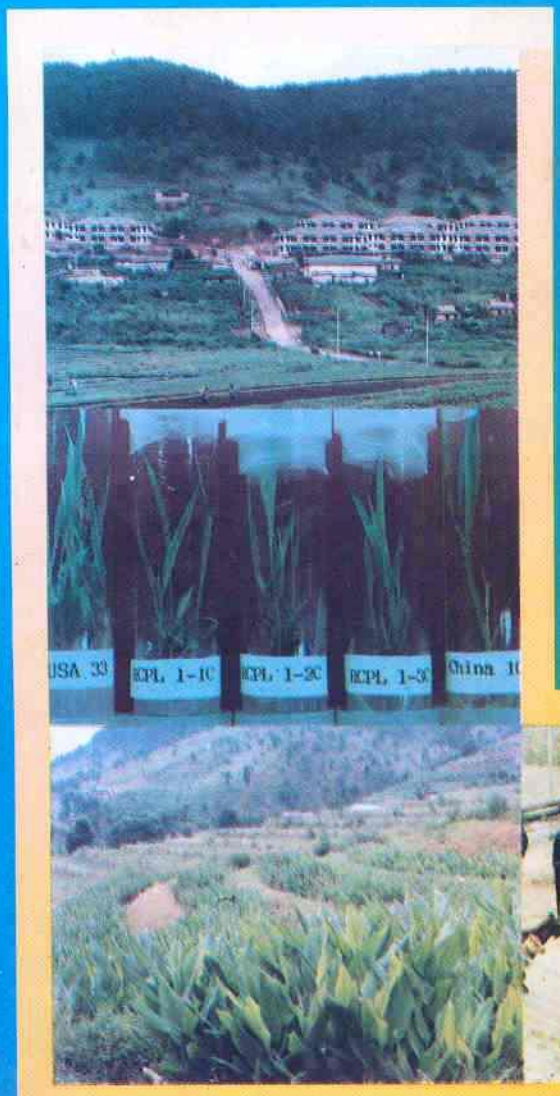

वार्षिक - प्रतिवेदन
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ANNUAL REPORT
1995 - 96

भाकृअनुप
ICAR

उत्तर पूर्वी पर्वतीय कृषि अनुसंधान परिसर

ICAR RESEARCH COMPLEX FOR N.E.H. REGION

वार्षिक – प्रतिवेदन

ANNUAL REPORT

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

ICAR Research Complex for N.E.H. Region
Barapani-793 103, Meghalaya

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CONTENTS

मेघालय (बड़ापानी)

MEGHALAYA (BARAPANI)

INTRODUCTION

The ICAR Research Complex for North Eastern Hills Region was established in the year 1975 with its Head Quarter at Shillong, Meghalaya. However, the Head Quarter was shifted to Barapani in 1991. It is the first institute of its kind set up by ICAR having disciplines of agriculture, horticulture, animal science, fishery and agricultural engineering to cater the research needs of tribal areas of North Eastern Hills Region including Sikkim. The institute has six centres at Basar (Arunachal Pradesh), Imphal (Manipur), Kolasib (Mizoram), Jharnapani (Nagaland), Tadong (Sikkim) and Lembuchera (Tripura). The institute has also six KVKs attached to different centres. There is one Trainer's Training Centre at Jharnapani (Nagaland) to cater the need of the entire NEH Region. The research farms of the institute are located at various altitudes such as Barapani (980-1080 msl), Jharnapani (500-550 msl), Lembucherra (60-70 msl), Basar and Kolasib, Langol hills (750-800 msl), and Tadong (1200-1400 msl) to cater the needs of various agroclimatic zones of the region.

While locating the research centre, the entire NEH region has been considered as one unit and the research centres have also so located as to present the varying altitudes and agroclimatics of the region. This has helped in rational utilization of scientists avoiding duplication of work. Further, the total research finding of the institute at different centres can thus be utilized for specific altitudinal range and agro-climatics in all component states.

The 101 ha farm (mostly hill terrain) of Head quarter is lying between 25°30'N and 91°51'E situated near Barapani lake almost 1.5 km from the junction of G.S. Road and Umroi Road. The site is about 22 km away from Shillong town. The land has mild to steep hill slope and flat valleys which provide almost all kinds of hill 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. Trenches and earthen dams have been made to harvest the run-off water. At present, the area under cultivation is approximately 60 ha. The major objectives of the institute are :-

* To develop and improve sustainable farming systems for different agro-climatic and socio-economic conditions of the region.
* To improve crops, livestock and fishery and to impart training for development of local competence for management of resources to enhance agricultural productivity.
* To maintain, analyse and project data based resources for perspective planning.

* To collaborate with the State Department of the region for testing and promotion of improved farming technologies.
* To act as centre for training in technology updating.
* To act as repository of information on different farming systems of the region.
* To collaborate with national and international agencies in achieving the above objectives.
* To provide consultancy.

The thrust areas of research during eight plan are :-

* To evolve suitable integrated farming systems for the hills of the region to replace *jhuming* (shifting cultivation) for increased productivity.
* Improvement of citrus plantations of rehabilitate citrus industry.
* Development of feed and fodder resources to include fodder and local resources based feeds for different livestocks.
* To increase the overall productivity of different crops through research in cereals, pulses, oilseeds, horticultural and other economic crops.
* Animal health coverage and improvement of livestock production system.

The institute has fifteen different disciplines-Plant Breeding, Agronomy Soil Science, Plant Pathology, Entomology, Animal Health, Veterinary Parasitology, Animal Nutrition, Animal Production, Fisheries, Agricultural Economics and Statistics, Agril. Engineering, Agril. Extension, Agroforestry and Horticulture. At present there are 32 ongoing research project in the institute. The institute headed by the Director has a total of 690 number of staff in position. The staff position of the Institute is presented below:-

	Sanctioned	Filled	Vacant
Scientific	192	91	101
Technical	326	262	64
Administrative	167	126	41
Auxillary	90	66	24
Supporting	149	145	4
Total	924	690	234

The institute has established a sophisticated agricultural research library which has acquired so far 13,791 books, reports, bulletin, etc and 7,045 back issues of serial publications. It has subscribed 42 foreign and 122 Indian Journals during the year. The library has been providing quite a good number of services to its scientists and other categories of users visiting the library regularly.

It has started to develop computerised data bases of library resources by using CDS/ISIS (ver.3.01) package received from DST, New Delhi under NISSAT project. It has also started to develop a computerised data base on *Environmental Degradation in North East India* by scanning six regional and national news papers. As Library is connected with NICNET it has been rendering *Selective Dissemination of Information Service* to its scientists by accessing the International Data Bases available with IASRI, New Delhi regularly, including E-mail services.

A well developed computer centre was set up to cater the needs of scientific and administrative requirement of the institute.

The budget of the institute for the year 1995-96 was as follows :

Budget	Alloted (Rs. in lakhs)	Expenditure (Rs. in lakhs)
Plan	225.00	208.31
Non Plan	572.33	580.46

The present Annual Report covers the research, training and extension activities of the Institute including each centre and KVK's for the year 1995-96. The salient findings are highlighted in the summary.

SCIENTIFIC, TECHNICAL AND ADMINISTRATIVE PERSONNEL

Post Sanctioned : 192 (Scientific)
Post vacant : 101 (Scientific)

Director

Dr. S. Laskar (upto 31.8.95)
Dr. N.D. Verma (from 1.9.95 to 17.11.95)
Dr. U.C. Sharma (from 18.11.95 to 2.1.96)
Dr. R.P. Awasthi (from 3.1.96 continuing)

Joint Director (HQ)

Dr. U.C. Sharma.

Plant Breeding

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Mr. A. Pattanayak, S.
Dr. J. Singh, S.
Ms. G. Sahay
Mr. R.N. Bhuyan, T-5

Water Management

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Dr. A.K. Mishra, S.

Agronomy

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Dr. U.K. Hazarika, S. (Sr. Scale)
Dr. D.C. Saxena, S
Shri Jagrup Abalkar, S (Plant physio)
Mr. N. Shah, T-6

Soil Science

Mr. M. Ram, S S

FSRP

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Mr. Jail Singh, T-5
Mr. H.H. Bareh, T-5

Horticulture

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Dr. S.G. Gupta, SS
Dr. R.P. Medhi, SS
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Dr. C. Aswath, S
Mr. V. Nagaraju, S (on study leave)
Mr. I.P. Singh, S.
Dr. M. Mishra, S.
Mr. D. Paul, T-5
Ms. U. Parthasarathy, T-5

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Dr. A.N. Shylesha, S
Mr. M. Sarma, T-5

Plant Pathology

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Dr. A.K. Singh, SS
Mr. S. Chandra SS
Dr. S. Prasad, S
Dr. (MS) L. Prasad, S
Dr. N. Bhat, S
Mr. V.S. Rana, T-5

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Mr. D.K. Sonowal, T-7
Mr. J.K. Bharali, T-6
Mr. E. Wahlang, T-5
Mr. V. Dakhar, T-5
Mr. A.V. Rynja, T-5
Mr. C. Adhikari, T-5
Mr. S.K. Biswas, T-5

Agril. Economics and Statistics

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Mr. M. Naskar, S
Mr. R. Das, T-5

Agroforestry

Mr. S.K. Dhyani, SS
Mr. L. Mishra, T-5

Animal Production

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Mr. J.K. Singh, S (on study leave)
Dr. S.K. Das, S (on study leave)
Dr. S. Naskar, S
Dr. R. Chandra, S
Mr. R.N.R. Law, T-5

Animal Health

Dr. H. Murakkar, S
Dr. A. Sanyal, S
Dr. D. Himadri, S

Veterinary Parasitology

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Dr. S. Banerjee, S
Mr. K. Sarma, T-5

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Mr. N. Prakash, S
Mr. P.P. Paul, S
Mr. Rajesh Kumar, S
Mr. P.K. Sarma, T-6
Mr. P. Nath, T-5

Fishery

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Ms. Cheryll H.S. Fernandes, S
Ms. S. Balasundari, S

Dr. A. Margauth M. Rathinam, S
Mr. P.K. Nayak, T-5

Animal Nutrition

Dr. B.P.S. Yadav, SS
Dr. J.J. Gupta, S (Sr. scale)
Dr. H.K. Gupta, (on study leave)
Dr. S.K. Sahu, S
Mr. J. Das, T-5

Farm Services

Dr. N.R. Roy, T-8

Scientific Coordination and Publication Unit

Dr. S.N. Goswami, T-7
Mr. A.K. Khaund, T-5
Ms. P. Purkayastha, T-5

Library

Mr. M.A. Prodhani, T-7
Mr. M.D. Syiem, T-5
Mr. G. Prasad, T-5

Instrumentation Cell

Mr. A.K. Acharjee, T-5
Mr. M. Kharphuli, T-5

Hindi Section

Mr. H.C. Joshi, ADOL

KVK, Tura

Mr. Vishwakam, T-7
Mr. K.K. Hazarika, T-6
Mr. B. Islam, T-5

Research Associates

Ms. B. Bhattacharyya, Plant Breeding.
Dr. Mahesh Kumar, Entomology
Dr. D. Kumar, Entomology
Mr. P. Mishra, Horticulture.
Mr. H.G. Jaspal, Plantt Breeding

Administration

Mr. I.K. Sharma, AO
Ms. M.J. Kharmawphlang, AAO
Mr. K. Bora, AAO
Mr. G. Sinha, AAO
Mr. B.K. Das, AAO
Mr. A.C. Deb, FAO

WEATHER

K.K. Satapathy and S.K. Jena

The weather being the most important factor in agricultural research and development, has been paid due attention to take observations of different meteorological parameters at Meterorological observatory of the institute. The different parameters include air temperature, soil temperature at 15 cm and 30 cm depth, rainfall, dry bulb and wet bulb temperature, evaporation, bright sunshine hours, relative humidity, wind velocity and direction. The observations were taken at 0830 hour and 1730 hour. The trend of different weather parameters are discussed below.

Air temperature

At Barapani, the mean monthly maximum temperature varied from 17.2°c in the month of January to 28.3°c in the month of May. The temperature gradually increased from February to May and remained almost constant untill August and started declining up to January. Mean monthly minimum temperature was recorded to be 5.4°c in the month of January and it started increasing and reached maximum of 22.0°c in the month of July. The mean monthly minimum temperature remained constant from May to September with a little variation. The difference in mean monthly maximum and minimum temperature is the highest in the month of January and the lowest in the month of July.

Soil temperature

The trend of soil temperature variation at Barapani indicated that, mostly in the morning the soil temperature at 30cm depth is slightly higher than at 15 cm depth, which is reverse in the evening. The difference in temperature at 15 cm and 30 cm depth is not much throughout the year. At 15 cm depth of soil the mean monthly minimum temperature was 12.4°c in the month of February and maximum was 24.6°c in the month of July. At 30cm soil depth the mean monthly minimum temperature was 14.1°c in the month of February and maximum being 25.2°c in the month of July.

Comparing the air and soil temperature it was observed that the soil temperatures at both 15 cm and 30 cm depth were always less than the air temperature. Data of both air and soil temperature indicated that crops during kharif and winter seasons would be better due to congenial environmental condition.

Relative humidity

Relative Humidity observed at 0830 hrs at Barapani was the highest (90%) in the month of January and the lowest (53%) in the month of April. The relative humidity increased to 73% in the month of May and further increased to 82% and remained constant with little variation between June to November, and decreased to 78% in December. It again increased and attained the highest in the month of January. So it was seen that relative humidity remained constant during rainy season and varied in dry spells. High humidity during winter may cause some pest attack in rabi crops.

Rainfall

Total rainfall received during 1995 at Barapani was 2433.7 mm, higher than previous year. The total number of rainy days were 180. There was rainfall in every month. The minimum rainfall of 2.9mm was in December and the highest of 543.0 mm was in August. About 91% of total rainfall was received from May to October. The intensity of rainfall was more in the month of June, August and September. There was sufficient rainfall at ICAR Farm, Barapani, which helped the better yield of different crops. Rainfall during winter season helped the rabi crops to grow properly. The soil erosion index was the highest in the month of August, causing maximum erosion because of high intensity rainfall.

Evaporation

Evaporation was measured by a USA-class A pan evaporimeter, which showed that the open pan evaporation at ICAR farm, Barapani was the highest of 6.8 mm/day in the month of April and the lowest of 2.0 mm/day in the month of December. It varied from 2 to 3 mm/day from July to February and the variation was higher during March to June. So the moisture loss from the soil was the highest in April which caused stress to horticultural crops.

Sunshine hours

The Sunshine hours at Barapani measured by a Campbell sunshine recorder showed that the maximum mean monthly sunshine hour was 7.6 hr/day both in the month of March and April, where as the lowest being 2.3 hr/day in July. Thou gh in the month of July the total number of rainy days were 30 days, still the mean monthly sunshine hour was 2.3 hr/day, as sunshine follows immediately after rain.

Wind velocity

The mean monthly wind velocity at Barapani varied from the lowest of 57.6 km/day in the month of November to the highest of 177.6 km/day in the month of April. The wind velocity was not significantly high to pose problems to standing crops or tall trees.

The mean monthly weather parameters of Barapani in the year 1995 is given in Table. 1.

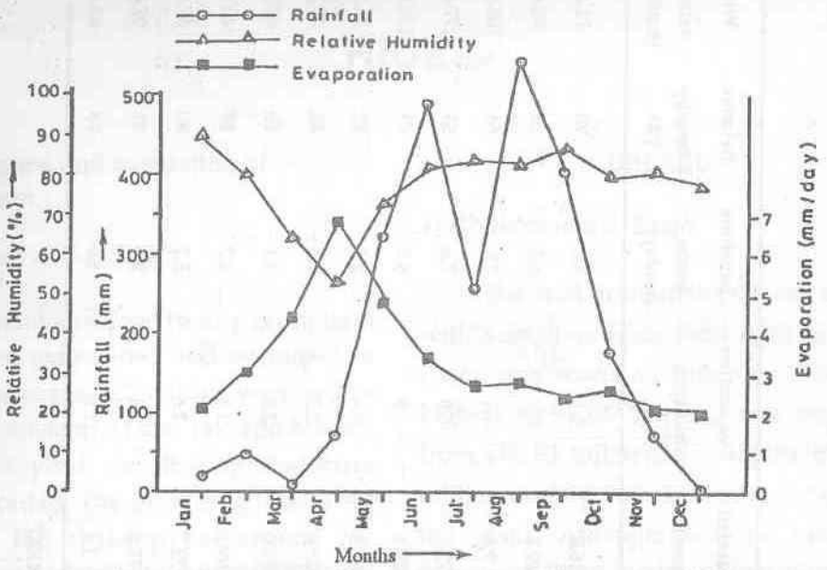

Fig. 1. Mean monthly weather parameters at ICAR, Barapani (1995)

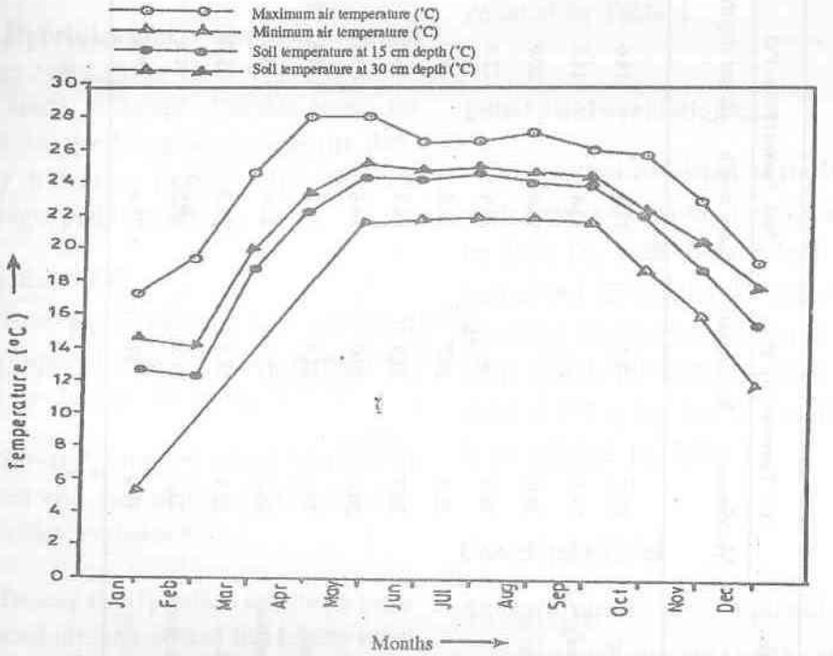

Fig. 2. Temperature variation at ICAR, Barapani (1995)

Table 1. Mean monthly weather parameters of Barapani 1995

Months	Air Temperature (°c))		Soil Temperature (°c)		Rainfall	Evaporation	Sunshine	Relative	Wind
	Maximum	Minimum	15 cm depth	30 cm depth	(mm)	(mm/day)	hours (hr/day)	humidity (%)	velocity (km/day)
January	17.2	5.4	12.8	14.6	16.0	2.1	6.2	90	74.4
February	19.5	-	12.4	14.1	49.8	3.0	6.2	80	98.4
March	24.8	-	18.8	20.0	9.9	4.4	7.6	64	105.6
April	28.1	-	22.4	23.4	72.4	6.8	7.6	53	177.6
May	28.3	21.7	24.5	25.2	323.4	4.8	6.3	73	153.6
June	26.7	21.9	24.3	24.8	494.3	3.4	2.5	82	76.8
July	26.8	22.0	24.6	25.1	257.6	2.7	2.3	84	67.2
August	27.2	22.0	24.2	24.8	543.0	2.8	3.1	83	67.2
September	26.2	21.8	23.9	24.6	409.2	2.4	2.7	87	60.0
October	25.9	18.9	22.2	22.3	179.7	2.6	5.2	80	57.6
November	23.1	16.1	18.9	20.6	75.5	2.1	5.9	81	57.6
December	19.4	11.9	15.6	17.8	2.9	2.0	6.0	78	69.4
Total					2433.7				

RICE

UPLAND

Maintenance and evaluation of germplasm

H.S. Gupta and J. Singh

Two hundred and twenty germplasm lines were maintained and evaluated in upland whereas 125 entries were evaluated in lowland. Data on agrobotanic traits and yield contributing characters were recorded. The promising lines were used in the crossing programme for development of suitable varieties for North Eastern Hills.

Hybridization : Seventeen single crosses were made at Barapani and hybrid seeds collected. Parents were selected on the basis of phosphorus deficiency tolerance, iron toxicity tolerance and high yielding ability.

Evaluation of F_4

Forty two F_4 families were evaluated under upland and 32 of them were selected for further screening.

Seven F_4 families were evaluated in lowland and two of them were selected for further evaluation.

Twenty five F_5 bulkod selections were evaluated under lowland and fifteen were found promising and were retained for further evaluation.

Initial yield evaluation trial

The trial consisted of twelve entries with local and exotic lines. It was sown on June 06, 1995. Bali, a local selection outyielded (37.4 q/ha) all other lines followed by Pinini (35.6 q/ha) and IRAT 144 (20.6 q/ha). PP 1522, resistant to blast, yielded 18.1 q/ha. Top five varieties have been collated in Table 1.

Coordinated trial

Advance varietal trial (Upland)

The trial consisted of 22 entries with check VL Dhan 221 and local check Ngoba.

The trial comprising of ten entries with selections from local lines and the check was sown on June 02, 1995. The highest yield (27.5 q/ha) was recorded from DR 92 followed by Ngoba but the milling quality of both the varieties was not good. Attempts will be made to improve milling quality by manipulating inputs. Top five ranking lines have been collated in Table 1.

Table 1. Yield data for upland trials conducted at Barapani (950 msl)

Rank	Station trial	IYET	AVT
I	DR92 (27.5)	Bali (37.4)	IET 13783 (36.03)
II	Ngoba (27.00)	Pinini (35.6)	IET 13459 (33.61)
III	Nagaland I (25.8)	IRAT 144 (20.6)	IET 13784 (32.04)
IV	Bali (19.06)	Yamuk (19.9)	IET 141.48 (30.78)
V	IC25708 (18.7)	PP1522 (18.1)	IET 14146 (30.25)
Check I	Ngoba (27.0)	IRAT 144 (20.6)	VL 221 (12.81)
II	Manipur Local (16.3)	Yamuk (19.9)	Ngoba (25.06)
Entries	10	12	22
CD 5%	18.22	12.7	10.65

yield q/ha in parenthesis

Highest yield was recorded from IET 13783 (36.03 q/ha) followed by IET 13459 (33.61 q/ha), IET 13784 (32.04 q/ha). VL Dhan 221 yielded 12.81 q/ha whereas Ngoba, the local control, yielded 25.06 q/ha. Since IET 13783 has been consistently performing well with 84 days to 50% flowering and long bold grains, it was recommended for release for Meghalaya by AICRP. Other promising lines are being tried further. The data have been collated in Table 1.

LOWLAND

J. Singh and H.S. Gupta

Station trial

A trial comprising of 18 entries with two local checks viz., Ngoba and DR92 were transplanted in lowland on 11th July 1995 with 40 days old seedlings. The entries included selections from stabilised lines, elite varieties and promising entries from centres. Top five entries

Table 2. Yield data for lowland trials conducted at Barapani (950 msl)

Rank	RCPT	IYET	AVT (IM)	AVT (IE)
I	DR 92 (41.8)	NIC 1 2612 (34.1)	IET 13484 (54.35)	RCPL 1-87-8 (46.11)
II	RCPL 1-4 (41.6)	IC 89200 (31.3)	IET 13481 (52.49)	IET 13476 (42.18)
III	RCPL 6-7 (38.4)	VL 89-1167 (30.8)	IET 13483 (50.98)	IET 13474 (41.6)
IV	RCPL 1-3 (38.2)	CN 881-2.6/1 (28.6)	RCPL 1-87-8 (50.3)	IET 13789 (40.16)
V	IR 62 (35.8)	NKG 318 (27.3)	IET 13485 (47.42)	IET 13470 (39.91)
Check	Ngoba (31.56)	RCPL 1-87-8 (22.6)	RCPL 1-87-8 (50.3)	RCPL 1-87-8 (46.11)
	DR92 (41.8)	RCPL 1-3 (26.4)	-	-
CD(5%)	7.6	12.35*	20.53*	10.07
D/S	16.95	56.95	96.95	12.6
D/T	11.7.95	77.95	18.7.95	19.7

The percentage of hulling, milling and head rice recovery for the promising lines/varieties is given in Table 3.

Table 3. Milling and head rice recovery

Variety/line	Hulling %	Milling %	Head rice recovery %
NEH Megha Rice 1	76.0	54.0	46.5
NEH Megha Rice 2	75.0	51.0	25.1
RCPL 1-87-8	74.0	58.0	39.1
RCPL 1-87-4	76.6	61.6	49.6
RCPL 1-3	73.3	58.0	41.6
RCPL 1-4	74.6	39.3	49.7
IRAT 144	70.6	57.3	52.1
DR 92 (control)	75.3	41.6	All broken
Ngoba (control)	74.5	55.0	11.1

The above table shows that head rice recovery was very poor in controls whereas it was much better in variety/lines developed by us.

have been collated in Table 2. Although DR92 yield the highest but RCPL 1-4, RCPL 6-7, RCPL 1-3 and IR62 were at par with the check DR62 and Ngoba. The major drawback of DR 92 lies in its 100% breakage during milling. RCPL 1-3 and RCPL 1-4 have been yielding at par or better than the checks with better milling recovery (Table 3) and therefore, they will now be tested in RCRT.

Initial yield evaluation trial

The trial included twenty three entries with two checks viz., RCPL 1-87-8 and RCPL 1-3 to select elite yielding better than the recommended varieties. The trial was transplanted on 7th July with 32 day old seedlings. Top five lines have been collated in Table 2. The trial will be repeated next year.

Coordinated trials

Four trials viz., AVT (Irrigated Medium maturity) Hill, IVT (Irrigated Medium maturity Hill), IVT (Irrigated Early Maturity Hill) and IVT (Japonica) were conducted at Barapani. The yield data of five top entries have been collated in Table 2.

Advance varietal trial (Irrigated medium maturity)

The trial consisted of sixteen entries with a local check. Highest yield was recorded from IET 13484 (VL89-1177) followed by IET 13481 (HPR 926) and IET 13483 (VL 89-1167). Local check, RCPL 1-87-8, yielded 50.3 q/ha and was ranked IV. The CD was high for this trial and it will be repeated this year.

Advance varietal trial (Irrigated early maturity)

Since early maturing varieties were not available RCPL 1-87-8 was used as check and it ranked first with 46.11 q/ha yield, However, other entries IET 13476 (VR89-1193), IET 13474 (VR89-1174), IET 13789 (VL 90-1683) and IET 13793 (CTH3) appeared proising with 97, 91, 94 and 97 days to 50% flowering as compared to 113 days in local check.

Testing of *Japonica* varieties

In view of export potential of rice to Japan, Directorate of Rice Research, Hyderabad launched a programme of testing the yield and quality performance of popular Japanese varieties. The initial varietal trial was conducted with 10 entries comprising of K39, Himalaya, HPU 2216, RP 2421 and local check RCPL 1-87-8. The highest yield was recorded from K39 (51.31 q/ha) followed by HPU 2216 (37.38 q/ha) and RCPL 1-87-8 (36.30). Among Japanese varieties, highest yield was recorded from Yamandanishiki (33.32 q/ha) followed by Gohyakumangoku (33.02), Hinohikari (31.87 q/ha) and Hiokumochi (29.56 q/ha). The lowest yield was recorded from Koshihikari (20.6 q/ha). Barring marginal differences in head rice recovery and anylose content, the quality traits of all the five Japonica varieties were comparable to original sample.

HIGH ALTITUDE

H.S. Gupta and J. Singh

Yield trial

An yield evaluation trial consisting of 20 varieties on two dates of sowing in lowland was continued for the 3rd year in succession and the yield data is presented in the table 4. IR 3941-23 outyielded all other varieties however, it was not significantly better than the checks. In the 2nd date of sowing which experiences severe cold at the time of flowering and seed setting, RCPL 1-9C topped with an yield of 22.74% q/ha followed by Abor B and Khonorullo. However, RCPL 1-9C was the only entry sowing significantly better yield than the check. The stabillity analysis is in progress and the most stable variety will be selected and recommended.

Initial yield evaluation trial

18 advanced breeding lines developed for high altitude were tested for their performance during the 2nd year. RCPL 1-25-1C yielded significantly better than the checks. The yield data is presented in Table 4.

BIOTECHNOLOGY

Development of cold tolerant rice through anther culture

A. Pattanayak, R.N. Bhuyan and H.S. Gupta

Nine double haploid (DH) lines selected during previous years were tested for yield performance at Barapani (950 msl) and at Upper Shilllong (1850 msl). At Barapani, DH 7 was found to yield the highest with 40.4 q/ha followed by DH 21 with 33.39 q/ha and DH 1 with 33.39 q/ha. The checks (parents) IR 70 and Khonorulo yielded 30.55 and 21.63 q/ha respectively.

Rice transformation

H.S. Gupta, B. Bhattacharee, H.G. Kang and Gynheung An (Pohang Univ. of Science & Technology, Pohang, Republic of Korea).

Having developed reproducible protocols for plant regeneration from protoplasts of Indica as well as Japonica varieties, successful attempts were made to transform rice during the previous years. Molecular characterization of the putative transgenic plants revealed integration of gene of interest (OsMADS 1). The molecular analysis was done in the lab of Prof. Gynheung An of Republic of Korea. The details are as follows :

MADS box genes in plants constitute a family of regulatory proteins which share a homologous putative DNA-binding domain and play a regulatory role in

Table 4. Yield data of the trials conducted at Upper Shillong farm (1850 msl) under lowland

Rank	D1	D2	IYET
I	IR3941-22 (34.89)	RCPL1-9C (22.74)	RCPL1-88-1C (22.04)
II	Meghalaya 1 (30.05) NEH Megha 1 (30.05)	Abor B (21.71)	RCPL 1-88-25-2C (19.75)
III	NEH Megha Rice 2 (29.7)	Khonorullo (21.57)	Khonorullo (19.51)
IV	RCPL 1-10C (29.19)	NEH Megha Rice 2 (19.69)	NEH Megha Rice 1 (19.39)
V	Abor B (red) (28.96)	RCPL 1-1C (19.18)	RCPL 1-88-85-1C (19.03)
Check	NEH Megha Rice 1 (30.5)	NEH Megha Rice 1 (16.52)	NEH Megha Rice 1 (19.39)
CD	10.18	5.98	2.76

D1	Nursery	Transplant
D2	22.4.95	12.6.95
D2	12.5.95	22.6.95
IYET	22.4.95	8.6.95

determining the developmental fate of cells. OsMADS1 is a c-DNA clone from rice and encodes a MADS-domain-containing protein. Ectopic expression of OsMADS1 has been shown to induce dwarfing and early flowering in *Nicotiana tabacum*. We report here, production of transgenic IR36 by Co-transformation of protoplasts using bar gene driven by maize Ubiquitin promoter as selectable marker and OsMADS1 under the control of cauliflower mosaic virus 35S promoter as the gene of interest.

Protocols were developed for fertile plant regeneration from suspension protoplasts of IRRI breeding line IR36. Utilizing the same protocols, protoplasts were isolated, purified and electroporated with equal concentrations of both the plasmids. The protoplasts were cultured in presence of feeders prepared from cell suspensions of RCPL-2C. Control as well as treated protoplasts underwent sustained divisions. Colony formation in presence of selection agent (20 ug/ml phosphinothricin) was, however, recorded only in the protoplasts electroporated with plasmids. The phosphinothricinresistant calli, on transfer to the regeneration medium, differentiated into shoots and roots. Expression of bar gene was tested by spraying phosphinothricin (400 mg/1) on the control as well as transgenic plants. Control plants died eight days after the spray whereas the transgenic plants remained green. In total, 13 primary transgenics were recovered. All the transgenic lines were fertile and set seeds on maturity.

T_1 seeds, obtained from the primary transgenics #, 1, 3, 5, 6 & 7 when grown on MS medium containing 100 mg/1 phosphinothricin, segregated in Mendelian ratio for herbicide resistance. DNA blot analysis showed integration and inheritance of OsMADS1 in the progenies of primary transgenic # 3, 6 & 11. Observations showed 12-15 days early flowering in the transgenic plants.

Results

All of the DNAs have about a 10 kb Eco RI band which carry the genomic gene of RAG 25, but only 3 lines from transgenic 3,6 and 11 have about a 1.5 kb of cDNA gene transformed. A 2.5 kb band in lane 2 and a 4.5kb band in lane 6 may be the results that DNA are rearrangements.

CROP PRODUCTION

Natural farming of transplanted rice as influenced by biofertilizer

G.C. Munda and U. K. Hazarika

An experiment with 11 promising rice cultivars, viz : DR-2 (Suvadra), IR-317891, RCPL-13, IRAT-144, Manipuri, Mendri, IR-317875, IR-317888, IR-317889, Sarasa and RCPL-87-8 were taken for the third consecutive year under natural farming condition for studying the stability of the performances under natural situation without aiding any plant protection measures and agro chemicals. Biofertilizer (water fern azolla) was used as a dual cropping along with the rice cultivars. *Azolla caroliniana* was released @ 500 g/15 sqm to all the plots under plantation of rice. The water fern multiplies to its full growth within one month period and spreads through out the water surface in the rice plots. The fern fixed atmoshpheric N by a symbiotic process through BGA living in the azolla leaf cavity on its dorsal leaf surface and released nitrogen by enzymic activities in the form of NH4+. The NH_4+ (ammonia) so released by the fern was utilized by the rice and ultimately enhanced the grain and dry matter yield. The maximum grain yield was recorded with RCPL-87-8 (48 q/ha) followed by DR-92 (36.5 q/ha) and IR-317889 (35.2 q/ha). The lowest yield was exhibited by IR-317891 and IRAT-144 with 17.3 q/ha and 19.6 q/ha respectively.

Influence of Azolla caroliniana and plant population on the growth and yield of transplanted rice under natural farming.

G.C. Munda and U.K. Hazarika

Rice cv Subhadra (DR-92) was taken as a test crop with three row x plant spacings viz; 20 x 10, 15 x 10 and 10 x 10 cm along with three levels of biofertilizer ie; 500 g. 1 kg and 1.5 kg/

plot of 15 sqm in 3 replication in a split plot design. Fifty day old seedlings of rice were transplanted during 1st week of July. Green azolla caroliniana were released during August as per the treatment schedule. The crop was manually weeded at the end of August. The result indicated that among the 3 plant densities maintained by different row spacings, 20 x 10 cm produced maximum grain yield (44.3 q/ha) followed by 10 x 10 cm (37.0 q/ha) and 15 x 10 cm (36.6 q/ha). Among the 3 biofertilizer levels, plot supplimented with 1.5 kg azolla proved to be superior as this treatment exhibited maximum grain (44.2 q/ha) yield. One kg azolla also yielded 39.8 q/ha which was quite encouraging. However crop received 500 g of azolla produced the lowest (33.4 q/ha) of grain yield.

Among the treatments combinations 20 × 10 cm spacing with 1.5 kg of azolla (S1B3) was best among the treatments followed by S2B3 (15 × 10 cm + 1.5 kg azolla) with 40.4 q/ha and was at par with S3B3 (40.6 q/ha).

Studies on water management conservation in situ for rice grampea rotation

S.K. Gupta

Field experiment was conducted during the year under report to see the rice response under different water management conservation for following the rice-gram/pea rotation. The experiment was sown on 30-5-95 with three rice cultivar (IRAT-141, IRAT-144 and DR-92 (Subhadra). The experiment was laid out in randomised block design with four height, and T_3-15 cm bund height) in three replications. The rice crop was harvested on 30-8-95. After harvesting of rice crop gram and pea was sown.

Experimental result showed the significant differences in grain yield as well as straw yield with different treatments (Table 5 and 6). Bund height 15 cm produced the significantly higher grain yield (15.95 q/ha) followed by 10 cm bund height which produced 15.05 q/ha over control. The mean yield increase was 42 and 34% with these over control. Similarly, paddy straw yield also was the highest with 10 cm bund height closely followed by 15 cm bund height. The mean increase in paddy straw was 32 and 30% with these treatments over control. The interaction 15 cm bund height with DR-92 cultivar produced the highest rice grain yield (24.58q/ha).

Different varieties differed significantly with regards to grain yield as well as straw yield production (Table 1 and 2). DR-92 (Subhadra) cultivar produced the highest rice grain yield (18.50 q/ha) over rest of the varieties. The mean yield increased with this 61 and 63% over IRAT-144 and 141, respectively. Similar trend was also noticed in regards to straw yield production. The interaction 15 and 10 cm bund height with DR-92 cultivar produced the highest straw yield (69.72 q/ha).

