशु स्वास्थ्य, पशु परजीवी विज्ञान, पशु पोषण, पशु उत्पादन, मत्स्य पालन, कृषि अर्थशास्त्र तथा सांख्यिकी, कृषि अभियांत्रिकी, कृषि प्रसार, कृषि वानिकी तथा उद्यान विज्ञान के अंतर्गत प्रगति पर हैं।

संस्थान में पदों की वर्तमान स्थिति निम्न है।

श्रेणी	स्वीकृत	भरे पद	खाली पद
वैज्ञानिक	192	117	75
तकनीकी	318	248	70
प्रशासनिक	154	113	41
सपोर्टिंग	136	134	2
कुल	800*	612	128

*कृषि विज्ञान केंद्र तथा टीटीसी के पद सम्मिलित नहीं हैं।

पुस्तकालय

संस्थान के पुस्तकालय में संप्रति 14,874 प्रतिवेदन तथा पुस्तकें एवं कई प्रकाशनों के 7045 बैंक वाल्यूम्ज भी उपलब्ध हैं। पुस्तकालय में मंगाए जाने वाले प्रकाशनों में 42 विदेशी तथा 122 भारतीय पत्रिकाएं सम्मिलित हैं। अभी तक पुस्तकालय में 3,995 भारतीय तथा विदेशी जर्नल्स उपलब्ध हैं जिनका उपयोग वैज्ञानिकों तथा अन्य श्रेणी के कर्मचारियों द्वारा नियमित रूप से किया जा रहा है।

CDS/ISIS (ver 3.01) पैकेज का प्रयोग करते हुए पुस्तकालय से संबंधित डाटा बेस विकसित किया गया है तथा 6 क्षेत्रीय तथा राष्ट्रीय अखबारों से एकत्रित सूचना के आधार पर पूर्वोत्तर भारत के पर्यावरणीय हास पर क्यूंप्यूटरीकृत डाटा बेस भी तैयार किया गया है। NICNET से जुड़े होने से ई. मेल सुविधाओं के साथ साथ IASRI, नई दिल्ली में उपलब्ध अंतर्राष्ट्रीय डॉटा बेस पर आधारित विशिष्ट सूचना सेवाओं का भी लाभ उठाया जा सकता है।

संस्थान की वैज्ञानिक एवं प्रशासनिक आवश्यकताओं के लिए एक सुविकसित कम्प्यूटर केन्द्र है, जहां वैज्ञानिक डाटा विश्लेषण तथा प्रशासनकर्मी अपने लेखा व अन्य कार्य संपादित करते हैं। वर्ष 1999-2000 के लिए संस्थान का बजट निम्न था।

(लाख रुपयों में)

बजट	आंवटित	व्यय
योजनागत	475.00	472.56
योजनेतर	1113.00	1066.04

राजभाषा कार्यान्वयन

भारत सरकार के राजभाषा विभाग के निर्देशों का अनुपालन सुनिश्चित करने के लिए संस्थान में हिंदी प्रकोष्ठ कार्यरत है जो कार्यान्वयन के साथ साथ कर्मचारियों को हिंदी में प्रशिक्षण की भी व्यवस्था करता है। प्रतिवेदित अवधि के दौरान निजी परीक्षार्थी के रूप में कर्मचारियों को हिंदी सिखाकर परीक्षा दिलवाने का प्रयास किया गया।



वर्ष के दौरान राजभाषा कार्यशालाएं तथा हिंदी सप्ताह का आयोजन किया गया। वैज्ञानिकों के लिए वैज्ञानिक संगोष्ठी का आयोजन तथा राजभाषा हिंदी में लेख लिखने की ओर अभिप्रेरित करने के उद्देश्य से हिंदी अनुभाग द्वारा पूर्वोत्तर पर्वतीय कृषि अंक-6 का प्रकाशन किया गया जिसमें

राजभाषा हिंदी में लगभग 20 वैज्ञानिकों ने विभिन्न विषयों पर लेख प्रस्तुत किए। इसके साथ ही भारतीय कृषि अनुसंधान परिषद के प्रकाशनों में संस्थान के वैज्ञानिकों को लेख लिखने के लिए अभिप्रेरित करने के लिए अनुवाद व टंकण सुविधा हिंदी प्रकोष्ठ द्वारा प्रदान की जा रही है। राजभाषा



हिंदी के प्रति कर्मचारियों का रुझान बढ़ाने के लिए संस्थान के पुस्तकालय में हिंदी की 1600 पुस्तकें उपलब्ध हैं तथा कई राष्ट्रीय दैनिक व अन्य पत्रिकाएं भी मंगवाई जा रही हैं।

वैज्ञानिक क्षेत्र में हिंदी को बढ़ावा देने के लिए नगर राजभाषा कार्यान्वयन समिति, शिलांग द्वारा संस्थान को वर्ष 1998-99 के लिए तृतीय पुरस्कार के रूप में शील्ड प्रदान की गई। यह शील्ड महानिदेशालय, असम राइफल्स, शिलांग के महानिदेशक द्वारा संस्थान के निदेशक को प्रदान की गई।

लिंकेंज:

विभिन्न शोध परियोजनाओं के संचालन के लिए राष्ट्रीय तथा अंतरराष्ट्रीय संस्थानों तथा इस

संस्थान के बीच सौहार्द्रपूर्ण संबंध कायम हैं तथा कृषि व सम्बद्ध विभागों को नियमित सूचना सलाह सेवाएं उपलब्ध कराई जा रही हैं। मेघालय सरकार के कृषि विभाग तथा संस्थान के विभिन्न विषयों के वैज्ञानिकों के बीच शोध एवं विकास संबंधी मामलों पर लगातार विचार विमर्श तथा समस्याओं के समाधान के लिए वर्ष में दो बार इंटर-फेस बैठकों का नियमित आयोजन किया जाता है।

शोध द्वारा अर्जित जानकारी को प्रकाशनों के माध्यम से किसानों तक पहुंचाया जाता है। संस्थान द्वारा नियमित रूप से वार्षिक प्रतिवेदन तथा त्रैमासिक संवाद पत्र का प्रकाशन किया जाता है

जिसमें शोध की मुख्य उपलब्धियों को प्रकाशित किया जाता है। इसके अतिरिक्त समय समय पर विभिन्न विषयों पर शोध तथा प्रसार पुस्तिकाओं का भी प्रकाशन किया जाता है।

शोध सलाहकार समिति की बैठक

प्रतिवेदित अवधि के दौरान संस्थान की शोध सलाहकार समिति की बैठक 25-26 अक्टूबर, 1999 को सम्पन्न हुई जिसमें डॉ. के. जी. तेजवानी तथा भा.कृ.अनु. परिषद, नई दिल्ली से सहायक महानिदेशक (कृषि वानिकी) डॉ. पी. एस. पाठक उपस्थित थे। शोध सलाहकार समिति की बैठक में विभिन्न विषयों के वैज्ञानिकों के साथ उनके शोध परियोजनाओं पर विस्तार से चर्चा हुई तथा भविष्य की शोध-नीति तय की गई।

किसान मेले का आयोजन

संस्थान का यह प्रमुख उद्देश्य रहा है कि किसान, जो कि भारतीय ग्रामीण अर्थव्यवस्था की रीढ़ हैं, को समय समय पर संस्थान में आमंत्रित करके शोध कार्य से परिचित कराया जाय ताकि वे अपने खेतों में उन्नत प्राद्योगिकी को अपना सकें। इसी क्रम में समय समय पर किसान-मेलों, फील्ड-डे तथा प्रशिक्षण-कार्यक्रमों का आयोजन किया जाता है। 21 अगस्त, 99 को आयोजित किसान मेले में हजारों की संख्या में किसान भाइयों ने प्रतिभागिता निभाई। इस अवसर पर मुख्य अतिथि के रूप में अपने विचार व्यक्त करते हुए मेघालय सरकार के माननीय कृषि मंत्री श्री सुचियांग ने कहा कि जहां तक मेघालय में कृषि के आधुनिकीकरण का प्रश्न है यह कार्य भारतीय कृषि अनुसंधान परिषद के उत्तर पूर्वी पर्वतीय परिसर के वैज्ञानिकों द्वारा बखूबी किया जा रहा है।

उन्होंने कहा कि वैज्ञानिक धान, मकई तथा मूंगफली की स्थानीय किस्मों को ऊँची उत्पादकता एवं उपज देने वाली किस्मों से प्रतिस्थापित करना चाहते हैं तथा इसी प्रकार सुअर तथा खरगोशों की स्थानीय नस्लों में सुधार लाकर अधिक मांस देने वाली नस्लें विकसित करना चाहते हैं जो कि इस क्षेत्र के अनुरूप एवं आवश्यक है। उन्होंने कहा कि इस क्षेत्र के किसान आज भी लाभ तथा उत्पादकता को अधिक महत्व न देते हुए पारम्परिक रूप से खेती करना पसन्द करते हैं जिससे वैज्ञानिकों का कार्य और भी दुरूह हो जाता है क्योंकि ऐसे में उन्हें किसी भी तकनीकी की अनुशंसा करने के पूर्व कई पहलुओं पर अपना ध्यान केंद्रित करना पड़ता है।

उन्होंने किसानों का आह्वान किया कि वे आगे बढ़ें तथा वैज्ञानिकों को पूरा सहयोग करें ताकि वे उनसे प्राप्त जानकारी के आधार पर शोध परिणामों को पूरा लाभ उन्हें देने में सक्षम हो सकें।

मेघालय विधानसभा के माननीय स्पीकर श्री ई. के. मावलांग ने मेले की अध्यक्षता की तथा संस्थान द्वारा किए जा रहे प्रयासों की सराहना भी की।

राष्ट्रीय सेमिनार का आयोजन

इस अवधि में संस्थान द्वारा राष्ट्रीय कृषि विज्ञान अकादमी, नई दिल्ली के तत्वावधान में एक तीन दिवसीय राष्ट्रीय सेमिनार का आयोजन शिलांग स्थित एंथनी कालेज के ऑडिटोरियम में किया गया। 10-12 नवंबर, 1999 तक चले इस तीन दिवसीय सेमिनार का विषय था पूर्वोत्तर भारत में कृषि अनुसंधान हेतु भावी रणनीति। इस सेमिनार का उद्घाटन मेघालय के राज्यपाल महामहिम श्री एम. एम. जेकब ने किया। उन्होंने अपने संबोधन में वैज्ञानिक समुदाय से कहा अनुसंधान के समय वैज्ञानिकों का एक ही लक्ष्य होना चाहिए कि किसान को किस प्रकार अधिकतम लाभ पहुंचाया जा सकें। उन्होंने वैज्ञानिकों का आह्वान किया कि वे अपनी पूरी शोध शक्ति को इस तरफ लगाएं। मेघालय के माननीय मुख्यमंत्री श्री. बी. बी. लिंगदोह समारोह में विशिष्ट अतिथि के रूप में उपस्थित थे उन्होंने अपने संबोधन में कहा कि वैज्ञानिकों को इस ओर विशेष ध्यान देना चाहिए कि वे किस प्रकार यहां के किसानों को आधुनिक तकनीक अपनाने की ओर मोड़ सकते हैं। क्योंकि पूर्वोत्तर अभी भी उन्नत कृषि की दौड़ में काफी पीछे है।

