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उत्तर पूर्वी पर्वतीय कृषि अनुसंधान परिसर
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ICAR Research Complex for N.E.H. Region
(Indian Council of Agricultural Research)
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1. Executive Summary

The activities of the Institute during the year centered around research on cereals, pulses, oilseeds, horticultural crops, soil and water conservation, agroforestry, development of farm tools and implements, animal health and production aspects, fish and fishery sciences and social sciences research. Extension of the evolve technologies to farmerss' field both through institute based project and IVLP was another important area. The Institute also handled around 40 NATP projects besides the projects on Technology Mission on Horticulture.

While, the Institute head quarter at Barapani, concentrated mostly on screening/developing suitable crop and animal varieties including the development of agro-techniques for agri-horticultural crops, the regional centres served as the location for multilocational testing of these varieties including development of location specific production and protection packages. Besides, this the regional centre at Arunachal Pradesh served as germplasm evaluation and maintenance particularly for bamboo resources MPTs, citrus species and indigenous fruits. Similarly, the regional centre at Sikkim and Tripura developed two and three tier agroforestry models based on large cardamom + MPT and MPT + blackpeeper + pineapple respectively. The regional centre at Manipur could develop and release high yielding rice varieties-Maniphou 5 and 7 having production potentiality of 6-8 t/hactare. The centre also released three tomato varieties suitable for rice based cropping system.

In the field of rice research, screening of different varieties continued and highest yield was recorded in IRAT 112 followed by IR71524-44-1-1. F3 and F5 segregating population from different cross combinations were advanced to F4 and F6 generation under upland ecosystem. Similarly, 13 genotypes for low land ecosystems were also evaluated besides, advancing aromatic rice lines through RCRT trials. Varietal trials under high altitude conditions were also carried out taking the earlier institute released varieties, Megha Rice-1 and Megha Rice –2 as local checks.

Under hybridization programme 7 genotypes were used under diallel mating. 21 F1 hybrids were also evaluated and performances of DR-92/IET-16471 followed by 16451 were observed to be better in yield character per plant. Comparative assessment of local and exotic varieties indicated potential yield of 40.85 q/ha from DRP-11 followed by the variety Sahyadri (40.40 q/ha).

In rice biotechnology, attempts were made to develop insect resistant transgenic plants. Under this programme, 22 and 12 hygromycin resistant plantlets of IR-36 and RCPL-1-2C respectively were initially recovered from 2 independent transformation experiments. PCR amplification indicated presence of *cry IA* © gene. *In-vitro* screening for toxicity against stem borer confirmed expression of the gene of interest. Research work on development of cold tolerant rice varieties through anther culture was also continued using G 5 medium. A total of 534 plants were evaluated for various agro botanic characters.

Different rice productions and protection measures under different agro climatic locations were developed through integrated nitrogen management, integrated pest management, integrated management of rice diseases including response of nitrogen to selected hybrids to support the recommended/ developed varieties.

Under maize improvement programme, promising entries of maize were identified besides initiating attempts to develop high yielding, short duration hybrids and composites through chain crossing and line x tester methods. Nucleus and breeders' seed were also produced in addition to

carrying out 110 numbers of front line demonstrations in farmer's field. Similarly 20 entries of maize were evaluated for rabi season and the best entries identified. Different intercropping experiments with maize were also carried out. The screening of varieties were supported by the pest and disease control measures developed against cob borer etc.

In pulses production sector, research work of the Institute was confined to the varietal evaluation and development of agronomical packages including diseases and pest control measures for ricebean (63germplasm), , urdbean, pigeonpea, black gram, green gram (15 lines), lentil (11), French bean (16) and fieldpea (6). Pigeonpea was identified to be one of the important pulse crop for the region having multiple uses including its use in contour bunds for soil erosion control measures.

Mustard, groundnut and soybean were particularly found to be very promising oilseeds under the hilly ecosystems of northeastern region. In addition to this the state of Manipur, Nagaland and Tripura were observed to be having higher potential for sun flower and sesamum. In soybean F_4 generation produce were evaluated for rust and frog eye leaf spot disease resistance in an effort to release a variety suitable for the region. Around 82 promising varieties/lines of groundnut varieties from ICRISAT and NRCG were evaluated and agronomical packages developed. Under different treatment combinations, the yield of groundnut varied between 16.24 q/ha and 29 q/ha indicating tremendous potentialities of this crop in the region. In mustard, M-27 variety was still found to be a dominating variety with little exception to the yellow sarson variety released earlier by the institute from its Sikkim centre.

Fruits, vegetables, spices and ornamental plants were the main areas of activities under horticulture sector development. In an effort to propagate citrus improvement, soft wood grafting on different rootstocks was carried out and maximum per cent success (80%) was recorded when *Citrus grandis* was used as rootstock. Field evaluation of such soft wood grafted plants of Khasi mandarin was also carried out besides studying the effect of plant growth regulators and effect of different chemicals on seed germination. For rejuvenating declined orchards, the method of top working i.e. detopping of the declined tree at different heights was observed to be one of the effective methods. Other fruits covered under different experiments were guava, pineapple, peach, papaya, aonla, banana, kiwi and passion fruits.

Under vegetable research programme, 26 varieties of tomato, 24 of brinjal, 80 of Indian beans, 24 of French bean, 24 of bottle gourd, 24 of cucumber, 13 of sweet potato, 31 of colocasia besides a number of germplasm of cabbage, radish, bhindi, yambean etc were evaluated, screened and recommended after developing suitable agro-techniques as per the need of specific areas.

Among the various spices, the institute concentrated on refining the agro techniques for the pre release variety of turmeric through multi locational trials. In addition to this, varietal evaluation of ginger and large cardamom was carried out both as sole crops, inter crops (ginger) and for development of large cardamom based agroforestry system. Research on floriculture was carried out with its base on gladiolus, gerbera, tubrose and marigold particularly at Barapani and Sikkim centre.

Soil and water conservation measures developed in institute were taken to the farmers field for assessment under partial area treatment in a watershed named Shipra watershed where hydrological evaluation of land use system facilities were also created. In addition to this, efficacy of RS and GIS systems for the treatment of severely degraded watershed was also studied for natural resource management planning. Climatologic water demand of major crops grown was also assessed besides devicing means for efficient utilization of harvested water through micro irrigation systems.

Under agroforestry programme MPT species were collected and evaluated under different land use systems besides evaluating multi storied agroforestry system with turmeric, colocasia, ginger, large cardamom, tea etc as components of multi storied system. One project on development of non-forest waste land through AF model was also initiated. In addition to this, bamboo species of the region were also collected, conserved and maintained.

A systematic attempt was made to develop suitable agricultural farm implements and machineries through the blending of indigenous and acquired knowledge / skills particularly to remove drudgery of the women agricultural work force. Several farm implements were manufactured and training imparted to the artisans on manufacture.

In animal science sector, pig, rabbit, poultry and goat continued to be the major thrust areas of research. Contribution of the earlier developed pig variety towards economic security of the tribal farmers was assessed through the Jai Vigyan Project of NATP in addition to continuing the work on comparative assessment of the variety at Institute level. In an effort to popularize artificial insemination in pig, semen collection and preservation techniques were further standardized.

Bamboo leaf based feeding was assessed particularly with respect to the content of HCN in bamboo plants. Efficacy of different treatments on reducing the HCN content was found out through which a good recommendation to reduce up to 72.20 per cent HCN through only sun drying of the leaves for 24 hours could be arrived at. Different feed formulae for all the above species of animal were prepared through the incorporation of locally available feed ingredients.

In animal disease sector the institute had the distinction to initiate work on DNA based animal disease diagnosis. Steps were taken to standardize PCR protocols in disease diagnosis. Research on weather based animal disease forecast and also developing a sound animal health information system through disease monitoring and surveillance were also initiated.

In fishery sector, research on composite fish culture, cage culture and cold water fisheries received the main thrusts. Several terrestrial weeds were identified as feed components for composite fish culture. Silk worm pupae and grass hopper were also identified to be valuable sources of fish feed besides finding out a replacement of fish meal up to 20 per cent through the use of African snail flesh.

Under farming system research project, data collection on hydrological parameters and soil health regeneration as influenced by systems like, dairy based FS, agro pastoral FS, agri horti pastoral, silvi-pastoral etc. farming systems were continued. Crop compatibility under different systems were also studied. Soil loss could be checked from around 42 t/ha to around 2.5 t/ha particularly under agri horti silvi pastoral system of land use which also continued to be the best land use systems. Another significant observation was that the slopes up to around 60% could be converted into terraces through initial contour bunding of 4 to 5 years duration.

The Institute was actively engaged in extending the evolved technologies for the benefit of the farming community through off farm trials, front line demonstrations and training and visit programme. Such extensions of the programmes were preceeded by PRA exercise in order to assess desired interventions. In addition to this, technology assessment and refinement programme under IVLP was also taken up based on cluster approach. Specific studies were also conducted to assess the areas through which drudgery of the farm sector women could be reduced. Several Kisan Mela/ Kisan Gosthi were also arranged.

2. INTRODUCTION

ICAR Research Complex for NEH Region has completed more than 26 years in the service of tribal farmers. The complex was established in 1975 under the aegis of ICAR – New Delhi, an apex body for the agricultural research in India, with its Head Quarter at Shillong, which was shifted to its actual site at Umiam (Bara Pani) in 1991. It is unique in the respect that all the disciplines of agriculture, horticulture, animal science, farming systems research, agro forestry and agricultural engineering are at the same platform to accomplish the overall development of the farmers through multidisciplinary approach.

The Complex has six centres, i.e., one for each hill state of the entire region, located at Lembucherra (Tripura), Kolasib (Mizoram), Imphal (Manipur), Basar (Arunachal Pradesh) and Tadong (Sikkim) with its Head Quarter at Umiam (Meghalaya), to generate the technology for different agro climatic zones of the entire region. Six Krishi Vigyan Kendras (KVKs) are functional to disseminate and broadcast the technology among farmers, generated through research. One TTC (Trainers' Training Centre) is also organising trainings for the officers of State Government Organization/NGOs, etc. so that a network could be made to train the farmers as well as trainers also. While selecting the sites for different states, the entire NEH region has been considered as one unit and research centres are so located as to represent the varying altitudes and agro climatic zones of the region. This has helped in rational utilization of scientists avoiding duplication of work and the total outcome of the research at different centres could thus be utilized for specific latitudinal range and agro climatic zones of all states.

The main complex is located at Umiam about 22 km away from Shillong nearby the Umiam Lake, which is the major source of power for entire state of Meghalaya. The latitude and longitude of the place are 20°30'N and 91°15'E. The 101 ha farm 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 have been developed for conservation of soil and water resources. Trenches and earthen dams have also been made to harvest the runoff water. At present, the area under cultivation is around 60 ha.

Thrust areas

- To evolve sustainable integrated farming systems for the hills of the regions to replace *jhum* (shifting cultivation) for increased productivity.
- Restoration of degraded *jhum* fallow lands through tree based farming.
- Development of feed and fodder resources including local fodders for different livestock.
- Improvement of Citrus plantation to rejuvenate the Citrus industry.
- To increase the overall productivity of different crops through research in cereals, pulses, oil-seeds, horticultural and other economic crops.
- Animal health coverage and improvement of livestock production systems.

Mandate

- To undertake the basic and applied research for delivering technologies based on sustainable farming systems for different agro climatic and socio-economic condition of the region.
- To improve the productivity of the crops, livestock and fishery.
- To act as a repository of information on natural resources, different farming and land use systems of the region.
- To provide training in (i) research methodology and (ii) use and application of improved technologies for enhancing agricultural productivity.
- To collaborate with the state departments for the agricultural development in the region, and testing and promotion of improved farming and land use technologies.
- To collaborate with National and International agencies in achieving the aforesaid objectives.
- To provide consultancy.

NATP Projects

During 2001-2002 a total number of 42 projects were in operation under National Agricultural Technology Project. The projects are:

Strength and Manpower

The Institute has 15 different disciplines viz. Plant Breeding, Agronomy, Soil Science, Plant Pathology, Entomology, Agro forestry, Agricultural Economics and Statistics, Agricultural Engineering, Agricultural Extension, Horticulture, Animal Health, Veterinary Parasitology, Animal Nutrition, Animal Production and Fisheries. At present there are more than six dozens ongoing projects in the institute. The institute, headed by the Director has a total number of 607 (excluding KVKs and TTC) staff in position. The staff position of the Institute is presented below.

Category	Sanctioned	Filled	Vacant
Scientific	192	112	80
Technical	318	248	70
Administrative	154	113	41
Supporting	136	134	2
Total	800	607	193

Library

The Institute has established a sophisticated agricultural research library, which has acquired so far 15,899 books. In addition, there are 7715 reports and 10,015 back issues of several publications. It has subscribed 61 foreign and 33 Indian journals. The library also has 21 CD Roms. The library has been providing good services to the scientists and other categories of users visiting the library regularly.

Computer Facilities

The Institute has a rich computer database of library resources. It is also providing computerised database on Environmental Degradation in North East India by scanning six regional and national newspapers. Library is connected with NICNET, and rendering Selective Dissemination of Information Services to its scientists by accessing the International Data Base available with IASRI, New Delhi including E-mail services. Internet Services were provided to all the staff by ARIS cell of the complex. A website http://icarneh.ren.nic.in has been launched depicting update staff position and other important information and publications.

Budget

The budget of the institute for the year 2001-2002 is given below:

(Rs. in lakhs)

Budget	Allotted	Expenditure
Plan	569.00	553.93
Non-plan	1410.00	1232.27
Total	1979.00	1786.20

Linkages

The institute regularly providing advisory services to the department of agriculture and other allied sectors. Biennial interface meetings are held at the institute to discuss various problems of agriculture and related matters for research and development with Department of Agriculture, Government of Meghalaya and scientists of various disciplines. The information generated through research is passed on to the farmers through publication of Books, Newsletters, Annual Reports and Technical Bulletins

IMPORTANT EVENTS

A three days National Seminar on "Approaches for increasing Agricultural Productivity in Hill and Mountain Ecosystem was organised at ICAR Complex from 18-20 Oct, 2001. Hon'ble Chief Minsiter of Meghalaya Sh. E.K. Mawlong inaugurated the Seminar.

Sh. E.K. Mawlong, Hon'ble C.M. of Meghalaya inaugurating the National Seminar

Dr. J. S. Samra, DDG (NRM), ICAR, New Delhi, visited the ICAR Complex on 4th April, 2001. He reviewed the progress of the Institute and inspected Research farm, laboratories and inaugurated the Dairy Farm of the Complex on this occasion.

Dr. J.S. Samra inaugurating the Dairy Farm

Dr. M.S. Swaminathan, an eminent scientist and founder of M.S. Swaminathan Research Foundation, Chennai, visited the exhibition stall of ICAR Complex at AAU, Khanapara, Guwahati during 5th Agricultural Science Congress. Dr. J. S. Samra, Deputy Director General (NRM), ICAR, New Delhi was also present on this occasion.

Dr. Swaminathan visiting the exhibition

Dr. J. S. Samra, Deputy Director General (NRM), ICAR, New Delhi visiting the exhibition along with Dr. M. S. Swaminathan

A 21 days Summer Institute on Agriculture for Hills and Mountain Ecosystem was organised at ICAR Complex for NEH Region, Umiam from 10th July to 30th July wherein 25 participants from all over the country partcipated.

Participants of Summer School

Ms. Sashi Mishra, IAS, Additional Secretary, DARE and Secretary, ICAR, New Delhi visited ICAR Complex on 21st February, 2002 . Dr. K. N. Kumar, IAS, Director, NRC on Values and Ethics (ICAR), New Delhi was also present on this occasion.

Smt. Sashi Mishra, IAS, Secretary, ICAR, New Delhi on her visit to ICAR Complex , Umiam

A five day training Programme on Management of Orchards with special reference to Citrus Decline in Meghalaya was organised at ICAR Umiam from 12 th – 16th Feb, 2002.

Training on Citrus Decline

Farmers' Fair

A farmers' fair was organized at the Institute where nearly 200 farmers took part. This was organized to expose the farmers towards research activities as well as to facilitate them to interact with the Scientist of this Institute on different aspects of agriculture, animal husbandry, fishery and allied sectors. Apart from the Director and Scientists the Hon'ble Chief Minister of Meghalaya was also present in the fair.

Visits

During the period under report, altogether 60 farmers, 212 school children and 52 rural enterprenures visited this Institute. They were taken to different research farms, laboratories and exhibition hall to appraise them of on going activities of this Institute.

3. Research Achievements

CROP SCIENCES

RICE

MEGHALAYA

UPLAND Varietal evaluation

A. Pattanayak and A. Annadurai

Four yield trials; two screening trials and one regional trial (RCRT) were conducted in upland. Bali recorded the highest yield in both RCRT-U1 and IVT-U(H) although the yield was lower than previous year. In the national trials no genotype was found superior to the local checks Bali and RCPL 1-29. In international upland rice observational nursery (IURON), a total of 55 genotypes were evaluated with four international and one local checks. The highest yield was recorded in IRAT 112, followed by IR 71524-44-1-1.

In the screening of F_3 segregating generation, seven progenies each of five crosses were evaluated in randomized block design in two replications. Superior progenies identified in each crosses were advanced to F_4. In another screening trial 100 selected progenies of F_5 segregating population of 12 crosses involving IET 13783, IRAT 144, IET 13459, Yamuk and Bali were evaluated. Selections were effected towards number of effective tillers, total spikelet, spikelet fertility and single plant yield. Forty six superior progenies identified were advanced to F_6.

Response of selected cultures to nitrogen under high and low input management

D.C. Saxena and N.P. Singh

On pooled basis, the results indicated that 50% recommended dose of nitrogen (RDN) along with 10t FYM/ha significantly gave higher yield (35.28 q/ha) which was 14.35, 19.23 and 41.36% higher over 150, 100 and 50% RDN, respectively. Among the rice cultivars, CH-988 recorded maximum yield to the tune of 37.37 q/ha followed by VL-Dhan-221 (33.90 q/ha).

Integrated pest management

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

National screening nursery (Hills)

All the 59 advanced/initial yield AICRP trial entries recorded reaction of 6-10 WBPH adults/nymphs/10 hills with the damage score of 3 in the 0-9 scale as per the Standard Evaluation Systems of IRRI, s and a damage score of 1 (<5 insects/10 hills) at 50 days after sowing (DAS).

Multiple resistance screening trial

To identify multiple resistances against insect pests 80 promising advanced cultures were tested in upland field. The entries have shown zero damage (immunity) to both leaf folder and stem borer at 30 and 50 days after sowing (DAS) were VSR-8, 15, 31, 33, VL 4041, BL 245, CB 96001, 98013, 98076, JGL 3827, 3918, MTU 1044, RNR 19994, RYT 2662, TTB 281-47-2 and PHB 71. Another 7 entries viz. CB 97033, 98006, BR 8, BPT 1788, JGL 420, 3858, MTU 1036 showed less than 10% damage by leaf folder and stem borer at 30 and 50 DAT.

Optimum insect pest control trial

Eight promising varieties were evaluated for their yield potential and insect pest reaction under need based protection (carbofuran 3G @ 1.0 kg a.i./ha at the time of transplanting) and spray with monocrotophos 0.05% at milking stage for the control of gundhibug. RCPL 1-87-4 was used as check. Under protected conditions RP 2941-43570 had the lowest stem borer damage (1.25 % dead hearts) and highest yield of 4.18 t/ha. The other best varieties were KAUM 59-29-2-1-2, RP 2932-44087, Jaya, MTU 1243-15 and RCPL 1-87-4 (Local check). Due to severe blast incidence, yield reduction was observed in some varieties. The differences between the protected and unprotected in terms of insect damage and yield is given in Table 1.

Screening varieties for resistance to insect pests in plant breeding trials (IVT)

All the 10 varieties under IVT recorded 2.1 to 2.9 WBPH/plant. Incidence of *Chaetocnema* (2-3/plant) started from 45 DAS and continued till 70 DAS. Like wise leaf folder (10-30% damage) was noticed on all the varieties and its incidence was high during 50-80 DAS. Gundhibug and stem borer incidence were negligible.

Advanced varietal trial

In this trial, 17 varieties were screened for resistance but no difference in infestation levels due to insect pests was found, as the incidence was negligible. In general, the leaf folder damage was severe at 45 DAS.

Research complex regional trial

As the incidence of all the insect pests of rice was very negligible in RCRT trials, all the 15 varieties did not show any significant difference in pest damage. The pest incidence followed the same pattern as in IVT and AVT except the leaf folder, which caused severe damage on all the varieties at 45-50 DAS.

Table 1. Differences in insect damage and yield in protected and unprotected plots

Variety	Dead hearts (% of TT)		White ears (% of PBT)		WMDL/10 hills		Yield (t/ha)	
	UP	P	UP	P	UP	P	UP	P
JGL 246*	9.39	2.76	9.69	4.04	3.75	0.00	2.20	2.60
Jaya*	7.18	1.50	11.25	4.00	5.75	1.50	1.40	3.22
RP 2941-43570*	3.80	1.25	10.41	3.28	6.50	1.50	2.74	4.18
KAUM 59-29-2-1-2	6.75	2.70	7.94	3.12	4.75	1.00	2.94	3.97
RNR 9891*	9.16	4.73	5.93	1.06	2.50	1.25	1.56	2.68
RP 2932-44087*	8.05	1.59	7.50	3.86	8.25	5.00	1.60	3.54
MTU 1243-15	5.62	2.70	10.0	3.95	2.50	0.75	1.44	3.14
RCPL 1-87-4 (Local check)	7.36	1.66	9.25	4.00	4.25	1.25	1.70	3.11
TN 1*	7.36	3.00	6.84	3.25	5.00	0.75	1.29	1.80

* Severe blast incidence; WMDL- Whorl maggot damaged leaves, UP-Unprotected, P- Protected, TT-Total tillers, PBT- Panicle bearing tillers

Integrated nitrogen management

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

A field experiment was conducted during kharif, 2001 with 3 levels of N (0, 30 and 60 kg/ha), 3 levels of biofertilizer (No biofertilizer, Azotobacter and Azospirillum) and 2 levels of FYM (0 and 5t/ha) in combinations to study the response of upland paddy (RCPL-1-29) to integrated nitrogen management. Results indicated that yield of paddy increased with increasing N and FYM levels and biofertilizer application. Among the treatments, a combination of 60 kg N, 5t FYM/ha and Azotobacter registered highest grain (35.4 q/ha) and straw (48.9 q/ha) yields followed by a combination of 60 kg N, 5t FYM/ha and Azospirillum. FYM has influenced the grain and straw yield at each level of N application.

Epidemiology and management of diseases

M. Srinivas Prasad, M. Santha Lakshmi, Y.P. Sharma and A.K. Singh

Two varieties of rice viz. HR 12 and IRAT 144 were sown under upland conditions at weekly intervals starting from 5 May to 9 June. Blast disease (*Pyricularia grisea*) appeared in first week of June in HR-12. The severity increased by 20 July. In the early date of sowing (5 May and 19 May) the incidence was comparatively less (20%). The severity of blast disease was more (82.47% and 92.09%) in late sowings (2 and 9 June). In IRAT 144, the incidence of blast was less. The favourable weather parameters were observed to be high relative humidity (90-91%), low sunshine hours (3-6 h), more rainy days (26-28) and minimum temperature (20°C).

Brown spot (*Helminthosporium oryzae*) disease appeared late in the season during August. In both varieties, the incidence of brown spot was more. The severity was more (66-69%) in late sown crop as compared to middle-sown crops (44%) in IRAT 144. In HR 12 also the incidence of brown spot was more in late sown crops (55-58%).

Integrated management of rice diseases

A field trial was undertaken to study the effect of integrated use of fertilizers and fungicides on incidence of rice diseases with two varieties of rice-HR 12 and RCPL 1-29, under upland conditions. Carbendazim (0.05%) as Bavistin was sprayed at 40, 80 and 100 days after sowing in protected plots.

Application of carbendazim at three intervals reduced the blast disease in HR-12 (9.82%) and RCPL 1-29 (3.46%). Combined treatment of carbendazim and fertilizers also considerably inhibited the disease occurrence in both varieties. Application of fertilizers only increased the blast severity in HR-12 (41.11%).

Brown spot disease appeared during July in HR-12 and its severity increased by August. Application of normal doses of fertilizers reduced the incidence of brown spot in HR-12.

Chemical control

Seeds of two varieties of rice (HR-12 and RCPL 1-29) were treated with different fungicides, *i.e.*, KTU 3616, Beam, Hinosan, Bavistin, Contaf and SAAF. The crop was sown in upland. Incidence of different diseases was recorded.

All fungicides reduced the incidence of blast disease in HR-12 and RCPL 1-29. However, Contaf (1.5 ml / l) and KTU 3616 (1.2 ml / l) considerably reduced the disease (2.96 and 4.19%) as compared to control (88.15%) in highly susceptible HR-12. In resistant RCPL 1-29 also Contaf (1.5 ml / l) and Beam (0.4 g / l) effectively reduced the blast disease (2.72 and 3.35%).

In HR-12, Beam (0.2 g / liter) reduced the brown spot disease considerably (12.59%), followed by Contaf (17.53%) as compared to control (51.85%). Hinosan and Bavistin also inhibited the brown spot disease considerably (12.59%), followed by Contaf (17.53%) as compared to control (51.85%). In RCPL 1-29, Contaf (1.5 ml) and Hinosan (1.5 ml) reduced the brown spot disease (20%) considerably when compared to control plots (57.04%). However, seed treatment failed to increase grain yield indicating that seed treatment alone may not be beneficial.

Screening against blast disease

Twenty cultivars of rice, received from VPKAS Almora, were tested under natural field

conditions. Among them, three were highly resistant (VLRB 5,11 and 20), ten were resistant (VLRB 1,2,8,9,10,12,13,14,15 and 19) and four were moderately resistant (VLRB 3,4,6 and 18) to blast disease.

LOWLAND Varietal performance

A. Annadurai and A. Pattanayak

Eight yield trials including two research complex regional trial viz., RCRT (lowland) and RCRT (aromatic rice), five national trials (AVT-IE, IVT-IE, IVT-IM, IVT-BT and IVT-J) and one international irrigated rice observation nursery were carried out. Besides these yield trials, seed multiplication of seven advanced varieties were also taken up.

In RCRT for lowland, 13 genotypes were evaluated. ITA 222, which ranked second in the last year ranked first this year. In the regional trial for aromatic lines (RCRT-Aromatic Rice) six advanced genotypes selected were evaluated along with three checks. All the test entries except IET 16339 were found better than checks with an yield advantage of around 8% (IET 16309) to 17% (IET 16310) over the high yielding check, Pusa Basmati.

Hybridization and selection

A. Annadurai and A. Pattanayak

Crossing was effected in seven genotypes viz., Mawri, Ngoba, Bapna, Jowai, Manipur, T 9846-7-1-1-2P-M and Tox 3055-10-1-1-1-2 in 4 dialle mating design. Twenty-one F_1 hybrids were also evaluated for their performance. Highest yield/plant was observed in DR 92/IET 16471 followed by DR 92/IET 16451. Other crosses showing superiority over the parents were IR 61979-138-1-3-1-2/UPR 1425-1-1-4, DR 992/UPR 1425-1-1-4, Ngoba/IET 16469, DR 92'IET 15482, DR 92/UPR 1425-1-1-4 and Manipur/IET 16451. Individual panicle was harvested separately and advanced to F_2 for further selection in subsequent generations.

Compartive study of local and exotic varieties including hybrids

A. Annadurai and A. Pattanayak

A study was conducted with eleven indigenous and improved varieties of NEH region and eleven exotic varieties and hybrids. Among the twenty two genotypes evaluated, DRP11 exhibited higher potential yield of 40.85 q/ha. Another exotic variety showing potential yield more than the best local check, Mawri (40.20 q/ha) was Sahyadri (40.40 q/ha).

Nutrient response of selected hybrids

D.C. Saxena and N.P. Singh

The results of the second consecutive year of the experiment indicated highest grain yield (38.13 q/ha) was produced by the local HYV - RCPL-1-87-8, followed by Hybrid DRRH-1 (33.58 q/ha). Hybrid KHR 2 yielded poorly (25.81 q/ha). The application of nitrogen increased grain yield. The highest grain yield (34.01 q/ha) was recorded with 120 kg N/ha followed by 90 kg N/ha (32.51 q/ha). However, a reduced grain yield (33.70 q/ha) was observed when high dose of N (150-kg/ha) was applied. The increasing level of potash, increased grain yield irrespective of doses of N application. The interactions of 90 kg N and 80 kg K_2O/ha gave highest grain yield in DRRH-1, whereas, Hybrid KHR-2 and RCPL -1-87-8 produced highest grain yield at interaction of 150 kg N and 80 kg K_2O/ha.

Performance of hybrids and HYVs under efficient management of nitrogen

D.C. Saxena and N.P. Singh

In the second year of experimentation, it was observed that RCPL-1-87-8 producing 36.73-q/ha grain yield was at par with DRRH-1, (35.02q/ha) but produced significantly higher yield than RCLP-1-3 (32.78 q/ha). The hybrid RCPL-1-3 and DR-92 was significantly superior to two other hybrids viz: KHR-2 (27.87 q/ha), ADTHR-1 (27.46 q/ha). The tall variety H-2686 (A) (26.43 q/ha) remained

poor grain yielder. But on pooled basis, RCLP-1-87-8 significantly out yielded other varieties in grain yield recording 35.30 q/ha, followed by at par yields of DR-92 (33.93 q/ha), RCLP-1-3 (33.76 q/ha) and hybrid DRRH-1 (33.75 q/ha). The application of nitrogen in two equal splits produced significantly higher grain and straw yield in both the years and also on pooled basis as compared to splitting of nitrogen in three doses (50% N at planting + 25% N at tillering + 25% N at PI stage). In terms of straw yield, the local high yielding variety H-2686 (A) has produced significantly higher straw yield in the year 2000–01 and also on pooled basis giving an yield of 98.83, 101.70 and 100.30 q/ha, respectively, followed by ADTHR-1 and DRRH-1.

Response of selected AVT-2 I-M (H) cultures to nitrogen

N.P. Singh and D.C. Saxena

In the second year of experimentation, the results showed that the growth and yield attributes significantly increased up to 100% of RDN, but the maximum values of these parameters were recorded with 150% of RDN. However, the yield of rice increased linearly with the increase in nitrogen levels recording maximum yield to the tune of 38.33 q/ha at 150% of RDN. Among the rice cultivars, RCLP-1-87-8 recorded maximum yield (43.09 q/ha) followed by RCLP-1-3 (43.18 q/ha). The hybrids were poor yielder as compared to HYVs during both the years.

Studies on efficient nutrient management

A.S. Panwar and U.K. Hazarika

Trials on effect of treatment variables on growth and yield of low land rice (RCPL 1–87-8) was combined for second consecutive year. It was observed that highest yield to the tune of 40.7 q/ha (2000-2001) and 37.4 q/ha (2001-2002) was recorded with the application of FYM @ 5.0 t/ha + 75 % of the recommended dose of NPK + *Azolla* dual cropping, followed by the 100 % of the recommended dose of NPK with same bio-organics. The yield recorded with the application of FYM @ 5 t/ha + 75 per cent RDN and/or 100 per cent of the recommended dose of NPK + inoculation with *Azospirillum* was almost similar to the yield recorded with 100 % of the recommended dose of NPK applied without any bio-organics. The yield also improved due to application of FYM @ 5 t /ha + *Azolla* / *Azospirillum* as compared to control but remained inferior to the yield recorded with the application of FYM @ 10 t /ha alone (Fig.1).

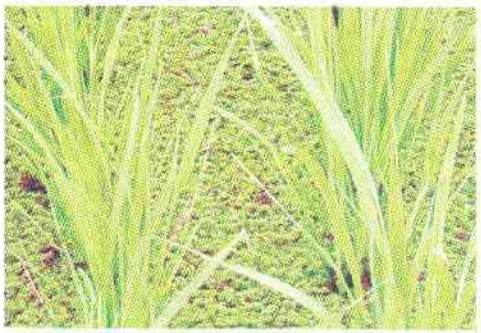


Fig1. Use of bio-organics in rice

Response to nutrient management and growth booster

U.K. Hazarika, A.S. Panwar and N.P. Singh

The experiment was initiated to study the performance of rice (cv. RCPL 1-87-8) on neem cake and crop booster, a growth promoting substances enriched with micro elements and vitamins, under low land situation. The results indicated that crop applied with 60:40:30 kg NPK/ ha + neem cake @ 10 q/ha along with crop booster 1.5 kg/ha produced highest grain yield (38.5 q/ha), which was superior to all the treatments except the treatment with 5 q/ha of neem cake application along with recommended dose of NPK + 1.5 kg crop booster (34.8 q/ha). Application of recommended dose of fertilizer alone and 10 q/ha neem cake in the presence of crop booster significantly increased yield over control.

Evaluation of new herbicides

Rajesh Kumar and N.P. Singh

A field experiment was continued for second consecutive year to assess the efficacy of six

herbicides in transplanted rainfed rice. The highest grain yield (44.10 q/ ha) was recorded with Riceguard followed by two hand weeding (42.70 q/ ha).

Integrated nutrient management

U.K. Hazarika, N.P. Singh and D.C. Saxena

The experiment was repeated for the second consecutive year with 18 different integrated nutrient management approaches under wetland conditions. The results revealed that application of FYM improved the grain and straw yield of rice. The grain and straw yield of 37.39 and 57.81 q/ha, respectively, was recorded with application of FYM @ 5 t/ha which was significantly superior to control (26.80 q/ha grain and 45.27 q/ha straw). Application of 2.5 t/ha of FYM also improved the grain yield but the extent was not significant. However, linear increase in straw yield was recorded with increasing level of FYM. Increasing level of N alone and in combination with zinc sulphate significantly increased the grain and straw yield. It was also observed that yield increased significantly with the increasing dose of fertilizer N. Height, tillers/m^2 and the results were overwhelming when the N doses were integrated with zinc sulphate. It was also observed that application of zinc improved the yield as compared to N alone, but the response of zinc was found in decreasing order with the increase in N doses. Application of 90 kg N with zinc sulphate 25 kg/ha enhanced grain and straw yield and was significantly higher over 60 kg N + 25 kg/ha of zinc sulphate and 30 kg N alone.

Effect of tillage and organics on soil health water loss and energy requirement

V.K. Mishra and S.K. Gupta

Field experiments were conducted on a highly permeable foot hill sandy clay loam soil (Typic Hapludalf) of Meghalaya to evaluate the effect of different tillage practices (zero tillage-T_0, puddling with spade-T_1, power tiller cultivator with cage wheel –T_2 and deshi plough-T_3) and organics (no organics-M_0, mixed jungle grass-M_1, *Ambrossia sp.* – M_2 and FYM-M_3) on rice grain yield, energy requirement, water loss and nutrients status of soil. The rate of water loss reduced significantly under puddled conditions over the zero tilled plots. The magnitude of reduction in water loss was the maximum in T_2 plots followed by T_1 and T_3. Consequently, the grain yield was observed in order of $T_2>T_1>T_3>T_0$. The energy requirement for production of rice varied from 11.56 x 10^3 MJ/ha for T_0 to 14.24 x 10^3 MJ/ha and T_2 tillage practices with the output of 111.70 x 10^3 to 153.10 x 10^3 MJ/ ha, respectively. The T_1, T_2 and T_3 treatments were at par and significantly superior to T_0 for root length density. The different sources of organics profoundly enhanced the root growth, yield and build-up of the fertility status and water storage capacity of soil but their effect was almost at par with each other. Puddling by power tiller cultivator mounted with cage wheel was found to be the most effective tillage practice for water conservation, grain yield and energy production. The negative effect of tillage practices on soil fertility particularly depletion in organic carbon status could be checked with the application of FYM or grass @ 10 t/ha in the foothill soil.

Insecticide evaluation trial

K.A.Pathak

Effectiveness of promising and new insecticides (which includes combination products) against major insect pests was studied. Bulldock (Beta-cyfluthrin 025 SC) (2.5% a.i.) @ 12.5 g a.i./ ha applied plots recorded lowest number of insects (green leaf hopper (GLH), white backed plant hopper (WBPH) and leaf folder) with highest yield of 4.53 t/ha. The other best treatments were Bulldock Star 262.5 EC (B-cyfluthrin 12.5 g + chlorypyriphos 250 g/litre)(26.25 a.i.) @ 393 g a.i./ ha, Upacy 50 DF (acephate 45% +cypermethrin 50%) (50% a.i.), Confidor Ultra 100 EC (imidachloprid 50 g + betacyfluthrin 50 g/lit) (10% a.i.) @ 30 g a.i./ha, chlorpyriphos 20 EC @ 500 g a.i./ha, Confidor 2002 SL (20 % a.i.)(imidachloprid) @ 20 g a.i./ha, Calypso 240 SC (24% a.i.) (Thiacloprid) @ 120 g a.i./ha and Ezeetab

(deltamethrin 25% a.i. in tablet).@ 10 g a.i./ha. The monocrotophos check 36 WSC though reduced all the pests did not give higher yield.. The control plot showed highest incidence of all the insects with lowest yield (2.78 t/ha).

Comparative studies of occurrence of diseases

M.Srinivas Prasad and Annadurai

Occurrence of diseases on the local varieties in comparison with direct introductions of exotic varieties and the influence of the diseases on the yield and yield contributing characters under rainfed lowland conditions of Meghalaya was studied. Test entries in this study were grouped into three categories, *i.e.*, (a) Indigenous and improved varieties of NEH region *viz.* RCPL 1-4; RCPL 1-30, RCPT 1-87-4, RCPL 1-87-8, RCM 9, DR 92, IET 16310, IET 16313, Basmati 370, Ngoba and Mantri (b) exotic varieties viz. Sahyadri, Krishnaveni,Chaitanya, Pratibha, Vajram and Dhanyalakshmi and (c) exotic Hybrids viz. DRRH 1, KRH 2, ADRH 2, CNRH 3 and Pant Shankar Dhan.

One or other fungal diseases affected almost all the genotypes. Brown leaf spot was found to be severe. Leaf scald (*Rhinchosporium oryzae*). was found only in two genotypes viz. RCPL 1-30 and DRRH 1. Two other diseases observed during this cropping season were udbatta (*Ephelis oryzae*) and Rhinchosporium spot. However, these two diseases were found only in RCM 9 and IET 16313.

With respect to yield, Hybrid DRRH-1 even though found affected by all the diseases exhibited higher potential yield of 40.85 q / ha, which showed scope of rice hybrids in this region. Another variety showing potential yield more than the best local check Mantri (40.20 q / ha) was Sahyadri (40.40 q / ha) showing resistance against all the diseases.

Effect of split application of nitrogen

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

A field experiment was conducted during kharif 2001 with 3 levels of N (30, 60 and 90 kg/ha) splitted as basal; 50% basal + 50% active tillering; 50% basal + 50% panicle initiation; 50% active tillering + 50% panicle initiation and 33% basal + 33% active tillering + 33% panicle initiation. The results revealed that grain and straw yield of lowland paddy (Manipuri) increased up to 60 kg N/ha application and split application of nitrogen has significant effect on grain and straw yield. Highest grain (33.3 q/ha) and straw (50q/ha) yields were recorded when 60 kg N/ha was applied at 50% basal + 50% panicle initiation stage.

HIGH ALTITUDE Yield trials

A. Pattanayak and A. Annadurai

One advanced varietal trial with advanced breeding lines with two dates of sowing and two Initial Yield Trial (IVT) were conducted. In the advanced variety trial (AVT – 1) with two dates of sowing, RCPL1- 10C was the best for normal sowing (first week of May) while NEH Megha Rice 2 was best for late sowing. In IVT 1 highest yield was recorded in RCPL1-12C (F8 – 5-3P-7-3). In IVT 2, RCPL1-13 (1F8-5-3P-5-1) was the best under normal sowing whereas the check variety NEH Megha Rice 2 was the best under late sowing. These results suggested that NEH Megha Rice 2 is the best variety for high altitude areas under late sown conditions. In the on-farm trials conducted at five locations in East and West Khasi Hills, RCPL1-10C and RCPL1-11C, RCPL1-12C and RCPL1-13C continued to perform well. Average yield of last three years (1999-2000 to 2001-2002) was computed as 42.5 q/ha, which is much higher than NEH Megha Rice1 or NEH Megha Rice2.

BIOTECHNOLOGY

Development of insect resistant transgenic plants

A. Pattanayak, Alpana Das and B. Bhattacharjee

Twenty hygromycin resistant- *gus* positive plantlets of IR36 and 12 hygromycin resistant- *gus* positive plantlets of RCPL 1-2C were initially recovered from two independent transformation

experiments. Amplification of *cryIA*(c) through PCR indicated the presence of *cryIA*(c). These genotypes were advanced to T_3 generation after selecting the F_2-derived seeds over hygromycin. Molecular analysis for integration of the transgene(s) through PCR amplification (Fig.2) showed presence of the gene. *In vitro* screening for toxicity against stem borer larvae confirmed expression of the gene of interest (Fig.3).

Fig. 2 Molecular analysis through PCR amplification

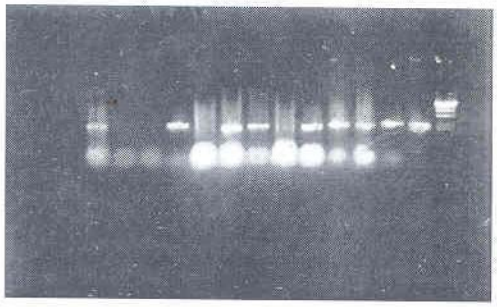


Fig. 3 Invitro screening against stem borer larvae

Transfer of AGP gene for enhancing starch synthesis

A. Pattanayak, A. Das, B. Bhattacharjee

Transformants regenerated using AGP gene were advanced to T_2 generation following the method described above. Mandelian segregation pattern was observed for hygromycin resistance. An increase in the seed weight and seed boldness was observed. Stability of expression would be tested in T_3 generation.

Development of cold tolerant rice through anther culture (NATP-CGP)

A. Pattanayak, A. Das, A. Annadurai, B. Bhattacharjee

Two crosses viz., Manipur x CT 9846 and Manipur x TOX 3055 were used for anther culture. Manipur was used as one of the parents as it is the most widely grown local cultivar and has desirable grain quality characteristics. Twelve F_1 plants from each cross were used for anther culture. Only G5 medium was used for anther culture as all the parent genotypes showed best response in this medium. However, in this experiment agarose was used a gelling agent to improve the quality of callus. A total of 6000 (approx.) anthers were cultured. Only anthers pre- treated at 10°C for 8 days and screened by cytological staging were used for culture. Average callusing percentage was 11.97. MSB medium was used for plant regeneration from anther-derived callus. Plant regeneration (green + albino) percentage was 35.07 out of which approximately 31.5% plants were albino. So far, 230 green plants have been regenerated. These plants are under hardening.

A total of 646 green plants were regenerated last year. Out of these 85 failed to establish in pot and 27 were sterile. Thus, a total of 534 plants were evaluated for various agrobotanic characters. Eight genotypes were found to be highly resistant to blast and were found to possess desirable plant characteristics (Fig.4).

Quality analysis

P.D.Thongbam, A.Anna Durai and A.Pattanayak

Crude protein content, total carbohydrate content, glutinous or nonglutinous and aroma qualities were studied in five popular rice varieties. Protein was found to be highest in local Ngoba (10.09%). There was no significant variation in total

Fig.4 Rice genotype highly resistant to blast

carbohydrate content (79.67 – 83.00%) among the genotypes studied. *Chakhou amubi*, the local variety of Manipur, was found to possess aroma and glutinous characters.

GENETIC RESOURCES

B.K.Sarma and Janak Kr. Singh

A total of 280 accessions were collected during the period under NATP – Plant Biodiversity. The state and district-wise collection of rice germplasm is collated in Table 2.

Table 2. Statewise collection of rice germplasm

State	District	Number of collection
Arunachal Pradesh	West Kameng East Siang Chanlang Tirap	85
Assam	Barpeta Bongaigaon	60
Manipur	Imphal East Thoubal Churachandpur Bishnupur	49
Meghalaya	RiBhoi West Khasi Hills	21
Sikkim/West Bengal	East Sikkim North Sikkim South Sikkim West Sikkim Darjeeling	65
Total	17	280

One part of the materials collected was conserved in the National Gene Bank along with passport data of each collection for medium term/ long term storage. All the collections were allotted IC (Indigenous collection) numbers by NBPGR, New Delhi. The remaining part was kept for evaluation and characterization. Two hundred thirty germplasm and 210 germplasm of previous year's collections from upland and lowland ecosystems, respectively were evaluated. Wide variability was observed in different germplasm.

ARUNACHAL PRADESH

Performance of wetland paddy

K.A. Singh

Fourteen wetland rice varieties were evaluated for their yield performance. Among the varieties tested RCPL-1-151-IP gave highest yield of 46.4 q/ha, followed by RCPL-1-230, RCPL-1-179-3P, Tox 324-221-2-3-2, SPR 88090-30-1-2-4 and ITA 222. Yields of PSL 85048-19-3-1-1 and Tox 3093-10-2-3-2 were about 30 q/ha.

In addition to the above, 18 rice varieties from Khampti tribe area of the State were also evaluated. Out of these, only two varieties produced grain yield i.e. Amrujoha (26.5 q/ha) and Bahadur (9.0 q/ha). Other 16 varieties flowered but they produced only chaffy grains. Therefore, these 2 fine rice varieties were recommended for low altitude of Lohit district only.

Evaluation of upland rice varieties

Seventeen varieties were evaluated for their yield performance under upland situation. Variety IR 65907-203-1-B gave highest yield of 31.0 q/ha, followed by IR 66421-039-1-1, RR 168-1 and local variety Bali (28.6 q/ha). The yield difference between highest yielding variety and local variety Bali was significant (2.4 q/ha).

MANIPUR

Breeding for high yielding disease resistance and quality for main kharif

S. V Ngachan

Ten selected progenies from the cross Prasas/ IR-24 and one line from the cross BR-1/Leimaphou along with four check viz., RCM-9 (RC Maniphou-7), RCM-10 (RCC), (Fig.5 & 6) Leimaphou (SGC) and Prasad (NC) were tested for their performance under low land transplanted condition. The lines viz., lMC-17-30-6-12, MC-17-8-2-16, MC-17-8-16-1 performed significantly better than remaining entries including checks and yielded 7.8, 7.7 and 7.3 t/ha respectively. These lines showed mild reaction to pest and diseases. The maturity period ranges from 130 to 145 days. The lines are being tested in the farmers' field.

Fig. RCM-9, a promising rice variety of Manipur

Fig. RCM-10, ready to release

A preliminary trial with eighteen progeny lines selected from the different crosses viz., Prasad/IR-24 (MC-17 series), Napnang mumei/Basmati-370 (MC-21) BR-1/Basmati-370 (MC-23) Napnang mumei/KD-2-6-3 9mc-26), br-1/rcm-7 (MC-30), IRT-109/Basmati-370 (MC-31) were conducted under valley condition at Lamphelpat farm. The line viz., lMC-17-8-2-11, MC-23-8-26-2, MC-30-5-17 and MC 17-50-3-1-1 were found higher yielder giving 9.26, 8.4, 8.26 and 8.20 t/ha respectively. However these lines were statistically comparable to RCM-9 (9.20 t/ha) in terms of yield.

Fifteen genotypes of advance generation selected from the cross of Akhanphou Prasad (MC-16) were maintained at Lamphelpat to be utilized in future studies for developing short duration and cold tolerant varieties for pre-kharif.

Co-ordinated trials

Research Complex Regional Trial on Rice comprising of 15 entries including 4 newly developed varieties at the centre were conducted during main kharif under valley condition. The yield differences were found significant. The entries, SPR-88090-30-1-2-4, RCPL-1-151-1p, MC-17-8-2-16-2, PSL-85048-19-3-1-1, ITA-222 and RCPL-1-2-30 gave significantly higher yield i.e. 8.83, 8.35, 8.33, 8.0.9.3, 8.0.6.7, 8.03 t/ha, respectively than rest of the entries.

The experiment on aromatic rice was laid out in main kharif under valley condition. Among these genotypes, Basmati-370, IET-16332, Pusa-Basmati were comparable and significantly higher yielder i.e. 8.43, 7.50, 7.30 t/ha respectively than rest of the entries.

Response of different levels of potassium under valley condition

During kharif season, four levels of potassium (0, 20, 40 and 60 kg/ha) were tested for Varietal performance of four varieties (RCM-9, KD-2-6-3, Prasad and Pusa-743) in split plot design with three replications. In general, with increase in levels of potassium there was increase in grain yield being a maximum of 50.43 q/ha at 60 kg K_2O/ha. Among the varieties, KD-2-6-3 performed well recording a highest of 54.97 q/ha RCM-9, Pusa-743 and Prasad. Though individual effect of variety and potassium level was not significant, interaction (K x V) was significant (Table 3).

Table 3. Influence of different levels of potassium on the performance of four promising varieties of rice under valley condition of Manipur

Treatments	Grain yield	
Potassium level (kg/ha)	Kg/plot	Q/ha
0	5.696	47.45
20	5.946	49.527
40	6.044	50.35
60	6.054	50.43
SEM	0.777	
C.D. (0.05%)	NS	
Varieties		
RCM-9	6.267	52.21
KD-2-6-3	6.599	54.97
Prasad	5.062	42.17
Pusa-743	5.812	48.41
SEM +	0.469	
C.D. (0.05%)	NS	
(K X V)	1.37*	

Evaluation of biocides against blast disease

Nine aqueous extract of plant materials at three different doses applied thrice (25, 35 and 45 DAT) were compared for their field bioefficacy against leaf and neck blast of paddy with two conventional checks (Trycyclozole and Carbendazime) and untreated control. All the treatments were significantly superior over untreated control. In general, there was decrease in disease infection (leaf blast and neck blast) with increase in dose of the pesticide of respective treatment. Among the botanicals aquous extracts of *Myrica, cuscutta*, Tulsi, Mary gold proved effective and showed encouraging results against leaf blast infection. In addition, *Lantana camera* came out to be effective against neck blast, but not against leaf blast. As regards to yield, the treatment of Trycyclozol (1-2 g/lit of water) registered highest yield followed by Carbendazime (1-3 g/lt of water). Among biocide, *Juglan* gave higher yield closely followed by Marry gold, caseuta and Tulsi, which can be taken advantage to contain the leaf and neck blast under Manipur condition.

Integrated pest management

A.B.Rai

Population dynamics

Under field condition, stem borer (*Scirpopnaga incertulus*), gall midge (*Orseolia orizae*), leaf folder (*Cnaphalocrocis medinalis*), grass hopper (*Oxya chinensis*), whorl maggot (*Hydrellia philippina*), rice hispa (Dicladispa armigera) were found to be of much significance to rice crop during kharif season in the region. Infestation of gall midge and stem borer appeared from second fortnight of September and reached peak during first week of October (3.76% Silver shoot and 2.27% dead hearts). Grasshopper occurred throughout the crop period causing 4.33 to 24.34% leaf damage. Major activity of leaf folder and whorl maggot was observed during August-October (3.20 and 2.89% leaf damage). Green leaf hoppers were observed throughout the period being fairly active from August to October. Among natural enemies, spiders were seen associated with rice pests being fairly active during first fortnight of October. During reproductive phase of the crop, some new sucking pests like green bug, black bug and small spotted bugs were observed in serious proportion feeding on rice panicles.

Monitoring of yellow stem borer using sex pheromone

Three pheromone baited (5 mg - mixture of Z-11 hexadecenal and Z-9 hexadecenal 3:1 ratio) sleeve traps were placed in an acre field, 60m apart in a triangular pattern above the crop canopy throughout the cropping season '*kharif*', 2001. The data on weekly counts of pheromone trap catches of yellow stem borer and corresponding field infestation revealed appearance of stem borer from September to November with a maximum peak during 4th week of September (av. 6.67 adults/trap/week) and corresponding values for maximum field infestation was observed a week later during first week of October (2.27% dead hearts) (Table 4). This envisages the close synchrony between pheromone trap catches and field infestation showing potential of pheromone trap for use in estimation as well as management of pest population.

Table 4. Weekly counts of stem borer using sex pheromone and its infestation under field condition during '*kharif*' 2001

Week	Pheromone trap catches			Av. Catch /trap	% infestation		EM/m²	AM/m²
	Trap-1	Trap-2	Trap-3		DH	WE		
1 August								
2								
3	0	0	0	0.00	0.00	0.00	0.00	0.00
4	0	0	0	0.00	0.00	0.00	0.00	0.00
1 September	1	0	0	0.33	0.00	0.00	0.00	0.00
2	0	4	1	1.67	0.00	0.00	0.00	0.00
3	2	3	1	2.00	0.82	0.00	0.10	0.00
4	2	13	5	6.67	1.20	0.00	0.10	0.00
1 October	0	4	0	1.33	2.27	0.00	0.10	0.00
2	1	1	0	0.67	1.00	0.00	0.20	1.00
3	0	0	2	0.67	0.90	0.00	0.00	0.00
4	0	1	1	0.67	0.00	1.27	0.10	1.00
1 November	0	0	0	0.00	0.00	2.69	0.00	0.00
2	0	0	1	0.33	0.00	4.00	0.00	0.00
3	0	1	0	0.33	0.00	5.72	0.00	0.00
4								

EM = Egg mass; AM = Adult moths, DH=Dead hearts, WE=White ears, Pheromone trap installed : 13.8.2001, Date of Planting = 3.8.2001, Variety = RCM-9.

Crop loss assessment due to major pests

An experiment was laid out in paired plot design with six replications, of RCM-9 transplanted on 4.7.2001 under valley condition. Plots under protection received alternate spray of Quinalphos (0.05%) and monocrotophos (0.04%) at 15 days interval, while unprotected plots were allowed to be damaged by naturally occurring paddy insect pest complex. Results revealed a significant difference in yield between treated and untreated plots. There was 15.15 per cent reduction in potential yield of rice recorded due to insect pest complex, which can be avoided under protected condition.

Insect pest management

Pest incidence as affected by dates of planting

A study on the effect of dates of planning on major insect pest infestation in 4 varieties of rice (Prasad, KD-2-6-3, Pusa-743 and RCM-9) indicated under split plot design with 3 replications revealed that early transplanted crop (last week of June) suffered less by insect pest and registered the highest yield (31 q/ha) compared to that of the crop was planted later. The minimum yield was recorded when the crop planted on 14th August (8 q/ha) due to maximum pest infestation viz., stem borer (1.89% DH & 16.73 WE), gall midge (3.04% SS), thrips (9.42%), whorl maggot (1.87%). Among the varieties, Pusa-743 registered highest yield (21.67 q/ha) followed by Prasad (19.50 q/ha), KD-2-6-3 (17.83 q/ha) and RCM-9 (12.67 q/ha). The later also highest PRST infestation.

Pest incidence as affected by different levels of potassium fertilizer

An experiment with 16 treatments (four levels of potassium x four promising rice varieties) was undertaken in split plot design with three replication under peat soil. Among the different levels of potassium (0, 20, 40 and 60 kg K_2O/ha), the crop fertilized with higher dose of potassium (60 kg K_2O/ha) suffered less by insect pests (31.86% cumulative infestation) and gave the maximum yield (50.42 q/ha), almost similar to that recorded with 40 kg K_2O/ha (50.33 q/ha and 34.35% cumulative infestation) which can be advantageously used for

yield increase and less pest attack. The highest yield was recorded with KD-2-6-3 (55 q/ha) followed by RCM-9 (52.25 q/ha), Pusa-743 (48.42 q/ha) and Prasad (42.17 q/ha).

Insecticidal control

Nursery protection trial with seed dip treatment and granular application

Three seed dip treatments (3 hours) viz., Chlorpyriphos (0.2%), Phosphamidon (0.1%) and Quinalphos (0.25%) were compared with conventional granular insecticide (Carbofuran 3G) application at five different dosages i.e. 2.5, 5.0, 7.5, 10, 15, 20 and 25 g/sqm 5 days after sowing for their effectiveness against major pests of rice. Seed (RCM-9) was sown on 2.6.2001 and observation on pest infestation was recorded till maturity of the seedling. The grasshopper, thrips, hispa, whorl maggot and stem borer were observed infesting the crop in seedling stage. Among the different dose of granular insecticide, carbofuran 3G @ 2.5 to 5.0 q/ sq. m area 5 days after sowing as well as 3 hours seed dip treatment of chloropyriphos (0.2%) were found highly effective against insect pest infestation in nursery.

Evaluation of combination products, new molecules, constituents of combination products against major pests

The trial involving four combination products, three constituents of combination products, two new molecules and two old insecticides in new formulations were evaluated in comparison to check insecticide (Monocrotophos) and untreated control against major pests of rice under valley condition. The crop was planted on 3.7.2001. The first round of application of these treatments was given 30 days after transplanting (DAT) and second need based at 45 DAT. The overall results on insect infestation and grain yield revealed that the combination products viz., Nurelle D 505 (Chlorpyriphos 50% + Cyfluthrin 5%), @ 625 ml/ha, Bulldock Star 262.5 EC (Betacyfluthrin 12.5 g + Chlorpyriphos 250 g) @ 1500 ml/ha, Upacy 50 DF (Acephate 45% + Cypermethrin 5%) @ 1000 g/ha and Confidor ultra 100 EC (Imidacloprid 50 g + Betacyfluthrin 50g) @ 300 ml/ha performed better than their constituents like confidor 200 SL (Imidacloprid) @ 100 ml/ha, Bulldock 025 SC (Betacyfluthrin) @ 500 ml/ha and Chlorpyriphos 20 EC @ 2500 ml/ha and were superior over check insecticide. Among other insecticides, Thiacloprid as well as deltamethrin and phosphamidon in new formulations were comparable with check insecticide and superior to untreated control. The overall less insect infestation (13.09% cumulative) and the highest yield (41.81 q/ha) was recorded with combination products Confidor Ultra followed by Bulldock Star (13.53% infestation and 37.64 q/ha). Nurelle D (16.86% infestation and 36.39 q/ha), Confidor (22.50% infestation and 36.11 q/ha), upacy (18.86% infestation and 35.14 q/ha), Bulldock (21.73% infestation and 35.00 q/ha) and chlorpyriphos (22.71% infestation and 34.03 q/ha). Remaining insecticidal treatments registered yield ranging from 21.67 to 25.56 q/ha with cumulative infestation range of 33.27 to 41.90% which were by and large comparable to check (37.08% infestations and 22.92 q/ha) and superior to untreated control (63.66% infestation & 19.72 q/ha).