Table 5. Rice grain yield (q/ha) under different treatments

Treatments	V_1 IRAT0141	V_2 IRAT-144	V_3 DR-92	Mean yield
T_0 - Control	19.13	9.94	14.58	11.22
T_1 - 5 cm bund ht.	10.40	12.30	15.56	12.75
T_2 - 10 cm bund ht.	13.89	11.97	19.30	15.05
T_3 - 15 cm bund ht.	11.65	11.61	24.58	15.95
Mean yield	11.27	11.46	18.50	13.74
SEm to compare variety (V) mean ±			0.66 q/ha	
C.D. (0.05)			1.94 q/ha	
SEm to compare treatments (T) mean ±			0.75 q/ha	
C.D. (0.05)			2.20 q/ha	
SEm to compare interaction (V x T) ±			1.33 q/ha	
C.D. (0.05)			3.91 q/ha	

Table 6. Paddy straw yield (q/ha) under different treatments

Treatments	V1	V2	V3	Mean yield
T_0 - Control	29.17	30.83	56.39	38.80
T_1 - 5 cm bund ht.	35.78	35.89	67.50	46.39
T_2 - 10 cm bund ht.	43.06	40.28	69.72	51.02
T_3 - 15 cm bund ht.	43.89	37.92	69.72	50.51
Mean yield	37.97	36.23	65.83	46.68
SEm to compare variety (V) mean ±			3.05 q/ha	
C.D. (0.05)			8.94 q/ha	
SEm to compare treatments (T) mean ±			3.52 q/ha	
C.D. (0.05)			10.33 q/ha	
SEm to compare interaction (V x T) ±			6.11 q/ha	
C.D. (0.05)			N.S.	

Table 7. Biological yield of gram and green pod yield of pea

Treatments	Biological yield of gram (q/ha)	Green pod yield of pea (q/ha)
T_0 - Control	41.23	4.85
T_1 - 5 cm bund ht.	45.30	10.12
T_2 - 10 cm bund ht.	48.71	12.90
T_3 - 15 cm bund ht.	53.50	14.05
Mean yield	47.19	10.48
SEm to compare treatments ±	2.45	2.45
C.D. (0.05)	10.10	7.79

The biological yield of gram was highest with 15 cm bund height. Similarly green pod yield of pea was also highest with 15 cm bund height and they differed significantly over control (Table 7).

DISEASE

Sangit Kumar

Upland disease management and yield trial against rice blast

Two promising rice cultivers IRAT 144 (Maturity 125 days) and 1512 (Maturity 145 day) were evaluated to see their disease response and yield performance to different fertilizer levels (80 : 80 : 60 and 60 : 60 : 40 NPK) along with zero fertilizer level as check under protected and unprotected treatments sown on 20th May 95. Three sprays of Carbendazim (0.1%) at 40 DAS, 80 DAS, and at flowering were given in the protected treatments in all fertilizer levels.

No foliar blast damage was observed in all the treatments. No significant difference was observed in Neck blast incidence in different treatments. Highest / grain yield (2600 kg/ha) in IRAT 144 was recorded at NPK 80 : 80 : 40 fungicidal protection. Rice culture 1512 recorded the highest yield of (2850 kg/ha) with NPK dose of 60 : 60 : 40 under protected condition. The results indicate that the rice cultures IRAT 144 and 1512 were resistant to foliar blast and exhibit tolerance to neck blast infection.

Blast management trial in lowland

Sangit Kumar

Three promising lowland rice cultures viz. RCPL 1-87-8, RCPL 1-87-4 and RCPL 1-3 received from Plant Breeding were evaluated under two fertilizer levels of NPK i.e. 60 : 60 : 40 and 80 : 80 : 40 to see Blast incidence and yield performance. The trials were replicated and performance was evaluated under protected (2 sprays of 0.1% Carbendazim 40 DAT and 80 DAT) and non protected conditions. Twentyfive days seedlings were transplanted on 30th June'1995.

No foliar blast infection was observed in all the treatments including non-protected plots. Percent Neck blast incidence ranged from 11-32 and no significant difference was found in Neck blast incidnce in protected and non-protected plots.

Rice cultures RCPL 1-87-8 yielded best (8537 kg/ha) in protected conditions with a corresponding 15.97% neck blast incidence.

RCPL 1-87-4 yielded 7000 kg/ha with 17.43% neck blast incidence under protected condition at 60 : 60 : 40 NPK level.

RCPL 1-3 recorded the yield 8412.5 kg/ha with 20.57% neck blast in protected conditions with 60 : 60 : 40 NPK level.

The result indicates tolerance to neck blast infection in all test rice cultures.

Screening against Foliar blast

Sangit Kumar

Ten rice cultures received from Division of Plant Breeding were screened under uniform blast nursery against foliar blast.

Rice culture RCPL 1-4, Yamuk, were resistant.

RCPL 3-6, RCPL 3-2, RCPL 1-87-4 were tolerant to foliar blast while RCPL 1-3, RCPL 3-4 were moderately susceptible to Foliar blast.

RCPL 3-3 was found to be highly susceptable.

MAIZE

CROP IMPROVEMENT

H.S. Gupta and Vinay Mahajan

Research Complex Regional Trial (RCRT)

Four improved populations of maize viz., RCM 1-1 (Yellow kernel), RCM 1-2 (pop corn), RCM 1-3 (White kernel) and Vijay (Yellow) were tested against local yellow and local white for finding out the superior populations (Table 1). The highest yield (72.3 q/ha) was recorded from local white but RCM 1-1 (a semi flint yellow population) with an yield of 66.3 q/ha was stastistically at par with local white. RCM 1-2 although yielded low (32.4 q/ha) was, nevertheless, desirable because of its almost three times higher selling price than the local varieties. The trial will be repeated this year as local white was included in the trial only this year.

Co-ordinated trials

Three tirals were specially constituted for North East during All India Coordinated Maize Workshop in 1994 and were repeated this year too at Barapani. In addition, one full season maturity (IET No. 61) was also condcted, because full season trial is better-suited for North Eastern Hill region.

North East Special Trial 1

Nine entries comprising of VL 16, Yayung early, Kiran, Renuka, Gujarat Makka 1, Gujrat Makka 2, SW-DMR-91-145-1 (F2), SW-DMR 91-100-1 (F2) with RCM 1-1 of medium maturity as check were evaluated. The performance of five top entries are collated in Table 1. RCM 1-1 was found to be the best for dry kernel yield of (56.8 q/ha) followed by Gujarat Makka 1 (44.9 q/ha). RCM 1-1 outyielded all the entries in 2nd successive year.

North East Special Trial 2

The trial consisted of seven entries of full maturity groups viz. Pusa composit II, RCM 1-3, Prabha, Navjot, Ageti 76, Muneng 8531, Sete Legoas 8531. RCM 1-1 was included as check whereas a newly developed white Kernel RCM 1-3 was included as an entry for evaluation. RCM 1-3 gave the highest dry kernel yield (53.9) followed by RCM 1-1 (4 7.9 q/ha). Both the poulations have been developed by this Institute. Navjot ranked 3rd (42.1 q/ha) followed by Sete Lagoas 8531 (38.4 q/ha).

North East Special Trial 3

Eleven entries with full season maturity viz. Keshari, NE Composite, Suwan composite, Laxmi, Dhawal, NLD Composite, Palmira 8529, Suwan, Dholi (I) 8644, SWMR 91-300-1 (F_2) and SWMR 91-345-1 (F_2) alongwith RCM 1-1 were evaluated for finding out suitable population. RCM 1-1 outyielded all the entries significantly, followed by NE composite and Suwan. Performance of top five entries have been collated in Table 1.

Table 1. Performance of maize populations in different trials for dry kernel yield in (q/ha) at Barapani

Rank	RCRT	NESP 1	NESP 2	NESP 3
I	Megh. Local white	RCM 1-1	RCM 1-3	RCM 1-1
	(72.3)	(56.8)	(53.9)	(69.3)
II	RCM 1-1	Gujarat Mukka	RCM 1-1	NE Compsite
	(66.3)	(44.9)	(47.9)	(5)
III	RCM 1-3	WSDMR-91-145	Navjot	Suwan
	(64.2)	(42.1)	(42.1)	(49.4)
IV	Megh. Local yellow	Kiran	Sete-Lagoas 8531	Keshari
	(55.4)	(34.7)	(38.4)	(48.0)
V	Vijay	VL 16	Ageti	Dholi (1) 8544
	(53.0)	(31.0)	(35.2)	(37.4)
Chekc	Meghalaya Local yellow	RCM 1-1	RCM 1-1	RCM 1-1
	(55.4)	(56.8)	(47.9)	(69.3)
Mean	54.8	31.4	38.3	26.6
Entries	6	9	8	12
SE ±	3.3	3.6	4.87	3.0
CD	5.98	6.28	8.57	5.15

The trials viz. Research Complex Regional Trial and North East special for early and full season maturity indicate that full season trials are better for this region because early maturity population do not generally perfform well in Meghalaya. In addition, entries from North East region appear to have a different gene pool as compared to varieties from other hills because populations developed here outyielded entries from other hills.

Initial evaluation trial (Full season maturity Trial)

Thirty entries viz. m DMR-V-121 to DMRV-150 were evaluated for full season maturity. Dry kernel yield ranged from 48.6 q/ha (DMR-V-124) to 108.1 q/ha (DMR V-126). Performance of top ten entries are presented below :

Rank	Name	Yield (q/ha)
I	DMR-V-126	108.1
II	DMR-V-149	106.9
III	DMR-V-158	100.4
IV	DMR-V-129	97.3
V	DMR-V-129	91.6
VI	DMR-V-139	90.0
VII	DMR-V-151	88.3
VIII	DMR-V-146	88.1
IX	DMR=V-132	88.0
X	DMR-V-128	86.0
Mean	-	75.5
SE ±	-	2.3
CD5%	-	4.5

Seed multiplication

The seeds of newly developed populations viz., RCM 1-1 (80 kg), RCM 1-2 (70 kg) and RCM 1-3 (56 kg) was produced maintaining time and/or distance isolation.

Studies on early maize under two moisture regimes in plain and furrow sowing

S.K. Gupta

Field experiment was repeated the year under report to determine the performance of early maize under plain and furrow sowing. The crop was sown on 22-4-95 and matured cobs were harvested on 5-9-95. The experiment was laid out in randomised block design.

Experimental result (Table 2) showed that application of 100 kg N/ha produced significantly the highest maize grain yield followed by 150 kg N/ha application. The mean yield increase was 94.7, 21.8 and 18.1% higher over control, 50 and 150 kg N application, respectively. Furrow sowing also yielded significantly higher yield over plain sowing. A difference of 4.05 q/ha grain was observed between furrow and plain sowncrop. To interaction between nitrogen application and moisture regime in regards to grain yield was not significant. However, furrow sowing with 100 kg N application produced the higher yield (26.48 q/ha) over any other interactions.

INSECT PESTS MANAGEMENT

A.N. Shylesha

Seven maize varieties were screened for cob borer incidence and these vars were RCM-1-1, RCM RCM 1-2 (Pop Corn), 7793, 91319, 943087, local yellow and Vijay composite. Among them RCM 1-2 had least cob borer incidence of 5% compared to 22% in RCM 1-1, 37% in Vijay composite, 13% in 7793 and 28% in 91319 and 39% in 943087. No. of seed damaged within the cob and no. of larvae were very less in case of pop corn and Vijay Composite. RCM 1-1, 7793, and local yellow had 7-9 larvae per infested cob compared to 3-5 larvae in case of Vijay Composite and 91319. In pop corn RCM 1-2, very few no. of larvaeie cless than 2 was recorded. 943087 (white) was found most susceptible as 10-15 larvae were

Table 2. Maize grain yield (q/ha) under different treatments

Treatments	M_1	M_2	Mean yield (q/ha)
(kg/ha)			
N_0	10.51	14.22	12.37
N_{50}	17.90	21.63	19.77
N_{100}	21.70	26.48	24.09
N_{150}	18.83	12.79	20.40
Mean	17.13	21.18	19.16
SEm to compare M mean ±			0.75 q/ha
C.D. (0.05)			2.20 q/ha
SEm to compare N mean ±			1.06 q/ha
C.D. (0.05)			3.12 q/ha
SEM to compare M x N interaction ±			1.50 q/ha
C.D. (0.05)			4.40 q/ha

found per cob and the number of seed damaged per cob were also high (Average 4 rows seeds) and was prone to rotting under rainy conditions.

Experiments on different date of sowing were undertaken to know the pattern of incidence of cob borer with different dates of sowing. Local yellow, a fairly susceptible line was sown on 27th April, 12th May, 27th May and 12th June in plots of 5×5 mts. spaced at 75×30 cm in replicated RCBD trial. It was found that early sown crop completely escaped from cob borer attack. Crop sown during 12th May onwards suffered heavily and the late sown during (12th June) had the highest cob damage of 86.6%, 2%, 22% and 57% damage was found in the crop sown during 27th April, 12th May and 27the May respectively. It may be suggested that crop should be planted before last week of April to overcome cob borer damage.

An experiment was conducted to check the incidence of cob borer on maize by using the Sorghum as the trap crop. In an exploded RCBD design, RCM 1-1 was alternated with Sorghum. Three varieties of Sorghum seeds procured from Univ. of Agril. Sciences, Dharwar, were used in the trial in comparison to local pop Sorghum. The Sorghum varieties IS-2312, DJ 6514, and DSV-1 had compact earhead and plant height was 2 mt. compared to local Sorghum which grew upto 4 meters. Sorghum was sown on the same day as that of maize. The Sorghum earheads emergence coincided with cob formation. In case of the three Dharwar

varieties but the local Sorghum did not flower at this stage. Cob borer incidence was very high on all the three Sorghum lines except the pop sorghum and among them DSV-1 attracted maximum number of cob borers. Average larval population on DSV-1 was 34 per ear (range 22-79) and on IS 2312 it was 16-42 (Av. 21.66) and in case of DJ 6514 larval population was 25-54 (X = 28.45) and RCM 1-1 virtually escaped from borer damage with only 2% of the cob heing damaged RCM 1-2 (pop corn) eventhough a host for cob borer adjecent to sorghum used in the experiment did not suffer more than 1/ % cob damage.

The larvae were fully grown up during the first week of August. One spray with Dipel @ 1 lt./ha on Sorghum crop (trap crop) gave satisfactory kill of the larvae and no spray was found necessary on the main crop. Maize RCM 1-1, local sorghum started flowering during end of September and the earhead was of open type and was completely free from cob borer attack. It can be inferred that Sorghum @ three lines for every 10 lines maize can be used as a successful trap crop for maize cob borer management.

Stalk borer and other pests

The incidence of stalk borer was very less in all the varieties tested. Aphids, leaf hoppers, grass hoppers and other pests were below economic threshold level. Adults of Xylotrupes giddeon were found to feed on maize cobs but was of minor importance.

Artifical diet for *Stenachroia clongella*

In order to have a large population of adults and larvae of cob borer, an artifical diet consisting of soymeal (120 g), cornmeal (120 g) and brewers yeast (72 g) alongwith Glucose (60 g), ascorbic acid 4g, sorbic acid (4 g) in 460 ml of water was prepared. Later instar larvae developed very well on the diet but the first two instars could not thrive very well on the diet. The diet modifications will be attempted in the forth coming season.

PULSES

CROP IMPROVEMENT

B.K. Sarma

Pigeonpea

Twenty three genotypes were evaluated for yield and other characters. ICPL 90052 (early determinate) and ICPL 90039 (extra early non determinate) performed well (12.59 q/ha and 12.11 q/ha respectively). The yield level was low due to pod borer infestation. Five genotypes which performed best in previous years were multiplied.

Ricebean

Seventy lines were maintained and evaluated. The yield, in general was low.

Blackgram

Out of 7 lines deveroped at Sikkim centre, performance of only one line vig. RCU 6-1 was found better at Barapani condition with an yield of 7 q/ha. The crop was severely infected by rust.

INSECT PEST MANAGEMENT

N.S. Azad Thakur, A. N. Shylesha and A. R. Desai

Rice bean

Studies on insect pest complex of rice bean revealed that sixteen species of insects damaged the crop to various extent from seedling stage till harvest of the crop. Pulse bettle and almond moth *(Ephestia cantella)* were found as the major pests in storage. Cut worms, *(Agrostis ypsilon)*, field crickets, beanfly and bean aphids occurred during the seedling stage and were found to be minor pests. During the vegetative phase of the crop leaf hoppers *Empoasca* sp., leaf rollers and leaf folder occurred as the major pests. *Monolepta signata* and *Monolepta* sp. were fond to be the most severe pests on rice bean throughout the cropping period causing more than 40% damage to yield. At flowering, *Mylabris pustulata, M. phelarata* and other *Mylabris* sp. were found to feed voraceously on flowers causing 80-90% damage to flowers and pod set. *Apion clavipes* weevils were found on pods 4.-6 per inflorescence but they caused less damage. Pod bugs *Riptortus* sp. werer also found in large numbers during 1995-96 resulting in poor seed set and malformed pods.

Jack bean

The insect pest complex of the two minor vegetable pulse crops, jack bean and sword bean were studied. A total of 35 insect pests were found to occur on jack bean and sword bean; among them 18 species were found to be major pests and the rest of minor importance under

different crop growth stages (Table II). Besides there, *Monolepta sp., Epicauta hirtipes, Xylotrupes giddeon* and *Parasa Lepida* were found as the major pests on these crops.

French bean

Forty four varieties were screened against incidence and damage stemfly among them pole types were found tolerant to stemfly damage compared to bush types. Kentucky Wonder and Contender had least damage compared to other varieties.

Blister beetles damage started in the month of April, when the plants started flowering. 75% of the bud and flowers were eaten by the beetles. Three species of beetles were recorded, *Mylabris pustulata Mylabris phelarata and Mylabris* sp. Among them, *M. pustulata*, the large sized beetles were more common on pole type varieties and *M. phelarata* on bush type varieties. In pole types, severe damage to tender pods, leaves and also twigs were noticed but the bush types sufferred only flower and flower bud damage. During the months of May to September the severity was observed. An Entomopathogen, *Beauveria basliana* was found to kill the beetles. 60-70% of the beetles were found infested by the disease at the end of August. The population was reduced in the month of September. An experiment was conducted by using the *B. besiana* spores spray during flowering period and found that 82.55% of the beetles got infection after 10 days of spraying in comparison to Sevin dust which resulted 46% kill only. The fungus can be effectively used for the control of the pest.

Pea

Nineteen pea varieties were planted for screening against stemfly. The incidence of stemfly was very less during the season. *Lampides boeticus, Catechrysops cnejus* were found as the major pod borers. However, the incidence was below economic threshold level in variety Rachana.

Incidence of pea aphid was quite high on Manipuri varieties and entomogenous fungal outbreak *(Erinium neoaphidis)* was found to excercise a natural check on the aphids, killing 80% of the field population. The surviving populations could not cause any economical damage on the crop.

OILSEEDS

CROP IMPROVEMENT

B.K. Sarma

SOYBEAN

Advanced varietal trial (AVT)

Twenty varieties were evaluated. JS 80-21; yielded the highest (44.50 q/ha) followed byMACS 58 (28.25 q/ha) PK 416 (22.50 q/ha) and JS 335 (21.25 q/ha). The average yield of the varieties was 15.64 q/ha (Table 1).

Initial varietal trial (IVT) :

In this trial 44 genotypres were evaluated. NEC 25 recorded the highest yield (48.25 q/ha) followed by TAS 9203 (38.75 q/ha), JS 80-21 (38.25 q/ha), JS (SH) 89-99 (35.00 q/ha) and MACS 428 (30.75 q.ha). The trial mean was 17.11 (Table 1.).

DISEASE

S. Chandra, and Sangit Kumar

The leaf spots caused by *Aristastoma camarographioides* is an endemic disease confined to high altitude (1500 m a.m.s.l.) area of Upper Shillong in Meghalaya. The disease causes considerable damage to soybean plants by reducing available photosynthetic leaf area. Presently the disease is of local importance, therefore, genotypes resistant to this disease were identified and effect to plant age on disease intensity was studied.

Resistance screening

Sixty-two genotypes were sown in the lasat week of May at Upper Shillong with two replication. Disease was recorded on 30th Sept using 1-9 scale (1 = no infection, 9 = more that 50% leaf area affected). Most of the genotypes showed less or equal score in comparision to susceptible check (Ankur) except DS 93-104-B which scored slightly higher score (5.5) in comparision to check. Some genotype showed erractic response to disease in different replication (Table 2).

Effect of plant age

Soybean cultivar 'Ankur' was planted at 15 days interval starting from 3rd May to 18th August to study the effect of plant age on disease intensity. The trial was conducted in a randomised block design with four replications. Disease was re` calculated. The plant age varied from 65 to 170 days. Results (Table 3) indicated that plants of all the ages were susceptible to disease. Percent disease index (PDI) was more (48-50%) in 170, 155 and 140 days old plant in comparision to PDI

Table 1. Performance of top 5 soybean genotypes in AVT and IVT

Variety	AVT yield (q/ha)	Variety	IVT yield (q/ha)
JS 80-21	44.50	NRC 25	48.25
MACS 58	28.25	TAS 9203	38.75
PK 416	22.50	JS 80-21	38.25
JS 335	21.25	JS (SH) 89-99	35.00
JS 75-96	17.50	MACS 428	30.75
Punjab 1 (Ch.)	11.25	Bragg	20.00
Entries	19	Entries	42
Trial mean	15.9		17.11
CD 5%	7.44		12.41

values (10-32%) of 125, 110, 95, 80 and 65 days old plant. However, the yield was drastically reduced in late (21st June onward) sown crop. There was no significant (P= 05) difference in yield and PDI values among 3rd May, 16th May and 5th June sown crop.

GROUNDNUT

Yield evaluation

B.K. Sarma

Germplasm evaluation

Six hundred germplasm collected so far were evaluated. The frequency of pod yield of different germplasm is shown in Fig. 1. The pod yield ranged from 143-3800 kg/ha. Five hundred fifty lines were screened for early leaf spot disease (0-9 scale) of which 22 lines had score 3, 58 lines had 4, 231 lines had 5, 158 lines had 6, 55 lines had 7, 23 lines had 8 and 4 lines had 9.

Yield evaluation : Twenty four varieties were tested under RCRT. JL 24, ICGS 76, ICGS 1, ICGV 86191 and ICGV 86188 performed well.

Seven varieties of TG series were also assessed for the second year. TG 27 yielded the highest than other varieties followed by TKG 19A (Table 4).

Screening for acid soils (aluminium toxicity)

One hundred genotypes were screened for Al toxicity with and without line application. The performance of genotypes viz., ICGV 1697, ICGS 5305, ICGV 86644, ICGV 3098, ICG 4747, JL 24, ICGS 76, TAG 24, TG 22 under no lime condition whereas ICG 221, ICG 1697 ICGS 5305,

Table 2. Reaction of soybean cultivars to leaf spot *(Aristastoma camrographiodes)* Upper Shillong, Rainy season 1995

Entry	Disease Score (1-9)	Entry	Disease score (1-9)
MACS 58	3.5	Himso 1563	3.5
MACS 24	3.5	PK 1134	3.0
NRC 2	4.5	TAS 0203	4.0
Punjab 1	3.0	VLS 43	4.0
PK 262	4.0	Himso 1565	3.0
Pusa 20	4.0	NRC 23	3.0
JS 74-46	4.0	MAUS 49	3.0
PK 471	5.0	JS (SH) 89-49	3.0
PK 564	4.0	TAS 41	4.0
PK 416	4.0	NRC 22	3.0
Monesa	4.5	JS (SH) 89-49	3.0
Durga	4.5	Bragg	3.0
NRC 1	4.5	MACS 428	4.0
MACS 13	4.5	NRC 24	4.0
PK 472	5.0	PK 1133	4.0
JS 335	3.0	MACS 438	3.0
Pusa 16	5.0	MACS 431	3.0
PK 327	5.0	DS 93-79-A	3.0
JS 80-21	3.0	JS (SH) 89-58	4.0
MAUS 38	3.0	NRC 26	4.5
PK 1135	3.0	DS 93-108-B	4.0
UGM 52	3.0	NRC 25	3.0
MAUS 45	4.5	PK 1112	4.5
JS (SH) 89-48	3.5	MACS 441	4.0
PK 1137	3.5	DS 93-104-B	5.5
NRC 19	3.0	MACS 414	4.0
NRC 18	3.0	Birsa Soya	4.5
PK 1125	3.0	Punjab-1	5.0
MAUS 53-2	3.5	JS 80-21	4.5
VLS-45	3.5	(Check)	
JS (SH) 89-2	4.0	Trial Mean 3.8	
KB 117	3.0	SEm ± 1.0	
		CV (%) 36	

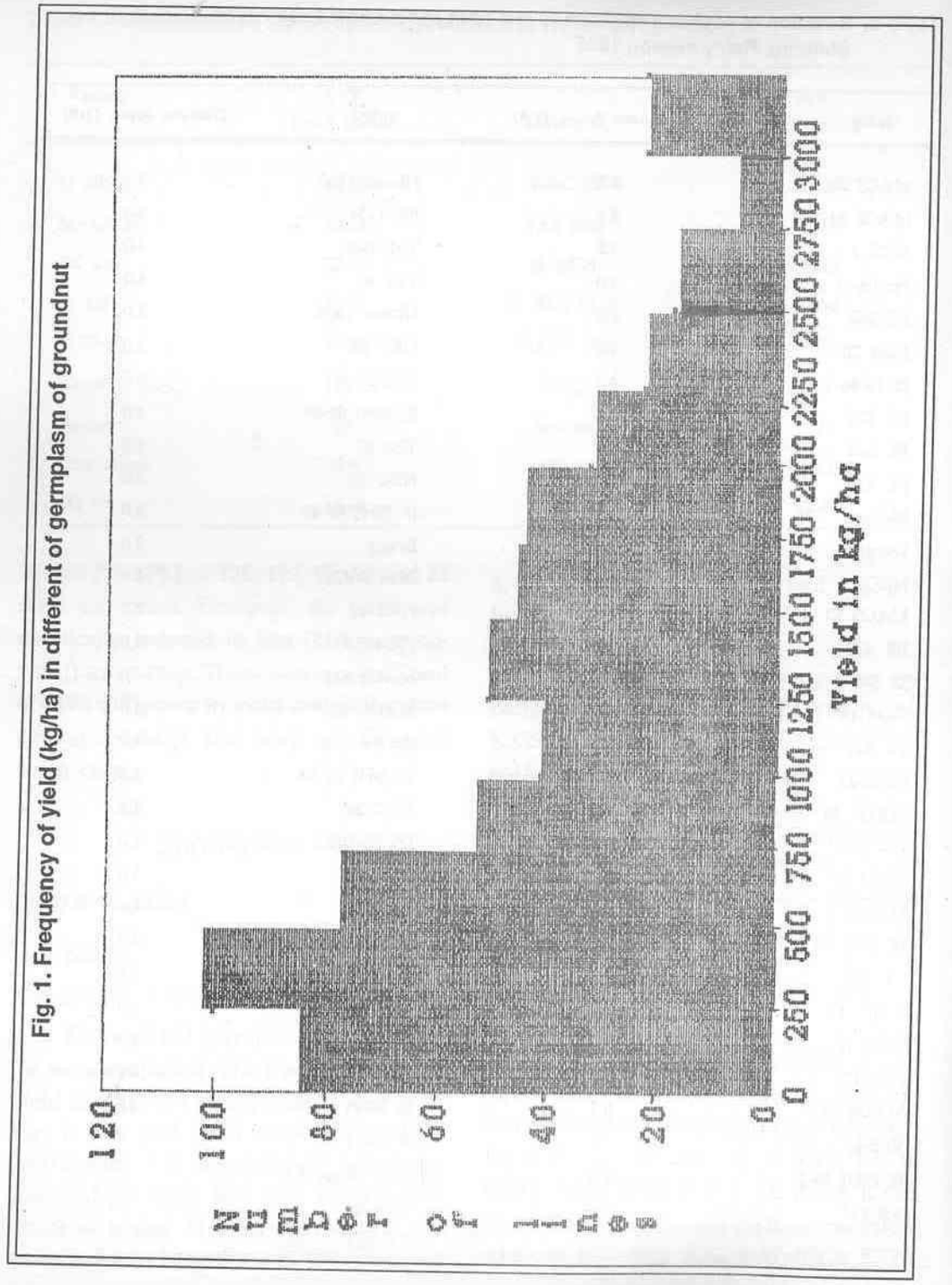

Fig. 1. Frequency of yield (kg/ha) in different of germplasm of groundnut

Table 3. Effect of plant age on leaf spot (*Aristastoma camarographioides*) intensity in soybean cv. Ankur. Upper Shillong, rainy season 1995

Plant age (Days)	Percentage disease index	Grain yield (kg/ha)
170	58.35 (50.10)	876
155	50.90 (49.47)	1100
140	48.33 (43.87)	1038
125	32.18 (34.31)	700
110	24.00 (29.01)	376
95	24.85 (29.87)	188
80	17.18 (24.42)	48
65	10.53 (18.79)	Nil
CD .05	11.28	326
CV (%)	21.92	35

Table 4. High yielding groundnut varieties in different trials (pod yield in kg/ha)

Rank	RCRT	ST
I	JI 24 (ch) (1688)	TG 27 (1767)
II	ICGS 76 (1644)	TICG 194 (1472)
III	ICGV 86191 (1378)	JL 24 (ch) (1439)
IV	ICGS 1 (1356)	TG 3 (938)
V	ICGV of 188 (1272)	TG 17 (894)
Trial Mean	1027	1152
Varieties	24	7
CD 5%.	284	532

ICG 3096, ICGV 89115, ICGS 76, ICG 799 under lime applied condition (Table 5) was found best.

Screening of another set of 62 advanced breeding varieties for aluminium toxicity indicated that ICGV 88347 (medium direction), ICGV 92224 (short duration), ICGV 86742 and ICGV 86745 (drought resistant) and ICGV 86518 and ICGV 86252 (insect pest resistant lines were tolerant to Al toxicity (Table 6).

Influence of 'Biozyme' and NPK on the growth and pod yield of groundnut

U.K. Hazarika and G.C. Munda

An experiment was initiated to assess the role of biozyme (kinetin enriched enzyme) and NPK on the growth and pod yield of two groundnut cultivars. A com-

Table 5. Screening groundnut genotypes for Al toxicity performance of tolerant types

Genotype	Pod yield (kg/ha)		% depression in yield due to Al toxicity	Tolerant index
	No lime	lime		
ICG 1697	2400	1900	—21.13	305.69
ICG 221	1075	1900	76.74	61.39
ICG 3704	1175	1067	—9.19	130.13
ICGS 5305	1359	2000	47.17	92.48
ICGV 86644	1317	859	—34.78	02.60
ICGV 86707 (B)	1200	717	—40.25	200.00
ICG 3086	1242	992	—20.13	155.31
ICG 3096	1242	1700	36.88	90.45
ICG 3098	1384	1092	—21.10	174.72
ICG 4226	1175	459	—60.94	302.70
ICGS 44	1067	917	—14.06	124.45
ICGS 4747	1475	600	—59.32	365.07
TAG 24	1325	1184	—10.64	149.91
TG 3	1159	400	—65.49	336.40
JL 24 (ch)	1475	1159	—21.42	188.83
ICG 4446	1009	568	—43.71	178.96
ICGS 76	1267	1675	32.20	96.01
ICGV 90116	1184	425	—59.88	290.08
Entries	100			
Trial Mean	802			
CD 5%	265			

mon dose of NPK @ 20:60:40 kg/ha was applied to all the treatments except control. The treatments comprised of T-1 (Biozyme gr.0. 9 kg/ha). T-2 (Biozyme gr. 18 kg/ha , T-3 (Biozyme (L) 300 ml/ha), T-4 (Biozyme (L) 600 ml/ha, T-5) No biozyme + NPK 20:60:40 kg/ha), and T-6 (control). All the 6 treatments were taken with 2 groundnut cv Girnar-1 and ICGS-76.

The results indicated that both the cultivars performed well at 600 ml of biozyme/ha with 20.1 q/ha due to Girnar-1 while ICGS-76 has also exhibited an encouraging pod yield of 24.6 q/ha at 18 kg of biozyme granule application. Both the cultivars yielded almost at par due to fertilization with only NPK without biozyme. (Table 7). The control produced the lowest yield by both the varieties.

Table 6. Performance of advanced breeding lines screening for Al toxicity (pod yield in kg/ha)

Lines	Pod yield	Features
ICGV 88347	2167	Medium duration
ICGV 88336	1500	
ICGV 92224	1733	Short duration
ICGV 92229	1556	
ICGV 87206	1256	Folier disease resistant
ICGV 87334	1244	
ICGV 86742	2144	Drought resistent
ICGV 86745	1667	
ICGV 89215	1444	confectionery
ICGV 89281	1289	
ICGV 86518	2000	Insect pest resistant
ICGV 86252	1578	
Entries	62	
Trial Mean	1548	
CD 5%.	NS	

Table 7. Effect of biozyme and NPK on the pod yield of groundnut cultivars

Treatments	Pod yield (q/ha)	
	Girnar-1	ICGS-76
T-1= Biozyme (gr) 9 kg/ha	19.2	23.4
T-2= Biozyme (gr) 18 kg/ha	19.6	24.6
T-3= Biozyme (L) 300 ml/ha	19.0	21.4
T-4= Biozyme (L) 600 ml/ha	20.1	25.2
T-5= No biozyme + NPK- @ 20:60:40 kg/ha	18.0	19.8
T-6= Control	14.2	17.7

Evaluation of effective phosphorus solublizing microbes

G.C. Munda, U.K. Hazarika and B.K. Sarma

A field trial was conducted to evaluate the effective phosphorus solublizing mocrobes. Twelve treatments comprising six rhizobium culture and two phosphorus sources were tested.

The highest pod yield (19.3 kg/ha) was registered at 50 kg P supplimented as SSP with *Bacillus polymyxa* microbes. Application of similar level of P applied as RP with the same *Bacillus polymyxa*

also exhibited encouraging pod (17.2 q/ha) yield. The lowest being 12.4 q/ha was recorded with control without any microbial application.

Evaluation of suitable rhizobium strain

G.C. Munda, U.K. Hazarika and B.K. Sarma

A trial was carried out during rainy season to assess the effective strain of rhizobium culture. Groundnut cv. JL-24 was taken as a test crop. The pod yield was increased with the application of rhizobium culture. The highest (21.7 q/ha) being recorded at NC-92 culture followed by 20.6 q/ha due to IGR-6. While untreated control exhibited the lowest (14.0 q/ha) pod yield. (Table 8).

Table 8. Effect of rhizobium culture on the pod yoeid of groundnut

Treatments	pods/ plant	DM yield (g)/5 plants	Yield q/ha
Control	2.65	30.00	14.0
NC-92	5.22	41.25	21.7
IGR-6	3.00	32.50	20.6
IGR-40	4.40	35.00	15.1
Tal-1000	4.55	36.25	17.3

Effect of organic and inorganic sources of nutrients on the growth and yield

G.C. Munda,Raj Singh, U.K. Hazarika and Jagroop Awalkar

An experiment was carried out with 11 treatments with different organic and inorganic sources manures and fertilizers to assess the suitable and affordable economic levels of nutrients for the groundnut crop. The results indicated that phosphorus @ 60 kg/ha supplimented through SSP has produced 26.3 q of pod yield/ha and was closely followed by 23.4 q of pod yield/ha due to same level of P applied through R.P. FYM, enriched FYM composted Azolla etc were the other selected treatments exhibited encouraging pod yield ranging from 18-20 q/ha and were at par with each other.

Groundnut pathology

S Chandra and B.K. Sarma

The early leaf spot (ELS) caused by *Cercospora arachidicola* Hori was predominant foliar disease observed in the rainy season at Barapani farm in Meghalaya. Groundnut genotypes obtained from ICRISAT, Patancheru Hyderabad and some selected genotypes from Plant breeding division of ICAR Research Complex, Barapani, Meghalaya were screened for ELS resistance under natural epiphytotic condition. Test entries were sown with two replications in the last week of May and harvested in the last week of September. Entries were scored on a 1-9 scale (1=no disease, 9=more that 50% leaf area affected) at 10 days before maturity.

A. Research Complex regional trial (RCRT) : Twenty three entries including susceptible check (JL 24) were tested for ELS resistance. Disease score ranged from 3.5 to 7.0 in test genotypes while check showed 7.5. Most of the entries were moderately susceptible. Dh-8 and ICGV 86259, were resistant and scored (3.5) and 4.5 respectively.

B. Insect Pest resistant advanced breeding varieties : Out of 12 varieties, only ICGV 86393. ICGV 86388, ICGV 86252 and 86031 were disease resistant. Rest of the varieties showed intermediate (Score 5) disease response. ICGV 86398 and ICGV 86436 were susceptible. Data are presented in Table 9.

C. Confectionary advanced breeding varieties : All the ten entries tested, exhibited good level of resistance against ELS. Disease score ranged 3.0-5.0 (Table 10) in the test entries while susceptible check JL 24 showed 8.0.

Table 9. Reaction of insect pest resistant lines to early leaf spot (*Cercospora arachidicola*) Barapani, Meghalaya, Rainy season 1995

Entry	Disease score (1-9)
ICGV 86011	5.0
ICGV 86031	4.0
ICGV 86252	4.5
ICGV 86388	4.0
ICGV 86397	3.5
ICGV 86398	7.0
ICGV 86436	6.5
ICGV 86518	5.5
ICGV 87415	5.5
ICGV 89259	5.0
ICGV 89280	5.5
ICGV 89281	5.0
JL 24 (Check)	8.0
Trial Mean	5.3
SE ±	0.4
CV (%)	11

Table 10. Reaction of confectionery advanced breeding varieties to early leaf spot (*Cercospora arachidicola*). Barapani, Meghalaya, Rainy season 1995

Entry	Disease score (1-9)
ICGV 88362	5.0
ICGV 88376	3.0
ICGV 88401	3.0
ICGV 88429	3.5
UCGV 88448	4.5
ICGV 88475	3.0
ICGV 88480	3.0
ICGV 89214	3.0
ICGV 89215	3.0
ICGV 89235	4.0
JL 24 (Check)	8.0
Trial Mean	3.0
SE ±	0.2
CV (%)	7.3

INSECT PESTS

A.N. Shylesha and B.K. Sarma

Groundnut : Groundnut varieties ICGV -44, JL-24, ICGV-88366, 88390 were screened for incidence of pests. Leaf folder population was quite high in JL-24, 9 leaf folds/plant with an average larval population of '7' compared to ICGV-44 and 88366 varieties which had less than 2 folds per plant. The incidence of leaf folder on 88390 was very less. Aphids and Jassid population was below economic threshold level.