भारतीय कृषि अनुसंधान परिषद के महानिदेशक डॉ राजेन्द्र सिंह परोदा ने इस अवसर पर अपने अध्यक्षीय संबोधन में मेघालय एवं पूर्वोत्तर राज्यों के अन्य प्रांतों से आए विशिष्ट अतिथियों को आश्चस्त किया कि परिषद इस क्षेत्र के विकास के लिए कृत-संकल्प है तथा कृषि एवं पशुपालन हेतु हर संभव प्रयास किया जाएगा।

मेघालय के माननीय कृषि मंत्री श्री एस. शुचियांग ने इस अवसर पर अपने संबोधन में राज्य सरकार के विभागों के अधिकारियों का आह्वान किया कि वे वैज्ञानिकों से सम्पर्क बनाए रखने हेतु किसानों को लगातार प्रेरित करें ताकि इस क्षेत्र का संपूर्ण विकास हो सके।

इस सेमिनार में देश के प्रतिष्ठित कृषि वैज्ञानिकों ने सहभागिता निभाई तथा अपने क्षेत्रों से संबंधित पत्रों को पढ़ा। सेमिनार में 4 तकनीकी सत्र थे तथा अंतिम सत्र प्लेनरी सत्र था। इस सेमिनार में 58 पोस्टर भी लगाए गए।

इसी अवधि के दौरान तीसरी रीजनल कमेटी की बैठक का भी आयोजन शिलांग में किया गया जिसमें पूर्वोत्तर के सभी राज्यों के कृषि उत्पादन आयुक्त, कृषि से संबंधित शीर्षस्थ अधिकारी तथा कई राज्यों के कृषि मंत्रियों ने अपनी सहभागिता निभाई तथा अपने अपने प्रदेशों में चल रहे कार्यों

पर चर्चा के साथ ही भविष्य के लिए अपने सुझाव भी दिए ताकि परिषद उन्हें क्रियान्वित कर सके।

माननीय कृषि राज्य मंत्री, भारत सरकार का संस्थान में आगमन

भारत सरकार के माननीय कृषि, पशुपालन, डेरी राज्य मंत्री श्री हुकुमदेव नारायण यादव ने 29 मार्च 2000 को इस संस्थान का दौरा किया तथा इस अवसर पर कृषि तकनीकी सूचना केंद्र, एटिक भवन का शिलान्यास किया।

माननीय मंत्री महोदय ने भारतीय कृषि, अनुसंधान परिषद के उत्तर-पूर्वी पर्वतीय परिसर तथा इस क्षेत्र में स्थित अन्य संस्थानों के केंद्रों के वैज्ञानिकों को संबोधित किया और कहा कि इस संपूर्ण क्षेत्र का आज से नहीं वरन महाभारत काल से ही संपूर्ण देश से पौराणिक रिश्ता रहा है। आज जरूरत है कि इस रिश्ते को और प्रगाढ़ बनाए जाने की, क्योंकि देश के शेष भागों से यहां की स्थिति बिल्कुल अलग हैं अतः कृषि वैज्ञानिकों को यहां अपना विशिष्ट योगदान देना होगा ताकि यह संपूर्ण क्षेत्र आर्थिक रूप से समृद्ध हो सके और देश के शेष भागों के साथ इसका संगम गंगा, यमुना तथा सरस्वती की तरह हो सके।

सारांश

मेघालय

प्रतिवेदित अवधि के दौरान अधिकतम तापमान 20°C (जनवरी) से 27.7°C (जून) के बीच रिकार्ड किया गया। अन्य महीनों की तुलना में जून विशेष रूप से गर्म रहा। एक दिन में अधिकतम तापमान 32.7°C दर्ज किया गया। न्यूनतम तापमान 7.2°C (जनवरी) से 20.6°C (जुलाई) के बीच रिकार्ड किया गया।

मृदा तापमान प्रातःकाल थोड़ा अधिक तथा अपराह्न में यह विपरीत क्रम में पाया गया। 15 से.मी. गहराई पर मृदा तापमान 13.8°C (दिसम्बर) से 24.1°C (जून) के बीच पाया गया। तापमान जनवरी से अप्रैल तक बढ़ते क्रम में तथा सितम्बर से इसमें घटने की प्रवृत्ति पाई गई जो कि दिसम्बर में 13.8°C तक दर्ज किया गया। 15 तथा 30 से.मी गहराई पर मृदा तापमान में कोई विशेष अंतर नहीं पाया गया तथा मृदा तापमान सामान्य तापमान से सदैव कम पाया गया।

इस दौरान कुल वार्षिक वर्षा एवं वर्षा दिवस क्रमशः 2091.2 मि.मी. व 189 पाए गए। पिछले वर्ष की तुलना में इस वर्ष 250 मि.मी अधिक वर्षा हुई तथा वर्षा दिवस भी अधिक रहे। फरवरी को छोड़कर लगभग सभी महीनों में वर्षा हुई तथा वर्षा-विस्तार 5.3 मि.मी. से लेकर 654.4 मि.मी (जुलाई) के बीच पाया गया। कुल वर्षा का 90% मई से अक्टूबर के बीच प्राप्त हुआ। वर्ष में 16 सप्ताह बिना वर्षा के रहे। जुलाई में हर दिन वर्षा रिकार्ड की गई तथा किसी एक

विशेष दिवस में सर्वाधिक वर्षा 19 जुलाई को हुई जो कि 124.4 मि.मी रिकार्ड की गई। अप्रैल के महीने में वाष्पीकरण सर्वाधिक (120.3 मि.मी) तथा जनवरी में 66.2 मि.मी. न्यूनतम वाष्पीकरण पाया गया। नवम्बर से लेकर अप्रैल तक वर्षा की तुलना में वाष्पीकरण अधिक था जब कि मई से अक्टूबर के बीच वाष्पीकरण की तुलना में वर्षा अधिक दर्ज की गई।

वायु वेग का मासिक औसत 2.17 (अक्टूबर) से 5.74 (अप्रैल) कि. मी. प्रति घंटे दर्ज किया गया। वर्षाकाल में अप्रैल को छोड़कर अन्य महीनों को दौरान वायु दिशा दक्षिण-पूर्वी तथा जुलाई-अगस्त तथा नवम्बर-दिसम्बर के बीच यह दक्षिण व पूर्वी पाई गई।

बड़ापानी में सापेक्षिक आर्द्रता जुलाई व अगस्त माह में प्रातःकाल के समय सर्वाधिक 92% पाई गई तथा दिसम्बर के माह में यह न्यूनतम 58% रिकार्ड की गई। सापेक्षिक आर्द्रता में जनवरी से लेकर जुलाई तक बढ़ने तथा तत्पश्चात घटने की प्रवृत्ति दर्ज की गई। जून से सितम्बर (वर्षाकाल) में सापेक्षिक आर्द्रता का विस्तार 80-90% के बीच पाया गया तथा 18 अक्टूबर को शत-प्रतिशत सापेक्षिक आर्द्रता रिकार्ड की गई।

बड़ापानी में जुलाई के महीने प्रति दिन 1.90 घंटा धूप मिली जबकि जनवरी में एक दिन में 7.94 घंटा धूप प्राप्त हुई। जून से सितम्बर के मध्य प्रति दिन धूप-काल 1.90 से 3.94 घंटा पाया गया जबकि अक्टूबर से मई के बीच यह

प्रति दिन 2.95 से 7.94 घंटा के बीच पाया गया। वर्षभर में 21 दिन 9 घंटा धूप मिली तथा अक्टूबर से जनवरी के बीच 15 दिन ऐसे भी पाए गए जब कि बिल्कुल धूप नहीं दिखी।

उच्च भूमि हेतु आरसीआरटी तथा प्रायोगिक धान की 14 लाइंस में आर.सी.पी.एल 1-21 से सर्वाधिक उपज प्राप्त हुई। IURON परीक्षण के अंतर्गत धान की 24 चयनित जीनोटाइप्स में आई.आर. 65258-27-13 तथा आई.आर. 66421-039-2-1 को सर्वाधिक उपज देने वाला पाया गया। अखिल भारतीय समन्वित शोध परियोजना में आई.ई.टी. 16487 (आर.सी.पी.एल 1-4) तथा आई.ई.टी. 160003 (आर.सी.पी.एल 1-28) को लगातार दो वर्षों तक अधिक उपज देने वाली किस्में पाया गया। किसानों के खेतों में लगाए गए ट्रायल में झूम तथा सीढ़ीदार खेती पद्धति के अंतर्गत आर.सी.पी.एल 1-28 की तुलना में आर.सी.पी.एल 1-29 से अधिक उपज प्राप्त हुई। निचली भूमि में लगाए जाने वाले धान की संभाव्य लाइंस को सम्मिलित करते हुए कुल 22 क्रास (संयोग) किए गए तथा उनसे प्राप्त संकर बीज एकत्रित किया गया। निचली भूमि के लिए आरसीआरटी वर्ग में आर. सी. पी. एल 1-4 तथा आर. सी. पी. एल 1-87-8, आर. सी. पी. एल 179-3P (चयन 1) व आई.टी.ए. 222 (चयन 2) को अधिक उपज वाला पाया गया। अधिक ऊँचाई वाले स्थानों में सामान्य तथा देर से बोने पर यनलेन 12 व यनलेन 20 क्रमशः अधिक उपज वाले पाए गए।

लीफ फोल्डर व गंधी बग की रोकथाम के लिए प्रति हेक्टेयर 1 कि.ग्रा. ए.आई. की दर से कार्बोफ्यूथ्रान का छिड़काव प्रभावी पाया गया तथा मृत क्रेब द्वारा गंधी बग को पकड़ने के लिए

अपनाई गई स्थानीय विधि को पमेलो या फ्रॉग स्टिक की तुलना में अधिक प्रभावी पाया गया।