Evaluation of promising granular insecticides and schedule application against major pests

Single application of different granular insecticides viz., Chlorpyriphos 10G (1000 g a.i./ ha), Cartap 4G (800 g a.i./ha) and fipronil 0.3G (75 g a.i./ha) at 20 days after transplanting (DAT) along with application of their counter part spray formulations viz., Chlorpyriphos 20 EC (500 g a.i./ ha), Cartap 50 SP (300 g a.i./ha) and Fipronil 5 SC (50 g a.i./ha) once at 60 DAT, twice at 50 and 70 and thrice at 45, 60 and 75 DAT were compared with Carbofuran 3G (75 g a.i./ha) plus monocrotophos (400 g a.i./ha) twice at 50 and 70 DAT as well as untreated control. The test insecticides have recorded 1.57 to 5.06% DH (dead hearts) as compared to 3.36% DH in carbofuran + monocrotophos spray treatment (check) and 8.71% DH in untreated control. At heading stage, test insecticides registered 3.67 to 7.67% white ear (WE) as compared to 7.33-11.33% and WE in check treatment WE in untreated control. As regards to silver shoot (SS) the test insecticides registered 0.73 to 2.47% SS as compared 1.11% SS in check

and 3.47% SS in untreated control. All the insecticide treatments lowered leaf folder damage (0.48 to 148%) as compaed to untreated control (3.11%). In general, the insecticidal treatments involving 2 or 3 spray recorded lower pest infestation than single spray application. The highest yield (30.83 q/ha) was recorded with Fipronil 0.3G (750 g a.i./ha) at 20 DAT + 3 application of its counter spray formulation Fipronil 5 SC (50 g a.i./ha) at 45, 60 and 75 DAT followed by Cartap 4G 800 g a.i./ha + 3 spray of Cartap 50 WP (300 g a.i./ha) at same periods as above (27.50 g/ha) and the corresponding values for cumulative pest infestations were 13.26 and 15.67% as against 22.00% infestation and 24.33 q/ha yield in check and 50.27% infestation and 19.33 q/ha yield in untreated control.

Evaluation of promising varieties under protected and unprotected condition

To find out degree of protection and the optimum yield potential of eight promising paddy varieties including local, the trial was conducted in paired plot design with three replication under valley condition. The six promising cultures included were MTU-1243-15, RNR-9891, KAUM-5929-2-12, RP 2932-44087, JGL-246, RP-2941-43570 along with Jaya as susceptible check and high yielding variety RCM-9 as local check. Soil application of Carbofuran 3G @ 1 kg a.i./ha was applied 5 days before uprooting the seedling in case of all the varieties considered under protected condition only. The protected plots (P) after transplanting received alternate spray of Monocrotophos (0.02%) and Quinalphos 0.05% at 15 days interval. The unprotected plots were allowed to be infested by naturally occurring pest population.

In general, none of the variety/culture exhibited resistant/tolerant reaction towards the pest. The varieties in descending order namely RP-2941-43576, RP 2932-44087, RNR 9891 and Jaya were observed to be highly susceptible to blast disease leading to considerably low yield as compared to rest of the varieties. The variety KAUM 5929-2-1-2 showed high yield least difference under protected (59.17 q/ha) and unprotected condition (54.17q/ha) as compared to others, thus compensating the yield gap possibly through host plant resistance. The corresponding values for cumulative pest infestation in protected and unprotected plot were 18.35 and 33.40%. It was followed by RCM-9 (53.75 q/ha (P) and 40.42 q/ha (NP), MTU-1243-14 (38.75 q/ha (P) and 21.67 q/ha (NP), and JGL-246 (38.33 q/ha (P) and 20.42 q/ha (NP). The cumulative pest infestation in these varieties under P and NP were 27.38 and 40.55%, 18.55 and 30.96% and 22.64 and 33.08%, respectively.

Varietal screening

Among eight entries (DRR,Hyderabad) under multiple resistance screening trial compared for their performance with check TN-1 under valley condition, the entries *viz.*, SYE-14-9-8, 4-32-5-8, VSR-5, 8, 10, 31,VL 4041, 4049, BL 245, CB-95019, 98004, BR-1, 4(a), 5, 9, 18, BPT-1788, CR-589-46-2-1, IET-15924, JGL-2813, 3827, 3918, 420, MTU-1042, 1044, RNR-19994, RYT-2662, 2663, TTB-281-50, VL-96-3538, DRRH-1, LTJ-2, PHB-71, BPT-107-18-1, 112-6-2, 2157, JGL-3858, M-45-20-1, MTU-1036, SYE-14-9-8 and VL-97-3656 recorded nill incidence of dead hearts by stem borer and silver shoot by gall midge. The highest incidence of dead hearts was recorded with CB-98006 (21.67%) followed by CB-97049 (4.65%), VSR-28(4.25%), while the highest incidence of silver shoots was recorded with VSR-28 (6038) followed by CB-97033 and CB-98002 (both 3.39%) as against check TN-1 (2.94% DH & 0.00% SS).

Fairly less population of plant hoppers was recorded in 35 entries (DRR, Hyderabad). Varietal reaction noted for other major pests revealed entries viz., CB97053, TTB 285-7151-1, TTB 292-426, KAU 9410-9, RNR 20582, RP 4295-50945, TTB 283-38-3, JAU 1661, RP 4295-50942, TTB 292-40 CB-95072, CB 96035, RP 4295-50944, RP 3896-49319 against stem borer with 0 to 3.33% DH as against 7.01 DH in check TN-1 (70.1% DH), KAU 9410-9, RP 3447-57565, RNR 20458, CB 98098, RP 4295-50942, TTB 285-715-1, ARC 6650 with 0 to 0.95% SS as against av. 2.31% SS in check TN-1, CB 96035, CB 97053, CB 98004, RP 4295-50930, RP 4295-50946, TTB 285-715-1 with 1.24 to 1.93% leaf damage by leaf folder against av. 2.91% in check TN-1, MO1, CB 97043, CB 97053, KAU 9410-9, TTB 285-715-1, TTB 286-731, TTB 291-

943-1 and TTB 292-426 with 7.61 to 18.41% grass hopper damage leaf as against 29.56% damage in check TN-1.

Among different insect pests observed in 59 hill entries (DRR Hyderabad) under National Screening Nursery trial (NSN-Hills) sown on 23.5.2001, the population of rice hispa and whorl maggot were comparatively higher. None of the entries was found immune to infestation of rice hispa. The highest incidence of hispa at 90 DAS was recorded with 4RP-2278-8-3 (T0.2%) leaf damage) followed by VL-97-3821 (4.8 leaves/hill), HPR-2140 (4.8 damaged leaves/plant), VL 97-3682, HPR 2158, 4PR 2866-98-37, VL 98-4187 (3.4 all leave/hill), 4 PR 2251-4-2-1, VL 98-4036 (3.2 both leaves/hill) and VL 81 (both 0.8 damaged leaf/hill) and CH 988 (1.0 damaged leaf/hill). As regard to whorl maggot, a maximum of 2.33 damaged leaves/ hill was recorded with entries viz., HPR-2140, 2158, UPR-2866-98-37, HPR 2021 while the damage was nil in case of entries VL 98-4009, VL 93-3635, 93-2767, HPR 2128, VL 98-98-4034, 98-3894, 98-4044, 98-4045, UPR 2253-4-1-1, 2284-9-4, VL 95-6446, RCPL 1-35, 1-37. The entries viz., VL 96-6747, RCPL 1-38, 1-39, HPR 2040, 2086, 2087, VL Dhan 221 and K-39 did not germinate. The infestation of stem borer, silver shoot, leaf folder was fairly low. The crop failed due to water stress condition coinciding with reproductive phase of the crop.

MIZORAM

RCRT upland trial

K. Laxminarayana and N.S. Azad Thakur

Fourteen upland varieties namely CNAX-2888-13-12-H, UR-600-32, CT-6942-9-1-2M-IP, IRAT-216, IR-659507-064-1-1B, IR-65907-203-1B, WAB-5650, TRC-87-251, RCPL-1-29, IR-63380-16, IET-13459, IR-65907-206-4-B, WAB-96-1-1, IR-66421-0389-2-1-1 were sown in the second week of May at the spacing of 20 X 10 cm. The trial was laid in three replications and a fertilizer dose of 80-60-40 kg N, P_2O_5 and K_2O/ha was applied. Among the varieties, the highest grain yield of 39.0 q/ha was recorded with TRC87-251, followed by CNAX-2888-13-12-H (35.0 q/ha) and IR-66421-0389-2-1-1 (34.8 q/ha).

RCRT lowland varietal trial

Fourteen lowland varieties namely, RCPL- 179-3p, RCPL-1-151-1P, RCPL-1-87-4, RCPL-1-230, DR-92, SPR-88090-30-1-2-4, TOX-3241-21-2-2-3, TOX-3093-10-2-3-2, PSL-85045-19-3-1-1, ITA-222, RCM-9, RCM-10, RCM-11 and RCM-12 were evaluated during *Kharif* 2001. The seedlings were transplanted in the second fortnight of June at a spacing of 20x10 cm. The trial was laid out in three replications in a RBD and a fertilizer dose of 100-60-40 kg N, P_2O_5 and K_2O/ha was followed. Of all the varieties, RCPI -1-179-3P recorded the highest grain yield of 51.2 q/ha followed by PSL-85048-19-3-1-1 (50.6 q/ha) and RCPL-1-230 (49.4 q/ha). It was observed that RCM-12 recorded the lowest grain yield of 25.9 q/ha. However, the other varieties showed a yield potential of 34 to 47 q/ha.

Advanced varietal trial under upland conditions

Under upland conditions, 15 varieties *viz.* AVT-2701, 2702, 2703, 2704, 2705, 2706, 2707, 2708, 2709, 2711, 2712, 2713, 2714 and 2715 were evaluated during *kharif* 2001. The seeds were sown in the third week of May at a spacing of 20 x 10 cm. Among all the varieties, AVT-2709 performed better with an average grain yield of 30.3 q/ha followed by AVT-2705 (26.2 q/ha). However, the other varieties recorded a yield potential of 13 to 22 q/ha, except AVT-2704, which recorded the lowest grain yield of 8 q/ha. The straw yield of these varieties ranged from 75 to 247 q/ha, 7.1 to 17.8 tillers/hill, and 106 to 199 grains/panicle with a test weight of 2.46 to 3.40 g.

In another screening trial under upland conditions, 14 varieties (AVT-2901, 2903, 29034, 2904, 2905, 2906, 2906, 2908, 2909, 2919, 2911, 2912, 2913 and VL-206) were evaluated in three replications in a RBD. The seeds were sown in the second week of May at a spacing of 20 x 10 cm and a fertilizer dose of 80-60-40 kg N, P_2O_5 and K_2O ha^{-1} was followed. Among these varieties, the highest grain yield (40.3 q/ha) was recorded for AVT-2901, while the lowest grain yield of other varieties (AVT-2907, 2908, 2910, 2906, 2905, 2904,

2902, 2909 and VL-206) ranged from 24 to 30 q/ha.

Advance varietal trial under irrigation in medium hills

Under this trial, a total of 10 varieties (AVT-2701, 2702, 2703, 2704, 2705, 2706, 2707, 2708, 2709 and AVT-2710) were screened. The trial was replicated thrice in a RBD and a fertilizer dose of 100-60-40 kg N, P_2O_5 and K_2O ha^{-1} was applied. The seedlings were transplanted in the third week of June at a spacing of 20 x 10 cm. The results showed that AVT-2702 has recorded highest grain yield (43.4 q/ha) followed by AVT-2705 (42.6 q/ha) and AVT-2706 (40.3 q/ha), while the lowest yield (29.2 q/ha) was observed with AVT-2701.

Integrated nutrient management in lowland

K. Laxminarayana

A field experiment was conducted to study the effect of integrated application of organic manures and inorganic chemical fertilizers on yield performance and nutrient uptake of lowland paddy. The experiment was laid out in three replications in a RBD with 12 treatments *viz.* 50% NPK, 100% NPK, 150% NPK, 100% N, 100% NP, 100% NPK + FYM @ 15 t/ha, 100% NPK + Poultry manure @ 5 t/ha, 100% + $ZnSo_4$ @ 20 kg/ha, 100% NPK + green manure @ 5 t/ha, 100% NPK + P solubilizing bacteria inoculation and control. An optimum fertilizer dose of 100-60-40 kg N, P_2O_5 and K_2Oha^{-1} was followed.

The results revealed that the highest grain yield (74.66 q/ha) was recorded with the application of optimum dose @ 5 t/ha and 100% NPK + FYM @ 15 t/ha (70.37 q/ha) and 100% NPK + Poultry manure @ 5 t/ha (68.96 q/ha). Application of organic manures could be compared to application of higher than the recommended doses of NPK. It was observed that the grain yield was significantly increased with the graded doses of NPK application. However, balanced application of NPK has resulted higher grain yields than the single nutrient application. The results indicated that combined application of organic and inorganic sources of nutrients produced highest crop yields and maintained the soil fertility status.

Effect of BGA on yield performance

A field trial was conducted during *kharif*, 2001 to study the effect of blue green algae on yield parameters of lowland paddy. The experiment was laid out in three replications in a RBD with eight treatments *viz.* control, 40 kg N ha^{-1}, 80 kg N ha^{-1}, 120 kg N ha^{-1}, BGA, 40 kg N ha^{-1} + BGA, 80 kg N ha^{-1}+ BGA, 120 kg N ha^{-1} + BGA. An uniform dose of P @ 80 kg P_2O_5 ha^{-1} and K @ 60 kg K_2O ha^{-1} was applied at basal. The N was applied as per the treatments in three split doses (½ at basal, each ¼ at tillering and panicle initiation stages, respectively in the form of urea. Straw based culture of BGA was mixed with the fine sand and broadcasted in the field after transplantation of the paddy. The collected plant samples were processed and analyzed for N concentration.

The results revealed that the highest grain yield (51.42 q/ha) was recorded with the application of 120 kg N ha^{-1} + BGA followed by 80 kg N ha^{-1} + BGA (51.06 q/ha). The grain yield was significantly increased with the increased doses of N up to 120 kg/ha whereas the graded doses of N boosted up the production to an extent of 10 to 20% in comparison to the application of fertilizer N alone.

Cropping system research

K. Laxinarayana

The yield performance of different cropping systems was studied during *kharif* and *rabi* seasons. The treatments (Rice sole crop; maize sole; groundnut sole; soybean sole; rice + groundnut, 4:2; rice + soybean, 4:2; maize + groundnut, paired rows; were replicated thrice in a randomized block design. Mustard was grown as a secondary crop during *rabi* season after harvest of *kharif* crops. Fertilizer doses of 80-60-40; 100-60-40; 60-60-40; 60-60-40; 50-50-40 kg N, P2O5 and K2O ha-1 were applied for paddy, maize, groundnut, soybean and mustard, respectively. Entire doses of P and K at basal and N in three split doses (½ at basal, ¼ at tilllering and ¼ at panicle initiation stage) were applied. Plant samples were analyzed for nutrient composition. Results obtained are presented in Table 5.

Table 5. Yield performance of crops under different cropping systems

Cropping system	Paddy	Maize	Groundnut	Soybean	Mustard	Maize equivalent yield (q/ha)
Paddy sole	23.25	-	-	-	4.07	23.58
Maize sole	-	29.16	-	-	2.27	33.05
Groundnut sole	-	-	8.30	-	2.87	16.78
Soybean sole	-	-	-	6.63	3.03	23.66
Paddy + groundnut, 4:2	10.9	-	3.28	-	2.43	16.64
Paddy +soybean, 4:2	11.75	-	-	4.45	1.73	23.76
Maize +groundnut (paired rows)	-	19.33	3.50	-	2.10	27.93
Maize = soybean (paired rows)	-	18.75	-	2.13	1.16	26.67

NAGALAND

Varietal trial

A.K. Khan and B.P. Hazarika

Sixteen short, medium and long duration varieties including local, high yielding and hybrid were tested over four years (1998-2001) in upland and lowland condition. Masoori dwarf gave significantly higher average yield (52.5 q/ha) over four years , followed by Kushal (53.20 q/ha) whereas, Ranjit and Bahadur occupied third and fourth rank among high yielding varieties with average production of 43.18 and 41.34 q/ha, respectively. Teke, RCM-5, Pant-10, Masoori (Tall), IET-6666, and RCM-9 and BPT-5204 showed average production of 26.10, 29.09, 34.34, 35.34, 35.93, 36.87 and 36.96 q/ha, respectively.

Hybrid rice (6201 and 611) varieties were also assessed for production potential. The yield was recorded to be 51.36 and 52.41 q/ha, respectively, for the two varieties. Among scented rice, U.P. special (Hingjeera) recorded highest average yield (27.67 q/ha) over four years, followed by Joha (Assam) 21.56 q/ha.

Wild rice

Eight wild accessions were collected and multiplied at wide spacing (50 x 30 cm) to obtain seed for further evaluation. Maximum yield was recorded for accession No. 1 (36.92 q/ha), followed by No. 4 and 5, with a yield of 30.45 and 31.92 q/ha respectively. Rest of the varieties exhibited comparatively lower production potential.

Similarly wonder rice (Melhite Kenye) was planted with three different spacing viz. 45 x 40, 45 x 60 cm in RBD along with a local practice. Treatment with close spacing 45 x 40 cm (full plot unrooted) gave significantly higher yield 55.00 q/ha, followed by treatment with spacing of 45 x 60 cm (40.00 q/ha).

SIKKIM

Nitrogen management in transplanted HYV rice under submerged conditions

R.K. Avasthe

An experiment was conducted on Pant Dhan-10 to identify the best method of nitrogen application to increase yield and nitrogen use efficiency. 30 day-old seedlings were transplanted with 20 x 15 cm spacing between rows and hills, 2 seedlings were placed at each hill in plots of 6 m^2. Nitrogen was applied @ 120 kg/ha through a combination of farmyard manure and urea. Phosphorus and potassium were basally applied before sowing through SSP and MOP @ 60 and 40 kg/ha, respectively. Nitrogen was applied at different times through 9 different methods. Of the nine methods of N application adopted, the highest grain yield was recorded for the treatments where N was applied in three splits, *i.e.*, ¼ broadcast and incorporated at transplanting without floodwater + ¼ top-dressed at maximum tillering stage + ½ at panicle initiation stage (57.63 q/ha), followed by ½ broadcast and

incorporated at transplanting without floodwater + ¼ top-dressed at maximum tillering stage + ¼ at panicle initiation stage (55.0 q/ha^{-1}) and 1/3 broadcast and incorporated stage + 1/3 at panicle initiation stage (53.0 q/ha^{-1}) as compared to the grain yield in the control plot (12.63 q/ha).

TRIPURA

Upland rice

K. Chattopadhyay and K. R. Dhiman

Three trials were conducted for kharif-2001. Besides yield estimation, varieties were evaluated on the basis of height, spikelets/panicle, panicle length, fertility, effective tillers, flag leaf length, grains/panicle, 1000 grain weight, plant yield and tolerance to leaf blast and drought. Generation advancement of crosses has also been done.

Adaptive trial: Twenty upland varieties were evaluated. IET-16806 (22.3 q/ha), IET- 16423 (21.7 q/ha) and Annada (20.1 q/ha) performed better than others.

AVT-VE: Twenty entries, including two ckeck varieties, Heera and Aditya and one local check, Rasi, were evaluated on the basis of yield and yield contributing characters. Due to some unwanted reasons like late sowing, heavy bird damage and heavy *gundhi bug* infestations, all yielded very low. All lines performed better than Heera. The yield performance of IET-16934 (1560 kg/ha) and IET-16810 (1400 kg/ha) were better than the others.

Evaluation of *Jhum* lines : Local upland rice varieties, which has been cultivated by jhumias since long, are the treasure of variation of plant characters and rice quality. Saventeen diverse lines were raised in replicated fertilized plots. Some of them were small bold white seeded Garomalati, small red seeded Aduma, round seeded jhum binni -Badia, medium bold red seeded, Kataktara, etc. Aduma (19.3 q/ha) was the best in respect of seed yield. This was followed by Mamy yathlok (18.8 q/ha), Garomalati (17.8 q/ha) and Kataktara (17.5 q/ha).

Hybridization : F_2 generation was raised from the crosses of various upland and *jhum* (tila) varieties aiming to improve the local land races. Some cross combinations, like TRC-87-251 (Ngoba/ Garomalati) / Bandana were found promising. Seeds were harvested in bulk and selection for the promising plants delayed up to F_3 generation.

Lowland rice

Three varietal trials of transplanted rice were conducted under shallow or medium shallow water depth situation in kharif,2001.

AVT Semi deep-water paddy: This All India Coordinated trial included 9 entries and local check variety, Pyzum. All lines performed better than regional check, Sabita (1546.7 kg/ha) and local check, Pyzum (2467 kg/ha). The estimated paddy yield of long and slender seeded IET-16958 and IET-17305 was 5293 kg/ha and 4883 kg/ha, respectively.

Varietal trials of aromatic rice: Evaluation of scented rice varieties namely three basmati, one improved basmati line, two small seeded aromatic local rice, Khasa and Kali khasa and one long slender seeded scented sticky local variety, Binni was repeated. It was observed that, the improved basmati line , IET-16310 was the top of the list with 23.3 q/ha estimated seed yield. Khasa (22.3 q/ha) and Kali Khasa (21.8 q/ha) also performed better than the rest.

Yield trial for low land rice: Thirteen diverse genotypes were evaluated. This not only included high yielding semi dwarf varieties, but also some tall traditional genotypes, like, Pyzum. Some of the varieties were medium bold seeded and some of them were long slender seeded, like, RCM-12. One high yielding line from this centre, namely, TRC-299-F-41, found suitable for waterlogged condition, gave the highest seed yield, ie, 41.8 q/ha. The seed of this line is long and medium bold. Another variety, RCM-12, developed in Manipur center of the Institute, also performed better (38.0 q/ha) than others.

Hybridization: To improve the quality like, aroma and yield performance of some highly adapted line of Tripura , namely Khasa (aromatic), Pyzum (tall pureline), Binni (local aromatic), were hybridized with Basmati-370, DR-92 and RCPL-1-87-4. Seeds from various crosses were shown and seeds from individual plants were harvested to raise the F_2 generation.

Effect of organics in long term manurial trial

M. Datta

A field trial was conducted in upland rice (var. TRC-87-251) and moong (var. UPM-79-4-12) was grown as residual crop. The treatments applied in the field trial were cattle manure alone or in combination with NPK. The yield data are presented in Table 6.

Table 6. Effect of organics on rice-moong crop sequence

Treatment	Direct experiment Upland rice (q/ha)		Residual experiment Moong
	Grain	Straw (q/ha)	Pod yield (q/ha)
T_0 – Control	17.12	26.72	4.07
T_1 - 2.5 tonnes cattle manure/ha	21.32	29.58	3.25
T_2 - T_1 + NPK (60:30:30)	35.26	49.0	3.83
T_3 - 5 tonnes C.M	25.89	31.0	3.50
T_4 - T_3+NPK	37.28	57.12	3.82
T_5 – 10 tonnes C.M	30.10	38.54	4.62
T_6 - T_5 + NPK	37.80	56.30	4.67
T_7 – 15 tonnes CM	30.0	37.68	5.27
T_8 - T_7 + NPK	36.44	52.22	6.52
T_9 – 20 tonnes CM	28.30	34.93	7.24
T_{10} – T_9 + NPK	37.90	52.88	7.18
T_{11} – NPK	33.28	44.91	3.47
SE (±)	2.02	9.98	0.78
CD (5%)	4.11	20.31	1.59

From the perusal of the data it is observed that cattle manure alone from 2.5 to 20 t/ha produced 24.5 to 75.8% and 10.7 to 44.2% increase in grain and straw yield over control, respectively. But in combination with NPK (60:30:30), there was an increase in grain and straw yield over control from 105.9 to 121.4% and 83.4 to 113.8%, respectively. The trend in increase in grain and straw yield indicated significant production in T_4 after the application of 5 t cattle manure/ha and NPK.

In residual trial, 15 t cattle manure/ha + NPK in T_8, 20 t cattle manure/ha in T_9 and 20 t CM/ha + NPK in T_{10} significantly produced moong with 60.2 to 77.9% increase over control.

Soil test crop response study

Under variable fertility gradient, upland rice was grown to study grain yield.It was observed that the coefficient of variation concomitantly decreased with the increase in soil fertility thus indicating low variability in grain yield in various combinations of NPK doses. Under very low and low fertility gradient, $N_{90}P_{60}K_{60}$ produced an increase in grain yield from 11.66 to 41.29 q/ha and 23.98 to 34.13 q/ha respectively. On the other hand, under medium and high fertility, $N_{90}P_{30}K_{30}$ and $N_{30}P_{30}K_{30}$ produced an increase in grain yield from 15.98 to 31.97 q/ha and 28.31 to 34.97 q/ha, respectively. Under high fertility, fertilizer requirement was observed to be low and only 23.5 % increase in grain yield over control was noted.

Integrated disease management

T. K. Sengupta

Integrated disease management of rice was done in upland situation in Kharif season. As local varieties grown by the farmers are susceptible to blast disease, varieties were collected from the farmers to screen the varieties against blast disease of rice and to evolved control measures. Pusa 2-21, a susceptible variety, was kept as control. All the varieties collected from the tribal farmers were included in the experiment. These were Garomalati, Gaduma, Mamithutru, Kalikhasha, Kechkibada and Jolly. Only bold and disease free seeds were selected. Before sowing seeds were treated with carbendezim @1kg of seeds. In pusa 2-21 variety both leaf and neck infection was serious. As a part of disease management, seed treated varieties were sprayed with carbendezim three times during their growth period. Some pin head spots of leaf blast type was recorded in treated varieties. No neck infection was noticed. In Pusa 2-21, both leaf and neck infection were recorded. On the other hand, the local varieties could thrive amidst high pressure of inoculum even under water stress condition. Carbendezim @1g/litre of water provided proper control of the blast disease. The treated varieties yielded much better than that of Pusa 2-21. It has been found that with proper disease management practice the blast disease of rice.

Banded leaf blight disease

Banded leaf blight disease of rice was recorded in the variety TRC 87-251in kharif season. Treatment of seeds with carbendezim @1g/kg of seeds and foliar application with carbendezim @1g/ litre of water was found to control the disease. Along with carbendezim, blue copper and dithane M-45 was also tested. Among these, carbendezim gave the best results.

MAIZE

MEGHALAYA

Varietal improvement in *Kharif* maize

D.K.Verma and B.K.Sarma

Fifteen trials were conducted to evaluate 505 strains including 221 CIMMYT materials to identify high yielding, disease resistant strains of medium, early and extra-early maturity under rainfed condition. Superior strains identified from different trials are listed in Table 7 and 8.

Development of new strains

In order to increase maize productivity in rainfed agro-ecosystem of hills, efforts were continued to develop high yielding, short duration, yellow flint hybrids and composites through chain crossing and line x tester methods possessing resistance to *H. turcicum* leaf blight.

Nucleus seed production

Nucleus seeds of RCM-75 (3Kg); RCM-76 (0.5 Kg), RCM 1-1 (12Kg), RCM 1-2 (6Kg); RCM 1-3 (13Kg), OCM-2 (6Kg), Coix (4 Kg) were produced by maintaining line and/or distance isolation for further production of Breeder Seeds during.

Breeder seed production

Breeder seeds of RCM 1-1 (108Kg), RCM 1-2 (78Kg), RCM 1-3 (110Kg), RCM 1-4 (8Kg), OCM-2 (12Kg), Coix (4 Kg) were produced by maintaining rime and/or distance isolation for further production of Breeder Seeds during Kh-2002.

Front line demonstrations

D.K.Verma, B.K.Sarma and Rajesh Kumar

One hundred ten frontline demonstrations (FLDs) were conducted in West Khasi Hills (36); Ri-Bhoi (51) and East Khasi Hills (23) districts using Vijaya Comp, RCM 1-1; RCM 1-2 and RCM 1-2 in collaboration with State Department of Agriculture, Meghalaya and Division of Extension of the Institute. The date of planting at various farmers' fields ranged from 28th April 2001 to 28th May. The fertilizers and other inputs provided to individual farmer were in the form of Urea @ 3.5 kg/acre, SSP @ 7.5 kg/acre, and MOP @ 1.25 kg/

Table 7. Promising entries of maize identified under different maturity groups

Rank	ZCT 101	IET(EE)	IET(MM)	IET(MM)	IET(FSM)	IET(EM)	ZCT-102
I	ZI-107 (61.95)	JKMH-549 (73.61)	Navjot (102.87)	HKH – 1206 (98.25)	F-1562 (48.97)	L-152 (51.48)	ZI-209 (55.00)
II	ZI-108 (55.35)	PRO-355 (69.12)	X – 1095 (98.16)	Zauari-2027 (97.24)	X- 1105 (41.54)	X-2005 (49.63)	ZI-213 (54.25)
III	ZI-105 (48.75)	Zauari–2050 (67.66)	L-173 (94.86)	AAMH- 203 (96.14)	GK-3043 (41.27)	L-168 (41.14)	ZI-201 (49.85)
Trial Mean	52.78	60.33	76.52	76.43	32.34	32.34	37.27
Entries	11	17	28	28	27	34	32
SE ±	0.221	0.119	0.918	1.121	0.233	0.414	0.318
CD	8.94	7.49	4.78	6.38	5.44	4.89	3.98

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

Table 8. Promising entries of maize identified under different maturity groups

Rank	AET (AZEEM)	AETZ-IEM	IET(FSM)	EVT-17 (CIMMYT -2001)	IPTT (CIMMYT -2001)	RCRT-2001	RCPC-2001	RCBC-2001**
I	JH 3125 (41.45)	FH-3138 (44.57)	NECH-110 (44.04)	POP.903.C.2 (62.38)	P30C8H-75-2XCL -04935 (92.42)	Vijaya (59.45)	RCPC-13 (38.93)	Laxmi (15.83)
II	JH-3795 (39.86)	Megha (35.77)	Sneha-6166 (43.16)	BA.98903-N (59.37)	P30C8H-156-1XCL -04935 (58.32)	NE Comp (61.15)	RCM-75 (37.44)	RCM-1-3 (15.48)
III	Surya (34.36)	Mahikanchan (35.46)	Bisco-851 (43.16)	ACROSS 98902/90352 (54.42)	P30C8H-69-3XCL -04935 (51.76)	MCU-508 (64.8)	RCPC-27 (37.18)	MLW (14.49)
Trial Mean	33.48	32.12	33.88	40.95	49.38	52.64	22.61	12.78
Entries	6	11	28	25	196	14	31	17
SE ±	0.991	1.113	0.809	1.260	0.908	1.802	1.28	1.018
CD	4.36	7.32	2.44	3.29	9.34	4.34	3.22	4.84

*Figure in parenthesis indicates grain yield (q/ha); **Baby corn yield.

acre. Pesticides used were Classic-20EC, Diafuron 3G and Folidol Dust-2%. The inputs were distributed on the spot viz., Mawkyllei, Nonglait, Teihnorgbah, Labyrtun and Umjynrew in West Khasi Hills; Mawlasnai, Pyllun, Umkhuti, Garo basti, Umden, Umroi Byrthih, Umro Madan and Laban Soro in Ri-Bhoi; Jaiaw, Mylleiem, Nongtungur, Mylliem Ba, Mylliem Kyndong, Mylliem Marbaniang and Mawnianglah in East Khasi Hills. The average yield per demonstration observed in West Khasi Hills for Vijaya Composite was 1381 Kg/acre, for RCM 1-3 was 1304 Kg/acre. For RCM 1-2 it was 932 Kg/acre and for RCM 1-1, 1410 Kg/acre. In Ri-Bhoi, it was 1431 kg/acre for Vijoya composite and for RCM 1-2, it was 988 kg/acre; while in East Khasi Hills Vijaya Composite had recorded 1135 kg/acre. Twenty maize meetings (*U riew hadem ka jingia kynduh*) were organized, one each at each village to discuss and disseminate the information regarding package of practices of maize and one at Research Farm, where farmers were imparted training on improved maize technology.

Further, in Jaintia hill district ehere 60 FLDs were conducted in similar fashion, average yield of Vijaya composite, RCM 1-1, RCM 1-3 and Suwan per demonstration area recorded to be 5943, 5528, 5540 and 6488 cobs/acre (Fig 7).

Fig 7. Frontline demonstratin on maize at farmer's field

Varietal evaluation in *Rabi* maize

D.K.Verma and B.K.Sarma

The initial evaluation/suitability trial was conducted with the 20 entries viz., RCM 1-1, Vijaya Composite, Navin, RCM 1-3, Gujarat Makki-1, MLY, NE Composite, RCM 1-2, MCU-508, SW/DMR-91-300-1F2, Munneng, MLW, Suwan-8529, Dewaki, POP.903.C.2, P30C8H-75-2XCL-04935, BA.98903-N, P30C8H-156-1XCL-04935, ACROSS 98902/90352 and P30C8H-69-3XCL-04935 to identify high yielding strains of early maturity under rainfed pre rabi condition after the harvest of first crop. The superior strains identified were Suwan, Vijaya Composite and BA-989 03N, which had yielded 12.63 t/ha, 11.84t/ha and 9.87t/ha of green cobs.

Studies on maize based intercropping

S.K. Gupta and V.K. Mishra

Groundnut (var. JL.24) with maize var. Vijaya composite performed well and the maximum yield of maize was obtained when shown in paried row of maize. The LFR was also highest with this treatment closely followed by maize groundnut (1:3) ratio which produced 1.841 LFR, whereas, maize + groundnut 1:6 ratio gave the LFR 1.505. The mixing of seed of maize + groundnut in 1:1 ratio gave the LFR 1.287.

Utilization of indigenous entomopathogenic nematodes (epns) for the management of major insect pests of rice and maize

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

Maintenance of laboratory insect culture

The insects that are used for baiting were cultured and maintained on artificial diet so that a continuous supply of larvae was available through out the experimental period. Greater wax moth larvae (*Galleria mellonella*) and rice moth larvae (*Corcyra cephalonica*). *G. mellonella* larvae were maintained on an artificial diet consisting of corn meal-200g, wheat flour –100g, wheat bran-100g, milk powder-100g, yeast tablets-100g, honey-175 ml and glycerin 175ml.

Mass production of Steinernema carpocapse

Steinernema carpocapse culture was obtained from Division of Nematology IARI New Delhi. The same was cultured using laboratory host *Galleria mellonella* using standard procedures. The cultured nematodes were used for testing efficacy on different insect pests prevailing in the region.

Bioassay on maize cob borer

Cob borer- *Stenachroia elongella* is the major insect pest of maize. The chemical control measures may lead to environmental hazards as green cobs are preferred for consumption. A bioassay study was conducted to see the efficacy of the entomopathogenic nematode in bringing about mortality of the larvae in laboratory conditions.

Twenty well grown healthy larvae of cob borer *S. elongella* were placed over a wet filter paper containing juveniles of *Steinernema carpocapse* in a petry dish and incubated for 2-3 days at 28°C and 90% R.H. Five such petry plates were maintained and observed for mortality after 24 and 48 hours. The dead larvae were washed in water and surface sterilized in 0.4% hyamine 10X and kept in Whites trap for release of nematodes.

Most of the cob borer larvae were killed after 48 hours of release and by 72 hrs >90% mortality was observed. The juveniles emerged from the cadavers on 9th day after death of the larvae. The juveniles were washed in sterile water and stored at 8-15°C in BOD incubators.

Efficacy of *S. carpocapse* on stem borers of maize *Chilo partellus* and *Sesamia inferens*

Efficacy of the EPN *S. carpocapse* was studied on stem borer *Chilo partellus* and on stalk borer *Sesamia inferens* using the petry dish method similar to that of cob borer. Twenty larvae of *C. partellus* and 10 larvae of *S. inferens* were used for the trial and five replications were maintained. The mortality was observed after 24, 48 and 72 hours of release. All the *C. partellus* larvae were killed within 48 hours of release and in case of Stalk borer it 80% of the larvae were killed in 48 hours. The juveniles emerged from the cadavers after 8-9 days of death.

MANIPUR

Improvement of maize

S.V. Ngachan

Among 16 entries of maize, SWDMR-91300 gave highest yield followed by Navajat, Prabhat, Swan-8529 and SETELAGOS-85 with yield potential of 84.50, 76.05, 71.89, 69.29 and 63.70 kg/ha respectively.

Use of biofertilizer in maize based cropping systems

Mausumi Roy Chowdhury

The experiment was repeated at Krishnagiri farm, in a split plot design with maize-mustard cropping systems. Main treatments consisted of 3 intercropping systems *viz.* 1) sole maize, 2) maize intercropped with blackgram and 3) maize intercropped with soybean. Sole maize was sown 60 cm apart and maize-blackgram/soybean were sown in alternate rows (1 : 1 ratio) spaced at 30 cm apart and plant to plant distance was kept as recommended for both crops. The sub-treatments were (i) control; (ii) FYM @ 5 t/ha + B, (iii) FYM @ 5 t/ha + B + ½ NPK, (iv) FYM @ 5 t/ha + B + NPK; (v) FYM @ 10 t/ha + B; (vi) FYM @ 10 t/ha + B + ½ NPK; (vii) FYM @ 10 t/ha + B + NPK. NPK denotes the recommended fertilizer dose for maize i.e. 80, 60 and 40 kg of N, P_2O_5 and K_2O respectively. The experimental soil was clay-loam in texture with pH 4.8, Organic carbon 16.8 g kg^{-1}, alkaline $KMn0_4$ oxidizable N 144 mg kg^{-1} and available P (Bray-2) 5.7 mg kg^{-1} . The treatments were applied in *kharif* and their residual effect was tested in *rabi*. *Azotobacter* were used as biofertilizer(B). The grain yield of maize and mustard are presented in Table 9.

Intercropping with both the crops increased the grain yield of maize over control. Intercropping with soybean was the best treatment found and could increase the grain yield of maize by 26 and 21 per cent over control and intercropped with black gram

Table 9. Direct and residual effect of intercropping and treatments on the grain yield (q/ha) of maize-mustard cropping systems

Treatments	Sole crop		Intercropping with				Mean	
			Black gram		Soybean			
	Maize Direct	Mustard Residual	Maize Direct	Mustard Residual	Maize Direct	Mustard Residual	Maize Direct	Mustard Residual
Control	17.3	1.5	20.6	2.2	24.9	2.4	21.0	2.02
FYM+*Azotobacter(A)*	29.7	3.4	31.2	4.0	33.3	4.2	31.4	3.87
½ FYM + *A*	24.1	2.3	26.9	3.3	29.8	3.2	26.9	2.96
½ FYM + *A* + ½ NPK	29.9	3.1	29.7	3.8	30	3.7	29.9	3.53
½ FYM + *A* + NPK	30.6	3.9	31.1	4.5	43	4.9	34.9	4.45
FYM + *A* + ½ NPK	33	4.5	31.8	5.4	46.8	5.7	37.2	5.19
FYM + *A* + NPK	36.1	4.8	37.7	5.6	45.1	5.9	39.6	5.44
Mean	28.7	3.38	29.9	4.11	36.1	4.29		
CD		Maize (Direct)				Mustard (Residual)		
Intercropping (I)	NS	0.56*						
Treatment (T)	4.86*	0.55**						
I xT	NS	NS						

FY M = FYM @ 10 t/ha. ** and * indicate significance at 1 and 5 % level significantly

respectively. All the treatments in the subplots also increased the grain yield of maize significantly over control. Maximum significant grain yield was obtained when FYM @ 10 t/ha + *Azotobacter* was coupled with ½ NPK and became at par with full NPK. The results showed similar trend as that of the earlier year. The interaction was insignificant. Under controlled condition FYM @ 10 t/ha + *Azotobacter* + full dose of NPK could give the maximum grain yield. This yield can be further increased by 25 per cent by intercropping with soybean and curtailing half dose of NPK. The N and P uptake by the grains also showed the similar trend as that of the grain yield.

MIZORAM

Varietal performance

K. Laxminarayana and N.S. Azad Thakur

Five varieties of maize *viz.*, RCM-1-1, RCM-1-2, RCM-1-3, MLY and MLW were sown in the first week of May at a spacing of 45 x 30 cm. The trial was replicated thrice in a RBD and a fertilizer dose of 100-80-60 kg N, P2O5 and K2O ha-1 was applied. It was observed that MLW performed better with a kernel yield of 49 q/ha, closely followed by MLY (48.8 q/ha) and RCM-1-3 (48.6 q/ha). The variety RCM-1-2 recorded lowest kernel yield of 27.8 q/ha. It was found that the kernels of RCM-1-2 were smaller and having low test weight of 13.7 g/100 kernels, whereas the other varieties showed a test weight of 22.6 to 26.4 g.

Baby corn

In an evaluation trial, five varieties of baby corn namely RCM-1-1, RCM-1-2, RCM-1-3, MLY and MLW were sown in the first week of May at a spacing of 45 x 30 cm. The trial was laid out in three replications in a RBD in 5.0 m2 plots. A fertilizer dose of 100-80-60 kg N, P_2O_5 & K_2O ha^{-1} was applied. Of all the varieties, MLW recorded highest kernel yield (50 q/ha) followed by MLY (46.7 q/ha) and RCM-1-1 (43.3 q/ha). Lowest kernel yield of 26.7 q/ha was recorded with RCM-1-2, which might be due to lower number of cobs/plant, lesser dry matter production and lower test weight of 13.1 g/100 kernels.

NAGALAND

Five varieties of maize viz. MlY, MLW, RCM—1-1, RCM-1-2 and RCM-1-3 were tested in RBD. Variety MLY gave significantly higher average yield (30.31 q/ha), followed by RCM 1-1 (29.81 q/ha). Composite maize (Vijaya) with yield record of 41.00 q/ha was found suitable for foot-hill areas of Nagaland with less problem of cob borer (20 to 25%).

SIKKIM

Studies on integrated nutrient management

An experiment with hybrid maize ProAgro P-4640 was conducted on integrated nutrient management for increasing maize yields during March 2001-2002. The seeds were sown with a 50 cm distance between row to row and 30 cm from plant to plant with 11 treatments in four replications. The seed rate was 20 kg/ha. Phosphorus and potassium were basally applied before sowing through SSP and MOP @ 60 and 40 kg/ha, respectively. Dolomite was applied @ 2 t/ha. Nitrogen was applied through urea @ kg/ha^{-1} through a combination of farmyard manure and urea with and without seed treatment with Azophos (Azotobacter inoculant). FYM was incorporated basally before sowing to supply 1/3, ½ and 2/3 nitrogen while rest N was supplemented through urea as top dressing at knee-high stage (full dose) or split applied at knee-high stage and tasseking. Highest grain yield of 99.50 q/ha was recorded in the treatment with Azophos seed treatment with 40 kg N through FYM at sowing and two-split top-dressing of urea, *i.e.*, half at knee-high stage and half at tasseling. This was followed by the treatment where 40 kg N was applied through FYM at sowing and two-split top-dressing of urea (half at knee-high stage and half at tasseling) that produced a yield of 88.50 q/ha^{-1} as compared to 27.0 q/ha grain yield in control.

TRIPURA

Varietal evaluation

K. R. Dhiman and K. Chattopadhyay

Eleven varieties were sown in the second week of May, 2001. Yield and yield contributing characters were estimated. Number of seeds/cob and cob girth revealed direct positive correlation with yield. White seeded variety, Sweta performed best in respect of seed yield among these varieties. The seed yield of Sweta was 41.1 q/ha. It has average seed yield / plant of 95 g and the average plant height was noted 120 cm. Navin Exp. Var (37.6 q/ha), Kanchan (36.42 q/ha) were some of the better performers among the rest.

Evaluation of local *jhum* varieties

Two *jhum* varieties of Maize, namely, *Jhum* Black and *Jhum* Yellow were evaluated in autumn season in 2001 on the basis of yield and yield attributing characters, like, plant height, number of cobs /plant, cob girth, cob length, seeds/cob, 100 seed weight, seed weight/cob and days to maturity. *Jhum* black and *jhum* yellow matures in 126 and 117 days respectively and their average number of cobs /plant was 2.29 and 2.0. They were having reduced cob size, but shows prolificacy to a great extent.

PULSES

MEGHALAYA

Varietal improvement

B. K. Sarma and G. Sahay

Ricebean

Two varietal trials *viz.* Research complex Regional Trial (RCRT) and Advanced Varietal Trial (AVT) with 8 varieties in each trial were conducted. In RCRT, variety BD-139-1 recorded the highest yield of 14.83 q/ha, followed by EC-2074 (14.14 q / ha) and RCRB 6-10 (13.14 q/ ha). In AVT the performance of RBL - 35 was best (7.0 q/ha).

Forty nine germplasm were maintained and evaluated of which the high yielding lines were RBS2 (28.31 q/ha), IC187911 (26.18 q/ha), IC 3074 (23.14 q/ha), EC18181 (23.06 q/ha) and EC114077 (19.89 q/ha). Most of the lines were high yielder with average trial yield of 12.59 q/ha (Fig.8)

Mungbean

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

Urdbean

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

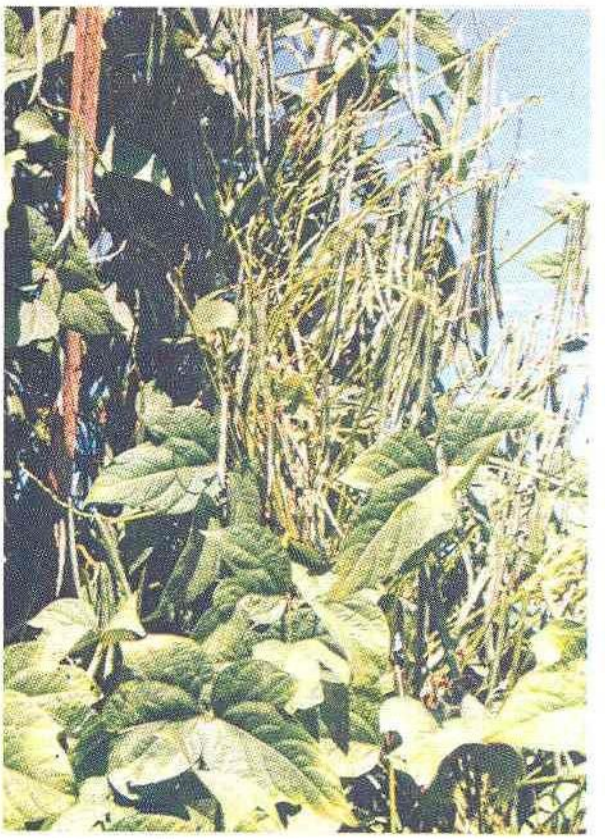


Fig 8. A Ricebean variety under RCRT trial

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

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

Response of genotypes to date of sowing

D.P. Patel and N.P. Singh

Experiment was repeated for the second consecutive year to find out the optimum time of sowing for black gram. This year all the varieties did not show any significant variation in yield. Highest grain yield was recorded when the crop was sown in the 2nd week of August (11.9 q/ha), which was significantly higher than all the dates of sowing. Significant reduction in grain yield was observed when crop was sown beyond the 3rd week of August. The main cause of reduction in grain yield was moisture stress and drop in temperature at grain filling stage.

Integrated nutrient management

D.P. Patel and N.P. Singh

All the treatments except phosphotica (1.0 g/m^2) and *Rhizobium* (1.0 g/m^2) showed significant increase in grain yield over control. Application of FYM (5 t/ha) + NPK (30:60:40 kg/ha) + Phosphotica (1.0 g/m^2) + *Rhizobium* (1.0 g/m^2) produced highest grain yield (13.9 q/ha) which was followed by the yield (12.5 q/ha) recorded with FYM (5 t/ha) + NPK (30:60:40 kg/ha) and found significantly higher than all the other treatments. Control crop produced a grain yield of 5.1 q/ha.

Pigeon pea

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

Performance of Rajmash genotypes in mid hills

D.P. Patel and N.P. Singh

Thirteen genotypes - HUR 15, HUR 150, HUR 76, HUR 137, BHUR 168, HUR 138, HUR 139, PDR 14, VL 63, Arka Komal, IVR FB 1, MFB 2 and MFB 3 were initially evaluated to find out the suitable line for green pod as well as seed yield. Arka komal, MFB 3 and IVR FB 1 lines were found suitable for green pod yield where as VL 63 was found suitable for seed yield.

Response of French bean/Rajmash to date of sowing

This experiment was continued in the 2nd year and French bean variety Naga Local (Fig.9) produced significantly higher green pod yield (89.8 q/ha) as compared to Meghalaya Local (78.3 q/ha) and Manipuri (74.7 q/ha). Highest green pod yield was observed in the crop sown in last week of July (123.4 q/ha), which was followed by crop sown in the 1st week of August (110.9 q/ha). Further delay in sowing significantly reduced green pod yield, irrespective of the variety.

Fig 9. Naga local Frenchbean - a promising variety

MANIPUR

Chickpea

Fourteen entries of chickpea, under AVT were sown on 7.12.01 after harvest of maize at rainfed foot hill condition. Among these, B-12 was found highest yielder followed by B-30, B-20, B-29 and B-19 with yield potential of 1844, 1706, 1508, 1410 and 1407 kg/ha respectively.

Similarly the experiment with eight entries of AVT of chickpea was sown in *rabi* season at Langol hill farm after harvest of maize crop. The yield differences were found non-significant. Among these B-105 recorded highest yield followed by B-103, B-102, B-104 and B-108 with yield of 1526, 1370, 1337, 1312 and 1303 kg/ha respectively.

Integrated nutrient management in black gram based cropping system

Integrated nutrient management experiment on black gram was repeated with 5 main-treatments *viz.*, control, lime @ 500 kg/ha, FYM @ 10 t/ha, Lime + FYM and *Rhizobium* inoculation; and three sub-treatments *viz.*, NPK (25 kg N, 26 kg P and 25 kg K/ha), ½ NPK and Zero NPK. The experimental design was split-plot with three replications.Lime was added in furrows at the time of sowing. The treatments were applied in black gram and their residual effect was tested in groundnut(Table 10).

Table 10. Effect of integrated nutrient management on the grain yield (q/ha) of blackgram

Main treatment	Fertilizer levels			
	$N_0P_0K_0$	$N_{12.5}P_{13}K_{12.5}$	$N_{25}P_{26}K_{25}$	Mean
Control	5.9	8.4	11.0	8.4
Rhizobium	6.2	9.7	11.9	9.3
Lime @500kg/ha	9.8	12.9	14.2	12.3
FYM @ 10 t/ha	10.9	13.9	13.1	12.6
Lime @500kg +FYM @10 t/ha	14.1	14.6	15.5	14.7
Mean	9.4	11.9	13.1	
$P_{0.01}$	Main treatment (MT)		Fertilizer (F)	*MT x F*
	3.33		1.94	NS

The grain yield increased significantly by all the main treatments except *Rhizobium* inoculation over the control. Maximum grain yield was recorded in Lime + FYM (14.7 q/ha) over control (8.4 q/ha) followed by FYM(12.6 q/ha). Liming + FYM increased the yield significantly over *Rhizobium* inoculation(9.3 q/ha). The fertilizer level ½ NPK increased the grain yield significantly over control and became at par with the full dose of NPK. The N and P uptake by the grains showed the similar trend as that of the grain yield. The nodule weight increased significantly with all the main treatments over control. Interaction of fertilizers with main treatment was not significant for grain yield. The results showed similar trend as that of the previous year though the overall yield was less compared to that of the previous year.

TRIPURA

Varietal evaluation of Pulses

K. R. Dhiman and K. Chattopadhyay

Blackgram

AVT 2+1: Five lines were sown in autumn season, 2001 under IVT of coordinated project of MULLaRP. Seed yield of KU-10 and KU-11 were 1992.59 and 1985.19 kg/ha, respectively. They matured in 75-82 days. 100 seed weight of KU-11 was high (5.1g). Their plant height and pods/plant were 52cm and 60cm and 32 and 26, respectively.

IVT-2001-2002: Twenty lines in three replications were evaluated in autumn under IVT-2001-2002. Dark green seeded KU-32 gave the highest seed yield of 2122.22 kg/ha in 85-90 days. The average plant height and pods/plant was recorded as 45-50 cm and 55, respectively.. Black seeded KU-45 and KU-3 yielded 2055.56 and 1994.44 kg/ha respectively.

Initial evaluation trial of developed lines: Twenty-two lines were selected from different crosses. For testing for 2 consecutive year. On the basis of yield, yield parameters, diseases and pest infestation, stability of performance and considering the effect of seasonal rainfall, weather conditions and other constraints, some of the lines like shinning black seeded TRU-99-16 (13- 15.5 q/ha), shinning green seeded TRU-99-12 (14-14.5 q/ha), Shinning green seeded TRU-99-29 (13.7-14.1 q/ha) and brown seeded TRU-99-14 (12-15 q/ha), were found to be promising.

Cropping System Research

Sabyasachi Mitra and M. Dutta

Effect of Bio-Mulches on yield and water use of kharif blackgram

The experiment was conducted to study the effect of various bio-mulches on growth and yield of kharif blackgram. The experiment was laid out in a Factorial RBD with three replications. The crop variety T9 was sown and harvested on 13/9/01 and 28/11/01, respectively. The data presented in Table 11 showed that application of *Chan (Saccharum sp.) + Glyricidia (Glyricidia maculata)* leaves in 1:1 ratio recorded maximum number of pods/plant (42.7), seed/pod (7.4) and finally significantly higher seed yield (10.6 q/ha) of the crop as compared to that obtained with *Chan + Acacia (Acacia auriculiformis)* leaves (1:1) (9.7 q/ha) or with rice straw (8.2 q/ha), respectively. Among the three mulching rates tested, mulching at the rate of 7.5 t/ha resulted maximum number of pods/plant (39.5), seeds/pod (7.9) and seed yield 11.2 q/ha) which was significantly higher than that with 5.0 t/ha (9.5 q/ha) or 2.5 t/ha (7.8 q/ha) rates, respectively.

Table 11. Effect of bio-mulches on growth and yield of kharif blackgram

Treatment	Yield attributes and yield of kharif blackgram (2001)		
	Pods/ plant	Seeds/ pod	Seed Yield (q/ha)
Mulch type			
Rice Straw	32.9	6.7	8.2
Chan + Acacia leaf (1:1)	36.4	7.1	9.7
Chan + Glyricidia leaf (1:1)	42.7	7.4	10.6
SEm+	2.25	0.37	0.42
CD(P=0.05)	6.7	1.1	1.2
Mulch rate			
2.5 t/ha	34.2	6.1	7.8
5.0 t/ha	38.1	7.2	9.5
7.5 t/ha	39.5	7.9	11.2
SEm+	2.05	0.37	0.42
CD(P=0.05)	6.1	1.1	1.2
CV(%)	18.1	15.7	13.1

Alley cropping

An experiment was conducted with an objective to study the efficacy of three different leguminous species, viz. Arahar (perennial), subabul *(Leucaena leucocephala)* and *Glyricidia (Glyricidia maculata)* as hedge row component as well as to determine to what extent the recommended fertilizer dose of the Rice- Cowpea crop sequence, which was grown in the alley can be reduced through green leaf addition. The sloppy land was converted in to bench terrace and the hedge rows were planted at both end of the riser. The hedge plants were cut at a height of 2 m and the leaves and tender twigs were applied in the inter - row space after 20-25 days in rice and at 2-3 leaf stage in cowpea. The fertilizer treatments were 100 % chemical fertilizer, 75 % chemical fertilizer + leaf manure @ 5 t/ha and 50 % chemical fertilizer + leaf manure @ 5 t/ha. The chemical fertilizer was applied in rice crop only while cowpea was grown on residual fertility only. Rice was sown and harvested on 22/5/01 and 12/9/01, respectively while cowpea was sown and harvested on 15/9/01 and 30/11/01, respectively.

Among the three hedge row species tested, application of arhar leaves recorded maximum grain yield of rice (22.4 q/ha) which was significantly higher than that with subabul leaf (19.3 q/ha) but statistically at par with application of *Glyricidia* leaf in this regard. Similar trend was obtained in case of succeeding cowpea crop and maximum seed yield was recorded with arahar leaf (37.4 q/ha) followed by Glyricidia leaf (36.3 q/ha). Besides both subabul and arhar produced significant amount of fuel wood which may generate extra earning from the hedge crop.

Application of 75% recommended fertilizer along with green leaf manure was statistically at par with 100% recommended fertilizer in its effect on rice grain yield (20.6 & 23.6 q/ha). Similar trend was observed in case of cowpea. This indicates that under upland situation fertilizer use can be economized through application of green leaf as manure.

Integrated nutrient management

Sabyasachi Mitra

The experiment was conducted to study the effect of various sources of organic matter on growth and yield of kharif blackgram. The experiment was laid out in a Factorial RBD with three replications. The crop variety T9 was sown and harvested on 15/9/01 and 19/11/01, respectively. Application of poultry manure recorded significantly higher seed yield (8.0 q/ha) of blackgram as compared to *Glyricidia (Glyricidia maculata)* leaf (6.2 q/ha) or FYM (6.2 q/ha). Both poultry manure and *Glyricidia* leaf when applied to the crop recorded significantly higher number of pods/plant (39.2 & 39.6, respectively) as compared to FYM (31.7) The seed yield and yield attributing characters of the crop, viz. pods/plant and seed/pod increased significantly with application of manures up to 5.0 t/ha (7.6 q/ha, 39.0 & 5.9, respectively) beyond which the increase was not significant.