In another trial, 24 varieties of groundnut were screened for leaf folder attack. Among them ICGV-86259, AIS-9211, ICGS-65, ICGS-1, AIIS-9208 were found to be free from leaf folders compared to 10-12 folds/plant in case of JL-24, 6-8 folds/plant in case of AIS 9104 and IES-9108 and INS-9112 had 46 leaf folds/plant.

Blister beetle, *Mylabris pustulata*, damage was more during the flowering season and a mean number of 6 flowers were found eaten by a single beetles. Beetles were killed in later stages by a natural epizootic of fungal disease caused by *Beauveria bessiana*.

RAPSEED-MUSTARD

Selection pressure in M 27 and Varuna

P.Kumar and B.K. Sarma

One hundred single plants of Varuna and 777 plants of M27 were selected for various characters viz., number of pods, number of branches, pod length, number of seeds/pod and yield per plant. Performance of some of the selections were shown in Table 11 and 12.

Table 11. Performance of selections of Varuna

Selections	Height of main shoots	Primary branch	Pods in main shoot (cm)	Pod seeds length (cm)	Seeds/ pod	Yield/ plant (g)
95-6	96	6	43	4	25	12.1
95-15	56	3	31	4	20	15.8
95-22	88	3	48	4	22	10.2
95-26	76	4	34	3	19	11.6
95-35	86	4	45	4	21	13.0
95-37	74	4	58	4	20	11.5
95-38	85	4	20	4	21	12.9
95-53	60	4	27	3	18	10.2
95-58	81	5	63	4	19	16.0
95-59	87	6	25	5	20	16.2
95-63	94	4	56	3	21	10.7
95-64	76	4	43	5	22	11.6
95-68	76	7	29	5	20	10.4
95-72	62	7	33	4	19	10.1
95-85	61	4	35	5	24	13.0
95-88	94	3	54	3	18	12.3
95-90	76	3	42	4	21	10.8
95-91	79	4	53	4	20	10.2
95-93	77	5	59	4	22	10.8

Table 12. Performance of some selections of M27

Selections	Plant weight (cm)	Primary branch	Pods in main shoot	Pod length (cm)	Seeds/pod	Yield/ plant (g)
95-11	70	3	33	5	17	12.7
95-14	79	5	18	4	18	10.2
95-41	71	6	31	4	16	10.4
95-47	79	6	44	4	13	12.9
95-62	76	5	36	4	21	15.0
95-70	95	5	42	5	20	12.0
95-71	93	3	59	4	19	11.6
95-76	71	6	38	3	21	10.9
95-92	74	6	52	3	20	13.3
95-94	92	4	55	5	22	10.4
95-100	84	4	41	5	17	12.1
95-101	99	4	47	4	23	14.1
95-102	97	4	42	5	22	10.7
95-128	78	5	35	6	23	10.3
95-129	84	4	44	4	18	10.3
95-130	79	5	37	5	26	14.7
95-131	88	5	32	4	27	13.5
95-135	85	5	36	3	16	13.7
95-'180	90	4	35	6	24	12.6
95-186	100	4	33	6	21	13.5
95-194	95	3	44	4	23	14.9
95-195	72	3	48	4	23	12.5
95-231	79	6	27	5	17	10.4
95-237	73	5	58	5	17	12.0
95-238	87	4	59	6	21	10.7
95-239	98	6	36	5	24	15.4
95-240	100	5	34	4	25	11.6
95-30	100	5	27	4	16	11.5

Response of biozyme and NPK on mustard cultivars

U.K. Hazarika, G.C. Munda and Jagroop Awalkar

An experiment was conducted with two mustard cultivars (M-27 and TM-4) with six levels of biozyme and NPK fertilizations. Among the various fertilizer levels liquid form of biofertilizer @ 600 ml/ha with 20:60:40 kg of NPK/ha produced maximum seed (7.44 q/ha) yield followed by 6.93 q/ha of seed yield at 18 kg biozyme granules + 20:60:40 kg/ha with out biozyme resulted 6.2 q of seed/ yield/ha. Between the two mustard cultivars M-27 produced 6.6 q/ha while TM-4 exhibited 5.89 q/ha.

Studies on utilization of stored water for live saving irrigation in mustard

S.K. Gupta

The field experiment was repeated during the year under report to see the performance of promising mustard cultivar M-27 under rained and irrigation condition with different row spacings. The experiment was sown on 20-10-95 as per treat spacings. The crop was harvested on 16-2-96. One irrigation was given on 7-12-95. The experiment was conducted in randomised block design with 10 treatments having three replications.

The results showed (Table 6) that the seed yield of mustard differed significantly with irrigation as well as with different row spacings (Table 6). Irrigated crop yielded the highest seed yield (5.28 q/ha) over rainfed crop which produced 4.22 q of seed yield per hectare. Further, it has been observed that paired row spacing $\frac{(50+10)}{2}$ cm produced significantly the highest grain yield (7.63 q/ha) closely follwoed by 30 cm and 20 row spacing which produced 4.52 and 4.30 q/ha grain yield. Paired row spacing increased the grain yield 118% over broadcast crop. Similarly, 30 cm row spacing also increased the grain yield 29% over the broadcast crop. The interaction between irrigation and different row spacing was also found to be significant. Paired row with irrigated crop produced the highest grain yield (9.59 q/ha). The lowest yield was observed with rainfed broadcast crop.

Table 6. Mustard grain yield (q/ha) as affected by different treatments

Treatments	I_0	I_1	mean yield
S_1 - 20 cm row spacing	3.96	4.63	4.30
S_2 - 30 cm row spacing	4.33	4.70	4.52
S_3 - 40 cm row spacing	3.56	4.07	3.82
S_4 - $\frac{(50+10)}{2}$ cm paired row	5.67	9.59	7.63
S_5 - Broadcast	3.59	3.41	3.50
Mean	4.22	5.28	4.75

SEm ro compare irrigation mean ±	0.38 q/ha
C.D. (0.05)	0.80 q/ha
SEm to compare row spacing mean ±	0.61 q/ha
C.D. (0.05)	1.81 q/ha
SEm to compare interaction (I x S) ±	0.85 q/ha
C.D. (0.05)	1.78 q/ha

CROPPING SYSTEM

Performance of different cropping system under mid altitude terraced land

G.C. Munda and U.K. Hazarika

A field study was carried out to study the economic level of productivity of various cropping systems under the mid hill terrace land of Meghalaya. Sixteen treatments of various cropping systems comprising maize, groundnut, soybean, rice and french bean were taken and evaluated their suitable cropping pattern and cropping intensities. Pop corn with groundnut at 1 : 2 line ratio yielded maximum maize equivalent yield (139.6 q/ha) closely followed by popcorn: soybean at 1:2 line ratio with 109.3 q/ha of maize equivalent yield. Among the sole crops, maize registered 30.6 q/ha while groundnut yielded 24.5 q/ha (maize equivalent yield = 68.69 q/ha), followed by soybean (24 q/ha and maize equivalent yield =33.6 q/ha) and rice with 23.5 q/ha (28.2 q/ha of maize equivalent yield). Frenchbean did not come up as it was affected by pest and diseases (Table 1).

Studies on paint population on productivity under maize based cropping system

U.K. Hazarika and G.C. Munda

A field experiment was carried out to evaluate the total production due to various plant densities adopted through various row ratios in maize based cropping system in mid hill terraces of Barapani, Meghalaya. Seven treatments comprising of various crops viz : maize, soybean and groundnut at different row ratios and intensities were adopted to evaluate the economic and suitable combination and densities of crop under maize based intercropping system.

The results indicated that among the plant intensities with maize + soybean intercropping (1:2) produced maximum maize equivalent yield (48.6 q/ha) which was followed by maize+soybean intercropping at the ratio of 1:2 with 47.7 q/ha. Maize groundnut (1:1) and Maize-groundnut paired rows as well as maize soybean paired rows, however, produced 47.14, 34.7 and 31.15 q/ha respectively, while maize (sole) registered 37 q/ha of grain yield (Table 2).

Table 1. Growth and yield components of various cropping systems and maize equivalent yield (q/ha).

Cropping systems	Pl. height (cm)	Yield q/ha	Maize equivalent yield (q/ha)	Total yield (q/ha)
Maize (sole)	183	30.6	30.6	30.6
Popcorn (sole)	192.2	23.0	73.6	73.6
Rice (sole) IRAT-141	50.2	23.5	28.2	28.2
Groundnut (sole)	54.8	24.5	68.6	68.6
Soybean (sole)	89.1	24.0	33.6	33.6
French bean (sole)	—	—	—	—
Maize+grounnut (1:2)	192.5	31.7	31.7	
	47.9	17.1	47.8	84.9
Maize+soybean (1:2)	190.2	36.0	36.0	
	60.4	4.0	5.6	41.6
Maize+French bean (1:2)	189.4	31.7	31.7	
Rice+groundnut (3:2)	64.5	107.5	3.1	27.7
	545	8.9	12.4	40.12
Rice+soybean (3:2)	56.8	18.6	22.3	
	62.1	5.8	8.12	30.40
Rice+Frenchbean (3:2)	55.4	20.2	24.2	
	—	—	—	24.2
Popcorn+groundnut (1:2)	188.8	29.3	93.7	
	46.0	16.4	45.9	139.6
Popcorn+soybean (1:2)	184.0	32.6	104.0	
	57.1	3.8	5.3	109.3
Popcorn+frenchbean (1:2)	179.0	26.3	84.1	
	—	nil	nil	84.1
Farmers practice	178.6	29.0	34.0	
chillies, brinjal etc.	—	3.5	11.20	49.20

Frenchbean failed.

Crops	Rate/Rs/q	Multiplying factor for maize equivalent yield
Maize :	Rs. 250	–
Rice :	Rs. 300	1.2
Groundnut :	Rs. 700	2.8
Popcorn :	Rs. 800	3.2
Soybean :	Rs. 350	1.6
Chillies, brinjals and other vegetables	Rs. 800	3.2

Table 2. Grain yield of maize and other component crops and maize equivalent yield under different row ratio + intercropping system

Cropping pattern	Planting pattern (cm)	Yield of individual crop (q/ha)	Maize equivalent yield (q/ha)
Maize (sole)	60 × 25	37.0	37.0 : 37.0
Maize+groundnut (1:1)	60 × 25	31.0	31.0 : 47.0
	30 × 10	5.7	16.0 :
Maize + groundnut (1:2)	60 × 30	28.5	28.5 : 48.6
	30 × 10	7.19	20.1 :
Maize+soybean (1:1)	60 × 30	32.5	32.5 : 40.1
	30 × 10	5.45	7.63 :
Maize+soybean (1:2)	60 × 30	34.5	34.5 : 47.7
	30 × 10	7.37	13.2 :
Maize+groundnut (paired rows)	45 × 25	32.0	32.0 :
	25 × 25	1.98	5.5 : 45.9
Maize+soybean (paired rows)	45 × 25	25.2	25.2 :
	25 × 45	4.25	5.95 : 31.1

BIOFERTILIZER

Multiplication and preservation of *Azolla caroliniana* during moisture strees period of winter months

U.K. Hazarika and G.C. Munda

Growth of azolla was tremendously slowed down during the winter months (December-February) due to extreme low water temperature and moisture stress situation. Therefore, suitable and affordable methods for preservation and multiplication of azolla during winter season was evaluated with six treatments, viz. Azolla in open canal (T-1) the side of the low land paddy field, in bare pond (T-2), in fallow paddy field (T-3). In azolla pond covered with weeds and grasses (T-4). In azolla pond covered with polythene sheet (T-5), and deep azolla pond maintained 20 cm of water level (T-6). The results indicated tremendous growth of azolla in deep pond with 20 cm of water level and yielded above 30 kg of green azolla/pond of the size 18 sqm during January to February. The azolla also multiplied faster under covered conditions. It was also noticed that the fern was surviving in bare pond and open canals. In bare pond azolla were seen in patches at random at different corners where moisture was noticed. The study confirmed the observations of the last year.

Yield of green azolla under different management practices

U.K. Hazarika, G.C. Munda and Jagroop Awalkar

Strains of *azolla caroliniana* was released in 50 azolla ponds with 5 management practices for the 3rd year for confirmation of earlier studies. It was confirmed that *Azolla caroliniana* can be raised under Barapani climatic condition during April to November in natural situation with normal management practices. It grew well under FYM (dry cowdung) @ 5 kg/pond of the size 6 sqm with 1 kg SSP/pond/harvest and registered 24.5 kg/pond/month with an annual turnover to 367 q/ha which was equivalent to 1468 kg of Nitrogen.

FRUIT

CITRUS

Survey, collection and evaluation

Sheo Govind

Certain interesting types of fruits belonging to Pummelo (*Citrus grandis),* sweet orange *(Citrus sinensis*), sweet group of rough lemon (*Citrus jambhiri*), Kagzi lime (*Citrus aurantifolia)* and Sharbati lime (*Citrus limetta*) having high juice content and least acidic were collected druing survey of certain areas of Mizoram and Tripura and evaluated. An interesting type of fruit akin to pummelo collected from Sabuai village of Jampui hills (Tripura) had very wide hollow axis, juciy and less acidic and juice taste similar to grapefruit. It may possibly be either the hybrid between pummelo and grape fruit or aberrant form of pummelo.

Residual effect of fertilizer on yield

The average number of fruits could be harvested maximum(293.7 fruits) from the plant received N and K 600 g each along with 300 g supplied previous year which was significantly more than all other treatments excepting N 600 P 500 K 400 and N 800 P 300 K 600 treatments. The minimum yield was however recorded from the plant received no fertilizer. Significant effect of different doses of fertilizer could be observed only on length and perimeter of leaf.

Intercropping in mandarin orchard

Sheo Govind and I.P. Singh

Out of seven intercrops, the maximum yield of rhizome could be obtained by ginger (7.2 kg/5m² plot) followed by Colocasia (7.0 kg/5m² plot) and turmeric (5.71 kg/5m² plot). The French bean and green chilly gave an yield of 3.1 and 1.6 kg/plot respectively. Although the yield of rhizomatous and tuber crops like ginger, turmeric and colocasia was found to be more than french bean and chilli, yet these crops may not be taken for a longer duration in the orchard as they may be detrimental to the main crop.

Studies on the flush emergence, flowering and flower characters in certain citrus varieties and species

Sheo Govind and I.P. Singh

In general, new flush was found to be started from mid February and lasted upto almost mid April and the majority of citrus species/varieties/hybrids put forth new flush in the month of March. The earliest emergence of new flush (15th Feb) was noted in Dulcis malta (*Citrus sinensis*) and latest (10th April) in Troyer citrange. However, new flush was recorded very late in case of Jamuna mukh tenga (*C. limon*). The time of flowering was found to be almost corresponding with the time of new flush in all the citrus varieties and hybrids. Cent per cent bisexual flowers was recorded in the species, viz. *C. reticulata, C. sinensis C. taiwanica, C. latipes* and citrangequat hybrid. The least percentage of bisexual flowers was noted in Troyer citrange (8%) followed by *C.assamensis* (13.5%), *C. karna* (28%), *C. limettioides* and *C. volkameriana* (35% each). The bisexual flower in remaining citrus was found to be in a range of 62 to 98.2 percent.

Studies on the shoot growth of certain species/types of citrus

Sheo Govind and I.P. Singh

Observations on the growth of March-April shoots of 26 different cultivars/types belonging to different species and hybrids were recorded when their growth ceased completely.

Shoot growth in respect of length (19.43 cm), diameter, leaf length (12.04 cm) and total dry matter content (2.970 g) shoot was recorded significantly higher in white fleshed pummelo (*C. grandis*) than all other species/types of citrus including hybrids. Leaves/shoot (86 number) and distance between two internode was recorded maximum in sweet lime *(C. limettioides*) and Dancy tangello respectively which was significantly more to all others but at par with white fleshed pummelo. The breadth of leaf was recorded maximum in karun jamir (*C.aurantium*) as compared to other species and types of citrus. The study revealed a great deal of variation in the shoot growth of different species/types of citrus.

Performance of Kinnow mandarin budded plants

Sheo Govind and I.P. Singh

All the plants came into flowering and fruiting during this year. The yield was recorded in a range of 25 to 102 fruits/plants. Observations on the vegetative growth of plant were taken and physico chemical analysis of fruit was done.

Performance of certain introduced hybrid

The maximum height (495 cm) of plant was recorded by citremon while stem girth (42.1 cm) and mean spread of plant (260.1 cm) was found to be the highest of Citrangequat plant as compared to other hybrids. The vegetative growth of Tangello plant was found to be poor. The yield was recorded the highest in Citrangequat (105 fruits) and the lowest in yama citrange (7 fruits)

Study of feeder root distribution in citrus

I.P. Singh and Sheo Govind

Three more species namely *Citrus limon* (Assam lemon), C. *jambhiri* (Soh

myndong and Estes rough lemon) and *C. taiwanica* were included in the study during this year.

Most of the feeder root biomass was observed to be surface oriented and about 70 per cent of root biomass remained confined withing a radical distance of 120 cm almost in all the species. It was also noticed that feeder root biomass decreased with the increase of soil depth above 20 cm depth and radical distance (beyond 80 cm). Root biomass was also found to be varied from species to species and at different soil depth.

Maximum feeder root biomass was recorded in *C. reticulata* (Khasi mandarin) followed by *C. madurensis* and *C. reshni.* The root biomass at the soil depth of 0-10 cm was recorded maximum in Soh myndong (*C. jambhiri*) and karun jamir (*C. aurantium*) which was significantly higher than other depths excepting in Cleopatra and Soh myndong where it was at par with 10-20 cm depth. However in case of Khasi mandarin (*C. reticulata*), *C. volkameriana* and Estes rough lemon (*C. jambhiri*) the feeder root biomass was found to be significantly higher at 10-20 cm soil depth.

Effect of urea, GA an $ZNSO_4$ spray on growth of Khasi mandarin and volkameriana seedlings

I.P. Singh and Sheo Govind

Growth of Khasi mandarin and volkameriana seedlings plants was found to be significantly increased with the spraying of urea, GA and $ZnSO_4$ either alone or in combination as compared to unsprayed plants with certain exceptions. The average height, number of leaves/plant, stem and root diameter and number of secondary roots/plant was recorded maximum by combine spray of 1% urea + 50 ppm GA + 0.2% $ZnSO_4$. Number of branches/plant and length of root was also recorded maximum under same treatment but the significant difference among the various treatments was found only in case of volkameriana excepting urea+GA treatment.

Total dry matter content of plant recorded under combined spray was found to be significantly higher than all other treatments in Khasi mandarin but at par with spray of GA in combination with urea and $ZnSO_4$ in case of *volkameriana.* The results indicated that vegetative growth of Khasi mandarin and volkameriana plants at nursery stage could be increased considerably by the spray of a mixture containing 1% urea, 50 ppm GA and 2% $ZnSO_4$.

Studies on the physico-chemical changes during growth and development of Kamla Australia fruit

Sheo Govind and I.P. Singh

It was observed that fruit weight and size increased consistently as the fruit approached towards maturity till the first Nov. after which there was no marked gain at the end of sampling ie on 16th Nov. (Fig. 1). Specific gravity of fruit gradually increase upto 17th Oct. and thereafter remained constant (Fig. 2). The minimum juice content was recorded on 2nd July which gradually increased with the development of fruit reaching maximum (43 ml/fruit) on 16th Nov.

Rind thickness was found to be maximum in developing immature fruit which gradually declined as the fruit advances towards maturity. TSS content slowly but consistently increased throughout the season reaching peak (10%) on 16th Nov. The acidity was found to decrease continuously from 1st August till 1st Nov and after that remained constant (Fig. 2) while ascorbic acid content was increased consistently upto 17th Oct. but thereafter decreased in last two sampling (Fig. 3).

The study indicated that Kamala Australia fruit become ready for harvest between first week of Nov. to mid Nov. under Barapani condition.

Study on the different methods of harvesting/picking on the storage of Khasi mandarin fruits

I.P. Singh and Sheo Govind

The mature fruits of Khasi mandarin harvested by five different methods were kept in laboratory under ambient condition for 25 days in storage.

It was observed that fruits harvested with a bit of stalk attached had minimum loss in weight as well as least spoilage of fruits and remained in good condition upto 20 days during storage followed by twisting of fruits as compared to other metods of harvesting. Snatching or pulling of fruits from branches was found to be worst method of harvesting as spoilage of fruits were recorded highest (43.22%) during 25 days of storage. The findings thus suggest that harvesting of fruits should either be done alongwith the bit of stalk attached to fruit or by twisting of individual fruit in order to retain their shape and quality during storage.

CITRUS BIOTECHNOLOGY

DBT project on micropropagation and micrografting in Khasi Mandarin (*Citrus reticulata* Blanco)

V. A. Parthasarathy, V. Nagarajau and A. Baruah

Procedures for shoot proliferation in a variety of citrus species were standardized. But the major problem in citrus micropropagation has been the successful transfer to nursery/field. An efficient method of acclimatisation of plantlets were standardised during the year. The method involves direct culturing of four weeks old *in vitro* proliferated shoots in sterile soilrite topped over sterile farm yard manure. The shoots rooted in about 15 days. After 4 weeks the caps were loosened and plantlets transferred to mist

house after 6 weeks. The plantlets established well with high survival percentage.

In micrografting studies, 8 rootstocks were tested out of which Kagzi lime (*C.aurantium*) and Rangpur lime were found to be good for graft success upto 30% from scions obtained from young filed grown trees. Pulsing of scions with 2, 4-D (5ppm) increased the graft success to 65%.

Citurs shoot proliferation *in vitro*

I.P. Singh and V.A. Parthasarathy

Shoot tips of *in vitro* grown seedling of twenty citrus species/types were cultured in MS media supplemented with BAP (0.75 mg/1) which was standardised in our Lab. There was great variation among species/types of citrus in term of number of shoots. Highest number of shoot/plant (8) was obtained in Carrizo citrange followed by Tangello Dany (6.75), citremon (5.5) and Jaintia lemon (4.5). All shoots were planted for further study.

Comparative study of micropropagated plants *vs* seedling of citrus

Micropropagated plants of Khasi mandarin and seedling was planted in field to see the growth pattern. It was observed that seedling plants grew faster than micropropagated ones. Maximum plant height (51.87 cm), highest number of leaves (58.75) was recorded in micropropagated plants whreas in seedling it was only 15.7 cm (height) and 30.75 (leaves/plant). The percentage increase in height was 230% over seedling plants.

Citrus diseases

A.K. Singh

In an experiment of disease management trial 3 treatments were undertaken. First treatment consisted of two sprays of Bordeux mixture (1%) in April and September. Three sprays of Carbendazim (0.05%) were applied in April, May and June. Second treatment consisted of 2 sprays of Bordeux mixture like first treatment and 2 sprays of carbendazim in April and June. Third treatment consisted of no fungicidal application. Citurs scab was the most important disease and thus observations were taken both on leaves and fruits. First and second treatment were statistically at par but significantly reduced the disease intensity and improved the quality of fruits.

In another experiment with 2 treatments protected from disease by fungicide application and another left unprotected from disease. The experiment is continuing since last 10 years. The protected plants yielded significantly more with better quality and better canopy and disease control. The increase in canopy was also due to disease control.

Insect pests

N.S..A. Thakur and A.N. Shylesha

Citrus mealy bugs : Mealy bug infestation started just after new flush during end of March and crawlers started settling on the new twigs. 4-62 crawlers were found on twig of 15 cm length with an average of 18 crawlers per twig (N = 20 twigs/plant). A single spray of Monocrotophos 0.07% brought down the population to 2-4 crawlers per shoot. Predatory coccinellid beetle population increased gradually starting from April till September and 3 species of coccinellid beetles were found feeding on the mealy bugs (*Planococcus citri*). The population of *Icerya burchasi* was negligible.

Citrus scales : *Saissetia nigra* was the predominant scale insect found during 1995. The crawlers settled just after fruit set when the fruit was peanut size. 22-28 scales were found on each twig. More numbers were found on the fruit bearing twigs. The scales sucked sap from the twigs and also from the stalks of fruits resulting in fruit drop in the premature stage. Very few scales were observed on the fruits. 43% of the bearing shoots were found infested by scales and an average of 7.58 scales were observed per twig. Monocrotophos @ 0.07% sprayed for the control of mealy bugs druing May first week failed to reduce the population of the pest. Coccinellid beetles were found to feed on these scales in initial stages but later on the predation was also very less.

Citrus psylla : Incidence of citrus psylla *D. citri* was very less during 1995.

Citrus aphids : Citrus black aphid *Toxoptera citricidus* was found predominantly during the onset of new flush period and maximum population was found during second fortnight of July with an average of 22 adults per twig. The population decreased by the end of August 1995.

Twig borer : (*Oberia* sp.) : Twig borer was found to be active during July - August and maximum twig damage of 12 twig per plant was recorded during second fortnight of August. The pest was successfully controlled by spraying Monocrotophos @ 0.07%.

Trunk borer : (*Monohammus versteegil*). The trunk borer started emerging from the plants just after a heavy shower during first week of March 1995 and continued till second week of August. Peak emergence was observed during the second fortnight of April. Emergence monitored in 50 infested plants revealed an average of 1.48 beetles per plant. A total of 74 beetles emerged. Adults, after emergence, started feeding on the twigs by scrapping bark due to this some twigs were killed. Mating started 2-3 days after emergence and occured on citrus plants on bright sunny days. Ovipositional sites on the trunk and made 'T' shaped incissions on the bark and a single egg was inserted which was visible partially. Sometimes due to plant ooze the eggs got covered up. 5-8 eggs are placed in a zig-zag manner on the trunk and the slit made for egg laying was always vertical and never horizontal. Females had a fecundity of 20-25 eggs. Although mated females on dissection revealed presence of

30-50 eggs in their ovary. Eggs were large (6-7 mm length and 2.5 - 3 mm wide), pure white when laid and turned cream colour on exposure; hatched in 10-20 days. The freshly emerged grub measured 7-8 mm in length and 3-4 mm width. Upto 1- 1/2 months the grubs fed on the bark and wood just beneath the bark and later entered into the wood. After two months of hatching the grubs measured 1.3 cm in length. The grubs fed on the wood and in the early stages frass excretion at the base of the trunk gave a clear symptom of infestation by the borers. Most of the eggs (55.03%) are laid in the collor region and upto 60 m of the trunk and 17.45% laid in the area 60-120 cm and 27% in the region above 120 cm on the trunk near the branching portion. Pupation was found during Feb.-March and adults started emerging during the last week of March. The integrated pest management practice formulated during 1995 was tested in the current year and the incidence was very less in the experimental plot.

Citrus fruit bug : *Rhynchocoris humeralis*, was found in large numbers sucking the juice from the young as well as mature fruits. The incidence started in the month of September and reached a peak during November and an average of two adults were found per bunch and nymp population was quite high upto 6 per bunch, 30-45 eggs were laid on the leaf and eggs hatched in 6-8 days and nymphs started feeding on the fruits sucking the sap. The punctures made by the nymphs and adults resulted in lopsided development of fruits and at the ripening stage the fruits had black spots and the fruits had very less juice and spongy, tissue was more and also resulted in uneven ripening; fruit rotting also occurred due to secondary infection. Monocrotophos, Neemta, endosulfan and Neemta + endosulfan and Neemarck were tested for the control. Neemarc 5 ml/ltr. and endosulfan gave good control of the pests under laboratory conditions.

GUAVA

Ram Chandra and A.R. Desai

Growth performance of hybrid and selections

Certain hybrids like Hybrid 1, 2, 3 and selection like GS-1 and GS 10 showed good performance in respect of vegetative growth.

Propagation

The maximum (60.4-71-2%) success of patch budding was found during the period of 15th March to 15th April followed by 3rd week of November to 1st week of March with 44.6 to 53.2 percent success. However, the time taken for bud sprouting in latter case was found to be more.

PEACH

Ram Chandra and A.R. Desai

Varietal evaluation

Of nine cultivars, fruiting was noticed in TA 170, Shane Punjab and Flordasun and fruit yield was found in a range of 2.5 to 4.8 kg/tree. Fruits were ready for harvest from the last week of April to 2nd week of May under Barapani condition.

Soft wood grafting

The best time of grafting was found between 15th Aug to 15th September and about 85 percent success was recorded using 4-5 months old scion grafted on 8-10 months old peach seedlings rootstocks.

Seed germination

Freshly extracted peach seeds stored in sand in the caly pots in open condition for 110 days and sown in raised beds at 6 cm deep in the last week of September. The beds were mulched with dry grasses and irrigation was done regularly from November to January. About 68 per cent germination was recorded by the second week of February.

Storage behaviour

Mature fruits of Shane Punjab and TA 170 were stored under ambient condition for 8 days. The results indicated that fruits could be stored upto four days under room condition without deterioration in colour, firmness and quality.

Plum, Pear, Kiwi and Aonla

Like previous year, observations on the vegetative growth of plants were recorded during this year. The growth of Kala Amritsari and Durfy Early June, sand pear and Lagoon and Kanchan cultivars of plum, pear and aonla respectively was found to be good. Flowering was noticed in Kala Amritsar and Sutlej People of plum and in Allison male plant of Kiwi only during this year.

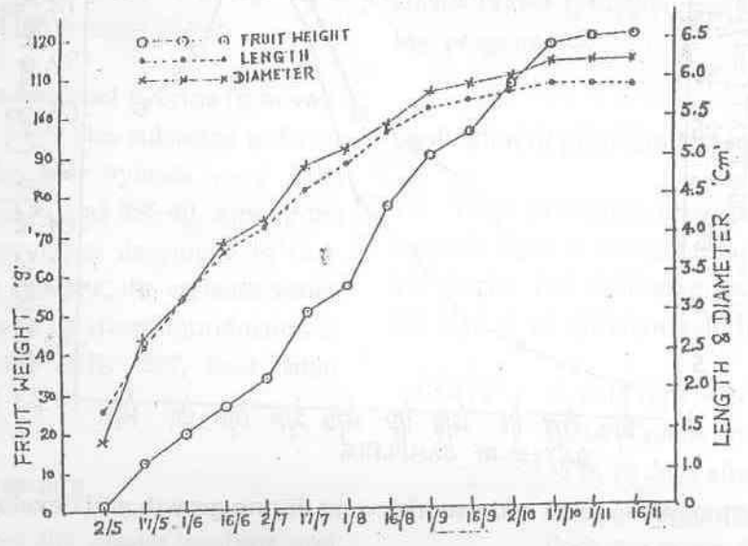

Fig. 1. Changes in fruit weight and size during growth and development

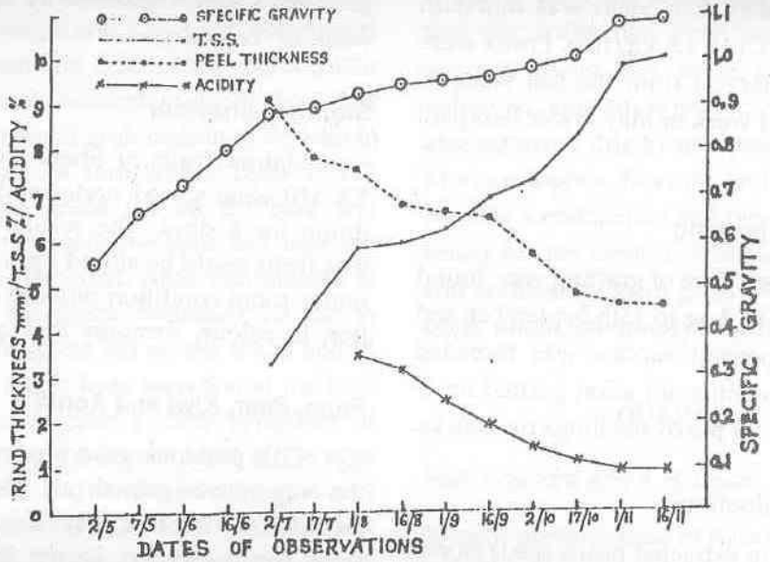

Fig. 2. Changes in rind thickness, T.S.S., acidity and specific gravity during growth and development

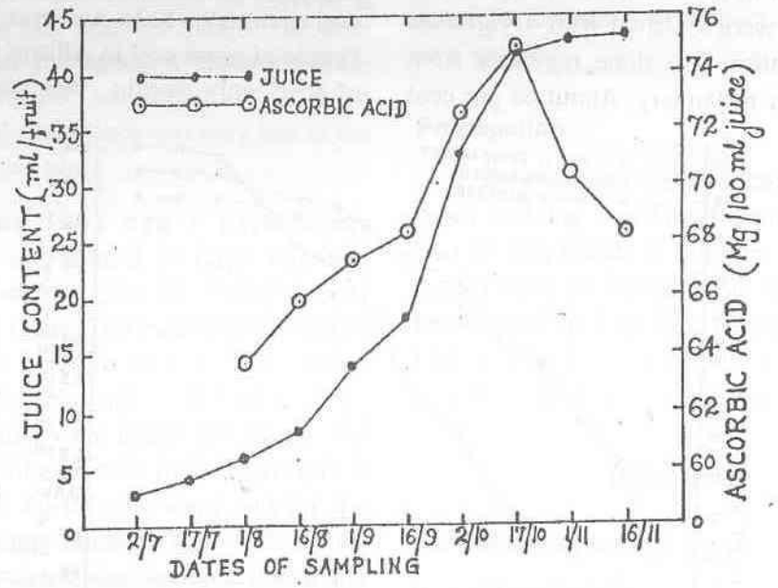

Fig. 3. Changes in juice and ascorbic acid during growth and development

VEGETABLES

TOMATO

V.A. Parthasarathy

Factor analysis

The data pertaining to 25 introductions from 12 countries were subjected to factor analysis for the yield and quality characters recorded during previous years. The final analysis indicated that the characters namely, plant weight, fruit size, fruit weight and fruit number were important as evidenced by sequential and principal component analysis. The data were further subjected to cluster analysis and the parents were identified for hybridization programme. The PI Nos. 198674, 205011, 205013, 376092, 36092, 92865 and 114038 were better.

The commercial hybrids from various sources were also subjected to factor analysis. The best hybrids were Arka Varuhan, BSS 39 and BSS 40. Among the improved genotypes developed in various research institute, the varieties which had good scope for direct introduction in North East are IIHR 1827, Pant Bahar Florada and LE 79.

Heterosis breeding

Based on the cluster analysis and performance of new introduction, 24 hybrids were made and evaluated as preliminary trial. Three hybrids, C-1 (720 gm/plant), C-12 (1135 g/plant) and C-14 (560 gm/plant), were found to exhibit heterosis over the better parent to a tune of 200% in terms of yield. These hybrids will be further evaluated.

FRENCH BEAN

A.R. Desai and V.A. Parthasarathy

35 pole types grown during Rabi and Kharif season indicated a large divergence among the genotypes. Cluster 4 showed maximum inter cluster distance with 5, 6 and 7. The varieties in the cluster (Table 1) may be useful for breeding programme.

Evaluation of promising lines

Three promising lines (pure line) of french bean were evaluated for 3 consecutive years. The following are the brief description of different selections.

RCFPP 1: A pole type with wax type pods. Comes to flowering 35 to 40 days after planting. 4 to 6 pickings can be made. Pods are green, fleshy long with an yield of about 25

tonnes/ha. Seeds are white in colour.

RCFPP 2 : A pole type with flower purple, fleshy pods, yield ranges from 23-25 t/ha.

RCFPP : (R2-51/93) : A bush type comes to flowering after 30 days of sowing, 2 to 3 pickings can be made, a short duration variety (75 days), yield ranges from 21 to 25 t/ha.

Table 1. Composition of cluster (Rabi season)

Cluster	Varieties/Lines
I	Canadian Wonnder; IC-39051 and IC-47643
II	Meghalaya Local-1; Manipur local-1, Manipur local-4; Manipur local-5; Mantulal (Sikkim); SVM-1, RC-5; Pusa Himalata and PI-289408
III	Manipur local-2; Manipur local-3; PI-289808; IC-37153 and IC-37156
IV	Meghalaya local-2;Meghalaya local-3; DVFB-4; Meghalaya local-4 purple
V	Sikkim local-1
VI	Ghewsimi (Sikkim) and PI-14339
VII	IC-41325; IC-39062; IC-43502, IC-46192; IC-41362; IC-59073 and IC-29062
VIII	Laxmi; Kentucky wonder and IC-37151

COLE CROPS

R.P. Medhi

Varietal trial

Four varieties in cabbage and five varieties in cauliflower were evaluated for yield and quality parameter. Superior performance was observed in cabbage variety Pride of Fuji (228 q/ha) and cauliflower variety local (Snowbali type) (219 q/ha).

Agrotechnique

A fertilizer trial with 5 levels of P and K separately with control each at 15, 30, 45, 60 and 75 kg/ha were applied with an improved variety, Purple Vienna. On the basis of yield data, it was observed that application of phosphorus and potassium @ 60 kg/ha give the highest yield of 103.33 and 110.05 q/ha respectively.