100:80:60 किलोग्राम, प्रति हेक्टेयर की दर से एन.पी.के. का अकेले या 10 टन गोबर की खाद (एफ.वाई.एम.) व 20 कि.ग्रा. जिंक सल्फेट के साथ मिलाकर प्रयोग करने पर धान में अधिक उपज प्राप्त हुई। गॉल मिज के लिए धान की विभिन्न किस्मों की स्क्रीनिंग की गई। दो समान भागों में 50 किलोग्राम प्रति हेक्टेयर K_2O का प्रयोग (एक शुरूआत तथा दूसरा बालियां निकलने पर) या बराबर अनुपात (1:1) में सिंगल सुपर फास्फेट व RP का प्रति हेक्टेयर 50 किलो की दर से P_2O_5 के साथ 5 टन गोबर की खाद से अनुकूलतम व अधिकतम धान की उपज प्राप्त हुई।

समन्वित ट्रायलों के अंतर्गत मकई की कई अच्छी किस्मों की पहचान की गई ताकि उनकी वृहद पैमाने पर खेती के लिए अनुशंसा की जा सके साथ ही सस्य प्रक्रियाओं के प्रमाणीकरण के लिए मकई की किस्मों का मूल्यांकन किया गया। आरसीआरटी की 14 एंट्रीज में एम.एल.वाई तथा आर.सी.एम. 1-1 को अधिक उपज देने वाला पाया गया जबकि आर.सी.एम. 1-1 को कॉब बोरेर के प्रति सुग्राही पाया गया। मकई की अच्छी किस्मों के बीज परीक्षण, मूल्यांकन तथा वितरण के लिए तैयार किए गए। बेबीकॉन की किस्मों में आर. सी. एम. 1-3 व आर. सी. एम. 1-1 को अधिक उपज वाला पाया गया। प्रति हेक्टेयर 100 कि. ग्रा. नाइट्रोजन+ 20 कि. ग्रा. सल्फर+ 5 टन सुअर के मल से तैयार खाद को प्रयुक्त करने पर मकई की अधिकतम उपज प्राप्त की गई तथा प्रति हेक्टेयर 20 कि. ग्रा. फास्फोरस

+ 2 टन चूना + 5 टन गोबर की खाद (एफ.वाई.एम) से भी अधिकतम उपज मिली।

दलहनी फसलों में मूंग की 99 एम-39, 99 एम-57, उर्द की 99 यू-26, 99 यू-45, 99 यू-35, 99 यू-49, 99 यू-33 अरहर की ए.एफ-239 तथा राजमा की एच यू.आर-137 को अच्छी पैदावार वाला पाया गया। नीम व गोबर की खाद + नीम की टिक्की से उपचारित मटर की क्यारियों में एफिड का प्रकोप कम पाया गया। तोरिया में कम संख्या में तथा सरसों की एम-37 में अधिक संख्या में एफिड पाए गए। पापैकान व मूंगफली को (4:2) में लगाने पर अधिकतम मेज तुल्यांक उपज प्राप्त हुई तथा पापैकान + फ्रैंचबीन का स्थान दूसरा रहा। मकई तथा मूंगफली को अंतः फसल के रूप में लेने पर प्रति हेक्टेयर 80:40:30 कि. ग्रा. एनपीके के प्रयोग से अधिकतम उपज प्राप्त हुई।

सोयाबीन की ब्रेग किस्म से प्रारंभिक तथा एडवांस वैराइटल ट्रायल में उपज सर्वाधिक पाई गई। प्रति हेक्टेयर 60 कि.ग्रा. P_2O_5 को एसएसपी + आरपी के साथ बराबर अनुपात में मिलाने पर सोयाबीन से अधिकतम उपज प्राप्त हुई। कार्बोफ्यूरान उपचारित प्लाटों में इमिडाक्लोप्रिड की तुलना में सेमीलूपर हानि कम देखी गई तथा सोयाबीन के साथ मकई को अंतःफसल के रूप में लेने की बजाय धान को लेने से यह हानि अधिक पाई गई। सोयाबीन की फसल में धान को अंतःफसल के रूप में बोने पर लीफ फोल्डर के नियंत्रण के लिए कार्बोफ्यूरान की तुलना में इमिडाक्लोप्रिड अधिक प्रभावी पाया गया। एन.पी.के. (20:60:40: कि.ग्रा. प्रति हेक्टेयर) 10 टन गोबर की खाद + 2 टन चूने का प्रयोग मूंगफली में सर्वाधिक फलियों की प्राप्ति हेतु

लाभकारी पाया गया तथा बी. पालीमाइकजा तथा पी. स्ट्राइटा के साथ प्रति हेक्टेयर 30 कि.ग्रा. सल्फर के प्रयोग से उत्पादकता में वृद्धि पाई गई। एक्रोकृत-प्रबंधन के अंतर्गत सोयाबीन के रोग-व्याधि का अनुश्रवण (मानीटरिंग) किया गया। सूरजमुखी को हानि पहुंचाने वाले कीटों में पंपकिन बीटल्स ई. पिकाउटा को प्रमुख पाया गया जो कि पौधे को पूर्णतः पत्तीरहित कर देते हैं तथा स्पेडोप्टेरा लिट्यूरा को दूसरे नंबर पर सर्वाधिक हानि पहुंचाने वाला कीट पाया गया।

उतक-संवर्द्धित नींबू वर्गीय पौधों का बीजू पौधों के साथ तुलनात्मक अध्ययन में देखा गया कि उतक संवर्द्धन विधि द्वारा तैयार पौधों में खासी संतरा को छोड़ अन्य में अच्छी बढ़वार पाई गई। साफ्ट-वुड ग्राफिंग तकनीक द्वारा अगस्त माह में तैयार खासी संतरे के प्रवर्द्धन में 80% सफलता पाई गई। संतरे के ऐसे फलों से जिनका टी.एस.एस. 40 से 55% के बीच था तैयार किए गए स्ट्रैश को स्वाद परीक्षण में सर्वोपयुक्त पाया गया। परिक्षण एवं प्रसंस्करण के लिए माइनर फलों का मूल्यांकन किया गया।

सिट्रस ऑरेंटिफोलिया तथा सी.कर्ना में सिट्रस सिला का प्रकोप लगभग नगण्य पाया गया जबकि कर्ना खट्टा, पमेलो तथा ईस्ट रफ लेमन में माइनर कम संख्या में पाए गए। सापेक्षित आर्द्रता ($R=0.9862$) तथा सिट्रस ब्लैक एफिड की संख्या में सकारात्मक संबंध पाया गया। सिट्रस में कीट-व्याधि की रोकथाम के लिए मोनोक्रोटोफास का 0.05% की दर से छिड़काव प्रभावी पाया गया।

कोलोकेशिया तथा शकरकंद की विभिन्न किस्मों का मूल्यांकन में पाया गया कि प्रति

हेक्टेयर 100 कि. ग्रा. पोटेश के प्रयोग से शकरकंद की अधिकतम उपज ली जा सकती है। फ्रैन्चबीन की मेघालय लोकल सेलेक्शन किस्म से तुलनात्मक रूप में सर्वाधिक उपज प्राप्त हुई। अदरक के नाडिया में सबसे कम तथा एक्सेसन 3573 में सर्वाधिक रेशा पाया गया।

प्रोटीन युक्त (30%) खाद्य पदार्थ के उपयोग से एल रोहित मछलियों के भार में वृद्धि देखी गई। सरसों की खली की टिकिया+धान पालिश के प्रयोग से कुल जैवभार (बायोमास) में त्वरित वृद्धि पाई गई।

इस अवधि में सुअर के F_1 जेनेरेशन के 19 तथा F_2 जेनेरेशन के 11 शिशुओं पर अध्ययन किया गया। अच्छी क्वालिटी के राइस पॉलिश को प्रोटीन के साथ मिलाकर देने पर सुअर में अच्छी वृद्धि पाई गई। सुअर के बच्चों की आकस्मिक मृत्यु के लिए गैस्ट्रोइंटेराइटिस को प्रमुख पाया गया। न्युजीलैंड व्हाइट, सोवियत चिनचिला तथा स्थानीय खरगोश के क्रॉस से सामान्य तथा विशिष्ट लक्षणों वाले खरगोशों को विकसित किया गया। मांस, शारीरिक-माप, मांस-गुणवत्ता तथा पोषक-तत्वों की दृष्टि से संकरित खरगोश अच्छे पाए गए। ई. कोली को सर्वाधिक सामान्य बैक्टीरियल आर्गेनिज्म पाया गया जबकि ई. ईरिसिडुआ, ई. इंटेस्टिननेलिस तथा ई. स्टीडी को काक्सीडायल संक्रमण हेतु प्रमुख कारक पाया गया।

मनीपुर घाटी में एच.एस./ बी.क्यू के नियमित टीकाकरण के बावजूद मई 1999 में पशुओं के ब्लैक क्वार्टर लैंग रोग की पुनरावृत्ति दर्ज की गई। कुक्कुट पालन हेतु जैक बीन के उपचारित बीजों को 20 से 40% तक बढ़ाने पर

आहारीय-प्रोटीन उपभोग में 11% की कमी पाई गई। ब्रायलर चिक्स के लिए मूंगफली स्ट्रामील्स को अधिकतम 10% तक प्रयोग में लिया जा सकता है।

वन-आच्छादित भूमि में मृदा क्षरण एवं बहाव न्यूनतम तथा जुताई की गई परती भूमि में सर्वाधिक पाया गया। धान की मड़ाई के लिए पर्वतीय क्षेत्र के अनुरूप हल्का पावर चालित श्रेसर विकसित किया गया। सुअर के कच्चे मल से प्राप्त औसत बायोगैस उत्पादन $0.044m^3$ कि. ग्रा. था जबकि खरगोश-मल (45 दिन HRT) तथा स्लरी-स्तर (1:1) से यह $0.053m^3$ कि.ग्रा. प्राप्त हुआ।

पूर्वोत्तर पर्वतीय क्षेत्र में सन 1972 से 1998 के दौरान क्षेत्रफल, उपज, उत्पादकता तथा क्षेत्रफलानुसार उपज का आर्थिक विश्लेषण किया गया। मिजोरम में कृषि-वानिकी पद्यतियों को शुद्ध वर्तमान मूल्य तथा लाभ/लागत विश्लेषण में तीसरे वर्ष के बाद शुद्ध लाभ प्राप्त होने की प्रवृत्ति दिखाई।

कृषि-प्रसार विभाग ने इस अवधि में निम्न अध्ययन किए:

1. विकसित कृषि प्रक्रियाओं को अपनाने में विभिन्न स्रोतों से प्राप्त सूचनाओं की सफलता।
2. आधुनिक खेती में आदिवासी महिला के ज्ञान स्तर तथा कार्य निष्पादन भूमिका।
3. मेघालय में सूचना-प्रसार ब्रानाम निवेश-प्रसार।
4. मेघालय में उन्नत तकनीक अपनाने में आदिवासी किसानों के व्यवहार को प्रभावित करने वाले तत्व।

5. मेघालय के किसानों की प्रशिक्षण-आवश्यकता का मूल्यांकन एवं
6. तकनीक हस्तान्तरण में सूचना आदान-प्रदान।

संस्थान-गांव सम्पर्क कार्यक्रम के अंतर्गत मकई की विजय कंपोजिट किस्म से स्थानीय किस्म एम.एल.डब्ल्यू की तुलना में 65% अधिक उपज की प्राप्ति हुई तथा उर्वरकों के प्रयोग द्वारा उपज में 20% अधिक वृद्धि पाई गई। टमाटर की स्थानीय किस्म की तुलना में इंडो-अमेरिकन संकर प्रजाति रूपाली से 57% अधिक उपज की प्राप्ति हुई तथा एन.पी.के (80:60:60 कि.ग्रा./हेक्टेयर) प्रयुक्त करने पर 10 प्रतिशत अधिक उपज प्राप्त की गई। इसी प्रकार सुअर की संकर-नस्ल हॅम्पशायर इस क्षेत्र के लिए अच्छी पाई गई।

प्रतिवेदित अवधि के दौरान मेघालय के विभिन्न गांवों में शाक-वर्गीय फसलों के अंतर्गत 6 प्रशिक्षण कार्यक्रमों का संचालन किया गया तथा संस्थान द्वारा विकसित तकनीक को किसानों तक पहुंचाने तथा उनसे जानकारी प्राप्त कर अनुसंधान में और प्रगति लाने के लिए कई प्रकार के तकनीक हस्तांतरण कार्यक्रमों का आयोजन किया गया।

फार्मिंग सिस्टम अनुसंधान के अंतर्गत पाया गया कि डेरी आधारित प्रणाली (एफ.एस.डब्ल्यू-1) को अपनाने से दो दुधारू गायों के लायक पर्याप्त चारा प्राप्त कर नौ महीनों में 1590 लीटर दूध तथा 9.9 टन गोबर प्राप्त किया जा सकता है।

मिश्रित वन ब्लाक (एफ.एस.डब्ल्यू-2) में देखा गया कि रोपण के 16 वर्ष के पश्चात एल्डर,

अकेशिया, एकजबकलेंडिया तथा तीता चाप में अच्छी वृद्धि हो रही है। एफ.एस. डब्ल्यू-5 तथा एफ.एस. डब्ल्यू-6 में संतरा तथा नींबू के पौधों में अच्छी वृद्धि देखी गई। प्राकृतिक बाधाओं से सुरक्षित 16 वर्ष के पश्चात पुर्नजीवित पाइनस अकेशिया तथा शिमा वैलीची प्रजाति को डामिनेंट वृक्ष प्रजाति पाया गया। वर्ष 1999 के दौरान एफ.एस.डब्ल्यू-1 तथा एफ.एस. डब्ल्यू-8 में किसी प्रकार का जल प्रवाह नहीं दर्ज किया गया।

बहुउद्देश्यीय वृक्षों में पी. फलकटेरिया को छोड़कर अन्य को अच्छा पाया गया तथा उनमें 70% वृक्ष सही सलामत पाए गए। अच्छी वृद्धि प्राप्त कर रहे पी. फलकटेरिया के वृक्ष (ऊँचाई 13.84 मीटर, व्यास 20 सेंमी) एक अनाम कीट ट्रंक बोरेर द्वारा पूरी तरह नष्ट कर दिए गए। खासी मंडारिन में सघन रोपण (2.5m×5m) द्वारा प्राप्त उपज दूर दूर लगाए गए पौधों (5m×5m) की तुलना में अधिक पाई गई जबकि सघन रोपण में कीट-व्याधि का प्रकोप अधिक पाया गया। मंडारिन तथा अमरूद के बीच ली गई धान (किस्म आर. सी. पी. एल 1-25, आर.सी.पी.एल 1-24 तथा आर. सी. पी. एल 1-29) से 4.5 से लेकर 6.2 टन प्रति हेक्टेयर उपज प्राप्त हुई। कृषि वानिकी प्रणाली के अंतर्गत झाड़ू घास, हल्दी तथा अदरक में प्रति हेक्टेयर क्रमशः 62 टन, 22.1 टन तथा 17.3 टन प्रकंद प्राप्त हुए। भारतीय मधु मक्खी एपिस सेरेना इंडिका इस क्षेत्र हेतु सुरक्षित पाई गई जबकि इटैलियन मधुमक्खी एपिस मेलिफेरा यहां के अनुकूल नहीं पाई गई। पॉलीथीन मल्लिचग में पापुलस डेलटोडिस के संभाव्य क्लोन में काफी संख्या में प्ररोह (41%) निकलते पाए गए।

अरुणाचल प्रदेश

अरुणाचल प्रदेश पूर्वोत्तर पर्वतीय क्षेत्र का सबसे बड़ा पर्वतीय राज्य है यहां कृषि तथा पशुधन संसाधन की अपार संभावनाएं हैं। इस परिसर का क्षेत्रीय केंद्र पश्चिमी सियांग जिले के बसार नामक स्थान पर अवस्थित है जिसकी ऊँचाई समुद्र तल से लगभग 800 मीटर है। इस केंद्र के गोरी शोध फार्म 40.5 हेक्टेयर तथा कृषि विज्ञान केंद्र के अनुदेशात्मक फार्म के पास 41.1 हेक्टेयर भूमि उपलब्ध है। गोरी फार्म को अनुसंधान परीक्षणों के लिए तथा बसार को कृषि विज्ञान केंद्र के रूप में विकसित किया गया है। वैज्ञानिकों की कमी के बावजूद इस केंद्र पर धान, दलहन, मूंगफली, बांस तथा बागवानी फसलों के सुधार हेतु विभिन्न प्रयोग किए जा रहे हैं साथ ही जल संसाधन, खेती, फसल पद्यति तथा तकनीकी हस्तांतरण का कार्य भी जारी है। पशु वैज्ञानिक के अभाव में पशुओं पर यहां शोध कार्य संभव नहीं हो सका है।

पनिहर भूमि (वैट लैंड) में उगाई जाने वाली धान की परीक्षण की गई 10 किस्मों में यहां आर.सी.पी.एल. 1-4 से सर्वाधिक उपज मिली जबकि दूसरे नम्बर पर आर.सी.पी.एल. 1-87-4 को पाया गया। उच्च भूमि दशाओं में धान के 15 प्रभेदों/ लाईस के परीक्षण में आई.ई.टी 15046 को सर्वाधिक उपज देने वाला पाया गया तथा आई.ई.टी 13783 को छोड़ अन्य सभी किस्मों को प्रध्वंश के प्रति रोधी पाया गया। पश्चिमी सियांग जिले के विभिन्न क्षेत्रों में फाल्स स्मट रोग का सर्वेक्षण किया गया।

मकई-सरसों की फसल को साथ साथ लिये जाने पर खाद (0,15, 30 व 45 टन प्रति

हेक्टेयर) तथा उर्वरकों (0, 30, 60 व 90 कि.ग्रा नत्रजन प्रति हेक्टेयर) के प्रभाव के एक अध्ययन में पाया गया कि प्रति हेक्टेयर 30 टन सुअर मल तथा 60 कि.ग्रा. नत्रजन तक के प्रयोग द्वारा मकई की उपज को बढ़ाया जा सकता है। मकई के बाद ली गई सरसों की फसल में खाद एवं नत्रजन के अपशिष्ट प्रभाव में देखा गया कि सरसों के पूर्व ली गई मकई की फसल में प्रति हेक्टेयर 45 टन सुअर खाद तथा 60 कि.ग्रा. नत्रजन देने पर सरसों की सर्वाधिक उपज मिली जो कि प्रति हेक्टेयर 12.48 कुन्तल थी। प्रति हेक्टेयर 45 टन सुअर मल तथा 60 कि.ग्रा. नत्रजन के प्रयोग द्वारा सुअर मल निर्मित खाद का अपशिष्ट प्रभाव सर्वाधिक स्तर तक महत्वपूर्ण पाया गया।

मकई की आर.सी.एम. 1-1 किस्म की बुवाई हेतु 20 मार्च अनुकूलतम समय पाया गया जबकि बुवाई में देरी से फसल की उपज में कमी पाई गई। मकई की 6 किस्मों की जांच में आर. सी. एम. 1-3 तथा गंगा से सर्वाधिक उपज मिली।

सोयाबीन की 60 किस्मों / लाईस की सोयाबीन रस्ट के प्रति स्क्रीनिंग की गई तथा पाया गया कि बसार की दशाओं में किसी भी किस्म पर इसका प्रभाव नहीं पाया गया। सोयाबीन की पी के 416, पी के 471, पूसा 16, जेएसएस 335 तथा दुर्गा किस्मों में राइजोक्टोनिया सोलेनी द्वारा जनित वेबब्लाइट का 5% से अधिक प्रभाव पाया गया। मूंगफली की जाँची गई किस्मों में ए आईएस 1-9706 में सर्वाधिक फलियां प्राप्त हुई जो प्रति हेक्टेयर 17.5 कुन्तल थी। रोगों के प्रति मूंगफली की किस्मों की जाँच में ए आई एस 1-9705 को लीफ स्पॉट, रस्ट तथा विल्ट से सर्वाधिक ग्रस्त पाया गया।

दलहन, निदेशालय, कानपुर से प्राप्त मूंग की 25 तथा उरद की 20 एंटीज के मूल्यांकन में प्राप्त उपज प्रति हेक्टेयर 1 से 1.5 टन पाई गई जबकि उरद में यह 0.5 से 1 टन प्रति हेक्टेयर के बीच पाई गई।

मंडारिन संतरे की चार किस्मों खासी मंडारिन, नागपुर संतरा, हिल मंडारिन तथा सिक्किम औरेंज के लिए उपयुक्त मूलवृत्त चुनने के लिए चार फल-वृक्षों के मूलवृत्तों पर परीक्षण किया गया जिसमें तायुम, *सिट्रस वोल्केमेरियाना*, कर्ना खट्टा तथा रफ लेमन सम्मिलित हैं। इस अध्ययन में पाया गया कि खासी मंडारिन के साइन को तायुम मूलवृत्त पर लगाने पर प्राप्त पौधों में लम्बाई, स्प्राउट मोटाई, शाखाओं की संख्या सर्वाधिक मिली जबकि सिक्किम मंडारिन ने तायुम तथा *सिट्रस वोल्केमेरियाना* दोनों ही मूलवृत्तों पर अच्छा प्रदर्शन किया।