Green gram

AVT 2+1 : Under AVT2+1, poor average yield was recorded which might be due to poor soil fertility, heavy rainfall during vegetative stages and root and stem rot. KM-2 was the highest yielder among them with 470.37 kg/ha seed yield.

IVT 2001-2002 : Out of 15 lines under IVT 2001-2002, KM-60 performed the best with 1422.22 kg/ha seed yield. It matured in 75 days and average plant height and pods/plant was recorded 60 cm and 20, respectively. 100 seed weight was 3.7g. KM-1 and KM-44 were the next to come. They yielded 1255.57 and 1216.67 kg/ha, respectively.

Lentil

Eleven selected lines with two replications were sown in the first week of December, 2001. IPL-93 out yielded others with estimated seed yield of 9.5 q/ha which was followed by IPL-91 and IPL-92 with 7.0 q/ha each. All these lines included in this trial have been tested for the last three years. IPL-93 came up with the first position. This was followed by IPL-91..

Pigeon pea

One hundred accessions of North-Eastern states, supplied by ICRISAT, were evaluated during period of 2000-2001, on the basis of days to 50% flowering, days to 75% maturity, plant height, 100 seed weight, seed/pod, grain colour, flower colour, growth habit, stem colour, extent of branching, *Heliothis* pod borer infestation and plot yield. Among those lines, 25 lines were selected and evaluated in 2001-2002. ICP-9039 (22.3 q/ha) and ICP-9044 (21.7 q/ha) were observed better than others. All lines were late maturing (220-270 days), tall (average height 3.5-4 m), semi-determinate, semi-spreading, green -stemmed and almost free from Heliothis infestation. Average seeds/pod varied from 4 to 5 whereas average plant yield was noted as 40g to 70g.Grain color showed wide range of variation, starting from white to deep red and even coffee black.

Rice bean

This pulse crop has already been established for its capability to withstand water stress situation to a great extent as an autumn crop in rainfed upland of Tripura. Fourteen lines of rice bean were sown by the end of September, 2001.The best yielders were EC-1667 (8.67 q/ha) and EC-2074 (8.63 q/ha). Evaluation of rice bean lines has been repeated for the consecutive last three years. So many lines were tested to find out the suitable high yielding variety (or varieties) for uplands of Tripura. Those lines were raised in autumn seasons of 1999, 2000 and 2001. Considering the stability of performance and average yield, EC-1667 (9.39 q/ha), BD-139-1 (8.83 q/ha) and RBL-52 (8 q/ha) could be considered for multi locational trials for future recommendation in this state.

Field pea

Six high yielding pea lines were evaluated for the consecutive three years under different environmental situations (including different dates of sowing). Yield evaluation trials were conducted under two sowing dates, i.e., end of November and second week of December, 1999. The average value of these two trials showed that bold seeded line TRC-pea-9 was the highest yielder (14.65 q/

ha) and Pant -P-2 gave 12.75 q/ha seed yield. Same trial was repeated and the crop was sown by the second week of December,2000. Despite of thunderstorm and heavy shower during the middle stage of flowering all lines except, late maturing, TRC-pea-9, performed well. TRC-pea-8 gave 19.5 q/ha seed yield which was followed by T-163 and DMR-7 with 19 q/ha, each. This was very much at per with last year results in late sown condition. In 2001, trial was raised in the end of November. TRC-pea-8 gave the highest seed yield of 16.2 q/ha and this was followed by DMR-7 (15.53 q/ha). The days to 50% flowering of this two lines was recorded 54-60 and 54-56, respectively. The developed line, TRC-pea-8 that has been so far established its superiority, can be put in advanced evaluation and multi-locational trials.

OILSEEDS

MEGHALAYA

Soybean

B.K. Sarma and G. Sahay

Two trials were conducted *viz.* evaluation of F_3 generation of various crosses and one trial under Darjeeling hills condition (Table 12, Fig.10). F_4 generation evaluation for rust and frogeye leaf spot (FELS) disease resistance was conducted with 29 hybrid lines. Line DS93-104B x JS80-21 (H_2) gave highest yield (26.76 q/ha) with disease score 1 for rust and 2 for FELS, followed by Bragg x DS93-104B (H_{30}) yielding 25.6 q/ha and disease score 1for rust and 0 for FELS, Pusa 16 x PK416 (H_{18}) yielding 24.00 q/ha and disease score 1for rust and 2 for FELS, PUSA16 x PK1137 yielding 23.90 q/ha and disease score for rust 1and 0 for FELS, JS (SH) 89-48 x DS93-104B yielding 23.83 q/ha, disease score for rust 2 and 3 for FELS.

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

Fig. 10 Soybean variety ready to harvest

In germplasm maintenance\evaluation, eighty-nine varieties were evaluated. JS (SH) 89 –48 recorded 31.10 q/ha yield followed by JS (SH) 89 – 2 (26.30 q/ha), JS (SH) 89 – 58 (25.80 q/ha) PK – 1137 (22.20 q/ha) and TAS – 41 (20.80 q/ha). Average trial yield was13.01 q/ha.

Phosphorus use efficiency by soybean in acid Alfisol

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

A field experiment was conducted for third year during kharif 2001 to study the response of soybean to SSP (single superphosphate), RP (rock phosphate) and their mixtures with and without FYM. The results revealed that SSP @ 60 kg P_2O_5 /ha singly or in combination with 5t FYM/ha was superior to RP @ 30 or 60 kg P_2O_5 /ha alone or

Table 12. Promising varieties of oilseeds from different trials

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

with FYM and was at par with mixture of SSP + RP @ 60 kg P_2O_5/ha with FYM with regard to grain and straw yields of soybean. The effect of SSP @ 30 kg P_2O_5 /ha was almost equal to RP @ 30 or 60 kg P_2O_5/ha.

Soybean diseases and management

Santha Lakshmi Prasad, M.Srinivas Prasad, Y.P. Sharma and A.K. Singh

Seventy five soybean cultivars were tested in field for their resistance against common foliar diseases *i.e.* rust (*Phakopsora pachyrhizi*), frog-eye leaf spot (*Cercospora sojina*), powdery mildew (*Microsphaera diffusa*), yellow mosaic and mosaic. Screening was done under natural disease pressure.

Twenty-eight cultivars showed multiple diseases resistance against above mentioned diseases and were completely free from powdery mildew disease. These cultivars were NRCs 1,2,7,12,19,22,24,28; MACS 24, MACS 49-1, PK 262,471,564,416,327, 1135,1125,1112; JS 75-46, JS 80-21, JS (SH 89-2), JS (SH 89-49), DS 93-108B, Monita, Durga, Pusa 16, VLS 45 and KB 117. The seed yield ranged from 5.5 -13.9 g/plant among test cultivars. Two cultivars *i.e.* NRC 12 and 28 were early maturing varieties so they escaped rust incidence. Two cultivars MACS 24 and DS 93-108B showed resistant to highly resistant reaction to rust, frog eye leaf spot, powdery mildew, yellow mosaic and mosaic with higher yields (9.09 and 13.85 g/ plant, respectively), NRC 28 and Pusa 16 also showed resistance to all the diseases but the yield per plant was less. Purple seed stain caused by *Cercospora kikuchii* was observed on seeds of some cultivars after harvest. Higher number of purple stained seeds (28.35%) were observed in NRC 12, followed by NRC 31 (27.5%).

Varietal Response of Soybean to Lime

Patiram

Out of 5 varieties of soybean tested for their response to liming on an acid Alfisol of Meghalaya all the tested varieties responded to liming @ 2t/ ha. Among the five varieties, Ankur and TS 80-1 peformed better than the others. The interaction of varieties x lime was non-significant. So this study revealed that none of the tested variety is tolerant to soil acidity.

Biocontrol of soybean rust

Santha Lakshmi Prasad, M. Srinivas Prasad, Y.P. Sharma and A.K. Singh

Studies on biocontrol of soybean rust disease were continued. *Trichothecium roseum* was used as biocontrol agent. *T. roseum* spore suspension (1.5 x 10^8 conidia / ml) was sprayed on 30-days old soybean plants as pre and post inoculation treatment. Uredospore suspension (2 x 10^4 spores/ ml) was sprayed on soybean plants for artificial inoculation. Additional spraying of *T. roseum* was done five days after inoculation. In one set of plants, Dithane M-45 @ 0.25% was sprayed 24 hrs after inoculation. As check, some plants were inoculated with rust uredospores only. The disease incidence was recorded as number of rust lesions and per cent sporulating pustules / trifoliate.

Number of rust lesions was minimum in plants sprayed with *T. roseum* 24 hrs before inoculation

of rust uredospores. As compared to check, biocontrol agent spray as post inoculation also reduced the rust lesions but not at par with pre-inoculation spray. Dithane M-45 spraying proved as effective fungicide for control of the rust disease. Lesion density was less in upper trifoliate leaves when compared to lower leaves.

The sporulating pustules (%) were less in fungicide sprayed plants followed by biocontrol agent pre-inoculated plants. This indicated that both fungicide and bioagent reduced the sporulation of rust fungus. In check plants, the per cent sporulating pustules were more. When the leaves of soybean plants sprayed with *T. roseum* were examined under microscope, white mycelium parasitizing on rust pustules was observed.

Effectiveness of granular and dust /powder formulations against insect pests of soybean

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

Different insecticide formulations comprising of 5 granular, 2 powder/dust and one soluble liquid formulation were used to test their efficacy on two insect pests of soybean viz. stem fly and leaf folder. The granular insecticides were broadcasted and mixed in soil while the powder and liquid formulations were used as seed treatment as such without application of water. All the granular insecticides showed superiority in pest reduction over the dust/ liquid formulations. Among all the insecticides carbofuran 3 G @ 1.0 kg a.i./ha recorded lowest stem fly incidence (3 damaged plancts/6 sq.m.) and highest yield (3.845 t/ha) followed by cartap hydrochloride 4G @ 800 g a.i./ha and carbosulfan 6 G @ 1.0 kg a.i./ha. Though fipronil 0.4 G @ 75 g a.i./ha plot recorded lowest leaf folder and *Spodoptera litura* damage, there was no increase in yield. The control plot recorded the maximum number of insects (12.55 leaf folder damaged plants and 1.99 stem fly damaged plants/6 sq. m.) and lowest yield (1.567 t/ha) (Fig. 11).

However, the natural enemies present in soybean ecosystem like coccinellids and spiders were all significantly lower in granular insecticide treated plots and moderate in seed treatment plots and highest in control plot (46.21 coccinellids and 25.33 spiders/6 sq.m.). (Fig.12). Granular insecticide application in soil resulted in almost 50% reduction in coccinellids and 65 % reduction in spiders and the ST was comparatively safe.

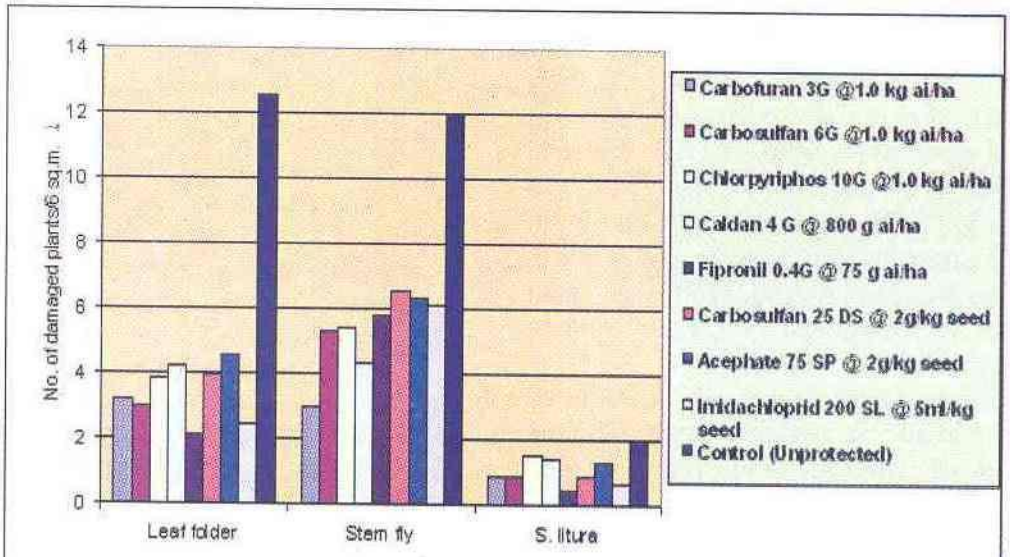


Fig 11. Effect of different formulation of insecticides on insect-pest of soybean

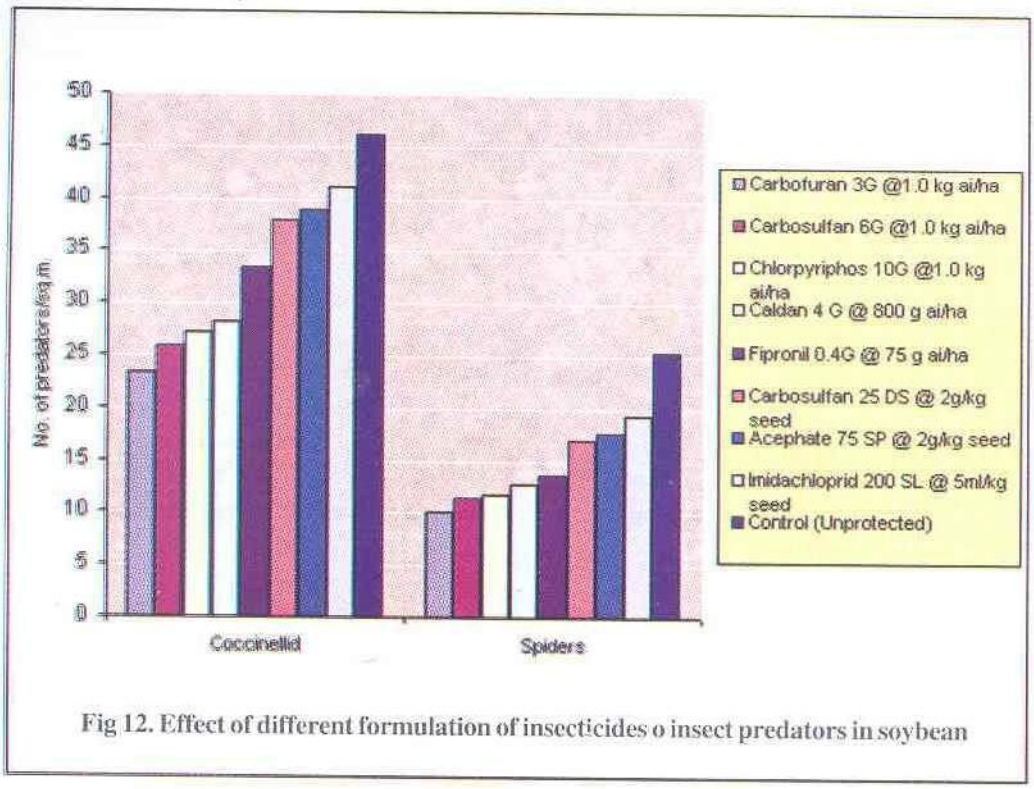


Fig 12. Effect of different formulation of insecticides o insect predators in soybean

Influence of seed treatment on germination of groundnut and soybean seeds

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

Five insecticides were screened for their efficacy on seed germination both in laboratory and field conditions. The seeds of groundnut and soybean were treated with these insecticides and kept on a germination paper under optimum conditions. Under both the conditions seed treatment of all the insecticides resulted in high germination of groundnut without any toxic effects on cotyledons (Fig. 13) whereas in the case of soybean, only three insecticides viz. acephate 75 SP, carbofuran 3g and imidachlorprid 200 SL as seed treatment showed high percent of germination in both lab and field conditions (Fig. 14).

Groundnut

Three trials were conducted *viz.* Evaluation of selections from JL-24, Screening for Al^{3+} Toxicity Tolerance and Optimum sowing time of promising varieties. A set of germplasm was also maintained.

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

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

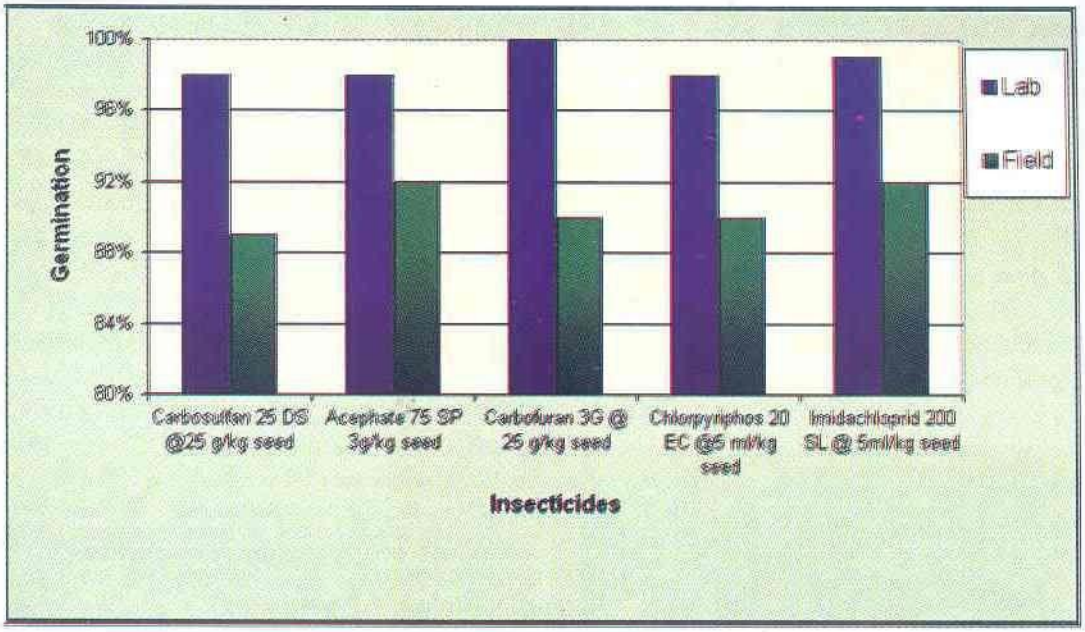


Fig 13. Effect of different formulation of insecticides on germination of groundnut in lab and field condition

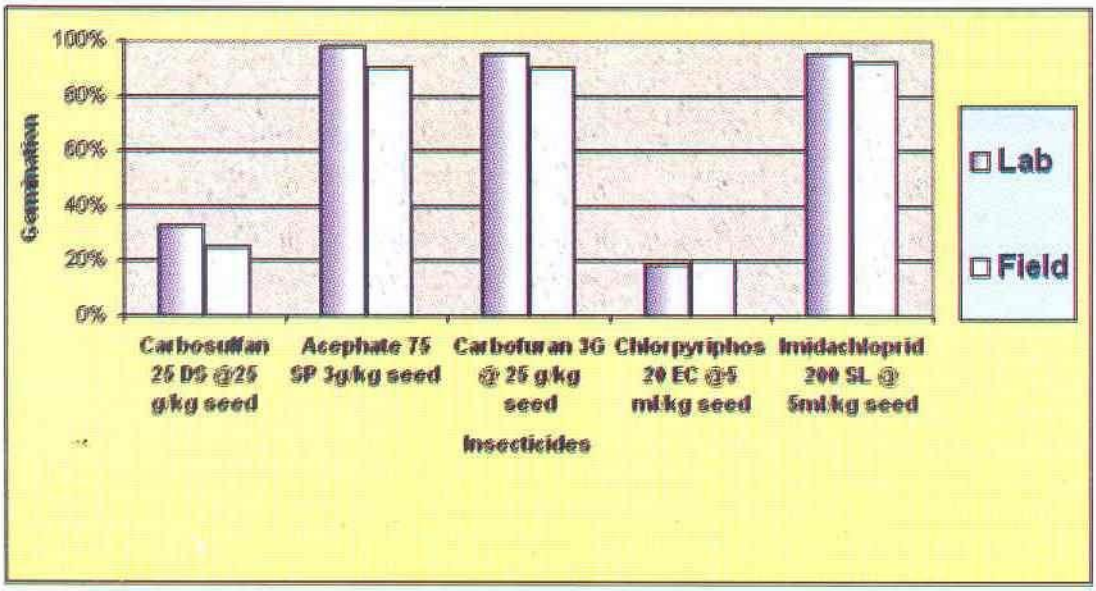


Fig 14. Effect of different formulation of insecticides on germination of soybean seeds in lab and field conditions

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

Performance of groundnut varieties under the mid altitude of Meghalaya

N.P. Singh and D.P. Patel

Twenty-one varieties - ICGS 76, TKG 19A, K 134, ICGV 86590, GG 12, DRG 12, TG 26, BAU 13, CSMG 84-1, GG 20, HNG 10, GG 13, B 95,

LNG 2, OG 52-1, GIRNAR 1, ICGS 44, VRI 2, R 9251, ICGS 11 and VRI 4 were evaluated along with JL 24 as check for their growth parameters, yield and yield attributes during *kharif* 2001. Highest mean pod yield was recorded in ICGS 76 (22.8 q/ha), followed by ICGS 44 (22.0 q/ha), ICGS 11 (20.6 q/ha) (Fig. 15), CSMG 84-1 (20.3 q/ha) and BAU 13 (19.5 q/ha). All these varieties were found at par with each other. Remaining varieties also produced higher than check variety JL 24 (13.1 q/ha) except B 95 (11.6 q/ha), which produced lowest pod yield.

Fig15. Performance of groundnut variety in Meghalaya

Performance of groundnut to different date of sowing

Rajesh Kumar and D.C. Saxena

A field experiment was conducted taking two groundnut cultivars i.e., ICGS 76 and TKG-19 (A) sown at four different dates i.e., 23rd May, 25th June, 20th July and 21st August. The data reveals that highest yield (21.82 q ha^{-1}) was recorded with ICGS 76 when sown on 25th June followed by a yield of 16.24 q ha^{-1} when the same cultivar was sown on 20th July. The lowest yield (4.67 q ha^{-1}) was recorded with cultivar,TKG19 (A) sown on 21st of August.

Effect of *Rhizobium* and PSM on growth and yield of groundnut

A.S. Panwar and N.P. Singh

The experiment was continued for the 2nd consecutive year to study the effect of biofertiliser and inorganic phosphorus on groundnut. It was observed that application of 60 kg P_2O_5/ha recorded maximum yield of 27.39 and 29.12 q/ha during 2000 and 2001, respectively. Seed inoculation either with *Rhizobium* or PSM alone marginally improved the yield but when applied together, significant increase in pod yield over control was observed. The pod yield further increased with the application of Neem cake @ 3 t/ha or FYM @ 10 t/ha. However, maximum yield to the tune of 31.28 q/ha (pooled of two year) was recorded due to application of 5 t FYM/ha in the presence of *Rhizobium* and PSM, followed by 3 t Neem cake/ha with the same biofertilisers.

Response of groundnut to mulching

A.S. Panwar, N.P. Singh

With a view to study the response of groundnut genotypes to mulching, three groundnut genotypes viz. K-134, HPS-II-9703 and ICGS-76 were kept in main plots while five mulching treatments - M1- No mulch, M2- Grass mulch, M3- Ambrossia weed mulch, M4 Polythene mulch on bun and M5- Polythene mulch on flat bed were kept in sub plots (Fig.16). The treatments were tested in Split Plot Design with three replications. An inquisition of the data revealed that groundnut cultivar ICGS-76 recorded maximum pod yield to the tune of 22.31 q/ha of groundnut, while lowest was recorded with K-134 (16.92 q/ha). Amongst the different mulch

Fig 16. Mulching in groundnut

treatments highest pod yield to the tune of 23.03 q/ha was recorded due to polythene mulch on bun, followed by 22.18 q/ha on flat bed. The grass or Ambrosia mulch also improved pod yield as compared to control but remained inferior to polythene mulch, irrespective of land configuration.

Influence of biofertilizer and bio organic sources of nutrients on groundnut

N.P. Singh and U.K. Hazarika

The experiment was conducted to study the effect of 12 treatments consisting of two phosphorus levels (0 kg, 50 kg P_2O_5/ha), two lime (0, 2.5 t/ha); with and without *Azolla* compost and phosphorus soliubilising microorganism (PSM-27). The data revealed that crop applied with 50 kg P_2O_5/ha + 2.5 t of lime/ha + composted *Azolla* @ 2.5 t/ha registered maximum pod yield (25.67 q/ha), followed by lime at 2.5 t/ha + *Azolla* compost 2.5 t/ha (22.67 q/ha). It was observed that application of *Azolla* compost, lime and phosphorus improved yield significantly as compared to control. Further, the yield increased due to combined application of these fertilizers.

Response to secondary micronutrients

M.S. Venkatesh, B. Majumdar, Kailash Kumar, Patiram and V.K. Mishra

Effect of sulphur and boron with or without FYM in acidic Alfisol

In a field experiment conducted during 2nd year (Kharif 2001) to study the effect of sulphur and boron with or without FYM on groundnut, highest pod and straw yields (33.51 and 37.96 q/ha,) were obtained with the application of 40 kg S, 3 kg B and 5t FYM /ha. Application of FYM significantly increased the pod yield over control.

Effect of sulphur, phosphorus and phosphate solubilisers in acid soil

The results of field experiment conducted during 2nd year (kharif 2001) to study the effect of sulphur, phosphorus and phosphate solubilisers on groundnut in acid soil revealed that application of S @ 30 kg S and P @ 60 kg P_2O_5 /ha produced maximum dry pod yield (35.0 q/ha). Among the 2 stains of P solubilisers, the effect of *Bacillus polymixa* was better than that of *Pseudomonas striata* on yield of groundnut.

Management of early leaf spot (*Cercospora arachidicola* Hori) in groundnut

S. Chandra and A.K. Singh

To develop economical control measure for early leaf spot (ELS) disease, effect of spray timing and frequency on ELS severity and yield was studied. Two varieties, *i.e.*, JL 24 (susceptible) and ICGS 76 (tolerant) to ELS were grown in rainy season following recommended cultural practices. A fungicidal mixture Dithane M-45® (0.2%) + Bavistin ® (0.1%) was sprayed at 10 days interval starting 30 days after sowing (DAS). Spray schedule consisted of four, three, two and single spray applications. Timings of single spray treatments used were 35,45,55 and 65 DAS. An unsprayed check was kept for comparison. Thus, in all there were eight treatments including check. The experiment was done in a completely randomized block factorial design. ELS severity was recorded at 100 DAS on a 0-5 scale (where 0 = no infection and 5 = >50% leaf area affected) and percent disease index (PDI) was calculated. Percentage defoliation was also recorded. The crop was harvested at 110 DAS dry pod yields, 100 kernel wt. and shelling percentages were recorded.

Result indicated that disease could be controlled up to 69% in JL 24 and 44% in ICGS 76 through a four-spray schedule treatment. There was significant ($P < 0.05$) variety x treatment nteraction, indicating that differential response to control due to resistance in ICGS 76. PDI ranged from 16.86 (four spray) to 53.78 (check) in JL 24 and from 15.93 (four spray) to 28.05 (check) in ICGS 76. Single spray at 35 DAS and 65 DAS recorded 45.52 and 56.25 PDI respectively and were par with check (53.78). This was because spraying too early (35 DAS) could not protect the crop for longer period (100 DAS) and late spray (65 DAS) was less effective in reducing PDI. Dry pod yield ranged from 1093 kg ha^{-1} (check) to 3159 kg ha^{-1} (four spray) in JL 24 and 3029 kg ha^{-1} (check) to 4617

kg ha^{-1} (four spray) in ICGS 76. Mean yield averaged over treatment was high (3502 kg ha^{-1}) in ICGS 76 when compared to JL 24 (1949 kg ha^{-1}). Four, three and two spray significantly (P=0.05) increased 100 kernel wt. in JL 24. In ICGS 76 three, two and single spray at 55 or at 65 DAS increased 100-kernel wt. There was significant variety x spray interaction. 100 kernel wt. ranged from 39.54 g (check) to 50.64 g (four- spray) in JL 24 and from 52.21 g (check) to 61.98 g (three-spray). Mean shelling percentage was significantly higher (68.65%) in ICGS 76 and when compared to JL 24 (67.16%). Variety x spray interaction was not significant for shelling percentage.

Integrated Pest Management in Groundnut

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

100 groundnut lines were screened against insect pests. Twelve varieties were found to be susceptible to jassid damage with > 8 jassids/leaflet. Varieties ICG-4083 and ICG-4070 were found to be tolerant to jassids. Varietal reactions for pod damage by false wire worm *Gonocephalum halfmansgi* revealed that varieties ICG-3674, ICG-3259, ICG-7030, ICG-1785, ICG-5185 and ICG 6988 were found to be susceptible for wire worm damage with >15% pod damage. Varieties ICG-1822, ICG-3273, ICG-4075, were found to be tolerant to wire worms damage. Leaf folder damage by *Nacolea vulgalis* was very less during the kharif 2001 on all the varieties screened.

Effectiveness of insecticides against groundnut foliage and pod damaging insects

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

All the insecticides reduced the damage by foliage feeding insects upto 60-90% and pod boring insects (10-30%) compared to control plot. Comparatively granular formulations were better than the powder formulations in reducing the pod boring insects (false wire worms). The highest damage (30% pod damage) by these false wireworms was noticed in control plot. Carbofuran 3 G @ 1.0 kg/ha was the best treatment with highest yield (3.108 t/ha) followed by carbosulfan 6 G @ 1.0 kg a.i./ha (2.921t/ha).

Rapeseed and mustard

Performance of mustard cultivars at different row x plant spacing

U.K. Hazarika and D.C. Saxena

An experiment was initiated during *rabi* season of 2001 with three spacing to assess the performance of mustard cultivars. It is revealed that mustard cultivar M-27 was found most promising (6.22 q/ha), followed by TS-8 (4.80 q/ha) and TM-4 (4.18 q/ha). Plant spacing of 30 x 15 cm was found to be better and recorded highest seed yield (5.59 q/ha), followed by 5.06 q/ha at 25 x 15 cm. Among the interactions, M-27 at 25 x 15 cm plant spacing was found best producing 7.67 q/ha of seed yield, followed by the same variety at 20 x 15 cm plant spacing (6.20 q/ha) (Fig.17).

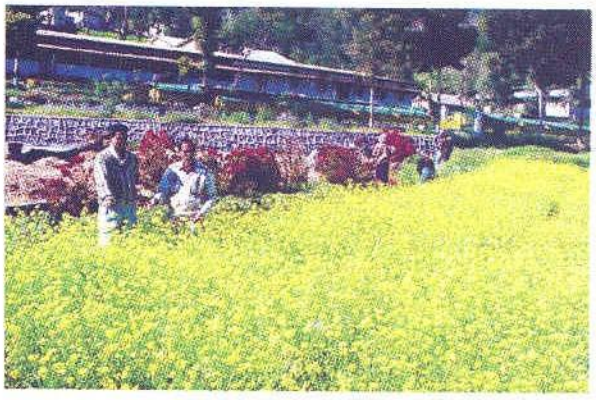


Fig 17. M-27, a promising mustard cultivar

MANIPUR

Groundnut

Integrated nutrient management in groundnut-mustard cropping system under rainfed foothills

The performance of groundnut (var. JL-24) was studied with application of eight different treatments combinations of organic and inorganic sources of fertilizer including control during 'kharif' 2001. The

yield differences as affected by different treatments were non-significant. The highest pod yield of 1.47 kg/plot was recorded with the treatment of FYM 2.5 t/ha + Rhizobium followed by N, P_2O_5 and K_2O (30:50:50 kg/ha). The minimum yield was recorded with Control (0.87 kg/plot) followed by the treatment of Rhizobium alone. Effect of Rhizobium and residual lime and FYM on the grain yield (q/ha) of groundnut under different fertilizer levels is presented in Table 13.

Table 13. Yield of groundnut as affected by different treatments

Treatments Potassium level (kg/ha)	Grain yield	
	Kg/plot	Q/ha
T_1 Control	0.87	11.60
T_2 Rhizobium	0.97	12.93
T_3 Rhizobium + 15 kg N/ha	1.42	18.93
T_4 Nitrogen 30 kg/ha	1.37	18.27
T_5 FYM 5 t/ha	1.44	19.20
T_6 FYM 2.5 t/ha + Rhizobium	1.47	19.60
T_7 FYM 2.5 t/ha + 15 kg N/ha.	1.15	15.33
T_8 NPK (30:50:50 kg/ha)	1.46	19.47
SEM+	0.192	
C.D. (0.05%)	NS	

Date of sowing : 27.4.2001; Spacing : 10 x 30 cm, Plot size : 1.5m x 5 m

Note : Common application of P_2O_5 and K_2O (50:50 kg/ha) in treatment No. 2 to 7 were made

Direct and residual effect of inorganic and organic inputs on groundnut

The experiment was initiated with 5 main-treatments *viz.*, control, residual lime @ 500 kg/ha, residual FYM @ 10 t/ha, residual Lime + FYM and *Rhizobium* inoculation; and three sub-treatments *viz.*, NPK (25 kg N, 26 kg P and 25 kg K/ha), ½ NPK and Zero NPK in the same plots after blackgram. The experimental design was split-plot with three replications. The groundnut cultivars GG-20 was taken as test crop.

The pod yield increased significantly by all the main treatments except *Rhizobium* inoculation over the control. Maximum pod yield was recorded with residual lime + FYM (17.9 q/ha) over control (11.8 q/ha) followed by FYM (17.6 q/ha). Residual effect of liming + FYM increased the pod yield significantly over *Rhizobium* inoculation(13.8 q/ha). The fertilizer level ½ NPK increased the pod yield significantly over control and became at par with the full dose of NPK. The N and P uptake by the pods showed the similar trend as that of the pod yield. The straw yield increased significantly with residual lime + FYM (38.4 q/ha) over control (30.4 q/ha). The N and P uptake by the straw showed the similar trend as that of the straw yield. Interaction of fertilizers with main treatment was not significant for pod and straw yield.

Integrated nutrient management in groundnut

The experiment was repeated this year in a split-split plot design with the following main treatments, sub-treatments and sub-sub-treatments. Main treatments were two levels of lime *viz.*, 0 and 2.5 t/ha lime as L_0 and L_2 respectively. The sub-treatments were two levels of P *viz.*, 0 and 50 kg P_2O_5 as P_0 and P_{50} respectively. The sub-sub treatments were four combinations of microbial inoculations, *viz.*, 1) Control, 2) TAL 1000 (*Bradyrhizobium*), 3) *Bacillus polymixa* (PSM), 4) PSM + *Bradyrhizobium*. JL-24 cultivars was used as the test crop. The experimental soil was clay loam in texture and taxonomically classified as Ultisol with initial chemical characteristics as pH 4.9, organic carbon 2.10 per cent, exchangeable Al as 1.24 cmol(p^+) kg^{-1} and available P as 7.94 mg/kg.

The pod and straw yield and their respective N and P uptake , nodule number and nodule weight/plant increased significantly with lime levels, P levels and microbial inoculations. Rhizobium and PSM in combination increased the pod yield significantly over control by 24 per cent. 50 kg P_2O_5/ha in combination with Rhizobium and PSM inoculation increased the yield significantly. Maximum pod yield of 19.9 q/ha was obtained with 2.5 t/ha liming + 50 kg P_2O_5 + Rhizobium + PSM inoculation. The lime x phosphorus interaction was significant for pod yield. Rhizobium and PSM alone could not increase the nodule weight significantly but in combination with 50 kg P_2O_5/ha and lime @ 2.5 t/ha the response was positive (Table 14).

Table 14. Effect of integrated nutrient management on groundnut pod yield (q/ha)

Lime levels	Microorganisms									
	Control		Rhizobium ®		PSM		*R* + PSM		Mean	
	P_0	P_{50}	P_0	P_{50}	P_0	P_{50}	P_0	P_{50}	P_0	P_{50}
L_0	8.7	11.5	8.9	11.4	9.4	12.6	10.7	14.7	9.4	12.6
L_2	11.6	16.4	13.5	18.5	13.4	18.8	14.6	19.9	13.3	18.4
Mean	10.15	13.95	11.2	14.95	11.4	15.7	12.65	17.3		
	Lime	2.28*		P levels		1.32**	Microorganisms			1.8**

** indicates 5 and 1 per cent level of significance, respectively.

The yield attributes *viz.*, plant height, numbers of nodules, nos. of pods, dry nodule wt., root and shoot dry wt., secondary roots etc. with respect to single plant were also recorded. The exch. Al^{3+} content of the soil (collected after harvest) reduced to 0.19 cmol (p^+) kg^{-1} with liming @ 2.5 t/ha i.e., 82.6 percent less than the control [0.820 cmol (p^+) kg^{-1}]. On the other hand the soil exch. $Ca^{2+} + Mg^{2+}$ and available P increased significantly to 9.34 cmol (p^+) kg^{-1} and 23.83 ppm respectively with liming over their respective controls [5.33 cmol (p^+) kg^{-1} and 12.41 ppm]

Organic farming of groundnut

The experiment was repeated for second year. The treatments taken were (1) Control, (2)$N_{30}P_{50}K_{40}$ (NPK), (3) NPK + lime 0.5 t/ha, (4) 10 t/ha FYM, (5) Mustard cake @ 1 t/ha (MC),(6) FYM + Rhizobium inoculation, (7) MC + Rhizobium (8) FYM + 1/2 NPK + *Rhizobium* (9) Mustard cake + 1/2 NPK + *Rhizobium* and (10) 1/2FYM + 1/2 Mustard cake + *Rhizobium*. The experiment was laid out in RBD with 4 replications. Initial chemical characteristics of the experimental soil was clay loam in texture with pH 4.9, organic carbon 19.2 g/kg and available P content 8.4 mg/kg. FYM used in the experiment contained 0.8, 0.6 and 0.9 percentages of N, P and K respectively. Groundnut cv. TG-22 was used in this experiment.

The pod yield increased significantly with all the treatments over control except NPK. FYM @ 10 t/ha along with *Rhizobium* increased the pod yield significantly over NPK and NPK + lime. Maximum significant pod yield of 24.3 q/ha was obtained with ½ FYM + ½ Mustard cake + *Rhizobium*. The yield attributes *viz.* nos. of pods, nos. of nodules, nodule dry weight, pod dry weight, root and shoot dry weight per plant were recorded. The kernel weight and 100 kernels weight followed the similar trend as that of the pod yield.

Agronomical management of groundnut under rainfed foot hill condition

The performance of groundnut (TKG-19A) was studied with application of nine different treatment combinations of organic and inorganic sources of fertilizers and lime during kharif, 2001. The yield differences affected by different treatments were insignificant. The highest yield (11.89 q/ha) was recorded with P_2O_5 and K_2O (50:50 kg/ha) + lime 2.5 t/ha flowed by P_2O_5 & K_2O (50:50 kg/ha) and P_2O_5 + K_2O (50:50 kg/ha) lime 2.5 t/ha + biofertilizer.

Mustard

In all, eight treatments incorporating organic and inorganic sources of fertilizer alone and in combinations as well as control were tested for their influence on yield and yield attributing characters of mustard (Var. M-27) under rainfed foot hill condition. All the treatments were significantly superior over control. N, P_2O_5 and K_2O (30:30:30 kg/ha) + S ($ZnSo_4$ 20 kg/ha) proved to be the best treatment recording significantly highest yield (9.07 q/ha) over all other treatments. It was followed by N, P_2O_5 and K_2O (30:30:30 kg/ha), FYM + 50% N, P_2O_5 and K_2O, FYM + 50% N, P_2O_5 & K_2O + Sulphur and FYM + S.

Performance of groundnut varieties under rainfed foot hill condition

Among 13 different varieties of groundnut tested, ICGS-65 have given the highest yield (28.67 q/ha) closely followed by ICGV-86590 (28.44 q/ha), TGS-1 (25.33 q/ha), OG-52-1 (25.11 q/ha), ICGS-44 (24.67 q/ha) and VRI-2 (23.11 q/ha). The lowest yield was recorded with VRI-3 (9.11 q/ha) followed by TAG-24 (10.22 q/ha), TG-20(11.78 q/ha) and JL-24 (18.00 q/ha).

Residual effect on mustard

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

Evaluation of different *Rhizobial* strains on groundnut

The experiment was initiated in association with RBDC, Imphal to assess the efficacy of different *Rhizobial* strains on groundnut. The experiment was carried out at Krishnagiri Farm, Langol Hill in split plot design with three replications. Two groundnut varieties were tested *viz.*, 1) TKG-19A and 2) JL-24. Different *Rhizobial* strains tested were *viz.*, 1) Control, 2) TAL-1000, 3) IGR-6, 4) NC-92 and 5) JCG-48. The varieties were kept in the main plots and the *Rhizobial* strains in the subplots. The experimental soil was taxonomically classified as Ultisol. The pod and straw yield data were presented in Table 15.

The yield attributes *viz.*, no. of nodules, no. of pods, dry nodule wt., dry pod wt, plant height, root length, shoot length, root wt., shoot wt. etc. with respect to single plant were recorded and showed significant characteristic difference between the two cultivars and their interaction with the different strains. The cultivars showed significant difference in pod and straw yield. JL-24 gave the highest significant yield over TKG-19A for both pod and straw. IGR-6 and NC-92 strains increased the pod yield significantly over control and TAL-1000. The interaction was significant for both pod and straw yield. The result revealed that all the strains except TAL-1000 could increase the pod and straw yield of JL-24 cultivars significantly. On the other hand these strains had very insignificant impact on the other cultivars. The N and P uptake by the crops (pod and straw) showed similar trend as that of their respective yields.

Table 15. Effect of different *Rhizobial* strains on two groundnut cultivars

Rhizobial strains	Pod yield (q/ha)			Straw yield (q/ha)		
	TKG-19A	JL-24	Mean	TKG-19A	JL-24	Mean
Control	10.88	13.1	11.99	18.53	18.48	18.51
TAL-1000	10.13	13.56	11.85	16.88	18.23	17.56
IGR-6	10.77	18.17	14.47	17.58	26.62	22.10
NC-92	10.27	18.51	14.39	16.67	24.03	20.35
JCG-48	10.55	16.64	13.59	18.19	23.03	20.74
Mean	10.52	15.99		17.57	22.13	
$P_{0.05}$	Pod yield (q/ha)			Straw yield (q/ha)		
Variety (V)	2.67*			3.28*		
Strains (S)	1.94*			3.03*		
V x S		2.74*			2.74*	

Soybean

Performance of soybean varieties under foot hill condition

Among the ten promising varieties of soyabean tested, Pusa-16 (29.83 q/ha) and JS-335 (29.50 q/ha) were comparable and registered significantly higher yield than rest of the varieties. The minimum yield was recorded with MACS-13 (6.08 q/ha) followed by PK-471, PK-472, NRC-2 and Bragg.

Development of package of practice for Thoiding (*Pirella ocymoides*)

Thoiding/Hecy (*Pirella ocymoids*) (*Fami labiatae*) a 'kharif' season oilseed crop commonly grown in hills and used for religious cooking as well as hair purpose. The crop was grown under three fertility levels with three spacing to find out optimum plant population and fertilizer requirement. The

maximum seed yield of 7.24 q/ha was recorded under fertility level of 30:30:30 kg N, P_2O_5 and K_2O/ ha. Among the spacing the highest yield was recorded with 50 x 30 cm. The yield differences as affected by fertility levels and spacing individually were non-significant but interaction (FxS) was significant.

MIZORAM

Groundnut

N.S. Azad Thakur

Under evaluation of groundnut, ten varieties namely, ICGV-86590, NRCG-5953, ICGV-87187, ICGV-86325, ICGS-1, JL-24, NRCG-1407, ICGS-65, ICGS-44 and Girinar-1 were sown in the second week of August at a spacing of 40 x 20 cm. A fertilizers dose of 60-40-40 kg N, P_2O_5 and K_2O ha^{-1} was applied. Lime @ 5 t/ha was applied uniformly well in advance of sowing of the crop. Among all the varieties, ICGV-86590 recorded the highest pod yield of 19.66 q/ha with an average of 40.5 pods/plant having a test weight of 40.20 g. The other varieties showed and yield potential of 15 to 19 q/ha, except ICGS-65, which showed lowest pod yield of 12.91 q/ha. It was observed that the kernels of ICGS-44 were bold and having a test weight of 68.2 g, while ICGV-86325 was recorded highest shelling percentage of 78.76 followed by JL-24 (76.63%). The major insect pests recorded were leaf fodders (*Nacoleia* spp) and *Spodoptera litura.*

Integrated nutrient management in groundnut

K. Laxminarayana

A field experiment was conducted during *kharif* 2001 to study the effect of integrated application of organic and inorganic manures on yield attributes and nutrient uptake of groundnut. The experiment was laid out in three replications in a RBD with 14 treatments *viz.* 50% NPK, 100% NPK, 150% NPK, 100% N, 100% NP, FYM @ 15 t/ha, 100% NPK + FYM @ 15 t/ha, Poultry manure @ 5 t/ha, 100% NPK + Poultry manure @ 5 t/ha, Pig manure @ 5 t/ha, *Rhizobium* inoculation, 100% NPK + *Rhizobium* and control. A fertilizer dose of 80-60-40 kg N, P_2O_5 and K_2O ha^{-1} (100% NPK) was followed. The results showed that highest pod yield (24.03 q/ha) was recorded with the application of 100% NPK + FYM @ 15 t/ha followed by 100% NPK + pig manure @ 5 t/ha (23.87 q/ha) and 100% NPK + poultry manure @ 5 t/ha (22.68 q/ha). That balanced application of NPK has produced highest pod yield in comparison with the application of N or NP. Inoculation of groundnut with *Rhizobium* also showed significant response than the application of 50% NPK. In conclusion, conjunctive use of organic manure and inorganic chemical fertilizers produced highest crop yield and maintains the soil fertility status for longer time.

Mustard

N.S. Azad Thakur and K. Laxminarayana

An evaluation trial was conducted during *rabi*, 2001 to study the performance of 17 mustard varieties (Sangita, Varuna, TM-4, Vaibhav, TM-2, Sharma, Pusa Bahar, RL-3159, Bio-902, Pusa Bala, Rohini, RH-819, Kranti, RH-30, PCR-7, Peela Sona and Hybrid Brown). The crop was sown in the first fortnight of November at a spacing of 2m x 1.5m. A fertilizer dose of 50-50-40 kg N, P_2O_5 and K_2O ha^{-1} was followed. Other intercultural operations were done as per the schedule. The crop was harvested at maturity and grain yield was recorded. Among all the varieties, *Kranti* found to be superior with highest grain yield of 9.94 q/ha followed by RL-3159 (7.92 q/ha), TM-2 (6.92 q/ha) and PCR-7 (6.74 q/ha), while the lowest yield was recorded with *Pisa Bala* (2.42 q/ha).

Insect pests

Aphids and mustard sawfly were observed as the major insect pests. In late sown crop the damage is very high due to pest infestation.

NAGALAND

Oilseed and pulse

Mustard, linseed and sesamum were grown in rainfed condition both for kharif and rabi season. Among mustard variety, TCN-42 and M-27

performed well and recorded highest yield (6.8 and 7.00 q/ha, respectively) followed by TCN-43 (6.59 q/ha). TCN-44 did not perform well for rain-fed condition due to all and long duration nature; however, its productivity was recorded to be 5.47 q/ha.

Besides TCN series and M-27 two more varieties of mustard-Kesari-100 and Pilasona (progeny type) developed by Pro-Agro were evaluated in rain-fed condition as well as in valley land. Pilasono was completely damaged due to severe wilting in valley but the same performed well in rainfed with the production of 4.66 q/ha. Results revealed that the varieties TCN-42 most suitable for rainfed condition. However, performance may be given to the tall with the long duration varieties of mustard wherever irrigation facility is available.

Linseed (Neem) and Sesamum (Local) were also grown and found suitable for foothill under rain-fed condition with the production of 6.0 and 5.5 q/ha.

SIKKIM

Evaluation of optimum plant density and date of sowing of mustard at mid altitude

K.P. Singh

The mustard/toria variety M-27 was sown in split design with different plant densities. The highest seed yield of 11.78 q/ha was recorded when the crop was sown on 15th October, followed by 25th October, 5th November and 15th November sown crop with the production of 11.0, 10.83 and 10.0 q/ha, respectively. Whereas, the highest seed yield of 12.45 q/ha was recorded with 30 x 10 cm, followed by the yield of 10.82 q/ha with 30 x 15 cm spacing.

Performance of mustard/toria varieties at mid altitude conditions

Twelve different mustard/toria varieties were tested at Tadong Farm during rabi 2001-2002 and crop was sown in October last week. Among various mustard varieties, Kranti gave the maximum seed yield of 7.06 q/ha, whereas in toria the highest yield of 7.66 q/ha was recorded with M-27.

TRIPURA

Sesame

K. Chattopadhyay and K. R. Dhiman

Eight lines of sesame were evaluated as summer crop and yield and yield attributing characters were noted under that situation. RAUSS-17-1 gave the highest yield of 12.4 q/ha. This was followed by BS-5-18-6(G)-2 (cream colour seed) (11.7 q/ha) and TRC-1-8-1 (10.9 q/ha). TRC-1-8 was a selection from a cross (BS-5-18-6(G)- x B-67-). This was further improved through single plant selection (TRC-1-8-1) in the previous years. Single plant yield of this line was noted 7g and the average plant height and capsules/plant was recorded 108 cm and 124, respectively.

Yellow sarson

Thirteen selection lines were sown at the end of November, 2001. Among those lines, SCRT-1-2-1 and SCRT-1-2 -3 performed better than others with 16.4 q/ha seed yield. These lines have been continuously evaluated for the last three years at Lembucherra in ICAR, Tripura centre. The average yield data of some selection lines like, SCRT-1-1-5 (13.3 q/ha), SCRT-1-2-3 (13.12 q/ha), SCRT-1-2-4 (13 q/ha), SCRT-1-2-1 (12.9 q/ha) and SCRT-1-1-2 (12.8 q/ha) reveales that they must be considered for multi locational trials in Tripura.

Twentynine lines were selected in the last year from 15 cross combinations on the basis of early ness, pod shape, seed color and seed size. These lines were sown in November,2001 in replicated plots. Some of them showed their huge potentiality of high yield and earlyness.

Mustard

Seventeen varieties of mustard *(B. juncea)* were evaluated in winter to find out suitable, high yielding short duration varieties for irrigated uplands of Tripura. Among the early-matured lines, dwarf variety, TS-38 matured fully within 80 days and performed also well with 7.3 q/ha seed yield. TM-6 matured in 95 days with 9.5 q/ha seed yield and TS-36 also was harvested within that period and yielded 7.65 q/ha. Kranti took more than 105 days to mature fully and the seed yield of that variety was 8.5 q/ha.

Soybean

Twenty five high yielding lines of soybean were evaluated under upland situation in autumn season, 2001, utilizing prolonged rainfall and soil residual moisture. Average yield of this crop was 7.11 q/ha. The best performer was DS-93-79-'A' (10.83 q/ha seed yield). Some other outstanding lines were NRC-21 (10.4 q/ha), MAUS-53-2 (10.0 q/ha), DS-93-108-13 (9.5 q/ha), etc. Number of pods/plant shows the highest positive phenotypic and genotypic correlation with the yield. It also shows high heritability and reveals that selection for this trait may improve yield.

Groundnut

Evaluation of groundnut germplasm for soil acidity tolerance

M. Datta and S. Mitra

Liming ameliorated soil acidity and the effect of liming on the productivity of groundnut was studied to screen out the acidity tolerant germplasm (Table 16).

Groundnut germplasm showing 4.2 to 70.0% and 6.3 to 81.3% decrease in pod and seed yield/ plant upon liming is observed to have tolerance to soil acidity.

Table 16. Effect of liming on groundnut yield (g/plant)

Accession Numbr	Control		Lime		*Percent decrease over control*	
	Pod	Seed	Pod	Seed	Pod	Seed
813	18.5	14.5	10.5	7.0	43.2	51.7
935	8.5	6.5	5.5	4.0	35.3	38.5
945	13.0	10.5	7.0	5.5	46.2	47.6
2670	15.5	2.0	9.0	5.5	41.9	-
3381	16.0	3.0	12.5	8.0	21.9	-
3458	8.0	2.0	4.0	2.0	50	-
4407	12.5	4.5	9.5	7.8	24	-
4472	16.0	3.0	7.5	5.5	53.1	-
4495	25.0	9.0	7.5	7.0	70.0	22.2
4513	17.0	3.0	8.5	6.0	48.2	-
4589	17.5	7.5	13.5	10.5	22.9	-
4594	24.0	14.5	12.5	8.0	47.9	81.3
4607	17.5	11.0	4.5	2.5	74.3	77.3
4654	9.5	8.0	5.0	3.0	47.4	62.5
4680	22.0	4.0	14.0	9.5	36.4	-
4706	17.5	7.0	7.5	4.0	57.1	42.9
6030	15.0	17.0	4.5	3.0	70.0	82.4
6234	17.5	5.5	8.0	4.5	54.3	18.2
6473	12.5	2.5	4.5	3.0	64.0	-
6491	26.5	6.5	7.5	4.5	71.7	30.8
10927	12.0	8.0	11.5	7.5	4.2	6.3
10964	5.0	2.5	3.5	1.5	30.0	40.0
11738	11.0	7.5	6.5	4.0	55.0	46.7
11748	9.0	5.0	3.5	6.0	61.1	-
11924	5.5	3.5	4.5	2.5	18.2	-
11954	6.5	4.0	3.5	2.0	46.2	50
11959	8.0	5.5	3.0	2.0	62.5	63.6

Integrated nutrient management in groundnut

A field trial was conducted in groundnut (var.ICGS 76) with *Bradyrhizobium* (IGR40) and phosphate solubilizing bacteria *(Bacillus Polymixa)*. It was observed that *Bradyrhizobium* and PSB in combination with phosphate and lime produced 19.6 to 18.7% and 20.9 to 29.1% increase in pod and haulm yield over control, respectively. 100 pod and seed weight insignificantly varied from 117 to 143g and 88 to 109 g with 71.5 to 85.2 shelling percent.

Integrated disease management of oilseed crops

Groundnut

Thirty lines of groundnut were received from ICRISAT for screening against early leaf spot and late spot diseases of paddy. Late leaf spot disease (*Phaeoisariopsis personata*) has been found to be predominant. Dark black spots of 1.4 - 1.88mm in diameter covered the entire leaflets. Lesions are darker on the lower surface. The late leaf spot disease covers the entire leaflet, and no variety has been found to be free from late leaf spot disease. Fungicides used were carbendezim, dithiocarbamate, captan, copper oxychloride. JL-24 could not stand due to high inoculum pressure. Among the fungicides carbandezim @ 1g/litre proved to be effective. Captan, Dithiocarbamate and copper oxychloride ranked after carbendezim.

Screening of groundnut cultivars against collar rot disease

The outbreak of collar rot disease was first noticed in Tripura Centre. The cultivar showed the symptoms of rotting of the collar portion. Succulent elongated *hypocotyl* was attacked by the pathogen at ground level causing the death of the seedlings. The *hypolosyl* was damaged both by soil borne inoculum and by the inoculum already present cotyledons. The hypolotyl developed water soaked

light brown lesions. ICG 10936 as found to be moderately tolerant to collar rot.

Diseases of mustard & sesamum

Two major diseases of mustard - leaf spot (*Alternaria brassica*) and powdery mildew (*Erysiphè cruciferam*) were found to occur in *rabi* season whereas charcoal rot of sesamum (*Macrophomina phaseoli*) was the major disease.

BIOFERTILISER

MEGHALAYA

Performance of *Azolla* (*Azolla caroliniana*) to the level and sources of phosphorus and varying depth of water

U.K. Hazarika, A.S. Panwar and D.C. Saxena

The experiment was conducted for the second consecutive year to assess the production potential of *Azolla* under different water levels and varying doses of phosphorus. It was observed that increase in pond water depth up to 15 cm increases green biomass yield of Azolla. Among the sources of nutrients supply (phosphorus) highest biomass to the tune of 181.9 kg/year/pond of 6 m^2 (37.38 t/ha/year) was recorded with the application of 20 kg P_2O_5 through SSP, while FYM produced only 138.6 kg/ha/pond (27.70 t/ha/year) (Fig.18).

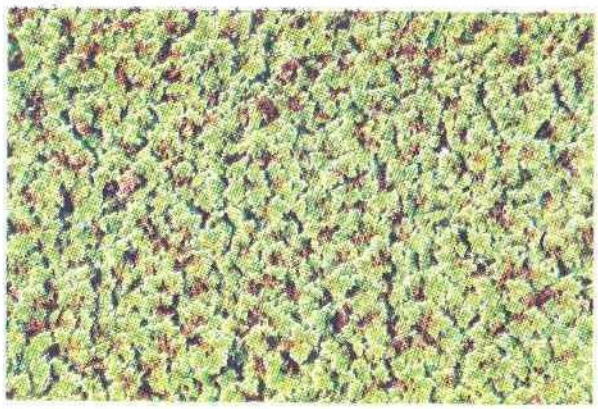


Fig 18. Azolla - a bio-organic source of nutrients

Utilization of organic wastes and mineral fertiliser in improving the soil quality and crop productivity in Meghalaya

N.P. Singh, D.C. Saxena and L.J. Bordoloi

Preparation of PSN Compost was started in March, 2002. The well decomposed Compost was harvested in the last part of June, 2002. The harvested compost was applied @ 10t/ha to *Kharif* Rice (RCPL–1-87-8) to study its effect on growth and yield of the crop. The *Kharif* Rice was transplanted on first week of July, 2002. At present analytical works are going on in the laboratory to determine the nutrient status of the compost as well as to study the nutrient uptake pattern by the crop from different organic (compost) and inorganic (fertiliser) sources.