TUBER CROPS

R.P. Medhi

Germplasm programme

A total number of 63 types were added to the genetic resources during the year 1995 and 139 germplasm were maintaned in the tuber crops like colocasia, alocasia, sweet potato, dicescoria etc. and these germplasm are being evaluated for important characters.

Colocasia

Uniform Regional Trial : Trial carried out with 12 improved and 11 local varieties showed significant difference in total tuber yield. In case of improved varieties, the total yield of 213.95 and 212.70 q/ha was recorded from variety TVM-293 and C-226 respectively. Whereas in case of local collection, the highest yield of 319.75 and 243.13 q/ha was recorded from varieties ML 4 and ML 8 respectively.

Sweet potato

Initial evaluation trial : Seven varieties evaluated under IET along with local best (S-162). The highest total yield was recorded in RS-III-3 (151.87 q/ha) followed by RS-III-2 (120.83 q/ha). However,l like previous year local best's (S-162) performance was better than the newly collected varieties (184.18 q/ha). Pooled analysis of both year (1994 and 1995) showed a significant differences in the yield of tuber of different varieties. The overall performance of the S-162 was best with a yield of 181.68 q/ha followed by RS-III-3 (146.25 q/ha). Besides, agrotechnique trials on colocasia and sweet potato also were connected.

SPICES

TURMERIC

Crop Improvement

Ram Chandra, A.K. Singh and A.R. Desai

Out of five identified clones, the maximum rhizome yield (17.99 kg/2.7m² plot) and d ry matter recovery (47.5 q/ha) was recorded in TC-2 while curcumin recovery (3.12 q/ha) was calculated more on TC-17. Excepting TC-37 all other clones were round to be resistant against leaf spot disease (*Colletotrichum capsici* and *Tabhrina maculans*).

Yield performance

Ram Chandra

An attempt was made to find out the yield response of eight turmeric varieties grown in the same field after keeping fallow for three consecutive years. The maximum yield (198.56 q/ha) was recorded by PCT-13 followed by RCT-1 (149.84 q) and Sugandham (131.699 q).

Post harvest technology

Ram Chandra and A.R. Desai

Effects of drying with or without boiling of rhizomes on the quality of powder was studied. Drying of rhizomes under room conditions gave the highest dry matter recovery (20. 2%) and curcumin (0.96%). Boiling of rhizomes followed by sun drying reduced the curcumin and poweder recovery. However, colour of powder was improved by boiling treatment.

DISEASES

A.K. Singh

Turmeric

Fifteen clones of turmeric were screened against *Colletotrichum capsici* causing leaf spot. TC 33, 17, 41, 44, 2 and 36 were highly resistant. TC 37 was resistant and TC 25 and 48 were moderately resistant to the disease. Rest were susceptible.

Twentyfive turmeric varieties were screened against *Colletotrichum capsici*. Kankikadu, 21A, Kasturi Tanaba, PTS, 11, Armoor, PCT 13, PCT 12 and RCT 1 were found highly resistant and No. 24, CL 1-344, CL 1-195, CL 1-367 were resistant to the disease.

INSECT PEST

Tuemeric and ginger : Turmeric suffered leaf damage in the initial stages of the crop by blue chrysomellid beetle (not identified). In the later stage the crop was free from any pest attack.

Ginger suffered damage from leaf feeders, *Dichocrosis punctiferalis* and Culm borerd. A weevil (sent for identification) was found to damage the Culm upto 17% between June - August. The grubs were found to bore into the culm and was hollowed completely resulting in the death of the plant. Pupation occurred within the culm. Excrate pupa became adult in 8-10 days. The adult weevils were brick red in colour measuring 1 cm length and 3-4 mm width with black spots in Elytra. Adults feed on the leaves of ginger. Rhizome fly Mimegralla sp. was also found which caused rhizome rot of ginger. Under farmers field conditions root grubs, rhizome fly and shoot fly were found to be the major pests.

FLORICULTURE

V. Nagaraju and V.A. Parthasarathy

Gerbera

Eight open pollinated selections of gerbera were evaluated for 7 important trials. All the eight selections were showing impressive colour. The number of flowers/plant ranged from 30 to 44 with a stalk length of 45 cm. The flower diameter was ranging from 9 to 12 cm with a good vase life of about 30 days during early winter.

Orchids

The orchid *Cymbidium giuganteum* seed culture was done in MS media with BAP supplementation (0,).25, 0.5, 0.75, 1.0 and 1.5 mg/l). The data indicated that maximum number of shoots (6) with 4cm long shoots were obtained in MS media supplimented with 0.5 BAP Another experiment to standardise the best basal medium was conducted with MS and Knudson C medium with 0.5 mg of BAP/1. MS media was better than Knudson C as it contained more nutrient than Knudson C.

PASTURE AND FORAGE

Nutriational evaluation of parari leves

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

A feeding trial on parari leaves was conducted to evaluate its feeding value in goat. The dry matter intake (g/day) was found between 301 to 351, while intake (kg/100 body weight) was observed as 5.45 ± 0.77, indicating the high acceptability and palatability of parari leves in goat. The dry matter digestibility (67.55 ± 1.79%) shows that it was digestible in goat. The growth (g/day) exclusively on leaves feeding was recorded 30.13 ± 3.22 against control diet of 52.42 ± 4.59. More growth than control could be achieved if supplemented with concentrate. The parari leaves may be a very good fodder with very easy propagation through stem in N.E.H. region.

Studies on pasture larval cocentration

C. Rajkhowa and S. Bandyopadhyay

This study was initiated from the month of January 1996 to study the larval population in pastures from various altitudes of Meghalaya.

During the 3 months period several visits were conducted to the high altitudinal areas of Upper Shillong. The grass samples were collected from large number of grazing sites randomly scattered throughout the area of grazing field to be sampled. "W" or "N" collecting routes were chosen to collect the samples. These samples were processed in the laboratory to identify the L3 of parasitic nematodes and their quantitative estimation. From the very few samples examined during the period, L3 of Trichostrongylus and Haemonchus were identified from these grazing fields in a concentration of 4,00-5,00/kg of grass.

AGROFORESTRY

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

S.K. Dhyani, B.P. Singh and L.K. Misra

Growth performance and biomass production

The tree responses (Table-1) evaluated indicated that tree species *Alnus nepalensis, Parkia javanicaa, Paraserianthes falcataria, Prunus cerasoides, Michelia oblonga, Gmelina arborea* and *Pinus kesiya* are well adopted to the site with a survival of 90 to 100% after eight years of planting. The height, diameter, canopy spread and volume production were greatly influenced within tree species. *Parkia* recorded maximum height (14.90m) followed by *Paraserainthes* (13.84 m) and *Alnus* (13.80 m), while the maximum diameter at breast height (dbh) was attained by *Gmelina* (22.1 cm), followed by *Parkia* (22 cm) and *Alnus* (20.6 cm). Though timber (main stem) volume production was the highest in *Parkia* (226.56m³) but its wood is not a very good timber, hence the maximum volume was produced by *Gmelina* (197.94 m³), followed by *Alnus* (184 m3). *Alnus* (6.8 m) had the maximum canopy spread, followed by *Parkia* (6.5 m) and *Gmelina* (6 m), while *Cryptomeria* and *Cupressus* recorded the minimum (2.2 m) conopy spread.

Development of suitable management practices for different agroforestry systems with special reference to productivity and sustainability

Arable crops with varied spacing of guava under evaluation of agri-horti system

S.K. Dhyani and L.K. Misra

Guava (*Psidium guajava* L.) cv. Allahabad Safeda, were planted at two levels of spacing (S_1-2.5 m × 5.0 m and S_2 - 5.0 m × 5.0 m) in August 1987 on contour terraces (with 1.2 - 1.4 m terrace width and 1.0-1.2 m terrace riser). The objective was to select suitable crops for maximum returns per unit area and also to study growth and yield response of fruit plants to intercropping. Initial results for six years indicated that there was no significant difference in fruit yield under the two spacings but the intercrop yields were higher under wider spacing. Therefore, for sustainable production from intercrops guava plants from closer spacing were thinned in 1993, resulting in wider spacing of 5 m × 5 m. Pineapple (cv. Kew) was planted in paired rows with guava and alternate terraces were utilized for raising intercrops. This year ginger (Nadia) and turmeric (RCT-1) were planted as intercrops. There was a declining trend in fruit yield of guava and it was 26 to 33% less than last year. How-

Table 1. Growth performance and timber volume of MPTS in an arboratum (age 8 years)

MPTS	Height (m)	Diam. (dbh) (cm)	Canopy Spread (m)	Timber2 Volume (cu m)
1. *Alnus nepalensis*	13.89 (1.39)	20.6 (3.1)	6.8	183.97
2. *Paraseri—anthes falcataria*	13.84 (2.16)	20.0 (3.9)	5.6	156.53
3. *Prunus cerasoides*	11.40 (1.71)	15.7 (2.3)	5.0	83.86
4. *Parkia javanica*	14.98 (1.40)	22.0 (2.9)	6.5	226.56
5. *Symingtonia populnea*	10.20 (0.99)	12.8 (2.0)	3.0	39.40
6. *Acacia auriculiformis*	8.65 (1.40)	15.3 (3.9)	3.9	47.71
7. *Michelia oblonga*	12.16 (1.35)	18.0 (2.8)	4.1	123.77
8. *Gmelina arborea*	12.90 (1.28)	22.1 (4.8)	6.0	197.94
9. *Cryptomeria japonica*	10.90 (1.51)	14.9 (1.4)	2.2	76.02
10. *Cupress torulosa*	8.79 (1.45)	13.6 (3.4)	2.2	51.08
11. *Pinus kesia*	9.05 (1.50)	14.3 (3.5)	3.2	58.14
12. *Robinea pseudoacacia*	9.65 (0.40)	16.9 (1.0)	5.4	86.59
% CV	19.04	19.15	35.90	58.62

[1]SD within parentheses

[2]on the basis of survived stem

ever, there was no significant effect of intercrops on the growth and fruit yield of gave (Table 2.) as such. There was severe rotting in ginger but turmeric yield was satisfatory. Land equivalent ratio (LER) was the highest in the guava × pineapple × turmeric system, indicating that combination is more suitable and viable.

Arable crops with varied spacing of mandarin under evaluation of agri-horti system

S.K. Dhyani and L.K. Misra

Khasi mandarin (*Citrus reticulate Blanco*) were planted at two levels of spacing (S_1-2.5m × 5.0 m and S_2 - 5.0 m × 5.0 m) in August 1987 on contour terraces (with 1.2 - 1.4m terrace width and 1.0-1.2 m terrace riser).

Mandarin started fruit bearing from sixth year onwards. This year there was profuse bearing and more than 10,000 fruits were harvested from 42 bearing plants. Three french bean (contender) intercrops during April-May, May-July and October-November were raised to get economic returns and enrich soil fertility. All the biomass after picking green pods was incorporated in soil. Intercrops and spacings did not affect growth and plant spread of mandarin (Table 3.) but spacing did affect total fruit and intercrop yield. There was significant difference in the fruit yield/tree under the two spacing. The fruit yield was higher under intercropping system than sole crop. Similarly fruit yield/tree was 45-48% higher under wider spacing compared to closer one. Though total fruit yield/ha was more in closer spacing due to more number of plants. French bean yield was significantly higher in wider spacing, consequently in terms of over all production from the system, wider spacing is more remunerative and viable.

Phyico-chemical characteristics of mandarin fruits under agroforestry system

Forty fruits samples from the two spacings (S1 and S2) were taken and analysed for physico-chemical characters. The results (Table 4) indicated considerable differences in all the parameters studied. Fruit and peel weight; fruit size and juice content were higher under wider spacing than closer one.

DISEASE AND PESTS

In general there was no incidence of diseses and pests in the whole orchard. However, interestingly few trees under closer spacing exhibited incidence of trunk borer and fungal infection, which again affirms that in long run wider spacing will be more viable.

Evaluation of a multistoreyed silvi-horti system on a hilly micor-watershed

S.K. Dhyani, B.P. Singh and L.K. Misra

Tea (*Camellia sinensis*) a heat sensitive and shade tolerant plant was intro-

Table 2. Growth response and yield of guava as influenced by spacing and intercrops

Treatment	Plant Height (m)	Plant Spread (m)	Fruit kg/tree	yield t/ha	Cropyield (t/ha) Pineapple	Ginger	Turmric
Guava monocrop	7.00 (0.40)	5.20	11.2	4.36	-	-	-
Guava+pine-apple+ginger	7.17 (0.40)	5.28	11.8	4.76	1.5*	0.6	-
Guava+pineapple + turmeric	7.17 (0.46)	5.28	10.9	4.36	1.8	-	1.4
Sole crop	-	-	-	-	7.0	0.8	1.8

S.D. in parentheses
* 7800 plants/ha

Table 3. Growth response and yield of Khasi mandarin as influenced by spacing and intercrops

Treatment	Plant Height (m)	Plant Spread (m)	Fruit yield t/ha No./ tree	kg/ tree	Frenchbean* (t/ha)	
S_1C_0	5.00	2.37	166	23.66	18.93	-
S_1C_1	4.89	2.31	180	25.68	20.54	15.7
S_2C0	5.18	2.51	226	34.31	13.72	-
S_2C_1	5.21	2.55	248	38.10	15.24	21.5
Sole crop (French bean)	-	-	-	-	-	30.0
Mean	5.07	2.44	204	30.44	17.11	19.4
SD	0.15	0.11	38	6.85	3.17	5.5
CV (%)	3.0	4.67	18.7	22.62	18.51	28.4

S1 = 2.5 m x 5 m, S2 = 5 m x 5 m
C0 = monoculture C1 = French bean * 3 crops

Table 4. Physico-chemical characteristic of Khasi mandarin fruits under two spacings

Characters	Spacings (m) Close (2.5 x 5)	Wide (5 x 5)
Av. weight of fruits (g)	142.5 (14.4)	153.5 (12.2)
Weight of peel (g)	46.9 (6.5)	55.1 (5.3)
Length of fruit (cm)	5.8 (0.5)	6.2 (0.4)
Diameter of fruit (cm)	7.1 (0.2)	7.1 (0.3)
Av. no. of segment	10.4	10.3
Juice content (%)	63.2 (3.4)	68.0 (4.1)
Acidity (%)	0.716 (0.11)	0.781 (0.15)

SD in parentheses

duced in June'91 in micro-watershed having 4 year old alder (*Alnus nepalensis*) planted in mini-terraces on hill slopes (40-60%). The existing tree density was 416 stem/ha, which was reduced to 393 stems/ha in the third year of tea planting in order to regulate shade for tea crop. The entire micro-watershed was divided into 3 blocks-lower, middle and upper on the basis of alder growth in the initial years. However, there was no significant difference in the growth of alder trees in the three blocks at eighth year. It recorded a height of 17.84m; diameter (dbh) 22.4 cm; plant spread 6.83 m; and timber volume of 220.78 m^3 at 8 year (Table 5). Tea saplings @ 12,345 q/ha were planted on terrace risers. Tea leaves (terminal buds) were harvested from second year of planting. The average yield recorded was 470 kg/ha in second year; 4444 kg/ha in third year and 6481.12 kg/ha in the current year from 2-3 pluckings/month during April to October. Caffeine in tea varied between 3.2 to 4.5% in the early stages of establishment. Thus, tea flourished will in the shade of alder, primarily because the system created its own favourable microclimate and tree added 5.2 t/ha from litter and root blomass, thus improving the soil fertility. In addition, two crops of french bean (contender) and rice bean were planted as intercrops. Pod yield (green) of 4.54 t/ha from french bean and 1.8 t/ha grain yield from rice bean was recorded. After harvesting pods and grains the remaining plant material was added in the soil, which initially served as mulch and on decomposition added the nutrients in soil.

Table 5. Performance of alder and yield of tea and intercrops under multi-storeyed silvi-horti system.

Components		Yield (kg/ha/yr)
Alder		
Height (m)	17.84 (2.78)	
DBH (cm)	22.4 (3.17)	
Plant spread (m)	6.83 (0.89)	
Timber Volume (m3)	165.8 (9.97)	
Tea (fresh tea buds)		6481.2
French bean		
Green pods (3 crops/yr)		4500.0
biomass (3 crops/yr)		18500.0
Rice bean		
grain		1800.0
green forage		22500.0

Studies on post harvest technology, on forest utilization, wild life, animals, fishery, apiculture, sericulture and lac etc. in relation to agroforesry systems

Development of sericulture based agroforestry systems for sloping lands

S.K. Dhyani, L.K. Misra, R.V. Kushwaha and S.T. Lepcha

Sericulture based agroforestry systems have great potential for higher returns in this region on sloping and valley land situations. The major benefit from such a system is its capacity to combine soil conservation with multiple output and income as well as employment generation. A collaborative project with Central Silk Board was initiated in November 1992.

Evaluation of suitable high yielding mulberry varieties and silkworm breeds

Six high yielding varieties (HYV) viz. TR-4, TR-10, BC-259, S-1635, C-763, Kanva-2(K-2) and one local planted at 0.9 × 0.9m spacing with 3 replications in May'93 were further evaluated. TR-4 attained the highest plant height of 1.98m, followed by K-2 (1.86m) and TR-10 (1.84 m), while the lowest height of 1.59m and 1.61m were recorded with S-1635 and BC-259. TR-4; S-1635 and TR-10 produced high leaf yield (24.5 to 25.5 t/ha) from four harvests, consequently recorded higher cocoon yield, followed by C-763 and BC -259 (Table 6).

To identity the best silkworm breeds capable of producing high quality raw silk, 9 breeds comprising bivoltine and B_1 × B_1 hybrids viz. NB-7, NB-18, P_5, KPG (A), KPG (B), NB-7 × NB-18, NB-18 × P5, P5 × KPG(B) and J-112 were evaluated in five rearing trial. Although, hybrids viz. P5xKPG(B) and NB-18 xP5 (Table 7) produced higher silk ratio, but bivoltine breeds like NB-18 and NB-7 produced better cocoons per unit quantity of leaf and capable of producing high quality raw silk thus fetch much higher price.

Evaluation of sericulture based agroforestry systems

Three sericulture based agroforestry systems (Fig. 1) viz. sericulture with 1. fruit trees and fodder grasses, 2. field (upland) crops, and 3. lowland rice were established in 1993.

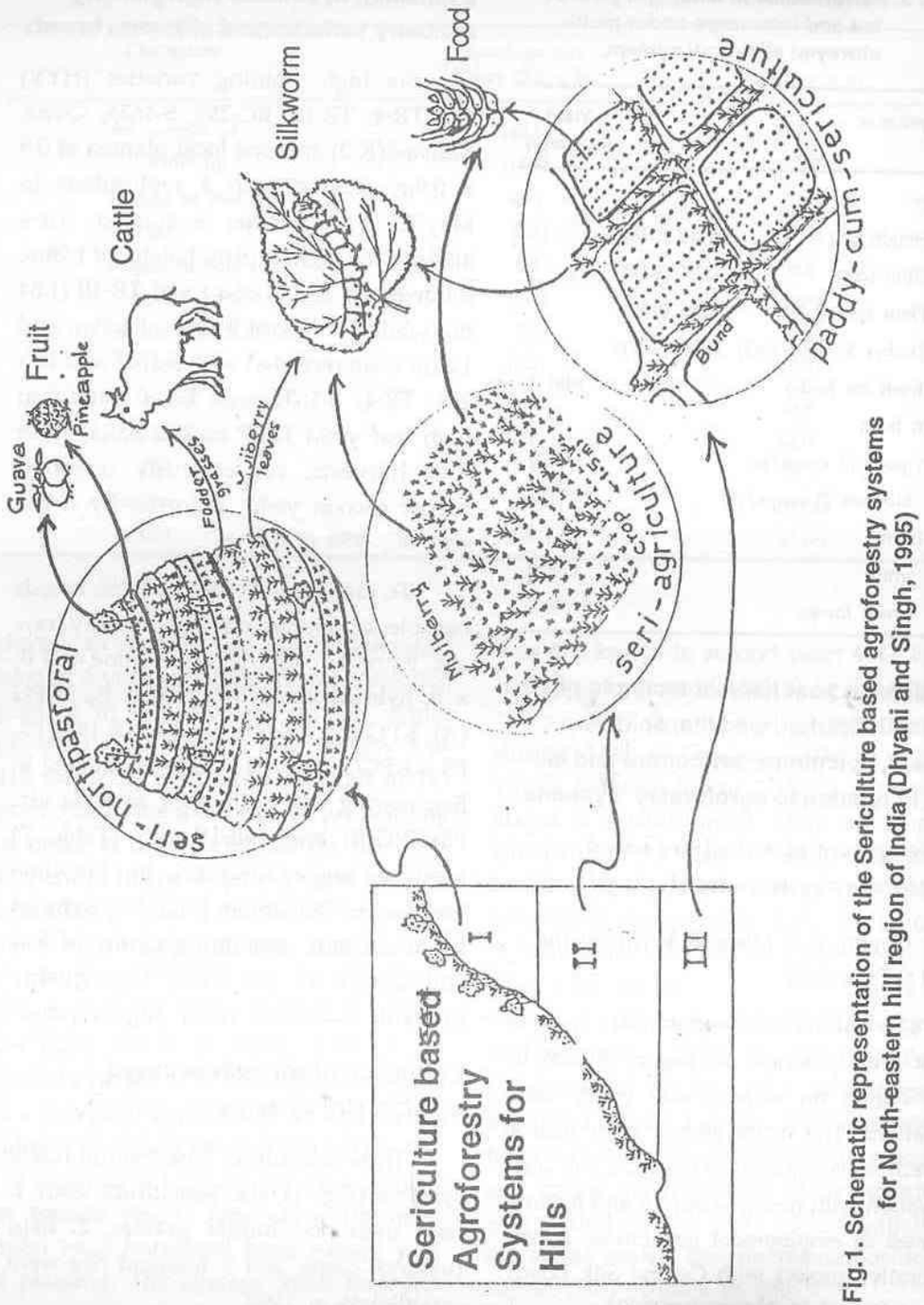

Fig.1. Schematic representation of the Sericulture based agroforestry systems for North-eastern hill region of India (Dhyani and Singh, 1995)

Table 6. Performance of mulberry varieties

Mulberry Variety	Plant height	Primary branches		Secondary branches		Yield (t/ha/yr)	
	(m)	No.	L (m)	No.	L (m)	Leaf	Cocoon
TR-4	1.98	6.0	7.16	2.8	1.05	25.53	1.09
TR-10	1.84	7.0	7.41	1.9	0.76	24.54	1.05
BC-259	1.61	6.0	5.74	1.1	0.37	21.88	0.93
S—1635	1.59	6.0	5.89	1.0	0.24	25.48	1.09
C-7635	1.76	6.9	6.85	2.3	0.71	22.31	0.95
Kanva-2	1.86	6.6	6.94	2.4	0.71	19.90	0.85
Local	1.28	5.6	5.10	1.6	0.26	9.14	0.39

Table 7. Rearing performance[3] of silkworm races at Research Farm.

Silkworm race	Hatching	ERR/10,000 Larvae		Silk ratio	Yield (kg/100 df1)
	(%)	No.	Kg	(%)	
NB-18	86.5	8103	17.49	19.3	72.1
NB-7	79.7	9365	18.87	19.9	71.6
KPG(B)	89.2	9492	19.13	19.4	73.3
P_5	78.4	8200	17.30	18.6	70.0
KPG(A)	79.3	8173	13.43	17.8	71.5
NB-7xNB-18	79.9	8495	16.50	17.9	66.0
NB-18xP_5	61.7	8679	19.85	20.3	70.0
P_5x KPG(B)	67.3	8713	18.63	21.8	68.3
J-112	89.3	-	-	16.0	64.0

[3]On the basis of 5 harvests in April, May-June, August, October-November, 1994 and May 1995, ERR-Effective rate of rearing

I. The sericulture with fruit trees and grass system comprised of guava cv. Allahabad safeda (6mx4m spacing) with pineaple (60 cm x 30 cm spacing) planted in paired rows on contours on slopy lands (30-48% slope). Two rows of mulberry 90 cm apart were planted between two rows of guava. The inter terraced area under riser was not disturbed to maintain grass cover and to avoid soil erosion. Local grasses dominated by *Arundinella bengalensis, Setaria paimifolia, Imperate cylindrica* and *Panicum maximum* were allowed to grow and harvested for cattle fodder. Thus, in one ha, there were 416 guava, 3,333 mulberry, 16,667 pineapple plants and about 3,333 m^2 area was under grasses. The yields (Table 8) from such a system were found to increase substantially from second year onwards besides production of sufficient grasses to feed $1^1/_2$ cattle unit/ha/year.

II. Sericulture with field crops system comprising mulberry (Kanva-2) with intercrops viz. french bean-contender, groundnut JL-24 and mustard-M 27 was laid out with 15 spacing combinations (5 row to row - 90, 120, 150, 180, 210 cm and 3 plant to plant, 60, 90, 120 cm) in 3 replications. In this experiment the highest yields (Table 9) of intercrops viz. french bean, groundnut and mustard were obtained with 210x120 cm spacing and the lowest with 90x60 cm, however 90x60 cm spacing recorded the highest leaf yield (31,480 kg/ha/year) followed by 210x60 cm and 150x60 cm, and minimum with 210x120 cm spacing. In order to balance the returns from cocoon and crop production, the optimum spacing was 150x60 cm spacing, but it has clear cut advantage of providing food security as the probability of successful harvesting of intercrops as well as cocoon yield was more in this spacing than others.

III. A system of sericulture with rice cultivation was established in 0.2 ha in lowlands. Mulberry (K-2 and C-763) plants were planted on raised bunds at 90 cm apart and rice followed by potato (Kufri Megha) was intercropped in plots. Four silkworm rearings were carried out each year since 1993. Mulberry growth, leaf production and rearing performance of silkworm and intercrop (rice) yield were higher with K-2 variety than C-763, though the differencs were not significant. In the current year four rice varieties viz. Ngoba, RCPL-1-87-8, RCPL-1-87-4, RCPL-1-3, and Prasad were evaluated under the system. Performance of all the rice varieties except RCPL-1-87-8, was good (Table-10). Noticeably, RCPL-1-3 (4.5 t/ha) recorded significantly higher yield under intercropping than as sole crop, while Prasad, Ngoba and RCPL-1-87-4

Table 8. Yield from seri-horti-pastoral system during the initial years of establishment.

Components	Yield (Kg/ha/year)		
	I year	II year	III year
Guava fruits	-	-	4360
Pineapple fruits	-	7050	9000
Mulberry			
Leaves	1160	6100	6400
(= cocoon)1	(67.6)	(302)	(340)
Fuelwood	471	950	985
Grasses (green fodder)	12100	19878	24000

One rearing in first year, thereafter 4 rearings/year.

Table 9. Cocoon and intercrop yield as influenced under varied spacings of mulberry

Spacing (cmxcm)	Yield (kg/ha/yr)			
	cocoon	French bean	Groundnut	Mustard
90 x 60	1342.7	642.5	-	-
90 x 90	797.4	793.7	690.0	202.2
90 x120	469.1	1018.3	920.0	258.1
120 x 60	798.7	1007.4	980.0	268.0
120 x 90	521.6	1485.1	980.1	311.0
120 x120	413.4	2612.5	1120.0	356.4
150 x 60	704.0	2293.8	1345.0	498.2
150 x 90	489.0	3659.6	1400.3	512.4
150 x 120	360.0	5108.3	1480.2	544.0
180 x 60	524.8	4866.0	1574.6	512.6
180 x 90	414.7	3724.8	2050.1	528.6
180 x 120	305.9	3936.0	1864.2	556.2
210 x 60	503.8	4628.0	1801.0	624.8
210 x 90	361.0	4835.7	2268.1	688.8
210 x 120	296.0	5572.5	2098.5	746.2
Mulberry (sole)	896.0	-	-	-
Frenchbean				
Groundnut-mustard		5850.0	2408.0	765.0

also performed well under the system. As reported earlier the land equivalent ratio (LER) was higher in the intercropping system of mulberry+rice than sole rice crop.

Table 10. Yield of mulberry and intercrop under sericulture with lowland rice.

Treatments	Yield (t/ha)		
	Cocoon	Fuelwood	Rice
Mulberry monoculture	0.80	21.60	—
Mulberry + intercrop	0.24	6.72	3.63
Mulberry+			
Rice (Ngoba)	0.24	6.72	3.18
Rice (RCPL-1-87-8)	0.24	6.72	1.70
Rice (RCPL-1-3)	0.24	6.72	4.51
Rice (RCPL-1-87-4)	0.24	6.72	3.20
Rice (Prasad)	0.24	6.72	3.60
Sole rice	—	—	3.86

3736 plants/ha on bunds

MUSHROOM

S. Chandra, A.K. Singh, and Sangit Kumar

Mushroom cultivation : To explore the possibility of year-round cultivation of Oyster mushroom (*Pleurotus* spp) under natural environment of mushroom house, six different types were tested at Barapani, Meghalaya. Three strains of *P. flabellatus*, two strains of *P. ostreatus* and one strain of *P. sajor-caju* were grown in different months. Paddy straw was used as substrate and standard block culture method was followed for growing mushrooms. Mushroom flushes were harvested 3-4 times during cropping period. The cumulative yield of each species/strains was recorded and expressed as fresh mushroom/kg of dry straw (Table-1).

The highest average yield (891 g) over months was recorded for *P. flabellatus* (B) followed by its strain (R) and (C). The average yield (619g) *P. sajor-kaju* over months was comparable with yield (623g) of *P. flabellatus* strain C. The yield performance of *P. ostreatus* (A) varied greatly in different months because of its low temperature (18°C) requirement for fruiting. It gave highest yield (870 g) in comparision to other strain/species in the cool (7.5°C minimum and 20.7°C maximum) months of January-February. Its yield was drastically reduced in moderate range (min. 12.1°C-19-5°C (22-26°C) of temperature i.e. from March to Octobetr. The strain R and B of *P. flabellatus* gave 777-881 g and 707-1133 g respectively in different months. The yield of *P. sajor-caju* was lowest (300 g) in January-February and in other months it ranged from 550-825 g.

The results showed that *P. flabellatus* R.B. and C were better adapted for wide range of temperature followed by *P. sajor-caju* which performed well except in cold season, *P. ostreautus* A was best for cooler months only.

Studies on the effect of temperature on mycelial growth of oyster mushroom

Ten type oyster mushroom (*Pleurotus* spp) were tested at 20°C, 25°C and 30°C to find out the optimum temperature for mycelial growth. The test species/strains were *P. ostreatus* (A) *P. ostreatus* (Phillipine strain), *P. florida, P. sajor-caju, P. sajorcaju* (p) *P. cornucopiea, P. flabellatus* (R), *P. flabellatus* (B) *P. flabellatus* (C) and *P. flabellatus* (S). These were grown on potato dextrose agar medium in plastic-petridishes of 9.5 cm diameter. The radial growth of mycelium was measured after seven days of incubation at 20°C, 25°C and 30°C. There were five replicates of each strain/species.

The results (Table-2) indicated that 25°C was best temperature for mycelial growth of all the strain/species tested. At

Table 1. Yield performance of Pleurotus spp/strains on paddy straw in different months at Barapani. Meghalaya , 1995

	Fresh Mushroom (g)/kg dry straw					
Species/strains	Jan-Feb.	Mar-April	May-June	July-Aug	Sept-Oct	Average
P. flabellatus (R)	777	725	905	828	883	823
P. flabellatus (B)	850	707	1133	711	1053	891
P. flabellatus (C)	700	500	1020	556	338	623
P. sajor-caju	300	643	775	825	550	619
P. ostreatus	395	450	410	193	213	332
P. ostreatus (A)	870	300	145	293	163	354
Trial mean	649	554	731	568	532	-
CD.05	375	N.S.	336	297	338	-
CV %	44	-	35	35	43	-

Table 2. Effect of different temperature on mycelial growth of Pleurotus sp/strains

	Colony growth (c.m.) on PDA			
Species/strains	20°C	25°C	30°C	Mean
P. ostreatus (A)	3.7	4.4	4.1	4.1
P. ostreatus (Ph)	3.6	5.0	3.8	4.3
P. florida	4.6	6.1	3.3	4.6
P. sajor-caju	4.6	7.7	1.5	4.6
P. sajor-caju (P)	4.6	7.4	1.5	4.5
P. corncopiea	4.6	6.6	4.4	5.2
P. flabellatus (R)	2.3	8.6	3.7	4.9
P. flabellatus (B)	1.5	7.9	4.0	4.5
P. flabellatus (C)	2.0	6.9	3.9	4.3
P. flabellatus (S)	4.8	6.2	3.6	4.9
Mean	3.6	6.7	3.4	
	SE	CD	CV%	
Species/strain	0.19	0.53*		
Temperature	0.10	0.29*		
Interaction	0.33	0.92**	14.3	

25°C maximum radial growth (8.6 cm) was recorded for *P. flabellatus* (R) followed by its strain (B) (7.9 cm) P. sajorcaju (7.7 cm) and *P. sajorcaju* (P) (7.4 cm). The least growth was shown by *P. ostreatus* (A) (4.4 cm). At 30°C *P. sajor-kaju* and its strain (P) showed minimum growth (1.5 cm). *P. flabellatus* (R), (B) and (C) showed 2.3, 1.5 and 2.0 cm growth at 20°C indicating their more sensitiveness to lower temperature range. All the test strain showed differential sensitivity to different temperature under test as evidenced by highly significantly interaction between strain and temperature. Mean radial growth averaged over strain at 20°C and 30°C was 3.6 and 3.4 respectively and did not differ significantly when compared to growth at 20°C and 30°C. It wsa concluded that mean temperature of 25°C would be essential for mycelial run of these strains/species in their cultivation.

FISH

Running water fish culture

B.K. Mandal

Trials were conducted using hillstream carp *Acrossocheilus hexagonolepis* with various stocking density of 5, 10, 15, 20 and 30 nos. fingerlings/M³ water area. The cultures were made for 12 months and the fishes were fed with supplementary feed at rice bran, oil cake, fish meal (1:1:1) @ 5% of the body wt. To avoid the loss of food under running water condition, the feed was kept inside a porous cloth bag hanging in water at the centre of the channel where water flow was slow. Further a wild herb (*Gynura crapidiodes*) was supplied @ 10% of the weight daily, hanging inside the water by rope. The growth of fishes (Table.1) indicated that the growth rate of fish declined with the increase of stocking density/M³ water area. The fishes reared in running water channel with minimum density of 5 nos. of fingerlings/M³ water area attained an average growth of 425 gms. However, in higher stocking density (30 nos. of fingerlings/M³ water area), the average growth of 310 gms were recorded during the 12 months period of culture.

The percentage of survival ranged from 91-97% with the stocking densities of 5 nos/M³ to 20 nos. fingerlings/M³ water area the survival rate was 85%. The percentage of relative growth rate are presented in Table 2. Higher percentage of relative growth rate was recorded from August to November. The prodution of fishes (Table -1) constantly increased at the stocking density of 5 nos.fingerlings/M³ water area to 20 nos. fingerlings/M³ water area. However, in higher stocking density (30 nos. fingerlings/M³ water area) indicated a decline in the rate of increase of production and were due to less growth as well as the increase in mortality rate during the culture period.

The observed food conversion ration (FCR) was 1.29 and daily weight gain per fish was 0.89 gms in the rearing density of 20 nos. fingerlings/M³ water area (Table -1). The average production of 6 kg fish/M³ water area was expected in this system.

Further, attempt was made to introduce the Common carp, *Cyprinus carpio* as a components of culture with chocolate mahseer, in the runing water system. The culture with chocolate mahseer, in the running water system. The culture were made by using *A. hexagonolepis*, 15 nos. fingerlings/M³ and *Cyprinus carpio* 10 nos. fingerlings/M³ water area. The fish were fed with supplementary feed of rice bran, oil cake fish meal and silk pupae (1:1:1) at the ratio of 5% of the body

weight. Further, as and when available the chopped chicken waste were added to the system. Aquatic weed/herbs were supplied @ 10% of the body wt. daily. The growth of fishes (Table 2) indicated the possibillity of mixed culture. However, at the initial stage of fingerlings selections, the common carp fingerlings should be larger in comparison to the *A. hexagonolepis* attained an average growth of 340 gms and *C. carpio* an average growth of 302 gms. From the system a fish production of 6.-7 kg fish/M³ water area can be expected.

Table 1. Growth and productivity of Chocolate Masheer in running water channels of 160 M³ water

Stocking density/M³ water area	% of survival	Initial weight of fish (g)	Final weight of fish (g)	Daily weight gain/fish (g)	Fish harvested weight	Production M³ water area during harvested (kg)	Feed conversion ratio (FCR)
1.	2.	3.	4.	5.	6.	7.	8.
5	96	25±3	425±20	1.09	326.40	2.04	1.39
10	97	22±2	402±25	1.04	623.90	3.89	1.41
15	95	20±3	388±18	1.0	884.64	5.52	1.30
20	91	25±4	350±22	0.89	1019.20	6.37	1.29
30	85	20±4	310±15	0.79	1054.00	6.58	1.28

Table 2. Growth and productivity of *A. hexagonolepis* and *Cyprinus carpio* in running water channels

Stocking density/M³ water area	% of survival	Initial weight of fish (g)	Final weight of fish (g)	Daily weight gain/fish (g)	Production M³ water area (kg)	Total production M³ water area (kg)
1.	2.	3.	4.	5.	6.	7.
15	96	25.30	340±20	0.85	4.6	—
10	100	35.50	302±15	0.71	2.6	7.2

HONEY BEE

N.S.A. Thakur and A.N. Shylesha

Introduction of *A. meltifera*

Performance of local strains under Barapani conditions revealed that 50% of the colonies could not perform well in the lean period of November and many colonies deserted. But the colonies developed fast during December-February when mustard was in full bloom. The colonies development retarded after February due to high wind velocity and non-availability of flora. During March the Brood frames were full of honey and colony started developing again when citrus was in flowering and during the second week of April sgain there was growth retardation due to non availability of flora.