आसाम लेमन की अपेक्षा ए आर. एल 1 से अधिक संख्या में फल प्राप्त हुए। पाया गया कि प्रति वृक्ष सुअर मल द्वारा तैयार खाद 110 कि.ग्रा, एक किलोग्राम नत्रजन तथा 650 किलोग्राम पोटाश के प्रयोग द्वारा मंडारिन औरेंज से सर्वाधिक उत्पादन मिला। साथ ही प्रति वर्ष प्रति वृक्ष 60 किलोग्राम सुअर मल, 700 ग्राम नत्रजन तथा 600 ग्राम पोटाश प्रयुक्त करने पर खट्टे संतरे की उपज में भी अच्छी वृद्धि देखी गई।

संतरे के बागों में प्रतिवर्ष 27 पीपीएम 2, 4 -D के तीन छिड़काव द्वारा फल गिराव में कमी तथा उपज में बढ़ोत्तरी पाई गई। वाशिंगटन माल्टा में 600 पीपीएम एनएए के प्रयोग द्वारा उसकी जड़ों में अच्छा विस्तार देखा गया। विभिन्न स्थानों से तायुम के फलों को एकत्रित कर उनके

भौतिक-रायसानिक गुणों का मूल्यांकन किया गया। आंवला की पांच किस्मों की जांच में कंचन को अच्छा पाया गया।

आड़ू, प्लम, बादाम की तीन तीन किस्मों तथा 1997 में रोपित अखरोट, चेरी तथा चाइनीज गूजबेरी की एक-एक किस्मों के वृद्धि पैरामीटरों को नोट किया गया। साथ ही क्षेत्र के 13 देशज फलों को एकत्रित किया गया तथा उन्हें रोपित किया गया।

बड़ी इलायची की रमला किस्म में अन्य की अपेक्षा अच्छे वृद्धि गुण देखे गए तथा साहनी नामक किस्म में सर्वाधिक कैप्सूल पाए गए। अदरक की अच्छी पैदावार के लिए प्रति हेक्टेयर 30 टन सुअर मल, 100 किलोग्राम नत्रजन, 90 किलोग्राम पोटाश का प्रयोग लाभकारी पाया गया जबकि 130 नत्रजन, 90 किलोग्राम पोटाश (P_2O_5) तथा इतनी ही मात्रा में पोटैशियम (K_2O) प्रति हेक्टेयर के प्रयोग से हल्दी में अच्छे प्रकंद प्राप्त हुए।

केंद्र पर एकत्रित 50 वृक्ष प्रजातियों में से 30 अच्छी प्रकार सुस्थापित हुए तथा उनके आर्थिक पैरामीटरों की माप की गई। वन-चारागाह पद्धति के अंतर्गत *बहुनिया परपूरिया + कांगोसिंगनला* गिनिया घास/गोल्डन तिमोथी/झाड़ू घास के अध्ययन में मकूनी से सर्वाधिक हरा चारा प्राप्त हुआ जो कि प्रति हेक्टेयर 1189 कुन्तल पाया गया। मेड़ों पर लगाई गई झाड़ू घास से द्वितीय वर्ष में प्रति हजार मीटर में 164.7 कुन्तल घास प्राप्त हुई। 28 वृक्ष प्रजातियों में *बी. वैरीगाटा* से सर्वाधिक प्ररोह प्राप्त हुए जबकि इस क्रम में *सी आरमाटा* द्वितीय स्थान पर पाया गया। प्रति क्लम्प सर्वाधिक संख्या में क्लम *बी. वल्लौरिस* की वैमिन

किस्म में मिले जबकि इस क्रम में दूसरा स्थान डी. एस्पर का रहा।

प्रतिवेदित अवधि के दौरान 10 शोध पत्रों का प्रकाशन किया गया। इस वर्ष शोध केंद्र का दौरा करने वालों में अरूणाचल प्रदेश के माननीय गृह एवं संसदीय कार्य मंत्री श्री लिजुम रोन्था (27 अप्रैल); श्री पी.एम. नायर, मुख्य सचिव, अरूणाचल प्रदेश सरकार (25 जून); श्री नरेश ग्लो, माननीय कृषि मंत्री, अरूणाचल प्रदेश (31 जनवरी), तथा श्री तागो बसार, संयुक्त निदेशक कृषि, अरूणाचल प्रदेश (31 जनवरी), प्रमुख थे।

मनीपुर:

मनीपुर पूर्वोत्तर पर्वतीय क्षेत्र का सुदूर पूर्वी प्रदेश है। समुद्र तल से इसकी ऊँचाई का विस्तार 51 मीटर से लेकर 2500 मीटर तक फैला हुआ है। प्रदेश के कुल भौगोलिक क्षेत्रफल का लगभग दसवां हिस्सा घाटी क्षेत्र है तथा शेष पहाड़ियों से घिरा हुआ है। विशेषकर घाटी वाला हिस्सा बहुत ही उपजाऊ है तथा यहां खेती की अपार संभावनाएं मौजूद हैं। यहां स्थापित शोध केंद्र का मुख्य उद्देश्य इस राज्य की खाद्यान्न, बागवानी फसलों के साथ पशुधन पर शोध करना है। वर्तमान में शोध केंद्र लम्फलपेट में अवस्थित है जिसकी ऊँचाई समुद्र तल से 750 से लेकर 800 मीटर के बीच है। इस केंद्र पर मुख्यतः धान, मकई, दलहन एवं तिलहन, बागवानी फसलों तथा मत्स्य पालन पर शोध कार्य संपादित किया जा रहा है। इसके साथ ही केंद्र से समबद्ध कृषि विज्ञान केंद्र प्रसार गतिविधियों तथा तकनीकी हस्तांतरण कार्यक्रम चला रहा है।

प्रतिवेदित अवधि के दौरान धान की प्रसाद×आई. आर. 24 की दस चयनित संततियों (प्रोजिनीज) तथा बी. आर.1/लेम्फाऊ तथा नापनंगमुमेइ/बासमती 370 प्रत्येक की एक चयनित प्रोजिनी (4 चेक आर.सी.एम. 9, चेक आर. सी, एम.10, लेईमाफाउ तथा प्रसाद को सम्मिलित करते हुए) की उपज तथा अन्य गुणों हेतु जाँच की गई। इस जाँच में बी. आर. 1 × लेईमाफाऊ, एम. सी 17-8-2-16-2 तथा 17-8-2-16 पर नेक ब्लास्ट. लीफ ब्लास्ट तथा शीथ ब्लाइट का न्यूनतम प्रभाव पाया गया। धान के 6 कल्चर में आर.सी.एम. 9 तथा आर.सी.एम.10 की परिपक्वता अवधि को लेईमाफाऊ के बराबर पाया गया जबकि आर. सी. एम. 9 से प्राप्त उपज 4,489 कि. ग्रा. प्रति हेक्टेयर पाई गई। आर. सी.आर. टी-1 ट्रायल में लोकल चैक आर.सी.एम.5 को सम्मिलित करते हुए 11 संवर्द्धों का मूल्यांकन किया गया। पी.एल.8/एस.पी.एस-1 से 43% अधिक उपज प्राप्त हुई। अखिल भारतीय समन्वित परियोजना के अंतर्गत जाँची गई ऊपरिभूमि की 13 धान की एंटीज में ए.वी.टी-1705, ए.वी. टी.-1724, ए.वी.टी-1704, ए.वी.टी. 1714 तथा ए.वी.टी-1709 ने सर्वश्रेष्ठ उपज प्रदर्शित की जो कि प्रति हेक्टेयर 3.1 से 3.3 टन के बीच पाई गई। क्षेत्रीय समन्वित धान की 11 एंटीज में पीएल1 एस.पी.एस-4 ने सर्वाधिक उपज प्रदर्शित की। धान की सर्वाधिक उपज प्राप्ति के लिए प्रति हेक्टेयर एन.पी.के. के साथ साथ प्रति हेक्टेयर 5 टन की दर से धान का भूसे का प्रयोग लाभ प्रद पाया गया।

घाटी के विभिन्न स्थानों से एकत्रित किए गए धान के निर्देशों में बीज की शुद्धता का प्रतिशत 81 से 84 प्रतिशत के बीच पाया गया। सामान्य परिवेश में सरसों व सोयाबीन के बीज

को दो वर्ष तक भंडारण के पश्चात उनकी जीवन-क्षमता (वायबिलिटी) नगण्य पाई गई। सामान्यतः नमभूमि (वेटलैंड) वाले प्लाट्स में धान की रेड करनेल वाइल्ड राइस को आनुवांशिक रूप से संदूषित पाया गया। सरसों के बीज की शुद्धता बनाए रखने में मधुमक्खियों द्वारा संकरण (क्रास-ब्रीडिंग) को मुख्य एक समस्या पाया गया।

सोयाबीन की 7 परखी गई किस्मों में जे एस.335 को सर्वाधिक उपज देने वाली पाया गया। अपरिमित सोयाबीन (इन-डिटरमिनेट) में पत्तियों में बीजों के बीच अधिक दूरी रखने पर डिटरमिनेट/सेमी-डिटरमिनेट किस्मों की अपेक्षा इनडिटरमिनेट सोयाबीन ने अच्छा प्रदर्शन किया। मूंगफली की 13 परखी गई किस्मों में टी.जी-26 से अच्छी उपज प्राप्त हुई तथा प्रति हेक्टेयर 50 कि.ग्रा. नत्रजन तथा पोटैश देने पर मूंगफली में सर्वाधिक फलियां मिलीं। मूंगफली के 113 जीनोटाइप्स में आई. एस. के. 8917, आई. एस. के. 8914, तथा आई. एस. के. 8909 में कॉलर रॉट रोग की तीव्रता अधिक पाई गई। प्रति हेक्टेयर एन 15, पी 30, तथा के 45 के प्रयोग से सर्वाधिक रोग प्रभाव देखा गया। मकई तथा मूंगफली की फसल साथ-साथ लेने पर रोग तीव्रता कम पाई गई जबकि जून में बोई गई मूंगफली की फसल पर रोग का सर्वाधिक प्रभाव देखा गया। मूंगफली में चूने, राइजोबियम तथा फासफोरस के मिले-जुले प्रयोग से मूंगफली में जड़ की लंबाई, प्रति पौधे फलियों की संख्या, शाखाओं, पत्तियों तथा पौधे की ऊँचाई एवं उपज में वृद्धि प्रदर्शित की। सस्य-चक्र (रोटेशन) में फसल लेने पर कंपोस्ट खाद+बोरन+नत्रजन, पोटैश एवं पोटेशियम के प्रयोग द्वारा सोयाबीन एवं उड़द में अधिकतम उपज प्राप्त हुई।