WEEDS

Weed survey in Meghalaya

Rajesh Kumar, N.P. Singh and U.K. Hazarika

During Kharif season of 2001, survey of weed flora in abandoned *Jhum* and cropped land of Umsaw, Umsning and part of Umroi was conducted. The data revealed that dicotyledonous weeds were more dominant than monocot weeds in the recently abandoned *Jhum* land. Among the dicot, weeds of compositae family were more than others species. In *Jhum* land abandoned for more than two years, weeds of Poaceae and Cyperaceae family were more dominant. Importance value index (IVI) of dominant weed species for the three location *i.e.*, Umsaw, Umsning and Umroi were *Galinsoga parviflora* (41.7, 28.1, 76.3), *Ageratum conyzoides* (18.2, 50.1, 41.5) and for *Spilanthus acmella* (11.4, 16.0, 4.8). Among the monocot weeds recorded, *Imperata cylindrica* and *Digiteria* sp. showed the highest relative density (29.0, 14.1,26.9 and 10.6, 17.4, 9.7). *Cyperus iria* had the highest relative density (18.7 and 23.4) in rice field of Umsaw and Umroi whereas; in Umsning, *Echinochloa crusgalli* had the maximum relative density (13.5). Ginger crop surveyed in

Umroi showed that the relative dominance of *Ageratum conyzoides*, which was followed by *Galinsoga parviflora* (21.2) as the second most dominating weed.

Weed shift studies

Rajesh Kumar and N.P. Singh

The study was undertaken to assess the dynamics of weed due to crop rotation, competition among the various species and herbicides application in the experimental plots. It was observed that there was distinct change in the weed flora composition in lowland rice. During 1989-91, weed species like *Monochoria* sp., *Echinochloa crusgalli* and *Echinochloa colonum* were the dominant species. While, during 2000-2001, the weed species *cyperus iria, scirpus* sp. and *Rotala rotundifolia* were the most dominant one. Under upland condition, weed species like *Galinsoga parviflora, Ageratum conyzoides* etc continued to be dominant species.

MUSHROOM

MEGHALAYA

Mushroom cultivation

Satish Chandra, A.K. Singh and Y.P. Sharma

Effect of supplementation on yield of Pleurotus sajor-caju

The experiment was conducted as per guidelines provided by All India Coordinated Mushroom Improvement Project during September-November 2001. Six supplements i.e. neem cake, wheat bran, rice bran and cotton seed cake each @ 5% dry wt. of substrate and soybean meal and deoiled soybean @ 2% dry wt were tested. The unsupplemented chopped paddy straw substrate served as check.

Rice bran supplement recorded the highest yield (1864 g / 6 kg wt. straw), followed by neem cake (1774 g). These two supplements were significantly (P = 0.05) different from un-supplemented check (1339 g) but were statistically at par. The lowest yield (1092 g) was recorded in cotton seed cake supplement. Wheat bran (1625 g), soybean meal (1189 g) and deoiled soybean (1322 g) were not significantly different from check. The biological efficiency ranged from 67% (check) to 93% (rice bran). Rice bran supplement could increase yield by 39% when compared to unsupplemented check.

MANIPUR

Standardization on cultivation of *Lentinus edodes* (Shiitake)

Trials were conducted to compare and standardize cultivation of Lentinus edodes (shiitake in Japanese) on different woods and saw dusts of local materials.

Cultivation on wood logs

Wood logs of *Quercus serrata, Q. acutissima, Alnus nepalensis, Sachima wallichii, Castanopsis* sp. felled in the months of November and December were drilled with small holes of 1x1 cm and 1.5 to 2 cm deep at a distance of 20-30 cm long axis and 6 cm between each row alternating the rows. Spawning was done in the month of January end to second week of February by inserting wood plug spawn and sealed with paraffin wax. The log size of 15 to 20 cm dia was selected for all the treatments. They were kept in shade/ shed in the flat piles and after eight months kept in slanting position leaned against supports with proper watering and wetting logs and gunny bags (Fig19).

Fig. 19 Cultivation of mushroom on wood logs

Fruiting on wood logs of *Quercus* spp. started 18 months after spawning. In *Alnus nepalensis* fruiting took 16-17 months. However, the yield on *Alnus nepalensis* was 1/3 lower than that of *Quercus* species, *Sachima wallichii* could not produce any fruiting as more contaminations were observed with other moulds and fungi.

Cultivation on saw dust

Non resinous saw dust of *Phoebe sp., Michelia champaca, Cinnamomum cecicodaphne, Ailanthus spp., Gmelina arborea, Mangifera indica, Melia azadirachta* etc. were collected and treatments of (1) saw dust mixture (80%) + Rice bran (20%), (2) saw dust mixture (70%) + rice bran (20%) + dried leaves of oaks (10%), (3) saw dust mixture (50%) + Paddy straw (40%) + rice bran (10%) were selected for cultivation of *Lentinus edodes*. In all the treatments $CaCO_3$ of 0.2% were added. Spawning completed in the 1st week of January.

The ingredients thorough mixed were adjusted to water content 60-65% (saw dust 2 months after collection soaked in water overnight and powdered leaves and rice straw for 2-3 hrs.). About 3-4 kgs of substrates is filled in polypropylene bags (500x160mm) immediately and heat/steam treatment is given. After cooling, the bags were inoculated with saw dust/wood plug spawn and covered the holes with adhesive tape. The polypropylene bags were removed when mycelia bump formation turned brown.

On synthetic saw dust logs, the saw dust mixture with rice bran gave the highest yield followed by mixture with oak leaves in the first year.

NAGALAND

Cultivation of mushroom

B.P. Hazarika, D.C. Baruah and Joseph Kikon

To popularize mushroom cultivation among educated and unemployed youth of Nagaland, artificial mushroom production was undertaken. Efforts were made to cultivate the *Pleurotus sp* .of mushroom by using un-chopped paddy straw instead of chopped one to reduce the cost of labour. In this method, yield of mushroom was slightly higher. During the same time, mushroom spawn production is also undertaken in the centre.

FRUITS

MEGHALAYA

Citrus improvement

A.K. Dubey and D.S. Yadav

Soft wood grafting in Khasi mandarin

Khasi mandarin was propagated through soft wood grafting on different rootstocks namely *Citrus volkamariana, C. latipes, C. grandis, C. reshnii* and *C. taiwanica*. The results indicated that percent success (80 %), plant height (38.40 cm), scion length (20.30 cm) and diameter (17.85 mm) were highest when *Citrus grandis* was used as rootstock. However, highest graft survival (73.90%) was recorded in *Citrus latipes*, followed by *Citrus volkamariana* (72.64%) and *C. grandis* (70.95%). The results also indicated that 16-20 cm long root stock produced maximum sprouts (8.00), length of scion (10.5 cm) and leaves per scion (15.40 cm) as compared to 8-10 cm long root stocks. Scion containing different internodes viz. 3-5, 6-8, 9-11 and 12-14 were used to standardize the length of scion for soft wood grafting.

Field evaluation of softwood grafted plant of Khasi mandarin

Khasi mandarin grafted on different rootstocks viz. *Citrus latipes*, Rangpur lime, and *Citrus volkamariana* were planted in field for evaluation. Maximum mortality was observed in *Citrus volkamariana*. The plant height (100.30 cm), stem diameter (2.33 cm) and plant spread (80 cm, 70.87 cm) was found to be highest when Rangpur lime was used as rootstock.

Effect of plant growth regulators

The foliar application of GA_3 and urea significantly increased growth of *Citrus latipes* and

Fig 20. Khasi mandarin in bearing

Citrus reshnii. Application of GA_3 - 30 ppm + 1% urea induced highest stem girth, whereas plant height was found to be highest when GA_3 - 50 ppm alone was sprayed on *Citrus latipes*.

Studies on effect of different chemicals on seed germination of Khasi mandarin

Among the different chemicals (KH_2PO_4, Ascorbic acid, GA_3 and KNO_3), percent germination was recorded highest (61.50%) when seeds were treated with KNO_3 at 2.5% concentration for 12 hours. The plant height (15.43 cm) and leaves per plant were found to be highest with the treatment of 3% KH_2PO_4 for 18 hours. Dipping of seeds in 500 ppm concentration of Ascorbic acid induced highest root spread (14.00 cm).

In vitro proliferation ability and control of pre-harvest fruit dropping in citrus

K.D. Babu and D.S. Yadav

Ten week old ovules of Khasi mandarin, Assam Lemon and Kagzi Lime were inoculated in Murashige and Skoog media supplemented with Malt Extract 500 mgl^{-1} to study their proliferation ability *in vitro*. Maximum number of shoots was noticed in Khasi mandarin (5.9), whereas Assam Lemon registered the maximum number of nodes (4.11), shoot length (13.5 cm) and culture weight (0.12 g). Kagzi lime was found to be intermediary with respect to its ability to proliferate *in vitro*.

Control of pre harvest fruit drop in Khasi mandarin

A field experiment was conducted in RBD with nine treatments and five replications to control the pre harvest fruit drop in Khasi mandarin (*Citrus reticulata* Blanco) during the year 2000 and 2001 using growth hormone 2,4 - D (20 ppm), fungicide Carbendazim(0.1%) / Bordeaux mixture(1%) and micro nutrients $ZnSo_4$(0.5%) + $MnSo_4$(0.5%) + $MgSo_4$ (0.5%) alone and in different combinations besides Paclobutrazol 20 ppm. All the treatments were found to be effective in controlling the fruit drop significantly. However the combination of 2,4-D + Carbendazin / Bordeaux mixture + $ZnSO_4$ + $MnSO_4$ + $MgSO_4$ was found to be the best with minimum pre harvest fruit drop (8.39%), maximum drop control efficiency (64.22 %) and maximum retention of fruits after drop (528.0 fruits/tree). The untreated control registered the maximum fruit drop (23.45%) and minimum retention of fruits after drop (312.0 fruits/tree) (Fig. 20).

Foliar fertilization of secondary and trace elements to Kinnow mandarin

A trial was conducted to establish the effect of magnesium, zinc and manganese on yield and quality parameters of Kinnow mandarin. Tree foliage sprayed with magnesium sulphate(0.5%), zinc sulphate(0.5%) and manganese sulphate(0.5%) alone and in different combinations. The maximum number of fruits (246.2) and yield (34.07 kg) were recorded with the application of zinc sulphate(0.5%) + manganese sulphate(0.5%) spray. Maximum fruit weight (140.0 g), fruit volume (154.5 ml), fruit length (62.4 mm), fruit diameter (69.2 mm), rind thickness (5.9 mm), total soluble solids (10.8%), TSS/acid ratio (13.00) and ascorbic acid (37.5 mg/100g) were registered by magnesium sulphate + zinc sulphate + manganese sulphate. The highest juice content (38.75 %) was recorded by zinc sulphate + manganese sulphate as well as magnesium sulphate + zinc sulphate + manganese sulphate spray. The untreated control registered the minimum values for most of the characters.

Evaluation and development of agrotechniques for some important fruit tree species

K.D. Babu and D.S. Yadav

Guava

Nine-year-old guava hybrids (*Psidium guajava* L.) evolved at this institute were evaluated for various horticultural traits. Out of nine hybrids, Hybrid-3 recorded the maximum yield (36.35 kg/tree) and maximum number of fruits/tree (252.00), followed by Hybrid-1 (30.93 kg/tree). However, Hybrid-7 registered the maximum fruit weight (153.12 g). The seed content was found to be the least in Hybrid-7. Total soluble solids were the highest in Hybrid-7 (11.50 %), followed by Hybrid-1 (11.20 %) whereas the maximum ascorbic acid content was noticed from Hybrid-3 (260.25 mg/100g), followed by Hybrid-1 (245.20 mg/100g).

Chinese goosberry

The fruits of four cultivars of Chinese gooseberry (*Actinidia chinensis* Planch) viz., Allison, Monty, Bruno and Abbott were evaluated for physico-chemical properties. The fruit length was maximum in Bruno (66.60 mm). The maximum fruit weight (68.44 g) and fruit volume (67.20 ml) were noticed in case of Abbott. The total soluble solids were the highest in Allison (15.60 %). Bruno recorded the highest amount of ascorbic acid (171.20 mg/100g) and acidity (1.98 %). The least amount of ascorbic acid (91.50 mg/100g) and acidity (0.89 %) were found in Allison whereas the total sugars were the highest in Allison (10.16 %).

Papaya

Seeds of fourteen varieties of papaya (*Carica papaya* L.) were collected and treated with GA_3 at different concentrations (0,75,150,225 ppm) for 4 hours. The treated seeds were sown in nursery and observed for characters like germination percentage, seedling length, vigour index and time taken for germination *i.e.* 60 days after sowing. The 1000 seed weight of the cultivars ranged from 12.02 g to 17.23 g with Coorg Honey Dew having the maximum, followed by Pant papaya-1 (16.74 g) The untreated control recorded the maximum time taken for germination (31.84 days) with minimum values for other characters under study. Increase in GA_3 concentration upto 150 ppm significantly increased the germination percentage (66.17 %), seedling length (17.39 cm) and vigour index (1368.04) and minimum time taken for germination (29.72 days). But higher concentration of 225 ppm was not found beneficial in improving the characters under study. The untreated control recorded the highest time taken for germination (31.84 days) with minimum values for germination percentage (42.40 %), seedling length (10.98 cm) and vigour index (469.14). The maximum germination percentage (84.00 %), seedling length (20.00 cm), vigour index (1679.20) were recorded by Coorg Honey Dew and the minimum time taken for germination (27.00 days) was recorded by Pant Papaya-1 at GA_3 150 ppm concentration.

Peach

Physical thinning in peach variety TA-170: The shoots of 90 –100 cm length were chosen in peach (*Prunus persica* (L) Batsch) variety TA-170 to standardize optimum thinning interval between fruits. A thinning interval of 5,10,15,20 and 25 cm were adopted and the excess fruits were removed. An increase in thinning interval from 5 to 15 cm brought out significant increase in fruit weight (55.24 g) fruit length (60.12 mm), fruit diameter (59.00 mm), fruit volume (57.20 ml), total soluble solids (12.80 %), ascorbic acid (225.00 mg/100g) and total sugars (6.32 %). Further increase in thinning interval beyond 15 cm was not effective in significantly improving the fruit characters. Thus a thinning interval of 15 cm was found optimum for obtaining good quality fruits.

Chemical thinning in peach variety Flordasun: 2,4- D (50, 100 ppm), GA_3 (100, 200 ppm), thiourea (2, 3 %) and carbaryl (0.06, 0.10 %) were foliar sprayed at full bloom stage on peach variety Flordasun. All the treatments were significantly effective in improving the fruit characters over the control. The best thinning was obtained with thiourea 3 % on 50 days after spraying which resulted in minimum fruit retention (48.50 %). The best results for fruit weight (57.64 g), fruit length (58.85 mm), fruit diameter (57.40 mm), fruit volume

(59.50 ml), total soluble solids (12.85 %), titrable acidity (0.70 %) ascorbic acid (212.30 mg/100g) and total sugars (6.15 %) were found with the spray of GA_3-100 ppm besides the least incidence for leaf curl (1.60 %) on 15 days after spraying.

Standardization of leaves to fruit ratio (LFR) in peach variety Shane Punjab: A study was taken up to determine the optimum LFR for best quality fruits in peach variety Shane Punjab. Among the various LFR maintained (control, 10:1,20:1,30:1,40:1 and 50:1), the best quality fruits with respect to fruit weight (48.10 g), fruit length (48.85 mm), fruit diameter (49.00 mm), fruit volume (50.20 ml), total soluble solids (12.30 %), ascorbic acid (220.50 mg/100g) and total sugars (6.10 %) were obtained with an LFR of 30:1. A wider LFR of 40:1 and 50:1 were not found to be effective in significantly improving the characters under study.

ARUNACHAL PRADESH

Orange

Studies on compatibility of rootstock on scion of mandarin orange

An experiment was conducted with four varieties of mandarin orange (Khasi mandarin, Nagpur santre, Hill mandarin and Sikkim orange) on different rootstocks (Tanyum, *Citrus volckamariana*, Karna khatta, Rough lemon, *Citrus latipes* and Trifoliate orange). Maximum plant height (55.1 cm) and stem diameter (1.7 cm) was recorded with Hill mandarin on *Citrus latipes* rootstock after one year planting of scion. Tanyum local rootstock showed significant effect on number of branch (4.7) per plant in case of Khasi mandarin, Karna Khatta on length of new shoot (21.0 cm) in case of Sikkim orange as scion. Maximum canopy spread was recorded to be 36 cm x 27 cm with Khasi mandarin on Trifoliate Orange rootstock. Performance of Nagpur santre on different rootstock showed that shoot (10.9 cm), number of branches (3.4) per plant and plant height (40.7 cm) were highest with Tanyum (Table 17).

Table 17. Vegetative growth of mandarin orange on different rootstocks

Treatments	Plant height (cm)	No. of branches per plant	Length of shoot (cm)	Canopy spread (cm)	Stem diameter (cm)
Khasi mandarin on Tanyum	37.1	4.7	13.0	21 x 18.3	1.3
Khasi mandarin on *C. volckamariana*	43.0	2.3	8.4	14 x 14.8	1.1
Khasi mandarin on Trifoliate orange	30.3	2.0	8.0	36 x 27	1.2
Sikkim orange on Tanyum	37.9	3.0	14.7	22 x 23.3	1.1
Sikkim orange on Rough lemon	21.0	3.0	7.0	23 x 32	1.4
Sikkim orange on Karna khatta	43.0	2.0	21.0	20 x 23	1.1
Hill mandarin on Tayum	54.2	2.0	18.5	32.5 x 26.5	1.45
Hill mandarin *C. latipes*	55.1	3.0	17.8	27.5 x 30.0	1.70
Nagpur santra on *C. volckamariana*	38.5	2.5	10.7	27 x 20	1.3
Nagpur santra on Tanyum	40.7	3.4	10.9	25 x 22.8	1.2

Effect of rejuvenation (Top Working) on vegetative growth of old Khasi mandarin

A top working schedule on rejuvenation was laid out in an old declined orchard of Khasi mandarin with five treatments including un-pruned control during 2001. The trees were detopped at three different heights of the main trunk (0.5 m, and 1.5m) and all primary branches pruned of a tree. Data on vegetative growth parameters viz. number of new shoots per tree, average length of new shoots and proximal diameter of new shoots, were recorded in the month of March 2002 (Table 18).

Table 18. Rejuvenation of old declining orchard of Khasi mandarin by top working

Treatments	No. of new shoots/tree	Length of new shoot (cm)	Diameter of proximal end ofnew shoot (cm)
Detopping (Metres)			
0.50	20.4±8.47	88.10 ±5.52	0.747±0.245
1.00	43.3±26.58	76.62±29.02	1.274±1.83
1.50	90.6±25.40	90.70±25.57	0.964±0.89
All primary branches pruned	277.9±40.50	85.96±24.00	0.862±0.18
Control	11±10.70	17.13±7.05	0.49±0.13

Varietal/genotypic evaluation of different fruits

L.C.De

Peach

Among three varieties of peach, Sarbati showed highest growth and bearing. It attained a height of 4.10 meters, maximum basal diameter of 6.63 cm and canopy spread 9356.0 cm x 367.0 cm) and produced highest number of fruits per plant (249), followed by Floridasun and T.A 170. Average weight of fresh fruits (5 Nos.) was recorded maximum in T.A. 170 (205 g) followed by Sharbati (171 g) and Floridasun (125 g).

Guava

In general, Allahabad Safeda showed better growth in terms of plant height, basal diameter and canopy spread than L 49. Closer spacing improved plant height and canopy spread in Allahabad Safeda. At 4m x 4m spacing, Allahabad Safeda attained 1.62m plant height, 3.7cm diameter and 155 cm x 162cm canopy spread whereas at 4m x 3m with 1.99m plant height, 3.7cm diameter and 207 cm x 177cm canopy spread. Maximum canopy spread (207 cm x 177 cm) was recorded with Allahabad Safeda at closer spacing).

Aonla

In the forth year of planting, vegetative growth of aonla varieties was studied. Out of six genotypes (NA-6, 7, 10, Kanchan, Chakaiya, Assam local), Assam local had maximum plant height (309.5 cm), maximum basal diameter (7.52 cm) and canopy spread (299 cm x 269.2 cm). Slowest growth was recorded in Chakaiya (186 cm plant height, 4.64 cm basal diameter and 153.6 cm x 153 cm canopy spread.

Banana

Reproductive performances of 30 varieties of banana established in germplasm block were recorded. Among them, Pakte (local) had highest bunch weight 926 kg) followed by Jahaji 912.50 kg), Vannan (9.7 kg), Malbhog (9.3 kg), Chini Champa (8.6 kg). Rasthali Robusta (8.1 kg), Kait Khullang (7.2 kg), Kanai basi (7.1 kg), Gross Michel (6.4 kg), Karpure Chakrakeli (5.3 kg). Red banana (4.1 kg), Bharat mani (2.3 kg), Garo maina (2.2 kg) and Dokli (1.6 kg). Maximum number of fingers per hand was recorded in Vannan and minimum with Jira banana. Pulp recovery of single finger was recorded highest in Pakte local (116.2 g) and lowest in Jira banana. Both Jahaji and Pakte Local showed maximum number of hands per bunch (Fig.21).

Fig 21. Germplasm evaluation of Banana

MANIPUR

Evaluation of subtropical, temperate and indigenous fruit crops

Post harvest studies on guava

Guava fruits are highly perishable and can be stored only for a few days at room temperature and experience moisture loss, surface enzymic browing, shrivelling and development of fungal rots on storage beyond one week. Therefore, an experiment was undertaken to study the effect of various post harvest treatments on shelf life and quality of guava variety Allahabad safeda. Six treatments were tried comprising of 500 ppm Bavistin, 100 ppm $KMnO_4$ (ethylene absorbant), 8% $CaCl_2$ and 200 ppm Gibberellic Acid (GA_3). The fruits subjected to various treatments were kept under refrigerated conditions at 5°C temperature and 85-90% relative humidity where as control fruits were kept under room temperature.

Among various treatments tried, fruits treated with Bavistin 500 ppm + GA 200 ppm recorded superior keeping quality (31.24 days), lower titrable acidity (0.26%), high reducing sugar (4.88%), non

reducing sugar (1.94%) and total sugar (6.82%) at 24 days after storage. Followed by this, fruits treated with Bavistin 500 ppm + $KMnO_4$ 100 ppm and Bavistin 500 ppm + $CaCl_2$ 8% recorded superior biochemical parameters and shelf life.

Management of fruit drop in mango cv. Moreh

Though flowering and fruit set are profuse in the Moreh cultivar of mango, fruit drop is a serious impediment in increasing its productivity. To regulate the fruit drop , an experiment was conducted using plant growth regulators such as NAA and GA3 at 3 levels of 20, 40 and 60 ppm each in six year old orchard. The mean values of various yield characters showed that the treatments varied significantly for number of fruits, weight of fruits and yield per plant. Among the various treatments tried plants treated with 60 ppm GA_3 recorded highest number of fruits (19.67) per plant, maximum values for fruit weight (270.83 g), TSS % (12.63%) and fruit yield per plant (5.70 kg). This was followed by plants treated with GA 40 ppm with significant improvement in all the parameters studied except for average fruit weight

MIZORAM

Guava

N.S. Azard Thakur

The saplings of *Allahabad Safeda* were planted in 1986 at a spacing of 5 x 5 m. A fertilizer dose of 600-400-300 g of N, P_2O_5 and K_2O along with 20 kg of FYM per plant was applied. Average yields of 41.8 kg (396 fruits) per plant with an average weight of 105.4 g. were recorded

NAGALAND

Banana

Naresh Babu

Effect of weed management practices on growth, yield and quality of banana

A field experiments was laid out with eight treatments in a randomized block designed with three replications during 2000-2001 to study the effect of different weed management practices on growth, yield and quality of banana cv. Jahaje. Results indicated maximum height (141.08 cm) and girth (57.33 cm) of pseudostem in hand weeding treatment, followed by black polythene mulch. However, number of functional leaves were not influenced significantly though leaf production and leaf area showed significant increase among different treatments. Varying fingers per bunch of different weed control measures showed significant increase in yield (Table 20). The mulch of black polythene significantly influenced the chemical composition of the fruits. Ascorbic acid content was highest (6.83 mg/100 g of pulp) under black polythene mulch and lowest in control (Table 21).

Table 19. Effect of various post harvest treatments on keeping quality of guava fruits

Treatments	Self life	TSS (%)	Acidity (%)	Sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Physio-logical loss of weight (%)
T_1-Bav. 500ppm + $KMNO_4$ 100 ppm	30.17	10.72	0.195	4.51	2.11	6.62	2.21
T_2-Vab 500 ppm + $CaCl_2$ 0%	30.38	11.46	0.288	4.21	2.36	6.56	3.46
T_3-CaCl2 8% + $KMNO_4$ 100%	32.17	11.3	0.31	4.89	0.49	5.38	4.76
T_4-GA 200 ppm	31.93	10.93	0.42	4.57	1.75	6.32	2.83
T_5-Bav 500 ppm + GA 200 ppm	31.24	10.77	0.26	4.88	1.94	6.82	7.19
T_6 (Control)	11.20	10.18	0.56	4.03	1.67	5.70	32.47

* Observations recorded after 8 days of storage

Table 20. Effect of different weed management practices on growth and yield of banana

Weeding management practices	Pseudo-stem height (cm)	No. of functional leaf	No. of fingers/ bunch	Yield (kg/ bunch)
Hand weeding	141.08	10.12	60.44	16.74
Banana trash mulch	122.73	9.13	52.81	14.35
Paddy trash mulch	120.28	8.92	56.13	12.61
Black polythene mulch	137.58	11.17	63.56	17.29
Double crop of French bean	123.33	9.42	46.87	12.17
Double crop of cow pea	121.29	9.92	47.22	13.80
Glyphosate (3 ml/lit.)	127.50	10.05	55.23	14.08
Control	117.60	7.36	43.35	10.45
C.D. at 5%	4.56	NS	7.40	3.68

Table 21. Effect of different weed management practices on quality of banana

Weeding management practices	TSS (0brix)	Acidity (%)	Total sugars (%)	Ascorbic acid content (mg/100 g of pulp)
Hand weeding	24.43	0.41	15.74	6.07
Banana trash mulch	24.63	0.40	16.30	6.13
Paddy trash mulch	21.48	0.46	14.34	4.95
Black polythene mulch	25.74	0.37	16.32	6.83
Double crop of French bean	22.80	0.49	13.07	3.46
Double crop of cow pea	22.09	0.44	13.84	5.54
Glyphosate (3 ml/lit.)	23.62	0.39	14.45	5.76
Control	19.26	0.53	11.43	4.11
C.D. at 5%	2.46	0.06	2.60	NS

Effect of weed management practices on the nutrient uptake of banana

Studies undertaken with 7 weed management practices showed that all weed control treatments significantly reduced the total weed population and weed dry weight as compared to control. The highest weed control efficiency (90.53%) was recorded with the use of black polythene mulch. Observations revealed that the uptake of nutrients, *i.e.*, N, P_2O_5 and K_2O was significantly higher in unweeded plot (94.21, 21.36 and 23.15 kg/ha, respectively) while the lower uptake of these nutrients was obtained under black polythene mulch. Weed population caused considerable reduction in the nutrients uptake by the banana plants and reduced the yield (47.84%).

Papaya

Naresh Babu and Anamika Sharma

Performance of twelve papaya cultivars was tested during 2000-2001. Results showed that the fruit set, number of fruits per plant, pulp and pulp/ peel ratio was significantly higher in Pusa Delicious while the fruit length, width and weight was the highest under Pusa Giant, followed by Pusa Dwarf. Seed and peel percentage was significantly lower with Pusa majesty and Co4, respectively. Plant height was significantly more in Pusa Giant while the yield was higher in Coorg. Honey dew (41.07 kg/plant), followed by Pusa Majesty. The highest total carotenoids, total sugars, sugar-acid ratio, ascorbic acid and TSS was found in Pusa Dwarf, Honey Dew, Co5 and Pusa Delicious respectively. Titrable acidity varied from 0.10 to 0.21 per cent (Table 22).

Table 22. Fruit quality of different cultivars of papaya

Cultivars	Total carotenoids (mg/100g)	Total sugar (%)	TSS (%)	Ascorbic acid (mg/100g)
Co-1	5.21	10.96	13.60	62.52
Co-2	6.80	11.50	14.51	47.50
Co-3	7.39	10.16	13.50	41.86
Co-4	5.79	8.02	10.90	55.32
Co-5	4.52	10.12	13.70	71.86
Co-6	3.85	11.61	11.55	28.37
Pusa Dwarf	7.73	10.40	13.26	37.75
Pusa Delicious	5.63	9.86	14.08	56.84
Pusa Giant	3.38	10.26	9.14	71.46
Pusa Majesty	7.51	10.95	9.58	56.91
Coorg Honey Dew	6.85	11.40	10.90	47.29
Honey Dew	5.62	12.45	10.61	41.89
C.D. at 5%	1.82	2.10	2.55	4.56

SIKKIM

Kiwi fruit

Performance of different cultivars

Unlike previous year, four cultivars were evaluated for their growth and yield performance

under mid hill condition. There was not much variation in the morphological character of different cultivars. Flowering was first noticed between third weeks of April in Allison but fruiting was found to occur at an early date in Bruno. Monty was observed to be late bearing variety. The fruits of variety Bruno were biggest in size (7.03 cm length) with maximum juice content (17.16 ml). The variety Abbott was found to be prolific bearer 9229.46 fruits) but the fruit yield in terms of kg per vine was recorded to be highest (13.48) in Allison. The fruits of Allison were highest in TSS (15.37°B) and lowest in acidity (1.31%). There was no difference in the moisture content of different cultivars and it was remained in between 85.94 to 86.61%.

Effect of pruning and manuring

The result of a trail with four pruning intensity (5, 10, 15 and 20) indicated that more the number of buds left on the cane, the more was the number of shoots. The shoot which grew from first bud carry no or few flowers but thereafter the number of flowers per shoot increased to a maximum of 5 or 6, which remained constant along the entire length of the cane. The cane pruned to 15 buds produced significantly higher yield than other treatments. None of the pruning intensity did affect the physico chemical characteristics of the fruits except that of size and juice content of the fruit, which decreased with increasing number of buds per cane. An application of 1000 g N, 500 g K_2 and 1000 g P_2O_5 was found to be optimum for better growth and development of eight years old vine.

Propagation of different cultivars

In a propagating trial with five concentrations of IBA (0, 2000, 4000, 6000 and 8000 ppm) and three types of cutting (hardwood, semi-hardwood and softwood cutting) on different cultivars showed that in all types of cuttings, application of IBA increased the percentage of rooting and number of roots per cutting. Maximum rooting (88.0%) was obtained when the softwood cuttings were treated with 6000 ppm of IBA while lowest (12.0%) was noticed in untreated hardwood cutting. Irrespective of the type of cutting and IBA conc., the variety Monty produced less number of roots per cutting. In varieties Abbott, Allison and Bruno, cutting taken from distal portion of the shoot was found to be best in their rooting ability while in Monty, cutting taken from middle portion of shoot rooted better.

Passion fruit

Germplasm collection

A total of seven germplasm were collected from different sources and maintained under field condition for further evaluation of important characters (Fig 22).

Seed germination

Freshly extracted seed treated with 0.2% bavestin were sown in the raised nursery bed at a depth of 5.0 cm in last week of February. The beds were mulched with dry grasses and watering was done regularly with the help of rose cane. About 68.0% germination was recorded within 20 days of sowing.

Fig 22. Passion fruit - a new introduction

VEGETABLES

MEGHALAYA

Improvement of Solanaceous vegetables

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

Tomato

Twenty-six varieties of tomato were evaluated during spring/summer grown in rainy season in open

condition. The varieties namely PSR-364 (275q/ha), CHRT-4 (250q/ha), Sel-7 (238.5 q/ha) and Sel-1 (235 q/ha) were found to be high yielders. Data on yield and quality parameters of five promising varieties are mentioned in Table 23.

Table 23. Yield and quality parameters of five promising tomato varieties

Varieties	Plant height (cm)	No. of branches	Fruit weight (g)	Yield (q/ha)	Pericarp (or) Epicarp thickness (cm)	TSS (%)	Acidity (%)
PSR-364	59.20	4.80	49.00	275.00	0.47	5.00	0.49
CHRT-4	37.80	4.00	41.50	250.50	0.55	4.00	0.58
Sel-7	32.40	5.60	57.11	238.50	0.46	5.15	0.81
Sel-1	38.60	4.00	71.00	235.50	0.70	4.20	0.69
Pusa Gaurav	54.00	5.00	43.33	216.67	0.51	4.20	0.36

Breeding for disease resistance in tomato: Five advance lines showing tolerance to late blight were selected from a population of F_4 generations. Seeds were collected for generation advancement and selection.

Generation advancement and evaluation in tomato: Families of F_3, F_5 & F_6 progenies were evaluated and individual plant selection was made. Seeds of 58 lines were collected for further generation advancement and evaluation.

Effect of paclobutrazol (PP_{333}) on tomato: Plant growth regulator namely paclobutrazol in various concentrations were applied twice *i.e.*,. 20 and 40 days after transplanting. The paclobutrazol @ 30 mg/L was found most effective treatment for increasing yield and quality of tomato variety Manikhamnu (Sel-1)

Brinjal

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

Twenty-four varieties of brinjal were evaluated in open conditions and the varieties CH-157-6-4-1 (353 q/ha), JC-4 (335 q/ha) and JC-2 (225 q/ha) were found to be high yielders and resistant to bacterial wilt (Table 24).

Development of bacterial wilt resistant hybrids in brinjal: Since bacterial wilt is a major problem in brinjal, 150 F_1 hybrids were made by using bacterial wilt resistant lines to find out resistance of high yielding hybrids to wilt.

Table 24. Yield and its contributing characters of brinjal varieties

Varieties	Plant height (cm)	No. of branches	Fruit diameter (cm)	Yield (q/ha)
CH-157-6-4-1	341.00	12.04	9.26	353.20
JC-4	268.00	19.80	6.61	325.75
JC-2	500.00	15.06	11.73	335.60
BB-40	145.00	15.30	5.67	342.25
CHBR-2	268.00	9.42	8.95	285.50

Improvement of legume vegetables

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

Indian bean

Eighty germplasm lines were collected from NEH and tribal areas of Chhattisgarh; and evaluated under terrace land condition. Ten promising lines were identified on the basis of yield and pod characteristics. The highest yield was recorded in ICARDL-112 (2.890 kg/plant) followed by ICARDL-111 (2.193 kg/plant).

French bean

Collection and evaluation of French bean having pole type growing habit: Twenty-four lines were collected and evaluated for yield and yield contributing characters were recorded. The highest yield (350.51 g/plant) was recorded in RCFB-24 followed by RCFB-60 (195.91 g/plant).

Studies on effect of paclobutrazol on French bean Meghalaya Local (pole type): Paclobutrazol @ 150 mg/L was found to be best treatment for increasing yield and suppressing vegetative growth.

Response of french bean genotypes to inter and intra row spacing

D.P. Patel and N.P. Singh

Like previous year French bean (Pole type) variety Meghalaya Local selection produced significantly higher green pod yield (91.3 q/ha) than Meghalaya Local (77.5 q/ha). Highest green pod yield of 90.6 q/ha was recorded with 30 x 15 cm plant spacing. The lowest yield to the tune of 78.8 q/ha was recorded with 40x15 cm.

Improvement of cucurbits

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

Bottle gourd

Germplasm collection and evaluation of bottle gourd: Twenty-four germplasm of bottle gourd were collected from different parts of NEH Region.

Effect of paclobutrazol (PP_{333}) on bottle gourd: The efficacy of different levels of soil applied paclobutrazol (PP_{333}) for increasing yield of bottle gourd var. 'Meghalaya Local' was studied. All the concentrations of paclobutrazol significantly decreased vine length, leaf size and fruit length, whereas side branches, number of fruits per plant, fruit diameter, TSS and dry matter content were increased. Application of paclobutrazol also caused early appearance of female flowers on the nearest node. Among all the treatments, paclobutrazol at 150 mg/L was found best, followed by paclobutrazol @ 175 mg/L for increasing yield and quality of bottle gourd variety 'Meghalaya Local'.

Cucumber

Germplasm collection and evaluation of cucumber: Twenty-one germplasm of cucumber were collected from different parts of NEH region.

Effect of paclobutrazol (PP_{333}) on cucumber: Four concentrations of paclobutrazol and two concentrations each of NAA and MH were applied at two true leaf stage. PP_{333} @ 125 mg/l, NAA @ 100 mg/l and MH 200 mg/l were found to be among highly effective treatments for increasing yield of cucumber variety of Meghalaya Local by increasing number of pistillate flowers and number of fruits/plant. PP_{333} 125 mg/l recorded 55.5 and 34.0 per cent more yield over NAA 100 mg/l and MH 200 mg/l respectively.

Germplasm collection and evaluation of Chow-Chow

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

A wide range of variability was observed out of five entries evaluated. The data indicated that the variation ranges in leaf length (10-14 cm), leaf breadth (9-18 cm), leaf stalk length (2.5-10.5 cm), female flower pedicel length (0.4-1.3 cm), corolla length (0.2-0.5 cm), calyx length (0.1-0.4 cm), number of flowers per cluster (4-8), length of gynoecium (0.05-0.5 cm), days to sprouting of fruits from harvesting (10-18 days), fruit weight (93-345 g), fruit length (10.11-17.20 cm), fruit diameter (3.40-7.40 cm), number of fruits per pit containing health vines (100-150), spine length (3-3.50 m), pulp thickness (3.10-5.10 cm), specific gravity (0.95-1.01), TSS (3.40-6.00%), acidity (0.043-0.068%), Juice (78.88-90.20%) and price ranges in Meghalaya (Rs 1-24).

Bitter gourd

R.K. Yadav

Effect of paclobutrazol (PP_{333}) on bitter gourd

Studies on plant paclobutrazol concentrations revealed that paclobutrazol @ 100 mg/l was found to be most effective treatment for increasing the yield of bitter gourd variety Meghalaya Local.

Improvement of tubers and rhizomatous crops

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

Evaluation of sweet potato

Among thirteen varieties of sweet potato tested, the varieties Sonopat (325 q/ha) and S-107 (286 q/ha) were found to be promising.

Evaluation of colocasia

Out of 31 varieties of colocasia evaluated, the varieties ML-9 (325 q/ha) and SJ-1 (296 q/ha) were found to be high yielder.

Integrated pest management in colocasia

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

Twenty-five varieties of Colocasia were screened against the major insect pest Corm borer *Haplosonyx chalybaeus*. Varieties BCC-1 and BK-Col-1 were found with less than 10% plant damage compared to susceptible C-3, and Sonajoli (>60%).

MANIPUR

Tomato

Role of biofertilizers in tomato

The experiment was conducted during 2001-02 in the valley to study the effect of different biofertilizers on growth and yield of tomato variety Pusa Gourav with a view to economize/substitute the use of chemical fertilizers. The experiment consisted of eight treatments including Azotobacter Azospirillum and phosphate solubilizer (PSM) individually and in combination along with varying levels of Nitrogen (0-90 kg/ha). Potassium and Phosphorus fertilizers were kept constant @ 60 kg/ha.

Among the various biometric parameters studied, the number of fruits per plant and fruit yield (t/ha) showed significant variation among different treatments. It was observed that fruit yield/ha in case of Azotobactor + 20 kg N or Azotobactor + PSM + 60 kg N or Azospirillum + PSM + 60 kg N were on par with that of full dose of nitrogen (90 kg/ha). This in turn revealed the scope for substituting the use of N-fertilizers in tomato by employing biofertilizers like Azotobactor, Azospirillum or Phosphate solubilizer either individually or in combination.

Crops improvement in tomato

Advance breeding lines of generation F_4, F_5, F_6, F_7 and F_8 were being raised under uniform package of practices. Observations were recorded on growth and yield parameters. The lines which showed superiority in performance were selected and seeds collected for further evaluation and advancement of the generations.

Cabbage

Management of cabbage pests

In cabbage, the major insect pests observed were diamond black moth (*Plutella xylostella*), Cabbage butterfly (*Pieris brassicae*), tobacco caterpillar (*Spodoptera litura*) and aphids (*Cracivora brassicae*). Cutworms (*Agrotis ipsilan*) were observed in initial stage of plant growth. An experiment with 11 treatments comprising of five botanical (*Artemisia* sp., *Kanghuman*, *Cuscutta* sp., neemazol), new molecule (Imidacloprid 200 SL), combination product (Acephate 25 + Fenvebrate 3 - Koranda) and new formulation (Betacyflutarin 0.25 SC), three conventional insecticides (DDVP, Endosulfan and Quinalphos) in comparison to untreated, control were tested against major pests of cabbagee under valley condition. The cabbage (cv. Local) was planted on 1.1.2002. Three rounds of need based treatments were given on 18.2.200, 6.3.2002 and 18.3.2002. As regards to pest infestation, the treatment Imidacloprid 200 SL registered highest yield (44.33 kg) with overall least incidence of DBM (10.50/5 plants) and less cutworm affected plants (2.67/plot) as against 21.41 kg yield/plot with 32.34 DBM/5 plants and 4.67 cutworm affected plants in untreated control. Next in order of effectiveness was ethanolic extract of *Kanghuman* and *Artemisia* sp. each @ 2 ml/lt of water which recorded 34.82 and 35.62 kg yield/plot respectively and the corresponding values for pest infestation were 13.00 DBM and 2.67 cutworm affected plants/plot, 15.84 DBM/5 plants and 4.00 cutworm affected plants/plot, respectively.

Pea

Management of insect pests infesting vegetable purpose pea

Cutworm (*Agrotis opsilon*) in early stage as well as aphid (*Cracivora brassicae* & *Myzus persicae*) and pod borer (*Heliothis armigera* & *Etiella zinckenella*) at pod formation stage were observed infesting pea crops (Cv. Arkel) sown on 27.12.2002 (Plot size 3x1.5m, spacing : 30x10 cm). Two spray of thirteen treatments including untreated check first starting at 18.2.2002 were given

coinciding with profuse build up of pest population and second spray 15 days later. Among these treatments, leaf extract of wild neem (*Melia* sp.), *Zatropha gossipifolia* and *Agaratum conyzoides* each at 3 ml/lt of water and ready to use botanicals (Neemectin 0.15%) and Imidacloprid 200 SL (1 ml/lt of water) were found highly effective against sucking pests (*Cracivora brassicae* And *Myzus persicae*) and Bulldock star (Betacyfluthrin + Chlorpyriphos 262 EC) 0.04% and Koranda (Acephate 25 + Fenvelerate 3)).03% against pod borers infesting pea under valley condition. The highest yield of three picking first starting from 13.3.02 was recorded with the treatment of Imidacloprid 200 SL (1333 g/plot) followed by Bulldock star 262 EC (1327 g/plot), Koranda (1323 g/plot). Among the plant products, the highest of 997 g/plot was recorded with Neemectin 0.15% (2 ml/lit of water) followed by leaf extracts of *Zatropa gossipifolia* (973 g/plot), *Ageratum* sp. (913 g/plot) and *Melia* sp. (903 g/plot) as against 593 g pod yield/plot in untreated control.

MIZORAM

N.S. Azad Thakur

Tomato

The variety Anmol F_1 hybrid (396) was planted during *rabi*, 2001 at a spacing of 45 x 30 cm. A fruit yield of 112.20 q/ha was recorded. Tomato fruit borers were observed as major insect pests.

Radish

The variety Japanese White was sown during *rabi*, 2001 at spacing of 30 x 10 cm. A yield of160 q/ha was recorded.

Cole crops

The seedlings of knolkhol (cv Rotal Sluis) were planted in the pits at a spacing of 30 x 20 cm. An average yield of 75.26 q/ha was recorded. The seedlings of cabbage (cv Golden Acre) was planted during first fortnight of November, 2001 in the pits at a spacing of 30 x 20 cm and an average yield of 62.78 q/ha was recorded.

Cabbage butterfly, aphids, diamond back moth and bagrada beetles were recorded as the major insect pests in different cole crops.

Pea

The variety *Rachana* was grown during *rabi* season in the first fortnight of November, 2001. the seeds were dibbled at a spacing of 45 x 15 cm and followed the intercultural practices. The green pods were harvested at weekly intervals and an average yield of 20.93 q/ha was recorded.

Pod borer and powdery mildew were recorded as the major insect pest and disease on pea crop resulting with severe yield losses.

TRIPURA

Bhindi

Performance of different varieties of bhindi in summer season

Ten genotypes of bhindi (3 improved varieties and 7 hybrids) were evaluated during summer season. Out of 10 genotypes. H-8040, TRCBH-1, TRCBH-2 showed early fruiting (52-55 days) whereas Harbhajan had late fruiting (61.5 days). TRCBH-1 attained maximum plant height (178.25 cm) followed by TRCBH3- (167.5 cm) and Harbhajan (159.75 cm). Number of fruits/plot ($4m^2$) and highest yield (q/ha) was recorded with TRCBH-3 (282.0, 85-29, respectively) followed by TRCBH-1 in respect of number of fruits and P. Kranti in terms of yield.

Gourd

Evaluation of ridge gourd hybrids

Five hybrids of ridge gourd viz. Green Gold, Summer Queen, Namrata, Lata and Raveena were evaluated under upland condition during summer season. Out of five genotypes, Namrata produced maximum number of fruits/ha (89,000) followed by summer Queen and Green Gold. Highest yield (77.9 q/ha) was also recorded with Namrata.

Yambean

Yambean - a potential leguminous tuberous vegetable for upland of Tripura

Yambean (*Pacchyrhyzus tuberosus*), a leguminous tuberous vegetable, locally known as

'Sakalu' can be easily grown in sandy loam soil of Tripura One or two seeds should be planted per hill at 25-30 cm distance during July-August. Earthing up is very much essential after one month of planting. Deflowering should be done to produce quality tubers. Few plants should be kept separately to produce seeds for future use. In general plant produces one tuber (100g-1000g) during January-February.

Collection and evaluation of local vegetables

A number of local vegetables such as Indian beans (Teliamura, Noldugi, White purple, green poded), kakrol, bottlegourd, bitter gourd, brinjal, (Bholanath, Singhnath), Chilli (Guwahati Black, Jhum), Pumpkin, ridgegourd were collected from different parts of West Tripura and evaluated at the centre. Among Indian beans, Teliamura was found to be early fruiting type whereas white poded as late fruiting type. Undulating and unutilized uplands were found suitable for beans and cucurbits and top flat uplands (5 per cent slope) for solanaceous and tuberous vegetables.

Introduction and evaluation of high value vegetables

Some important high value vegetables such as sprouting Broccote (KTS-1), Brussels sprouts (Hild's ideal), capsicum (Pusa Deepti, California Wonder, Anupam), French bean (Pusa Parvati, Mizoram purple), Broad bean (Pusa sumeet) were introduced and evaluated at different land situations during winter season.

Vegetable based cropping system

An attempt was made to findout the suitable vegetable based cropping system under upland situation. Out of different combinations, the following were found to be more suitable.

i) Bhindi - Cowpea - brinjal/tomato.
ii) Cowpea/bhindi - chilli-radish.
iii) Amarnath - Radish - Laisag/Palak.
iv) Ridge gourd/Ashgourd-bottle gourd/ Indian bean.

Disease management of brinjal and tomato wilt

In winter season farmers grow brinjal and tomato in vast areas of Lembucherra, Mohanpur, Fatikcherra in uplands situation. But these crops suffer enormous losses (50-60%) due to bacterial wilt and fusarial wilt. *Pseudomonas solanalearum* of brinjal wilt and *Fusarium solani* for tomato wilt.

In an effort to reduce the wilting of the plants, crop rotation programme was taken up before transplanting of brinjal and tomato seedlings in rabi season. In kharif season maize seeds (*Zea mays*) *amaranthus* seeds and marigold branches were sown and the plants were grown upto maturity. Root exudates of maize, amaranthus and marigold might have the capacity to inhibit the growth of *Pseudomonas* and fusarium sp. After the harvest of maize, amarnthus and Marigold tomato and brinjal seedlings were sown in p lots where previous crops were grown in winter season. Both tomato and Brinjal collected locally were susceptible to wilt diseases. Brinjal growth was good and only 10% plants died. But tomato started wilgting after one month of sowing. 40% plants died due to Bacterial wilt. Yield of Brinjal was also good. Apart from Maize, Amarnthus and Marigold more crops are planned to be included in future to consolidate the study.

FLORICULTURE

MEGHALAYA

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

Collection, evaluation and maintenance of gerbera germplasm

Twenty three varieties of gerbera were evaluated during the year 2001 for eight characters. The highest plant height (30.93 cm) and no. of leaves/plant (38.33) were recorded in Alesmera and RCG-95, respectively, under polyhouse condition. The longest stalk length (46.87 cm) was measured in RCG-114 while maximum stalk diameter (0.56 cm) in RCG-65 under the same condition. The maximum flower diameter (9.78 cm) was found in Popular followed by Alesmera (9.37 cm). However, maximum number of flowers/plant (5.00) was recorded in G. S. Lal, followed by Orange Glame (4.89) (Fig. 23).

Fig 23. Gerbera at Umiam

Evaluation and maintenance of gladiolus germplasm

Twenty varieties of gladiolus were evaluated during the year 2001 for eight characters. The highest plant height (141.00 cm) and spike length (116.33 cm) were recorded in Appolo. However, there was no significant difference for number of leaves/plant. Early flower opening was noticed in W. Boquet. The maximum spike diameter (11.13 cm) and flower diameter (12.00 cm) were observed from G.W. Pecka and Bellarina, respectively. The highest number of florets/plant (21.33) was counted from No.77-59-32, followed by Red Majesty (20.67) and No.82-18-16 (20.67). However, maximum no. of spike/plant(2.00) was recorded in Wild Rose, followed by Dorsan Dol (1.67).

Vase life of gerbera cut flowers under polyhouse and open conditions

Longevity of different gerbera cut flowers was evaluated under polyhouse and open conditions. The maximum vase life of cut-flower(19 days) was recorded in RCG-95 (17.67 days) and Black Heart (16.67 days) treated with vase solution containing AgNO3 @20 ppm + sucrose @ 4%. The highest water uptake (31.00 ml) was observed in RCG-95. The maximum water uptake (31.00 ml) was recorded in RCG-95 under polyhouse condition, however under open condition the highest water uptake (53.00 ml) was measured in RCG-113. The cut flowers were treated with vase solution containing AgNO3 @ 20 ppm + sucrose @ 4%. The longest vase life was recorded in RCG-113 was 19.00 and 17.00 days under polyhouse and open conditions respectively, followed by Alesmera 18.33 and 16.33 days in the same conditions.

SIKKIM

Gerbera

Ramesh Kumar

Varietal evaluation

Seventeen varieties of gerbera were maintained and evaluated for the second consecutive year in open condition. The varieties J.S. Lal, Divas memory, Pride of Sikkim and Salman spray recorded more plant spread as compare to all other cultivars. The length of stalk varied from 20.36 to 41.60 cm with maximum being observed under the variety General kesar, followed by Orange glem (36.00 cm) and J.S. Lal (35.72 cm). The time taken from flowering to wilting was observed to be maximum (16.74 days) in Divas memory and minimum 911.40 days) in Yellow dueen. Maximum number of flowers (32.70) was noticed in Genetal kesar, followed by Red monarch (28.17) and Salman spray (26.63) but the flowers of largest size were produced on Divas memory, Favoury rahman, Benzo and Orange glem.

Seasonal response of cultivars

An experiment was carried out to assess the seasonal response of gerbera in different months and the results indicated that vegetative and floral characters of different cultivar varied with the season. Among different months, maximum plants spread (37.0 cm) were recorded in May while the

number of leaves were found to be maximum (44.0) in June. Time taken from bud emergence to bud burst ranged from 10.86 days in May to 14.40 days in December. Stalk length and flower size was observed to be maximum in April (41.11 and 9.30 cm, respectively). However, flowers produced during winter months lasted longer as compared to those flowered during spring and summer months. Highest flower production (6.91) was obtained in March, followed by in April (6.11).

Micronutrient trial

A field trail was conducted with three levels (0, 0.2% and 0.4%) of each of Fe, Mn and Zn. Spraying of 0.2 or 0.4% Zn improved growth and flowering. However, none of the level of Fe and Mn exhibited significant (P= 0.05) effect on plant spread and number of leaves. Spraying of Mn and Zn irrespective of their concentration produced more number of flowers (31.84 and 31.76, respectively) with largest size (10.05 and 10.28 cm, respectively). Flower longevity was observed to be maximum (5.72 days) with the application of 0.2% Zn as compared to all other treatment.

Gladiolus

Ramesh Kumar

Varietal performance

Seven varieties were evaluated for their flower quality and corm production. Her Majesty took the least number of days (99.10 days) for flowering, whereas delayed flowering (114.34 days) was observed in Friendship. Spike length was recorded to be maximum (95.16 cm) in American beauty and it was closely followed by Eighth wonder (91.42 cm). Number and size of floret varied from 12.73 to 15.17 and 9.87 to 10.60 cm, respectively in different varieties. Highest corm and cornel production was obtained in Eighth wonder while lowest was recorded in oscar.

Effect of staggered planting

A replicated trial with staggered planting of corm from January to December was carried out to explore the possibility of round the year production of cut flower. It was observed that planting during winter months resulted in better growth but flowering was delayed and maximum of 141.11 days was taken by December planting to induce flowering. Earliest flowering (84.44 days) was noticed when planting was done in June. Though number and size of floret remained unaffected throughout the season but the planting beyond October in hills resulted in very poor propagation coefficient and it is the only March planting which provided better propagation coefficient (2.20).

Studies on corm size and depth of planting

An attempt was made to investigate the effect of six corm sizes *viz.* 1.90-2.50, 2.50-3.20, 3.20-3.80, 3.90-5.10, 5.10-6.00 and 6.00-6.50 cm along with three depths of planting (3.00, 6.00 and 9.00 cm) on flower quality and corm production of cultivar Eighth wonder. Plant height increased with the increase in bulb size but decreased with the depth of planting with minimum (100.95 cm) being recorded under deepest planting. Spike emergence was earliest (80.00 days) when largest corm was planted. Similarly yield and quality of spike improved significantly as the size increased at the time of planting. Deep planting (9.00 cm) delayed the sprouting of corm by 12.14 days. Propagation coefficient increased with the increase in the size of corm planted but decreased with the depth of planting.

Breaking of corm dormancy

An experiment was undertaken to overcome corm dormancy by treating them with different growth regulators and storage temperature. The results revealed that over 66.0% sprouting was registered within on month when dormant corms were soaked for 24 hr in 5 ppm BA solution. Soaking in 20 ppm of IBA induced 100.0% sprouting. The effect of GA_3 was slightly weaker in this regard and there was no difference when IBA and was used alone or in combination with GA_3. Higher concentration of NAA inhibited sprouting but the lower conc. (5 ppm) proved to be beneficial for breaking the dormancy in corm. Alternate heating at 30°C and cooling at 4°C at 15 days interval for 45 days had a better effect than the cooling alone on the sprouting of summer corms, which showed delayed and uneven sprouting.

TRIPURA

L. C. De

Gladiolus

Performance of exotic varieties of gladiolus in Kharif season

The experiment was conducted with twelve varieties of gladiolus viz. Fidello, Peter pears, Novalux, Eurovision, white prosperity, Jester, Oscar, Tropic sea, High style, Creamy white, Shillong Mix and TRC-G-2 during Kharif season in the year 2001. Among them, High style and Peter pears showed early flowering, Oscar, Novalux, White prosperity, Bis Bis and creamy white bloom in the middle of a season whereas Tropic sea, Sylvia and Eurovision were identified as the late flowering types. Maximum spike length was recorded with White prosperity (110 cm) followed by Tropic sea (100 cm) and Creamy white (85 cm). Oscar and Tropic sea produced highest number of florets/spike (15) followed by High style (12) and TRCG-2(12). Largest basal floret was obtained with white prosperity (10.5 cm) followed by Peter pears (10.0 cm) (Fig 24).

Fig 24. Peter Pears

Round the year production of tuberose

An attempt has been made to produce marketable tuberose spikes alomost round the year through the use of bulbs of different grades (1.5 cm to 3.0 cm), planting at different depths (3-6 cm) and at 15 days intervals from the month of February to May. A dose of 200 kg N_2, 200 Kg P_2O_5 and 150 Kg K_2O was recommended to produce 2,00,000 - 2,50,000 spikes from one hectare of land. Nitrogenous fertilizer was applied in four split doses, 25 per cent at planting and other doses @25 per cent after one month of planting.

Performance of improved varieties of marigold

Out of 8 varieties of French Marigold, Orange winner and Queen Sophia come into flowering in summer season. For winter season, Queen Sophia, Red Brocede, Star Fine and Golden Boy were found promising.

Round the year production of cut flowers of rose varieties through staggered pruning

An experiment was conducted with six varieties of rose (American Pride, Flamingo, Kiss of Fire, Tajmahal, Bazazo and cassaniva) and thrice pruning (Feb-March, July-August and October-November in a year) to produce maximum number of flowers. American Pride had largest spike and Tajmahal gave big size flowers for all the season. Pruning upto 30-45 cm height along with 3-4 well formed shoots was found to be effective for production of good quality flowers.

SPICES

MEGHALAYA

Improvement of ginger and turmeric

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

Evaluation and maintenance of different varieties of ginger

Out of 35 varieties, it was observed that the maximum plant height (64.33 cm) was noted in Karakai (Fig.25), which was significantly superior to all but Tinglaidon, Acc- 294 and Ernad ginger varieties. Maximum number of tillers per plant (10.33) was recorded in Tinglaidon, Karakai and Acc- 27. However, varieties Meghalaya Local, Jorhat, Acc- 15 and Acc- 294 were at par with Tinglaidon, Karakai and Acc- 27 for the trait number of tillers per plant.