Weak colonies suffered from lesser wax moth infestation and low temperature during Nov.-Feb. and mortality of adult bees was maximum last week to end of January.

Floral calender : During September-November Khasi cherry plants were in full bloom and during November-December peach plants were in flowering. Citrus flowering was observed in the last week of Feb. to 2nd week of March.

Influence of bee pollination on rapseed mustard

Two varieties M-27 and Baruna were sown in terraces. Two honey been colonies were also maintained in the field. Two sq. mt. areas of nylon mosquito cages were erected in field at 3 different places, net regulated bee movements which served control plants. without bee pollination. At flowering, the number of bees visited per plantt were recorded at different hours of the day starting from 8.00 hrs onwards upto 15 hrs on 10 plants for 5 mins. Other pollination were also recorded. The growth of the colonies were monitored. The colonies grew from 2 frames to 6 frames in $1^1/_2$ months and population also increased drastically. The pollen and nectar collection was very high during 8 hrs to 1200 hrs and 13 to 16 hrs. During Nov.-January, foraging started after 7.00 hrs during cold winter days. Bee pollinated mustard Varuna yielded 25.5 q/ha and M-27 yielded 19.5 q/ha during Rabi 1995. Yield in control (without bee pollination) was 14.34 q/ha in M-27 and 17.23 q/ha in Varuna varieties.

Insects pests on rabi crops

Mustard : Mustard sawfly population was very less on M-27 and Varuna varieties. During flowering and pod set mustard aphid *Lipaphis erysimi* and *Brevicoryne brassicae* incidence started, but was below economic threshold level.

Cabbage : Cabbage crop during early stages was attacked by aphids. Laboratoy experiment on the control of *Pieris brassicae* using *Bacillus thurengiansis* preparations like Biosop, Biobit and Biolep and neem formulations like Limanod. Neemark and Rakshakand fungal spores of *B. basiana* were tested along with cypermethrin and endosulfan. The B.T. preparations and neem based chemicals performed well and brought 80 - 90% kill after 48 hrs of treatment. Fungal spores of *B. basiana* was also equally effective and fungal spores started developing on the dead larvae after 72 hrs of treatment.

PIG

Breeding and Production

K.M. Bujarbaruah and A. Das

Upgraded Variety

Inter-se mating of the upgraded variety was carried out to study their stability as well as to maintain the varietyy for distribution to farmers and Govt. agencies. 267 animals of various age groups were distributed among Govt. and Private agencies of this region.

In addition to the assistance given in establishing 2 farms at Govt. level, (Meghalaya & Nagaland) around 120 small piggery Units were also established with our technical guidance.

Besides, 2 commecial Units, one at Byrnihat (Pig producers' Co-op Society) and the other at Changsari in Assam were established with the help of our technologies.

Production and repooduction paramenters recorded in the variety both in the Institute and state Department's farms are presented in Table 1.

While the performance of the variety at the Institute level was almost stable (Annual Report, 1994), its performance under State Veterinary Department's farm was comparatively better.

Indigenous pigs of Meghalaya (KL)

Progress made through Selection of indegenous pigs of Meghalaya upto 4th generation of selection was analysed. Pooled data collected on each generaton on different parameters are presented in Table 2.

The indegenous pigs, however, maintained their supremacy in the reproductive traits of age at first farrowing (314.00±16.64-387.00±14.02) and at inter farrowing interval (194.52±4.23-209.30±18.07) in 1st to 4th generation (Table 2) against 413.60 and 201.00 days respectively in the UG variety.

FEED AND FEEDING

Rice polish based feedding system

B.P.S. Yadav, and J.J. Gupta (Meghalaya)

A fedding trial was conducted, on four female pigs having average body weight of 23.50 ± 2.10 kg, for six months. The concentrate mash feed was offered *ad-libitum* having rice polish 60, wheatbran 37 parts and fortified with minearls, vitamins and salt alongwith green roughages available during the period viz. 1. Native grasses (Sept./Oct.) 2. Without green roughages (Nov./Dec.) and 3. Radish fodder (Jan/Feb). The maximum body weight gain (g/d) in pigs was on rice polish based feeding alone (256.25±16.14) and then on native grass (214.75 ± 8.72) and radish fodder (146.75 +18.72) supplemented groups. The nutrients digestibility and N-balance were satisfactory and almost similar in all groups except less protein and fibre utilization on radish groups (Table 3).

The rice polish based feeding system may be economical and practically feasible to the farmers of this region.

Nutritional value of Job's tear (*Coix-lachryma*) grain in pigs

J.J. Gupta, B.P.S. Yadav, and K.M. Bujarbaruah (Meghalaya).

A six weeks feeding trial on 87.5% upgraded Khasi local with Hampshire

Table 1. Performance record of the UG variety in the Institute and State Govt. Farm

Traits1`	Institute Farm	State Govt. Farm
Litter size at birth	7.12 (42) ±0.58	8.90 (10) ±0.47
Litter wt. at birth (Kg.)	7.51 (42) ±0.45	-
Litter size at weaning	6.12 (42) ± 0.58	7.70 (10) ±0.47
Litter wt. at weaning (kg)	55.50 (42) ±3.37	77.46 (10) ±4.33
Pre-weaning growth (9/days)	128.00	—
Wt. at 120 days	±16.14 (34) 0.41	-
Wt. at 180 days (kg.)	25.78 (11) ±0.87	28.75 (12) ±1.66
Post weaning growth (9/day)	139.00	155.75
Age at first farrowing (days)	413.60(10) ±26.62	-
Inter-farrowing interval (days)	201.00 (18) ±3.66	216.60 ±7.4

Figures in parenthesis indicate number of observations.

Table 2. Comparative performance of indigenous pigs from 1st to 4th generations

Traits	Generation				Percent increase from 1st to 4th
	1st	2nd	3rd	4th	
Litter size at birth	5.50 ±0.72	5.81 ±0.44	5.86 ±0.47	5.93 ±0.51	7.82
Litter wt. at birth (Kg.)	2.61 ±0.53	2.75 0.28	2.86 0.44	2.88 ±0.37	10.34
Litter size at weaning	3.50 ±0.46	3.18 ±0.51	3.56 0.41	4.54 0.31	48.85
Litter wt. at weaning (kg.)	15.61 +1.21	15.90 2.46	18.30 1.31	23.44 2.71	50.16
Individual birth wt. (kg.)	0.474	0.474	0.489	0.485	2.32
Male	0.495 ±0.23	0.486 ±0.02	0.498 ±0.15	0.495 ±0.23	—
Female	0.453 ±0.31	0.462 ±0.02	0.481 ±0.01	0.475 ±0.11	4.85
Individual weaning wt. (kg)	4.97	5.00	5.14	5.16	3.82
Male	4.83 ±0.41	4.72 ±0.33	5.26 ±0.16	5.01 ±0.45	3.72
Female	5.11 ±0.62	5.28 ±0.31	5.02 ±0.13	5.31 ±0.72	3.91
Wt. at 120 days (kg)	7.45 ±0.92	7.66 ±0.74	8.13 ±0.33	8.93 0.66	19.86
Wt. at 180 days (kg)	11.34 ±0.92	11.90 ±0.99	13.06 ±0.65	12.71 ±0.92	20.08
Age at first farrowing (days)	367.47 ±15.11	314.00 ±16.64	387.00 ±14.02	357.34 ±6.14	—
Inter-farrowing Interval (days)	194.52 ±4.23	209.30 ±18.07	207.66 ±7.33	205.57 ±16.26	—

Table 3. Performance of pig on rice polish based feeding system

Particulars	Treatments ± SE		
	Sept. - Oct. (Native grasses)	Nov. - Dec. (Without roughages)	Jan. - Feb (Radish fodder)
DM intake (kg/d)	1.39 ± 0.02	1.43 + 0.07	1.93 ± 0.03
Digestibility (%)			
DM	62.47 ± 4.54	64.23 + 0.72	66.35 ± 0.86
CP	63.18 ± 4.18	64.80 + 1.78	53.87 ± 1.94
CF	62.96 ± 4.47	63.27 + 1.91	42.05 ± 3.08
EE	71.10 ± 3.83	71.07 + 1.96	77.48 ± 1.63
NFE	65.61 ± 4.47	68.07 + 1.67	77.91 ± 0.61
N-balance (g/d)	0.93 ± 0.19	0.80 + 0.08	1.01 ± 0.10
Body weight gain (g/d)	214.75 ± 8.72	256.25 + 16.14	146.75 ± 18.72

pigs (10.78 ± 0.62 kg) was conducted to evaluate feeding value of corticated job's tears grains (CJTG). Twelve piglets of 60 days old in equal sex ratio were divided into 3 groups. The energy source of control diet was replaceed with 50 and 75% levels of CJTG and made isonotrogenous (CP 16%) with control. The growth, feed conversion efficiency and digestibility of DM and CP were similar in all the groups (Table 4). However, the digestibility coeffecient of Ca was significantly ($P<0.05$) higher on control (73.71 ± 3.69) test rations. CJTG can be safely utilized in swine ration as energy feed.

Salmonellosis

H.V. Murugkar

Studies were undertaken regarding the prevalence of Salmonella in pig in this region.

A total of 42 pig samples from Meghalaya were collected from diarrhoeic and apparently healthy animals. The samples were processed after proper enrichment in the enrichment media and subsequently isolated from the various selective media. *viz.*, Hektoenn Enteric Agar, Bismuth Sulphite Agar and Bril-

liant Green Agar. They were then confirmed by biochemical and serological tests. A total of 4 (9.52%) of the samples were found to be positive for Salmonella. The antibiogram studies of the Salmonella isolates revealed a varyig pattern of sensitivity. However, most of the isolates were found to be sensitive to Gentamycin (1 mcg) (9), Chloramphenicol (30 mcg) (8) and Amoxycillin (10 mcg) (7).

Studies on pig parasites

C. Rajkhowa and S. Bandyopadhyay

689 pig samples were examined during the reported period. Out of which 70 (10.15%) 47 (6.82%), 26 (3.77 per cent), 22(3.19 per cent), 59(8.54 per cent), 55 (7.89 per cent) were found to be positive for Strongyle, *Ascaris suum, Trichuris suits, Storongloides* sp., Sarcoptes sp. and *Coccidial* infection respectively. (Table 5).

Table 4. Growth performance and nutrient digestibility in pigs fed on job's tears grain based ration.

Particulars	Treatments ± SE		
	Without job's tears	50% job's tears	75% job's tears
Feed intake (g/d)	693.00 ± 8.51	686.57 ± 2.34	665.52 ± 8.65
Feed efficiency	8.74 ± 0.55	10.64 ± 1.00	11.73 ± 1.24
Nutrient digestibility (%)			
DM	83.88 ± 2.33	79.07 ± 3.16	81.27 ± 2.52
CP	84.08 ± 2.07	79.12 ± 2.76	83.63 ± 2.08
Ca	73.71 ± 3.69	63.75 ± 2.27	65.35 ± 2.04
Growth performance			
Body weight gain (g/d)	80.36 + 5.86	66.07 + 5.44	58.93 + 7.03

Table 5. Pattern of different pig parasites

Montha	Age group	NUmber of animals examined	Number of animals found positive					
			strong-yle	Ascaris suum	Trichu-ris	Strongy-loides	Sarcop-tes	Coccodial cyst
January to March	0-3 months	46	5 (10.86)	1 (2.12)	2 (4.35)	-	-	3 (16.52)
	3-6 months	47	6 (12.76)	2 (4.25)	1 (2.13)	-	2 (4.25)	4 (8.51)
	Above 6 months	85	5 (5.88)	2 (2.35)	1 (1.18)	2 (2.35)	5 (5.88)	4 (4.70)
April to June	0-3 months	25	2 (8)	-	-	1 (4)	-	2 (8)
	3-6 months	57	5 (8.77)	2 (3.51)	1 (1.75)	3 (5.26)	1 (1.75)	3 (5.26)
	Above 6 months	89	9 (10.11)	11 (12.36)	2 (2.25)	3 (3.70)	4 (4.49)	5 (5.62)
July to September	0-3 months	29	3 (10.34)	-	2 (6.90)	-	-	5 (17.24)
	3-6 months	41	2 (4.88)	2 (4.88)	4 (9.76)	3 (7.32)	4 (9.76)	3 (7.32)
	Above 6 moths	95	21 (22.10)	16 (16.84)	8 (8.42)	5 (5.26)	12 (12.63)	15 (15.79)
October to Decem-ber	0-3 months	25	2 (8)	1 (4)	-	-	-	5 (20)
	3-6 months	62	2 (3.22)	3 (4.84)	3 (4.84)	2 (3.22)	16 (25.81)	3 (4.84)
	Above 6 months	88	8 (9.09)	7 (7.95)	2 (2.27)	3 (3.41)	15 (17.04)	3 (3.41)
Total		689	70 (10.15)	47 (6.82)	26 (3.77)	22 (3.19)	59 (8.56)	55 (7.98)

Figure in parentheses indicate the percentage.

POULTRY

FEEDS AND FEEDING

Utilization of different fibre sources in broiler chicken

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

Feeding experiment was conducted on 176 VENCOB white broiler chickens (age 21 days) for a period of 42 days to evaluate the nutritional value of different fibre sources. Five fibre sources namely rice bean and stylosanthes fodder, groundnut, soybean straw and arhar (pigeon or cajan pea) pods were used at two levels of 5 and 10% respectiely in mash diets having 19% CP and compared against control. The birds gained highest body weight with better feed efficiency on control diet, which was at par to test diets containing rice bean fodder and groundnut straw meals at both levels (Table 1). The birds retained maximum protein, calcium and phosphorus on control and similar retention was also observed on diets based on rice bean fodder, groundnut and soybean straw fibre source. The lipid profiles in blood at 63 days indicated that among fibre sources soybean and groundnut had more lowering effect of cholesterol and lipids in serum.

The studies indicated, rice bean fodder and groundnut straw meal can be utilized to the level of 10% in broiler ration. The fibre levels from straw meals also helped in lowering cholesterol content of serum.

Economics of broiler chicken production

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

The day old Vencob broiler chicken strains were maintained at ICAR farm, Barapani, Meghalaya for two times. The standard conventioal mash diet (CP 22%) was offered *ad-lib*. The birds were reared for the period of 8 weeks. The growth rate, feed intake and mortality were recorded and their feed conversion ratio (FCR) and economics of production were calculated. The same data were also recorded from the two poultry farmers residing nearby Barapani, Meghalaya.

The birds reared at ICAR farm attained body weight 1.67±0.07 kg with 2.89 ± 0.07 FCR whereas the birds at farmer house attained similar body weight with better FCR (2.73±0.6). The mortality percentage was recorded less (3.50+0.50) at farmer house than ICAR farm (7.50 ± 1.50), and resulted into more net income (Rs. 19.97 ± 0.22) per bird at private farm than Govt. Farm (Rs. 18.01 ± 0.58) with 1.42 and 1.36 cost benefit ratio, respectively.

Table 1. Effect of feeding different fibre sources on growth performance, Nutrient utilization and blood lipids profile in broiler chicken.

Particulars	Treatments + SE										
	D_1	D_2*	D_3**	D_4*	D_5**	D_6*	D_7**	D_8*	$D9_*$	D_{10}*	D_{11}**
Growth performance											
Body weight gain (g/d)	32.30 ±0.36	31.70 ±0.42	30.30 ±0.33	31.60 ±0.41	31.70 ±0.07	24.90 ±0.21	24.60 ±0.05	26.60 ±0.56	26.10 ±0.13	26.60 ±0.21	26.20 ±0.09
Feed efficiency	3.20 ±0.09	3.24 ±0.01	3.42 ±0.06	3.08 ±0.03	3.49 ±0.05	4.19 ±0.01	4.43 ±0.11	3.79 0.04	4.21 ±0.08	3.49 ±0.06	3.82 ±0.04
Nutrient balance (g/100g intake)											
Protein	79.59 ±1.47	75.84 ±2.59	72.26 ±0.87	77.51 ±1.13	64.53 ±1.99	55.84 ±2.53	51.25 ±0.98	54.89 ±3.13	53.79 ±1.05	69.43 ±4.37	65.91 ±1.50
Fibre	14.18 ±0.49	25.16 ±1.57	23.73 ±0.92	32.33 ±1.67	24.00 ±2.07	25.72 ±0.77	19.17 ±0.81	24.70 ±0.90	22.38 ±4.82	22.66 ±1.46	21.66 ±2.74
Calcium	76.19 ±0.81	73.74 ±4.18	72.42 ±1.42	66.14 ±0.85	60.04 ±3.00	62.89 ±0.70	50.46 ±1.24	61.62 ±1.98	57.66 ±1.90	70.23 ±0.74	68.09 ±1.49
Phosphorus	71.12 ±1.24	70.76 +2.12	67.89 ±1.99	67.14 ±1.10	59.66 ±2.64	61.68 ±0.54	49.04 ±2.06	62.83 ±2.37	61.74 ±2.00	68.36 ±1.20	67.47 ±1.23
Lipids in serum (mg/100ml) at 63 days											
Total lipids	1540 ±20	1537 ±32	1511 ±31	1516 ±11	1465 ±05	1516 ±14	1453 ±06	1470 ±25	1460 ±19	1496 ±24	1465 15
Total cholesterol	348 ±16	355 ±05	341 ±13	272 ±24	267 ±03	283 ±15	287 ±14	362 ±09	327 ±15	367 ±18	289 +05

* 5% Fibre source ** 10% Fibre source

D1 : Control; D2/D3 : Rice bean; D4/D5 : Groundnut
D6/D7 : Soybean D8/D9 : Pigeon pea D10/D11 : Stylosanthes.

Thus, the studies indicated, the Vencob broiler strain can be reared for economical production in Meghalaya.

DISEASE

Salmonellosis

H.V. Murugkar

Studies were undertaken regarding the prevalence of *Salmonella* in poultry in this region.

A total of 26 poultry samples from Meghalaya were colected from diarrhoeic and apparently healthy birds. The samples were processed after proper enrichment in the enrichment media and subsequently isolated from the various selective media, viz., Heltoen Enteric Agar, Bismuth Sulphite Agar and Brilliant Green Agar. They were then confirmed by biochemical and serological tests. A total of 6(23.07%) of the samples were found to be positive for Salmonella in poultry. The antibiogram studies of the Salmonella isolates revealed a varying pattern of sensitivity. However, most of the isolates were found to be sensitive to Gentamycin (1 mcg) (9), Chloramphenicol (30 mcg) (8) and Amoxycillin (10 mcg) (7).

RABBIT

PRODUCTION AND REPRODUCTION

K.M. Bujarbaruah and A. Das

Broiler rabbit

Production and reproduction parameters collected on the broiler rabbit over the years were pooled and analysed. Findings are presented in Table 1.

There is significant difference of litter weight ($P< 10.01$) at birth and litter weight of weaning ($P< 0.05$) in two breds. With Newzealand White recording a litter weight at birth and weaning of 401.09 ± 47.61 g and 3.82 ± 0.09 kg. respectively against 362.72 ± 7.89 and 3.51 ± 0.11 in Soviet Chinchilla. Body weight at 96, 120 and 180 days also differed significantly.

It was observed that age at first kindling and inter-kindling interval differed highly significant ($P<0.01$). Difference in gestation period was significant ($P<0.05$) in the 2 breeds.

Angora rabbit

Performance of German Angora rabbit was found to be unsatisfactory with an average production of 650 g of wool per rabbit during the year. Production wise, the rabbits were observed to be suffering from a state of temporary infertility. Even the rabbits that did deliver, the litter size was observed to be only 3.50 at birth.

Wool quality was, however, observed, to be good with a staple length of 7.0 ± 0.25 fibre diameter of 11.

The wool so collected was spun locally with local skill and the spun wool was used for the preparation of shawls and sweaters which displayed in different exhibitions.

DISEASE

Salmonellosis

H.V. Murugkar

Studies were undertaken regarding the prevaalance of *Salmonella* in rabbit in this region.

A total of 66 rabbits samples from Meghalaya were collected from diarrhoeic and apparently healthy animals. The samples were processed after proper enrichment in the enrichment media and subsequently isolated from the various selective media, viz., Hektoen Enteric Agar, Bismuth Sulphite Agar and Brilliant Green Agar. They were then confirmed by biochemical and serological tests. A total of

Table 1. Production and reproduction traits of NZW and SC rabbits

Traits	Breeds	
	Newzealand White (NZW)	Soviet Chincilla (SC)
Litter size at birth	6.38±0.11 (116)	6.45±0.14 (116)
Litter wt. at birth (g)	401.09±47.61 (116)	362.72±7.84 (116)
Litter size at weaning	4.89±+0.08 (116)	4.99±0.09 (116)
Litter wt. at weanign (kg)	3.82±0.09 (110)	3.51±0.11 (110)
Body wt. at 96 days (kg.)	1.93±0.11 (96)	1.82±0.07 (96)
Body wt. at120 days (kg.)	2.34±0.09 (96)	2.17±0.13 (96)
Body wt. at 180 days (kg.)	2.68±0.16 (96)	2.59±0.08 (96)
Age at first kindling (days)	206.88±1.44 (116)	211.25±0.82 (116)
Gestation period (days)	30.28±0.09 (96)	30.66±0.10 (96)
Inter-Kindling interval (daya)	90.55±0.67 (96)	15.68±0.67 (96)

(Figures in parenthesis indicate number of observations)

1(1.52%) of the samples were found to be positive for Salmonella in rabbits. The antibiogram studies of the *Salmonella* isolates revealed a varying pattern of sensitivity. However, most of the isolates were found to be sensitive to Gentamycin (10 mcg) (9), Chloramphenicol (30 mcg) (8) and Amoxycillin (7).

Pasteurellosis

Pasteurella multocida antigen was prepared using purified *P. multocida* culture and specificity testing was done with the help of a standard *P. multocida* serum. An hyperimmune serum was raised against the antigen in rabbits and is being used for confirmation of *Pasteurellosis.*

Monitoring and surveillance of rabbit coccidiosis

C. Rajkhowa and S. Bandyopadhyay

938 rabbit samples were examined throughout the year from 3 age groups

Table 2. Pattern of mite infestation

Months	Number of animals examined	Number ofNumber of Animals found positive			
		Psoroptes cuniculi	Sarcoptes scabiei	Both	Total
January	165	14 (8.48)	12 (7.27)	9 (5.45)	35 (21.2)
February	194	9 (5.45)	11 (6.66)	6 (3.63)	26 (13.40)
March	220	9 (4.09)	10 (4.54)	6 (2.72)	25 (11.36)
April	225	10 (3.92)	12 (4.70)	5 (1.96)	27 (10.59)
May	196	7 (3.57)	8 (4.08)	3 (1.53)	18 (9.18)
June	280	7 (2.50)	9 (3.21)	3 (1.07)	19 (6.78)
July	255	8 (3.14)	10 (3.92)	4 (1.56)	22 (8.63)
August	175	7 (4)	8 (4.57)	3 (1.71)	18 (10.28)
September	290	14 (4.83)	16 (6.53)	6 (2.45)	36 (12.41)
October	245	166 (6.53)	19 (7.75)	8 (3.26)	43 (17.55)
November	265	17 (6.41)	18 (6.79)	10 (3.77)	45 (16.98)
December	215	15 (6.98)	14 (6.51)	9 (4.18)	38 (17.67)

Figure in parentheses indicate the percentage.

(0-3 months; 3-6 months and above 6 months). Out of these animals only 25 animals (2.67%) were found to have low level of *Coccidial* infection. The main species of *Eimeria* recorded during this period were *Eimeria stiedae; E. intestinalis; E. media* and *E. irresidua.*

Out of 25 animals found positive no animals were recorded with high level of infection. This was due to the implementation of Preventive dosing from April to September. The percentage of positive animals during March, April, May, August, October, November and December were 3.27%, 4.05%, 3.70%, 4.42%, 4.54%, 6.34% and 1.73% respectively.

Monitoring and surveillance of rabbit mite infestation

C. Rajkhowa and S. Bandyopadhyay

During the reported period of 1995-96, ear cankers caused by *Psoroptes cuniculi* and skin lesions due to *Sarcoptes scabiei* were detected throughout the year. The mite infestation was found to be high during the cooler months. (Table 2). The percentage of animals infected with both of these mites were higher in the age group of Above 6 months of age. No animals could be detected with mite infestation in the age group of below 3months of age, while in the age group of 3-6 months the percentage of animals sufer from *Psoroptes cuniculi* and *Sarcoptes scabiei* were 8.21% and 7.67% respectively. The percentage of Animals infected, in hte age group above 6 months were 21.15% and 21.51% from *Psoroptes cuniculi* and *Sarcoptes scabiei* respectively.

The animals affected with these mites were successfully treated with Butox at a concentration of 50 ppm and 75 ppm against *Sarcoptes scabiei* and *Psoroptes cuniculi* respectively.

CATTLE

DISEASES

Mastitis in dairy cows

H.V. Murugkar

Twenty three milk samples from cows suspected for mastitis from the Institute's farm and the neighbouring areas of Shillong were subjected to bacteriological examination. the samples were streaked directly on vogel Johnson's Agar. Slanetz and Bartley medium and Blood agar and incubated at 37°C for 24 hours. the isolates were further subjected to biochemical tests for identification and confirmation. Antibiogram studies were carried out for the isolates unsing antibiotic sensitivity discs (Hi-Media). *Staphylococcus aureus* was isolated from most of the samples (ii) followed by *Streptococcus faecalis* (5) *Streptococcus aglactiae* (3) *Klebsiella sps* (1) and others (3).

Antibiogram studies revealed Amoxycillin (78%) streptomycin (61%), *Penicillin* (65%) were the most effective antibiotics against the isolates.

Partial farm budgeting techniques in different situation related to control of gastro-intestinal parasites of cattle.

C. Rajkhowa and S. Bandyopadhyay

This study was also initiated from January 1996 and with an aim to find out the economic consequence of a change in farm procedures. From this we considered milk yield and dung yield which are likely to be influenced by gastro-intestinal parasites. For this 5 farmers were choosen from Pynthorumkhrah areas. 5 lactating animals were choosen from each of the farmers to put them in 5 different farm procedure to control gastro-intestinal parasites. The five procedures choosen were as follows.

(a) **Non strategic treatment I** - The anthelmintic treatment will be given as and when the farmer feel their animals to be treated.

(b) **Non strategic treatment II** - Anthelmintic treatment will be given to the animals when they will be diagnosed to be affected clinically on examination.

(c) **Anthelmintic schedule I** - This will be once in a month throughout the year.

(d) **Anthelmintic schedule II** - This will be once in a month during vulnerable period/season.

(e) **Control** - They will not be treated.

Each group will have 5 animals. All these animals will be supported with fortified diet.

The marginal cost put in these different systems will be calculated along with the marginal cash return over from each of the strategies. The milk yield and dung yield which are likely to be influenced by gastrointerstinal parasites as well as due to adoption of strategies will be taken in to consideration.

During the reported period, the animals were examined and the following parasites were identified.

(a) Strongyle infection

(b) *Coccidial infection*

(c) *Trichuris sp.*

(d) *Strongyloides sp*

After finding out their seasonal pattern various strategies for their control will be implemented during the next year.

Studies of protein profile of tick gut antigen by Sodium dodecyl sulphate polyacrylamide gel electrophoresis. (SDS-PAGE)

S. Bandyopadhyay and C. Rajkhowa

SDS-PAGE was carried out in 10 percent uniform concentration of gel to see the polypeptide pattern of tick gut antigen of *Boophilus microplus* tick of cattle. These ticks were collected from various localities of Barapani areas. After staining with commasie blue stain, we could identify 10 polypeptides in the tick gut antigen. But the same antigen, when we stained with silver nitrate, the number of polypeptide bands was increased to 25. We could not determine the molecular weight of polypeptides due to non-availability of molecular weight marker. Efforts are on to determine the molecular weight as well as the immunopotent ractions which will help us to determine the immunoprotective antigen in future.

Development of data-based computer programme related to parasitic disase of livestock.

S. Bandyopadhyay abd C. Rajkhowa

(a) A data-based Computer programme has been developed to facilitate the identification of Parasitic ova as well as larvae of different host. This programme is based on morphological characters only. This programme the users can identify up to the genus level of different parasites. The programme ask users to select the appropriate choice which were already been entered in the programme on the basis of choice, the computer can identify specifically the parasitic egg and larvae. This programme is very much users friendly and can run in any personal computer, having at least 2 MB Ram.

(b) An expert system was designed to facilitate retrieval of detailed information on Haemonchus infestation in animals. This programme is written in dbase language which includes information regarding host, morphology, epidemiology, life cycle, pathogenesis, clinical signs, postmortem lesions, immunology, diagnosis, treatment and control. This programme is menu driven and users friendly. On each menu there is an online help option for the menu. Sequentially arranged reference pertating to every aspects of the disease can be retrieved through this menu driven option. This programme will provide the users an easy access to the detailed information and references on any aspects of haemochosis in sheep, goat and cattle.

SOIL AND WATER RESOURCE

Rainfall-runoff model for small hils watersheds

K.K. Satapathy

Rainfall hydrological planning necessitates the estimation of quantum of water that can be developed for utilization in relation to the quantum of water infiltrated into the soil with various treatments. For nine small watersheds (area ranging from 0.52 ha to 3.8 ha) in the ICAR farm hydrological data are now available for considerable length of time to make an accurate assessment of the water yield characteristics of the watersheds. The unit hydrograph model attempts to establish a relationship between the effective rainfall of a storm and the resulting direct runoff hydrograph for a watershed without directly involving the losses of rainfall in the model. By inspection of discharge records isolated and single peaked stormflows of relatively short periods were selected to derive average 30 minute unit hydrogrphs for all the nine experimental watersheds following standard procedures. Five unit hydrograph parameters (Fig 1) Q_p (peak runoff rate); T_p time to peak; T_b (time base), T_{50} (time to 50% peak discharge) D_{50} (unit hydrograph width at 50% peak discharge) were regressed on three independent variables : area of the watershed, average slope and conservation factor (the effect of conservation measures, land use as well as human and animal interferences). The regressions equations of the parameters namely, Q_p , T_p, T_b, T_{50}, D_{50} is in term of watershed area, conservation factors, average slope obtained with multiple correlation analysis using log transformed value are as follows :

$$Q_p = 0.156\ A^{1.22}\ S1.22\ S^{0.392}\ C^{0.787} \quad (n = 9,\ r = 0.997)$$

$$T_p = 0.696\ S^{0.128}\ S^{0.360}\ C^{0.252} \quad (n = 9,\ r = 0.99)$$

$$T_b = 1.49\ A^{0.227}\ S^{0.212}\ C^{0.411} \quad (n = 9,\ r\ 0.98)$$

$$T_{50} = 0.55\ A^{0.094}\ S^{0.251}\ C^{0.263} \quad (n = 9,\ r = 0.98)$$

$$D_{50} = 0.64\ A^{0.121}\ S^{0.251}\ C^{0.263} \quad (n = 9,\ r = 0.93)$$

Where,

Q_p = peak discharge (m^3/sec)
T_p = time to peak discharge (hr)
T_b = time base of unit hydrograph (hr)
T_{50} = time to 50% peak discharge (hr)
D_{50} = unit graph width at time T50 (hr)
A = area of the watershed (hectre)
S = average slope of the watershed (percent)
C = conservation factor.

According to above equations, watershed with large area should have greater peakflow, time base and time to peak. It

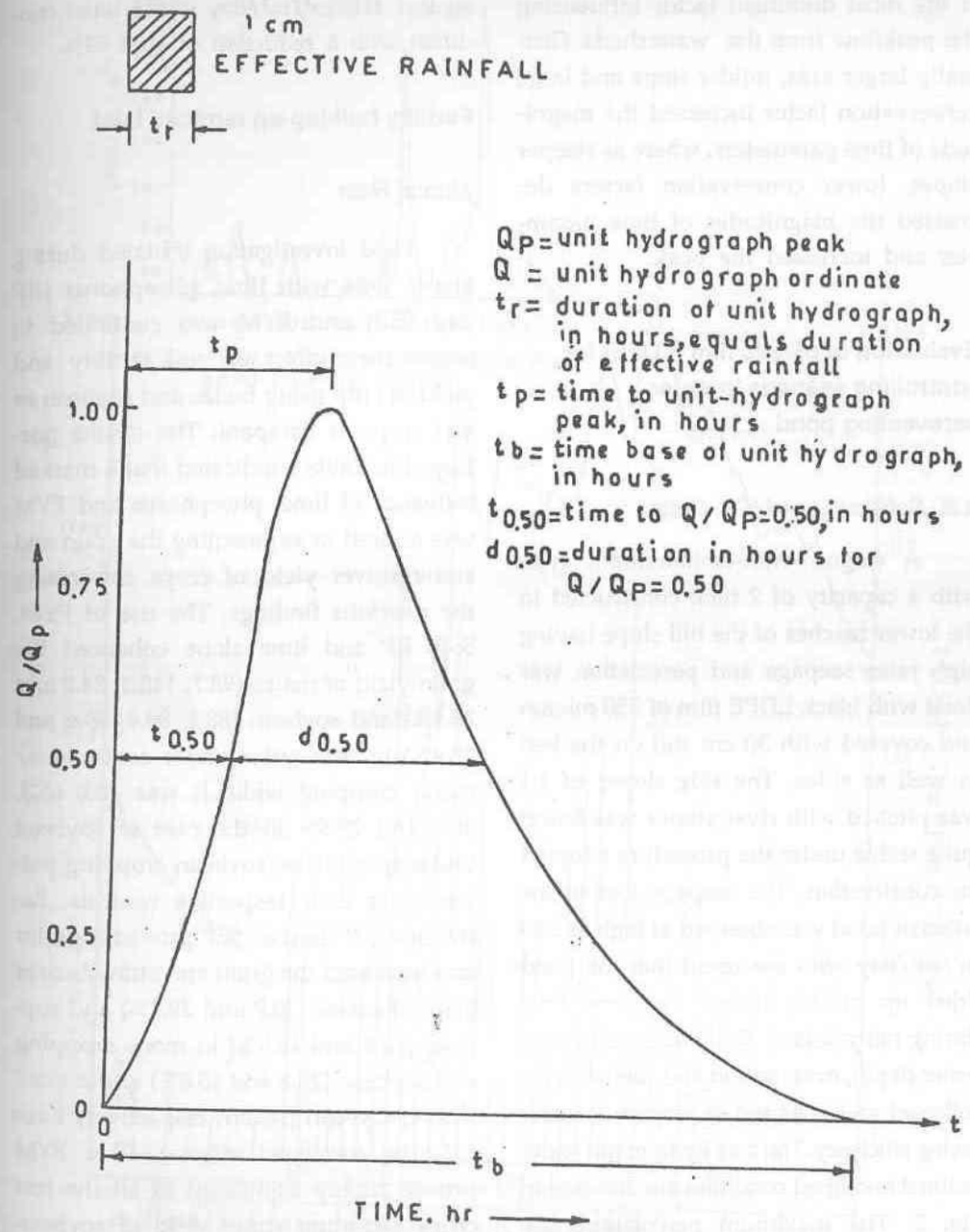

Fig. 1. Unit hydrograph parameters-definition sketch

is the most dominant factor influencing the peakflow from the watersheds. Generally larger area, milder slope and large conservation factor increased the magnitude of time parameters, where as steeper slopes, lower conservation factors decreased the magnitudes of time parameter and increased the peak.

Evaluation of plastic film (LDPE) for controlling seepage in water harevesting pond

K.K. Satapathy and K.K. Dutta

A dugout-cum-embankment type with a capacity of 2 ham constructed in the lower reaches of the hill slope having high rates seepage and percolation was lined with black LDPE film of 250 micron and covered with 30 cm soil on the bed as well as sides. The side slopes of 1:1 was pitched with river stones was found quite stable under the procedure adopted for construction. The seepage loss in the adjacent pond was observed as high as .055 m^3/m^2/day with the result that the pond dried up quickly except for some time during rainy season. Daily observations on water depth, evaporation and rainfall were collected and analysed in respect of water saving efficiency. The total hydrograph under unlined and lined condition are depicted in Fig. 2. The maximum percolation rate through the pond under unlined conditon was to the tune of .040 m^3/m^2/day as against .0029m^3/m^2/day under lined condition with a reduction of abot 93%.