भार वृद्धि, पाचनशीलता तथा एफ.सी.आर. की दृष्टि से राइसबीन तथा एम.ओ.सी.(1:1) मिश्रित आहार का मछलियों पर अच्छा प्रभाव पाया गया जबकि 34.4, 34.4 तथा 30.2% एम.ओ.सी. अजोला तथा एल्टरनेथेरा मिश्रित आहार इस क्रम में दूसरे स्थान पर पाया गया। फिश मील (10%) सोयाबीन (5%) तथा मकई के आटे (25%) से बना आहार *सिरहिना म्रिगाला* के अंगुलिमीन (फिंगरलिंग्ज) के लिए अच्छा पाया गया तथा इस आहार से अंगुलिमीनों में सामान्य (कंट्रोल) की तुलना में 74% अधिक वृद्धि पाई गई। पौधों से प्राप्त प्रोटीन की तुलना में पशुओं से प्राप्त प्रोटीन को मछलियों द्वारा अंतर्गृहण हेतु अधिक उपयोगी पाया गया। कम्पोजिट फिश संबर्द्धन के अंतर्गत *इंडियन मेजर कार्प* को 2 से 5 महीने तक रोके रखने पर अन्य मत्स्य प्रजातियों को हानि पहुँचाए बिना पेंगबा के उत्पादन में सहायक पाया गया। स्थानीय फिश स्मोकिंग विधि में सुधार के लिए ऑयल ड्रम (क्षमता 240 लीटर) को उपयोग में लाते हुए विकसित फिश स्मोकिंग अवेन बनाया गया जिसमें फ्यूल उर्जा का दक्षतापूर्ण उपयोग किया जा सकता है।

कृषि वानिकी के अंतर्गत सभी मापदंडों (पैरामीटर) को दृष्टि में रखते हुए *केसूरिना*, *सी.ईक्रीसेटीफोलिया* ने अच्छा प्रदर्शन किया। वन-उद्यान-चारागाह पद्धति के अंतर्गत 9 विभिन्न वृक्ष प्रजातियों की अधिक ऊँचाई तथा बढ़ते वितान (कैनोपी) के कारण टेरेसेज पर रोपे गए केले के वृक्षों एवं *एल. पोलिएथा* व *एस. वालिची* के सप्रेसन के कारण कि इन वृक्षों के नीचे ली जा रही चारागाह फसलों में *पी. मेक्सिकम* तथा एन.बी-21 में बिल्कुल भी उपज नहीं प्राप्त हुई।

पी. पेडीसेलेटम तथा टेरेस राइजर पर लगाने पर, बागवानी फसलों को बंड तथा टेरेसेज पर खाद्यान्न फसलों को लगाने पर घासों की वृक्षों से प्रतिस्पर्धा देखी गई।

मिजोरम:

उत्तर पूर्वी पर्वतीय अनुसंधान परिसर के कोलासिब केंद्र की स्थापना सन 1975 में की गई तथा तब से यह केंद्र झूम खेती के विकल्प के रूप में कृषि, पशुधन व बागवानी आधारित भूमि उपयोग पद्धति के विकास तथा राज्य की कृषि समस्याओं के वैज्ञानिक समाधान के लिए तत्पर है। इस केंद्र में शोध कार्य के लिए 32.32 हेक्टेयर भूमि उपलब्ध है तथा इस जगह की ऊँचाई समुद्र तल से 750 से 800 मीटर के बीच है, जिसमें मध्यम से लेकर तीव्र ढलान वाली पहाड़ियां, घाटियां तथा झरने आदि सम्मिलित हैं।

कोलासिब में इस वर्ष अधिकतम तापमान अप्रैल में 30.72°C रिकार्ड किया गया जबकि न्यूनतम तापमान जनवरी में जो कि 11.13°C रहा। वर्ष का सर्वाधिक गर्म दिन (35.0°C) 16 जुलाई को तथा 1 जनवरी को सर्वाधिक ठंडा (9.5°C) दिन था। आपेक्षिक आर्द्रता सर्वाधिक 89.29% पाई गई जो कि जुलाई के दौरान थी जबकि न्यूनतम अप्रैल माह में जो 84.55 प्रतिशत थी। प्रतिवेदित अवधि के दौरान कुल वार्षिक वर्षा 2303.75 मि.मी. रिकार्ड की गई जिसमें सर्वाधिक अगस्त में 461 मि.मी. तथा जनवरी और फरवरी में बिल्कुल वर्षा नहीं हुई। सितम्बर माह की चार तारीख को सर्वाधिक वर्षा (94 मि.मी.) दर्ज की गई।

निचली भूमि में धान की टेस्ट की गई 20 किस्मों में आर.सी.पी.एल 1-88-78, अंगोबा,

डीआर-92, आर.सी.पी.एल 1-87-4 तथा आर.सी. पी.एल 1-87-8 ने क्रमानुसार अच्छा प्रदर्शन किया। स्थानीय धान जननद्रव्य के 15 किस्मों में जेड.एल.-1 एल.टी-4 तथा एम.पी-2 से सर्वाधिक उपज मिली जो कि प्रति हेक्टेयर 21 से 22 कुन्तल के मध्य थी। उच्च-भूमि हेतु धान की 13 किस्मों में वी.एल-206 तथा आर.सी.पी.एल-1-27 से अधिकतम उपज की प्राप्ति हुई। निचली भूमि के धान में एन.पी.के (10:60:40) को प्रति हेक्टेयर 5 टन कुक्कुट-खाद के साथ प्रयुक्त करने पर सर्वाधिक तथा अनुकूलतम उपज प्राप्त हुई।

मकई की 10 किस्मों में आर.सी.एम-1-3 ने सर्वश्रेष्ठ प्रदर्शन किया इस क्रम में एम.एल.डब्ल्यू तथा आर.सी.एम-1-1 को दूसरे तथा तीसरे स्थान पर पाया गया। मकई की पांच जाँची गई किस्मों में से तीन को अप्रैल के पहले सप्ताह में बोने पर सर्वाधिक उपज मिली।

मूंगफली की 10 किस्मों की जांच में गिरिनार-1 सर्वश्रेष्ठ प्रदर्शन किया जबकि आई.सी.जी.एस-44 तथा आई.सी.जी.एस-1 क्रमशः दूसरे व तृतीय स्थान पर रहीं। आई.सी.जी.वी-87/187 में छिलका (शैलिंग प्रतिशत) अधिकतम पाया गया। मूंगफली में अधिकतम फलियां प्राप्त करने के लिए प्रति हेक्टेयर एन.पी.के. की संस्तुत खुराक तथा 15 टन कंपोस्ट (FYM) या 5 टन कुक्कुट-खाद को सर्वाधिक उपयुक्त पाया गया।

सरसों की 15 परखी गई किस्मों में रोहिनी, क्रांति तथा पी.सी.आर-7 से क्रमानुसार सर्वाधिक उपज प्राप्त हुई। सोयाबीन की 15 किस्मों में जे.एस-335, एन.आर. सी -2, पी.के. 472 तथा ब्रेग ने क्रमशः अच्छा प्रदर्शन किया।

खरीफ मौसम में हल्दी की आठ किस्मों के मूल्यांकन के एक ट्रायल में आर. सी.टी-1 से सर्वाधिक प्रकंदों की उपज मिली जो कि प्रति हेक्टेयर 579 कुन्तल थी जबकि इस क्रम में मेघालय लोकल 11 तथा कस्तुरी तनाका का क्रमशः दूसरा तथा तीसरा स्थान रहा जिनसे प्राप्त उपज क्रमशः 426 तथा 381 कुन्तल प्रति हेक्टेयर थी। हल्दी की लकाडांग किस्म से प्रति हेक्टेयर 310 कुन्तल उपज प्राप्त हुई तथा इसमें करक्यूमिन तत्व की प्रतिशतता सर्वाधिक पाई गई।

मूली की जापानी व्हाइट किस्म से अधिकतम उपज प्राप्त हुई जबकि दूसरा स्थान पूसा चेतकी का पाया गया। आलू की कुफ्री मेधा किस्म से अधिकतम उपज मिली जबकि कुफ्री ज्योति को दूसरे नम्बर पर पाया गया। अमरुद की किस्म इलाहाबाद सफेदा में प्रति वृक्ष 400:300:300 ग्राम के अनुसार एन.पी.के तथा 20 कि.ग्रा गोबर की खाद के साथ प्रयुक्त करने पर प्रति वृक्ष औसतम 176 फलों की प्राप्ति हुई। खासी मंडारिन के 13 साल पुराने वृक्षों में इस वर्ष सिट्रस डाय-बैंक, ट्रंक बोरोर, टिवग-बोरर तथा सिट्रस-सिल्ला व साथ ही पोषक तत्वों की कमी के कारण फल नहीं लग सके।

प्रतिवेदित अवधि के दौरान शोध केंद्र से पाँच शोध पत्र प्रकाशित किए गए तथा केंद्र पर कई विशिष्ट व्यक्तियों तथा छात्रों ने शोध परियोजनाओं की जानकारी के लिए भ्रमण किया।

नगालैंड:

नगालैंड में मोकोकचुंग के निकट 1975 में यसमियांग तथा झरनापानी नामक दो अलग अलग जगहों पर शोध केंद्रों की स्थापना इस परिसर के अंतर्गत की गई। मोकोकचुंग को अधिक ऊँची

तथा झरनापानी को कम ऊँचाई वाली पहाड़ियों की कृषि समस्याओं के समाधान के लिए चुना गया। वर्तमान में दीमापुर से लगभग 27 कि.मी.दूर झरनापानी में यह शोध केंद्र कार्यरत है। ऊँची पहाड़ियों के लिए शोध कार्य अब फुटसेरो में सम्पन्न किया जा रहा है। यह केंद्र धान, मकई, तिलहन, पादप संरक्षण, पशुधन प्रबंधन पर शोध रत है तथा तकनीकी हस्तांतरण का कार्य कृषि विज्ञान केंद्र के माध्यम से सम्पन्न किया जा रहा है।