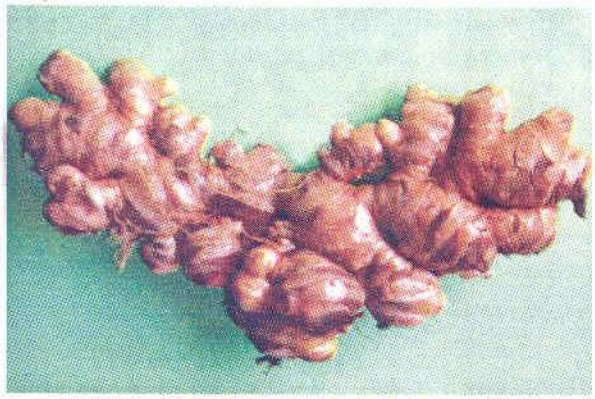


Fig 25. Ginger variety Karakai

Maximum number of leaves per plant (216.67) was recorded in Karakai, which was significantly superior to all the ginger varieties studied. Maximum leaf length (25.66 cm) was noted in Tinglaidon, however most of the varieties were at par with Tinglaidon for this trait. Maximum leaf breadth (3.10 cm) was recorded by Acc- 27 and all others were found at par with Acc-27. On an average, Acc-49 recorded the maximum yield of 183.33 q/ha.

Evaluation of different varieties of turmeric

Among the turmeric varieties under study, it was recorded that maximum plant height (105.00 cm) was noted in Mydukum. However, most of the varieties were at par with Mydukum for this trait. Maximum number of tillers (6.00) was recorded for Lakadang, VIK-145 and RCT-1. Most of the varieties were also at par with above-mentioned varieties for this trait. Maximum number of leaves per plant (49.67) was recorded under TC-17 (RCT-1), however, no significant differences among the varieties were found for this trait. Maximum leaf length (56.56 cm) was recorded in PCT-8, which was statically at par with Kuchi Pudi, Mydukum, TC-17 (RCT-1), CLI-315 and CLI-316. Maximum leaf breadth (14.11 cm) was measured in TC-17 (RCT-1) and Kuchi Pudi (Fig. 26 & 27).

Fig 26. Turmeric at farmer's field

Fig 27. Megha Turmeric-I

Post harvest studies

A. Nath

Storability of 'Gin kinnow' a blended beverage from Kinnow

Kinnow mandarin juice and ginger were blended in the ratio of 0:30, 5:25, 10:20, 15:15, 20:10, 25:5 and 30:0 and squash were prepared from these blends. Total soluble solids (TSS) were fixed at 40 to 40.5 °B. KMS was added as preservative @ 0 ppm, 100 ppm, 150 ppm, 200 ppm and 250 ppm. The squash from 25:5 blend and scored the highest in terms of sensory attributes.

Storage studies on osmotic dehydrated carambola slices at room temperature

Osmotic dehydrated carambola slices having TSS 68 % were kept in different packaging material such as LDPE (100 gauge and 200 gauge), plastic and glass jars for one year to assess the storage quality of the product both the glass and plastic jars were found to retain the flavour and taste of the product, whereas product stored in LDPE could not be able to retain the flavour at room temperature.

Mint syrup and RTS preparation (new product development)

Mint syrup having different TSS (40, 45 and 50 %), juice content (20, 25 and 30 %) and acidity (2.0, 2.5 and 3.0 %) with KMS 300 ppm and RTS having different TSS (15, 18 and 20%), acidity (0.5, 0.9 and 1.2 %), juice content (10, 15 and 20 %) with KMS added @ 100 ppm were prepared. Syrup containing TSS 45 %, acidity 2.5 % and juice content 25 % and RTS with TSS 18 %, acidity 0.9 % and juice content 15 % were found highly acceptable.

Storability of carrot and beet root tuity-fruity

Carrot tuity-fruity having TSS 70% and beet root tuity fruity having TSS 72% were kept in different packaging material such as LDPE (100 gauge and 200 gauge), plastic and glass jars for one year to assess the storage quality of the product. Both the glass and plastic jars were found to retain the flavour and taste of the product, whereas product stores in LDPE could not be able to retain the flavour at room temperature.

MIZORAM

Turmeric

N.S. Azad Thakur and K.Laxminarayana

Under a screening trial, nine varieties of turmeric namely, RCT-1, Lakadang, PCT-II, Meghalaya Local-II, PCT-12, Baktawng local, PCT-15, Meghalaya Local-I and Kasturi Tanaka were evaluated during *kharif*, 2001. The rhizomes were planted during first week of April at a spacing of 40 x 20 cm. The trial was laid out three replications in a RBD and a fertilizers dose of 160-80-80 kg N, P_2O_5 and K_2O ha^{-1} was applied. The crop was harvested in the second week of January 2002 and the yield parameters were recorded. It was found that RCT-1 was performed better with an average yield of 100 q/ha followed by Lakadang (70.21 q/ha) and Kasturi Tanaka (69.35 q/ha), while the varieties PCT-II and PCT-12 were recorded lowest rhizome yield of 27.7 and 34.7 q/ha, respectively. The other varieties were recorded an average yield of 47 to 69 q/ha.

FEED & FODDER

MEGHALAYA

Technique for estimation of HCN in bamboo plant and losses during processing

J.J. Gupta and B.P.S. Yadav

A simple technique after little modification of the one described by Hayes was developed for HCN estimation in bamboo. The samples were collected from different portion of bamboo plant. The HCN content was estimated in these samples as fresh and after giving various treatments. Maximum concentration of HCN (0.97%) was estimated in top shoot portion. The base shoot portion contained a marginal value that varied from 0.41-0.46% and minimum in matured leaf 0.03%. The losses in HCN content of shoot portion after giving different treatments are presented in table

25. The results indicated that 72.20% HCN was lost even due to 24 hours sun drying.

Thus, it was concluded that those green herbs containing high amount of HCN be first cut and left in field as such at least for 24-48 hours and then be fed to the livestock to avoid cyanide poisoning (Fig 28).

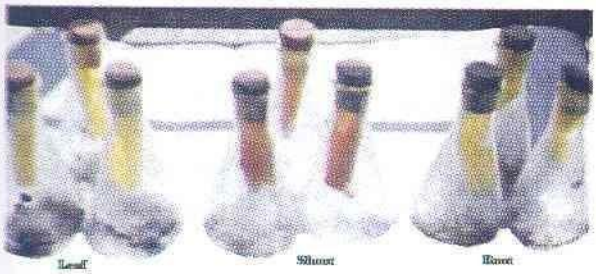


Fig 28. HCN estimation in bamboo

Table 25. Loss of HCN concentration in bamboo shoot during treatments

Treatments	HCN values in Shoots Portion (%)	
	Top Shoot	Base Shoot
Fresh	0.98 (0.00)	0.41 (0.00)
Sun Dry	0.27 (72.20)	0.23 (43.97)
Oven Dry	0.18 (82.02)	0.18 (56.95)
Boiled	0.00 (100.00)	0.00 (100.00)

Figure in parentheses represent % loss of HCN in comparison to fresh basis during various treatments

NATP on nutritional profile of tribal women

D. Agrahar-Murugkar, B.P.S. Yadav and P.P. Pal

Under the project, all together, 11 out of 13 villages were surveyed from Meghalaya covering a total numbers of 795 women and children. It has been observed that, majority of the villagers made their living from farming either tilling their own land (32.8% having land more than 1 acre) or working as agricultural laborers (38.3%). On average, more than 50% of the energy in the diet of tribal women was derived from carbohydrates mainly rice and roots and tubers. The protein requirements were generally met by flesh foods. Locally and seasonally grown fruits and vegetables were consumed in plenty. Milk was missing from the diets of most participants. The calcium deficiency was met out from fermented foods especially fermented fishes, which are a staple and consumed in small quantities everyday. However, habitual consumption of betel leaf with lime adds significantly to the calcium consumption. Consumption of visible fat in the diet is very less as most of the food is eaten boiled.

SIKKIM

Chemical composition of some important fodders

Asit Das and Debasis De

Samples of some important fodders of Sikkim were collected from three different locations. Broom grass was found to be the most popular fodder species.Different varieties of hybrid napier are also grown by the farmers. Among the annual grasses, maize and oats are most important during Kharif and Rabi season, respectively. Among the leguminous fodder, *Desmodium* sp. though found naturally in native pasture, is not so popular among the farmers due to its low biomass yield. Rice bean is the most popular leguminous fodder, which can be cultivated almost round the year.

Chemical composition, though revealed that broom grass is inferior in quality in comparison to other perennial grasses, it's availability during lean period and its role in soil conservation makes it an integral part of farming systems prevailing in Sikkim. Guatemala grass also remained available during lean season, however, is reported to cause haematuria on sole feeing and hence is not popular among the farmers (Table 26).

Chemical composition of some important tree fodders

Tree fodders are generally cultivated in terrace risers; terrace borders, farm boundaries and in degraded land. Tree fodders are important component of farming systems prevailing in Sikkim viz. Silvi-pastoral system, silvi-horti-pastoral system, agro-horti-silvi-pastoral system and as a shade to large cardamom plantations. Chemical composition of some of the important tree fodders was worked out Table 27.

Table 26. Chemical composition of some important fodders of Sikkim

Fodder's name	DM	% DM basis						
		OM	CP	NDF	ADF	HC	Cellulose	Lignin
Hybrid Napier BN 82048	25.00 ±1.93	88.15 ±1.16	5.25 ±0.51	69.37 ±1.32	41.34 ±0.73	28.02 ±0.97	24.99 ± 0.83	6.80 ±0.63
Hybrid Napier NB21	25.30 ±1.79	88.24 ±1.24	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 *Setaria palmifolia*	25.17 ±1.74	88.15 ±1.16	7.29 ±0.39	60.91 ±1.15	34.72 ±3.04	26.63 ±1.44	23.83 ±2.18	3.82 ±0.37
Nandi setaria *Setaria sphaecelata*	21.26 ±1.16	88.15 ±1.16	7.15 ±0.38	61.59 ±1.45	34.31 ±3.49	27.29 ±0.66	22.65 ±0.65	6.35 ±0.37
Dallis	21.92 ±1.93	88.27 ±1.80	8.02 ±0.14	65.54 ±1.72	37.95 ±0.22	27.64 ±1.95	23.93 ±0.93	5.41 ±0.41
Broom grass *Thysaenolaena maxima*	26.15 ±2.09	88.83 ±1.33	4.94 ±0.34	73.99 ±0.82	46.45 ±1.29	27.55 ±0.56	29.97 ±1.09	9.26 ±0.56
Guatemala grass *Tripsacum laxum*	21.28 ±0.28	87.60 ±1.54	5.69 ±0.44	63.89 ±2.30	35.59 ±1.89	27.49 ±1.42	22.14 ±2.33	5.56 ±0.41
Guinea grass	23.49 ±3.18	88.60 ±0.97	6.81 ±0.67	58.59 ±1.45	27.94 ±1.53	29.16 ±0.86	21.07 ±1.37	3.44 ±0.31
Hybrid Napier Co 1	20.73 ±1.10	90.37 ±0.66	7.05 ±0.55	56.02 ±1.11	32.67 ±1.81	23.35 ±1.63	25.43 ± 2.02	4.72 ±0.34
Signal grass	21.66 ±1.96	88.26 ±1.10	6.75 ±0.67	56.95 ±1.84	31.80 ±1.14	25.18 ±1.62	23.42 ±1.20	5.24 ±0.38
Oat	22.40 ±2.15	88.95 ±1.20	10.74 ±0.74	53.50 ±1.74	34.95 ±1.74	18.55 ±1.74	26.70 ±1.49	3.15 ±0.07
Maize	18.33 ±2.33	89.00 ±1.46	7.75 ±0.39	58.56 ±2.01	36.50 ±2.20	22.06 ±0.91	28.97 ±1.93	5.23 ±0.22
Rice bean	19.00 ±1.83	88.30 ±1.39	16.16 ±0.15	47.13 ±0.43	35.78 ±1.06	11.35 ±0.53	23.97 ±1.07	4.03 ±0.44
Desmodium	22.44 ±2.47	85.20 ±057.	16.77 ±0.82	53.70 ±1.28	40.67 ±1.76	12.03 ±0.61	29.29 ±2.43	5.86 ±0.51
Seratro	21.41 ±1.19	87.20 ±1.18	15.21 ±0.58	53.63 ±2.34	40.83 ±1.19	12.79 ±0.25	29.65 ±2.71	6.75 ±0.33

Herbal composition of mixed jungle grass

Samples of native pastures were collected from ICAR farm Tadong. Three composite samples of 1 kg (fresh basis) were collected in different seasons and separated into different constituents. The predominant species during monsoon include *Persicaria nepalensis* (19.5-22.5%), *Galinsoga perviflora* (19-20%), *Atrimisia vulgaris* (20-22%), *Ageratum conyzoides* (5-7%), *Crystella parasitica* (6-7%), *Hydyatis scandens* (6-9%), *Setaria palmifolia* (3-5%), *Thysanlaena maxima* (2-3%) and *Cynodon dactylon* (3-4%). During winter, however, the predominant pasture species were, *Eupotarium* sp (25-30%), *Ageratum conyzoides* (26-30%), *Setaria palmifoli* (4-8%), *Crytella parasitica* (5-9%). The composition of summer pasture was almost similar to that of monsoon. These findings will also help to formulate feeding strategies based on mixed jungle grass.

Feeding practices of different livestock

A survey was conducted to study the feeding practices followed to feed different categories of animal in different districts of Sikkim. It has been found that cattle are generally fed concentrated mixture consisting of maize grain, maize bran,

Table 27. Chemical composition of some important tree fodders

Local name	Botanical name	DM	% DM basis						
			OM	CP	ND	AD	HC	Cellulose	Lignin
Barhar	*Artocarpus lakocha*	28.15 ±1.15	87.81 ±0.88	12.07 ±0.71	47.66 ±0.57	22.82 ±0.74	24.82 ±0.42	18.93 ±2.73	7.23 ±1.88
Nevaro	*Ficus hookerii*	29.15 ±2.08	89.92 ±0.38	11.71 ±0.97	44.80 ±1.76	24.69 ±1.34	20.10 ±2.93	16.63 ±1.60	6.15 ±0.67
Gogun	*Sauraria nepalensis*	27.80 ±1.45	85.63 ±2.66	13.99 ±0.90	40.27 ±2.30	22.82 ±2.91	17.45 ±0.75	19.65 ±3.32	3.43 ±0.34
Dudhilo	*Ficus nerifolia*	28.17 ±1.16	90.04 ±0.03	10.57 ±0.67	36.53 ±2.05	25.73 ±2.28	10.80 ±0.38	18.04 ±3.15	4.27 ±0.66
Khanyun	*Ficus cunia*	25.49 ±1.76	89.58 ±0.17	11.68 ±0.78	41.94 ±1.46	29.16 ±0.85	12.78 ±0.73	20.83 ±2.39	3.43 ±1.00
Chuletro	*Brasiopsis hainla*	24.48 ±2.35	89.50 ±0.68	9.31 ±0.43	63.13 ±0.94	41.85 ±3.09	18.28 ±3.90	33.52 ±3.75	5.27 ±0.28

mustard cake and a little amount of salt in wet form. In most instances concentrate mixture is cooked with vegetable waste and fed. Most of the cattle are stall fed. In some area cattle are freed to graze for a certain period of the day. Forest lands continue to be important source of fodder for cattle in the state. Cattle are fed 25-46 kg/head/d green fodders consisting of tree fodder and cut jungle grasses, and 1.5-4.5 kg paddy straw/head/d. Stall feeding of goat is very common in Sikkim. They are allowed to graze to a limited extent in some part of the state. Stall fed goats are fed 4-13 kg/head/d of green fodder consisting of tree fodder and cut jungle grasses. Generally about 100g of maize grain twice or thrice in a week along with little amount of salt are given to male goats. Sometime millet waste is also fed to goats. Female goats are offered maize grain only during kindling. Earlier yaks were reared by grazing but now-a-days for better performance of animal farmers feed their yak with concentrate mixture, consisting of gram, wheat, flour, mustard cake, mustard oil, maize bran, molasses and salt, twice a day. In few cases use of tea liquor with concentrate mixture has also been found. Sheep's are reared entirely by grazing. They hardly receive any concentrate or salt. Sometimes they are fed millet waste.

Tree fodder and jungle grass fed to cattle and goats

A survey was conducted to identify tree fodder and grass fed to cattle and goats of Sikkim. About 42 tree fodder species and 50 grass species were identified and sample were collected for chemical analysis. Some poisonous plants have also been identified which animal usually eats during fodder scarcity i.e., in the month of March-April.

TRIPURA

Fodder development and nutritional evaluation of local feeds

Chander Datt

Fodder development

To increase the productivity of ruminant animals particularly for milk production it is necessary that intensive system of animal rearing be followed for which forage crops have to be cultivated on an

extensive basis. With this view, different crops like cowpea, ricebean, maize , sorghum, oat, chinese cabbage and grasses (napier, thin napier, para grass, guinea grass and broom grass) were grown during the year under report. These cultivated crops and other agricultural by-products used as fodder were analysed for proximate composition. The yield of cultivated green fodders like maize, cowpea and grasses were recorded.

Chemical composition and nutritional evaluation of local feed resources

The local weeds including grasses and non-grasses (dicotyledons) are the important and major source of nutrients for ruminands during rainy season (April-October). Similarly during lean period (November-March), feeds are less available, tree leaves are normally supplemented to the animals. Hence, 13 species of grasses, 17 species of non-grasses and 14 species of fodder trees enlisted in Table 28 were collected, identified and analysed for proximate principles, cell contents and cell wall constituents. *In vitro* experiments were also conducted in order to determine their dry matter digestibility (IVDMD) and organic matter digestibility (IVOMD).

Average CP contents (per cent DM basis) were generally lower in grasses (9.14) than non-grasses (15.05) and fodder tree leaves (16.05). On the other hand, CF percentage was higher for grasses (28.56) than non-grasses (17.40) and tree leaves (18.82). Average cell contents (per cent DM) were the lowest in grass species (29.39) followed by tree leaves (52.80) and dicots (55.17) whereas, a reverse trend was found for NDF. Lignin concentration was found to be the highest in tree leaves (9.74 per cent) and the lowest in grass species (4.34 per cent). Percentage of IVDMD and IVOMD (Table 29) averaged 45.24 and 48.15, 46.43 and 49.64 and 47.38 and 50.10 in grasses, non-grasses (dicots) and fodder tree leaves, respectively.

Major and trace minerals were also determined in fodder tree leaves and some local grasses using atomic absorption spectro photometer. In fodder tree species (m=9) the mean values were 0.72 per cent, 0.17 per cent, 195.70 ppm, 10.74 ppm, 81.23 ppm and 281.90 ppm for Ca, P, Fe, Cu, Zn and Mn, respectively. It seems that Ca : P ratio is quite wider as compared to their dietary required ratio.

Table 28. List of local fodder sources used for chemical composition and *in vitro* digestibility studies

Grass species	Non-grass species	Fodder trees
1. *Panicum sp.*	1. *Mimosa pudica*	1. *Artocarpus heterophyllus*
2. *Imperata cylinderica*	2. *A. Spinosus*	2. *Erythrina indica*
3. *Digitaria sp.*	3. *Enhydra fluctuans*	3. *Ficus hispida*
4. *Commelina benghalensis*	4. *Alteranthera sessilis*	4. *Leucaena leucocephala*
5. *Paspalum notatum*	5. *Acalypha indica*	5. *Gmelina arborea*
6. *Cynodon dactylon*	6. *Oxalis Corniculata*	6. *Albizzia lebbeck*
7. *Eleusine indica*	7. *Leucas aspera*	7. *Bambusa sp.*
8. *Dactyloctinium aegyptium*	8. *Phyalis minima*	8. *Gliricidia sp.*
9. *Setaria glauca*	9. *Phyllanthus niruri*	9. *Grewia sp.*
10. *Echinochloa colonum*	10. *Centella asiatica*	10. *Moringa oleifera*
11. *Leptochloa filiformis*	11. *Portulaca oleracea*	11. *Acacia auriculiformis*
12. *Cyperus sp.*	12. *Mikania scandens*	12. *Zizyphus sp.*
13. *Sachharum munja*	13. *Chenopodium album*	13. *Morus sp.*
	14. *Boerrahavia duffusa*	14. *Ficus religiosa*
	15. *Amaranthus viridis*	
	16. *Euphorbia hirta*	
	17. *Gyandropsis sp.*	

Table 29. Chemical Compostion (on DM basis) and *in vitro* digestibality of different fodders found in Tripura

Proximate Parameter	Composition Grasses (n=13)	Non-grasses (n=17)	Fodder Trees (n=14)
DM	23.47 (12.99 - 37.62)	16.39 (8.71 - 25.00)	35.31 (23.50 - 48.99)
OM	88.20 (83.66 - 93.58)	85.89 (81.92 - 94.42)	89.93 (77.68 - 93.87)
CP	9.14 ((5.24 - 16.12)	15.05 (9.12 - 18.47)	16.05 (9.44 - 23.33)
EE	1.33 (0.87 - 1.72)	2.27 (1.29 - 3.68)	2.93 (1.75 - 4.60)
CF	28.56 (18.62 - 34.65)	17.40 (7.57 - 25.12)	18.82 (10.05 - 29.41)
NFE	49.16 (40.83 - 54.45)	50.90 (38.60 - 58.55)	52.13 (42.28 - 58.12)
TOTAL ASH	11.80 (6.42 - 16.34)	14.40 5.58 - 18.08)	10.07 (6.13 - 22.32)
As per Van Soest method of fibre analysis			
Cell contents	29.39 (18.56 - 40.78)	55.17 (44.86 - 63.78)	52.80 (29.92 - 63.84)
NDF	70.61 (59.22 - 81.44)	44.83 (36.22 - 55.14)	47.20 (33.20 - 70.08)
ADF	33.98 (20.24 - 42.35)	28.82 (17.54 - 39.58)	26.76 (18.86 - 38.69)
Hemicellulose	36.63 (28.21 - 42.84)	16.01 (6.71 - 24.41)	20.44 (12.81 - 35.00)
Cellulose	27.33 (15.15 - 38.74)	16.82 (7.93 - 24.92)	15.43 (9.32 - 26.04)
Lignin	4.34 (2.60 - 6.06)	9.57 (4.47 - 12.96)	9.74 (3.28 - 24.23)
Silica	2.28 (0.06 - 5.53)	2.39 (0.32 - 8.14)	1.51 (0.03 - 6.13)
In vitro digestibility (Per cent)			
IVDMD	45.24 (35.62 - 53.61)	46.43 (38.23 - 55.56)	47.38 (36.95 - 63.18)
IVOMD	48.15 (37.93 - 56.62)	49.64 (41.38 - 59.12)	50.10 (39.23 - 65.64)

Figures in parentheses indicate the range.

ANIMAL SCIENCES

PIG

MEGHALAYA

Genetic improvement of selected indigenous pig crossing with Hampshire

Anubrata Das, S. Naskar, G. Kadirvel and S.K. Das

In continuation with last years progress in 50 % exotic inherited (Local x Hampshire) the productive and reproductive performance of 75% exotic inherited pigs is presented in Table 30, (Fig. 29). The litter size at birth was 8.10±0.28 and litter size at weaning was 6.44±0.29 and individual weight at weaning was 7.49±0.39 and age at first farrowing was 250.35±72.32 days, which was a little higher than 50% inherited animals. However, there was significant difference between the characters.

Fig 29. Upgraded pig breed with 75% exotic inheritance

Table 30. Production and reproduction performance of different crossbred pig

Parameters	Different crossbred 75%	87.5%
Litter size at birth		
Male	4.40 ± 0.25	2.56 ± 0.59
Female	3.78 ± 0.23	3.40 ± 0.70
Total	8.10 ± 0.28	6.00 ± 1.04
Litter weight at birth (kg)	8.07 ± 0.32	6.83 ± 1.09
Litter size at weaning		
Male	3.38 ± 0.22	1.90 ± 0.41
Female	3.06 ± 0.23	2.60 ± 0.48
Total	6.44 ± 0.29	4.50 ± 0.78
Litter weight at weaning	44.95 ± 2.01	31.60 ± 5.57
Individual weight at birth (kg)	0.99 ± 0.02	1.20 ± 0.07
Individual weight at weaning (kg)	7.49 ± 0.39	7.00 ± 0.22
Age at first farrowing (Days)	250.35±72.32	

Improvement of local pig

Anubrata Das, S. Naskar and G. Khargharia

Under the NATP project a survey on local pig of Meghalaya was undertaken to find out the pig production system and also to find various constraints of pig production faced by the farmers in the state. The survey was conducted mainly in

the districts of East Khasi Hills, West Khasi Hills, Jaintia Hills and Ri Bhoi district. The constraints of pig production were evaluated. In the next phase of the project, to maximize the production potential of the local pig of Meghalaya through selective breeding, a total of 30 number (20 females and 10 male) animals were procured from various villages of the state. The animals were kept under the same managemental condition in the institute farm. The breeding of the procured animals was started to find out various productive and reproductive performances of the local pigs and the data generated were recorded were kept accordingly. Details are presented in Table 31 & 32.

Table 31. Productive and reproductive performance of *Khasi* local pig of Meghalaya

Parameters	Mean ± SE
1. Litter Size at Birth	7.33 ± 0.65
Male	3.50 ± 0.51
Female	3.83 ± 0.48
2. Litter wt at birth (kg)	4.59 ± 0.46
Male	2.22 ± 0.31
Female	2.58 ± 0.29
3. Litter size at weaning	3.58 ± 0.34
Male	1.50 ± 0.25
Female	2.08 ± 0.28
4. Litter wt. at weaning (kg)	13.34 ± 1.74
Male	5.54 ± 0.94
Female	7.80 ± 1.47
5. Individual wt. At birth (kg)	0.63 ± 0.01
6. Individual wt. At weaning (kg)	3.73 ± 0.26

Table 32. Various linear body measurements of *Khasi* local pigs of Meghalaya (inch)

Age	Height	Body length	Neck girth	Heart girth	Belly circumference
1 day	3.82 ± 0.46	7.00 ± 0.59	5.69 ± 0.52	6.89 ± 0.55	7.38 ± 1.46
28 day	7.87 ± 0.98	11.16 ± 1.26	9.59 ± 1.70	11.33 ± 1.92	12.80 ± 2.16
56 day	9.88 ± 1.54	13.92 ± 1.54	11.25 ± 2.16	13.52 ± 2.02	16.23 ± 2.40

Integrated piggery development for Eastern and North Eastern region (NATP)

Anubrata Das, S. Naskar, G. Kadirvel and S.K. Baishya

According to the technical programme for the year 2001-02, out of 80 farmers from 10 villages, 8 from each village and 10 societies/ breeder, 64 farmers from 8 villages and 7 societies were selected from 4 different district of Meghalaya. In each farm family, 3 piglets (1male and 2 female) and in each society 8 piglets (2 males and 6 females) were given along with 50% balanced concentrated ration. Institute looked after health care measures. Detailed growth parameters were recorded. The production and reproduction performance of these distributed animals are presented in Table 33 and 34 (Fig.30).

Fig 30. Upgraded sow with piglets at farmer's field

Table 33. Production performance under village level

Name of the Village	Initial body weight (kg) at 3 months	Average in body weight at different ages		
		5months	6months	7months
Umsaw	12.25	17.91	25.15	27.28
Mawkriah	13.89	20.75	29.48	37.23
Nongumlong	15.29	18.94	23.79	34.06
Pyllun	10.00	18.45	24.81	30.16
Sorreidblei	11.62	17.65	25.82	31.23
Kyrdem	11.00	15.84	24.00	31.45
Nongkrem	12.64	16.33	25.87	28.45
Pomlum	9.30	17.50	27.65	32.94

Table 34. Reproduction performance of pig under village condition

Reproductive parameters	Range	Average
Age at first hear (months)	7 – 16	11.19
Age at first furrowing (months)	11 – 21	15.76
Litter size at birth	4 – 9	6.52
Litter weight at birth (kg)	3.5 6.7	5.67
Individual weight at birth(kg)	-	0.87
Litter size at weaning	2 – 6	4.00
Litter weight at weaning (kg)	12 – 36.5	27.50
Individual weight at weaning (kg)	-	6.88

Studies on preservation of boar semen in relation to artificial insemination

S. Naskar, G. Kadirvel, Anubrata Das and Dilruba Hasin

Collection of boar semen through gloved hand technique was standardized. Semen was collected in a sterile plastic bottle and the gel fraction was strained by Buchner funnel with gauge. Immediately after collection, physical and morphological characteristics were evaluated by standard methods (Fig.31).

A total of 25 semen ejaculates were collected from seven young Hampshire boars with the presence of estrous sow. Average volume of semen was 102.66±19.44 ml with thin milky in colour. The pH ranged from 7.24 to 7.84 with average of 7.55±0.19. Average motility percentage of these ejaculates was 79.06±3.94. Average percentage of live and abnormal sperm was 86.58±4.64 and 24.29±3.83, respectively.

Fig 31. Semen collection through artificial insemination

The semen with more than 80% motility was diluted in BTS (Beltsville Thawing Solution) at the ratio of 1:3 and preserved at 17 ^{0}C – 18^{0}C and evaluated at 0 hrs, 24 hrs, 48 hrs, 72 hrs and 96 hrs after preservation on the basis of sperm motility, percentage of live sperm and abnormal spermatozoa. Results indicated that with the lapse of time, the motility percentage of spermatozoa decreased and abnormality percentage increased. However it was observed that, motility was more than 60 per cent up to 72 hrs, which can be used for Artificial Insemination. Moreover, a total ten sows were inseminated with the diluted semen and the Conception Rate (CR) in first insemination in Non-Return (NR) basis was70 %.

Development of DNA based diagnostic for important livestock and poultry diseases (NATP-CGP)

B.R. Shome, Rajeswari, Shome, H. Rahman, Ashok Kumar, H.V. Murugkar and I. Shakuntala.

Piglet diarrohea

E. coli and *Salmonella* sp. were found to be the major organisms responsible for the piglet diarrhea. *Citrobacter fruendii*, *Proteus vulgaris*, *Pseudomonas fluorescence*, *Enterobacter aerogenes*, *Clostridium butyricum*, *Cl. rectum*, *Cl. perfringens* and *Cl. Paraperfringens*, etc. were the other organisms identified.

Colibacillosis

Out of 73 fecal samples from diarrhoeal cases, 56 yielded *E. coli* as pure or mixed infections. Serotyping of *E. coli* showed high antigenic heterogeneity. A total of 25 different 'O' groups of *E. coli* were recovered. The predominant serogroups were 06, 08, 09, 026, 065, 089, 0101, 0107, 0131 and 0149. Most of the *E. coli* isolates were found to be enteropathogenic/ enterotoxigenic when tested *in-vivo*. *In-vitro* antibiotic sensitivity test revealed 100% sensitivity to norfloxacin and chloramphenicol followed by 88% sensitivity to gentamicin and enrofloxacin, whereas 100% resistance was observed against tetracycline

Salmonellosis

Seventy-three fecal samples from piglets suffering from diarrhoea were enriched in

tetrathionate broth and cultivated on Brilliant green agar. The colonies were purified on MacConkey agar, characterized biochemically and further confirmed using polyvalent *Salmonella* 'O' antisera. A total of 21 isolates of *Salmonella* recovered were serotyped as *Salmonella* Typhimurium (4, 5:i:1,2). Experimental inoculation of isolates proved to be fatal to the mice. *In-vitro* antibiotics sensitivity test revealed 100 % sensitivity to chloramphenicol, 81% sensitivity to gentamicin and norfloxacin and 100% resistance to amoxycillin and tetracycline.

***Streptococcus suis* infection in piglets**

During postmortem examination of piglets showing pneumonic changes in lungs, the samples were collected and cultured on blood agar. On the basis of cultural, morphological and biochemical characteristics, the isolates were identified as *Streptococcus suis*. The organism was found highly virulent in guinea pig and mice. The infection caused by *Streptococcus suis* are not usually recorded. However, its involvement in various infections of pigs especially in pneumonic cases should be given right diagnostic emphasis for effective control of the disease.

Atrophic Rhinitis

Investigation of swine suffering from respiratory diseases at the state piggery unit, Nongstoin, Meghalaya revealed occurrence of atrophic rhinitis amongst the animals. A total of 23 nasal swabs collected were processed for isolation and identification of causative organisms. *Bordetella bronchiseptica* was found to be responsible for the disease. Further detailed analysis revealed that all the 11 *B. bronchiseptica* were non-haemagglutinating with the RBCs from cattle, goat, pig and duck. The isolates produced amylase enzyme *in-vitro*.

Characterization haracterization of virulence factors/toxins

Bordetella bronchiseptica

Six isolates of *B. bronchiseptica* recovered from pigs were analyzed for virulence factors. None of the isolates showed DNase or proteinase activity but 4 out of 7 (57.12%) isolates showed amylase activity, of which isolates No. PBB-07 and PBB-09 showed maximum activity. Sugar fermentation test showed varied results. While three isolates namely, PBB-01, PBB-04 and PBB-09 were maltose fermenting, only PBB-07 could ferment xylose. None of the isolates could ferment Galactose, sorbitol, mannose, sucrose or trehalose. The isolates were found non hemolytic when tested on agar plates incorporated with 5% calf, rabbit, goat, sheep and chicken blood.

The hemagglutinating property of the *bronchiseptica* isolates revealed that fresh culture of the isolates, including bacteria in the initial log phase of growth, failed to give any hemagglutination response. Further, the hemagglutinating reaction of the isolates under study gave a positive response only with rabbit RBCs and failed to elucidate any response with RBCs of other animal species studied *viz.* cattle, goat, duck and pig. The only plausible explanation to this could be due to certain antigenic variations resulting out of repeated cultures of the old isolates on different media.

Plasmid distribution pattern amongst the *Bordetella* isolates

The plasmid numbers in six isolates of *B. bronchiseptica* ranged from 1 – 4 of 3.5 kb to 28.7 kb sizes, three isolates were having multiple plasmids (3 – 4 numbers) (Fig.32). The only common plasmid was of 22.1 kb – 24.1 kb size. Clustering of plasmid profiles using Pearson product at 4 % autofit (AAB software, USA) taking isolate No. PBB 3 as reference showed that, four out of six isolates were having more than 92% similarity, whereas, the overall similarity was 51.8% among all the isolates.

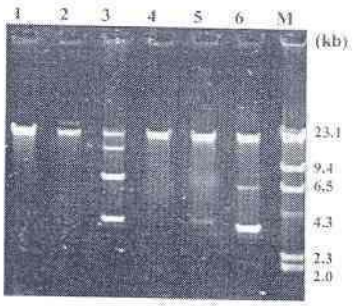


Fig 32. plasmid profile of *B. bronchiseptica*

Dendogram generated by Un-weighted Pair Group Method using Arithmetic averages (UPGMA) with simple band match at 3.20% tolerance generated 4 clusters with similarity from 46.67-100% (Fig 33); whereas UPGMA clustering using Pearson product at 4.00% autofit generated 5 clusters with similarity ranging from 55.95-95.06%. UPGMA clustering using Euclidean Distance at 4.00% autofit also generated 5 clusters having scales ranging from 112.72 to 391.08. The clustering analysis of UPGMA using both band match and amount at 3.20% tolerance also generated 5 clusters ranging from 41.21-75.58%.

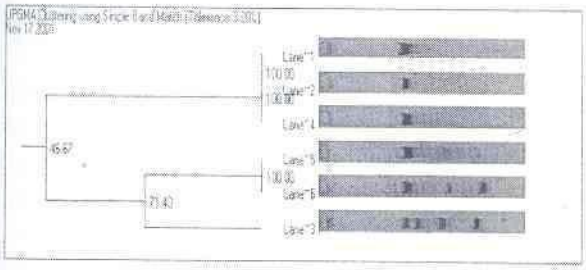


Fig 33. Dendogram of *B. bronchiseptica*

Identification of polypeptide profiles

Bordetella bronchiseptica

A total of 23 -27 major polypeptides bands were detected in the molecular weight range of 13.4 - 114.0 kDa in whole cell extract of *B. bronchiseptica* isolates (Fig 34). The two isolates namely, BB-04 and BB-09 were citrate negative strains and showed major differences in the polypeptides in the molecular weight range of 35-38 kDa and 55-62 kDa with other isolates. Isolate BB-07 presented a unique band in the molecular weight range of 35.2 ± 0.5 kDa absent in other isolates.

Identification of major immunogens

Bordetella bronchiseptica

The hyper immune serum was raised in rabbits against whole cell preparation from *B. bronchiseptica* field isolates No. PBB-09. Polypeptides separated by SDS-PAGE were blotted on to the polyvinylidene difluoride (PVDF) and processed further using raised hyper immune serum and anti-rabbit IgG-Horseradish peroxidase conjugate. All the immunogenic protein bands separated were in the range of 20 to 100 kDa. Few immunogenic bands were also visible in the molecular weight above 100 kDa.

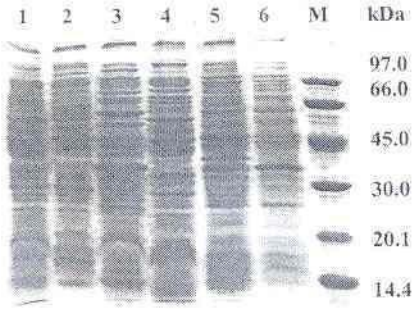


Fig 34. A whole cell polypeptide profile of *B. bronchiseptica*

Escherichia coli

Analysis of plasmid profile of 45 *E. coli* isolates revealed 35 different patterns of multiple plasmids with a common one in the range of 23.1 kb – 26.4 kb. Moreover, the eight enterotoxigenic/ enteropathogenic isolates showed plasmid similarity ranging from 64.75% to 91.53% in the dendogram of overlaid graph based on plasmid profile similarity with Pearson product (AAB software, USA) at 4% autofit. The common plasmid was predominant in all the eight strains with an amount ranging from 23% to 72%.

Bacteriological quality of pork sold in Meghalaya

Ashok Kumar, H.V. Murugkar and H. Rahman

To assess the quality of pork sold for human consumption in and around Shillong, a total of 38 pork samples were processed for total viable count (TVC), differential viable count for faecal coliforms, faecal strepotococci, *Staphylococcus aureus* and isolation of specific pathogens like *Salmonella*, *Campylobacter* sp. and *Listeria monocytogenes*.

The pork samples from Laitumkhrah had the highest TVC indicating the lower microbiological quality of pork. As regards the differential counts, lowest faecal coliform and *S. aureus* counts were

observed from Barabazar. The differential counts for all the major groups of indicator organisms, viz., faecal coliforms, *S. aureus* and faecal streptococci were highest in case of the samples from Laitumkhrah. No *Salmonella*, *Campylobacter* sp. or *Listeria monocytogenes* could be isolated from these samples. The variations in bacteriological quality observed from the samples collected from various locations could be due to the health status of animal slaughtered or the sanitary and hygienic quality of slaughtering followed at different localities. However, all the samples were within the acceptable levels of bacterial counts as per Bureau of Indian Standards (BIS).

Characterization of virulence factors/toxins of *Salmonella*

H.V. Murugkar, H. Rahman and Ashok Kumar

Production, purification and characterization of Salmonella enterotoxin (Stn)

Salmonella enterotoxin (Stn) has been found to be one of the major virulence factors involved in the pathogenicity of the organism. Production and purification of Stn was achieved by production of toxin in brain heart infusion broth and subsequent purification by fractional ammonium sulphate precipitation, dialysis and gel filtration chromatography. The molecular weight of the Stn was found to be approximately 60 kDa in SDS-PAGE. Detection of Stn was carried out with the help of rabbit ligated ileal loop assay (RLIL) as a biological method and biken test, staphylococcal coagglutination test and dot-ELISA as immunological tests. A comparative evaluation of the various Stn detection methods indicates greater usefulness of the immunological tests *vis a vis* RLIL. Amongst the three immunological assays, viz. biken test, CoA test and dot-ELISA, the latter was found to be the most suitable in terms of its accuracy, simplicity and rapidity.

Detection of virulence genes of Salmonella

Detection of *Salmonella* enterotoxin *(stn)* gene by Polymerse Chain Reaction (PCR) was carried out in 95 *Salmonella* isolated from poultry, pigs, cattle and humans. In the PCR assay, *stn* gene was found to be present in all the 95 isolates that were detected by the presence of a 617 bp product in the shi gene segment. Considering its cent percent detection level, this method has a potential to be used as a diagnostic tool for rapid detection of *Salmonella* from field samples.

Weather Based Animal Disease Forecasts (NATP-MM)

Monitoring, surveillance and forecasting of livestock diseases

H. Rahman, B.R. Shome, Ashok Kumar, Rajeswari Shome, H.V. Murugkar and I. Shakuntala.

Data collection from Meteorological department: Meteorological data with respect to Meghalaya was collected for two locations namely Shillong and Cherapunj from the Regional Meteorological Centre, Borjhar, Guwahati as per the requisite proforma supplied by the lead centre. All the data regarding available parameters for Shillong for seven years were collected on the month wise basis. Monthly average of the requisite parameters was calculated and wherever required the requisite classification as per the intensity of individual parameters was also computed.

Animal Health Information System through Monitoring and Surveillance (AHIS_DMS) – NATP _DMS

H. Rahman, B.R. Shome, Ashok Kumar, Rajeswari Shome, H.V. Murugkar and I. Shakuntala.

Serum samples from various species have been collected as per the priority of the region and taking into account the mandate of the project defined by PD_ADMAS. After approaching all the State Directorates in the region, success could be achieved in case of Mizoram, Meghalaya and Tripura only. Serum collections from various species have been started and the same is preserved for further analysis. ELISA and dot-ELISA have been standardized.

CU PD_ADMAS (Collaborating Unit-Project Directorate on Animal Disease Monitoring and Surveillance

H. Rahman, B.R. Shome, Ashok Kumar, Rajeswari Shome, H.V. Murugkar and I. Shakuntala.

Serum collections from various species have been started and the same is preserved for further analysis. ELISA and dot-ELISA have been standardized. The following diseases were studied:

Screening for pig diseases

Regular screening and post-mortem examination are carried out in the Institute Pig Farm and nearby villages. Faecal samples from piglets suffering from diarrhoea were screened for bacterial pathogens in various organized and unorganized farms. *S. Typhimurium* 4,5,12:1:1,2, *S. Enteritidis* 9,12:g,m, *S. Bareilly* 6,7:y:1,5 and *S. Paratyphi* B 4,5,12:b:1,2 serotypes were confirmed by the National *Salmonella* and *Escherichia* Centre, Kasauli. Different serotypes of *Escherichia coli* were also isolated, of which O6, O65, O8, O9, O107 and O101 were predominant. Samples were also positive for different *Clostridium* sp. and they were identified as *Cl. butyricum, Cl. rectum, Cl. perfringens* and *Cl. paraperfringens* based on their morphological, cultural and biochemical characteristics.

Screening for cattle diseases

Serum samples from cattle in Government Cattle Farm, Upper Shillong, Meghalaya, and Dairy Unit of the Institute was screened for the presence of antibodies against brucellosis with the help of STAT (Standard Tube Agglutination Test) and RBPT (Rose Bengal Plate Test). All the samples were found to be negative for *Brucella* antibodies.

Screening for goat diseases

Respiratory affections amongst goats in Government Goat Farm, Nongshillong, Meghalaya was investigated in the month of May-June 2001. Serum samples were also collected. *Staphyloccus* sp., *Klebsiella* sp., *Shigella* sp. and *Flavobacteria* sp. were isolated from the nasal swabs of affected animals.

Screening for rabbit diseases

Regular screening and post-mortem examination are carried out in the Institute Rabbit Farm and nearby villages. Animals in the Government Rabbit Farm, Upper Shillong, Meghalaya, were also screened for respiratory bacterial pathogens following reports of respiratory distress. *Bordetella bronchiseptica, Pasteurella multocida, Staphylococcus aureus* and *Streptococcus* sp. were associated as the important respiratory pathogens. The necropsy findings revealed that highest mortality was due to pneumonia, followed by trauma, nephritis and peritonitis.

Serum samples were also collected for seroscreening of important rabbit diseases.

Prevalence of larval cestode of zoonotic importance in the livestock

C. Rajkhowa and S. Bandyopadhyay

The prevalence of *Cysticercus cellulosae* was investigated in 185 pigs slaughtered in different locations of Shillong and 7.02 per cent were found to be positive. Cysts were commonly observed in the thigh muscles, under neck and tongue of the animals (Table 35).

Table 35. Prevalence of *Cysticercus cellulosae* in pigs slaughtered at Shillong

Period	Total number of animals examined	Total number of animals found positive
October to March	45	3 (6.67%)
March to May	30	4 (13.30%)
June to September	110	6 (5.45%)

Epidemiological studies on pig and cattle parasites

C. Rajkhowa, S. Bandyopadhyay and P. Devi

Faecal samples of 303 cattle and 253 pigs were collected from various places of Meghalaya. Out of these, 48 (15.84%) and 111 (43.87%) were found to be positive for various parasites from cattle and pig, respectively. Percent of positive animals are more in pig. This might be due to poor hygienic environment in pig farms as compare to cattle farm.

Percent of positive animals in cattle are more in Kyrdemkulai (18.947%) and Jowai (17.241%)

than the Upper Shillong (12.40%). This might be due to location of Upper Shillong farm at a higher elevation than the other two farms. It might also be due to better care in maintainance of hygiene in Upper Shillong farm.

Parasitic infection in pig from Jowai farm (58.77%) is higher than the farm located in Kyrdemkulai (31.65%). This is due to the better managemental practices obsserved in Kyrdemkulai farm.

Separation and purification of antigens

C. Rajkhowa, S. Bandyopadhyay and P. Devi

The parasites (both *Haemonchus* sp. and *Oesophagostomum* sp.) were trichurated separately and the materials were treated with 60% ammonium sulphate. The materials were then centrifuged and the precipated materrials were collected. The precipitated materials were dissolved using 0.5 M PBS (pH 8.0, 7.5 and 4.0).

The supernatant material of 60% ammonium sulphate precipitation were further treated with 80% ammonium sulphate. The precipitated material were again dissolved using 0.5 M PBS (pH 7.5, 6.0 and 4.0).

Both 60% and 80% amonium sulphate precipitation, higer molecular weight protein was separated when the pH was neutral or alkaline in nature (marked as red arrow). But lower molecular weight protein was separated when the pH was acidic in nature (marked as yellow arrow)

From the SDS PAGE of *Hemaonchus sp.* antigen, it was clear that there was a definite role of pH for separation of different molecular weight protein in SDS PAGE. The antigens of *Oesophagostomum sp.* was divided in two groups.

a. 80% ammonium sulphate precipitation (pH 7.5, Neutral)
b. 60% ammonium sulphate precipitation (pH 8.0, Alkaline)

80% amonium sulpahte precipitaion (pH 7.5) showed comparatively better separation of protein than those of 60% ammonium sulphate precipitation (pH 8.0). As we have not done the SDS-PAGE in other pH gradient, it was not possible to interpret the role of pH for separation of different molecular weight in case of *Oseophagostomum sp.*

Chromatographic separation of membrane associated antigens of *Fasciolopsis buski* collected from slaughtered animal

C. Rajkhowa, S. Bandyopadhyay and P. Devi

The parasites were triturated in pestle morter using Milli Q water. The materials were then centrifuged at 10,000 rpm for 20 minutes. The sediment material was then treated with 0.3 % Sodium Deoxycholate and incubated for one hour at 37° C. The materials were again centrifuged at 10,000 rpm for 20 minutes. The supernatant was collected and dialysed in dialysis sac (Snake, Pierce, USA), against Milli Q water for 24 hours at 4°C. The membrane associated proteins were fractionated in Sepahdex G 100 column in FPLC system (Pharmacia Biotech). The flow rate was adjusted to 0.5 ml/minute. The fractionated proteins obtained from Sephadex G 100 column were further fractionated using Resource Q column. The flow rate was adjusted to 1 ml/minute.

The membrane associated antigen was first fractionated using Sephadex G 100 column. The result showed 3 protein fractions of different molecular weight. Using anion exchange column (Resource Q) did further fractionation of these 3 proteins. The result showed the presence of one protein each in peak 1, 2 but 3 protein fractions in peak 3.

The total protein present in the membrane of the parasite initially fractionated in 3 different proteins according to their molecular weight. The proteins, which are of similar molecular weight, can not be separated with this technique. For further separation of these proteins fractions isolated in Sephadex G 100 column. Peak 1 and 2 separated in sephadex G 100 column showed only one protein after passing through Ion exchange column (Resource Q). These findings confirmed the presence of only one protein each in these 2 peaks, but the 3rd peak of Sephadex G 100 column showed total 3 protein fractions after passing through Ion exchange column (Resource Q). These findings

clearly confirm the presence of 3 proteins of similar molecular weight but different in ionic strength in the 3rd peak.

Pig nutrition and feeding

B.P.S. Yadav, S. Doley and J.J. Gupta

Growth performance of pigs on various rations formulated without maize grain

Experiment was conducted on crossbred (Hampshire x local) growing piglets to evaluate growth performance on various rations formulated without maize grain. Twelve piglets were randomly divided into four groups and allotted experimental rations during growth trial of 70 days duration. The control group (T_1) was offered concentrate mixture containing crust maize grain; where as experimental groups were offered rations formulated without maize grain. Treatment groups were offered rations formulated with rice polish and wheat bran (T_2); wheat bran and banana stem (T_3) and wheat bran and sweet potato (T_4) and all rations were made isonitrogenous. The average growth (g/d) of piglets were observed 171.33; 176.33 and 186.33 in treatments T_2; T_3 and T_4 respectively in comparison to 277.00 g/d of control group (T_1). The study indicated that rations formulated without maize grain did not supply sufficient energy and protein needs of growing piglets.

MIZORAM

Integrated piggery development (NATP)

N.S. Azad Thakur, A.K. Saikia and P. Goswami

As per the technical programme, 9 beneficiaries including a breeder farmer from each village and 4 villages each form Kolasib and Aizawl districts, respectively were selected. The piglets were distributed to 36 and 5 nos. of beneficiaries of Kolasib and Aizawl districts, respectively. Out of these 41 beneficiaries, 37 were of poor category and 4 nos. of breeder farmers. The initial body weight was recorded followed by monthly growth rate up to one year of age. It was observed that the daily gain in body weight of the distributed pigs is in the range of 150 to 300 g with an average of 160 g/day per pig during the first 6 months of age and about 200 g in the second 6 months of the year. The concentrate feed was also distributed to the beneficiaries at the rate of 64.77 feed per pig. Along with the feed supplement, medicines were also provided to the farmers whenever needed.

Some female pigs were observed to come to their first heat after attaining an average age of 11 to 13 months. Some of the females were found to be conceived and attained a gestation period of 1 to 2 months, while the others had given birth of 7-8 litters per pig. The litter weight at birth was recorded to be 5.60 kg with an average body weight of 800 g per piglet. At the initial stage of their growth, most of the piglets suffered from skin infestations, liver dysfunction, urinary tract and respiratory infections. Different species of parasites recorded in pigs under the study were *Strongyloides* sp., *Ascaris* sp., *Oesofagostomum* sp., *Trichuris* sp., and *Coccidia* sp.

NAGALAND

Improvement of local pig (NATP) survey report on *Naga Local* Pig (NATP)

P.P. Rohilla and H. Choudhury

Sample survey has been conducted in various districts of Nagaland to study the existing pig production system and constraints at farmers level. It has been observed that Naga Local pig with short and erected ears long snout, pot bellied and small size pigs are purely indigenous animals with native tract lying around 93.95°5E longitude and 25.27°N latitude. Various local communities of farmers are rearing these pigs mostly in free-range system with supplemented feeds and fodders available with them. Generally small size herds are maintained by the farmers at close proximity to their houses using open and kutcha housing as night enclosure. Veterinary aids presently available in field condition

are not sufficient to support the animal to resist themselves from diarrhoea, gastro-intestinal parasitism, swine fever and FMD. Detailed study of various parameters during survey has given useful information on body measurements, productive and reproductive performances along with carcass characteristics of the animals. Mortality trend in field condition showed prenatal mortality around 10% including abortion (8%) and stillbirth (15%); pre-weaning mortality 20% and annual adult mortality 5%. Though pig population in Nagaland is highest among all NEH states, the present survey on Naga Local pigs clearly reflected genetic degradation to these small size pigs with poor productive and reproductive performances and lack of proper feeding, management and health care practices which can be improved further by scientific intervention.

Improvement of *Naga Local* Pig

D.T. Pal, H. Choudhury and H.D. Karmakar

Research has also been conducted on Naga Local pig at Research Farm of the Institute for improvement of production system to maximize production per animal. Required germplasm of pigs have been collected from different areas of the state. The animals are maintained under uniform conditions of housing, feeding and health care in an intensive system of management. The animals have performed well up to the next generation for various economic traits in organized farm. Reproductive performance of the animals has shown some improvement in farm condition with higher litter size, litter weight at birth and weaning, and reduced gestation period as compared to the field (Table 36). Growth performance of the first generation piglets have also been recorded along with body surface measurements up to adulthood. Various causes of mortality in these animals include premature birth (10.68%), crushing (16.50%), winter stress (16.5%) and *E. coli* infection (25.24%), along with noticeable in availability of milk (9.71%), cannibalism (9.71%), tympanitis (0.97%) and other causes (7.77%). The present observations have shown better performances of Naga Local pigs in farm collection with further scope of genetic improvement as well as improvement through better nutrition, management and health care.

Table 36. Some reproductive traits of indigenous pigs of Nagaland under farm condition

Parameters	Nos. of observations	Mean ± SE
Litter size at birth (LSB)- nos.	31	6.32±0.49
Litter weigh at birth (LWB)-kg	21	3.56±0.38
Litter size at weaning (LSW)-nos	16	3.88±0.67
Litter weight at weaning (LWW)-kg	16	17.05±3.14
Gestation period (GP)-days	30	112.83±0.68

TRIPURA

Adaptive trial on cross-bred pigs

Chander Datt, S.K. Ghosh and M. Niranjan

Production performance of the crossbred pigs (Hampshire x Local) introduced at this centre in March, 2000 was further evaluated. The pigs were fed on standard diets according to their requirements. The production traits of the pigs have been shown in Table 37. During the year under report, 8 farrowings were obtained. The piglets were given iron (Imferon) injections intramuscularly at the age of 3, 7 and 14 days in order to prevent piglet anaemia. The mortality rate upto wearing stage was about 15 %. In general, the pigs weighed about 55-60 kg at 8-8.5 months of age. Butox (deltamethrin) at a concentration of 2 ml/litre was used control tick infestation during March-April and July-September. Vaccination was done against swine fever after 3 months of age. For prevention of endoparasitic infestation, regular deworming schedule was followed. No other major disease was observed. The local farmers were provided with the facility of natural service from the institute boars so as to improve the desi stock.

Table 37. Average performance of crossbred pigs (Hampshire x Local) under Tripura climate

Sl. No	Character	Average value
1.	Age at first service (days)	247
2.	Age at first farrowing (days)	361
3.	Gestation period (days)	114
4.	Litter size at birth (No's)	7.00
5.	Litter size at weaning (No's)	5.80
6.	Litter weight at birth (kg)	8.05
7.	Litter weight at weaning (kg)	68.56
8.	Sex ratio at birth (M : F)	55 : 45
9.	Sex ratio at weaning (M : F)	56 : 44
10.	Individual weight (kg) at week 0(birth)	
	M:	1.14
	F:	1.21
11.	Individual weight (kg) at week 8 (weaning)	
	M:	11.00
	F :	12.00
12.	Individual weight (kg) at week 12	
	M:	19.00
	F:	21.87
13.	Individual weight (kg) at week 16	
	M:	32.25
	F:	34.53
14.	Individual weight (kg) at week 20	
	M:	40.52
	F:	38.83
15.	Individual weight (kg) at week 24	
	M:	51.25
	F:	44.80
16.	Dressing percentage	72.00

RABBIT

MEGHALAYA

Studies on general and specific combining ability of rabbit.

Anubrata Das, S. K. Das, S. Naskar and G. Kadirvel

In continuation of previous year programme analysis of data showed that out of three pure bred rabbits viz. New Zealand White (NZW), Soviet Chinchilla (SC) and Local (LC)—NZW encells the other two breeds in all the productive and reproductive performance except in the live weight at 180 days.

The performance of different cross bred were compared and the Table 40 depicts that SC X NZW (SN) performed best in litter size at birth, litter weight at birth and weaning, litter weight at 90 days and average post weaning daily weight gain where as NZW X SC (NS) showed better results in litter size at weaning, individual litter weight at weaning and litter weight at 60 days.

The carcass trait of different group of rabbit , *i.e.*, SC, NZW, local and pulled cross bred presented in table 3 shows that the dressing percentage was highest in NZW (53.47%) however, there was no significant difference with SC (53.37%) and in crossbred animals. The over all dressing percentage was 52.84±1.22.

Effect of early weaning on the growth , feed efficiency and carcass characteristics of broiler rabbit under two feeding regime

Anubrata Das

Growth rate of 30 nos. each of NZW and SC was assessed in different concentrates feeding and concentrate feeding plus green feeding in different weaning regime *i.e.*, 4th week, 5th week and 6th week. At 12 week of age, the body weight of NZW breed under group i ,ii and iii were 1095.00 and 990.00,1244.00 and 1195.00 and 1425.00 and 1394.00 g, respectively in different feeding regime. The body weight of group iii was significantly ($p<0.01$) higher than group i & ii in NZW and in SC breed the 30 day weight of group iii was significantly ($p<0.05$) different from group i. In all the three weaning groups of both the breeds, there were no significant difference in body weight due to breed and varied feeding treatments. In general rabbits fed on concentrate feed attained higher body weight than those fed on concentrate plus green in both the breeds (Tables 38-39).