Fertility buildup on terraced land

Munna Ram

Field investigation initiated during kharif 1984 with lime, phosphorus (RP and SSP) and FYM was continued to assess their effect on soil fertility and yield of crop using maize and soybean as test crops at Barapani. The results portrayed in Table 1 indicated that a marked influence of lime, phosphorus and FYM was noticed in augmenting the grain and straw/stover yield of crops confirming the previous findings. The use of FYM, SSP, RP and lime alone enhanced the grain yield of maize (98.7, 140.3, 84.0 and 26.1%) and soybean (88.1, 86.4, 59.6 and 25.4%) in that order under continuous/mono cropping while it was 108, 65.3, 36.8 and 29.8% in the case of soybean under rice/maize/soybean cropping pattern over their respective controls. Between the P sources, SSP proved superior and increased the grain and straw/stover yield of maize (30.9 and 29.1%) and soybean (16.8 and 16.9%) in mono cropping and soybean (20.8 and 15.8%) under rice/maize/soybean pattern respectively over RP. The combined effect of P x FYM proved highly significant in all the test crops excepting straw yield of soybean under rice/maize/soybean pattern. Whereas P x L and L x FYM effect did

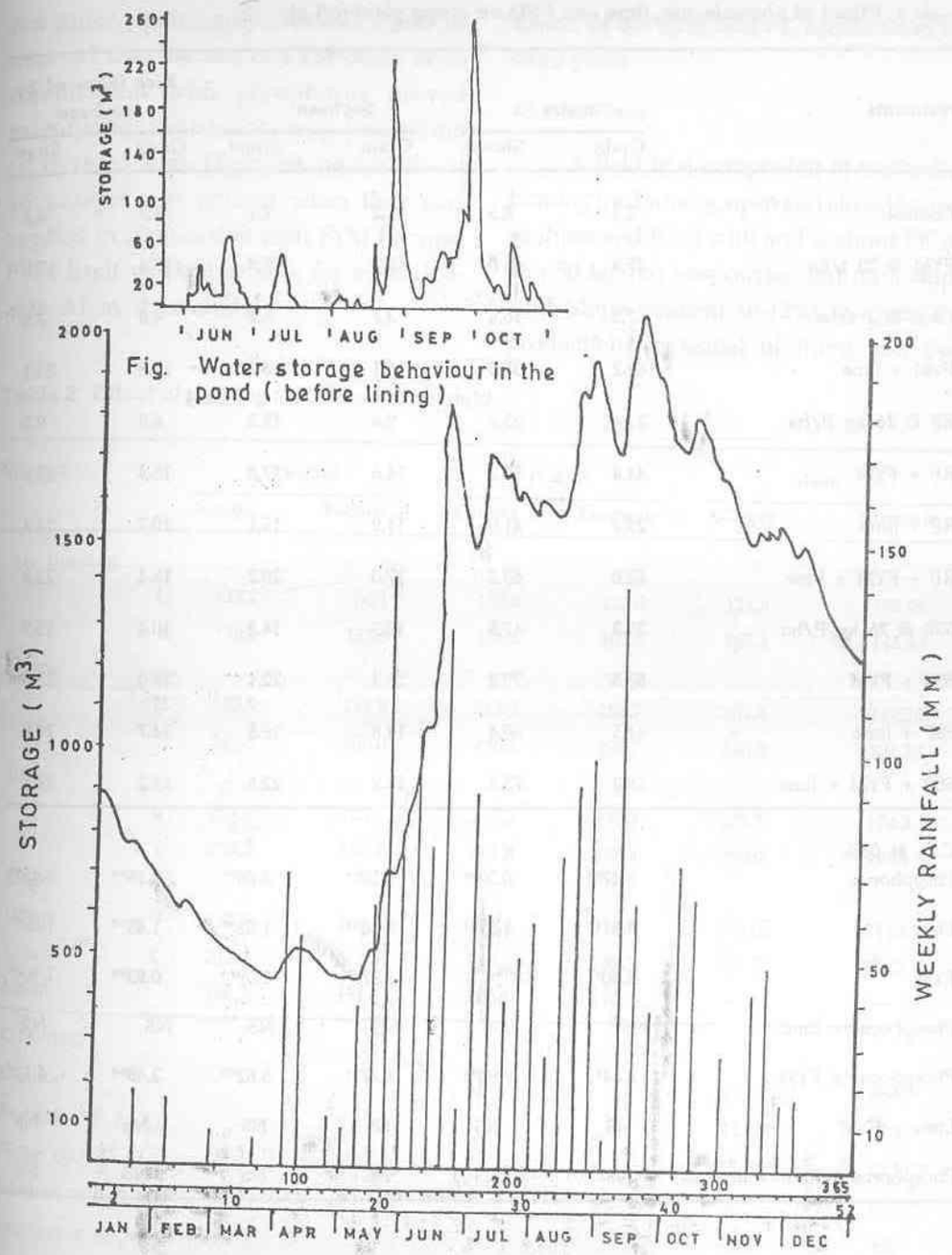

Fig. 2. Water storage behaviour of the pond (after lining)

Table 1. Effect of phosphorus, lime and FYM on crops yield (q/ha)

Treatments	maize		Soybean		Rice followed by soybean	
	Grain	Stover	Grain	Straw	Grain	Straw
Control	2.5	8.5	1.2	2.1	1.7	4.8
FYM @ 20 t/ha	27.9	44.0	12.3	15.8	13.4	17.5
Lime @ 2 t/ha	7.3	16.4	3.7	6.2	4.8	7.8
FYM + lime	42.2	55.0	16.1	18.2	17.8	23.1
RP @ 26 kg P/ha	21.6	33.6	9.6	13.3	6.8	9.2
RP + FYM	44.4	56.7	14.6	17.8	15.4	23.6
RP + lime	28.7	41.0	11.9	15.1	10.7	14.4
RP + FYM + lime	52.0	63.5	17.0	20.2	18.4	23.8
SSP @ 26 kg P/ha	35.3	47.5	10.3	14.2	10.4	15.9
SSP + FYM	53.6	70.2	18.2	22.1	18.0	23.5
SSP + lime	44.5	60.4	14.8	18.5	14.7	18.0
SSP + FYM + lime	58.7	73.3	18.8	22.8	19.2	24.8
C.D. at 05%						
Phosphorus	5.47**	6.39**	2.20**	3.06**	2.18**	3.45**
Lime	3.31**	4.27**	1.40**	1.82**	1.43**	1.59**
FYM	2.80**	3,87**	1.37**	1.59**	0.93**	1.90**
Phosphorus x lime	NS	NS	NS	NS	NS	NS
Phosphorus x FYM	6.44*	7.93**	2.77**	3.62**	2.45**	4.15*
Lime x FYM	NS	NS	NS	NS	NS	NS
Phosphorus x FYM x lime	NS	NS	NS	NS	NS	NS

not differ significantly. Thus, it could be inferred that the use of FYM alone or in combination with phosphorus proved essential for sustainable crop production on terraced land. However, no additional advantages was noticed when lime was applied in conjunction with FYM because FYM itself worked as sink for exchangeable Al in these soils.

Effect of burning and PK application on crop yield

Munna Ram

A field trial comprising of method of burning (no burning, open and closed known as Jhum and Bun) with and without PK (@ 26 : 50 kg/ha) was carried out on a slopy land (slope gradient 10-12%) to assess the productivity potential of Jhum and Bun

Table 2. Effect of burning and PK on crop yield

Method		Control		P & K		Mean	
		Ginger	Turmeric	Ginger	Turmeric	Ginger	Turmeric
No burning							
	U	112.7	86.1	130.9	120.0	121.8	103.05
	L	138.2	123.6	156.4	167.3	147.3	145.40
Jhum							
	U	185.5	141.8	218.2	152.7	201.8	147.20
	L	243.6	200.0	236.4	203.7	240.0	201.90
Bun							
	U	203.7	163.6	247.3	185.4	225.5	174.5
	L	258.2	196.4	261.8	196.4	260.0	196.4
Slope							
Upper	U	167.3	130.5	198.8	152.7	183.05	141.6
Lower	L	213.3	173.3	218.2	189.1	215.75	181.2
Mean		190.3	151.9	208.5	170.9	—	—
C.D. 05%							
Method						77.77*	38.93*
Fertilizer (P & K)						12.32*	7.45**
Slope (U/L)						11.08**	12.11**
Method x fertilizer						NS	39.97*
Method x slope						NS	NS
Fertilizer x slope						16.54*	NS
Method x fertilizer x slope						NS	NS

farming under identical soil and climatic condition at Barapani. Ginger and turmeric was raised as test crop with 80 kg N/ha. The result presented in Table 2 indicated that burning had profound effect on growth and rhizome yield of both the crops. In general, burning proved superior to no burning whereas Jhum and Bun did not differ significantly. On an average, 40.4, 49.3 and 12.5% additional rhizome yield of turmeric was obtained under Jhum, Bun and PK treatment over control while it was 63.7, 79.1 and 9.6% in case of ginger in that order. However, 28.0 and 17.9% additional yield of turmeric and ginger was also recorded in between the upper and lower half of the same bun indicating the effect of slope gradient. The interaction effect of method x fertililzer and fertilizer x slope was significant in turmeric and ginger respectively. In general, turmeric yield was very poor due to servere damage caused by leaf disease.

Residual effect of burning and PK application on crop yield

Muna Ram

A field trial initiated during 1994-95 on method of burning and PK application was continued to assess their residual effect on crop yield at Barapani. Sweet potato cv. local was raised as test crop with 80 kg N/ha. The result presented in Table 3 indicated that the difference in tuber yield was more pronounced with method of its burning than PK application and slope gradient. On an average, 39.6, 53.7, 21.9 and 31.4% additional tuber yield was recorded under Jhum, Bun, PK application and slope gradient while it was 14.2, 63.7, 20.3 and 48.3% in case of sucker in that order. A non-significant difference in tuber yield was also recorded in the case of Jhum and Bun farming. However, the interaction effect of method, fertililzer application and slope gradient was non-significant.

Table 3. Residual effect of burning and PK on sweet potato yield

Method		Control		P & K		Mean	
		Tuber	Sucker	Tuber	Sucker	Tuber	Sucker
No burning							
	U	79.0	4.4	110.1	5.8	94.55	5.1
	L	111.4	6.5	146.5	8.1	128.95	7.3
Jhum							
	U	116.1	4.4	155.6	5.6	135.85	5.0
	L	156.5	8.1	196.0	10.6	176.25	9.1
Bun							
	U	147.5	7.6	151.4	9.8	149.45	8.7
	L	181.8	11.4	206.1	11.6	193.95	11.5
Slope							
Upper	U	114.2	5.47	139.03	7.07	126.62	6.27
Lower	L	149.9	8.67	182.87	9.93	166.40	9.30
Mean		132.05	7.07	160.95	8.50	—	—
C.D. 05%							
Method						19.66**	1.36**
Fertilizer (P & K)						12.42**	NS
Slope (U/L)						10.60**	0.91**
Method x fertilizer						NS	NS
Method x slope						NS	NS
Slope x Fertilizer						NS	NS
Method x fertilizer x slope						NS	NS

AGRICULTURAL PROCESSING

Dilip Jain

Biogas evolution from piggery waste

The cylindrical digester of 58 cm diameter x 70 cm length (185 litre) supported in a horizontal position and a floating gas holder of 53 diameter x 85 cm length inverted barrel were fabricated for an expermental anacrobic digestion. The piggery waste procured from pig barn of animal production division was having bulk density of 1.033 g/cc at 64.06% moisture content. The digester was loaded with the slurry of piggery waste and water in 1:! ratio by volume. After 2 week of initial loading, a regular loading rate was mentained as 0.06 1/1 of digester/ day of waste and water slurry (1:1 ratio). Gas evolution was observed on the lift basis of gas holder. The average gas evolution was 0.4421 1/1 of digester/day for 45 days. The PH of slurry ranged from 5.9 to 8.1. This gas was tried to burn in a biogas stove, but gas showed no burning tendency ans smelt badly. The following points were inferred from this trial, (a) methane percentage in the gas was not sufficient, (b) H_2S gas might be responsible for bad smell, and (c) absence of methnogenic bacteria in the digester (Fig 1 and 2).

With a view to generate methanogenic bacteria, the culture was prepared by reloading the digester with the slurry of cow dung and water in 1:1 ratio by volume. After 2 weeks of initial loading, a regular loading rate was mentained same as first trial as 0.06 1/1 of digester/day of piggery waste and water slurry (1:1 ratio). A uniform gas evolution was obtained from 4th week of initial loading. This gas was also tried to burn on the biogas stove. It burnt nicely with blue flame and remained odourless. The daily gas evolution was recorded. The weekly gas evolution was analysed with every week and average maximum temperature of the week. The gas evolution on week basis in graphically represented in the Figure 2. The gas evolution increased as 3.0 1/1 of digester upto 14th week and decreased to 1.5 1/1 of digester upto the 26th week of the reaction. The linear regression have been established in two halves from 1st to 14th week and from 14th to 26h week of the reaction as :

$Y = 0.567 + 0.2099\ W_{1\text{-}14}$ ($r = 0.8270$)

$Y = 5.0299 - 0.1414\ W_{14\text{-}26}$ ($r = 0.9216$) where

Y = gas evelution in 1/1 of digester/week

$W_{1\text{-}14}$ = reaction time in week from 1 to 14

$W_{14\text{-}26}$ = reaction time in week from 14 to 26

Observation were recorded from July to December months. The weekly gas evolution and average maximum temparature of week were shown in figure 2. A linear

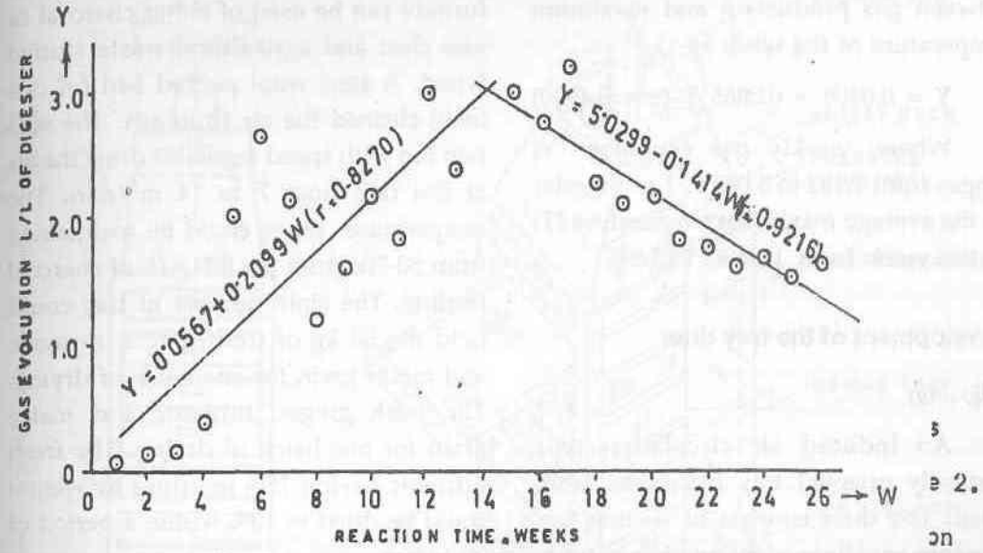

Fig. 1. Gas evolution depends on reaction time

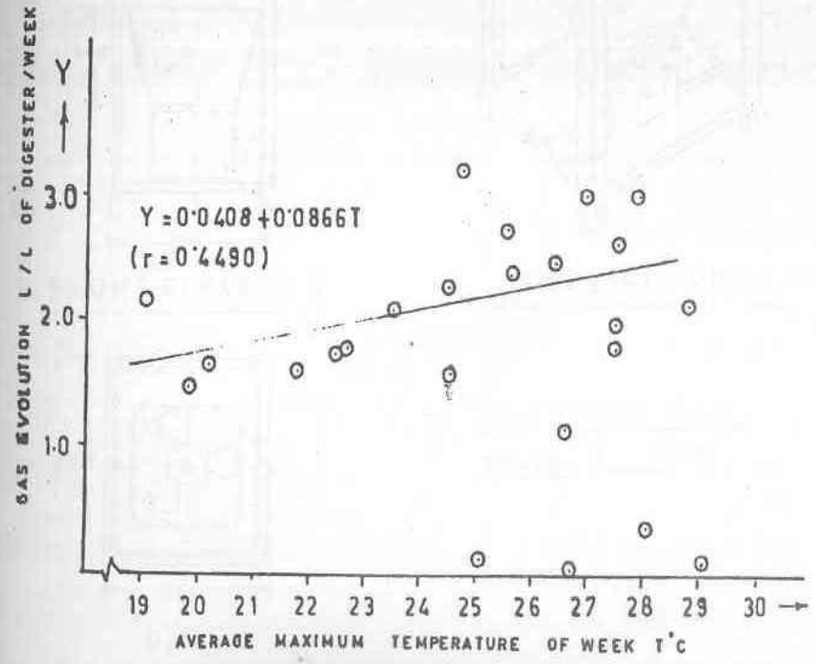

Fig. 2. Gas evolution depends on temperature

regression represents a poor carelation between gas production and maximum temperature of the week as

$$Y = 0.0408 + 0.0866\ T\ (r = 0.4990)$$

Where, weekly gas evolution (Y) ranges from 1.192 to 3.095 1/1 or digester on the average maximum temperature (T) of the week from 19.9 to 29.1c.

Development of the tray drier

Dilip Jain

An induced air circulation type vertically oriented tray drier was fabricated. The drier consists of suction fan, pressure equalizer, eight number of trays, air cleaner and furnace (Fig 3). The furnace can be used of either charcoal or saw dust and agricultural waste stuffed typed. A steel wool packed bed (of one inch) cleaned the air from ash. The suction fan with speed regulator drew the air at the rate from 7 to 14 m^3/min. The temperature range could be maintained from 50-70c from the 500 g/h of charcoal feeding. The eight number of tray could hold the 50 kg of fresh ginger, turmeric and maize grain for one batch of drying. The fresh ginger, turmeric and maize grain for one batch of drying. The fresh turmeric having 75% moisture by weight could be dried to 10% within a period of 30 hours.

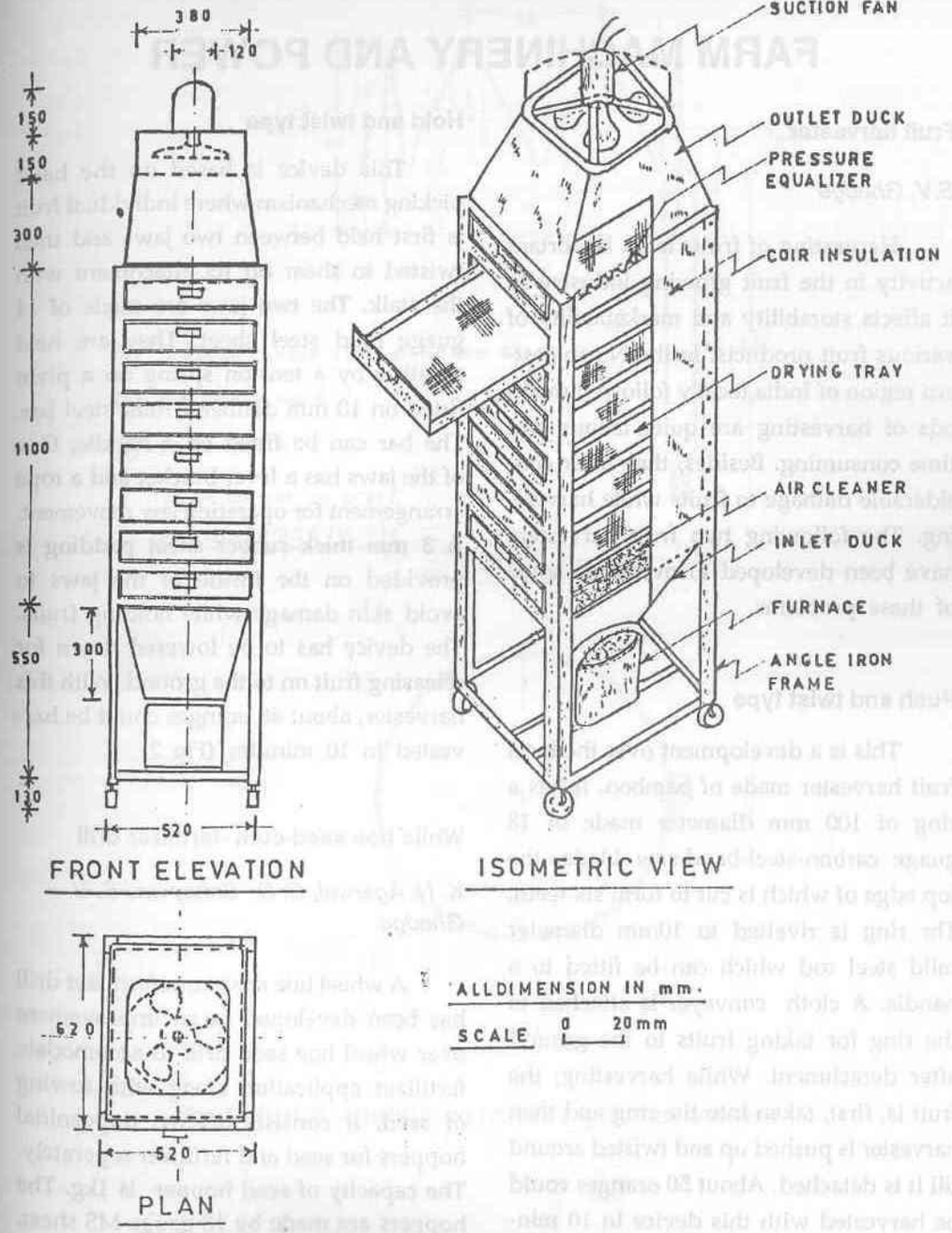

Fig. 3. Tray drier

FARM MACHINERY AND POWER

Fruit harvester

S.V. Ghadge

Harvesting of fruits is an important activity in the fruit growing industry as it affects storability and marketability of various fruit products. In the North-eastern region of India,locally followed methods of harvesting are quite labour and time consuming. Besides, they offer considerable damage to fruits while harvesting. The following two fruit harvesters have been developed to overcome some of these problems.

Push and twist type

This is a development over the local fruit harvester made of bamboo. It has a ring of 100 mm diameter made of 18 guage carbon-steel-band-saw blade, the top edge of which is cut to form six teeth. Thr ring is rivetted to 10mm diameter mild steel rod which can be fitted to a handle. A cloth conveyer is attached to the ring for taking fruits to the ground after detachment. While harvesting, the fruit is, first, taken into the ring and then harvester is pushed up and twisted around till it is detached. About 50 oranges could be harvested with this device in 10 minutes (Fig. 1).

Hold and twist type

This device is based on the hand picking mechanism where individual fruit is first held between two jaws and then twisted to shear off its attachment with the stalk. The two jaws are made of 14 guage mild steel sheet. They are held together by a tension spring on a pivot fitted on 10 mm diameter mild steel bar. The bar can be fitted on a handle. One of the jaws has a lever bracket and a rope arrangement for operating jaw movement. A 3 mm thick rubber sheet padding is provided on the inside of the jaws to avoid skin damage while holding fruits. The device has to be lowered down for releasing fruit on to the ground. With this harvester, about 40 oranges could be harvested in 10 minutes (Fig 2).

While hoe seed-cum -fertilizer drill

K. N. Agarwal, C. S. Sahay and S. V. Ghadge

A wheel hoe seed-cum-fertilizer drill has been developed as an improvement over wheel hoe seed drill to accomodate fertilizer application along with sowing of seed. It consists of two trapozoidal hoppers for seed and fertilizer seperately. The capacity of seed hopper is 1kg. The hoppers are made by 18 gauge MS sheet. The hopper for fertilizer is provided with

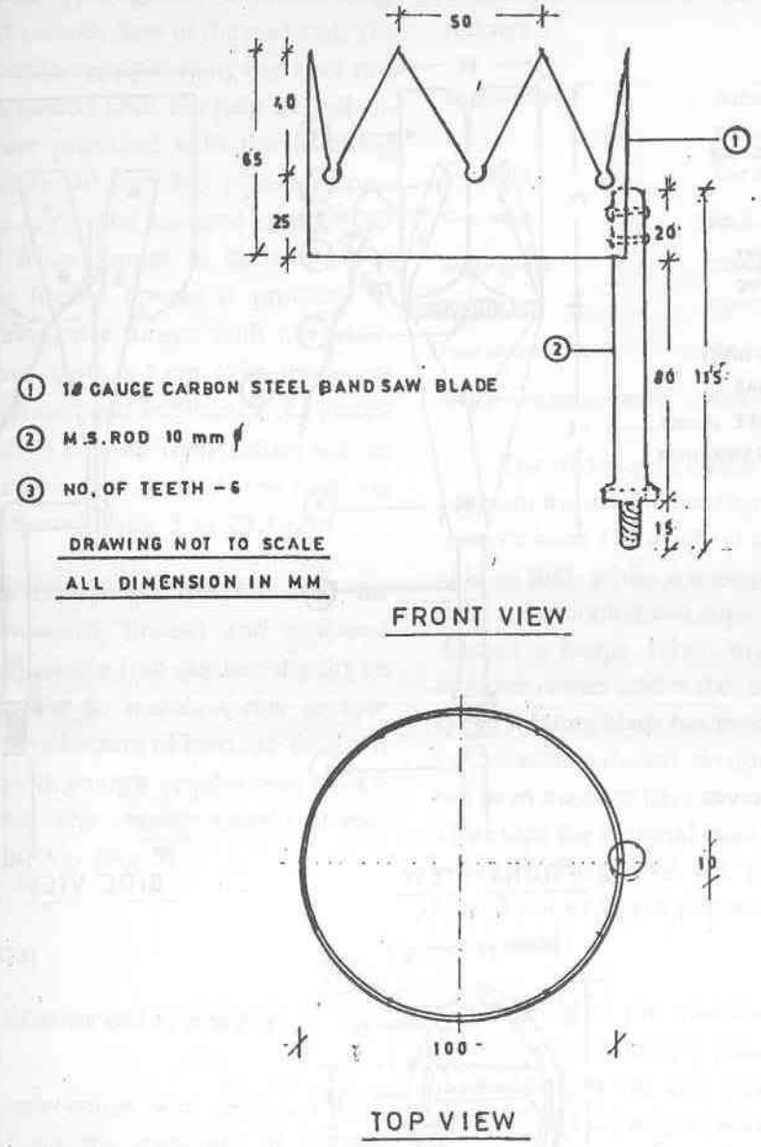

Fig. 1. Push and twist type (modified) fruit harvester

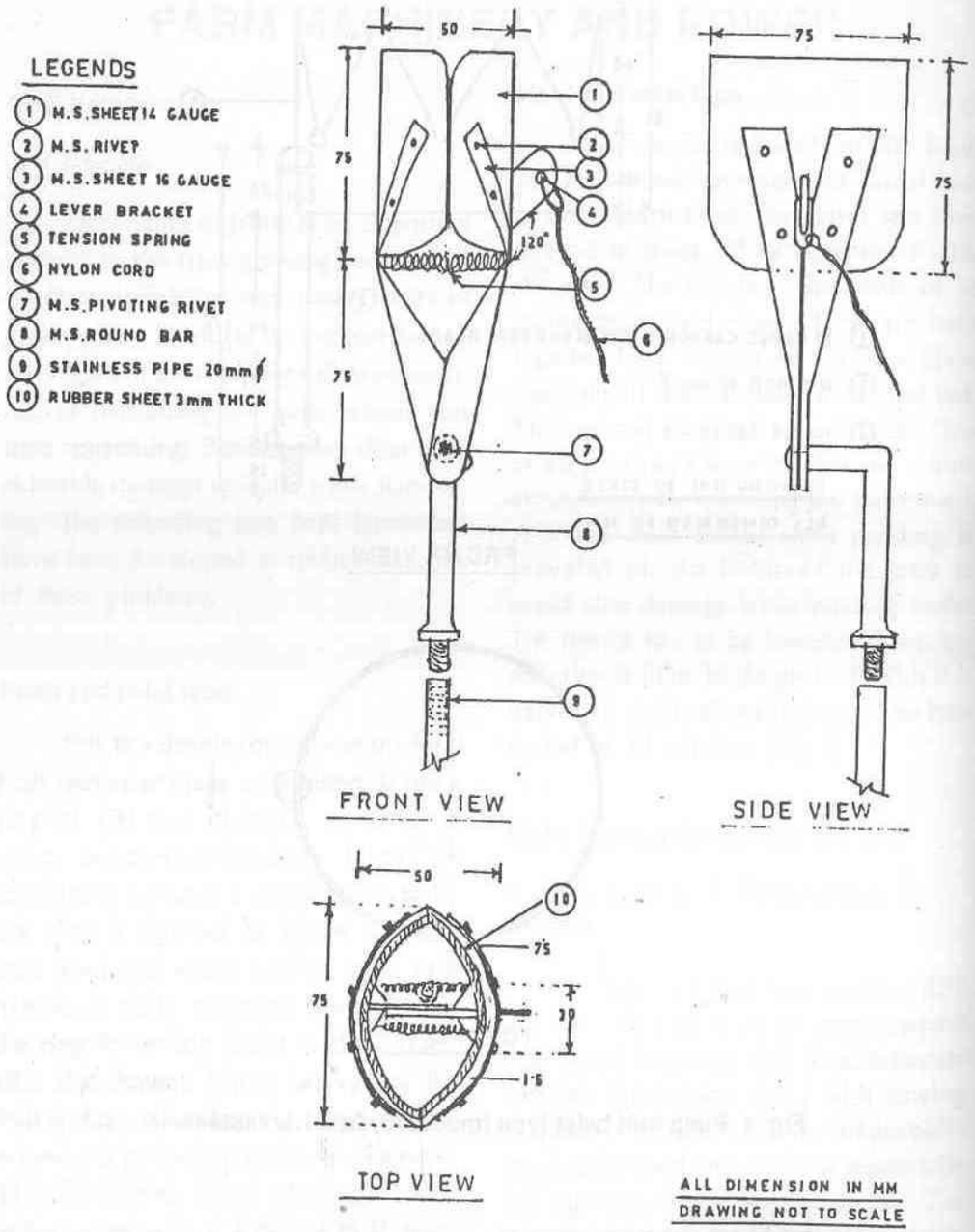

Fig. 2. Hold and twist type fruit harvester

wheel-cam type agitator to avoid clogging and smooth flow of the material. The rate of fertilizer application and seed rate can be adjusted with the help of adjustable screw provided with the metering mechanisms. 10 mm MS pipes are provided to carry the metered quantity of material from hopper to the furrow. A hoe type furrow opener is provided to open a triangular furrow with top width 5-8 cm and depth 3.-5 cm. With the use of implement seed and fertilizer can be placed at a depth of 3-5 cm. The fertilizer will be place just a head of the seed. The seed rate can be adjusted from 5 to 20 kg/ha.

This implement can be used for sowing mustard, linseed and rapeseed crops. Adjustable row marker should be used in order to maintain row to row spacing. One hectare of land can be sown in 25 hrs with energy requirement of 24.6 man hr/ha. The average weight of machine is 10 kg. (Fig 3).

Bush cutter

Chandra Shekhar Sahay and K. N. Agarwala

A bush cutter was designed and developed on the principle of impact cutting. In impact cutting the object to be cut is not supported from the other side and cutting is achieved from giving certain impact to it.

The developed cutter uses a rotary blade being operated by an engine. Detailed specifications of the machine are as follows :

Engine make	:	Enfield, 3400rpm, 1.5kw, Petrolstart Kerosene run
Coupling	:	Jaw clutch
Gear ratio	:	1 : 7 : 1 (Bevel gear)
Blade speed	:	2000 rpm at rated engine speed
Fuel consumption	:	0.8 lit/h kerosene
Man power requirement	:	One man

The distance of cutter bar is kept 30 cm from the axis of rotation about ground wheel's axis. Third wheel is kept removable so that while working in undulated field conditions it can cope up with small ditches or heaps. When any other object or stone comes under the blade, the high speed rotating blads has tendency to throw the material outward. So one safety guard has been made of bars covering the blade. This stops the material from being thrown outward. Height of cut can be varied from 3 cm to 30 cm depending upon the requirement.

Testing of the machine in the field gave excellent cutting of grass. The grasses of height upto 1m and bushes of thickness upto 1.5 cm are cut excellently. Field capacity of the machine is about 500m²/hin dense grasses. When operating in dense vegetation, one more man is required to do raking so as to collect the cut material for easy operation of the machine and collect the material at one place. (Fig. 4).

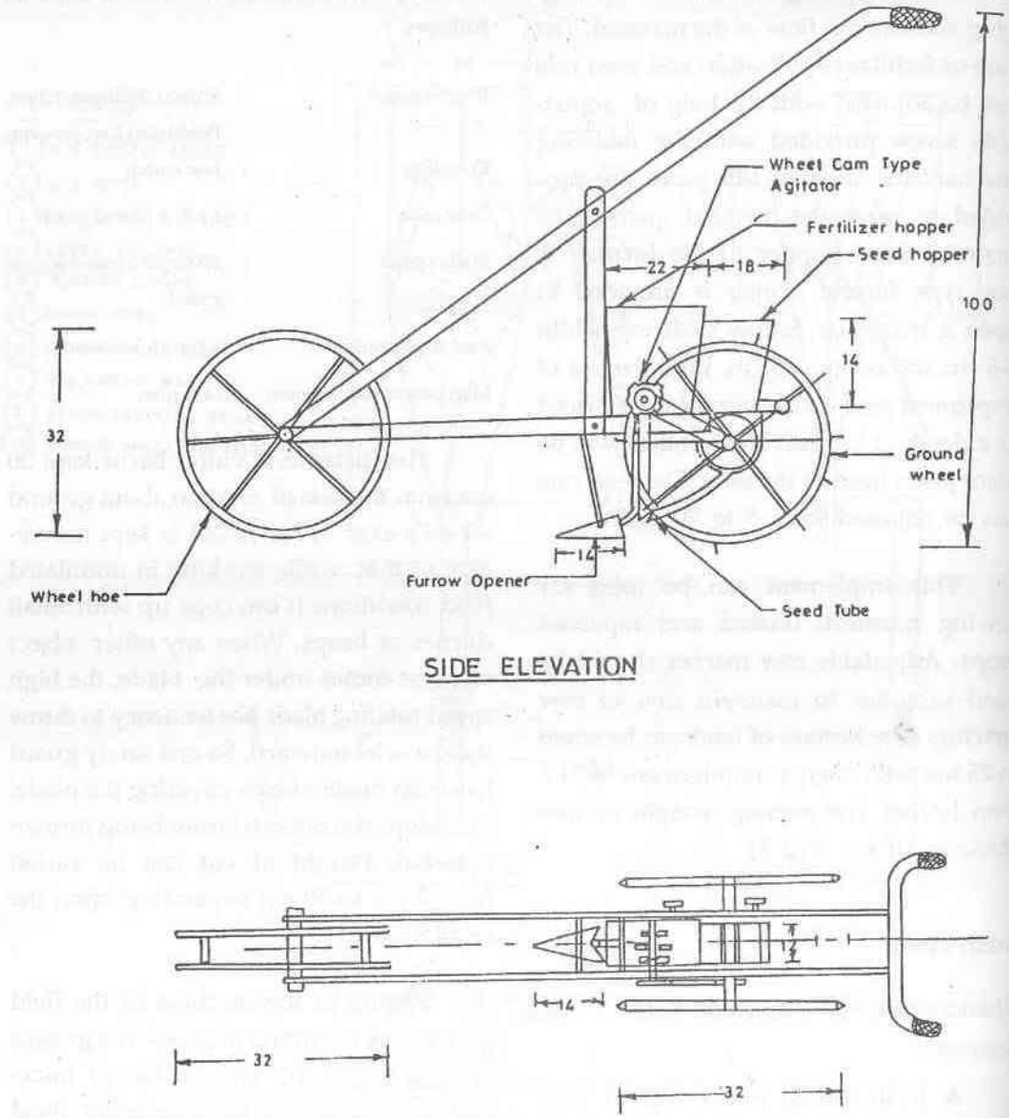

Fig. 3. Wheel hoe seed-cum-fertilizer drill

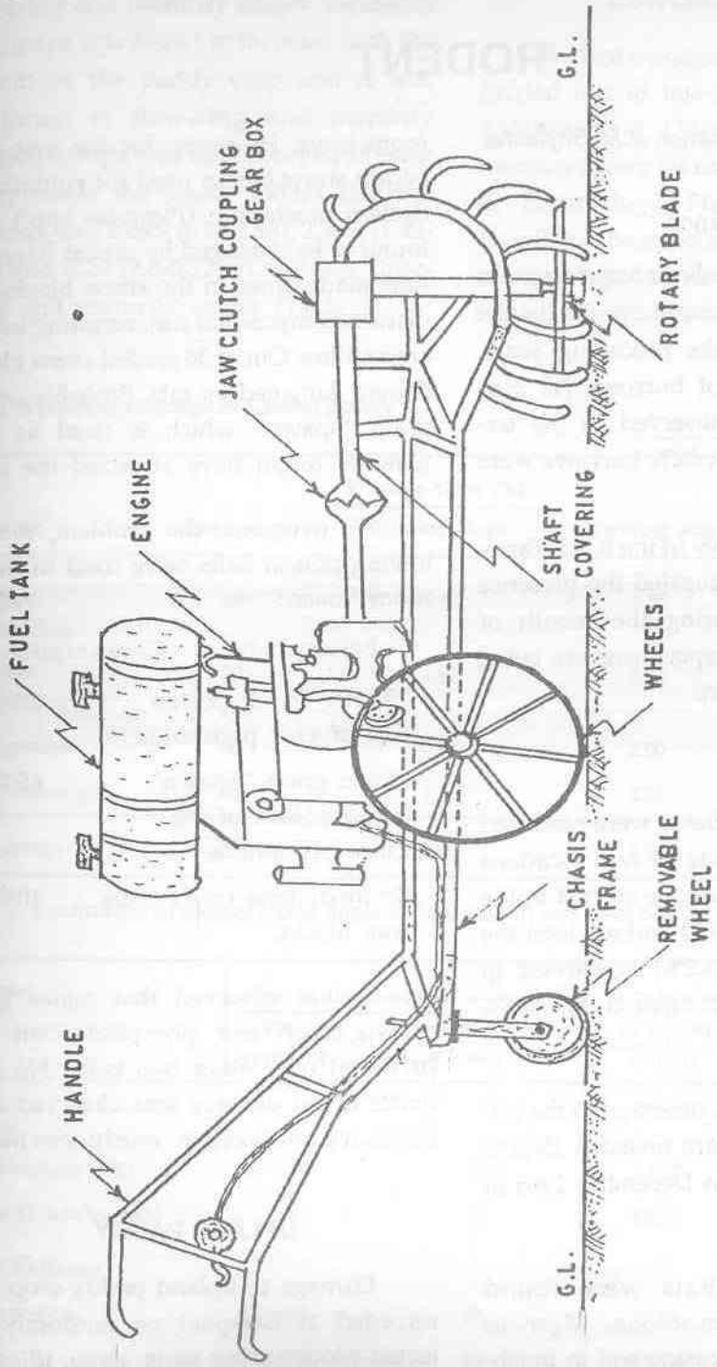

Fig. 4. Schematic diagram of bush cutter

RODENT

Mahesh Kumar, D. Kumar, A.N. Shylesha and N.S.A. Thakur

Survey and surveillance

Meghalaya : *Bandicota bengalensis* was found to be predominant species in the fields at Barapani like preceding years. Maximum number of burrows (12 burrow/terrace) were observed in the terraced fields of which 52% burrows were found alive.