धान की 14 किस्मों में ड्वार्फ मशूरी, मशूरी तथा सरसा किस्म को लीफ रोलर से सर्वाधिक हानि हुई जबकि हींग, जीरा, के डी-263, एम.डब्ल्यू-10, हाइब्रिड 6111 तथा 6201 किस्में इससे न्यूनतम प्रभावित रहीं। तना बेधक की रोकथाम के लिए फ्यूरेडान 3G (कारबोफ्यूथ्रान) को अत्यधिक प्रभावी पाया गया। गंधीबग की रोकथाम में स्थानीय विधियों की तुलना में कीटनाशी दवाओं को अधिक प्रभावकारी पाया गया। धान की हाइब्रिड 6201 को 6111 की तुलना में अधिक उत्कृष्ट एवं कीट-व्याधि मुक्त पाया गया तथा औसत उपज प्रति हेक्टेयर 53 कुन्तल दर्ज की गई।

मूंग की परखी गई 22 किस्मों में आई. वी. टी., एम.आई.वी.टी., -865, 853, 850, 851, 867 और 848 से प्रति हेक्टेयर 10 से 13 कुन्तल के बीच उपज पाई गई जो अन्य किस्मों की तुलना में अधिक थी।

सरसों की एम-27 किस्म से अधिक उपज प्राप्त हुई जो कि प्रति हेक्टेयर 15.35 कुन्तल थी। सूरजमुखी की मॉडर्न किस्म ने खरीफ की बजाय रबी में अच्छा प्रदर्शन किया।

टमाटर में 300 पी.पी.एम बोरान के प्रयोग से अच्छी उत्पादकता प्राप्त हुई। पात गोभी की संकर किस्मों ने प्रचलित किस्मों की तुलना में दुगना उत्पादन दिया।

केले की फसल में प्रति वृक्ष 10 ग्राम अजोला तथा 20 किलो गोबर की खाद और एन.पी.के की संस्तुत खुराक की आधी मात्रा देने से उपज में वृद्धि पाई गई। खरपतवारों के नियंत्रण के लिए खरपतवारनाशी के प्रयोग के साथ साथ हाथ से निराई करना समान रूप से लाभकारी पाया गया। गाय, खरगोश तथा सुअर से प्राप्त गोबर को 25% डी.ए.पी. के साथ मिलाकर प्रयोग करने से अधिक उपज प्राप्त हुई। जीए, का 100 पीपीएम की दर से छिड़काव पपीते के फलों के आकार हेतु अच्छा पाया गया। पपीते की चार परखी गई किस्मों में सीओ-6 से सर्वाधिक प्रति वृक्ष औसतन 79.54 फल प्राप्त हुए जबकि फ्रुट-सैट (56.07%) तथा सर्वाधिक फल भार (2.03 कि. ग्रा.) पपीते की सीओ-5 किस्म में पाया गया। किचन गार्डन का एक छोटा माडल (41.0×17.5 मीटर) विकसित किया गया जिसमें विभिन्न प्रकार के फल एवं सब्जियां लगाई गई तथा प्रतिवेदित वर्ष के दौरान केवल सब्जियों से रुपया 1392 की आय प्राप्त हुई।

पशुओं के त्वचा रोग के नियंत्रण हेतु विगत चार वर्ष के अध्ययन के आधार पर हाईमैक्स तथा चारमिल दोनों को ही समान रूप से सुरक्षित एवं प्रभावी पाया गया जबकि चारमिल को इस वर्ष सस्ता (रुपया 3.50 प्रति 10 ग्राम) पाया गया। खरगोश के आहार में 40% केले की पत्तियों को शामिल करने पर अधिक पशु वृद्धि दर्ज की गई। खरगोशों के आहार में एफ्लोटोक्सीकोसिस (0.8 ppm) के प्रभाव को रोकने के लिए आहार

में प्रति टन 4 कि.ग्रा. लाइवफिट या 40 मि.ली. द्रव/50 पशु-आहार के हिसाब से प्रयोग किया जा सकता है। ब्रायलर खरगोश के लिए रूचमेक्स को नियमित टानिक के रूप में प्रयुक्त करना लाभकारी पाया गया।

प्रतिवेदित अवधि के दौरान केंद्र के वैज्ञानिकों द्वारा 8 शोध पत्र प्रकाशित किए गए तथा इस केंद्र का दौरा करने वाले विशिष्ट व्यक्तियों में कृ.वै.चयन मंडल के चेयरमैन डॉ कीर्ति सिंह, आर.ए.यू. बीकानेर के उप-कुलपति डॉ के प्रधान, तमिलनाडु कृषि विश्वविद्यालय के कृषि संकायाध्यक्ष डॉ कान्यायन, नगालैंड के सांसद माननीय श्री अपोक जमीर, राष्ट्रीय बागवानी बोर्ड के अधिशाषी निदेशक श्री. जे.पी. नेगी, आईएस, राष्ट्रीय बागवानी बोर्ड की उप-निदेशिका डॉ (श्रीमती) मित्रा, नगालैंड सरकार के बागवानी निदेशक डॉ के. चुबा आओ, नगालैंड सरकार के वेस्टलैंड डेवलेपमेंट मंत्री माननीय श्री रोकोनिचा, भारतीय कृषि अनुसंधान परिषद, नई दिल्ली के सहायक महानिदेशक (पशु पोषण एवं नियोजन) डॉ अरुन वर्मा तथा केंद्रीय कृषि विश्वविद्यालय, इफाल, मनीपुर के उपकुलपति डॉ एस. एस बघेल प्रमुख थे।

सिक्किम:

सिक्किम केंद्र, गांतोक से पांच कि. मी. दूर टाडोंग में अवस्थित है जिसकी ऊँचाई समुद्रतल से 1200 से 1400 मीटर है। केंद्र में उपलब्ध 21.5 हेक्टेयर भूमि को इस क्षेत्र की महत्वपूर्ण खाद्यान्न फसलों तथा पशुधन पर शोध कार्य के लिए प्रयोग में लाया जा रहा है। वैज्ञानिकों द्वारा कृषि विज्ञान केंद्र की मदद से तकनीक हस्तांतरण

कार्यक्रम के अंतर्गत उपलब्ध शोध उपलब्धियों को किसानों तक पहुंचाया जाता है।

संकरण कार्यक्रम के अंतर्गत सफेद दाने वाले मकई की पांच किस्मों का वांछित गुणों की प्राप्ति हेतु संकरण किया गया जिसमें *आरसीएम 1-3*, *सिक्किम लोकल व्हाइट*, *एमएलडब्ल्यू*, *एनएलडी व्हाइट* तथा *गुजरात मक्की-1* सम्मिलित हैं। सभी संभावित जोड़ों से संकरण किया गया (विपरीत क्रम को छोड़कर: तथा 41 कॉब भविष्य में उन्नतीकरण हेतु प्राप्त किए गए। F3 इंटर वैराइटल ट्रायल के उन्नतिकरण में *एन ई. कांप* × *आर.सी.एम 1-1* से सर्वाधिक उपज प्राप्त हुई जबकि क्रमानुसार *आर.सी.एम.1-2* × *लाइन 9681* तथा *आर. सी. एम 1-1* × *रेनुका क्रमशः* द्वितीय तथा तृतीय स्थान पर रहे। जोनल कोआर्डिनेटेड ट्रायल के अंतर्गत *जेडएमआर 101* तथा *जेडएमआर -113* सर्वाधिक उपज की प्राप्ति हुई।

उड़द की 25 परीक्षित किस्मों में *आरसीयू 6-12*, *केयू-92-1* तथा *टीएयू-9406* से सर्वाधिक उपज प्रति हेक्टेयर 7 क्विंटल प्राप्त हुई। राजमा/फ्रेन्चबीन की 78 लाइंस में *पीआर-84-78*, *यूपीएफ-627* तथा घेउ सेमी/बटर बीन से घटती हुए क्रम में सर्वाधिक फलियां प्राप्त हुई। इनकी अगली पीढ़ी का विभिन्न गुणों के लिए मूल्यांकन किया गया।

पीली सरसों की 6 संभाव्य किस्मों/ लाइंस को सम्मिलित करते हुए हाफ डायलेल फैशन के तहत 7 जेनरेशन से 27 पौधों का चयन किया गया। इसी प्रकार भूरी सरसों की 6 संभाव्य लाइंस को सम्मिलित करते हुए 25 पौधों का चयन किया गया। सरसों की 15 भारतीय किस्मों में से *पूसा बोल्ड*, *पूसा बहार* और *टीएम-2* से

क्रमशः सर्वाधिक उपज की प्राप्ति हुई। दो लाइनों के बीच 45 से.मी. स्पेस रखते हुए 25 सितम्बर को बोई गई सरसों की फसल से सर्वाधिक उपज प्राप्त हुई। सोयाबीन की उपज प्रति हेक्टेयर 40 कि.ग्रा. नाइट्रोजन के प्रयोग से सर्वाधिक प्राप्त की गई।

ऑक्सीसपोरा पेनीकुलाटा और *मेकारंगा अकुलेटाडेंट* के स्वास्थाने (इन विट्रो) लीफ एक्सट्रेट परीक्षण में *पी. एफेनीडरमेटम* में 94% तथा *पिथियम स्पीसीज* में शत प्रतिशत वृद्धि पाई गई। अदरक के राइजोम रॉट पैथोजेन में *ट्राइकोडरमा हारजिएनम.*, *टी. कोनिंगी* तथा *टी. विरीडी* के दो प्रभेदों का प्रभाव देखा गया।

पशुओं में रोग अधिकतर पाचन सम्बन्धी गड़बड़ियों तथा परजीवी के कारण होना पाया गया। गो-पशुओं के सरवाइकल म्यूकस सैम्पल्स में 36 बैक्टीरियल पैथोजन पृथक किए गए। जर्मन अंगोरा खरगोश में मृत्यु के महत्वपूर्ण विशेष कारणों में दैहिक-इंफेक्शन तथा न्युमोनिया को प्रमुख पाया गया तथा अन्य कारणों में चोट लगना तथा यूरेमिया को प्रमुख पाया गया। नर व मादा बच्चों का लिंग अनुपात सिक्किम लोकल गोदस में 1: 08 पाया गया तथा इनमें मृत्यु का कारण न्युमोनिया तथा एंटराइटिस पाया गया।

पातगोभी के अपशिष्ट को खरगोशों के आहार के रूप में प्रयुक्त किया जा सकता है। अगस्त माह में जंगली घास खिलाने से स्थानीय बकरियों की पाचन तथा अंतर्गृहण क्षमता सर्वाधिक पाई गई। बरहर पत्तियों को जंगली घास के साथ मिश्रित आहार के रूप में देने से पशुओं के शुष्क पदार्थ अंतर्गृहण में वृद्धि पाई गई तथा उनके खाने की आदतों में कोई परिवर्तन नहीं देखा

गया। ब्रूम घास तथा हाइब्रिड नेपियर में रासायनिक संरचना के आधार पर सबसे अधिक रेशायुक्त पाया गया।