Bacterial pathogens from upper respiratory tract of rabbits

Ashok Kumar, Rajeswari Shome, H.V. Murugkar, B.R. Shome and H. Rahman

Among the various causes of rabbit mortality, diseases involving respiratory system have been

Table 38. Performance of pure breed rabbit

Parameters	Breed NZW	SC	LC
Litter size at birth	6.80 ±0.20* (25)	6.59 ±0.21 (22)	5.29 ±0.27 (14)
Litter wt. at birth(g)	420.40 ±19.15* (25)	372.18 ±16.05 (22)	268.46 ±13.65 (13)
Individual litter wt. at birth(g)	63.15 ±3.40* (25)	55.18 ±1.89 (22)	54.77 ±2.30 (13)
Litter size at weaning	5.42 ± 0.20* (23)	4.69 ±0.22 (22)	3.64 ±0.34 (11)
Litter wt. at weaning(g)	3297 ±144* (23)	3159 ±147 (22)	1672 ±134 (11)
Individual litter wt. at weaning(g)	605.70 ±10.40* (126)	604.62 ±8.74 (115)	450 ±18 (40)
Live wt. at 90 days(g)	1591 ±17* (125)	1567 ±19 (115)	1262 ±29 (40)
Live wt. at 120 days (g)	2283 ±20* (103)	2280 ±25 (115)	1550 ±36 (40)
Live wt. at 180 days (g)	2424 ±26 (97)	2522 ±24* (84)	1926 ±35 (40)
Av. Daily gain in post weaning Period (g/d)	20.53 ±2.17* (125)	20.03 ±1.68 (115)	10.93 ±1.87 (40)

reported to be one of the major causes. A total of 171 nasal swabs were collected from adult rabbits comprising 117 healthy and 54 with respiratory distress manifested by coughing, sneezing and dyspnoea with nasal and ocular discharges. The samples were screened for presence of bacterial pathogens. Diseased rabbits were found to harbour both *Staphylococcus aureus* and *Pasteurella multocida* significantly more than their healthy counterparts. *Bordetella bronchiseptica* was isolated from diseased rabbits only. *Streptococcus sp.* was isolated along with *P. multocida* or *B. bordetella* from diseased rabbits. Other respiratory bacterial flora included *Diplococcus* sp., *Staphylococcus epidermidis*, *Bacillus* sp. and *Micrococcus* sp. The study establishes the role of *S. aureus, P. multocida* and *B. bronchiseptica* as important etiological agents for respiratory diseases of rabbits, however, *Streptococcus* sp., *Diplococcus* sp., *S. epidermidis*, *Micrococcus* sp. and *Bacillus* sp. as primary respiratory pathogens of the rabbit remains obscure. Antibiogram studies against 10 antibiotics revealed varying results with highest (100%) sensitivity to enrofloxacin, ciprofloxacin, followed by erythromycin, gentamicin and chloramphenicol (87%).

Table 39. Performance of crossbred (F-1) rabbits

Parameters	SN	NS	SL	LS	NL	LN
Litter size at birth	6.22±0.25* (9)	5.72±0.25 (10)	5.70±0.21 (10)	6.00±0.26 (10)	5.40±0.34 (10)	5.80±0.20 (10)
Litter wt. at birth(g)	395.56±*36.80 (9)	359.00±25.31 (10)	328.95±8.47 (10)	348.11±17.05 (10)	306.00±22.45 (10)	364.87±25.31 (10)
Ind. Litter wt. at birth(g)	64.20±6.31 (9)*	62.89±2.70 (10)	58.29±2.24 (10)	59.03±4.20 (10)	55.73±1.83 (10)	63.31±4.51 (10)
Litter size at weaning	5.43±0.57 (7)	5.57±0.30* (7)	5.00±0.22 (7)	4.75±0.31 (8)	4.75±0.37 (8)	4.88±0.30 (8)
Litter wt. at weaning(g)	3475±349* (7)	3326±262 (7)	2671±122 (7)	2780±161 (8)	2579±194 (8)	2885±171 (8)
Ind. Litter wt. at weaning(g)	596±15 (38)	597±19* (39)	534±16 (35)	584±15 (38)	560±13 (37)	593±13 (39)
Litter wt. at 60 days(g)	881±18 (38)	898±19* (39)	746±24 (35)	769±16 (38)	677±13 (37)	702±16 (35)
Live wt. at 90 days(g)	1584±31* (38)	1509±41 (34)	1482±36 (35)	1558±32 (38)	1495±32 (37)	1530±33 (34)
Live wt. at 120 days(g)	2109±27 (38)	2106±28 (34)	2125±31* (24)	2090±32 (38)	1916±42 (32)	1981±35 (30)
ADG in post weaning Period(g/d)	20.59±1.87 (38)*	19.01±1.44 (34)	19.76±0.99 (35)	20.29±1.03 (38)	19.48±1.05 (37)	19.52±1.27 (34)

SIKKIM

Growth Performance of Angora rabbits maintained on two different housing systems

Ramesh Chandra and H.D. Karmakar

A growth trial was conducted for 138 days (from 42 to 180 days of age) with 22 rabbits of both sexes. The weaners were randomly divided into two housing system of 11 each, as and when they were weaned at 42 days from their mothers. All the animals were maintained under uniform feeding and management conditions. The both groups were maintained on pellet feed at the rate of 50 gm for weaner, 75 gm for grower and 100 gm for adult per day. Pellet feed was composed of crushed maize 40%, wheat bran 15%, groundnut cake 30%, fish meal 5%, molasses 8%, mineral mixture 1.5% and salt 5%. The weekly body weights of all the rabbits were recorded from weaning to 180 days. Though the initial body weight of the weaners was almost similar (595/586 gm) in both the system and thereafter body weight at 90, 120 and 180 days was found higher in out door system (1440.91±32.21, 1845.45±19.60 and 2381.25±23.02 gm, respectively) than indoor system (1346.36±29.46, 1785.00±29.86 and 2100.00±64.12 gm, respectively).

As far as mortality in Angora rabbits is concerned, the highest mortality (33.33%) was recorded due to Nephritis, followed by congestive cardiac myopathy (16.67%), Enteritis (16.67%), Hepatitis (16.67%) and Pneumonia (16.67%), respectively.

Effect of cold process pellet feed on performance of rabbit

Debasis De and Asit Das

Effect of cold process pellet feed on feed intake and digestibility of young rabbit

Forty two crossbred (SC x NW) young (42 d) rabbit were randomly divided into seven groups six each and were housed individually in mesh wire cages with facilities for feeding watering and excreta collection in a well ventilated house. Animals of groups I, II, III, IV and V were fed concentrate mixture and cold process feed in the ratio of 100:0, 70:30, 50:50, 30:70 and 0:100, respectively along with *ad lib* mixed jungle grass. Animals of groups VI were fed hot process pellet feed and *ad lib* mixed jungle grass. Rabbits of group VII were solely fed on mixed jungle grass. Feed was offered twice a day to all animals. Fresh drinking water was supplied free of choice to all the animals. Metabolism trial was conducted at the end of three months growth trial. Voluntary feed intake was measured and recorded for two consecutive days in every week. Total dry matter (DM) intake and digestible DM intake (DDMI) was significantly ($p<0.01$) higher in groups V as compared to that of other groups. DM (g) and DDM (g) intake was lowest in groups VII but DMI in terms of g/100 kg body weight (bw) and g/kg $W^{0.75}$ were significantly ($p<0.01$) higher in groups VII followed by group V. DM digestibility was significantly ($p<0.01$) lower in only jungle grass fed group *i.e.*, group VII. So, it can be conducted that cold process pellet can completely replace concentrate mixture/hot process pellet without affecting DMI and digestibility.

Effect of cold process pellet feed on growth rate and feed conversion efficiency of growing rabbits

Growth trial was conducted for 91 days. To measure the daily weight gain all animals were weighed on two consecutive days at 7d intervals, before feed and water was offered. Total live weight gain and average daily gain (ADG) was negative in animal fed only jungle grass. Live weight gain and ADG were similar among the groups I to VI. Total DM intake in 91d growth period was significantly ($p<0.01$) lower in group VII as compared to that of other groups. Total DMI was highest in group I but similar with group III, IV and V. Feed conversion ratio (feed: gain) was similar among the groups I to Vi. But, total feed cost was significantly ($p<0.01$) higher in group I and VI as compared to that of all cold process pellet (CPP) fed groups (*i.e.*, groups I, II, III, IV and V). Among the CPP fed groups feed cost was similar and it was lower in CPP fed groups. So, it can be concluded that cold process pellet can completely replace the concentrate mixture and hot process pellet feed without affecting growth rate and feed conversion efficiency. Cold

process pellet feeding can reduce the total feed cost and feed cost per kg weight gain

Effect of cold process pellet feed on carcass characteristics of rabbit

At the end of growth trial rabbits were slaughtered to study the carcass characteristics. Weight at slaughtering was significantly ($p<0.01$) higher in group I as compared to that of groups V, VI and VII. Weight at slaughtering was lowest in group VII. Hot carcass weight, commercial carcass weight and reference carcass weight were similar among the groups I, II, III and IV, but were significantly higher than that of group VII. No significantly differences in weight at slaughtering, hot carcass weight, commercial carcass weight and reference carcass weight were observed between group V and VI. Commercial dressing percentage and hot dressing percentage did not differ significantly among the groups. Among no edible parts, gastro intestine (GI) tract (% wt. at slaughtering) was significantly ($p<0.01$) higher and skin (% wt. at slaughtering) were similar among the groups I to VI but it was significantly ($p<0.01$) lower in group VII. Among edible parts, reference carcass weight (% commercial carcass weight) and weight of liver and heart (% commercial carcass weight) did not differ significantly among the concentrate and cold process pellet (CPP) fed groups. No significant difference in reference carcass weight was also found between CPP (i.e. group V) and hot process pellet (HPP) (i.e. group VI) fed group. So, it can be concluded that replacing 100% concentrate mixture/hot process pellet with cold process pellet feed did not make any difference in dressing percentage and reference carcass weight.

TRIPURA

Adaptive trial on broiler rabbit in Tripura

S.K. Ghosh, Chander Datt and M. Niranjan

Two breeds of broiler rabbit viz. New Zealand White (NZW) and Soviet Chinchilla (SC) were introduced at the centre during 1997-98 under the project "Adaptive trail of broiler rabbit in Tripura". The animals were kept in individual cages made by galvanized welded wire (size: 50-60 cm x 35 - 40 cm). Commercial pellets and green fodder (25-30 : 70-75) were used as their feed. The green fodder included leaves of mulberry, cauliflower, cowpea, radish, turnip, carrot, cabbage and grasses like dubgrass, napier etc. When productive and reproductive performances were compared between the two exotic breeds, it was observed that both the breeds were performed equally good. No significant differences observed between the two breeds in respect of their litter size at birth, litter weight at birth, litter size at weaning, litter weight at weaving and individual weight at 90 days of age.

GOAT & CATTLE

MEGHALAYA

Goat

Respiratory infections among goats in Government Farm, Nongshillong, Meghalaya were investigated. *Staphyloccus* sp., *Klebsiella* sp., *Shigella* sp. and *Flavobacteria* sp. were isolated from the nasal swabs of affected animals.

Goat feeding and nutrition

B.P.S. Yadav, S. Doley and J.J. Gupta

Comparative performance of goat during winter season

Thirteen male goats of average body weight 9.58±0.14 Kg were selected and during conditioning period they were castrated. The goats were randomly divided into two groups and offered concentrate mixture @ 1% of body weight in addition to grazing in group I and goats of group II were provided only grazing on native pasture. The study lasted for 90 days during peak winter of December to March months.

The study revealed that only grazing on native pasture during winter supported a growth of 15 to

16 g/d where as supplementation of concentrate offered a growth of 23 to 24 g/d. It indicated that growth of goat drastically reduced during winter due to less availability of green vegetations and cold weather. It is only 40% to 50% growth in comparison to growth of rainy season on grazing and supplementation of concentrate respectively.

Epidemiological investigation through autopsy examination of goat slaughtered in Meghalaya

C. Rajkhowa, S. Bandyopadhyay and P. Devi

A total of 56 number of stomach and intestine of goat were collected from local unorganised slaughter places located in Shillong and follwing parasites were recorvered and identified

1. *Oesophagostomum radiatum* (25%)
2. *O. venulosum* (26.79%)
3. *Haemonchus sp.* (87.5%)
4. *Trichuris ovis* (41.07%)
5. *Bunostomum sp.* (12.50%)
6. *Moniezia benedeni* and *M. expansa* (19.64%)
7. Amphistomes (21.42%)

Out of these 56 animals, 43 (76.79%) were found to be positive for *Haemonchus* sp. Out of 43 *Haemonchus* positive animals in 37 animals, parasites were exclusively recovered from reticulum, while in other 6 positive animals the parasites were recovered from their normal site of predilaction i.e. abomasum. Interestingly, in these 6 animals no parasites were recovered from reticulum.

SIKKIM

Goat

Causes of mortality in Sikkim local goats

The highest mortality (33.33%) was found due to pneumonia, followed by contagious carprine pluero pneumonia and systematic infection (9.52%). The month wise mortality ranged from 4.55% (July) to 31.82% (February). The highest mortality was recorded in the month of Feb. (31.82%), followed by March (22.72%), June (18.18%) and April (13.64%), respectively. The incidence of mortality in females was found higher (71.43%) than male (28.57%). The season wise distribution of mortality percentage revealed highest mortality in rainy (57.14%) and lowest in winter (42.86%) season.

Effect of different levels of concentrate supplementation on growth performance of Sikkim local goat fed mixed jungle grass based diet during summer

Fifteen male Sikkim local kids (6-9 months of age) were divided into three groups of 4 each in an experiment. Mixed jungle grass (summer season, Mar-May) was offered as lib to all the animals. Concentrate was supplemented @ 0.5 and 1.5% in groups I, II and III, respectively. The trial was conducted for 90 days during which weekly change in body weight and feed intake was recorded. Consumption of jungle grass was 499, 482 and 447 g/day. Concentrate consumption was 92, 185 and 324 g/day and total dry matter intake (DMI) was 592, 668 and 772 g/day and DM digestibility was 64.30, 70.80 and 70.20%, in groups I, II and III, respectively (Table 40).

Table 40. Effect of concentrate supplementation on growth performance of kids fed mixed jungle grass based diet during summer

Parameter	I	II	III	SEM
Initial body weight (kg)	14.7	14.6	13.8	1.19
Final body weight (kg)*	16.6	19.6	18.0	2.72
Change in weight (kg)*	1.9	5.0^b	4.2^b	0.32
Average daily gain (g/day)**	23.3^a	55.6^b	47.3^b	3.61

*P<0.05; **P<0.01

Total DMI was significantly (P<0.05) higher in groups III in comparison to other groups. Digestibility of DM was significantly (P<0.05) higher in groups II and III in comparison to group I. Initial body weight was 14.7, 14.6 and 13.8 kg. Whereas,

the final body weight was 16.6, 19.6 and 18.0 kg with average daily gain of 23.30, 55.56 and 47.30 g/d, in groups I, II and III, respectively. Average daily gain was significantly higher in groups III in comparison to other groups. Hence, it was concluded that maximum growth rate during summer season can be obtained in Sikkim local kids fed with mixed jungle grass alongwith the concentrate feed @ 1.0% of their body weight.

TRIPURA

Cattle

Management of cattle

Chander Datt, S.K. Ghosh and M. Niranjan

A small herd of about 20 crossbred cattle was maintained at the livestock farm. The availability of green fodders including cultivated and non-cultivated (grassy/non-grassy weeds) species was sufficient during rainy season. During this period, the animals were allowed to graze for 6-7 hours a day. The animals were also supplemented with concentrate mixture and some quantity of cultivated fodders like napier hybrid, thin napier, guinea grass, paragrass, broomgrass, sorghum, maize, cowpea and rice bean in order to meet their requirements. During the lean period from November to April, however, the animals were mostly stallfed mainly on paddy straw supplemented with concentrate mixture and also green fodders like maize, cowpea, Chinese cabbage and tree leaves like jackfruit, *Leucaena*, dumur etc.

For breeding, natural service was practised. During the year under report a total of 6 calvings were obtained with equal number of male and female calves. The average gestation period was observed to be 285 days. The animals were vaccinated against FMD in the month of February followed by HS and BQ vaccination. Endoparasite infestation was prevented by regular deworming. Tick infestation was successfully controlled using Butox (deltamethrin) at a concentration of 2 ml per litre during March-April and July-September.

POULTRY & DUCK

MEGHALAYA

Effect of Different brooding systems on subsequent broiler chicken production

J.J. Gupta, S. Doley and B.P.S. Yadav

An experiment was conducted on Vencob strain broiler chicks under deep litter to study the different brooding methods and their effect on subsequent performances. One hundred fifty unsexed day-old chicks were divided into three groups and brooded separately for 21 days. The birds of group I were provided electric brooder where as, birds of group II were provided electric brooder along with a provision of angithi also. However, the birds of group III were provided angithi and an electric bulb for light purpose only during night hours. The twenty-four chicks having nearer to group average body weight were taken out at 21 days of age from all three groups and further distributed into three groups to study their subsequent performances. All chicks were offered conventional compound mash diet and water in *ad-libitum* containing 20 and 22% dietary protein levels in starter (4-21d) and grower (21-42d) ration, respectively.

The bird's brooded in-group II was showed better subsequent performances in terms of growth rate (50.04 g/d) and FCR (2.41) than other groups. However, the subsequent performances of bird's brooded in-group III were equally well as group II and achieved growth rate of 49.11 g/d and FCR 2.45 with 6% mortality during brooding period.

Therefore, it is concluded that day-old chicks can even be brooded simply with the help of angithi only and an arrangement of light during night hours in remote areas of villages.

Production and utilization of buckwheat grain in poultry ration

The buckwheat (*Fagopyrum esculentum* Moench) seed was collected from NBPGR, Regional Station, Umiam, Meghalaya and sown

consecutively three times in same plot (100m^2) after the gap of 20 days of previous crop in the months of February, June and September, respectively. The soil was enriched with FYM @ 5t/h once in the beginning only.

Maximum crop duration was recorded in first crop during Feb. – May and minimum during Sept. – Nov. The maximum plant height was recorded in second crop during June – August which received highest rainfall 1268mm. However, grain yield, dry matter in grain and coat to grain ratio were not affected due to rainfall, sunshine hours and temperature. Although, maximum grain yield 7.71 q/h was recorded during third crop in the month of Sept. – Nov. All together, total 20.09 q/h grain yields was recorded. The chemical analysis data revealed that grain contains good amount of protein and energy and at par with other cereals like maize and wheat etc. Thus, it is concluded that three crops of buckwheat can be successfully taken in a year in acid soil at mid altitude of northeastern region.

A feeding experiment of 28 days duration was conducted on seventy-two numbers 21 days old Vencob broiler chicks to study the growth performances and nutrient utilization fed buckwheat (*Fagopyrum esculentum* Moench) grain. Three isoproteic (22%) test diets were prepared which contain buckwheat grain meal at the level of 15, 30 and 45% and compared against control conventional ration. All mash diets were fortified with minerals and vitamin mixtures. The growth performances of chicks and their nutrient utilization are presented in Table 41. The results showed that under-utilized non-conventional cereal like buckwheat grain could be fed to chicken to the level of 30% without any adverse effect on growth, nutrient utilization and physiology of birds.

Rural poultry (NATP)

Under NATP project, all together, 8 villages were surveyed from 4 districts of Khasi and Jaintia Hills of Meghalaya covering a total numbers of 200 farmers. It has been revealed that on average, tribal people of Meghalaya rear 14.29 birds per family and birds are of desi types only, which produced average 54.58 eggs/bird/year (Photo 2). Majorities of farmers are not satisfied with their present stock and most of them (95%) desired to keep improved breed of dual type (meat and egg), suitable for their agro-climatic conditions. Almost 100% farmers want some subsidy for purchase of improved breed, feed and other related materials. The 86% tribal farmers want training for upliftment of rural poultry through better way of management practices. Most

Table 41. Growth performance and nutrient balance in chicken fed buckwheat grain based ration

Particulars	Treatment Means ±				LSD ±
	Control	15% Buckwheat	30% Buckwheat	45% Buckwheat	
Growth Performance:					
Growth Rate (g/d)	41.83^{b}±1.46	41.71^{b}±1.25	39.27^{b}±2.16	33.62^{a}±1.51	5.32*
Feed Intake (g/d)	108±1.53	110±2.03	108±3.18	110±3.76	NS
Feed Conversion Ratio	2.59^{a}±0.07	2.63^{a}±0.06	2.77^{a}±0.08	3.29^{b}±0.11	0.38**
Nutrient Balance (g/100g intake)					
Dry Matter	67.06^{bc}±1.16	68.28^{c}±1.41	62.22^{a}±0.67	62.60^{ab}±0.18	4.62**
Protein	64.44±2.08	61.57±2.27	58.37±1.42	56.31±1.77	NS
Calcium	35.01^{b}±2.36	35.21^{b}±1.75	21.90^{a}±1.69	20.79^{a}±1.50	8.75**
Phophorus	41.26±1.33	51.49±2.65	46.84±2.10	47.77±2.20	NS

Different superscripts in a row differ significantly (P<0.05)* , (P<0.01)**

of poultry owners offered self produced grains and kitchen waste to their desi birds and allowed for scavenging in daytime. However, those farmers kept broiler chicken, they provided commercial mash ration that purchased @ Rs. 12/Kg from open market. The farmers never spent money on veterinary aids even on broiler chicken, which increased average mortality up to 22.81%. The major diseases recorded are coccidiosis, salmonellosis, RD, CRD, MD and fowl pox.

Development of DNA based diagnostics for important livestock and poultry diseases (NATP-CGP)

B.R. Shome, Rajeswari, Shome, H, Rahman, Ashok Kumar, H. V. Murugkar and I. Shakuntala

Duck virus enteritis (Duck plaque)

The examination of sick birds during an outbreak at the duck farm near Umsning, Meghalaya showed symptoms like pasted eyelids, droopiness, and watery diarrhoea. Inappetence, extreme thirst and reduced egg production along with high mortality were also reported. Consistent presence of blood in the body cavities and extensive hemorrhagic lesions on intestinal musculature and lymph node was found during post-mortem examination. The disease was diagnosed as duck plague.

Formalin inactivated virus vaccine was prepared in the laboratory using the infected tissue material and was inoculated in the rest of the flock along with supportive therapy. The mortality was drastically reduced.

Infectious Bursal Disease

Two outbreaks of IBD were recorded during the period. The dead and ailing birds were brought to the laboratory and postmortem was conducted. The inflamed bursa filled with caseous material was collected, triturated, centrifuged and supernatant (50% Bursal suspension) was tested positive by AGPT test using IBD standard serum. Antibiotic cover with supportive therapy in the infected flock improved the condition.

Colibacillosis

Out of 56 fecal /intestinal contents subjected to bacteriological investigations, 50 isolates of *E. coli* were recovered. Interestingly, two strains of *E. coli* were found to be highly pathogenic belonging to O157: H7 serotype which is recognized as one of the pathogen of public health importance at global level. Other predominant serotypes were O8 and O78.

MANIPUR

Poultry production (NATP-MM-III)

S.V. Ngachan

Introduction of Vanaraja germplasm and popularization of the breed in the hilly and backward tribal areas of the state

A total of 7770 fertile eggs were procured from Project Directorate on Poultry, Hyderabad and produced healthy chicks. The per cent hatchability on total eggs set ranged from 46.7 to 71.4% for all the seven batches. All the chicks produced were raised upto the age of six weeks. Their average body weight was 594 g with a feed efficiency of 2.16. The mortality has been around 5.5 upto the age of six weeks. This centre distributes chicks from its nursery after rearing them for six weeks under controlled conditions. Details of the distribution of chicks to different farmers in nine districts of Manipur are presented in the Table 42.

Table 42. Distribution of Vanaraja chicks from nursery to households in different districts of Manipur

District	Chicks supplied (number)					
	1st batch	2nd batch	3rd batch	4th batch	5th batch	6th batch
Bishnupur	-	-	-	-	-	10
Chandel	30	50	-	-	-	110
Churachandpur	10	-	-	-	-	20
Imphal West	85	55	-	55	30	164
Imphal East	58	30	-	-	5	68
Senapati	45	120	-	-	-	5
Tamenglong	70	180	-	-	-	-
Thoubal	23	20	-	-	-	43
Ukhrul	153	30	20	20	-	206
Total	446	485	20	75	35	625

The average body weight at twenty weeks of age for the breed reared in "Open" and "Semi-open" system was 2360 g and 2520 g respectively.

At seventy-two weeks of age, the average body weight attained was 3430 g and 4350 g in the above system of rearing. On average females weighed 2450 g at the point of lay and at the same age, the male weighed 3180 g at different locations of rearing in Manipur. The female matured between 164 to 173 days of age (Average is 168 days). During the initial 100 days of lay, 36 to 38 eggs were produced.

Another dimension of utilization of *Vanaraja* eggs was by hatching them to produce day old chicks in and around Imphal have access to the state farm where hatching facility exists. Data from 16 different families who had hatched chicks in state farm were collected. Several setting observations ranging from 2-10, 6 families on fertile eggs ranging the six families produced 38-417 chicks with hatchability of 57.9 to 76.6%. The chicks produced were either retained for continuation of the stock or for disposal @ Rs. 15/- per chick without vaccination and Rs. 18/- with vaccination.

The beneficiaries in remote hills and villages also adopted a similar approach by resorting to natural incubation using local broody hen. Data collected from 15 beneficiaries have indicated that 460 fertile eggs were set under locally available broody hens at different intervals (1-4 times) to generate 320 (day old) chicks with an average hatching of 69.6%. However, it is clear that beneficiaries were effectively utilizing the eggs for higher income generation through production of chicks.

The impact of poultry farming at rural level is clearly evident from the manner in which the eggs were utilized for consumption, sale as table eggs and fertile eggs, besides generating chicks for replacement of old birds for backyard farming. The basic objective of the project to provide food and nutritional security is met through poultry farming, although in a limited way.

MIZORAM

Backyard poultry production

N.S. Azard Thakur, A.K. Saikia and P. Goswami

Under this project, a total of 1680 fertile eggs of "Vanaraja" breed were received from project Directorate on Poultry, Hyderabad in 4 consignments. Around 20-47% of the eggs were found unsuitable for setting due to damage during transpiration. The eggs were kept in the Departmental hatchery at Aizawl. It was observed that the per cent mortality was high in the first two weeks as compared to subsequent weeks of growth and the survivability attained maximum at the advanced stages. The growth pattern of the chicks appeared to be higher than the anticipated weight at six weeks of age, which might be due to feeding of concentrated feed at the nursery level of rearing. The chicks were vaccinated against Ranikhet disease in the initial stage of rearing. The mortality of the chicks was due to bacterial diseases like salmonellosis, callibascillois Omphalities etc.

A total of 49 beneficiaries were selected from Kolasib district and were distributed 4-6 weeks old birds. The beneficiaries reared the "Vanaraja" birds under free range system by feeding locally available wild grasses, vegetable leaves, rice, broken maize, dry fish, kitchen wastes etc. It was observed that the sex ratio in the distributed chicks was found to be 1:1:35 (male to female ratio).

The birds were found matured between 22-28 weeks of age with an average maturity of 173 days 924.7 weeks) and started egg laying. The egg production during the first month of lay ranged from 8.18 to 20.9 per bird. Some of the farmers set eggs under brooding hen and a total of 53.22 per cent natural hatchability was recorded. The mortality of grown up birds at farmers household level was mostly due to diseases like fowl pox, salmonellosis, arthritis, respiratory infections etc. and preventive measures were adopted accordingly by supplying medicines, mineral supplement etc.

TRIPURA

Evaluation of guinea fowl under Tripura climate

M. Niranjan

Pearl variety of guinea fowl (*Numida meliagris*) was evaluated during the current year. Fertility was 75.17 per cent and hatchability on fertile egg set was 92.23 per cent. The growth rate was maximum upto 12 weeks of age and started

declining thereafter. Therefore, 12 week was most appropriate market age for guinea fowl. Total number of eggs produced was 92.80 between April to September months and age at sexual maturity was 225 days.

Evaluation of index selection in white Leghorn

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 and reproduced. The production traits like egg number upto 280 days of age, egg weight at 20 and 40 week of age and age at sexual maturity (Table 43) were measured in both the lines.

Table 43. Performance of two white Leghorn lines

Line	Egg no. to 280 days of age (no.)	Egg weight (g)	Age at sexual maturity (days)	Body weight 20th week (g)	Body weight 40th week (g)
IWH	84.17	52.10	158	1265	1762
IWI	81.63	51.9	162	1287	1779

Evaluation of Rhode Island Red (RIR) breed in Tripura

M. Niranjan

Five hundred fertile eggs of RIR were procured and incubated in the institute hatchery. The percentage of fertility was 83.17 and hatchability on fertile eggs set was 88.62. The birds are under evaluation for production traits.

AICRP on poultry improvement

M. Niranjan and S.K. Ghosh

All India coordinated research project on poultry improvement (Rural Poultry Production) was initiated at Agartala centre at the end of the year 2000-01 and the actual work has been initiated during the year 2001-02. The main objective of this centre is to test various stocks developed for rural poultry production North Eastern region. During the present year one thousand fertile eggs each of two dual purpose type of germ plasm viz. Vanaraja and Giriraja were procured from Project Directorate on Poultry, Hyderabad and University of Agricultural Sciences, Banglore, respectively. Their performances are reported in Table 44 and 45.

Table 44. Hatching Performance of Vanaraja and Giriraja

Variety	No. egg	No. of	No chicks	Fertility	Hatchability TES	Hatchability FES
Vanaraja	934	804	700	86.08	74.95	87.06
Giriraja	907	830	747	91.51	82.35	90.00

Table 45. Body weight and mortality

Variety	Body Weight (g) 4th week Male	4th week Female	6th week Male	6th week Female	Mortality (per ent)
Vanaraja	377.25	327.16	720.39	658.05	7.52
Giriraja	405.97	362.23	815.59	717.83	8.23

Of the total number of number of birds available, half of these at 6 weeks of age were distributed to twenty farmers each of Vanaraja and Giriraja. Each farmers received 13 birds. Remaining fifty per cent are being maintained at Institute farm. Growth rate and production performance of the birds at farm will be compared with that of the birds reared under backyard system at farmers level.

FISHERIES

MEGHALAYA

Survey for fishery resources of NEH region and assessment of their ornamental potential

B.K. Mandal, B.K. Mahapatra and K. Vinod

The surveys conducted have revealed that the NEH region has diverse ichthyofauna. There are

many small fishes like *Brachydanio rerio*, *Danio dangila*, *Badis badis*, *Colisa lalia*, *Botia striata* and *Lepidocephalus guntea* with ornamental value which can be grown in aquarium throughout their life span. These are referred to as 'classified ornamental fishes'. The large food fishes which are attractive like *Notopterus chitala*, *Channa striatus* and *Labeo calbasu* has also great demand as ornamental fish during their juvenile stage and these are referred as 'non-classified ornamental fishes' (Fig 35).

The diversified ornamental criteria were also noticed in many of the collected fish species like beautiful colour (e.g. *Tetradon cutcutia*, *Colisa lalia*), stripes and banding pattern (e.g. *Botia dario*, *Botia striata*) attractive appearance (e.g. *Notopterus chitala*), keeled abdomen (e.g *Chela labuca*), small size (e.g. *Nemacheilus sikimensis* max. total length 35mm), peaceful nature and calm behaviour (e.g. *Ctenops nobilis*), transparent body (e.g. *Chanda baculis*, *Chanda ranga*), hardiness (e.g. *Danio dangila*, *Brachydanio rerio*), compatibility (e.g.*Puntius shalynius*), beautiful jumping behaviour (e.g. *Esomus darnicus*), chameleonic habit (e.g. *Badis badis*), charming predatory habit (e.g. *Glossogobius giuris*) and longivity (e.g. *Channa, gachua, Channa barca*).

There are many native ornamental fish species, which are abundant in nature but needs proper exploitation as they are not given any importance in commercial fishery. Few examples to cite are *Brachydanio rerio*, *Danio dangila*, *Badis badis*, *Lepidocephalus* spp., *Botia dario* etc. Although, some species like *Puntius shalynius* have very good market even in the overseas, their natural population was found to be less.

Assessment of potentiality of the exotic ornamental fish species in Meghalaya

A survey was carried out in the aquarium shops of Shillong to assess the potentiality of the exotic ornamental fish species. It was understood that the local hobbyists prefer the exotic fish species to beautify their aquarium. The exotic fish species are not bred here. These fishes are brought mainly from Kolkata.

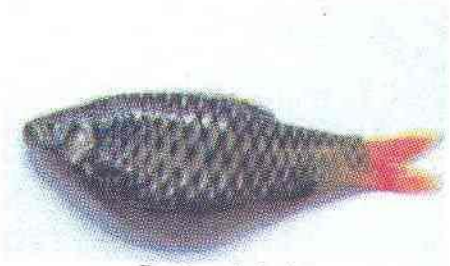
The cost of these exotic fishes are very high (Gold fish - Rs. 60-80 per pair; Angel - Rs. 80-160 per pair; Sword Tail - Rs. 30-50 per pair; Kissing Gourami - Rs.70-90 per pair; Discus - Rs.400-500 per pair; Oscar - Rs.150-200 per pair; Silver shark -Rs.120-150 per pair). Hence, studies have been initiated in this line to develop the breeding and farming techniques of some of the non-native ornamental fish species like gold fish (*Carassius auratus*) and koi carp (*Cyprinus carpio* var. *koi*), which has got tremendous scope in the region.

Identification of some terrestrial weeds as feed components in composite fish culture

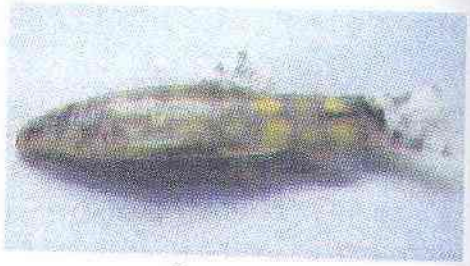
Three common terrestrial weeds viz. *Vernonia anthelmentica*, *Bidens pilosa* and *Ageratum conyzoides* have been identified as feed components in composite fish culture comprising of Catla, Rohu, Mrigal, common carp, grass carp and silver carp. These weeds were fed in the morning hours, an hour prior to the administration of rice polish and mustard oil cake, in specially designed feeding trays made of bamboo. The response to these weeds by the grass carp was good, and among the three tested weeds, *Vernonia anthelmentica* was found to have a better acceptance when compared to the other two weeds.

Growth performance of Indian major carps in Umiam reservoir

The growth of Indian Major Carps in Umiam reservoir was assessed to study the performance of culture-based fisheries in this reservoir. The studies have shown that the growth of *Catla catla* was 1000g , *Labeo rohita* was 600g , *Cirrhinus mrigala*, was 350 g and of *Labeo calbasu* was 650g after one year of stocking. The contribution of stocked Indian Major Carps in commercial catch in terms of flesh biomass production was 24.53%. The studies have indicated that the culture-based fisheries would help in optimizing the fish yield in Umiam reservoir.



Puntius shalynius



Botoa rostrata

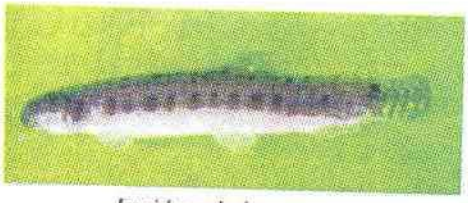
Acanthocobitis botia

Puntius ticto

Nandus nandus

Macrognathus pancalus

Brachydanio rerio



Lepidocephalus guntea

Botia dario

Badis badis burmanicus

Balitora brucei

Barilius bendelisis

Fig 35. Diversified ornamental fishes of North Eastern Region

Nutritional studies

Evaluation of silkworm pupae as protein source in feeds for Labeo rohita

A 40 day feeding trial was conducted to evaluate the efficacy of powdered Tasar Silkworm pupae (*Antheraea proylei* Jolly) in formulated feeds for the major carp *Labeo rohita*. Silkworm pupae were found to be an effective source of protein in feeds for *Cyprinus carpio* in earlier experiments during 2000-01. Ten fingerlings of 4.5 to 4.9 g individual live weight were stocked in circular plastic containers having filtered pond water, in three replications for each treatment and control. Four formulated, pelleted (2mm. dia.) feeds F_1 (control), F_2, F_3 and F_4, with varying levels of pupae and fish meal along with other constant ingredients were prepared so as to get 30% crude protein (approximately) in each feed, similar to that used for *Cyprinus carpio* in earlier study.

The feeds were offered *ad. lib.* in two split rations daily. The left over feed and faecal matter in the tubs were siphoned out and separated for analysis. Water in the tubs were changed in every alternate day. Vigorous aeration was provided in all the containers. The fishes in each container were weighed alive before start and at the end of the experiment after starving them for 12 hours. Although the control feed (F_1) produced highest weight gain (2.36g) lowest FCR was recorded for F_3 (2.01) followed by F_4 (2.11). The weight gained with F_3 (2.11 g) and F_4 (2.12 g) were also appreciable when compared to F_1. This showed that 15 to 20% fish meal can be substituted with Silkworm pupae in feeds for *Labeo rohita* (Table 46).

Evaluation of fish feeds containing grass hopper as source of protein

Grass hoppers appear in swarms in cultivated/ harvested paddy fields and grass lands in Manipur during September-December months. They were collected in large quantity by two persons holding a fine mosquito mesh net (20x8 feet) spread vertically one feet above the ground and running for about 20m then quickly folding lengthwise and twisting the net into a tight rope to immobilize the hoppers. They were then hand picked. Two persons could collect a total wet weight of 2.5 kg in two hours. The hoppers were predominantly of the species *Oxya chinensis* (about 96%). These were then oven dried and their proximate composition analysed as having 27.2% dry matter, 47.25% crude protein, 2.4% ether extract, 1.0% crude fibre, 23.58% NFE and 25.98% Ash.

Table 46. Weight gain, nutritive value and survival parameters

Parameters	Feeds			
	F_1	F_2	F_3	F_4
Weight gain (g. average wet wt./fish)	2.36	1.14	2.11	2.12
Daily weight gain (g)	0.10	0.05	0.07	0.10
Dry feed intake (g)	5.19	5.23	4.24	4.47
F.C.R.	2.21	4.58	2.01	2.11
Survival (%)	90	70	100	90

Seven fingerlings of *Cyprinus carpio* var. *communis* were stocked in all glass aquaria (3x1.5x1.5 feet) in two replications and were fed on four different diets (40% protein) made with the ingredients and combination as shown in Table 47. The proximate composition of the feeds is shown in table 20. All the feeds were accepted by the fish and gave 100% survival. The experimental design, feeding rates, and water management were same as in earlier experiment. Although maximum weight gain (2.11 g) and lowest FCR (3.0) were recorded for F_1 (control) containing 45.64%fish meal, the appreciable weight gain (1.98 g) obtained with F_2 containing 22.84% each of grass hopper and fish

Table 47. Proximate composition of grass hoper incorporated feeds (% dry matter basis)

Feeds	Crude protein	Ether extract	Crude fibre	N.F.E. content	Ash content
F_1	40.25	9.7	0.18	40.15	9.72
F_2	40.08	10.3	1.26	40.27	8.09
F_3	40.25	10.4	0.72	42.15	6.48
F_4	40.43	12.1	0.18	42.38	4.86

meal showed the possibility of using grass hopper as protein ingredient in feeds (Table 48).

Table 48. Parameters monitored in the feeding trial

Parameters	Feeds			
	F_1	F_2	F_3	F_4
Weight gain (g. average wet wt./fish)	2.11	1.98	1.43	1.31
Daily weight gain (g)	0.07	0.07	0.05	0.04
Dry feed intake (g)	6.33	7.33	5.43	9.02
F.C.R.	3.00	3.7	3.8	6.90
Survival (%)	100	100	100	100

Optimization of African snail flesh as protein source in fish feeds

Preliminary studies conducted earlier (2000-01) showed that 10 to 20% fish meal can be replaced using African snail flesh in feeds for *Cyprinus carpio*. To optimise this, the experiment was repeated with different feed combination using fingerlings of *Cyprinus carpio* (10.0-12.05 g). The fishes were stocked in aquaria (3x1.5x1.5 feet) and fed on the diets for 40 days. The experimental design, feeding rates and water management were similar to earlier experiments.The fluctuation in water temperature, pH, dissolved oxygen and alkalinity of the water during the trial was 23.4-25.5°C, 7.68-8.62, 5.6-6.9 ml/l and 53-58 ppm and were within desirable range. Maximum weight gain was obtained with F_4 (6.3g) containing 40% fish meal and no snail flesh, followed by F_2 (5.85 g) in which fish meal was replaced by snail flesh upto 20 and more than 20% replacement reduced growth considerably (F_1 and F_3). Although F_4 showed better weight gain, lowest FCR was recorded for F_2 (1.70). Highest protein digestibility was for F_1 (52.30%). The results of the feeding trial are shown in Table 49.

Protein requirement in supplementary feeds for *Osteobrama belangeri*

Osteobrama belangeri, an endangered medium carp in Manipur, is highly prized and has good demand. Induced breeding and composite culture with major carps are successful. However

Table 49. Values of the parameters observed in the feeding experiment

Parameters	Feeds			
	F_1	F_2	F_3	F_4
Weight gain (g. average wet wt./fish)	3.2	5.85	4.12	6.3
Daily weight gain (g)	0.08	0.12	0.10	0.16
Dry feed intake (g)	8.99	9.97	11.78	11.98
Protein digestibility	52.30	56.81	56.50	58.71
F.C.R.	2.88	1.70	2.80	1.90
Survival (%)	100	100	100	100
Stability (%)	78.30	78.11	76.40	78.4

the protein requirement of the fish is not known in order to formulate feeds while culturing them. A preliminary study was thus conducted, using feeds containing different levels of protein. The experimental design, feeding rate and water management were similar to earlier experiments. Four pelleted feeds (2mm. dia.) with protein levels of about 20% (F_1), 30% (F_2), 40% (F_3) and 50% (F_4) were prepared (Table 50). Four fishes each (10.5-13.1 g) were stocked in all glass aquaria with two replications and were fed on the respective diets for 30 days. Maximum weight gain was obtained with F_2 and F_3 (2.86 and 2.71 g respectively) containing 30.3 and 40.3% crude protein. The optimum level is expected to be between this. These two feeds also produced the lowest FCR of 2.12 and 2.41. Survival was 100% with F_1 and F_2.

Table 50. Feeds with varying levels of protein (% dry matter) and their ingredients

Ingredients	Feeds			
	F_1	F_2	F_3	F_4
Fish meal	6	20	30	40
Silkworm pupae	10	25	35	45
Azolla pinnata	35	35	15	5
Alternanthera philazeroides	17	10	10	5
Wheat flour	29	7	7	2
Oil	2	2	2	2
*Vitamin & mineral mix	1	1	1	1
Calculated protein (%)	20.28	30.06	40.42	50.08
Calorific value (K. Cal/g)	3.49	3.55	3.94	4.13
Supplevite-M				

TRIPURA

Effect of different levels of dietary protein on growth of *Notopterus notopterus*

B. Santhosh

So far there is no information available on the protein requirements of *Notopterus notopterus*. Different types of pelletted feeds were prepared with protein contents of 20, 30, 40 and 50 per cent using fishmeal, ricebran, groundnut, oil-cake and wheat flour as ingredients. Experiments were conducted for four months in glass aquarium tanks. 30 per cent mortality was observed in the treatment with 50 per cent protein.

Data regarding the specific growth rate, feed conversion ratio and protein efficiency ratio were collected and the biochemical analysis are still continuing. The preliminary results indicated a significant variation in weight gain among the treatments. Both SGR and FCR were the highest in the group of fishes fed with 30 per cent of protein.

Effect of self recruiting populations of *Notopterus notopterus* and *Oreochromis mossambicus* in composite fish culture experiments with Cyrinid fishes

B. Santhosh

Three composite fish culture ponds of area 0.1 h. were stocked with *Catla catla, Labeo rohita, Cirrhina mrigala, Cyprinus carpio* and *Ctenopharyngoden idella* at the ratio 2:1:1:1:2 with a stocking density of 6000/h. along with 3 males and 8 females each of adult *Notopterus notopterus* and *Oreochromis mossambicus*. The third pond was kept as a control. All the ponds were fertilized with organic and inorganic fertilizers and no artificial feeding was done except for grass carp. The productivity was maintained optimum throughout the year.

N. notoptreus fingerlings were observed after two months of stocking and the tilapia fingerlings were found within one month of stocking. Regular and repeat breeding was observed in tilapia where as there was no further breeding for *N, notopterus*. Growth rate of all fishes were similar during the initial months of stocking in all the ponds but there was gradual reductionin the growth rate of all the cypinids stocked along with tilapia. After one year of experiment it was observed that there was a significant reduction in the growth of common arps (*Cyprinus carpio*) and Rohu *Labeorohita* (*180 and 250) in the pond with tilapia than the control pond (610 and 792). Total fish production was found higher (4610 kg/h) in the stocking pond with *N. notopterus* followed by the control (3820 kg/h) and (3350 kg/h) stocking pond with tilapia.

Occurence of the digenetic trematode *Centrocestus formosanus* in the gills of five species of fresh water fishes

The diagenetic trematode, *Centrocestus formosanus* is the most common larval digenean mainly infecting the gills of fresh water fishes of Tripura state. Of the 9 species of fishes examined (Table 51), the infection was noticed only in 5 species of fishes. The prevalence was the highest in *Aplocheilus panchax* (79.5) and the mean intensity was the highest in *Channa orientalis* (8.0). There was no infection in *Cirrhina mrigala, Cyprinus carpio, Mystus bleekeri* and *Oreochromis mossambicus*.

Table 51. Prevalence and mean intensity of infection of *Centrocestus formosanus* in five species of fresh water fishes

Sl. No.	Host	Prevalence (%)	Mean Intensity
1.	*Aplocheilus* panchax	79.5	5.5
2.	*Channa orientalis*	13.2	8.0
3.	*C. striatus*	29.2	2.7
4.	*Heteropnieustus fossilus*	40.1	3.6
5.	*Puntius conchonius*	61.1	4.0

RODENT CONTROL

MEGHALAYA

K.A. Pathak and D. Kumar

Survey and surveillance

Surveillance at Barapani farm revealed that maximum active burrows were recorded in upland areas in the month of September followed by August and least in February.

Damage assessment

Rodent damage at various locations was recorded in paddy and maize. Highest damage was recorded in upland paddy (22.73) ranging between 2.74-42.53% in different terraces in Plant Breeding field. Damage to lowland paddy ranged between 5.28-17.34% at different locations. Maize cobs were damaged to the extent of 7.41%. *Bandicota bengalensis* was recorded predominant species in fields.

Evaluation of rodenticide

Burrows in upland paddy field were treated with fresh bait of racumin (0.0375%) prepared from racumin tracking powder, for one and two days which resulted in 81.67 and 80.00% reduction in active burrows, respectively. In these fields the damage was observed considerably low after treatment.

In other fields also a cumulative reduction of 81.60% (range 79.49-82.46%) and 81.49 (78.57-86.67%) was observed after one and two days treatment of racumin bait, respectively.

When racumin bait was kept on bunds and inside the fields, average consumption of bait recorded was 39.04 – 43.16%, 42.55 – 43.94% and 37.65 – 38.52% in one, two and three days respectively, at various locations. After treatment, rodent population reduced significantly in treated areas (Table 52 and 53).

Zinc phosphide bait (2%) in houses, shops and godowns was consumed between 15.38-19.00% in 1 day and effective control of rodent population was achieved within 1-2 days. Racumin bait (0.0375%), when used for 1,2 and 3days, gave effective control within 3-11 days in houses, shops and godowns. The average consumption of racumin bait ranged between 36.44- 41.66%, 40.08 – 46.41% and 36.71 – 41.35% in 1, 2 and 3 day exposure, respectively.

Evaluation of racumin paste, a new formulation, is in progress in laboratory against predominant rodent species.

Table 52. Burrow treatment with racumin bait (0.0375%)

Locations	1 day		2 days	
	No. of burrows treated	% reduction of active burrows	No. of burrows treated	% reduction of active burrows
Rice upland	60	81.67	15	80.00
Rice lowland	57	82.46	15	86.67
Upland (uncultivated)	56	82.14	14	78.57
Maize field	39	79.49	8	80.00
Total / Average	173	81.60	54	81.48

Table 53. Exposure of racumin bait (0.0375%) on bait stations

Locations	1 day		2 days		3 days	
	No. of bait stations	Av. bait consumed	No. of bait stations	Av. bait consumed	No. of bait stations	Av. bait consumed
Rice lowland	20	42.40	15	42.55	15	38.52
Rice upland	20	43.16	15	43.94	12	38.33
Maize field	25	39.04	10	43.60	10	37.65

ERI SILK WORM

MANIPUR

Collection and maintenance of Eri Silkworm under Manipur condition

The eggs of eri silkworm (white race) first obtained from the State Department of Sericulture (Jiribam) in the first week of February, 2001 (6th & 8th February, laid eggs) were maintained continuously on locally available castor varieties (Green and Red Type) in laboratory at room temperature and used for various studies. Tray rearing was carried out according to standard rearing practices. Daily three feedings in first instars and four feedings in later instars till cocoon formation were provided at regular intervals at fixed timings. Beginning with the larval hatched for first 48 hours after a gap of 16 days (incubation period) in last week of February, 2001 were taken for detail studies on bionomics performance as well as cocoon qualities were also analysed.

Beginning with eggs laid on 6th February, 2001 till 26-2-2002 during the period under report, the worm over an annual cycle completed six generations (egg to egg generation) taking 66 days (Feb – April), 50 days (April-June), 62 days (June-August), 46 days (August – September), 47 days (September - November) and 109 days (November - February), respectively. Effective rate of rearing (ERR) varied from 88.95 to 90.61 per cent.

Bionomics

Developmental duration

Incubation period varied from 8-10 days. There was more than 90% egg hatching ranging from 90 to 95.8%. The eriworm passed through five larval instars taking a total of 22-32 days. Between instars, there was a short period of quiescence in which larvae remained inactive and stopped feeding. Pupal stage lasted for 19-26 days. Male lived shorter (7-9 days) than female (12-17 days). The mature larvae measured on an average 6.45 ± 0.27 cm in length and 1.27 ± 0.08 cm in width. Cocoon were elliptical in hape measuring 3.67 ± 0.31 cm in length and 1.89 ± 0.21 cm in width. Mature larva weighed on an average of 5.24± 0.88 g as against first instar larval weight of 0.002 g. One DFLs egg weight on an avreage of 0.54±0.28 g having an average 266.87±94.40 number of eggs per female per laying.

Cocoon quality and character

The fully mature larvae when offered different kinds of substrate (dried leaf bunches and bamboo made Chandrika), successfully formed cocoon. Based on 100 random cocoon observations in each substrate, good cocoon varied from 77% (mango and guava leaves) to 85% (bnana and ecalyptus leaves). Stained cocoon were noticed higher in case of mango and guava, where as it was minimum in Banana leaves followed by Chandrika. Thus the good shell (silk) recovery was observed from the cocoon formed on Chandrika (13.61%) followed by Eucalyptus (13.37%) and guava (5 7%). Mango (54% and Banana (11.01%). Weight and size of cocoon varied when formed on different kinds of substrate. Number of green cocoon per kg (quantitative) and per litre (volumetric) varied from 405 to 750 (533±89.06) and 170 to 206 (195.6±21,79), respectively.

Impact of coupling on fecundity and viability of eggs

In natural condition, mating lasted for 48 hours which was compared with artificial decoupling made 3, 12 and 24 hours of mating. Fecundity did not vary much by period of mating. Viability of egg under 3 hours of mating was significantly low. As regards egg laying and hatching characteristics, the maximum of total eggs laid was recorded in first day and maximum on second day. Fecundity varied on an average 266.87 ± 94.40 egg per female.

Effect of Cocoon refrigeration on eclosion (White race)

There was no significant difference in adult emergence upto 38 days of storage in refrigerator, which varied from 70-90 per cent as against 90 per cent under normal room temperature. Adult did emerge even upto 55 days of refrigeration but were deformed.

Evaluation of nutritional efficiency of Eri Silkworm in relation to castor varieties

White race and Assam race of eri silkworm was reared indoor at room temperature on different

six castor varieties (2 locals and 4 exotic). Consumption index of white race (individual intake of leaves) varied among the different varieties. Higher consumption index was observed from the feeding of leaves of local red variety (77.51 g) closely followed by Jyoti and DCH-177. The minimum value was recorded with 48-1. When leaves of all varieties were provided in mixture to larvae, consumption index was the maximum (82.47 g).

The gross growth and net growth efficiency were maximum when reared on Bangalore tree followed by 48-1, local green, DCH-177 and local red. Among different varieties, growth rate equal and higher on local red, local green, 48-1, Bangalore tree and DCH-177. It was minimum on Jyoti.

Efficiency of conversion of ingested food to body biomass (ECI) was maximum when reared on Bangalore tree closely followed by local green, 48-1, DCH-177, local red and Jyoti.

The highest consumption index of 5th. generation Assam race(individual intake of leaves) was recorded on Bangalore tree (45.55 g). The quantum of feed consumed by larvae on remaining five varieties did not vary appreciably which ranged from 44.12 g (green stem) to 45.07 g (DCH-177).

In 6th. generation race individual intake of leaves (C1) was recorded to be maximum on DCH-32 (21.99 g) followed by local green (21.77 g). The minimum value (C1) was recorded with 48-1 (19.58 g) followed by Bangalore tree, Jyoti and DCH-177.

Individual approximate digestibility was maximum on DCH-177 (60.14%) followed by local green (59.90%) and Jyoti (59.81). The minimum was recorded with Bangalore tree (49.88%). ECI did not vary much among the varieties which varied from 28.92 (DCH-32) to 29.67 per cent (Jyoti). As regards to EDC, it was maximum on Bangalore tree (59.18%) followed by 48-1, DCH-32, Jyoti, DCH-177 and local green (48.26-53.25%).

Evaluation of castor varieties through bioassay of silkworm rearing and cocoon production

White race (2nd generation - April -June)

Silkworm rearing parameters: Higher mature larval weight was recorded on Bangalore tree (4.76 g) closely followed bylocal red (4.72 g), 48-1 (4.71 g), DCH-177 (4.61 g) and local green (4.58 g). The minimum was recorded on Jyoti (4.30 g). However, the highest mature larval weight was recorded when worm reared on mixed leaves of all the tested varieties (4.92g). The larval mortality ranged from 22.67% (local green) to 29.33% (Jyoti). Effective rate of rearing (ERR) was maximum on local green (77.33%) followed by Bangalore tree and 48-1 (both 76%), DCH-177 (73.33%) and local red (72 %).

Cocoon parameters: The highest single cocoon weight was recorded with DCH-177 (1.93 g) followed by Local green (1.83 g), Jyoti (1.57 g), local red (1.56 g). The shell weight was recorded to be maximum on Bangalore tree and DCH-177 (both 0.25 g) closely followed by local red (0.21 g), 48-1 and Jyoti (both 0.19 g). The pupal weight was maximum when reared on DCH-177 (1.67 g), followed by local green (1.65 g) and Jyoti (1.37 g). The minimum was recorded with 48-1 (1.23 g). The highest shell ratio was recorded from feeding of leaves of Bangalore tree (16.08%) closely followed by local red (14.06%), DCH-177 (13.49%), 48-1 (13.33%) and Jyoti (12.55%).

Grainage behaviour

The percentage of moth emergence varied from 70 (Jyoti) to 85.5 (local green). The highest fecundity (egg per female) was recorded with local red (295 eggs) closely followed by local green, Bangalore tree, 48-1, DCH-177 and Jyoti. The hatching percentage did not vary much among different varieties which varied from 91.00% (DCH-177) to 95.87% (local green).

Assam race
(5th generation : September-November)

Silkworm rearing parameters : The highest mature larvae weight was recorded on Bangalore tree (5.68 g) followed to that of DCH-32 (5.52 g), DCH-177 (5.45 g) , local green (5.39 g) and Jyoti (5.32 g). The larvae fed on local green, DCH-177, Bangalore tree and Jyoti registered low mortality (10-12%) as compared to that of 48-1 (21.33%) and DCH-32 (32 %). The effective rate of rearing (ERR) was maximum on local green (90 %) closely

followed by DCH-177, Bangalore tree and Jyoti (88 to 89.33%). It was minimum on DCH-32 (68 %) followed by 48-1 (78.66%).

Cocoon parameters : The highest single cocoon weight was recorded with DCH-177 (2.92 g) followed by local green (2.88 g), Jyoti (2.83 g), Bangalore tree (2.76 g), 48-1 (2.71 g) and DCH-32 (2.44 g). The maximum shell weight was recorded with Jyoti (0.53 g) followed by local green (0.43 g) and DCH-177 (0.41 g). It was minimum when fed on Bangalore tree (0.36) followed by DCH-32 (0.38 g) and 48-1 (0.39 g). The highest shell ratio and silk productivity per day was recorded from feeding of leaves of Jyoti (18.66 and 0.096) closely followed by local green and DCH-177. The minimum values were recorded with Bangalore tree.

Management of Castor for rearing eri silk worm (*Samia cynthia ricinni*)- NATP(ROPS-4)

S.V. Ngachan, A.B. Rai and Nemneihoi

Performance of some local and exotic castor cultivars under rainfed foot hill condition

An experiment with 6- Castor Cultivars (5 exotic: DCH-32, 48-1, DCH-177, Jyoti, Bangalore tree and 1- Local) spaced at 90x45 cm in a plot size of 1.5x3 m was carried out.

Plant height

The highest plant height was recorded with local green at different growth stage (202.00cm at 120 DAS) except 90 days after sowing. The lowest plant height was recorded with DCH-177 (133.35 cm at 120 DAS).

Number of leaves

Number of leaves per plant, it did not vary much among the varieties upto 105 days after sowing. At 120 DAS, the highest number of leaves were recorded with the variety DCH-32 (16.73 leaves) followed by Jyoti. Among the different castor varieties, the maximum leaf area was recorded in the variety Bangalore tree during all the period of observation with 1003.20 sq.cm. of leaf area at 120 DAS. 362.49 sq.cm.