Mizoram : Survey in the ICAR Farm, Kolasib (Mizoram) revealed the presence of *Rattus* group during the month of December 1995. The specimens are being sent for identification.

Damage

Maize : Maize fields were observed against rodent damage at two locations of Barapani. Initial damage started in the first week of July (0.3%) and attained the maximum damage (6.2%) at harvest in the lower terraces compared to 7.86% damage in the upper terraces.

Pineapple : Loss observed in the off-season crop in Mizoram revealed 15-20% damage by rodents in December 1995 at Kolasib farm.

Mushroom : Rats were found damageing button mushroom (*Agaricus bisporus*) by digging, casing soil in mushroom trays. However, for the first time, paddy straw blocks used for cultiation of oystem mushroom (*Pleurotus* spp.) were found to be damaged by rats at Barapani. Rats made holes in the straw blocks and disturbed mycelelial run, resulting in total crop failure. Out of 36 seeded straw blocks, 6 were damaged by rats. Probably, maize grain "spawn" which is used as seed material might have attracted the rats.

To overcome the problem, the following poison baits were used in mushroom house :

Poison bait	Consumption (%)
2% rice based poison bait of zinc phosphide	20%
Maize grain "Spawn" based poison of 2% Zince phosphide	60%
Bromodiolone ready-to-us wax blocks.	10%

It was observed that maize grain spawn based zinc phosphide bait was preferred over other two baits. No incidence of rat damage was observed after the above treatment in mushroom house.

UPLAND PADDY

Damage to upland paddy crop was recorded at Barapani on randomly selected plots during early stage, tillering, flowering and maturity stages. Incidence of damage was found to increase with the growth of the paddy crop and it was maximum at flowering and maturity stages. Damage was not observed at early stage, while the mean rodent damage recorded was 1.26% (0.82-1.98), 2.39% (1.95-3.12) and 4.24 (2.0-5.12) at tillering, flowering and maturity stages (Table 1).

LOWLAND PADDY

Rodent management programme was carried out in low-land paddy areas at Barapani and Upper Shillong. Control measures were taken at two locations viz., (I) Entomology, Plant pathology, Plant Breeding at Barapani and (ii) Upper Shillong. No treatment was done at NBPGR field. In treated areas, all the active burrows were

Table 1. Rodent damage in upland paddy

Location	Damage tiller (%)			
	Early stage	Tillering stage	Flowering stage	Maturity stage
Plant Breeding	00	0.82	1.95	3.32
Plant Pathology	00	1.98	3.12	4.95
Agronomy	00	0.95	2.00	3.19
Entomology	00	1.75	2.95	5.12
Average	00	1.26	2.39	4.24

Table 2. Evaluation of rodenticides against field rats in low land paddy.

Treatment	No. of live burrows		% reduction in rodent activity	Cumulative reduction in activity
	Pre-treatment	Post treatment		
Barapani				
Zinc phosphide (2%)	160	89	44.37	93.75
Celphos (2 tab/burrow)	89	10	88.76	
Upper Shillong				
Zinc phosphide	145	76	47.58	
Celphos	76	13	82.89	91.03

treated with Zinc phosphide (2%) followed by Celphos (2 tab./burrow) before the treansplantation of crop, which reduced the rodent activity to 93.75% and 91.03 (Table 2) at Barapani and Upper Shillong, respectively.

Rodenticide treatment was repeated at flowering stage by using Bromodiolone (ready-to-use wax cake) followed by Zinc phosphide (2%). Rodent damage was recorded during early stage after transplanting, tillering, flowering and maturity stages of crop in treated as well as untreated plots. Percent damage was worked out by cut tiller count basis. No damage was observed at early stage after transplanting. However, in untreated field, percent tiller cut was found to increase to 1.90%, 3.28% and 6.95% at tillering, flowering and maturity stages respectively as shown in Table 3.

In the treated areas the damage was observed considerably low in comparison to provious years (8.63% in 1993 and 7.96 in 1994) and untreated areas.

Burrow system of *B. bengalensis* (Gray) in paddy fields

This species of rodent was found to make its burrows on the bunds in paddy fields at Barapani. The number of openings per burrow varied from 4.-14. Burrows were confusingly remified with several pouches. it was also observed that

Table 3. Rodent management in low land paddy at Barapani and Upper Shillong.

Location	Treatment	Percent damage tiller				
		Early stage	Tillering stage	Flowering stage	Maturity stage	Cumulative damage (%)
A. Barapani	1. Pre-transplantation					
Entomology	control measures	00	0.14	0.18	0.21	
Plant Patho.	by using Zinc	00	0.12	0.17	0.19	0.19
Plant Breed.		00	0.15	0.16	0.18	
B. Upper Shillong	phosphide followed by Celphos.	00	0.11	0.13	0.16	0.16
	2. Control measures at flowering stage with bromodiolone followed by Zinc phosphate.					
C. NBPGR	No Control Measures	00	1.90	3.28	6.95	6.95

burrows were made near water sources and comparative broader bunds were preferred to make burrows. On an average 200 to 470 gm paddy was recovered from each live burrow. The retiring chamber in the burrows were found having dry grass and paddy leaves for the purpose of thermo-regulation. Large amount of soil excavated by them was also seen on each opening.

Efficacy of coumatetralyl against *Mus musculus* (Gray)

Trials carried out with coumatetralyl indicate that ready-to use tracking powder used as an oral bait in combination with paddy resulted in 69.4% mortality within 4 to 8 days. 0.375% bait was prepared by mixing one part of 0.75% ready-to-use coumatretaly1 (Racumin) tracking powder with 19 parts of paddy. (Table 4).

Social engineering

Twenty kg of Bromadiolone cakes (.005% RB) were distributed among farmers, shopkeepers, house-wives and staff members. A feedback received from the users revealed its efficacy as an effective rodenticide without any danger to th non-target species.

Table 4. Efficacy of Coumatetralyl against *Mus musculus* (Gray)

Replication	Mortality 0-5 days	6-8 days	9 days	% Mortality
1	1	5	2	66.6
2	2	3	4	75.0
3	1	4	3	66.6
% mortality after days	11.11	33.33	25.0	69.4

n = 12 (6 M x 6 F)

AGRICULTURAL EXTENSION

P. K. Thakur, Narendra Prakash, P. P. Pal and Rajesh Kumar

Pilot project on technology assessment and refinement through institution village linkage

A pilot project on research extension linkage is launched with the following goal and objectives.

Goal

In view of market liberalization particularly in relation to agricultural development and in the context of growing public concern for globalization, household food security, regional imbalances and wide variety of eco-systems, there is need to provide new directions in planning and promoting transfer of technology. This would be achieved by developing effective operational linkages between scientific institutions and farmers for technology intergration and optimization to meet the growing demands of different production systems to increase productivity, augment income and improve the quality of life of rural people.

Objectives

1. To introduce technological intervention with emphasis on stability and sustainability along with productivity of small production systems.
2. To introduce and integrate the appropriate technologies to sustain technological intervention and their integration to maintain productivity and profitability taking environmental issues into consideration in a comparatively well defined production system.
3. To introduce and integrate the appropriate technologies to increase the agricultural productivity with marketable surplus in commercial and off farm production systems.
4. To facilitate adoption of appropriate post-harvest technologies for conservation and on-farm value addition of agricultural products, by-products and wastes for greater economic divident and national priorities.
5. To facilitate adoption of appropriate technologies for removal of drudgery, increased efficiency and higher income of farm women.
6. To monitor socio-economic impact of the technological intervantion for different production systems.
7. To identify extrapolation domains for new technology/technology modules based on environmental characterisation at meso and mega levels.

Progress

A cluster of 13 villages from Ri-Bhoi district of Meghalaya was purposely selected to implement this programme with nearness to implementing institution, communication, farming systems etc. as some of the criteria. The vaillages namely Pyllun, Umeit, Umdoh Byrthih, Umroi-Madan, Umroi Labansaro, Umroi Nongrah, Umroi Jaiawpdeng. Umden-Arka, Umden-Mission, Umden-Umsaitprah, Mawtneng, Mawbri and Mawlasnai are situated in the vicinity of 25 km from the implementing Institute.

The information related to the villages were selected by the member of the core team, specially trained for this purpose by Participatory Rural Appraisal (PRA) method. The information revealed that most of the villages practice traditional method of jhum and boon cultivation. Majority of the families have small production system with valley or terraced land. Paddy, Maize, Ginger, Turmeric and seasonal vegetable are the main crops being cultivated in this area. Piggery is common among the farmers and majority of farming families have piggery attached to their houses. The villages have also small fish ponds in which the water of the streamlet are tapped and stored for fishery. The rearing of the cattle is for the purpose of beef. A few families also have poultry birds.

The village is headed by the Leader known as village head who also works as leader in order to implement any developmental programmes. The religion followed is Christianity and the society enjoys peculiar social system of matriarchy. The local weekly market is the main source of purchase/sell and the capital city of the State is 30-40 km away from the villages.

The major problem identified are 'jhuming' (shifting cultivation), loss of top soil, deforestation, poor return from piggery and fishery, non-adoption of improved seed and fertilizers, improper storage of ginger causing of low return, drudgery in farm operations, poor communication, lack of knowledge and skills in different farm operations and marketing. The agriculture is diversified but risk prone and lack of financial resources are the major constraints in agricultural development.

The major intervention points to the problem could be to suggest alternation to jhuming, creating awareness and improve skill to check soil loss, aforestation, suitable store of ginger prepared with locally available materials. The proper care and management of piggery and fishery cultivation of improved and disease resistant varieties and use of fertilizer in order to increase production could be some of the important interventions.

Initially only four interventions of technology has been planned for 675 farmers which will need an amount of Rs. 14 lakhs including all expenditure related to this project.

Apart from the Pilot Project the following research projects are continuing

(a) Communication and adoption of an innovation and economic factors associated with it.

(b) A study of Extension, Research Linkage at various levels of Agriculture in Meghalaya.

(c) Fodding habit of Jaintia tribe and its nutritional improvement through locally available material.

The reliability and validity of the scale to measure the different parameters under these studies are being tested. The collection of data on the food habit of Jaintia tribe has been completed and it is being processed.

Demonstration

The various crops demonstrations were conducted in the field of farmers at Mawlasnai village during the year. The yield performance of various crops under demonstration were as folows :

Name of crops	No. of demonstration	Area (Sq.m.)	Av. yield (q/ha)
Paddy	10	150	32.5
Maize	4	100	27.00
Groundnut (JL-24)	12	200	18.5
Turmeric	2	150	218.0
Tomato	8	100	82.0

Mass contact

The division of extension has organised farmer's day/field days and group meeting in different villages of Meghalaya and also participated in exhibition at different locations of Meghalaya.

Activities	Place	No. of farmers
Farmers' Day	Umroi	152
Farmers' Day	ICAR Barapani	200
Exhibition	Nongpoh	400
Exhibition	Shillong	350
Field Day	Mawlasnai	100
Group meeting	Mawlasnai	40
Group meeting	Mawtneng	31
Group meeting	Mawbri	25
Group meeting	Umeit	20
Group meeting	Umroi (Jaiawpdeng)	15
Group meeting	Umdoh Byrthih	12
Group meeting	Umroi Labansaro	13
Group meeting	Umroi Madan	14
Group meeting	Umroi Nongpoh	50
Group meeting	Umden Arka	20
Group meeting	Umden Umsaitprah	15
Group meeting	Pyllun	10

Training

Four training programmes were organised during the period.

Name of training	Category of trainees	No. of trainees.
Training of Poultry Managemet and Broiler Chicken Production	NGO personnel	8
State Level Training on Production Technology of Coarse Cereals	Extension personnel of NEH State	9
State Level Training on Rice Production Technology	Agril. Officers of NEH State	11
Training programme on Mushroom Cultivation and Flower cultivation	NGO personnel of Meghlaya State	22

VISITORS

During the period under report, 4 District Agricultural Officers from Assam; 63 farmers, 230 students from AAU, Jorhat, CAU, Imphal, RKM, Charrapunjee, N.C. Hills of Assam; and 4 teachers from CAU, Imphal and 2 from NC Hills; 30 beneficieries of PM Rojyen Joyane visited the Institute which was organised by the division.

Summer Institute

One Summer Institute on "Sustainable Hill Agriculture" was organised from 11.7.95 to 30.7.95. Altogether 27 participants from various parts of India participated.

Linkage/Coordination

Division of Agril. Extension is participating and conducting the Inter Media Coordination Committee Meeting every month.

Linkage with different State Government Departments of NEH State, different Central Government organisations, NGOs has been established. Besides this, average good rapport has been established with Doordarshan, AIR, Newspaper and other Mass Media.

Ban Mahotsava

Ban Mahotsava day was organised where 150 persons participated and one plant by each persons was planted in the ICAR campus at Barapani.

FARMING SYSTEMS RESEARCH

Project Leader : S. Laskar (up to 31st. August 1995)

Coordinator : U. C. Sharma

Multidisciplinary Team

Agronomy & Agro forestry : K.A. Singh

Animal Nutrition : B.P.S. Yadav

Horticulture : Ram Chandra

Soil & water Conservation Engineering : K.K. satpathy

Plant Protection : Satish Chandra
K.A. Pathak

Agricultural Economics : S.N. Goswami

Dairy farming (FSW_1)

Under dairy farming system three fourth top portion of the micro watershed and the terrace risers of the bottom terraced lands were put to guinea grass, broom grass and fodder trees. Terraced lands were utilized for protein rich ricebean and soybean for fodder. Two milch cows and one heifer were kept under this watershed to be fed on 38.9 tonnes green fodder produced in the watershed. Additionally, 2.8 tonnes concentrate and 1.0 tonnes paddy straw fed to livestock were external input. Dairy cows produced 4.611 litres of milk and 20.4 tonnes manures. Besides heifer growth was valued at Rs. 6.000 and 166 kg spikes was obtained from broom grass. There was no soil erosion noticed in the watershed as surface flow was completely checked. Base flow was 0.756 mm with a record of 0.173 mm/hour peak flow (Table 1).

Mixed block forests (FSW_2)

Fuel tree species in 12th year after planting showed that *Michelia oblonga* had the highest current annual increments in basal girth and girth at breast height followed by *Symintonia populnes* and *Alnus nepalensis*. Soil arosion was negligible. Hydrological behaviour of the micro watershed ravealed that there was 148.16mm base flow and 13.27mm surface flow resulting into 161.43 mm total water yield (Table 1). This watershed had highest base flow among the eight watershed having different land use practices. Peak flow of 0.42 mm/hour was recorded during 1995.

Silvo-pastoral system for goat production (FSW_3) :

On a 32% hill slope, *Symingtonia populnea*, *Ficus auriculata* and *Bauhinia* spp. as silvi component and *Brachiaria ruziensis* and *Thysanolaena maxima heerbaceous* component formed the silvo- pastoral system in an area of 0.90 hectare. The system produced 1.38 tonnes tree leaves. 15.5 t broom grass and 7.97 t congo signal grass

Table 1. Hydrological behaviour of micro-watershed based farming systems

Parameters	FSW_1	FSW_2	FSW_3	FSW_4	FSW_5	FSW_6	FSW_7	FSW_8
Total water yield (mm)	0.756	161.43	40.53	Nil	0.23	0.51	Nil	Nil
Base flow (mm)	0.756	148.16	34.53	Nil	0.23	0.51	Nil	Mil
Runoff (mm)	Nil	13.27	5.97	Nil	Nil	Nil	Nil	Nil
Peak Flow (mm/hour)	0.173	0.42			0.60	0.13		

on which a herd of 20 goats was maintained. The goats multiplies to 28 in number with body weight gain of 339 kg excluding the weight of two goats died during the year. Broom grass also gave 0.25 t spikes for broom. Soil erosion was negligible. hydrological behaviour of the micro watershed showed 5.97 mm surface flow and 34.53 mm base flow. The total water yield under silvo pastoral system was less than the mixed forest system.

Agro-pastoral system (FSW_4)

In agro-pastoral system on a 32% hill slope, crop production was practised on bench terraces and forage grasses were grown on terrace risers to feed a dairy cow unit. Under semi organic farming, productivity of maize, groundnut, soybean and ginger were 25.2, 26.5 (pod). 23.6 357.8 q/ha in kharif season and the productivity of mustard and radish were 12.2 and 158.8 (roots) q/ha. respectively. There was significant improvement in the yield of ginger, soybean and mustard over previous year under organic farming. High yield of mustard may largely be attributed to exceptionally high and well distributed winter rainfall. Yield of maize and radish also indicated improvement over previous year.

One dairy cow unit was maintained on guinea grass-broom grass system of round the year green fodder production. The feeding pattern of forage resources produced in the watershed, external input of concentrate and minimal requirement of urea treated paddy straw during winter months and the milk yield during the year has been depicted in Figure 1. The total milk yield obtained was 3,198 litres.

Soil erosion was negligible due to zero surface flow (Table 1). Base flow was also not found in this watershed, indicating bio-efficiency of sustained utilization of land and water resources for high productivity.

Agro-horti-silvo-pastoral system (FSW_5)

The model lans use system on a 42% hill slope in an area of 1.03 ha had three components, crop production on bottom terraced Lands, horticulture on middle portion with half moon terraces and silvo-

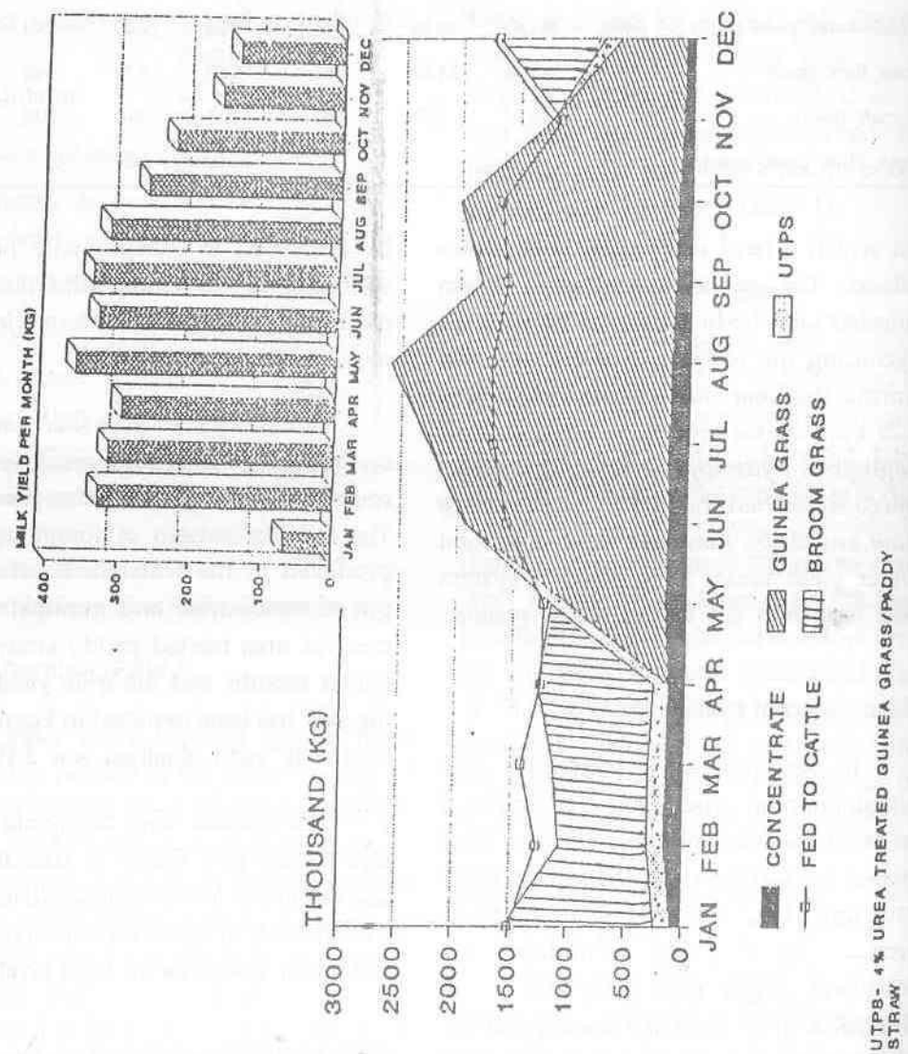

Figure 1. Feeding pattern of forage resources produced under Agro-Pastoral System and milk yield in 1995

pastoral system on top portion along with goat and pigs as livestock components. The productivity of maize, groundnut, ginger, mustard and radish under crop production was 45.3.18.7 (pod), 269.8 9.0 and 373.3 (roots) q/ha, respectively. Performance of three fruit trees i.e. orange, assam lemon and peach has been presented in Table 2. Average number of fruits/tree were 83.4 and 40.5 in orange and assam lemon, respectively. Guines grass and pine apple were established as intercrops. In place of guava, pear and peach were planted. They showed good growth performance during establishment year. A unit of 10 goats and 10 pigs were maintained on silvo pastoral system and crop byproducts. Within 108 days of feeding, pigs gained 145.6 g/day with a total body weight of 336 kg sold for pork. There was no soil erosion due to completely checked runoff (Table 1). Base flow was also minimal i.e. 0.23 mm.

Silvi-horticulture system (FSW_6):

In this micro watershed, soil depth was very shallow. Therefore, alder, a non leguminous nitrogen fixing tree, was planted in upper part of the hill slope and vegetables were grown in the lower terraced lands. The yield of chilies. french bean and radish seed obtained were 12.5, 23.5 and 6.7 kg. respectively. Growth of alder was good in upper part of hill slope with more than 60% survival of plants. There was no surface flow (runoff). Hence, no loss of soil from the watershed (Table 1). Base flow and peak flow were 0.51 mm and 0.06 mm/hour, respectively.

Natural regenerated forest (FSW_7):

In 12th year of protection from biotic pressure, the self regenerated natural pine forest had 439 trees/ha in 10-170 cm basal girth range. Frequency distribution of pine trees showed that 51-60 cm basal girth class had 17% of total tree population (Table 3). The mean basal girth was 55.8 cm and mean girth at breast height was 45.5 cm in this girth class. Under growth of herbaceous biomass was 3.02 and 6.33 t/ha dry matter of grasses and forbes, respectively. Consequent upon dense herhaceous growth and good tree stands, there was no runoff and base flow in this micro watershed (Table 1).

Timber forestry (FSW_8)

About 0.50 ha land on 41% hill slope was put under *Michelia champaca* plantation in July 1992. in 4th year, plant growth across the hill slope revealed that mean basal and diameter at breast height were 1.3 and 1.5 times more at bottom than the top portion of the hill (Table 4). This difference may be attributed to the difference in soil depth and soil moisture regimes during dry winter months. This year, trees were heavily (100% plants) infested with *phoma* sp., woolly aphid *Eriosoma langerum*. The fungus attacked young shoots, which became black and

Table 2. Growth and yield performance of orange, Assam lemon and peach in Agro-horti-silvo-pastoral system (FSW_s)

Parameters	Orange	Assam lemon	Peach
Plant height (m)	4.52 ± 0.53 (4.0 — 5.25)	2.10 ± 0.27 (1.65 — 2.45)	0.91 ± 0.43 (0.61 — 1.98)
Stem girth (cm)	37.2 ± 8.15 (30.0 — 55.0)	21.10 ± 6.24 (16.0 — 28.6)	4.59 ± 1.22 (3.0 — 7.0)
Spread(m)	1.94 ± 0.32 (1.5 — 2.4)	2.29 ± 0.32 (1.9 — 2.8)	
No. of fruits/tree	83.4 ± 18.2 (27.0 — 165.0)	40.5 ± 23.65 (15.0 — 87.0)	

( ) — Range, Mean ± S.D.

Table 3. Annual biomass yield of herbage and frequency distribution of pine trees under different basal girth class

Herbage (DM t/ha)		
Grasses	Forbes	Total
3.02	6.33	9.35

Basal girth class	frequency	mean B.G. (cm)	Girth at breast height (cm)
10 — 20	10	18.5	11.5
21 — 30	47	25.6	19.4
31 — 40	43	34.9	29.4
41 — 50	52	56.0	37.8
51 — 60	72	55.8	45.5
61 — 70	56	64.6	52.3
71 — 80	46	75.4	61.2
81 — 90	30	85.9	69.5
91 — 100	20	95.0	78.1
101 — 110	8	104.4	86.8
111 — 120	6	118.7	93.2
121 — 130	7	124.4	103.7
131 — 140	6	135.5	118.5
141 — 150	2	145.5	124.5
151 — 160	2	157.5	119.0
161 — 170	1	161.0	88.0

died off, showing dieback symptom. The wooly aphid nymphs and adults, both were damaging growing points on the twigs by sucking the sap. The aphids were confined to the scorches showing white spots on tree visible from a distance. One to ten scorches were observed per twig. The ultimately affected twigs were defoliated and stem portion also started dying from tip. The disease and the insect was completely controlled by single spray of monocrotophos @ 0.05% and bavistin (carbandazin 50 wp) @ g/litre along with adhesive Tritan X 100 @ 1 ml/litre of water. There was 99% survival of trees and these trees recovered to normal growth.

Studies on alternative methods of bench tarracing :

A trial on alternative methods of bench terracing was undertaken during 1993 to have a detail study of the different aspects of bench terracing including different methods of developing terraces through contour bunds and vegetative barriers i.e. broom grass and *Erythrina* spp. on contour bunds. The extent of slope reduction on the terrace top (the area between two consecutive bunds) after three years of maize cultivation was 68% in highest slope group (>30%) and 8% under lowest slope group (<16%). Area loss due to terracing was highest (49%) under the highest slope group and 17% under lowest slope group. Productivity of maize in third year was 33.3 q/ha on bench terraced lands followed by 31.6 q/ha under contour bunded lands with *Erythrina* hedge and 24.6 q/ha under contour bunded lands with broom grass hedge. The lowest yield of 18.1 q/ha was found on contour bunded lands without any hedge. The yields reflected a gradient of washing out of nutrients and build up of soil fertility under different systems of terracing methods.

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Farming System Research

Sharma, U.C. and Prasad, R.N. (1995). Socio-economic considerations in enhancing agricultural productivity in North Eastern States. *J. Indian Assoc. Soc. Sci.* **12** : :6-16.

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Book chapters

Goswami, S.N. (1995). Regional rural bank : a land work in rural banking. *Management of Rural Sector* Ed. S.G. Hundekar. Mittal. Publication New Delhi.

Singh, K.A. and Yadav, B.P.S. (1995). Advances in forage resource development and its potential for sustainable hill agro-ecosystems in Eastern Himalayan Region. *New Vitas in Forage Production*. Eds : C.R. Hazra and Bimal Misri, Publication and Information Directorate, New Delhi.

C. Research/Technical Bulletin published

Chandra, S., Singh, A.K. and Kumar, S. (1995). Cultivation of Oyster Mushroom. ICAR Research Complex for NEH Region, Barapani, Meghalaya.

Goswami, S.N. (1996). Economic Appraisal of Indigenous Hill Farming System in West Garo Hills District of Meghalaya. ICAR Research Complex for NEH Region Barapani, Meghalaya.

Bujarbaruah, K.M., Das, A, Ghosh, S.S. and Rajkhowa, C. (1996). Rabbit farming. ICAR Research Complex for NEH Region, Barapani, Meghalaya.

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Mahajan V, Gupta H.S. and Sarma B.K. (1996). Population Development in Maize for North Eastern Hills of India. ICAR Research Complex for NEH Region, Barapani.

Sarma B.K. Singh M. Gupta H.S. Singh G and Srivastava L.S. (1995). Studies in Rice Bean Germplasm. ICAR Complex, Barapani.

D. Consultancy Reports etc

Gupta, S.K. and S.V. Nagachan (1996). Agricultural practices with crops and cropping pattern in Nagaland. Report submitted to WAPCS (India) Ltd. vide his agreement letter No. WAP/MIGW & D/NAGA/96 dtd. 14-02-96. pp.1-30.

Gupta, S.K. and S.K. Roy (1996). Agricultural practices with crops and cropping pattern in Arunachal Pradesh. Report submitted to WAPCS (India) Ltd. vide his agreement letter No. WAP/MIGW & D/AP/96 dtd. 14-02-96. pp. 1-38.

Papers presented in Conference/Seminar/Symposia

Agricultural Economics

Goswami, S.N. "Appraisal of hill farming systems with special reterance to West Garo Hills". Paper presented in "Summer Institute on Sustainable Hill Agriculture"; organised by ICAR Res. Complex, Barapani from 11-30th July, 1995.

Goswami, S.N. "Agricultural marketing in the hills of North East India". Paper presented in "Summer Institute on Sustainable Hill Agriculture" organised by ICAR Research Complex, Barapani from 11-30th July, 1995.

Agroforestry

Dhyani, S.K. "Measures of watershed development". Organised by SIRD, Nongsder, Meghalaya on 11.7.95 to 12.7.95.

Dhyani, S.K. "Agroforestry interventions for sustained productivity in the hill region" for the Summer Institute on Sustainable Hill Agriculture, organised by ICAR RC, NEHR, Barapani 11th July to 30th July, 1995.

Dhyani, S.K. "Agroforestry for Watershed Management in Hilly areas" for the Workshop on Concept of Watershed Management Technology in Shifting Cultivation Areas. Organised by the Department of Soil Conservation, Meghalaya at Umsohping, W. Khasi Hills on 28th and 29th July, 1995.

Dhyani, S.K. "Agroforestry for mitigating energy scarcity in rural India" for National Training Programme on Energy Technology for Rural Development organised by Meghalaya Non-Conventional & Renewable Energy Development Agency, Shillong from Oct. 31-Nov. 4, 1995.

Dhyani, S.K. "Agroforestry : an approach to eco-friendly and sustainable production technology from north eastern hill region" Paper presented in 2nd Congress on Traditional Sciences and Technologies of India, held at Anna University, Madras, December 27-31. 1995.

Farming System

Sharma, U.C. "Use of informatics for enhancing agricultural productivity in N.E. region". Paper presented at a Seminar held in New Delhi.

Sharma, U.C. and Laskar, S. "Soil factors limiting agricultural productivity in N.E. region". Paper presented at National symposium on "Agriculture in relation to environment" held at New Delhi.

Singh, K.A. and Yadav, B.P.S. "Advances in forage resource development and its potential for sustained and hill agro-ecosystems in Eastern Himalayan regions". Nat Symp. "Forage production systems for sustainable development ", RMSI, 20-23. December, 1995 IGFRI, Jhansi.

Plant Breeding

Sarma B.K. and Pandey D.K. "Genetic Resources of rice in North East India". 2nd Agrl. Sci. Cong. Symposium on National Water Policy, Vector Biology and Integrated on Farm and off Farm Employment. APAU, Hyderabad, Jan. 19-21, 1995.

Sarma B.K. and Senapati A. "Genetic Resources of orchids of north east India". National Seminar on ornemantal Horticulture and Environment. Agr. Hort. Socity of India, Calcutta 6-8 Feb. 1995.

Sarma B.K., "Pulses and oilseeds in sustainable hill agriculture". Summer Institute on Sustainable Agriculture in Hills, ICAR Complex, Barapani July 9-31, 1995.

Sarma B.K. "Suitable varities of coarse cereals and their production technology". State level Tranning production on coarse cereals. Directorate of Maize and Millets, Govt. of India.

Plant Pathology

Kumar Sangit, 'Disease management strategies for important field crops in North eastern hill region' in the Summer institute on sustainable hill Agriculture' organized by ICAR, Barapani w.e.f. 11th July to30th July 1995.

Kumar Sangit; "Important diseases of rice and their management" in State level training programme on 'Rice Production Technology' sponsored by Directorate of Rice Development. Ministry of Agriculture, Govt. of India held at Barapani w.e.f. 19 Sept-21st Sept. 1995.

Singh, A.K. "Strategy for disease management in important horticultural crops under agroclimatic conditions of north eastern hills" in the Summer institute on Sustainable Hill Agricultural" organized by ICAR, Barapani w.e.f. 11th July to 30 July 1995.

Chandra, S. "Mushroom cultivation—A subsidiary source of income" in the Summer institute on sustainable hill Agriculture organized by ICAR, Barapani w.e.f. 11th July to 30th July 1995.

Chandra, S. 'Disease management' in orientation course on 'Integrated Pest Management' organized by SIRD, Nongsder, Meghalaya on 23rd February 1996.

Water Management

Gupta, S.K. (1995). Water management and watershed approach for Coarse Cereals Cultivation in N.E.H. region. Presented in State Level Training Programme on Production Technology of Coarse Cereals. Sponsored by Directorate of Millets Development, Ministry of Agriculture, Govt. of India held at the ICAR Research Complex for N.E.H. region, Barapani fro 7th to 9th August, 1995. PP. 24-27.

Gupta, S.K. (1995). Water management for sustainable hill farming in N.E.H. region. Presented in Summer Institute on Sustainable Hill Agriculture, Sponsored by ICAR, Krishi Bhavan, New delhi, held at the ICAR Research Complex for N.E.H. region, Barapani from 11th to 30th July, 1995. pp. 66-83.

Gupta, S.K. (1995). Water management for rice crop in NEH Region. Paper presented in State Level Training Programme on Rice Production Technology. Sponsored by Directorate of Rice Development, Ministry of Agriculture, Government of India, held at the ICAR Research Complex for N.E.H. region, Barapani from 19th to 21st September, 1995. pp. 19-22.

Animal Nutrition

In VII Animal Nutrition Research workers conference of Animal Nutrition society of India held at Bombay Vety. College, Mubai from 7th to 9th December, 1995.

Yadav, B.P.S. and Gupta,, J.J. Nutritional evaluation of tubers in pig.

Gupta, J.J. Yadav, B.P.S. and Bujarburuah, K.M. Incorporation of job's tears grain in pig ration.

Gupta, J.J., Yadav, B.P.S. and Das, A. Evaluation of weed and grass as rabbit feed.

Gupta, J.J. Yadav, B.P.S. and Das, A. Nutritional value of leguminous roughages for rabbits.

Gupta, J.J., and Yadav, B.P.S. Yield potential of grasses in alfisol of NEH hills.

Veterinary Parasitology

Rajkhowa, C. Parasitic disease of rabbit in North-Eastern Hill Region and their control. Proceeding of summer Institute on Sustainable Hill Agriculture. ICAR Research Complex for NEH Region, Barapani, Meghalaya. 11th July to 30th July. 1995.

Bandyopadhyay, S. Tick infestation in livestock in NEH Region. Proceeding of Summer Institute on Sustainable Hill Agriculture. ICAR Res. Complex for NEH Region, Barapani, Meghalaya. 11th July to 30th July. 1995.

Rajkhowa, C. and Bandyopadhyay, S. Incidence of *Sarcoptes scabiiei* and *Psoroptes cuniculi* in rabbits in Meghalaya. 7th National Congress of Veterinary Parasitology, Tamil Nadu veterinary and Animal Sciences University, Madras 19th to 21st August.

Bandyopadhyay, S. and Rajkhowa, C. A databased Computer programme (IDPARA) for specific identification of eggs and larvae of Paraasites. 7th National Congress of Veterinary Parasitology. Tamil Nadu Veterinary and Animal Sciences University, Madras, 19th to 21st August.

Radio/T.V. Talks

1. Agroforestry models for valley lands. dt. 29.5.95 by S.K. Dhyani.
2. Mandarin based agroforestry system for sloping lands, dt. 15.11.95 by S.K. Dhyani.
3. A multistoried system for micro-watershed in hilly areas, dt. 18.11.95. by S.K. Dhyani.
4. Guava + Large cardamom—a potential system for hill areas, dt. 18.11.95 by S.K. Dhyani.