त्रिपुरा:

भारतीय कृषि अनुसंधान परिषद के उत्तर पूर्वी पर्वतीय परिसर का त्रिपुरा केंद्र अगरतला से लगभग 14 कि. मी. दूर लेम्बूचेरा में स्थित है तथा 1976 से यहां शोध कार्य सम्पन्न हो रहा है। उपोष्ण तथा आर्द्र जलवायु के कारण यहां विभिन्न प्रकार के फसलें खरीफ में उगाई जाती हैं। निचली भूमि जिसे स्थानीय भाषा में लूंगा कहते हैं फसल तीव्रता की दृष्टि से बहुत अच्छी है जबकि ऊपरी भूमि जो कि कुल भौगोलिक क्षेत्रफल का लगभग 60 प्रतिशत है, में फसल तीव्रता कम है। इस केंद्र में वर्तमान में कृषि एवं पशु विज्ञान की कई शाखाओं में शोध कार्य चल रहा है जिसमें खाद्यान्न के अंतर्गत धान, तिलहन, दाल, सब्जियां, एवं पुष्प, तथा पशुओं के अंतर्गत बकरी, खरगोश, सुअर आदि पर शोध कार्य जारी है। इसके अतिरिक्त कृषि वानिकी तथा खेती पद्धति पर भी अनुसंधान कार्य किया जा रहा है। शोध से प्राप्त तकनीक को किसानों के खेतों तक पहुंचाने का कार्य दक्षिणी त्रिपुरा बीर चंद्रामनु स्थित कृषि विज्ञान केंद्र द्वारा किया जाता है।

प्रतिवेदित अवधि के दौरान न्यूनतम तथा अधिकतम तापमान 7.4°C से लेकर 14.8°C के बीच पाया गया। अधिकतम तापमान 26.5°C से 35.1°C तथा न्यूनतम 12.1°C से 24.6°C के बीच रहा।

वायु में आर्द्रता क्रमशः प्रातः काल 78.4 से 87.8% तथा अपराह्न 19 से 66% के बीच

पाई गई। गर्मी तथा खरीफ के दौरान जाड़े के महीनों की तुलना में आर्द्रता में कमी पाई गई। इस वर्ष कुल वर्षा 2527.7 मि.मी. दर्ज की गई तथा कुल 119 वर्षा दिवस दर्ज किए गए। इस वर्ष खरीफ-पूर्व वर्षा कम होने से (42.2 मि.मी.) वर्षापोषित फसलों को देर से बोया गया। वर्षा वितरण ग्राफ के अनुसार जुलाई में सर्वाधिक वर्षा (596.3) मि.मी हुई जबकि नवम्बर तथा दिसम्बर में बिल्कुल वर्षा नहीं हुई। इस दौरान कुल वाष्पीकरण 198.1 मि.मी. था जिसका प्रभाव मृदा प्रतिबल के रूप में परिलक्षित हुआ। वायु वेग में 1.70 से 7.60 कि.मी. प्रति घंटा का विविधता पाई गई तथा अप्रैल से अगस्त के बीच सर्वाधिक वायु वेग रिकार्ड किया गया। इस दौरान औसतन 3.8 से लेकर 8.2 प्रतिदिन धूप उपलब्ध हुई तथा जुलाई से लेकर सितम्बर के बीच कम धूप मिली। इस दौरान प्रातःकाल तथा अपराह्न में मृदा तापमान ($5-30$ से.मी. गहराई) लिया गया तथा पाया गया कि प्रातःकाल की तुलना में यह दिन में अधिक था। गहराई के साथ मृदा तापमान प्रातः काल बढ़ता हुआ तथा दिन में घटता हुआ पाया गया।

धान की 14 लाइंस में टी.आर.सी-87-251 ने सबसे अच्छा प्रदर्शन किया तथा इसे लीफ ब्लास्ट (पर्णध्वंस) के प्रति रोधी पाया गया। कंट्रोल की तुलना में प्रति हेक्टेयर 20 टन वर्मीकम्पोस्ट के प्रयोग से 82 प्रतिशत उपज-वृद्धि पाई गई। खर-पतवार रहित धान प्लाटों में अधिकतम उपज पाई गई जबकि बूटाक्लोर और प्रेटिलाक्लोर खरपतवार-नाशियों के छिड़काव वाले प्लाटों का दूसरा एवं तीसरा स्थान रहा। फसलों के 8 विभिन्न संयोगों में तिल-धान संयोग से

सर्वाधिक धान-तुल्य उपज प्राप्त की गई जबकि इस क्रम में दूसरा एवं तीसरा स्थान क्रमशः धान-उड़द व मूंग-धान का रहा।

कवकनाशियों की जाँच में कारबेंडेजिम को प्रध्वंश एवं ब्राउन स्पॉट रोग के लिए सबसे अच्छा पाया गया।

जल्दी तैयार होने वाली मकई के एक परीक्षण में मकई की प्रकाश किस्म से सर्वाधिक उपज तथा मध्यम अवधि में तैयार होनी वाली किस्म के रूप में हर्षा ने अच्छा प्रदर्शन किया। राइसबीन की आर.बी.एल-52 तथा उड़द की पहेलो/यूजी किस्म को अच्छा पाया गया। कंट्रोल की तुलना में भूसा, चान और पालौथीन को मलच के रूप में प्रयोग करने पर उड़द से सर्वाधिक उपज प्राप्त हुई। मूंग में पंक्तियों के मध्य 45 सेमी. की दूरी तथा मलच के प्रयोग से सर्वाधिक उपज प्राप्त की गई। उड़द तथा मटर में बढ़ती उपज के लिए फास्फोरस एवं राइजोबियम का प्रयोग सकारात्मक पाया गया।

मूंगफली की सभी परीक्षण की गई किस्मों मृदा-अम्लता के प्रति सहिष्णुता पाई गई। फास्फोरस, चूने तथा फोस्फेट सालुबिलाइजिंग बैक्टीरिया के एक साथ प्रयोग से मूंगफली में सर्वाधिक उपज प्राप्त की गई। मूंगफली में अर्ली व लेट लीफ स्पॉट रोग के प्रति सहिष्णुता के लिए परीक्षित 30 किस्मों में से आई.सी.जी.-10936, आई.सी.जी.-10932, आई.सी.जी.-10943 तथा आई.सी.जी.-11183 को सहिष्णु (टालरेंट) पाया गया। प्रति हेक्टेयर 25 कि.ग्रा नत्रजन तथा एजोबैक्टर के प्रयोग से सरसों की उपज में उल्लेखनीय वृद्धि दर्ज की गई। सरसों की 44 चयनित लाईंस व संकर सरसों में

(एस.सी.आर.टी-1-1)-1 से सर्वाधिक उपज मिली जबकि इस क्रम में (एस.सी.आर.टी-1-1)-1 तथा (एस.सी.आर.टी-1-1)-5 क्रमशः द्वितीय तथा तृतीय स्थान पर पाई गई। सोयाबीन की किस्मों में वी.एल.एस-45 से सर्वाधिक उपज प्राप्त हुई तथा एम.ए.यू.एस-45 तथा यू.ए.एम-52 को क्रमशः द्वितीय तथा तृतीय स्थान पर रही।

ग्लेडिओलस के वृद्धि नियामकों में 25 पी.पी.एम 2, 4-D के प्रयोग से सुधार पाया गया तथा 0.2% पोटेशियम सल्फेट का प्रयोग द्वारा कारमैल्स में शीघ्र प्रस्फुटन दर्ज किया गया जबकि बहते पानी में लगातार रखने तथा हॉट वाटर ट्रीटमेंट क्रमशः इस क्रम में सफल पाया गया। 2.5 से.मी.से लेकर 3.5 से.मी. व्यास वाले बड़े कारमैल्स से लंबे पुष्प स्पाइक्स प्राप्त किए गए। गुलदाउदी की अगस्त में लगाई गई पौध में कलियां अधिक संख्या में तथा पहले निकली जबकि अक्टूबर में लगाने से इनकी न्यूनतम संख्या मिली।

ओकरा के 19 क्रास में से पार्वती क्रांति×7-धारी, पार्वती क्रांति×हिबिस्कस रोजा साइनेंसिस, पार्वती क्रांति×हरभजन ने यैलो वीन मोजेक वाइरस के प्रति F6 पीढ़ी में 90 प्रतिशत प्रतिरोधिता प्रदर्शित की जबकि पार्वती क्रांति × 7-धारी, पार्वती क्रांति×हिबिस्कास रोजा साइनेंसिस में व्यक्तिगत फलों का भार अधिकतम पाया गया। टमाटर के बीजों को प्लुमेरिया, क्रॉटन तथा इंडियन रबर के लेटेक्स से उपचारित करने पर प्रति पौध सर्वाधिक भार के फल पाए गए।

कृषि वानिकी के अंतर्गत विभिन्न बहुउद्देश्यीय वृक्ष प्रजातियों के वृद्धि नियामकों तथा ईधन-

काष्ठ उत्पादन क्षमता की माप की गई तथा देखा गया कि इन वृक्षों की 50 प्रतिशत छटाई (पुनिंग) करने पर *जी.अरबोरिया*, *एस.समन* तथा *टी.ग्रांडिस* में सर्वाधिक ईंधन-काष्ठ उत्पादन-क्षमता दर्ज की गई। विभिन्न वृक्ष प्रजातियों के नीचे हल्दी तथा अनन्नास की उत्पादकता का भी मूल्यांकन किया गया। बांस की प्रजातियों में मकाल में सर्वाधिक ऊँचाई दर्ज की गई जबकि न्यूनतम ऊँचाई मूली प्रजाति में पाई गई। मृदा पर वन-चारागाह पद्धति का सकारात्मक प्रभाव देखा गया।

एन.डब्ल्यूडी.पी.आर.ए. कार्यक्रम के क्रियान्वयन के लिए लेम्बूचेरा गांव-पंचायत की

सामुदायिक भूमि का चयन किया गया तथा शोध केंद्र पर उच्च-भूमि हेतु फार्मिंग-पद्धति को विकसित किया जा रहा है। मछलियों के कृत्रिम आहार को पारिस्थितिक अनुकूलन की दृष्टि से जांचा गया तथा सजावटी मछलियों की 11 प्रजातियों के लिए यह अनुकूल पाया गया तथा मछलियों की *कोपेपाँड पेरासाइट* युक्त तीन नई प्रजातियों की उपस्थिति देखी गई।

प्रतिवेदित अवधि के दौरान 8 शोध पत्रों का प्रकाशन किया गया तथा सेमिनार/सिंजिया में 6 शोध पत्र प्रस्तुत किए गए।