Leaf yield

At 120 DAS, Bangalore Tree type produced highest fresh weight of leaves per plant (136.67 g) followed by DCH-32 (124.33 g), DCH-177 (122.5 g), Jyoti (112.5 g) Local Green (88.33 g) and 48.1 (71.33 g). The maximum dry weight of leaves per plant was recorded with DCH-32 (40.10g) followed by Bangalore Tree (38.90g).

FARM MACHINERY AND POWER

MEGHALAYA

Power tiller utilisation

R.K.P. Singh and K.K. Satapathy

Considering the concentration of the power tillers at different locations, a survey was conducted to examine the utilization pattern, problems being faced in its operation, availability of spare parts and repair and maintenance facilities and related aspects. Twenty-four power tiller owners from six different villages and Government run hiring centers were contacted for the study. It was observed that average annual use of power tiller in the state was only about 481 hrs ranging from 260 to 950 hrs and was mostly used for ploughing and puddling operations. Custom hiring of power tillers is very common among small land holding category of farmers and hiring charge is Rs.120/-hr by the private owners and Rs.1235/-ha (for 3-4 operations of ploughing/puddling) by the Government owned hiring centers. Majority of farmers expressed satisfaction over usefulness and economic return by the use of power tillers, but articulated dissatisfaction on availability of spare parts, repair and maintenance facility on time and matching implements for sowing, weeding, harvesting, threshing etc.

Identification of mechanization gaps of major horticultural crops

K.N. Agrawal, R.K.P. Singh and S.V. Ghadge

A study was conducted to identify the prevalent cropping practices and existing mechanization gaps for major horticultural crops grown in the region such as citrus, pineapple, arecanut, ginger, turmeric,

large cardamom, vegetables, etc. It was found that area under traditional fruit crops varied between 0.1–1.0 ha. Citrus is preferred as homestead crop while pineapple is grown on small and large plots on hill slopes after jhuming (Shifting Cultivation). The vegetables are grown as major cash crop while large cardamom is main commercial crop of Sikkim state. Ginger and turmeric are major spices grown in the Meghalaya and Sikkim. The human power was found to be main power source since most of the growers are using traditional tools. The human power requirement for land preparation, planting, weeding, harvesting was found to be 50-70, 25-30, 40-60 and 70-100 man-days/ha, respectively. The identified mechanization gaps were categorized in three categories *i.e.*, new developments, developed but needs adoption in the region, already commercially available and needs popularization. Based on this some improved tools and implements were identified and evaluated. To collect, the information regarding improved tools and implements available across the country. A total of 37 manufacturers of improved implements were contacted and 14 types of small hand tools and implements were procured for adoption and demonstration purpose. The preparation of directory of tools suitable for horticultural cultivation is under progress.

Anthropometry of agricultural workers

R.K.P. Singh, K.N. Agrawal and K.K. Satapathy

To generate ergonomic database of agricultural workers of Meghalaya, an anthropometric survey was conducted in Ri-Bhoi, East Khasi Hills and West Khasi Hills districts of Meghalaya. Data on 69 different body dimensions having direct implication of agricultural tools and implements design were collected from 400 agricultural workers (200 male and 200 female) in the age group of 20-45 years. Subjects were selected randomly from different villages. It was found that body dimensions of agricultural workers of Meghalaya were significantly different than the people of other parts of the country. The average value of stature, eye height, elbow height, knee height, sitting height, sitting eye height, hand length, palm length, hand breadth at metacarpal III and weight of male agricultural workers were 157.5, 146.3, 98.1, 45.0, 81.5, 72.9, 16.3, 9.4, 7.7 cm and 49.3 kg respectively. Corresponding value of the female workers were 150.4, 137.7, 94.2, 42.3, 76.2, 64.9, 16.0, 9.0, 7.6 cm and 43.7 kg. Data were also collected on time spent, drudgery perceived and gender involvement in different farm activities being carried out for paddy, maize and ginger cultivation in Meghalaya.

Status of farm mechanization

S.V. Ghadge and K.K. Satapathy

A study on major crops, cropping patterns and the level of mechanization of major operations was conducted. The survey indicated that multipurpose dao, spade, hoes, sickles, country plough, bamboo made leveller and transporting baskets were the common types of hand tools and implements used in Meghalaya. These are manufactured by age-old traditional methods in small forging workshops spread across the state. All the hand tools and animal drawn equipment need improvement for increasing capacity, efficiency and life. There is a special need of appropriate tools for paddy land puddling, transplanting/sowing, weeding, harvesting and threshing besides suitable implements for horticultural crop production and processing.

Prototype manufacturing of agricultural implements

R.K.P. Singh and K.K. Satapathy

Characterization of identified prototypes were completed and manufacturing drawings of wheel hoe, hand winnower, maize sheller, citrus harvester and pedal operated paddy thresher were prepared Using tooling, die, punches, jigs and fixtures total 75 numbers of pedal paddy thresher, 75 numbers of fruits harvesters, 55 numbers of wheel hoe and 50 numbers of seed drills were fabricated during the year. To develop human resources in manufacturing technology, three traininf programme of 3 days, 10 days and 20 days duration were organized for the artisans and blacksmiths of Meghalaya and Sikkim state under NATP project on Prototype Manufacturing of Agricultural Implements in which

altogether 48 participants participated and learnt about fabrication of maize sheller, wheel how, fruit harvester, garden rake and grass slasher.

Study on food and nutritional availability and post harvest activities

R.K.P. Singh, K.N. Agrawal and K.K. Satapathy

Bench mark survey was conducted to study the present status of food and nutritional availability and post harvest activities being followed in ten identified villages. Data were collected through a structured schedule containing information on household composition, land holding, sources of irrigation, farm inventory, tools and implements used, animals resources, crop enterprises, post harvest technologies being used, food consumption and dietary pattern, months in which problem is faced regarding food availability, processing/preservation technique used for foods items, product prepared indigenously for preserving shelf life of the food grain and horticultural crops, type of packaging used for storage of food items and food grains etc.

Traditional method of soybean processing

R.K.P. Singh and K.K. Satapathy

Study of indigenous method of soybean processing was conducted in Ri-Bhoi and East Khasi Hills district of Meghalaya. It was found out that the people of Meghalaya consume soybean in the form of fermented product called *Tungrymbai.* (Fig 36) The steps involved in preparation of *Tungrymbai* is cleaning, soaking, removal of skin, cooking and packing and incubation. Cleaning of soybean seeds is done to remove impurities like stone, mud, dirt, chaff, etc. and followed by washing with water. After cleaning and washing, the soybean seeds are soaked in water for about 8-10 hours. The outer skin is normally removed before cooking by rubbing the soaked seeds gently in between the two palms and then it is removed through repeated washing of the soaked grain through water. After removing the skins the soybean seeds are cooked with water for 5 to 6 hours. When it is well cooked, the product is allowed to cool down and then it is ready for packing and incubation. Packing and incubation is done to ferment the cooked soybean. This step is very important, because it governs the quality of the final product. For packing the cooked soybean, leaves of *Clinogyne dichotoma* (locally called 'Lamet') are used. The cooked seeds are placed in a bamboo basket whose interior surface is well lined with the lamet leaves and folded over the top surface of it. After proper covering the digester (or basket) containing the cooked soybean is hung over the cooking place (chulah) of the house to maintain warm condition and faster fermentation. The incubation is done for 3-5 days to get the desired product. The color of this product is brown and the smell is somewhat unpleasant with mild pungency. It was assumed that the logic behind the mechanism of this fermentation could have been due to the wild fungi (or bacteria) present in the leaves used for packing and incubation. After the product is well fermented, it is ready to make different food items. The people of Meghalaya consume the tungrymbai after making a delicious food item by frying the fermented product with mustard oil, garlic paste, green chilly, turmeric powder and ground roasted sesame, salt etc.

Fig 36. Traditional methods of soybean processing

Agricultural implements manufacturing

R.K.P. Singh and K.K. Satapathy

A survey of units engaged in manufacturing of agricultural implements was conducted in the East Khasi Hills and West Khasi Hills district of Meghalaya. The information was collected on types of agricultural tools and implements manufactured/

fabricated, raw materials used, manufacturing facilities available, processes followed etc. for the fabrication of products. It was observed that most of the local artisans who manufacture the agricultural tools are concentrated at few places like Mylliem, Sohryngkham, Mairang etc and manufacturing of agricultural implements is done in blacksmith workshop using mainly the bellow and rotary type blower, hammer, anvils, tempering/ quenching trough etc. The most commonly manufactured tools are different types of Khasi spade, dao, kitchen knife, fish cutting knife, axe, etc. Most of the units at one place are manufacturing similar types of tools and implements and products made by various units are almost similar in shape, size and quality. Raw materials used are mainly rejected leaf springs of automobiles, MS angle, MS flat etc. and coal as fuel. Workshops are made of wooden piers with thatched or GI sheet roof and kutcha earthen flooring. Individuals own most of the units and workforce comprise of 5-7 labours generally unskilled and hired from the locality on contractual basis. Tools manufactured are seasonal in nature and quantity of products varies according to demands and supply basis. There is no proper system for the sale of products and manufacturers have to sell themselves either at Shillong or during weekly village market. There are no firms manufacturing improved and approved agricultural tools and implements.

Adaptation of attachments on light weight power tiller

C.S. Sahay

The various attachments such as plough, puddler and leveller were adopted with the AAI 3000 model light weight power tiller and tested for its suitability. Two types of plough attachment namely chisel type (Fig 37) (for heavy soil of valley land) and mould board plough (Fig 38) (for lighter soil in upland) were tested. The power tiller was tested in valley and terraced lands and different parameters were noted. The actual field capacity was found to be 0.018 and 0.027 ha/h in valley land and terraced land conditions respectively. A bullock drawn rectangular blade puddler was modified to make it suitable for power tiller through a single point hitch. The axis of hitch was vertical and it was acting like a hinge. The frame joining the puddler with power unit was made in such a way that it allowed seating of operator on the wooden seat above puddler (Fig 39). The actual field capacity of the puddler was found to be 0.30 ha/h with field efficiency of 70. 4 %. A 1.2 m long wooden plank was used for the levelling operation. The field capacity was found to be 0.32 ha /h with field efficiency of 77%.

Fig 37. Puddler attachment with light weight Powertiller

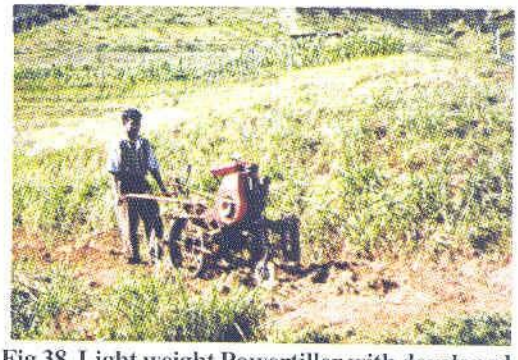


Fig 38. Light weight Powertiller with developed attachment

Fig 39. Animal drawn puddler

Prototype feasibility testing and Front Line Demonstration

K.N. Agrawal, C.S. Sahay, R.K.P. Singh and S.V. Ghadge

Five prototypes were taken for feasibility studies to evaluate its suitability while 7 implements and few horticultural tools were taken for front line demonstration in the farmers' field. The feasibility studies were conducted both at research farm and farmers filed. The area covered and feed back received from the study are given in Table 54.

SIKKIM

Agricultural Mechanization

R.K.P. Singh, S.V. Ghadge and K.K. Satapathy

A survey was conducted to study the present status of agricultural mechanization in Sikkim state. Data on crops grown, cropping pattern, tools and implements used etc. were collected from all the four districts of Sikkim districts using stratified random sampling technique through a structured proforma. Based on the observations, a mechanization gap was identified for major crops grown in the state. It was observed that most of the agricultural operations are performed manually with the help of animate power sources and no improved tools and implements are used at present. Based on identified mechanization gaps and prevalent cropping patterns, it was found that there is large scope for introduction and popularization of animal drawn implements like mould board plough, ridger plough and manually operated tools namely pregerminated paddy seeder, maize planter, wheel hoe, garden rake, pedal paddy thresher, maize Sheller, hard winnower etc. in the state.

Table 54. Area covered and feed back received for different improved implements

Equipment	Area/No. of Demo (ha)	Farmer's Feed Back/Remark
Grass Cutter Assembly of Light Weight power tiller	1	The initial cost is very high.
Citrus Harvester	3	Acceptable to farmers, reduces the risk of climbing on trees, may be taken for large scale demonstration
Motorized Wirelδop thresher	50 q	Needs more demonstration
IIT Puddler	0.5	Needs further evaluation
Self Propelled Paddy Transplanter	0.25	Needs further evaluation
Pre Germinated paddy seeder	1.0	More evaluation is needed
Vertical Conveyor Reaper	0.5	Good cutting action by the machine, difficult to be taken to typical terraced fields
Tree Prunner	3	It reduces the risk of climbing on trees, can be propagated among farmers having orchards but cost has to be reduced
Horticultural Tools	12	Reduces the drudgery of operations of weeding but needs more demonstration.
Wheel Hoe	0.34	Suitable for crops in terraces and in rows especially vegetables and flowers, reduce the labour requirement and easy to carry but initial cost is high

SOIL AND WATER CONSERVATION ENGINEERING

MEGHALAYA

Runoff Plot Studies for Soil Erosion control Modelling

A.K. Mishra, R. K. Singh, K.K. Satapathy and B. Majumdar

Eleven runoff plots of 22.1m X 1.5 m size were laid out (8 Nos. at 28% Convex and 3 Nos. 36% concave slope) and the instrumentation of plots were done with the help of one day water stage level recorder, 20 cm HS flume. Different agronomic practices / land use of the region *viz.*, uncultivated bare fallow (P1), ginger cultivation with Mizo Method (P2), ginger cultivation on Bun (Khasi Method) (P3), cultivated bare fallow (P4) sole paddy upland (Variety IET-13459), sole maize (P5), topo sequential cropping (Line sown along the slope) on upper half slope plus upland paddy (Line Sown) along the slope on lower slope (P6), upland paddy (Line Sown) along the slope on upper half slope plus maize (Line sown) on lower slope (P7) and natural vegetation (P8) soybean sole crop(P9), natural vegetation (P9), sole paddy (P10), sole maize (P11), were simulated in the plots and their response to runoff and sediment production were evaluated to suggest a safe economic agricultural practice for different situation. The total runoff , soil loss and nutrient are being analyzed. The soil analysis was carried out in all the plots and it was found that the soil is grossly deficient in N, P and K.

Natural resources management planning through RS and GIS for treatment of severely degraded Cherrapunjee Watershed

A.K. Mishra

Watershed traversing and qualitative assessment of the resources scenario has been undertaken. The topographic maps of the scale 1: 50,000 and 1: 25,000 was acquired from the North Eastern Regional Circle Office of the Survey of India, Shillong. A watershed area of approximately 20 sq.km. was been delineated after careful examination of the topographic sheets and field visits. Tracing of watershed contour maps, drainage maps and prominent features in the watershed were done and points on the maps were located in the field for ground truthing in future. From the SOI map of 1: 25,000 scale the morphological parameters of the selected watershed are: Average slope of watershed, 25%; relief, 1156 m; relative ratio, 4.203; elongation ratio, 0.225; form factor, 2.8708; circulatory ratio, 2; basin length width ratio, 2.8; drainage density, 4.702 km/ km^2 ; and stream frequency, 26.63 per km^2. Some other watershed characteristics have been estimated as under Table 55).

Table 55. Some watershed characteristics studied

S. No.	Particulars	Details
1	Area (A_u)	30143750 m^2 / 30.143750 km^2
2	Perimeter (P)	27.5 km
3	Maximum elevation	1656 m
4	Minimum elevation	500 m
5	Basin length (L)	10.5 km
6	Maximum Width	3.75 km

Consumptive use and total water requirement of major crops of NEH region

A. K Mishra and K.K. Satapathy

Climatologic water demand of major crops grown in Umiam and around in Meghalaya was worked out. To estimate the crop water requirements and crop consumptive use of main crops viz., upland direct seeded and lowland transplanted paddy, maize, soybean, groundnut, vegetables (tomato, potato and French beans) CROPWAT (Ver., 5.2, FAO) computerised simulation model was used. Standard crop parameters and the long term average climatic parameters of the meteorological observatory maintained by ICAR were used as inputs. The results

showed that the Kharif season crops exhibit nil or very low requirements of water as effective rainfall is received during this period. The climatic water demand of rice was found to be varying from 196-274 mm, irrespective of rainfall depending upon the dates of transplanting. The seasonal climatic water demand of maize varied from 11.9 to 70.4 mm. Though no crops are grown in the post monsoon season yet it was observed that if the crops are to be grown they have to be supplemented with irrigation up to 100 mm.

Efficient utilization of water harvesting structures

A.K. Mishra, R. K. Singh, K. K. Stapathy and N. Rai

Six years old peach orchard was supplied irrigation as per water requirement estimations made using established principles with the help of small drip irrigation equipment. The crop response to irrigation was studied. It was observed that the overall health of the irrigated plants was better as compared to the unirrigated plants. There was an increase in the fruit yield of the order of 25 – 45% in various treatments with varying level of irrigations. As the year in reporting was an OFF year due to pruning of the plants, the yields per plant was less but the size of the fruits was bigger (5-7 cm diameter) as well as the average weight varied from 50-70 g. A new orchard of low chilling variety of plum variety from Manipur (Local variety) has been established. Out of the total plants planted near AEW microwatershed approximately 65 % are surviving mainly due to the proper application of irrigation with the help of drip system. Another 60 nos. of tissue cultured citrus plants are also being established near Runoff plots and the survival rate is 100 %.

Partial area treatment of upper Shipra Watershed

K.K. Satapathy, S.K. Jena, J.L. Singh, D.K. Sonowal and J.M.S. Tomar

Upper Shipra Watershed having 925.64 ha area under Umsning development block in Ri-Bhoi district was selected as study area under the project. Watershed characteristics were studied through interpretation of remote sensing imagery collected from NRSA, Hyderabad. Ground truth verification was done on different aspects of land use/ land cover, soil, slope, aspects, geomorphology etc. Under Upper Shipra Watershed a sub-watershed comprising an area of 57.17 hectares was selected for Partial Area Treatment. The area was subdivided into 13 microwatersheds and the various morphological parameters were calculated. Based on the land capability class of different land use, treatments were imposed in different microwatersheds. Contour bunding, half moon terrace, bench terrace, grassed waterways were some of the soil conservation measures adopted in microwatersheds. Landuse imposed were agri-horti-silvi-pastoral, horti-silvi, agro-pastoral and low land paddy. Crops such as Radish, laipatta, french bean, groundnut, maize, tomato, brinjal were grown as field crops. Horticultural crops like Assam lemon, orange, guava, pear and litchi were planted. As a part of gap filling, 25 numbers of orange seedlings and 30 numbers of guava variety (*Allahabad safeda*) seedlings were transplanted in horticultural portions. The crops found promising in the watershed are french bean (4.545 t ha^{-1}), lai pata (2.598 t ha^{-1}), and brinjal (2.667 t ha^{-1}). Three numbers of ponds of 0.06 ha, 0.07 ha and 0.11 ha area with 2 m depth were excavated. *Rohu, Mrigal, Katla, Common Carp, Grass Carp, Silver carp* were put in the pond. Works are under progress to introduce poultry, duckery and piggery component with fish.

Within the sub watershed three main waterways were identified in which various structures like drop spillway, diversion wall, gully plug etc. are proposed for arresting erosion and harvesting of water for its efficient utilization. In order to assess the impact of partial area treatment on hydrological behaviour, a 3' deep triangular weir has been constructed from which hydrological data such as runoff and sediment yields etc. are collected. PRA exercise was conducted in Mawpun village to analyze the agro- ecosystem and identify the agricultural and livestock problems perceived by the villagers. The major problems being faced by the villagers were drinking water, unemployment, lack

of school, non-availability of insecticide/fungicides and financial support.

Hydrological evaluation of land use systems in hilly micro catchment

K.K. Satapathy, A.K. Mishra, M.S. Venkatesh and K.K. Dutta

The watershed is located in Umsning development block in the in the Ri-Bhoi district of Meghalaya at a distance of 10 km from the Institute. Main watershed (MW) having an area of 240.6 ha was delineated from Survey of India Toposheet. Three numbers of smaller watersheds (WS_1, WS_2, and WS_3) of area ranging from 3 to 13 ha within and adjacent to the MW have been delineated for development and study/ evaluation of hydrological behavior, soil and water conservation measures, soil fertility status, sustainability of production systems etc. Another three micro-watershed within the WS_2 (WSS_1, WSS_2 & WSS_3) of area about 2 ha each have also been delineated for micro level study of different land treatment measures, hydrological aspects and sustainability of crop production etc. Contour and drainage maps of all the watersheds, land use and land capability maps of WS_1 and WS_2 micro watersheds were prepared. Soil survey and mapping for NPK of WS_1 and WS_2 were done. Seven gauging stations of different types are installed in the watershed to record runoff and sediment from the watersheds as found necessary and suitable. These include H flumes of 1.5 ft, 2.0 ft and 3.0 ft, and Parshall flume. One small meteorological observatory is also set up to monitor rainfall and evaporation. The indigenous method of cultivation, BUN is prevalent in the watershed and chemical properties of the soil after BUN cultivation were studied. Soil pH and cation exchange capacity were found to increase while organic carbon reduces. Infiltration rate was found to be high, varying from 0.26 to 4.2 cm/min. Contour bund is adopted as structural measure to check soil loss down the slope. Contour bunds were aligned at 1.0, 1.5 and 2.0 m vertical interval depending on the slope. It is expected that the land within the bunds will be converted to terraces after few years. For sustainability of production system, change in land use is proposed and land use maps were prepared for watersheds WS_1 and WS_2. Implementations are at various stages.

AGRICULTURAL EXTENSION

MEGHALAYA

Drudgery as perceived by the tribal women in agricultural operation with special reference to Meghalaya

N. Prakash, Rajesh Kumar and P.P. Pal

A study, was conducted in six randomly selected drudgery faced districts of Meghalaya taking 120 women involved in agricultural activities to assess the extent of their involvement in difficult agriculture operation.

The women were interviewed to know the degree of drudgery they perceived in different activities and a vast majority of women (60.0%) perceived that high degree of drudgery was involved in agriculture. With regard to degree of drudgery, manual threshing of paddy has been considered as the most tiresome operation by 89.17 percent of the tribal women followed by transplanting (79.16%), weeding (62.50%) and transportation of vegetables from field (56.67%).

An analysis of crop and livestock management practices in Garo Hills of Meghalaya in a gender perspective

A study was conducted in four randomly selected villages of West Garo Hills to find out the contribution of male and female workers in selected agricultural and animal husbandry practices. From each village, 20 male and 20 female were randomly selected based on a single criterion that they must be engaged in both form of activities. Thus a total of 80 male and 80 female were finally selected and interviewed.

The maximum involvement of women in farming was noticed in drying and cleaning (75%), followed by transplanting (62.50%), weeding (40%)

and application of FYM (38.75%). The male perceived their major involvement in plant protection (77.50%), followed by watch and ward (60.80%), direct sowing (43.75%) and fertilizer application (37.50).Maximum involvement of male as per the perception of women was selling of milk/meat (100%), purchase of feed (43.75%) and anthelmentics (27.50%).

Tribal women participation in agriculture

A study was conducted in a few randomly selected villages of Meghalaya with a sample size of 100 tribal women to know their involvement in agriculture and livestock activities. It has been observed that the women spent maximum average hours in transplanting (8.30 hrs). As regards livestock activity, health care consumed maximum average time of women (3.33 hrs). The other significant activities of farming included harvesting (10.00 hrs) sowing (8.30 hrs), intercultural practices (4.30 hrs) and sale of produce (4.20 hrs). Regarding decision-making pattern, their counterpart consulted the women in storage, transplanting, drying, cleaning and thrashing.

Fig 40. Production potential of different crops under IVLP

Fig 41. Capsicum & Tomato at farmers' field

TECHNOLOGY ASSESSED AND REFINED

Institute Village Link Programme IVLP (NATP)

This project was implemented among 1000 farm families through execution of different interventions so as to assess different identified technologies against the micro farming situation as well as to solve the identified problems of the project area.

Three rice varieties (Local, RCPL–1-87-8 and RCPL–1-87-4]) were tested for their production potential in farmers' fields and it was observed that the production potential of RCPL-1-87-8 and RCPL-1-87-4 was quite high (39 – 43 q/ha) in the existing micro-farming situation.

On farm trial conducted to assess the performance of improved variety of maize indicated that Improved varieties performed better as compared to local varieties.

On farm trial conducted to assess the performance of hybrid variety of tomato in the existing micro-farming situation indicated that more than double production could be achieved through adoption of hybrids like Rupali and Vaishali than local varieties (Fig.40 & 41).

On farm trial conducted to assess the efficiency of Butachlor in controlling weeds of paddy in upland conditions showed that spraying of butachlor @ 1.5 kg per hectare was most economical and beneficial.

Forty piglets (Hampshire 87.5% inheritance) were distributed to the selected farmers of different IVLP adopted villages to assess the performance of pig rearing at farmers' field condition. Performance of these pigs are being studied.

ARUNACHAL PRADESH

Vishwakam, Jyoty Bora and B. Soloi

Training

During the reported period 52 courses were conducted in the disciplines of crop production, horticulture and home science involving a total number of 436 participants, out of which 286 were females.

Front line demonstration on mustard Crop

A total number of six farm families were adopted under Front Line Demonstration on Mustard (var. M-27) covering an area of 6 ha of East Siang District, in Kabu, Nyigam, Daring and Nyodu subdivision in collaboration with Department of Agriculture, Along and Basar. Field day cum training programes were also organized in collaboration with the state Agriculture Department during the crop period.

Farmer Scientist Interaction Program at Pasighat

The scientists and Extension Officers of Arunachal Pradesh Centre also participated in a two days interaction programme organized by District Farmers Training Center, Pasighat, Arunachal Pradesh. Cropping pattern and cropping sequences on hill slope with special reference to pulse, horticulture crops and agro-forestry like bamboo, broom grass and tree species were discussed. A model of Zero Energy Cool Chamber was also demonstrated and construction method was explained to the participants.

Awareness programme on conservation of agrobiodiversity

A Grassroot Level Awareness Generation Programme on Conservation of Agro-biodiversity under NATP sponsored by NBPGR, Barapani, Meghalaya was organized at ICAR, KVK, Basar on 5th December 2002 involving more than 100 participants.

NAGALAND

R.C. Verma, Mrs. V. Kenny Naleo, H.D. Singh, W.R. Singh, A.K. Khan, Anamika Sharma and Naresh Babu

Training

Fifty two training programme in agronomy, horticulture, animal science, home science, mushroom production were conducted in adopted villages under transfer of technology in Tenuiphe, naga United Village and Showuba village with a total participants of 1269 farmers. Some inputs were also distributed to farmers for demonstration in their own field/community land.

Front line demonstrations

FLD programme on oilseed and pulses were carried out in Tenyiphe, Naga United village and Showuba village covering 198 beneficiaries in 46.75 ha area (Table 56).

Table 56. Results of Front Line Demonstration on oilseed and pulses during 2001-2002

Crop/var.	Nos. of farmers /area covered	Average yield (q/ha)		% increase over local check
		In demonstration	Out demonstration	
Groundnut(JL-24)	36/5	17	12	41.66
Soybean(JS-335)	9/2.75	15	11	36.66
Sesamum(Local)	17/25	6	5	20.00
Mustard(M-27)	68/10	6.3	5.5	12.69
Field pea(Rachana)	35/2	50.0 (Green pod)	NA	-
Gram(C-235)	33/2	7.0	-	-

Different orchards of horticultural crops were established at KVK Instructional farm and package of practices were imparted to the trainees. Teak, gamari, hollock, titachap and Nahar etc. were maintained under wastelands development.

TRIPURA

Front Line Demonstration, training and extension activities undertaken during the period under report are presented in the following tables.

Table 57. Training:

Discipline	On Campus	Off. Campus	Total Courses	Duration	ST/SC	Male	Female	Total Trainees
Agri I. Engg	6	2	8	1-2 day	43	82	19	82
Agri I. Extn.	6	4	10	1-2 day	70	109	24	133
Agronomy	2	-	2	1 day	12	22	-	22

Total nos. of training = 20; Total nos. of trainees = 237

Table 58. Frontline demonstration

Name of the crop	Variety	Area (ha)	No. of Farmers	No. of SC/ST	Average Yield	Local Check	Increase In yield
Mustard	B-9	20.0	94	58	8.3 q/ha	5.0 q/ha.	66%
Hybrid	Pro-Agro	2.0	2	7	Standing crop	-	-
Paddy		6201	-	-	-	-	-

Table. 59 Extension activities

Activities	No. of Programme	No. of participants	Male	Female
Field Day	2	78	70	8
Farmers visit to K.V.K	-	264	255	9
Scientist visit to farmers field.	19	180	-	-
Diagnostic service	4	50	-	-
Extension Literature prepared	6 Nos.	-	-	-

MEGHALAYA

TRAINERS' TRAINING CENTRE

G.C.Munda

Training programmes conducted during 2001-2002 are shown in Table 60.

Table 60. Training programme conducted in TTC

Name of the training programme	Duration	No. of participants		
		Male	Female	Total
Poultry production technology	9-11th June, 2001(3 days)	0	21	21
Grafting training on fruit bearing trees	22-27 Feb. 2001 (6 days)	24	0	24
Women in Agriculture	6-17 Mar. 2001 (12 days)	0	3	3
Special orientation programme on rice production technology	8-12 Oct. 2001(5 days)	12	13	25
Advance methods of pig production and management	4-6 Feb. 2002 (3 days)	4	0	4
Mushroom production technology	19th Mar, 2002 (1 day)	10	0	10
Total		50	37	87

FARMING SYSTEM RESEARCH PROJECT

MEGHALAYA

K.K. Satpathy, B.P. Bhatt, K.A. Pathak, K.N. Agrawal, KK Dutta, B. Majumdar, R. Rahman and J. L. Singh

Dairy based farming system (FSW_1)

The watershed had an area of 0.94 ha with slope of 32 .02% .The bund and risers were utilised for cultivation of perennial fodder such as broom and guinea grass, while terraced area was put under annual fodder viz. rice bean, soybean and maize cultivation. Two milch cows with their calves were maintained on the green biomass (326.66 q) produced from the watershed with additional supplementation of concentrate feed (23.70 q) and paddy straw (19.60 q) from outside source. During January-April paddy straw and broom grass was fed to cattle. Dairy cows produced 3757.0 litres of milk and 12.0 t manure in 237 days. The average milk yield was 8.2 litres /day/ cow.

The average productivity of broom and guinea grass was 283 and 248 q/ha after 16 years of continuous fodder cutting. The average productivity of annual fodder was 81.9, 122.17 and 120.0 q/ha for rice been, soybean and maize fodder respectively.

Agropastoral system (FSW_4)

This system was designed on 32.5% sloppy land having a watershed area of 0.58 ha. The annual crops were grown on bench terrace and fodder grasses on terrace risers. To generate subsidiary source of income, a cow with its followers were maintained on the biomass produced from the system. However, concentrate feed (10.9 q) and paddy straw (8.6 q) was supplemented from outside. The system gave an yield of 72.16, 4.5, 14.79 and 172.16 (q/ha) of maize, ragi, popcorn and ginger respectively during Kharif while rabi mustard grown in residual moisture gave 9.16 q/ha yield. Cowdung production was recorded to the tune of 14.5 ton, which was recycled in watershed to improve soil fertility. Guinea grass planted on the terrace risers of the watershed produced 1410.8 q/ha biomass in the monsoon season. Milk production from the system was 2120.0 litres in 237 days with average milk yield of 9.72 litres /day/cow.

The energy flow pattern of the agro pastoral system having 0.36 x .58 ha area under crop with grasses in risers was analysed. The overall output-input ratio of crop cultivation on terraces during Kharif season was found to be 4.01. Corresponding figure for rabi was 2.43. Among the various crops grown in the system, highest output-input ratio was found to be 10.069 for ginger crop. About 58%of the feed requirement (69250 MT) of animals kept in the system was supplied from the grasses grown on risers. The remaining feed was supplemented using animal feed and paddy straw during lean season. The output-input ratio of livestock system was found to be 0.765 while that of the whole system 1.05.

Agrihortisilvipastoral system (FSW_6)

The watershed has 1.03 ha area with average slope of 42%. The whole area was divided into 3 portions. The bottom portion land was utilised for crop production, middle portion with half monsoon terrace for fruit crop and top portion for the forest trees and pasture. Maize (35.0 q/ ha), ginger (33.70 q/ha) and groundnut (5.0q/ha) were grown in Kharif season while radish (196.5 q/ha) and mustard (2.60 q/ha) were grown in residual moisture in rabi season. During the year, the orange and Assam lemon showed poor performance. The size of the fruit of the orange was reduced to unmarketable size. Assam lemon suffered from shooty moulds. Plants were removed during the month of August and new seedlings of Assam lemon were transplanted by changing the place of old plants. The interspaces in the middle portion and risers in lower terrace were utilised for production of guinea grass which yielded 27.95q (469.38 q/ha) green grass.

In the upper portion of the watershed (silvipastoral), broom grass produced a total biomass of 26.78 t along with 80 kg broom spikes.

The energy flow pattern of the agrihortisilvipastoral system was estimated. Among the various crops grown, radish, ground nut and mustard were found to be energy efficient compared to ginger .The overall output -input ratio

of the crop growth was estimated as 2.47. The energy requirement for the horticultural crops was found to be 5055 MJ but due to poor bearing of the plants, the energy output was very less. However, the silvipastoral component gave a very high energy yield of 44651 MJ.

Goat production in silvipastoral system (FSW_3)

Goats and cattle maintained in FSRP were regularly monitored for various important infectious diseases. During the period, broad- spectrum anthelmentics was advocated for goats. Post mortem examination of dead animals was conducted to find out the causes of death and to take remedial measures.

Soil properties under different land use systems

V. K. Mishra, Kailash Kumar, Patiram, M.S. Venkatesh and B. Majumdar

Soil samples were collected from conserve forest, degraded/eroded land and farmer's field under Shipra watershed. In farmer's field, crops were taken for two years continuously after three years of jhum cycle. Faster soil degradation in physical characteristics like bulk density, water holding capacity (WHC) and organic carbon content was observed in bun system. Organic carbon content reduced from 1.88 to 1.50 per cent, WHC from 45.23 to 41.06 percent and bulk density increased from 0.82 to 0.89 g/cm^3. These properties were not very much affected in terraced pasture and in upland maize fields. Organic carbon content and WHC were very high and bulk density was very low in conserve forest. The most part of degraded/eroded land had less than 30 cm soil and organic carbon, WHC and bulk density were 2.05 per cent, 39.62 per cent and 1.72 g/cm^3, respectively.

Effect of bun systems on physico-chemical behaviour of soil and ginger crop production under terraced condition

V.K. Mishra and S.K. Gupta

Although the bun system of Meghalaya is very much hazardous for soil , still it is very popular among the farmers. Survey indicated different types of bun being practiced to utilize the local materials like weeds, grass, FYM etc. However, information on changes in soil properties and crop production under control condition of different type of buns are not available. Hence the study was planned to assess the effect of FYM- bun grass, bun closed burned bun, open burned-bun, ridge and flat system on soil properties and crop yield. The ginger yield was observed in the order of FYM bun >close burnt-bun> grass-bun>open burnt-bun>ridge>flat. Favourable changes in physico chemical properties were also onserved under bun systems. The values were recorded in the range of 4.7 – 5.2 pH, 1.55 – 1.85% organic carbon, 375-485 kg/ha. Available N, 6.89 – 16.05 kg/ha available P_2O_5 and 124-315 kg/ha. available K_2O under different bun systems. Physical properties like bulk density decreased from 1.08 to 0.85 g/cm^3 and moisture content from 0.46 to 0.32% under close burned- bun. Under flat condition high value of bulk density and moisture content might unfavorable environment for ginger crop production.

Distribution pattern of forms of nitrogen in different farming systems

The rate of mineralisation of organic matter to N is effected by factors like land use, soil conservation measures, supply of nutrients and amendments. The different land use system in FSRP is about 20 yrs old. The effect of different farming system on distribution pattern of N forms was studied (Table 61). The NH4+-n, NO3-N and mineral N content was lowest indicating higher rate of mineralisation in this system. The potentially available and total N were higher in FSW8 (Shifting cultivation land use) but it was recorded the lowest amount of NH4+-N, NO3- -N and mineral N among all the systems indicating lower rate of mineralization in this system.

Insect-pests studies under different farming systems

FSW_1

Maize: Maximum population of *Monolepta* sp during 1st week of July was 2.7/ plant and maximum population of *Mylocerous* sp. was 1.3/plant during

Table 61. Effect of different farming systems on forms of N

Form of N	FSW_1	FSW_2	FSW_3	FSW_4	FSW_5	FSW_6	FSW_7	FSW_8
NH4+- (ppm)	32.7	31.5	31.7	46.7	29.5	30.3	28.0	23.3
NO3 - -N(ppm)	3.3	2.3	2.8	6.3	4.2	2.8	4.7	2.3
Mineral N(ppm)	36.0	33.8	34.5	53.0	33.7	33.1	32.7	25.6
Available N(ppm)	221.1	253.8	214.6	233.3	220.3	210.9	179.2	251.1
Total N (%)	0.20	0.18	0.17	0.17	0.19	0.20	0.18	0.20

second week of July. The crop was then harvested for fodder purpose.

FSW_2

Alder was found infested with green aphids severely till leaf fall. *Chrysopa* larvae were found feeding on aphids during the month of Feb-May.

FSW_3

No significant insects were observed feeding on the trees except grasshoppers.

FSW_4

Soybean: Maximum population of *Monolepta* sp. 2.10/plant was recorded in the 1st week of July. The maximum infestation (53.33%) of leaf folders *Nacoleia* sp. was recorded during last week of July in plants while the leaf infestation per plant was 2.42 leaves/plant. The population of *Mylocerous* sp. was 2.4/plant only during first week of August. The incidence of *Mylabris* sp. (1.14/Plant) was recorded in the 2nd week of August and continued till flowering.

Groundnut: The population of *Monolepta signata* was recorded 1.25/plant during 1st week of July. Leaf folders infested 26.67% while the leaf infestation was 1.5 leaves/plant. The maximum population of *Mylabris sp.* was 1.90/plant during 3rd week of August.

Ginger:Culm borer weevil was the only major insect pest recorded. Maximum of 36.67% plants were infested during second week of August. The infestation continued up to 3rd week of September with an infestation level of 10% in plants and 1.47% in culms.

Ragi: The crop was found to be damaged by grasshoppers *Attaractomopha* sp. *Oxya velox* and weevil (*Mylocerous viridis*). The population of grasshoppers recorded was 2.0/plant during first week of August, while weevil population was 1.6/ plant during 3rd week of August.

Popcorn: The incidence of *Monolepta* sp. was recorded in the first week of July with a population of 0.4/plant. The cob borer was the major pest causing 40% damage at maturity. At harvest, 59% cob damage was recorded.

Khasi mandarin: Leaf miner (*Phylocnistis citrella)* incidence was recorded from July to November. Maximum damage of 58.33% in August and 87.50% in November was observed. Maximum no. of aphids (27.6/twig recorded during 1st week of September.

Assam lemon: Leaf miner (*P.citrella*) incidence was 64.29% during the month of August. The aphid population was very less (4.7 aphids/ twigs) due to poor growth of plants.

FSW_6

Brinjal: During 1st week of July to 1st week of September, maximum of 20% shoot borer infestation was recorded per plant. Numbers of fruit borer holes recorded was 1.33/fruit in the 3rd week of September.

Watershed 8

Leaves and twigs were heavily infested by pentatomid bugs (*Urostylis punctigera*: Pentatomidae). The leaves were also skeletonised by a yellow chrysomelid beetle.

Farming system new block

Leaf miner (*P. citrella*) damage on Khasi mandarin was recorded up to 83.45% during last week of October. *Myllocerus* weevil incidence was observed on peach plants. The maximum

population recorded was 3.3 aphids/plants, during last week of October.

Maize: The maize plants were damaged by flea beetle *Monolepta signata* and maximum population was recorded during 2nd week of July. Cob borer *S. elongella* was the major pest and the incidence started during 2nd week of August and attained maximum damage (60% during last week of August. At harvest, the cob damage of 62.66% was recorded with 164 holes/100 cobs. The population of larvae was 36/100 cobs and pupae 11/100 cobs.

Growth performance of multipurpose tree species (MPTS) in microwatersheds of FSRP

Table 62 depicts the data on growth performance of five MPTs, *i.e.*, *Acacia auriculiformis, Symingtonia populnea, Michelia oblonga* and *Alnus nepalensis* on more than 50% slope.

Soil under canopy of trees was more moist and fertile than the surrounding open area. Water content decreased with increase in depth of soil in all the blocks. Bulk density was less under canopy due to microbial activity that increased the soil porosity, whereas it was more in the soil of open areas, which were compact.

Table 63 represents the data on understrorey cover of MPTs. It was observed that under storey plots of *Acacia auriculiformis* harboured maximum (168.83 ±39.0 g/m^2) ground cover, followed by *M. champaca* (149.33±31.37 g/m^2).

Table 63. Biomass under different MPTs and control

Species	Under canopy Biomass (g/m^2)	Open area Biomass (g/m^2)
Michelia champaca	149.33±31.37	209.83±47.67
Acacia auriculiformis	168.83±39.00	272.50±68.58
Symingtonia populnea	68.83±41.10	144.66±48.60
Alnus nepalensis	132.00±25.70	219.16±24.45
Average	128.96±29.34	210.29±41.46

Hydrological behavior of experimental watersheds

Hydrological behavior of experimental watersheds in terms of total water yield, base flow, surface flow (runoff) and peak flow were studied (Table 64). Monthly rainfall and water yield pattern from different experimental watersheds are presented in Table 64.

Table 62. Growth performance of different MPTs

Species	Height (m)	DBH (m)	Clean bole (m)	Canopy spread (sq.m)	Basal area (sq.cm)	Timber volume/ tree (cu.m)
Acacia auriculiformis	13.190 ±1.634	0.195 ±0.031	5.034 ±0.939	42.177 ±13.920	0.0309 ±0.009	0.155 ±0.060
Symingtonia populnea	13.224 ±1.578	0.167 ±0.007	6.070 ±0.512	18.125 ±4.499	0.0211 ±0.002	0.134 ±0.020
Michelia oblonga	10.360 ±0.854	0.104 ±0.013	6.357 ±0.579	10.115 ±2.357	0.0086 ±0.001	0.054 ±0.007
Alnus nepalensis	7.958 ±0.121	0.094 ±0.008	3.913 ±0.380	16.227 ±1.893	0.0070 ±0.001	0.027 ±0.005

Table 64. Annual water yield, base flow, surface flow, peak flow, soil loss etc from experimental watersheds of FSRP (2001)

Parameteres	Experimental watersheds								
	FS-W_1	FS-W_2	FS-W_3	FS-W_4	FS-W_5	FS-W_6	FS-W_7	FS-W_8	AE-W_1
Surface flow (mm)	29.50	99.27	165.54	Negligible	Negligible	37.61	Negligible	Negligible	136.97
Base flow (mm)	46.43	191.49	146.75	0.00	0.00	16.44	0.00	0.00	401.71
Total flow (mm)	75.93	296.42	312.81	Negligible	Negligible	54.05	Negligible	Negligible	539.69
Peak flow (mm/hr)	1.672	3.779	2.767	0.00	0.00	1.460	0.00	0.00	1.486
Soil loss (T/Ha)	-	-	-	-	-	-	-	-	-

Table 65. Monthly water yield from different experimental watersheds of FSRP (2001)

Months	Rainfall (mm)	Total Wateryield from experimental watersheds								
		FS-W_1	FS-W_2	FS-W_3	FS-W_4	FS-W_5	FS-W_6	FS-W_7	FS-W_8	AE-W_1
Jan	6.5	0	0	0	0	0	0	0	0	0.00
Feb	45.2	0	0	0	0	0	0	0	0	0.00
Mar	24.2	0	0	0	0	0	0	0	0	0.00
Apr	140.6	0	0	0	0	0	0	0	0	0.00
May	365.3	69.18	0.26	0.00	0	0	4.09	0	0	3.58
Jun	410.5	1.81	8.37	3.01	0	0	15.43	0	0	28.19
Jul	507.1	4.71	34.93	10.78	0	0	26.85	0	0	92.41
Aug	433.8	0.23	63.09	61.94	0	0	4.39	0	0	97.60
Sep	415.2	0	97.72	108.91	0	0	0.93	0	0	170.48
Oct	282.3	0	81.57	127.85	0	0	2.36	0	0	126.24
Nov	88.6	0	7.90	0.32	0	0	0	0	0	19.66
Dec	2.3	0	2.58	0.00	0	0	0	0	0	1.53
Total	2721.6	75.93	296.42	312.81	0.00	0.00	54.05	0.00	0.00	539.69
Mean	226.8	6.33	24.70	26.07	0.00	0.00	4.50	0.00	0.00	44.97
Max	507.1	69.18	97.72	127.85	0.00	0.00	26.85	0.00	0.00	170.48

*1 Rainfall corrected by day for Hydrological analysis

MIZORAM

N.S. Aazad Thakur and K. Laxminarayana

Dairy based farming system (FSW_5)

The watershed area of 2.5 ha with a slope of 54% was utilized for cultivation of broom and guinea grass, *Congo signal* and *Setaria* to maintain 12 cattle heads. Five milch cows were maintained on the biomass produced from the watershed. These cows produced 6000 liters of milk and 30.0 t of farmyard manure.

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 were studied from W_1 to W_5, against the annual rainfall of 3402 mm during the year. The data are under analysis.

TRIPURA

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Keeping the overall objectives of increasing land use efficiency, water harvesting, soil erosion and control measures etc in view, Farming System Research models were developed in and around ICAR farm Lembucherra covering top flat land having mild slope of 5-10% followed by the steep slopes and then the valleys of medium upland or the low lands with 0-5% slopes.

Watershed land utilization

The top nearly flat land was utilized for the arable cropping i.e cultivation of paddy, maize, pulses (urd, mung, ricebean), and oilseeds (sesamum, ground nut and mustard). While utilizing the top land , care was taken for the slope and the common drainage system of the land so that proper conservation strategies could be adopted. Bunding was done across the slope at frequent intervals and the perennial arhar (TRA-99-2) seeds were dibbled on the bunds for conserving the soil and moisture, supply pulses, fuel as well as fodder for the livestock component. In the second alternative, planting of ginger or turmeric on the conservation bunds proved to be highly successful. Paddy/maize were sown in the month of May and harvested by the end of August after which, sowing of short duration (75-80 days) rice bean (RBL-52), or urd or mung or groundnut or sesamum in the different fields was done for a second crop under the upland situation only with the residual moisture, thereby, increasing the cropping intensity to 200 per cent and also the crop productivity significantly.

Planting double row of Napier hybrid or broom grass at the transact point after the top flat land was observed to check soil erosion.

The steep slopes are planted with horticultural crops mainly pine-apple, Assam lemon, mango (Amarpalli) etc. Pine-apple variety Queen was planted under high density planting system so as to accommodate about 44000 suckers per hectare. Two rows of pine-apple at a distance of 90 cm with within row space of 60 cm were planted across the slope.

Valley land could be utilized for intensive crop/ vegetable husbandry for increasing the profitability of the system. The area was put under cowpea, brinjal, tomato, amaranthus, rai, cabbage, cauliflower and cucurbits (seasonal).

Water harvesting

The water harvesting structures are being utilized for fishery where 3000-4000 composite fish culture fingerlings are stocked every year and 300-400 kg of fish harvested annually. In addition, the waterbodies are also used for duck husbandry with a size of 30-40 ducklings.

Components of farming system research

Agriculture

Rice, maize, urd, mung, ricebean, sesamum, groundnut, mustard and arhar.

Horticulture

Fruits: Pine-apple, mango (Amarpalli), lemon (Assam lemon), and banana.

Vegetables: Tomato, brinjal, bhindi, cucurbits (seasonal), cabbage, cauliflower, rai, cowpea, amaranthus, carrot, beetroot, sweet potato, chillies, Capsicum and radish.

Spices

Ginger, turmeric and cinnamon.

Grasses

Napier hybrid, thin napier, lemon grass and broom grass.

Tree Species

Bamboo and Gammar.

AGROFORESTRY

MEGHALAYA

Collection and evaluation of multipurpose tree species suitable for agroforestry systems (AFS)

B.P. Bhatt

Alnus nepalensis, *Parkia roxburghii*, *Prunus cerasoides*, *Michelia oblonga*, *Simingtonia populnea*, *Gmelia arborea* and *Pinus kesiya* have been identified as a promising species for integration in various AFS. The height, diameter and timber volume production varied significantly among the species. However, *Parkia roxburghii* attained maximum height and dbh (28.35m, 41.23cm), followed by *Michelia oblonga* (19.70m, 43.32cm), *Gmelia arborea* (18.90m, 27.74cm), Wild cherry (17.88m, 25.68cm) and *Alnus nepalensis* (20.5m, 24.90cm), respectively. The mean annual increment (MAI) ranged between 0.95-2.20m for height growth and 1.76-2.95cm for dbh, irrespective of species.

Development of suitable management practices for different AFS with special reference to their productivity and sustainability

B.P. Bhatt, J.M.S. Tomar and L.K. Misra

Studies on agrihorticulture system

Guava based AFS has shown gradual decrease in production over last three years. The average fruit yield (64.60 q/ha) was severely lowered compared to earlier years.

Khasi mandrin (*Citrus reticulata* Blanco) exhibited average 6.75 cm growth with a plant spread of 3.90 m^2 after 13 year's of growth. The average fruit yield was 34.2 kg/tree, which was comparatively lower than the yield of last year.

Production potential of Assam lemon (*Citrus lemon* cv. Local) was recorded to be 43.0 q/ha, with a density of 416 plants/ha.

Studies on agrihortipastoral system

Under this system, one line of each of three grasses, *e.g.*, broom, congo and guinea were transplanted at 5m apart in a mild sloping land and khasi mandarin were planted 5m apart in inter space. Turmeric (RCT-1) was sown as intercrop. The yield of turmeric was 16.7 t/ha. The yield was comparatively lowered to other shade or partial shade area. Mandarin recorded an average height and spread of 2.7m and 0.98m, respectively, after three year's of plantation. The green biomass (above ground) yield of broom grass was 60.24 t/ha including flower. The yield of Congo and guinea were 27.7 and 36.4 t/ha, respectively.

Studies on hortisilvipastoral system

In this system, fodder grasses (Congo and guinea) were intercropped with silver oak on the terrace risers and pineapple (Var. Kew) has been intercropped single row in each terrace with 30 cm distance from plant to plant). After fifth year, silver oak attained an average height of 6.95m and dbh 7.6cm.The yield of fodder grass was 26.4 t/ha and 28.45 t/ha respectively for Congo and guinea.

Evaluation of multistoried AFS

B.P. Bhatt

Under this system, one row each of turmeric (cv. RCT-1) and colocasia (cv. Meghalaya local) was sown in terraces along with standing crops of tea on risers and black pepper under the shade of Alder tree. Thirteen years of observation revealed that alder has positive effects on the production of tea. From the month of April to October, 6240 kg/ha of green buds could be harvested from the systems besides turmeric (17.7 t/ha) and Colocasia (18.50 t/ha). The yield of black pepper was very poor because black pepper cannot tolerate frost. The alder attained average height, diameter, and spread of 24.2m, 27.89cm and 8.9m, respectively.

Restoration of degraded lands through agroforestry

B.P. Bhatt and L.K. Misra

Under the research scheme entitled "Development of Non-Forest Wastelands through

Agroforestry Models in Northeastern Hill region" 23.4 ha of institutional wastelands and 22 ha of clan wastelands and private land in the farmers' field at Umden village was taken up for restoration purpose. The type of wastelands includes *jhum* fallow land, abandoned agricultural land and marshy/wet land. The land is being rehabilitated through horti- pastoral, silvi-pastoral and agri-silvi-horti and agro-aquaculture (composite fish culture + fruit trees + low land paddy + seasonal vegetables, etc.) agroforestry systems.

Growth performance of fruit trees species

Among the 5 species, *Citrus reticulata* and *Psidium guajava* showed highest survival percentage (90.0 and 81.5%, respectively) whereas, *Prunus persica* and *Pyrus communis* had comparatively low survival. As far as height growth is concerned, guava plants had highest (115cm) and *Citrus sinensis* the lowest (36.0cm) height growth after one year of plantation. The collar diameter growth was highest to guava (1.07cm) and the lowest to *Citrus lemon* (0.62cm). On average *Pyrus communis* and *Prunus persica* showed less than 50% survival but other species had more than 50% survival (Table 66).

Table 66. Growth performance of fruit trees at Institutional wasteland (tree density 400 plants /ha)

Sl. No.	Fruit tree species	Survival %	Growth after one year of plantation (Cm) Height growth	Collar diameter
1	*Citrus lemon*	77.77	38.00±9.51	0.62±0.07
2	*C. sinensis (varvalencia)*	55.00	35.60±13.12	0.74±0.25
3	*C. reticulata*	90.00	41.70±13.15	0.80 ±0.33
4	*Prunus persica*	38.46	73.11± 40.74	0.78±0.24
5	*Pyrus communis*	47.36	55.29± 15.51	0.82±0.23
6	*Psidium guajava*	81.48	114.80± 34.85	1.07±0.15

Growth performance of seedlings in farmers' field

Five plots of different sizes (Total area 18.0 ha) were taken up for agroforestry model development in farmers field at Umden village, situated near Umroi airport. In the first and second plots, each measuring 1.5 ha area, the tree species planted were damaged by animals during free grazing period.

Another area (3.5 ha of land) was also taken up for the development of horti pastoral agroforestry system in the same village. On this site, the survival as well as the growth was found comparatively better than the other sites. Almost all the species showed more than 60.0% survival. The height and collar diameter was observed optimum in *Psidium guajava* as compared to other fruit tree species. *Michelia champaca* was also planted as a forestry species and it exhibited 48.0% survival with 16.4 cm height and 0.52 cm collar diameter (Table 67).

Table 67. Survival and growth performance of some multipurpose tree species at Umden village

Species	Survival %	Height (cm)	Collar diameter (cm)
Citrus lemon	70.00	39.17±17.32	0.72±0.09
Citrus reticulata	74.00	45.50±34.56	0.73±0.16
Citrus sinensis	70.00	24.20±8.35	0.46±0.15
Psidium guajava	73.33	108.50±57.61	0.92±0.23
Pyrus communis	63.00	44.00±7.16	0.82±0.09
*Michelia champaca**	48.00	16.40±3.21	0.52±0.19

*Forestry species

Growth performance of multipurpose tree species (MPTs)

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

Michelia oblonga showed low survival (20.0%). Among the other species highest survival was observed for *Chukrasia tabularies* (80.77%), followed by *Alnus nepalensis* (70.0%), *Gmelina arborea* (65.0%) and *Simingetonia populnea* (60.0%), respectively. As far as height and diameter growth is concerned, it was optimum (67.60 cm height and 2.35 cm collar diameter) in *G. arborea* and lowest (23.0 cm height growth and 0.61 cm collar diameter) in *S. populnea*..

To establish silvipastoral and agrisilviculture agroforestry systems at old research site of the agroforestry division, 10 various MPTS were also

planted. Among various species *Chukrasia tabularis*, *Prunus cerasoides* and *Albizia lebbek* responded maximum survival as compared to other species. Whereas, *Bauhinia variegata*, *Schima wallichii* and *Grewia optiva* had poor survival. Survival performance of rest of the species ranked in between these two extremes. As far as height growth is concerned, *Populus deltoides* and *Parkia roxburghii* exhibited highest and lowest growth, respectively. The collar diameter growth was also highest to *Populus deltoides* but lowest to *S. wallichii*.

Growth performance of one-year-old multipurpose tree species and fruit trees under nursery conditions

In general 12 forestry species and 3 fruit tree species have been raised in the nursery. Among various forestry species, *Dendrocalamus strictus* showed average highest height growth followed by *Terminalia arjuna*, *Bauhinia variegata*, *Prunus cerasoides* and *Melia azadirachta*. *Michelia champaca* had lowest (32.0 cm) height growth. As far as collar diameter is concerned, *Terminalia arjuna* had the highest, followed by *Gmelina arborea*. Among various forestry species, *Albizia lebbek* exhibited lowest (0.28 cm) collar diameter growth. Among the fruit tree species, *Carica papaya* and *Citrus lemon* both had average 57.0 cm height growth. The collar diameter was, however comparatively higher to *Carica* seedlings as compared to *Citrus lemon*.

ARUNACHAL PRADESH

K.A. Singh

Evaluation of tree species of economic importance

Among the 50 tree species in the arboretum, 15 species were established in 1997, 20 in 1998, 06 tree species in 1999, 06 in 2000 and 03 in 2001. Among the tree species established in 1997, growth performance of *Pinus kesyia, Altinga excelsa and Michelia champaca* was highest in terms of plant height and diameter. They attained more than 5 meters height. Among the tree species established in 1998, *Acacia mangium* attained highest plant height followed by *Alnus nepalensis*, *Pinus wallishiana*, *symingtonia populnea* and *Dubanga grandifolia*. Among the six tree species established in 1999, *Aleurites Montana* attained highest plant height followed by *Emblica officianalis*, *Bauhinia purpurea*, *Manglietia insignis* (Papulaluk) and *Parkia roxburghii*. In the tree species established in 2000, *Elaecarpus sphaericus* Attained highest plant height followed by white *jutuli*, *Sapindus mukrosonii* and *Chukrasia tabularis* with 53 to 97 per cent survival rate. Exotic tree *Acacia mangium* became susceptible to root lodging and stem borer heavily infested them. Flowering occurred in *Altingia excelsa*, *Cinnamomum camphora*, *Cryptomeria japonica*, *Cupressus torulosa* and *Pinus kesiya* in fifth year; *Acacia mangium* in forth year and *Aleurites monyana* and *Bauhinia purpurea* in third year after planting.

Studies on pasture/silvipasture system

Studies on *Bauhinia purperea* + Congo signal/ guinea grass/golden timothy grass and broom grass showed highest harvestable fresh biomass of 1174 q/ha for broom grass (548.3 q/ha leaf for fodder, 74 q/ha spike for broom and 551.7 q/ha stem for fuel in a single cut) followed by 456 q/ha for guinea grass (4 cuts) and 390.6 q/ha for golden timothy grass (3 cuts). Under *Bauhinia purpurea* + Congo signal system, Congo signal produced 390.6 q/ha fodder (2 cuts) and the tree attained 2.02 m plant height.

Effect of tree densities on the growth performance of bola (*Morus laevigata*)

The trial was established in 1998 to study the effect of five tree densities (556, 667, 833, 1111 and 1667 plants/ha) in a rectangular geometry on growth performance (Table 68). In the fourth year, the effect of tree densities became evident. Highest plant height of 2.30 m and basal girth of 2.6 cm and girth at breast height 1.8 cm was attained at 667 trees per ha. The lowest plant height and diameter of trees was attained at highest density. The coefficient of variation of tree densities was 18% for plant height, 23 % for basal diameter and 33% for diameter at breast height.

Table 68. Effect of densities of Bola on plant height and diameter in forth year

Tree densities (No/ha)/spacing (m x m)	Plant height (m)	Basal height (m)	Basal diameter at breast height (cm)
1667 (2.0 x 3.0)	1.43	1.534	0.754
1111 (3.0 x 3.0)	1.88	2.093	0.984
833 (4.0 x 3.0)	1.62	1.618	0.790
667 (5.0 x 3.0)	2.30	2.617	1.557
556 (6.0 x 3.0)	1.86	1.819	0.877
Coefficient of variation (%)	17.97	22.54	33.05

Effect of tree densities on the growth performance of gamhari (*Gmelina arborea*)

The spacing trial on gamhari was established in 1999. In third year of establishment, gamhari attained highest plant height of 2.37 m at 833 trees/ha with basal diameter of 5.98 cm and 3.0 cm diameter at breast height, followed by growth at 667 trees per ha. Growth did not exhibited difference due to tree densities at this stage. Coefficient of variation ranged 6 to 8.5% for different growth parameters.

Evaluation of some bamboo plant species

K.A. Singh

In 2001, eight plant species were established at 5m x 5m spacing to evaluate their growth performance and new shoot production behaviour. The species include *Dendrocalamus asper, Sejaranjai* (similar to *Bambusa tulda*, FRI) (*B. tulda* from FRI, Dehdradun), *Bambusa polymorpha Chimonobambusa griffithiana, Phyllaostachys assamica, Schizostachyum polymorpha* and *Ochlandra travancorica*. All the species established except *O. travancorica* and *Chimonobambusa griffithiana, B. tulda* and *D. asper* had 33 per cent established and others has 100 per cent establishment.

In the three bamboo species established during 1997-1999, *D. asper* produced highest number of total culms per clump (16) with 2.7 m circumference followed by *Phyllostashys pubescens* (5) (monopodial) and *Bambusa wamin* (4) with 1.65 circumference of the clump. In 2001, *D. asper* produced 4 new shoots per clump followed by *P. pubescens* (3) and *B. wamin. D. asper* introduced from china got heavily infested with culm borer and a leaf disease.

Effect of clump densities on new shoot production in bamboo plant species

Out of 12 bamboo species established, survival of 09 species was 100%, 01 species 92% and 02 species 67% (Table 10). *Bambusa khasiana* could not get established. Among the 12 bamboo plant species, *Bambusa cacharensis* had produced highest shoot number (2.25 pr culms), followed by *Dendrocalamus sikkimensis, Cephalostachys pergracile, D. hookerii, D. sahnii, B. nutans* and *D. hamiltonii*. Effects of three clump densities (204, 278 and 400 clumps/ha) were not exhibited on new shoot emergence in the first year after planting.

Studies on the mineral contents in the different components of live biomass and the leaf litter of bamboo plant species

Coefficient of variation of calcium contents for 31 bamboo plant species was studied (Table 69). Microelements in the different parts of 31 plant species showed wide variability. The coefficient of variation was 30.57 per cent in the leaf to 140.11 per cent in branch for copper, 47.62 per cent in the leaf to 75.44 per cent in the branch for iron, 17.37 per cent in the leaf to 63.88 per cent in the branch for manganese and 38.92 per cent in the stem to 53.20 per cent in the branch for zinc in different plant species.

Table 69. Variability in mineral contents in the biomass of 31 bamboo plant species

Mineral elements	Components of biomass			
	Leaf litter	Leaf	Branch	Stem
Calcium	30.40	33.81	25.50	84.67
Magnesium	33.76	34.99	16.05	55.28
Copper	66.40	30.57	140.11	80.80
Iron	50.03	47.62	75.44	74.43
Manganese	54.64	17.37	63.88	46.65
Zinc	39.80	47.35	53.20	38.92

Collection and Evaluation of Casuarina species

Evaluation of five *Casuarina* species collected from Australia Tree Seed Centre and *C. equisetifolia* collected from the Deputy Conservator of Forest (Genetics), Coimbatore were continuing for the 9th year. Maximum plant height and BHD were recorded with *C. equisetifolia* (21.95m and 15.02 cm) followed by *C. glauca* EC 316191 (16363) (17.65m, 17.10 cm); *C. cunninghamiana* EC 326195 (15574) (13.10m, 15.35cm)respectively. Though the maximum plant height upto 21.95m was recorded with *C. equisetifolia*, there is no change in plant height after 7 years of planting .

Effect of Stump Sizes in the Growth of *Gmelina arborea*

A trial to study the effect of stump sizes (T_1-1.15 cm, T_2-1.30cm, T_3-1.45 cm and T_4-1.60 cm) in the growth performance of *G. arborea* was established in May, 1996. Treatment T_2 and T_3 are significantly dominating the last three years by giving maximum height upto T_2 (7.31m) and T_3 (7.18m) against the mean height of T_1 (5.84m) and T_4 (5.52m). Diameter at the breast height for all the treatments is almost same. Maximum DBH was recorded with T3 (7.53 cm) followed by T_1 (6.75 cm) and T_2 (6.70 cm) and T_4 (6.47 cm).

Provenance variation in *Parkia roxburghii*

An extensive survey was carried out on *Parkia roxburghii* (tree bean) in five districts of Manipur. The Division has classified the collected species into 15 provenances, out of 15 provenances, 4 provennces viz., Prov. LNo. 11, 12, 14 and 15 were damaged by jungle fire during 1999. Maximum plant growth (height and DBH) after nine years of planting was recorded with provenance No. 4 (8.90m, 15.83cm) followed by almost equally by the prov. No. 7, 6, 3 and 9 respectively. Maximum canopy and bole height and number of branches were also recorded with prov. No. 4. The data reveals that after 9 years of planting, there is no significant increase in plant growth for *P. roxburghii*.

A trial on the effect of stem and root cutting of four years old *Parkia* plants were also carried out from the 15 provenances which were collected from five districts of Manipur for further study of mode of branching, fruiting etc. After five years of planting, maximum plant height and DBH was recorded with provenance collected from Churachandpur district (6.30 m and 12.83 cm) followed by provenances from Ukhrul (6.06m and 12.22cm) and provenances from Bishnupur district (5.49m and 11.45cm) respectively. Though there were flowering and fruiting observed in the provenances from Churachandpur and Bishnupur districts, the fruits were not maturing properly for the last three years (Table 70).

Table 70. Districtwise performance of P. roxburghii (planted after cutting stem and root)

Provenance No.	Mean height (m)	Mean CHD (cm)	Mean BHD (cm)	Mean nos.of branches	Mean Bole height (m)	Canopy
Bishnupur	5.49	11.45	8.85	7.80	1.53	2.74
Thoubal	4.20	9.39	6.46	5.17	1.01	2.08
Churachandpur	6.30	12.83	9.96	8.13	1.95	3.50
Ukhrul	6.06	12.22	8.93	7.33	1.25	3.77
Senapati	4.69	9.17	6.26	7.75	1.74	2.60
Mean	5.34	11.01	8.09	7.24	1.49	2.94

Studies on growth performance of different multipurpose tree species

A trial was laid out at Krishnagiri (Langol) hill farm of ICAR in July, 1999 with the following MPTS viz., *A. falcataria, A. malaccensis, A. nepalensis, C. arabica, C. tamala, P. roxburghii, S. album* and *T. myriccarpa* for identification and preservation of germplasm for further study. After three years of planting, maximum plant height upto 1.38m was recorded with *T. myriocarpa* followed by *S. album* (0.89m) and *C. arabica* (0.81m). Whereas maximum CHD was recorded with *C. arabica* (2.20 cm) followed by *A. falcataria* (1.83cm) and *A. malaccensis* (1.65 cm) (Table 71).

Table 71. Growth performance of different multipurpose tree species

Species.	Mean height (m)	Mean CHD (cm)	Mean nos.of branches	Mean Bole height (m)	Canopy
A. falcataria	0.71	1.83	0.72	0.07	0.26
A. malaccensis	0.63	1.65	5.40	0.14	0.49
A. nepalensis	0.69	1.53	6.13	0.15	0.39
C. arabica	0.81	2.20	13.80	0.36	0.75
C. tamala	0.68	1.02	5.25	0.22	0.32
P. roxburghii	0.75	1.25	-	-	0.25
S. album	0.89	1.20	11.67	0.25	0.33
T. myriocarpa	1.38	1.15	4.60	0.25	0.54
Mean	0.82	1.48	5.95	0.18	0.38

Development of suitable management practices for different agroforestry systems

Silvi-horti pastoral system.

An experiment to study the effect of different tree species viz., *B. variegata, P. roxburghii, L. polyantha, S. wallichii, A. integrifolia, M. azadirach, E. citriodora, A. lauriculiformis* and *E.* teriticornis which were planted in 1992 on the yields of banana and fodder crops were initiated in April, 1998. During the fourth year, growth and yield of banana sharply decreased which were planted below *B. variegata, P. roxburghii, L. polyantha, S. wallichii,* whereas maximum banana yield upto 2.44 t/ha was recorded in combination with B. variegata followed by treatment No. 4 (2.04 t/ha) planted between *S. wallichii* and *A. integrifolia* and treatment No. 3 (1.83 t/ha) planted between *L. polyantha* and *S. wallichii* (Table 8). Maximum plant height and BHD after 9 years of planting was recorded with *E. teriticornis* (20.16m and 25.21 cm) followed by *E. citriodora* (17.63m, 23.74cm) and *A. auriculiformis* (15.26 and 25.32 cm) respectively. Whereas maximum canopy was recorded with *P. roxburghii* (7.33m) followed by M. azadirach (6.97m) and *A. auriculiformis* (5.98m) respectively.

Maximum fodder yield (variety - P maximum) upto 48.5 t/ha was recorded in combination with *L. polyantha* followed by treatment No. 1 (46.0 t/ha) in combination with *B. variegata* and treatment No. 3 (23.00 t/ha) in combination with *P. roxburghii* in three cuttings per year.

Agri-horti-pastoral system

A trial on the crop productivity of 5 different agricultural crops viz., groundnut (JL-24), maize (Vijay composit), rice (RC Maniphou-6), soybean (PK-472) and redgram (ICPL-87) on the terraces was conducted in the last three years successively with recommended doses and spacing. Groundnut yield ranging from 1.35 to 2.15 t/ha, maize 3.85 to 4.61 t/ha, rice from 3.05 to 3.45 t/ha were recorded under rainfed condition (Table 72). Yields of redgram and soybean were negligible may be due to erratic distribution of rainfall during the period under report.

The Division tried to check growth declination and immature dropping of fruits (Orange) by applying micro nutrient treatments i.e. I(i) Zinc sulphate, 80 g/plant, (ii) Manganese Sulphate, 40 g/plant, (iii) Magnesium Sulphate, 40 g/plant and (iv) Lime 40 g/plant along with FYM and chemical fertilizers etc. did not control the remedy. The data reveals that there is no significance in the growth of Khasi Mandarin even after ten years of planting. Maximum height upto 3.44m was recorded with the treatment No. 1 followed by treatment No. 2 (2.73m).

Two varieties of fodder viz., *P. maximum* and *P. pedicellatum* were also planted on the terrace raisers. Average fodder yield upto 165.13 t/ha ranging from 121.75 to 205.75 t/ha was recorded with *Panicum maximum* in three cutting per year and 62.13 t/ha ranging from 49.00 to 75.75 t/ha with *P. pedicellatum* in two cutting per year. Due to flowering and over maturing in the stalk of the *P. pedicellatum* we made only two cuttings per year.

Silvi-horticultural system

A trial on the effect of root cutting for about one year old *P. roxburghii* at different soil depth (i.e. 10, 13, 16, 19 and 21 cm) and control (without cutting) were examined by planting in between trenches and bunch of 2.50m spacing at Langol Hill farm having about 50% slope. The growth performance were not significant.

Table 72. The yield performance of different Agricultural crops and fodder crops

Agricultural crop	Variety	Grain yield (t/ha)	Green haulm yield (t/ha)
Groundnut	JL-24	1.75	12.47
Maize	Vijay composit	4.23	48.62
Rice	RCM-5	3.25	15.35
Soybean	PK-472	-	-
Red gram	ICPL-87	-	-

Horticultural crops of *Mangifera indica* dwarf variety locally known as Moreh heinou (polyembrionic) which were planted in between the trenches and bunds of 2.50m spacing were also recorded. Maximum plant height upto 2.17m was recorded in treatment No. 6 followed by treatment No. 3 (2.15m), treatment No. 5 (1.83m) and treatment No. 1 (1.81m). Mode of branching, flowering and canopy were not lincreased significantly compared to the last year.

Silvipastoral system

Four tree species viz., *A. falcataria, A. nepalensis, P. roxburghii* and *B. purporea* were planted along the contour line of 1m vertical intervals at Krishnagiri farm, Langol hill of ICAR in July, 2001. And fodder crops of *Thysanoloena maxima* (broom grass) was also planted with four replications viz., 1.5m, 2.0m, 2.5m and 3.0m with row to row spacing ranging from 4.5 to 5.5m according to the slope of the experimental area. Maximum tree height upto 0.89m was recorded with *B. purporea* followed by *A. falcataria* (0.85m) whereas the minimum was recorded with *A. nepalensis* (0.26m). Fodder crops were not yet harvested (Table 73).

Table 73. Growth performance of different MPTS under silvi-pastoral system

Tree species	Mean height (m)	Mean CHD (cm)	Mean nos.of branches	Mean bole ht. (m)	Canopy
A. falcataria	0.85	2.11	2.00	0.91	0.28
A. nepalensis	0.26	1.06	1.70	0.03	0.12
P. roxburghii	0.54	1.08	-	-	0.15
B. purpurea	0.89	1.75	2.6	0.24	0.29
Mean	0.64	1.50	1.58	0.30	0.21

SIKKIM

Development of suitable management practices for agroforestry systems (AFS) with reference to their productivity and sustainability

M. Singh and R.K. Avasthe

Agrihorti AFS

Maize, rice bean and tapioca were intercropped in the interspaces of the 11-year old Sikkim mandarin plantation during the pre-kharif season of 2001-2002. The yield was recorded 12.27 q/ha, 3.5 q/ha and 139.0 q/ha, respectively, for maize, rice bean and tapioca. Tapioca was sown on risers of terraces. Mandarin recorded the average height and basal diameter of 4.7 m and 21.8 cm, respectively.

Silvihorti AFS

In this system, turmeric var. local was sown in the understorey of seven multipurpose tree species viz., *Leucaena leucocephala, Alnus nepalensis, Terminalia myriocarpa, Pinus petula, Ficus hookerii, Saurauia nepalensis and Artocarpus lakoocha.* Turmeric produced the highest yield under *Leucaena leucocephala*(18 t/ha), followed by *Alnus nepalensis* (16 t/ha). Whereas, the lowest yields were recorded under *Terminalia myriocarpa* (4 t/ha), followed by *Pinus petula* (5 t/ha). The height and diameter growth of the tree species varied significantly among the species. On average, *Alnus nepalensis* attained the maximum height and diameter of 27 m and 36.30 cm, followed by *Terminalia myriocarpa* (18 m and 32.3 cm).

TRIPURA

M. Datta and K.R. Dhiman

Multipurpose tree species (MPTS) suitable for humid subtropical region were planted in RBD with 8 replications in 1987. Growth characteristics indicated that *E.hybrid* attained the maximum height (17.1m) followed by *G. arborea* (13.8m), *A. lebbeck* (12.6m), *M. champaca* (12.2m), *T. grandis* (11.8m) and *D. sisso* (9.9m). *G. arborea* attained the maximum basal girth (96.2 cm) and

girth at breast height (73.8cm). The least basal girth was noted in *Morus alba*. *E. hybrid* also showed the maximum timber volume (23.3 m3 x 10-2 tree-1) followed by *G. arborea*, *A. lebbeck*, *S. saman and M .champaca*. Growth increment in height and girth at breast height in 14 year old MPTS was recorded and presented in fig.42.

$$\text{Growth Increment (\%)} = \frac{(V2 - V1)}{N \times V1} \times 100$$

Where, V1 is the initial growth and V2 is the growth after N nos of years.

T. grandis and A. lebbeck showed the maximum growth increment in height and GBH after a period of 14 years respectively. The least growth increment in height and GBH was noted in *L.leucocephala* and *D.sisso*, respectively.

Crop productivity

Pineapple, turmeric and cowpea as green fodder were grown as intercrops and their productivity indicated that *E. hybrid* produced the maximum number of pineapples followed by *A. indica*. The increase in yield of pineapple over control under the canopy of *E. hybrid* and *A. indica* was 76.2% and 34.9%. *Leucaena* produced only 9% increase in pineapple yield over control. The productivity of turmeric was very low in all the plot under study. Acacia remaining as boundary plantation after clear felling produced the maximum rise in thre yield of cowpea as green fodder.

Growth of bamboo species

Growth of some bamboo species planted in 1994 in the arboretum was recorded and presented below (Table 74).

Table 74. Growth of bamboo species

Bamboo species	Height (m)	Girth (cm)	Internode distance (cm)
Nol barak *(D .hamiltonii)*	12.3	11.5	18.6
Pechi *(B. cacharensis)*	11.7	20.3	32.7
Muli *(M. bambusoidis)*	4.9	5.7	14.5
Mirtinga *(B. tulda)*	12.4	20.1	34.3
Konkiss *(B. nana)*	11.7	18.5	6.2
Makal *(B. nutans)*	13.9	20.6	19.1
Yai *(B. pallida)*	8.9	14.8	16.4
Mean	10.8	15.9	20.3
CV (%)	25.4	32.8	45.7

The perusal of the data on the growth of bamboo species showed that Makal attained the maximum height (13.9m) and Muli showed the least height of 4.9m. Maximum girth (20.6 cm) was also noted in Makal and Mirtinga showed the maximum internode distance of 34.3 cm. Muli and Konkiss were of the least girth(5.7 cm) and internode distance(6.2 cm) respectively.

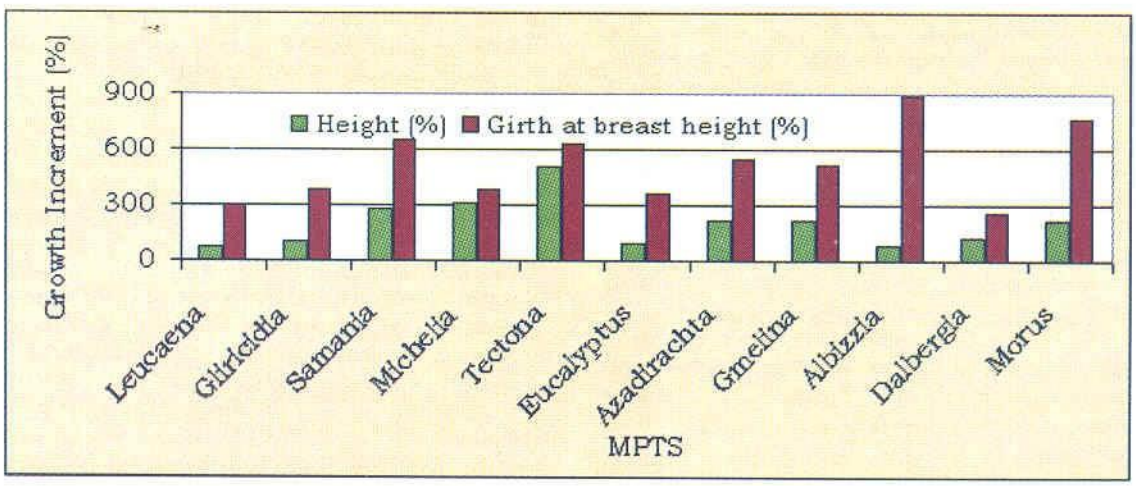

Fig. 42 Growth parameters of different MPTs

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Dr. Ramesh Chandra, Scientist (Animal Reproduction)
Sri. R. K. Jangra, Scientist)Horti)
Sri Matvar Singh, Scientist (AF)
Sri S.B. Singh, Farm Manger (T-8)
Sri B.K. Mishra, Farm Manger (T-6)
Sri S. Purkyastha, Asst. Admin. Officer (Posted at ZC Unit III, Umiam)
Sri Dvis Jopseph, AAO

ICAR Research complex, Nagaland Centre

Dr. Naresh Babu, Scientist (Hort)
Dr. H.D. Karmakar, Scientist (Vety. Parasitology)
Sri S.S. Ghadge, Scientist (Agril. Exten.)
Sri H.S. Nogbri, AAO

ICAR Research complex, Mizoram Centre

Dr. K. Lakshminarayana, Scientist (Soil Science)
Sri Kamta Prasad, Scientist (Agril. Extn)
Sri Bikram Deberma, Tech. Officer
Sri S. K. Das Biswas, AAO

ICAR Research complex, Arunachal Pradesh Centre

Sri D. C. Bhuyan, AAO

Officers of KVK, Manipur, Imphal

Sri K. Lakeshwar Singh, Trg. Associate (T-7) Agri. Engg.
Sri B.K. Sarma, Trg.Assoc (T-7) (Agronomy)
Ms. R. Jasumati Devi, Trng. Assoc (T-7) (Home Sc)
Dr.Th. Meghachandra Singh, Trng Assoc (T-6) (Animal Sc)
Smt. S.K. Rama, Trg. Asst. (T-6) (Home Science)
Sri L. Ingobi Singh, Trng. Asst. (Agro) T-6
Smt. Ng. Sanatombi Devi, Trng. Asst. (T-6) (Hort)
Sri Kh. Hera Singh, Trng. Asst. (Agril. Engg) T-6
Sri G.P. Kabui, Trng. Asstt. (Hort) T-6
Smt A. R. Devi, Trng. Asst. (Animal Sci.) T-5

KVK, Nagaland

Sri J.K. Sonowal, Trg. Assoc. (Ag. Engg) Posted at TTC, Umiam.
Sri R.C. Verma, Trng. Assoc. (Hort)
Sri W. Ranen Singh, Trng. Assoc. (Hort)
Smt. V. Kenny Naleo, Trng. Assoc. (Home Sc)
Sri A.K. Khan, Trng. Assoc. (Agro)
Sri R.K. Tarat, Trng. Assoc. (Agro) Posted at ZC Unit, Umiam
Dr. (Mrs.)Anamika Sharma, Trg. Assoc. (Hort) T-5
Dr. Suresh Kr. Meiti, Trng. Asst. (Agro) T-5 Posted at Umiam.
Smt. Ng. Sanatombi Devi, Trng. Asst (Hort) Posted at Manipur.

KVK, Arunachal Pradesh
Sri Vishwakam, Trng. Assoc. (Hort) T-8
Sri K.K. Dutta, Trg. Assoc. (Ag. Engg) Posted at TTC, Umiam
Sri Joyti Borah, Trng. Assoc. (Home Sc) T-6
Sri Bharati Saloi, Trng. Asst. (Home Sc) T-5

KVK, Tura
Ms. Jyoto Bora, Trng. Assoc. (Home Sc) T-6
Sri K. K. Hazarika, Trg. Assoc. (Ag. Engg)
Sri A. S. Singh, Trng. Assoc. (Hort)
Sri Mithalesh Kumar, Trng. Assoc. (Agro)
Sri L.L. Singh, Trng. Asst (An. Prod.)
Sri b. Islam, Tech. Officer

KVK, Sikkim
Sri V.K. Sachan, Trng. Assoc. (Hort) T-7
Sri S.N. Mehta, Trg. Assoc. (Ag. Engg) T-6
Sri S. Verma, Trng. Assoc. (Agro) T-6
Sri L.N. Singh, Trng. Asst. (Agril. Extn) T-5
Sri Sanjay Kumar, Trng. Asst. (Agro) T-6
Sri S. Verma, Trng. Asst. (Extn) posted to Manipur centre

KVK, Tripura
Sri P.K. Sharama, Trng. Assoc. (Fishery) T-7 posted at Complex Hq, Umiam.
Sri G.P. Kar, Trng. Asst. (Agro) T-5
Sri J.L. Singh, Trng. Asst. (Agro) posted at Complex Hq, Umiam
Sri T.D. Barma, Trng. Asst. (Fishery) T-5
Sri G.P. Kabui, Trng. Asst. (Hort.) Posted at Manipur centre

TTC
Dr. Babu Lal, Senior Scientist (Soil Science)
Sri G.P. singh, Trng. Asst. (Posted at Farm manager)
Sri D. K. Sonowal, Trng. Assoc. (Ag. Engg.) T-7

6. सारांश

परिचय

भारतीय कृषि अनुसंधान परिषद का उत्तर पूर्वी पर्वतीय परिसर यहां के जनजातीय किसानों की सेवा में विगत 25 वर्षो से भी अधिक समय से सेवारत है। इसकी स्थापना 1975 में शिलांग में की गई जिसे 1991 में उमियम (बड़ापानी) में ले आया गया जहां अनुसंधान फार्म व प्रयोगशालाओं के साथ-साथ आवासीय परिसर भी स्थित है। इस परिसर में कृषि के साथ-साथ बागवानी, पशु विज्ञान, मत्स्य पालन तथा कृषि अभियंत्रण आदि विषयों पर शोध कार्य किये जा रहे हैं ताकि किसानों को पूर्ण लाभ मिल सके।

इसके 6 केन्द्र यहां के अलग अलग प्रान्तों में स्थित हैं। त्रिपुरा स्थित लेम्बूचेरा केन्द्र समुद्रतल से 60-70 मीटर की उंचाई पर है। मिजोरम स्थित कोलासिब केंद्र, मणिपुर स्थित इम्फाल केंद्र तथा अरूणाचल प्रदेश स्थित बसार केंद्र समुद्र तल से क्रमशः 750से लेकर 800 मीटर तक की उंचाई वाले स्थानों पर अवस्थित हैं। सिक्किम स्थित टडौंग केंद्र की उंचाई 1200-1400 मीटर के बीच है जबकि मेघालय स्थित मुख्य परिसर 980-1080 मीटर की उंचाई पर स्थापित किया गया है ताकि इस सम्पूर्ण क्षेत्र के प्रत्येक कृषि जलवायवीय खंडो का प्रतिनिधित्व हो सके। केंद्रों का चयन करते वक्त सम्पूर्ण क्षेत्र को एक यूनिट के रूप में लिया गया है ताकि उचांई तथा कृषि जलवायवीय दशाओं के लिए एकीकृत शोध किया जा सके तथा वैज्ञानिकों को दोहरे कार्य से बचाकर गहन अनुसंधान के लिए उनका विवेकपूर्ण उपयोग किया जा सके।

अनुसंधान तकनीक को किसानों के खेतों तक पहुंचाने के लिए इस परिसर के तहत 6 कृषि विज्ञान केंद्र कार्यरत हैं। किसानों के साथ-साथ प्रशिक्षकों, सरकारी तथा गैर सरकारी संगठनों के प्रसार कार्यकर्ताओं को प्रशिक्षण प्रदान करने हेतु एक प्रशिक्षक प्रशिक्षण केंद्र भी यहां कार्यरत है।

उमियम स्थित मुख्यालय, 25°30´ उत्तर तथा 91°51´ पूर्व पर गुवाहाटी शिलांग रोड 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 में स्थित संस्थान कहीं पर मध्यम से तीव्र ढलान वाली पहाड़ियों से घिरा है तो कहीं पर सपाट घाटियों से जो कि प्रत्येक प्रकार की पहाड़ी भू-स्थलाकृति का प्रतिनिधित्व करता 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 ट्रैचेज बनाई गई है। वर्तमान में खेती के अंतर्गत 60 विशिष्ट क्षेत्र हेक्टेयर भूमि का उपयोग किया जा रहा है।

विशिष्ट क्षेत्र

1. अधिक उत्पादकता प्राप्त करने हेतु झूम खेती का प्रतिस्थापन तथा पर्वतीय इलाकों हेतु उपयुक्त एकीकृत खेती-पद्धति का विकास।
2. वृक्ष आधारित खेती द्वारा निम्न कोटि की झूम/परती भूमि का पुनः स्थापन।
3. स्थानीय रूप से उपलब्ध चारे को शामिल करते हुए पशुओं के लिए आहार व चारे का विकास।
4. निंबुकुल के वृक्षों में सुधार लाना ताकि इसे फिर से पुर्नस्थापित किया जा सके।
5. खाद्यान्न फसलों, दालों, तिलहनों, बागवानी तथा अन्य महत्वपूर्ण फसलों पर अनुसंधान करके उनकी कुल उत्पादकता बढ़ाना।
6. पशुओं की उचित देखभाल तथा पशु उत्पादन प्रणाली में सुधार लाना।

प्रमुख उद्देश्य

1. इस क्षेत्र विभिन्न कृषि जलवायवीय खंडों तथा आर्थिक-सामाजिक 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. अनंसंधान 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 परीक्षण करना।
6. उपरोक्त उद्देश्यों के प्राप्ति के लिए राष्ट्रीय तथा अंतराष्ट्रीय संस्थाओं से सहयोग करना।
7. कृषि से संबंधित सलाह व सूचनाएं प्रदान करना।

राष्ट्रीय कृषि तकनीकी परियोजना

राष्ट्रीय कृषि तकनीकी परियोजना के तहत 42 परियोजनाओं पर कार्य चल रहा है। कृषि संबंधित विभिन्न विषयों पर अनुसंधान के लिए संस्थान में 15 प्रभागों में अनुसंधान कार्य जारी है जो सम्प्रति 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 सांख्यकी, कृषि अभियांत्रिकी, कृषि प्रसार, कृषि वानिकी तथा उद्यान विज्ञान के अंतर्गत प्रगति पर हैं।

इसी प्रकार उपरोक्त विषयों पर वर्तमान में 32 शोध परियोजनाओं पर कार्य किया जा रहा है। संस्थान की स्टॉफ संख्या नीचे दी जा रही है।

श्रेणी	स्वीकृत	भरे स्थान	रिक्त
वैज्ञानिक	192	112	80
तकनीकी	318	248	70
प्रशासनिक	154	113	41
सपोर्टिंग	136	134	2
कुल	800	607	193

संस्थान के पुस्तकालय में कृषि विज्ञान से संबंधित विभिन्न विषयों की 15,899 पुस्तकें, रिपोर्ट, बुलेटिन आदि उपलब्ध हैं। पुस्तकालय द्वारा 6 क्षेत्रीय तथा राष्ट्रीय अखबारों से एकत्रित सूचना के आधार पर 'पूर्वोत्तर भारत के पर्यावरणीय ह्रास' पर जानकारी के लिए कंप्यूटरीकृत डॉटा बेस भी विकसित किया गया है। ई-मेल सेवाओं के साथ-साथ भारतीय कृषि सांख्यकी अनुसंधान संस्थान नई दिल्ली में उपलब्ध अंतर्राष्ट्रीय डॉटा बेस पर आधारित 'सेलेक्टिव डिसेमिनेशन ऑफ इंफारमेशन सेवाए' भी यहां कार्यरत वैज्ञानिकों को पुस्तकालय द्वारा उपलब्ध करवाई जा रही है। संस्थान की अपनी वेबसाइट http://icarneh.ren.nic.in// के नाम से विकसित की गई है जिसमें संस्थान के स्टाफ तथा प्रकाशन संबंधी सूचनाएं उपलब्ध हैं।

वर्ष 2001–2002 के लिए संस्थान का बजट

बजट	आवंटित (लाख रुपयां)	व्यय
योजनागत	569.00	553.93
योजनेतर	1410.00	1232.27
कुल	1979.00	1786.20

संस्थान नियमित रूप से कृषि विभागों और अन्य संबन्धित क्षेत्रों में परामर्शमूलक सेवा उपलब्ध कराती है। कृषि संबंधी विभिन्न समस्याओं और उससे सम्बन्धित विषय परीक्षण और विकास के लिए कृषि विभाग, मेघालय सरकार और विभिन्न वैज्ञानिकों के साथ विचार विमर्श हेतु संस्थान में द्विवार्षिक बैठक आयोजित की जाती है। अनुसंधान से प्राप्त तकनीक तथा महत्वपूर्ण सूचनाओं को पुस्तक, संवाद पत्र, वार्षिक रिपोर्ट और तकनीकी सूचना पत्र के माध्यम से कृषकों तक पहुंचाया जाता है।

प्रतिवेदित अवधि के दौरान मौसम के विभिन्न घटकों को रिकार्ड किया गया । मेघालय में औसत तापमान जनवरी में 18.8 डिग्री तथा जुलाई में 28.2 डिग्री सेल्शियस के बीच पाया गया जबकि न्यूनतम औसत तापमान जनवरी में 6.4 तथा जुलाई में 20.9 डिग्री सेल्शियस दर्ज किया गया। उमियम में वर्ष 2001 के दौरान कुल 191 वर्षादिवसों में 2728.6 मिमी कुल वर्षा रिकार्ड की गई जो कि विगत वर्ष की तुलना में 76 मिमी अधिक तथा औसत वार्षिक वर्षा की तुलना में 350 मिमी अधिक पाई गई। एक दिन में सर्वाधिक वर्षा 4 जून को प्राप्त हुई जो कि 124.7 मिमी थी।

वर्षा आधारित दशाओं में अपलैंड धान की IR-71524-44-1-1 से प्रतिहेक्टेयर 37 क्विंटल धान की उपज प्राप्त हुई जो कि इन दशाओं में सर्वाधिक पाई गई। सुगन्धित धान के IET को छोड़कर अन्य सभी प्रविष्टियां चैक की तुलना में अच्छी पाई गई तथा अति उपज देने वाली चेक पूसा बासमती की तुलना में इनसे प्राप्त उपज 8 से 17 प्रतिशत तक अधिक पाई गई जबकि अति उँचाई की दशाओं में एनईएच मेघा राइस–2 को पिछेती किस्मों में सर्वाधिक अच्छी किस्म के रुप में पाया गया। प्रारंभिक मूल्यांकन में धान की IET-16046, 16047 तथा IET कल्चर RP-2421 से सर्वाधिक उपज प्राप्त हुई। 10 टन एफवाईएम को 50 प्रतिशत नाइट्रोजन की संस्तुत खूराक के साथ प्रयोग करने पर सर्वाधिक उपज मिली। नाइट्रोजन की दो स्पिलट डोज आधा रोपाई के समय तथा आधी पेनिकल निकलने के 18 दिन पहले अनुप्रयुक्त करने पर अधिक उपज मिली जबकि तीन स्पिलिट डोज 50 प्रतिशत रोपाई के समय, 25 प्रतिशत टिलरिंग

अवस्था में तथा 25 प्रतिशत बालियां निकलते वक्त देने पर यह कम पाई गई।

अजोला के रुप में बायो नत्रजन की आपूर्ति करने से निचली भूमि के धान में उर्वरकों की कम खपत होती है। एनपीके की संस्तुत खुराक के 75 प्रतिशत को अजोला के साथ प्रयोग से अधिकतम उपज प्राप्त हुई । प्रति हेक्टेयर 90 किलोग्राम नत्रजन के साथ 25 किलोग्राम जिंक सल्फेट तथा 10 टन कम्पोस्ट के प्रयोग से उपज के दानों तथा बायोमास में भी वृद्धि देखी गई। धान में रोपाई के 30 तथा 50 दिन पर दो बार निराई करने पर अच्छी उपज पाई गई जो कि प्रति हेक्टेयर डेढ़ किलोग्राम बूटाक्लोर के प्रयोग के बराबर पाई गई। धान निदेशालय हैदराबाद से प्राप्त धान के 80 संभाव्य उन्नत संवर्द्धों में से 16 में लीफ फोल्डर तथा तना छेदक से कोई नुकसान नहीं देखा गया। संरक्षित परिस्थितियों में धान की RP- 2941&43570 में तना बेधक से न्यूनतम नुकसान पाया गया।

वर्षापोषित परिस्थितियों में मकई की उत्पादकता बढ़ाने के लिए अधिक उपजशील कम अवधि में फलने वाली तथा पीली फ्लिंट संकर किस्मों के विकास के प्रयास जारी रहे। लक्ष्मी RCM-1-3 तथा MLW को बेबी कार्न के लिए अच्छा पाया गया।

सोयाबीन की 89 किस्मों का मूल्यांकन किया गया तथा JS(SH) 89-48 से प्रति एकड़ 31-1 एकड़ सर्वाधिक उपज प्राप्त हुई। मूंगफली की 68 इंट्रीज में NRCG-1241 को सबसे उत्तम पाया गया। राइसबीन में BD-139-1 उर्दबीन में VCG-23 को सर्वाधिक उपज देने वाली किस्में पाया गया। राजमा में हरी फलियों के लिए अर्का कोमल, FFB-3 तथा IVR-FB-1 को उपयुक्त पाया गया जबकि पॉड के लिए जुलाई के प्रथम सप्ताह में बाई गई किस्म VL- 63 को उपयुक्त पाया गया ।

साफ्ट वुड तकनीक से विभिन्न रुटस्टाकों पर खासी संतरे की कलम बांधी गई तथा सिटस ग्रांडिस को सबसे अच्छा रुटस्टाक पाया गया। अमरुद के कई संकर किस्मों का मूल्यांकन किया गया तथा इनमें हाइब्रिड 7 से सर्वाधिक भार वाले फल मिले। चीनी गूजबेरी की ब्रूनों किस्म लंबाई, भार तथा आयतन के लिहाज से अच्छी पाई गई तथा इसकी एबाट किस्म में ये गुण सर्वोत्कृष्ट पाए गए।

टमाटर की PSR-364, सीएचआरटी 4 सेल 1 तथा सेल 7 को मेघालय की मध्य पहाड़ियों के लिए उपयुक्त किस्में पाया गया। बैंगन की CS-157-6-4-1 जीएससी 4 तथा GSC-2 को बैक्टीरियल विल्ट के प्रति रोधी पाया गया तथा अन्य किस्मों की तुलना में अधिक उपज देने वाली पाया गया। फ्रैंचबीन की RCFB-24 तथा RCFB-60 को अच्छा पाया गया। इसके साथ ही इस क्षेत्र में अच्छी उपज के लिए बाटल कर्ड, कुकुम्बर, लोभिया, कद्दू, बीटिल कर्ड, अदरक, हल्दी, शकरकंद तथा कोलोकेसिया के जननद्रव्य का मूल्यांकन किया गया। पुष्पों में जरबेरा तथा ग्लेडिओलस के जननद्रव्यों को एकत्र कर उनका मूल्यांकन किया गया।

पशु आहार तथा चारे के अध्ययन में पाया गया कि पूर्वोत्तर की अम्लीय मृदा में बकव्हीट को वर्ष में तीन बार तक सफलतापूर्वक उगा कर चारे की आपूर्त्ति की जा सकती है। स्थानीय संसाधनों का प्रयोग करते हुए नवजात चिक को अंगीठी के प्रयोग द्वारा सफलता पूर्वक ब्रूड किया जा सकता है विशेषकर सुदूर क्षेत्रों में जहां बिजली उपलब्ध नहीं है। खरगोशों के एक अध्ययन में बढ़वार, आहार, प्रजनन गुणों तथा करकास की दृष्टि से सोवियत चिनचिला को उपयुक्त पाया गया। यह भी देखा गया कि 30 दिन के खरगोशों की वीनिंग से उनके भार पर कोई प्रतिकूल प्रभाव नहीं पड़ता है। सुअर सुधार कार्यक्रम में उत्पादन एवं प्रजननात्मक गुणों की दृष्टि से F_2 पीढ़ी को तुलनात्मक रुप से अच्छा पाया गया। इस क्षेत्र में पोर्क एवं बीफ में विषाणुओं की उपस्थिति से उनके मानव उपभोग हेतु उपयुक्तता पर अध्ययन में पाया गया कि विषाणुओं की अधिक संख्या में उपस्थिति देखते हुए यहां मीट उत्पादन में गुणवत्ता नियंत्रण पर अधिक ध्यान देने की आवश्यकता है।

मत्स्य उत्पादन में ऐसी मछलियां जो इस क्षेत्र में उपलब्ध हैं किन्तु पारम्परिक रुप से नहीं पाली जाती उन्हे सजावटी मछलियों के रुप में पाल कर अच्छी आय प्राप्त की जा सकती है। ऐसी मछलियां सुंदर रंग, देखने में आकर्षक, धारीदार व घुमावदार, छोटे आकार वाली, शांत स्वभाव, पारदर्शी, तथा अन्य कई गुणों से युक्त होने के कारण सजावटी मछलियों के रुप में पाली जा सकती हैं। इस क्षेत्र में विदेशी सजावटी मछलियों की लागत अधिक होने के कारण स्थानीय शौकिया मछली पालक विदेशी प्रजाति की मछलियों की जिसमें गोल्ड फिश की 60 से 80, एंजिल की 80 से 160, तथा डिस्कस की 400 से 500 रुपया प्रति जोड़ा तक की कीमत अदा करते हैं अतः यदि यहां स्थानीय रुप में उपलब्ध ब्रेकिडेनियो रेरियो, बेडिस बेडिस, लेपिडोसिफेलस गनटिया, कोलिस लेलिया, बोटला स्टियाटा तथा डेनियो डेंगिला को पालकर सजावटी मछलियों के रुप में बेच कर अच्छी आय प्राप्त कर सकते हैं जिन्हें यहां के लोग अभी तक बेकार व अनुपयोगी समझते हैं। यहां के उमियम झील में एकत्र की गई इंडियन मेजर कार्प की अच्छी बढ़वार पाई गई है तथा कटला, रोहू, म्रिगाल तथा कलबासु की बढ़वार स्टॉक के एक वर्ष के पश्चात क्रमशः 1000 ग्राम, 600 ग्राम, 350 ग्राम तथा 650 ग्राम दर्ज की गई। कृषि अभियांत्रिकी के क्षेत्र में तकनीकी उन्नति जारी रही तथा फार्म मशीनरी तथा पावर, मृदा एवं जल संरक्षण तथा तुड़ाई पश्चात उपयोग पर कई प्रदर्शन किसानों के खेतों पर आयोजित किये गए ताकि वे भी इन तकनीकों का लाभ उठा सकें। स्थानीय रुप में उपलब्ध अदरक, अनन्नास, क्वास तथा टमाटर का जाम, जैली तथा अचार बनाने

के लिए बेरोजगार युवकों को प्रशिक्षित किया गया ताकि वे इनके उत्पाद बनाकर अपनी जीविका के साधन जुटा सकें तथा साथ ही लोगों को स्वादिष्ट तथा पौष्टिक आहार प्राप्त हो सके। ग्रामीण युवकों तथा आंगनबाड़ी कार्यकर्ताओं को सोयाबीन से दूध, पनीर, सोयानट तथा अन्य पौष्टिक उत्पाद बनाने हेतु प्रशिक्षण दिया गया।

अरुणाचल प्रदेश केंद्र पर वर्ष के दौरान 123 वर्षा दिवसो से 2092 मिमी वर्षा प्राप्त हुई तथा शीत काल में 19 वर्षा दिवसों में 247.5 मिमी वर्षा मिली। वर्ष के दौरान अधिकतम तथा निम्नतम तापमान क्रमशः 30.6° और 11.6° सेल्शियस रिकार्ड किया गया। धान की वैटलैंड किस्मों में RCPL-1-151-1P (46.4 क्वि/है), RCPL-1-230 (42.4 क्वि/है), RCPL-1-179-3P (42.3 क्वि/है), TOX-3241-221-2-3-2 (41.5 क्वि/है), SPR-88090-30-1-2-4(40.2 क्वि/है), और ITA-222 (39.7 क्वि/है) ने उपज की दृष्टि से अच्छा प्रदर्शन किया। अरूणाचल प्रदेश के खाम्पती जनजाति द्वारा उगाई जाने वाली धान की 18 पारम्परिक किस्मों के मूल्यांकन में अमरुजुहा और बहादुर से क्रमशः प्रति हेक्टेयर 26.5 क्विंटल और 9.0 क्विंटल उपज पाई गई है।

उपज की दृष्टि से जाब्स टियर की चार प्रजातियों के परीक्षण में H–2279 से सर्वाधिक उपज प्राप्त हुई। फल प्रजातियों में किन्नो, आंवला, अमरुद प्लम और आड़ू जिन्हें यहां कि निचली पहाड़ियों पर लगाया गया था में अच्छी संभावनाएं पाई गई। केले के 30 प्रजातियों में पाक्टे में सर्वाधिक बंच भार देखा गया इस कम में इसके बाद जहाजी, मालभोग, चीनी चम्पा और रासथाली रोबस्टा को पाया गया। बांस के 12 प्रजातियों में बेम्बोसा केचारेन्सिस से सर्वाधिक उत्पादन प्राप्त हुआ। कृषि विज्ञान केंद्र द्वारा उन्नत कृषि तकनीकों को 52 प्रशिक्षणों के माध्यम से 436 किसानों तक पहुंचाया गया। किसानों के 6 हैक्टेयर कृषि भूमि क्षैत्र में सरसों का अग्र पंक्ति प्रदर्शन किया गया जिसमें औसत बीज उपज प्रति हैक्टेयर 8.6 क्विंटल पाई गई।

मणिपुर में धान की IMC -17-30-6-12, MC-17-8-2-16 और MC-17-8-16-1 को खरीफ में तुलनात्मक रूप से अन्य प्रजातियों से उपयुक्त पाया गया है जिनसे प्राप्त औसत उपज 78-33, 77-33 और 73-33 क्विंटल प्रति हेक्टेयर थी तथा इनका परिपक्वता समय 130 से 145 दिनों के बीच पाया गया। धान की इन किस्मों को मणिपुर की जलवायवीय स्थितियों के अनुकूल पाया गया है। खरीफ पूर्व में धान की SPR-880-30-1-2-4, RCPL-1-151-1P, MC-17-8-2-16-2, PSL-85048-19-3-1-1, ITA-222, RCPL-1-2-30, RCPL-1-179-3 और RCPL-1-87-4 को उपयुक्त पाया गया है।

दलहनी फसलों में चिक पी की B-12, B-30, B-20, B-29 और B-9 किस्मों को अनुकूल पाया गया । मक्के की प्रजातियों में RCM-1-1 और RCM-1-3 को मणिपुर के लिये उपयुक्त पाया गया। सोयाबीन की पूसा 16 और जेएस 335 प्रजाति को पहाड़ी तलहटियों के लिए उपयुक्त पाई गई। मूंगफली की 13 प्रजातियों के मूल्यांकन में ICGS-65 सर्वाधिक उपज वाली पाई गई जिससे प्राप्त उपज प्रति हेक्टेयर 28-67 कुन्तल थी।

एजाटोवेक्टर, अजोस्प्रिलियाम तथा फासफेट सोलोविलिजार जैव उर्वरकों का प्रयोग से टमाटर की उपज में प्रभावी वृद्धि पाई गई तथा औसत उपज 30-19 टन प्रति हैक्टेयर तक दर्ज की गई। मक्के के साथ सोयाबीन या उड़द को अन्तःफसल के रुप में लेने पर मक्के की उपज को बढ़ाया जा सकता है। धान की फसल में तना बेधक, गाल मिज, लीफ फोल्डर तथा ग्रास हापर आदि प्रमुख रुप में नुकसान पहुंचाने वाले कीट पाए गए तथा इनके कारण 15.15 प्रतिशत फसल का नुकसान रिकार्ड किया गया।

एग्रीहार्टी पेस्टोरल सिस्टम में मूंगफली, मक्का तथा धान को खासी मंडारिन तथा पेनिकम मेक्सीमम व पेनीसेटम पेडीसेलेटम जैसी चारा फसलों के साथ सफलतापूर्वक उगाया गया।

मिजोरम केंद्र कोलासिव में स्थित है यहां इस वर्ष सर्वाधिक तापमान 32.8° और न्यूनतम तापमान 7.8°तथा कुल वर्षा 3407.5 मिमी रिकार्ड की गई। उच्चभूमि धान की 20 प्रजातियों के परीक्षण में TRC-87-251 ने अच्छा प्रदर्शन किया और प्रति हेक्टेयर 39 क्विंटल उपज प्राप्त हुई।

मक्के के MLW प्रजाति ने औसत उपज प्रति हेक्टेयर 49 क्विंटल के साथ अच्छा प्रदर्शन किया। बेबीकार्न की MLW किस्म को सबसे अच्छा पाया गया। मूंगफली में ICGV-86590 से प्राप्त उपज प्रति हेक्टेयर 19.66 कुन्तल पाई गई। सरसों के 17 प्रजातियों में क्रांन्ति से प्रति हेक्टेयर 9.94 क्विंटल उपज प्राप्त हुई जो कि सर्वाधिक पाई गई। हल्दी की 9 प्रजातियों के मूल्याकंन में RCT-1 ने अच्छा प्रदर्शन किया।

पिछड़ी जनजातियों और पहाड़ी क्षेत्र में खाद्य सुरक्षा हेतु जय विज्ञान राष्ट्रीय कृषि तकनीकी परियोजना का वर्ष 2000 में प्रारम्भ किया गया। इसके अन्तर्गत एकीकृत सुअर विकास परियोजना में कौलासिब और आइजोल जिले के 36 और 5 हितग्राहियों को पिगलेटस् का वितरण किया गया और पाया गया कि वितरित सुअरों के वजन में प्रतिदिन 150 से 300 ग्राम तक बढ़वार पाई गई। हितग्राहियों को बिना मूल्य संकेन्द्रित खाद्य उपादान और दवा उपलब्ध कराई गई। कुक्कुट उत्पादन परियोजना के अन्तर्गत पीडीपी हैदराबाद से 'वनराजा' के 6 सप्ताह आयु के मुर्गी के बच्चों को कोलासिव के विभिन्न गावों के 49 परिवारों में वितरित किया गया। साल्मोनेलोसिस, केलिबेसिलोसिस तथा एमर्फलाइटिक्स को इन पक्षियों की मष्यु का मुख्य कारक पाया गया। मुर्गी के रानीखेत रोग की रोकथाम के लिये शुरुवात में ही उनका टीकाकरण किया गया।

नगालैंड में धान की 16 प्रजातियों में ड्वार्फ मसूरी से सर्वाधिक औसत उपज 52-56 क्वि/है. प्राप्त हुई इस क्रम में इसके बाद कुशल रही जिससे प्राप्त उपज 53-20 प्रति हेक्टेयर पाई गई। रंजीत व बहादुर ने क्रमशः तृतीय और चौथा स्थान प्राप्त किया है। सुगधित धान में यूपी स्पैशल जिसे हींग जीरा नाम से जाना जाता है से सर्वाधिक उपज मिली जो कि प्रति हेक्टेयर 27.67 कुन्तल थी।

सरसों की प्रजातियों में एम 27 से सर्वाधिक उपज मिली जो कि प्रति हेक्टेयर 7 कुन्तल रिकार्ड की गई। मक्के की पांच प्रजातियों के मूल्यांकन में एमएलवाई ने सर्वाधिक उपज दर्शाई जो कि प्रति हेक्टेयर 30.31 कुन्तल थी। नागा स्थानीय सुंअर के एक अध्ययन में देखा गया कि पीढ़ी दर पीढ़ी जानवरों का प्रदर्शन अच्छा हो रहा है।

पपीते की 12 प्रजातियों के परीक्षण में देखा गया कि गुणवत्ता, फलों की संख्या तथा स्वाद व अन्य गुणों के आधार पर पूसा डेलिशस को सर्वोत्तम पाया गया जबकि पूसा मेजिस्टी किस्म में बीज व छिलके सबसे कम पाये गए। केले की फसल में मानवीय प्रयासों द्वारा खरपतवारों के नियंत्रण से अच्छी बढ़वार व उपज मिली । देखा गया कि केले की अच्छी उपज के लिए प्रति फसल हरेक पौधे को NPK की संस्तुत डोज के साथ 20 किग्रा FYM और 10 किग्रा अजोला के प्रयोग से उपज में सार्थक वृद्धि पाई गई। इस केंद्र के कृषि विज्ञान केंद्र द्वारा तकनीक हस्तान्तरण के भी कई कार्यक्रम चलाये गए जिससे किसानों को लाभ मिल सके।

सिक्किम में धान की प्रजातियों के प्रतिरोपण में नाइट्रोजन को 3 भागों में (प्रतिरोपण के दौरान ¼, शाखानावस्था में ¼ और पुष्पगुच्छ लगाने के दौरान ½) प्रयोग करने से उत्पादन प्रति हैक्टेयर 57.63 क्विंटल तक बढ़ सकता है। मक्के, राइसबीन और टैपियोका का उत्पादन क्षमता प्रति हैक्टेयर क्रमशः 12.27, 3.5 और 139.0 क्विंटल पाई गई। विभिन्न फलों में कीवी ब्रुनो और एलीसन को फलोत्पादन के लिए उपयुक्त पाया गया । पेसन फ्रूट भी सिक्किम में सफलता पूर्वक उगाया जा सकता है।

अंगोरा खरगोश को प्राकृतिक दशाओं में पालने पर देखा गया कि घर बनाकर उन्हें पालने की अपेक्षा खुले रुप से रखने पर वजन में अधिक वृद्धि हो रही है। अंगोरा खरगोश और सिक्किम लोकल गोट में मृत्यु का मुख्य कारण वृक्क शोथ और निमोनिया पाया गया।

त्रिपुरा में इस वर्ष अधिकतम व न्यूनतम तापमान क्रमशः 23.4° से 34.0°और 11.0 से 26.1° के बीच रिकार्ड किया गया। इस दौरान कुल 3421.0 मिमी वर्षा हुई जो विगत 20 वर्षो में सबसे अधिक थी तथा मई महीने में सर्वाधिक वर्षा हुई। अपलैंड धान की 20 प्रजातियों में IET-16806, IET-16423 और आनादा दूसरों से बेहतर है। झूम में बोये गये धान में में आदुमा किस्म से सर्वाधिक उपज मिली। लो लैंड धानं में 13 जीन प्ररूपो का परीक्षण किया गया, जिसमें TRC-299-F-44 को उपज के अनुसार सबसे अच्छा पाया गया। दलहनी फसलों में उड़द की KU-10, KU-11, KU-32 , मूंग की KM-60, मसूर की IPL-93, अरहर की ICP-9039, ICP-9044, राईसबीन की EC-1667, EC-2074 और TRC-P-9, मटर की पांट P-2 सबसे अच्छी प्रजातियां पाई गई। तिलहनी फसलों में तिल की RAUSS-17-1 पीले सरसों की SCRT-1-2-1, SCRT-1-2-3, मस्टर्ड की TS-38, TM-6 और सोयाबीन की DS-93-79 'A' से अच्छी संभावनाएं हैं। मक्के की किस्मों के मूल्यांकन में श्वेता से सर्वाधिक उपज प्राप्त हुई। कम्पोस्ट को एनपीके 60:30:30 के साथ मिलाकर अनुप्रयोग करने से उच्चभूमि धान की उपज में वृद्धि पाई गई है। ग्लैडिओलस की 17 प्रजातियों में व्हाइट प्रास्परिटी को स्पाइक की सर्वाधिक लम्बाई व बेसल फ्लैरिट के हिसाब से अच्छा पाया गया। गुलाब की अमेरिकन प्राइड किस्म से बड़े स्पाइक वाली किस्म रही तथा गुलाब की ताजमहल प्रजाति से बड़े आकार के फूल प्राप्त हुए। भिन्डी के 10 जीन प्ररूपों के परीक्षण में टीआरसी बीएइस 3 से सर्वाधिक उपज प्राप्त हुई। कटक नौकी के नम्रता प्रजाति को सर्वोत्तम उपज वाली किस्म पाया गया। यामबीन को फलीदार के रूप में चिन्हांकित किया गया।

केंद्र पर पशुओं को दुग्ध उत्पादन तथा रोग नियन्त्रण हेतु एक सीमित संख्या में पाला गया। सुअरों की संकर नस्लों से 8 फैरोइंग प्राप्त हुई उनके विभिन्न गुणों का अध्ययन जारी है। ब्रायलर खरगोश की दो नस्लें सोवियत चिनचिला और न्यूजीलैंड ह्वाइट और उनसे प्राप्त संकरों के विभिन्न गुणों का अध्ययन किया गया। अखिल भारतीय समन्वित परियोजना के तहत कुक्कुट पालन परियोजना में 'गिरिराजा' और बनराजा पक्षियों का इस केंद्र में लाया गया तथा मूल्यांकन किया गया। सरसों और संकर धानों को सम्मिलित करते हुए कृषि विज्ञान केंद्र पर 20 प्रशिक्षण आयोजित किए गए तथा मक्का उत्पादन और जलसमेट प्रबंध पर भी दो प्रशिक्षणों का आयोजन किया गया ।