Workshop/Symposium/Training/Conference attended

Scientist	Prrticulars	Venue and date
Dr. B.K. Sarma Dr. V.A. Parthasarathy	Ornamental Horticulture and Environment,	Calcutta
Dr. B.K. Sarma	Technology Mission on Oilseed and Pulses	IIPR Kanpur
Dr. B.K. Sarma, Dr. G.C. Munda	First Rabi Groundnut Workshop	IIT, Kharagpur
Dr. A.N. Shylesha	All India Coordinated Workshop on Soybean	UAS, Dharwar
Mr. S.K. Dhyani	Measures of Watershed Development	SIRD, Nongsdar, 11.7.95 and 12.7.95
Mr. S.K. Dhyani and Dr. K.K. Satapathy	Concept of Watershed Management Technology in Shifting Cultivation Areas	Umsohping, 28-29-July, 95
Mr. S.K. Dhyani	National Training Programme on Energy Technology for Rural Development	Shillong 31-10-95 to 4-11-95
Mr. S.K. Dhyani	Second Congress of Traditional Sciences and Technologies of India.	Anna University, Madras, 27-31 December, 95
Mr. S. Kumar Dr. A.K. Singh Dr. S. Chandra Dr. P.K. Thakur Mr. N. Prakash Mr. P.P. Paul Mr. R. Kumar Dr. G.C. Munda Dr. U.K. Hazarika Dr. H.S. Gupta Dr. B.K. Sarma Dr. V.A. Parthasarathy Dr. S.G. Gupta Dr. R.P. Medhi Dr. S.N. Goswami	Summer Institute on Sustainable Hill Agriculture	NEHR, Barapani, 11-30July, 95.

Scientist	Prrticulars	Venue and date
Dr. K.M. Bujarbaruah Dr. A. Das Dr. C. Rajkhowa Dr. S. banerjee Dr. H. Murugkar Mr. S.K. Dhyani Dr. K.A. Singh Dr. S.K. Gupta Dr. B.P.S. Yadav Dr. K.K. Satapathy Mr. D. Jain Dr. N.S. Azad Thakur		
Dr. S.K. Gupta Dr. H.S. Gupta Dr. G.C. Munda Mr. S. Kumar	State Level Training Programme on Production Technology of course cereals	NEIIR, Barapani 7-9 August, 95
Dr. H.S. Gupta Dr. P.K. Thakur Mr. N. Prakash Dr. N.S. Azad Thakur Dr. G.C. Munda Dr. U.K. Hazarika Mr. S. Kumar Dr. A.K. Singh Dr. S. Chandra	State Level Training Programme on Rice Production Technology	NEHR, Barapani, 19-21 September, 1995
Dr. S.K. Gupta	Badle Parivesh Me Krishi Anusandhan Ke Naye Aayam	IARI, New Delhi, 29-31 December, 1995
Dr. N.S. Azad Thakur	National Symposium on Integrated Pest Management	S.D. College, Muzaffar Nagar, 22-24 September, 1995
Dr. B.K. Sarma	Rabi Pulses Workshop	PAU, Ludhiana, 6-9 September, 1996.
Dr. A.K. Mishra	Water Management research for Scientist	WTC, New Delhi, 15-12-95 to 12-11-96
Dr. V.A. Parthasarathy	Advance Course on Agril. Research Scientist Development for Personnel and Effectiveness	NAARM, Hyderabad, 5-26 December, 1995

Scientist	Prrticulars	Venue and date
Dr. B.K. Sarma	Writing of Scientific and Technical Papers	NAARM, Hyderabad, 17-23 Nov., 1995
Shri H.C. Joshi	33rd Hindi Workshop on Official Language Management and Policy Implementation	Central Translation Bureau, New Delhi
Dr. Y.P. Singh Dr. D. Kumar	VIII Group Meeting on AICRP on Rodent Control	PAU, Ludhiana 14.9.95
Vishwakam	7th National Workshop on KVKs/TTC	Tirupati 9.9.95
Dr. U.C. Sharma	National Symposium an Agriculture in relation to Environment	New Delhi
K.M. Bujarbaruah A. Das	National Seminar on Embryo Transfer Genetic Engineering	5-7 May,95 Mukhdoom

Training Imparted

Course	Duration (days)	Period	No. of participants	Organised by
Summer Institute on Sustainable Hill Agriculture	20	11-30 July 1995	27	Agricultural Extension Division
Production Technology of Coarse Cereals	3	7-9 August, 1995	9	Agronomy and Agricultural Extension Division
Rice Production Technology	3	19-21 September, 1995	11	-do-
Orientation on Modern Agriculture	1	29-7-95	20	KVK, Tura
Agroforestry for Wasteland Development in hilly Region	50	1-6-95 to 20-7-95	30	Agroforestry Division

CONSTITUTION OF QUINQUENNIAL REVIEW TEAM

The Quinquennial Review team (QRT) of the Institute for reviewing the work for the period 1989-94 is constituted with the following eminent persons.

1. Dr. I.C. Mahapatra, Ex-Vice-Chancellor, OUAT, Bhubeneswar - Chairman
2. Dr. N. Panda, Ex-Vice-Chancellor, Sambalpur University - Member
3. Dr. R.M. Acharya, EX-DDG (AS), ICAR, New Delhi, - Member
4. Dr. S.N. Rao, Ex-Director of Research, APAU, Hyderabad - Member
5. Dr. Banarasi Lal, Professor of Agronomy, G.B. Pant University of Agriculture and Technology, Pant Nagar. - Member

CONSTITUTION OF RESEARCH ADVISERY COMMITTEE

The Research Advirsery Committee of the Institute is constituted with the following eminent persons.

1. Dr. S.S. Khana, Ex-Vice Chancellor, NDUAT, Faizabad - Chairman.
2. Dr. D.N. Borthakur, Ex-Vice-Chancellor, Assam Agricultural University, Narikalbasti, Guwahati. - Member.
3. Dr. S. Lama. Principal Director of Agriculture, Sikkim, Gangtok - Member.
4. Dr.D.K. Uppal, Director, National Horticultural Board, Gurgaon. - Member.
5. Dr. R. Kapthuama, Ex-Director of Animal Husbandry, Mizoram, Aizawl - Member.

APPOINTMENT OF DIRECTOR AS ADVISER, NEC

The Chairman, North Eastern Council, has appointed Director, ICAR Research Complex for NEH Region, as the Ex-officio Adviser for agriculture and allied sectors.

VISIT OF NATP TEAM

The expert team consisting of Dr. D.S. Balain, DDG (AS), ICAR, New Delhi and Dr.P.S. Lamba,Ex-Vice-Chancellor, Haryana Agricultural University, visited ICAR Research Complex for NEH Region from 16th to 22nd June,1995 for reviewing and making recommendations regarding Zone III for financial assistance from the World Bank under National Agricultural Technology Project.

KISAN MEELA

A Kisan Mela was organised at ICAR Research Complex, Barapani on 17th June, 1995. About 200 farmers from different parts of Meghalaya attended the Kisan Mela. The farmers were given training on improved methods of cultivation. Inputs were also distributed to the farmers.

FAKHRUDDIN ALI AHMED AWARDS FOR OUTSTANDING AGRICULTURAL RESEARCH IN TRIBAL AREAS 1992-93

The Fakhruddin Ali Ahmed Award for Agricultural Research in Tribal Areas for the biennium 1992-93 is jointly given Dr. U.C. Sharma, Sri Kamla Singh, Dr.P.D. Sharma and Karan Singh, for their outsanding contributions in Agricultural Sciences.

SUMMER INSTITUTE

The Agricultural Extension Division of ICAR Research Complex for NEH Region, Barapani conducted 20 days long Summer Institute on Sustainable Hill Agriculture from 11th to30th July, 1995. In this programme altogether 27 participants from 14 different states mostly of the rank of Assistant and Associate Professor of different State Agricultural Universities took part.

FARMERS DAY CELEBRATED

Farmer's day was held on 30th September, 1995 at the ICAR Research Complex for NEH Region, Barapani. This was organised as a part of extension activity in this institute and also in compliance with the special request made by the farmers of this locality.

This Farmer's day was attended by two hundred farmers of the adjacent area. Some were from the adopted villages and some from non-adopted villages. On this occassion some special guests were also invited to take active part in this programme.

E-MAIL

The Institute has been connected with NIC (National Information Centre) network on November 10, 1995. E-Mails are being received regularly from different Institute of the ICAR system besides providing selective dissemination of Information (SDI) services to the scientists of the Institute by accessing various national data bases. The E-Mail address of the Institute is RC NEHR at No. 400. nicgw + nic in and the contact person is Mr. M.A. Prodhani, Library and Information officer.

EXTREMIST'S ATTACK ON ICAR STAFF

Extremists attacked the staff and labourer of Tripura centre of the Institute on 29th November, 95 while they were working at the cocotilla farm near Lembuchera. In the exchange of fire between the extremist and Special Armed Forces (SAF) jawans, one of the SAF jawans was killed and another was injured. The extremist took away the rifle and ammunition from the deceased. At this incident all the staff of Tripura centre are working under great tension and a sense of insecurity is previling at the centre. The matter was brought to the notice of the Government of Tripura and a request was made to deploy more security personnel at the centre.

SPORTS

A contingent of 22 staff members from ICAR Research Complex participated in ICAR Sports meet (Zone-III), held at NDRI, Karnal, from 14th to 17th November, 1995.

ICAR Research Complex, Barapani, bagged the best march-past and most disciplined contingent trophy among the nineteen participating institutes. The Institute also got the runners-up trophy in Badminton Doubles.

MEETING ORGANISED

A meeting between the officials of the Agriculture Department of Meghalaya and Scientists of ICAR Research Complex was held at Barapani on 26th April, 95 to discuss about the effective dissemination of technologies to the farmers. Dr.J.K. Durong, Director of Agriculture, Meghalaya presided over themeeting.

The Local Meghalaya Committee Meeting of KVK, Tura was held on 31st July, 1995 under the chairmanship of Dr S. Laskar, Director , ICAR Research Complex. This was attended by Shri J.Singh, Deputy Commissioner Tura.

FOREIGN VISIT

Dr. R.P Awasthi, Director, ICAR Research Complex for NEH Region attended the Regional Consultation on Strengthening Research and Education for Sustainable Mountain Agriculture in the Hindukush Himalayan Reigon from 23-26 January at ICIMOD, Kathmandu, as a member of the team nominated by Department of Agricultural Research and Education, Govt. of India.

Dr. R.P Awasthi, Director along with Dr.K.C. Mishra, Principal Scientist (VB&V) Visited Thimpu, Bhutan from 25-28 th march, 1996 as two member delegation of the Project Management Review Committee (PMRC) for attending the third meeting of PMRC of Indo- Bhutan Gaylegphug Integrated Area Development Project.

ENVIROMENTAL AWARENESS PROGRAMME

KVK, Tura, organised an Environmental Awareness Programme on Enviromental Preservation on 21st June, 1995 in collaboration with District Research Station (Agri), District Farmers Traininng Centre, Mechanical Division (Agri) and M.E school, Chunamati. The programme was attended by 200 farmers.

HINDI WEEK CELEBRATED

Hindi week was celebrated at the Institute from 14-20 september, 1996. Thirty employees of the Institute got award in the different competition organised during the Hindi week.

ARS/NET/ SRF EXAMINATION

Agricultural Reesearch Service (ARS), National Elligibility Test(NET) and Senior Research Fellow (SRF) Examination was conducted by the Institution at NEPA, Barapani from 5-7 october, 1995.

RETIREMENT

Dr. S. Laskar, Director, ICAR Research Complex and Dr. C.R. Maiti, Principal Scientist (AH) retired from service on 31st August, 1995.

TRANSFER

Dr. S.S. Ghosh, Zonal Coordiator to ZCU, Jabbalpur.
Mrs. S. Sardana, Senior Scientist (PB) to IARI. New Delhi,
Dr. N. Balaraman, Senior Scientist (AN) to NDRI, Karnal.
Dr. J. Singh, Scientist (PB) to IISR, Lucknow
Dr. A.R. Desai, Scientist (Hort) to ICAR Res. Complex, Goa.
Dr. Y.P. Singh, Scientist (Ento) to NRCRM, Bharatpur.

NEW COMERS

Dr. P.R. Kumar, Principal Scientist (PB)
Dr. A. Sanyal, Scientist (VBeV)
Shri S.D. Bundela, Scientist (SWCE)
Dr. S.K. Shahoo, Scientist (Animal Nutrition)
Shri A.K. Sarkar, Scientist (Agril. Economics)
Shri M. Naskar, Scientist (Agril. Statistics)
Shri S.S. Mane, Scientist (Plant Pathology)
Shri V.R. Suresh, Scientist (Fish & Fish culture)
Shri B.D. Rawat, Scientist (Hort)
Shri A.K. Dubey, Scientist (Hort)
Dr. A.K. Sood, Scientist (Agril. Economics)
Shri L.C. De, Scientist (Hort)
Miss. Cheryll H. Fernandes, Scientist (Fish & Fisheries)
Miss. S. Balasundari, Scientist (Fish Processing tech).
Shri C.S. Sahay, Scientist (FMP)
Shri S.K. Jena, Scientist (SWCE)
Shri Rajesh Kumar, Scientist (Agril. Exten).
Dr. A.K. Mishra, Scientist (SWCE)
Shri M. Mishra, Scientist (Hort)

Dr. Ramesh Chandra, Scientist (LPM)
Shri K.N. Agarwal, Scientist (FMP)
Dr. N. Bhat,Scientist (Plant Pathology)
Dr. S. Prasad, Scientist (Plant Pathology)
Dr. (Mrs) L. Prasad, Scientist (Plant Pathology)
Shri J. Abalkar, Scientist (Plant Physiology)
Dr. D. Himadri, Scientist (Animal Virology)
Shri T.K. Bag, Scientist (Plant Pathology)
Shri S. Naskar, Scientist (LPM)
Dr. A. Margauth, M. Rathinam, Scientist (Fish processing and tech)
Dr. P.R. Rohilla, Scientist (LPM)
Shri Naresh Babu, Scientist (Hort)
Shri P. Venkateswarulu,, Scientist (Ento)
Shri R.K. Singh, Scientist (SWCE)
Shri A.K. Nair, Scientist (Agronomy)
Shri R.K. Singler, Scientist (Hort)
Shri S.K. Ghosh, Scientist (Animal Nutrition)
Dr. B.K. Bhattacharyya, Scientist (SWCE)
ShriAsit Das, Scientist (Animal Nutrition)
Dr. S. Mitra, Scientist (Agronomy)

OBITUARY

Shri A.N. Choudhury, Senior Scientist (Z.C. Unit), Dr. B.P. Singh, Scientist (Soil) and Shri H.S. War, Technical Assistant, Division of Horticulture expired due to sudden illness. The Scientist and staff of the Institute condoled the death of Shri Choudhury, Dr. Singh and Shri War.

DISTINGUISHED VISITORS

	Visitors	Date
1.	Shri Rishang Keishing Chief Minister, Manipur	30.4.95
2.	Dr. J.K. Durong, Director of Agriculture, Meghalaya	26.4.95
3.	Mr. Dirk Van Genberg Agronomist, IFAD	30.5.95

4.	Miss Gargi Sen, Consultant, IFAD	30.5.95
5.	Dr. D.S. Balain, DDG (AS), ICAR	16-22 June, 95
6.	Dr. P.S. Lamba, Ex-V.C., HAU	-do-
7.	Hon'ble Minister of Agriculture, Meghalaya	5.8.95
8.	Dr. D.N. Borthakur, Ex-V.C., AAU	20.11.95
9.	Shri G.C. Sahani, Secretary, ICAR	16 to 18 January, 96
10.	Shri A. Saikia Joint Secretary, Department of Agriculture and Cooperation, Govt. of India.	-do-

ADVISORY AND EXTENSION ACTIVITIES

* Betelvine growing areas of east Khasi Hills near Bangla Desh border were visited on 12th May 95 to assess the disease problems. The request was made from North-Eastern Council and voluntary organisations. Drying of vines and leaf blight were major disease problems in Mawlat village and neighbouring areas. The pathogen associated with disease was identified as *Colletrichum capsici*. Strategy for management of diseases was suggested. A booklet (published by Project Coordinator, AICRP on Betelvine IIHR, Bangalore-560080) containing coloured photograph of betelvine disease and control measures was also given to a social worker for increasing awareness among farmers.

* On the request of United Balat Border Area Youth Organization visit was made on 3rd June 95 to suggest remedial measures for diseases of orange, betelvine, Arecanut and cinnemon. Control measures for important diseases of these crops were suggested.

* A team of scientist imparted training on Oyster mushroom cultivation from 22nd March-24 March 95 at KVK, Arunachal, Silchar. The training was meant for tribal youth.

* A training on Oyster mushroom was organised by extension division on 27th March. The Scientist participated as resources persons.

* A number of educated youths were trained by Animal Production division of Barapani on rabbit production. A video film was also made with the financial assistance from D.S.T.E., Manipur on rabbit farm management for the benefit of the farmers. Total number of 195 persons from Manipur, Nagaland, Meghalaya and Mizoram were trained in rabbit production. 132 rabbitry have been established in these States with our guidance.

* Following NGOs and other agencies are working today on rabbit development it Manipur with the ICAR Research Complex's Guidance.

  1. I.M.A. (Ideal Mothers Association).
  2. C.V.T.C. (Citizen Volunteer Training Centre).
  3. C.M.I. (Club Mountaineering Institute)
  4. All Manipur Rabbit Breeders Association.
  5. All Manipur Rabbit Development Council.
  6. Imphal Rabbit Breeders' Council etc.

* Apart from training of number of local people periodically, a comprehensive training was organised for the educated youth wherein a total of 28 youths were trained in Pig Production technology.

अरुणाचलप्रदेश (बसार)

ARUNACHAL PRADESH (BASAR)

INTRODUCTION

Arunachal Pradesh is the largest hill state in the North-Eastern Hill region and possesses vast potentiality both in the fields of agriculture and animal resources. To cater to the research needs of the state, the Research Centre was established at Basar, located at 800 m altitude in the Siang District. The Centre has 40.5 ha land at Gori Research Farm and 4.1 ha land in KVK Instructional farm. The Gori farm was developed for the research trials of the centre and Bame farm was developed into KVK farm and its campus. Despite the infrastructural facilities developed already, the centre remained mostly without any scientist. Inspite of dearth of scientist, the centre is currently working on some aspects of crop imporvement in rice, pulses, groundnut, horiticulture, water resources, farming and cropping systems and transfer of technology. Due to absence of animal scientist, no work on animal science could be done.

SUMMARY

Weather conditions prevailed during the year were conducive for Kharif and Rubi crops production. The total rainfall received during the year was 2553.1 mm with 150 days of rain. The average maximum and minimum temperature were 26.4°C and 19.1°C respectively.

Maximum fruits from sweet orange were obtained from Sahniang riang and in mandarin orange highest number of fruits were given by Cleopetra mandarin and Kamala Australia. *Citrus volkaneriana* showed maximum trunk girth and average yield/plant whereas maximum fruit weight and juice/fruit were given by *Citrus latipes*.

The turmaric varieties RCT 1 and Nadia gave good performance with respect to yield and quality. The performance of cabbage, spinach, carrot and radish was very satisfactory under Basar condition.

Growth status of 35 bamboo species establised at the bomboorium indicated more number of climps in *Bambma tulde* (E jo III), *B. tulda* (E jov), *B. teras, B. varigata, Dendrocalemus hookeri, Chimonbambush griffithione, B. pallida,* B. mane, *Pseudostachnm polymorpherm,* and *B. cachariensig*. Fifteen selections from ethrel and colchicine treated varient clump showed excellent growth at 5 years crop age. A linear increase was observed for clump circumference over increasing spacing.

In all, 24 training on field crops, forage crops, livestock, horticultural crops and home science were organised where 257 trainees participated. Two villages involving 15 farm families were adopted under Lab to Land programme. Demonstrations on oilseeds were organised in

two villages on soybean and mustard. In addition to the demonstration at KVK Instructional Farm, the other TOT activities were field demonstration of forage crops, field day cum-group discussion, advisory services, radio talk etc.

SCIENTIFIC AND TECHNICAL PERSONNEL

Scientific

Dr. Sukumar Roy, Joint Director I/c

Shri A.K. Dubey, Scientist (Horticulture)

Technical

Shri R.C. Sachan, Technical Officer (T-5)

WEATHER

Temperature

The mean maximum temperature at Basar varied from 18.93°C in January to 30.78°C in August. There was gradual increases in maximum temperature from January to September, thereafter, it started declining. The trend was same for mean minimum temperature also.

Rainfall

The total rainfall received during the year at Basar was 2553.1 mm. More than 85% of the total rainfall was received from May to October. The intensity or rainfall was more in June and July. Rain was scanty on November to January. Good amount of rain received during rabi season was helpful for production of rabi crops. (Table 1).

Table 1. Weather parameters of Basar (1995)

Month	Temperature		Rainfall	Rainy days
	Mean Maxi	Mean Min	(mm)	(Nos)
January	18.93	8.39	63.6	7
February	19.47	11.19	151.0	13
March	21.73	13.87	90.1	13
April	26.16	17.99	132.4	11
May	27.26	23.02	226.0	19
June	29.88	23.49	525.0	27
July	29.77	23.48	509.0	19
August	30.78	24.56	291.5	15
September	30.48	25.22	292.0	15
October	29.77	23.02	228.0	8
November	26.46	16.34	44.5	3
December	-	-	-	-
Average/total	26.42	19.14	2553.1	150

FRUIT

A.K. Dubey and S. Roy

Citrus

Sweet orange : In the varietal evaluation of oranges, washington malte, Daccus malta, Sahniang riang, Paramalte and Exaleir malta were found more vigorous with respect to trunk girth, height and circumference of the trees than other varieties. The maximum trunk girth (71.67 cm) was recorded in washington malta followed by Daccus malta, where as maximum height (4.93 mt.) and circumferance (6.70 mt × 6.50 mt) and maximum fruits (750 nos) were found in Sabninag riang. The heavier fruits (145.25 gm) was recorded in washington malta followed by vanilla malta. Juice.fruit (68 ml) and T.S.S. (8.0%) was also maximum in Vanilla malta. (Table 2.)

Table 2. Growth behaviour, yield and physico-chemical characteristics of different varieties of sweet orange and Kagzi lime under Basar condition

Varieties	Trunk girth (cm)	Height (m)	Spread N.S.X E.W. (M)	No. of plant fruiting	Average wt/ fruit (nos.)	Average wt/ fruit (g)	Juice (ml)	No. of seed/ fruit	Percentage
Washington malta	71.7	4.7	4.53×4.80	3	125	145.3	60	4	4.8
Vanilla malta	62.5	4.7	5.10×5.00	2	225	110.4	68	4	8.0
Valencia Newton	60.0	4.7	5.10×5.05	2	170	78.1	60	14	5.9
Rubi malta	40.0	6.3	3.10×3.30	1	350	45.0	35	13	5.2
Sahning Riang	55.0	4.9	6.70×6.50	4	750	60.0	38	4	4.3
Exalier malta	59.4	4.3	5.70×5.60	5	506	50.0	48	7	4.7
Malta orange	38.0	3.7	4.60×5.60	2	415	50.0	45	7	4.7
Rubi blood red	57.3	4.4	5.00×5.60	4	350	60.0	50	8	4.9
Whittawar malta	60.2	4.5	3.90×4.70	5	210	70.0	50	8	4.7
Majurica malta	54.3	4.1	5.50×5.80	4	225	60.0	45	11	4.6
Italien large	62.8	4.5	5.35×5.50	4	230	50.0	45	10	5.0
Daccus malta	67.2	4.4	5.70×5.20	5	375	125.0	55	20	5.3
Mosambi Austrialia	56.0	4.6	4.1×3.70	1	340	50.0	46	8	4.7
Para malta orange	67.0	4.8	5.20×4.30	2	295	48.0	35	9	4.7
Kagzi lime	35.6	3.9	4.75×4.44	41	205	45.3	35	9	2.9

Mandarin orange

In a 15 years old germplasm block of 10 bearing varieties of mandarin orange, King theppi showed maximum trunk girth (62.5 cm) and height (5.46 m) follwed by Mediterrean orange. However, maximum spread of the tree was recorded in Kamla Australia. Maximum fruits and weight of the fruit were recorded in Cleoptra mandarin and Kamla Australia respectively. But juice/and TSS fruit were recorded maximum in Sikkim orange which was at par to Nagpur Santra and hill mandarin.

Root stocks

Seven varieties of root stocks were maintanied and evaluated for screening of suitable roots stocks under Basar condition. The *citrus volkamriana* showed maximum trunk girth (76.0 cm, plant spread (7.50 mt × 7.00 mt) and average yield per plant (1175 fruits). However, maximum height was observed in Karna khatta. The maximum fruit weight (370 g) and juice/fruit (65ml) were obtained in *citrus latipes*.

Extension of orchard

About three hundred seedlings of mandarin orange were planted in the newly developed area of orchard during August.

Performance of Kagzi lime

About 50 seedlings of Kagzi lime were planted during the year and also the old orchard of Kagzi lime was maintained. The maximum trunk girth, height and circumference 35.6 cm, 3.90 mt and 4.75 mt × 4.40 mt. respectively and highest average yield (025 fruits) weight of fruit 45.53 g and 35.0 ml juice were recorded.

SPICES

Turmeric

RCT 1 yielded highest (215 q/ha) in one location whereas Nadia performed better than other varieties with respect to yield and quantity. The variety RCT 1 possessed disease resistance.

VEGETABLES

The performance of cabbage (C.M. Golden Acre), Spinach (C.V. All green), carrot (early nantes) and radish (Pusa chetki and Japanese white) was better under Basar condition.

BAMBOO

S. Roy and B.K. Sarma

Studies on bamboo germplasm

Growth status of 35 species established at Bamboorihm was studied. The variability of various growth characters are as given in Table 3.

Maximum clump number in *Bambusa varigata*, circumference in *B. vulgaris*, diameter in *B. pallida*, nodal length in *B. tulda* and plant height in *B. nutans* was observed.

Table 3. Veriability in bamboo germplasm

Character	Range
Number of new clump	1-74
Number of young clump	2-94
Number of old clump	1-180
Total number of clump	3-334
Circumference (m)	1.0-13.6
Diameter (m)	2.6-40.4
Nodal length (cm)	5.6-38.8
Leaf length (cm)	9.8-35.0
Leaf width (cm)	1.0-7.4
Plant height	1.0-30.0

Chemically induced varients in *B. pallida*

Fifteen selections were made from etherol and colchicine treated promising varient clumps were made. The selections showed excellent growth Enermons variability amongst the selections with respect to number of clumps, nodal length was noticed.

Effect of espacement in *B. pallida*

A spacing trial on *B. Pallida* with 3 spacing levels viz. 6x6 m, 7x7 and 8x8 m was plented in June 1990. The range of clump circumference and clump girth was more in 8x8 m spacing whereas internodel length and druing clump number were more in 7x7m spacing. A linear increase was observed for clump circumference over inceasing spacing.

TRANSFER OF TECHNOLOGY

S. Ray and J.K. Pandey

The different activities for transfer of technologies and other programmes through training on/off campus demonstration, field-day, field advisory services and visits etc. at KVK Basar summerised below :

Training

Training programmes were conducted during the reported period (upto 31.3.96) on various topics to impart the technology to the farmers.

Training programmes conducted at KVK Basar during 1995-96 are as follows:

Discipline	Nos of courses			Participants		
	on campus	off campus	Total	Male	Female	Total
Agronomy	1	-	1	3	17	20
Forage Crop	2	2	4	30	37	67
Live stock	1	-	1	5	4	9
Horticulture	3	2	5	30	42	72
Home Science	13	-	13	-	89	89
	20	4	24	68	189	257

The trainings were of short duration (2-3 days). One hundred participants also took training on rice production technology.

Lab to land demonstration

Fusi Doke and Pading villages were adopted and 15 farm families during Kharif and 13 during Rabi were covered from both the village. Improved and recommended crops varieties with viable low cost technologies were provided to the adopted farmers including critical inputs.

Oil seed and pulses demonstration

The oil seed and pulses demonstrations were conducted at various farmers' fields in Pusi Doke and Pading villags during Kharif and Rabi seasons.

Visit to farmers' field

Technical staffs of this centre visited 16 times to the different villages and covered 80 farmers field and advisory services were provided.

Fifty three farmers/growers visited KVK Instrctional Farm, Bame and they were shown the different demonstration plots and the various activities.

Dairy

A small Dairy Demonstration Unit is being maintained to demonstrate the dairy management, health care and other related matter to the farmers. One bull is also kept for servicing facilities to the farmers service.

Demonstration at KVK Instructional Farm

Demonstration on land use systems, crop production technologies for various fruit, agrocrops, forage and vegetables throughout the year were conducted.

Table 4. Details of soil seed and pulses demonstrations at Farmers' field conducted during 1995.

Name of village	Name of crop varieties	Adopted farmers (no)	Total areas coverd (ha)	Demonstration field Average yield	Highest yield
Pading	Soybean	15	1.2	9.1	12.1
Pusi Doke	-do-	10	1.0	8.8	13.0
Pading	Mustard	5	0.7	8.8	10.0

Crop demonstration

The details of crops demonstration are given below :

Crop/variety	Yield (q/ha)	Remarks
A. Field crops		
Rice (HPU-626)	15.0	
Groundnut (J-24)	16.0	
B. Vegetable crops		
Bottle Gourd	100.0-105.0	
Palak (All green)	70.0-80.0	
Bhindi (Pusa sawani)	105.0-110.0	
Radish (R.S. - 1)	180.0-300.0	
Cabbage (Pride of India)	350.0-400.0	
Carrot (Early nantes)	170.0-180.0	
C. Fruit Crops		
Guava	90-100 (nos/plant)	
D. Spices		
Turmeric	190.0	
E. Forage Crops		
Maize (green fodder)	330.350	
N. Napier (H.B. 21)	2000-2200	
Pusa giant	1300-1400	
Gunia-Hamil	1500-1600	
Gotton pani	600-850	
Nandi setaria	800-850	

FLORICULTURE

Some of the seasonal and perennial flowers Rose, Dalia, Calendule, Chrysanthemum, Cactus, Gladiolus and Marigold were maintained at KVK Farm to demonstrate the flowers to growers.

Field demonstration on forage crops

A field demonstration on parennial grass (congosignal) was planted at the farmer's field at padding. The crop was established and three cuttings were obtained during the year.

Field day-cum-group discussion

A field day cum group discussion was organised at farmer field to popularised the technologies on forage crops generated at this centre. A large number of farmers/dairy owners, teachers, public leaders including states officers were participated in the programme. On the occasion training, techniques, exhibition and technical session were also organised.

Advisory services

The advisory services were provided to the local farmers officials and State Deptt. of Agriculture and allied depertments, regarding the improved technologies of crop production. Past and disease manegement, forage production and livestock management.

Radio talk in Hindi

A radio talk was given by Sri J.K. Pandey on Seed Production Potentiality in Arunachal Pradesh.

PUBLICATION

K.A. Singh and J.K. Pandey. Crow zizania for green fodder on waterlogged lands in North Eastern Hill Region. *Indian Farming* April-May, 95.

Two leaflets were published on crop production technology for Arunachal Pradesh for pea and teosinte fodder.

VISITORS

	Name of visitor	Date
1.	Shri Tomio Ribm MLA, Arunachal Pradessh	20.4.95
2.	Shri S. Taying, Minister, Horticulture Arunachal Pradesh.	8.5.95
3.	Shri K. Taipodia, Minister of Tax, Arunachal Pradesh	29.9.95.
4.	Shri S. Ngenn, Minister, PWD, Arunachal Pradesh	18.12.95.

मणिपुर (इंफाल)

MANIPUR (IMPHAL)

INTRODUCTION

Manipur is the eastern most state in the North Eastern Hill Region. It ranges on a altitude from 51m to almost 2500m msl. One tenth of the geographical area of the state is valley, and the rest is surrounded by hills. The valley's highly fertile area has enormous agricultural potentialities. The research program of the centre was directed towards to fulfill the research requirements in the field of agriculture and animal science of the state. The research farms are located at Lamphelpat (750-800m msl) and Langol hill (800-850m, mls). The Centre is presently engaged in research in rice, maize, pulses, oilseeds, horticultural crops and fishes. The KVK attached to the centre is undertaking extension activities under technology transfer programme.

SUMMARY

Rice cultures suitable for pre-khorif season (February/March-June/July) were selected from F_7 and F_2 generation. Four lines were found promising for main Kharif having high yield, blast resistance and glutinious quality. Eleven single plant from KD 2-6-3, 3 from RCM 5 and 1 from RCM 6 were selected from M3 population derived from irradiation of these varieties. Seven tonnes of breeder seeds of 14 different rice varieties were produced.

JS 35, PK 471, MACS 13, PK 472 and JS 75-46 were most high yielding soybean varieties. Application of lime, phosphorous and rhizobium significently increased the nodule weight, grain yield and N, P, K, Ca, Mg uptake in soybean. Grain yield of soybean was significantly increased by 0.25 LR equivalent level whereas application of K doses increased the grain yield and K-uptake in soybean beyond 15 mg/kg dose.

ICGV 92224, ICGV 88336, ICGV 88376 and ICGV 86023 were identified as most high yielding groundnut genotypes having short duration, medium duration confactionary quality and folier disease resistance respectively. Eight groundnut genotypes were increased for early leaf spot (ELS) and late leaf spots (LLS) diseases of which 21 tolerant to LLS and 19 to ELS. Three sprays of Mancozeb 0.2%, Dithana M 45 2-6 g and Bavistin 1g/lit water at 35, 50 and 65 DAS effectively controlled leaf spot and rust disease of grounnut and gave higher pod yield. The grain yield of mustard was significantly increased by 2/3 NPK over 1/3 NPK.

Different forms of aluminium and iron in Manipur soils were studied. Significant differences were observed in maize, soybean and blackgram in their respective yield. N and P uptake with FYM and FYM+biofertilizer was studied. Nutrient dynamics of Manipur hill soil under different land use systems were worked out.

In citrus, Sohsyteng recorded maximum fruits/tree followed by Heizang (citron). L49 was the most pormising

variety of guava. Growth performance of 17 mango varieties was studied in different situations. Pant Samrat was the high yeilding brinjal variety followed by Arka Kashev. Seven brinjal lines were developed having wilt resistence and better plant type. Thirty tomato lines were evaluated and maintained. IAHS BB was found to be best tomato. GL Puram, Dugyirala 325 and PCT II in turmeric and Suprabha, Poona, Thingpui and Deomali local in ginger were identified as most promising varieties. There was significant effect of phosphorus on the fresh rhizome yield of turmeric.

E. citriodora showed maximum plant hieght, collar and B.H. diameter and total biomass amongst different tree species. Highest root biomass was also recorded in *E. citriodara. Casurina glanea* had maximum height and canopy spread *C. cunninghamiana* had maximum collar and breast height dismeter and branching. Provinance of *Parkia roxburghii* was studied with respect to plant height, DBH, total height, branching and canopy. Growth performance of different tree species and crops and physiochamical properties of soils of different land use systems were studied.

Forty four training programmes, 2 front like demonstrtions, 3 demonstration under LLP and 4 on farm trials on paddy mustard and brinjal were conducted by KVK besides other extension activities.

SCIENTIFIC TECHNICAL PERSONNEL

Shri Jai Singh, i/e Joint Director
Shri A.C. Sharma, SS (PB)
Dr. D.S. Yadav, SS (Hort.)
Shri B.P. Hazarika, SSG (PP)
Shri Kailash Kumar, S (Soils)
Shri I.M. singh, S (Seed Tech,)
Dr. S.P. Singh, S (Hort)
Ms M. Roy Choudhury, S (Soils)
Shri V. R. Surech S (Fishery)
Dr. Ramesh Singh, T-7
Dr. S.M. Mishra, T-7
Shri K.L. Singh, T-7
Ms. R.K.J. Devi, T-6
Ms S. Devi, T-5
Shri B.K. Sharma, T-6
Shri S.K. Sharma, T-5
Shri L.I. Singh, T-6
Shri N.A. Singh, T-5

RICE

A. C. Sharma, I.M. Singh and Y.R. Singh

Breeding for cold tolerance and better plant type suitable for pre-Kharif season (Feb/March-June/July)

Replicated trial with advanced breeding lines in F7 and F8 generations derived from the crosses, Akhanpphou × Prasad, Prasad × IR-24 and Prasad × RCM-8 consisting of twentyone entries including two checks were sown on 16.3.1995 and

planted on 21-4-95 at Sangaipat farm. The yield differences were found significant. The highest yield of 750 g/m² was recorded with the entry MC-18-1-1-46-19 followed by the MC-16-49—19-13, MC-18-1-1-4-18, MC-16-39-14-12 yielding 733g/m², 633 g/m² and 583 g/m² respectively. The difference among these however, being insignificant.

F_1 plants of the crosses Konlong × Basmati, Napnangmumei × Kungilu, IRAT-109 × Basmati, Basmati × KD-2-6-3 and BR-1 × KD-2-6-3 were raised and their F_2 seeds were produced.

Breeding for high-yielding and blast resisant, glutinious, and good quality rice varieties for main kharif (June/July-Nov/Dec.) season

Eighteen promising lines were selected from the cross prasad × IR-24 as preliminary trial under Lamphelpat condition. The trial was sown on 6-6-95 and planted 8-7-95. The yield differences was found significant. The highest yield of 711 g/m² was recorded with the entry MC-17-10-5 and MC-17-50-3 yielding 624 g/m², 584 g/m², 576 g/m² and 550 g/m² respectively. The difference among them were insignificant.

M_3 population derived from irradiation of RCM-5, RCM-6 and KD-2-6-3 with gama ray were raised at Lamphelpat farm which was sown on 6-6-95 and planted on 8-7-95. Out of the twentyfive lines selected, 11 single plant from KD-2-6-3, 3 different plants from RCM -5 and one plant from RCM-6 were selected for preliminary trial in the next season.

F_3 plants of eight crosses were sown on 6-6-95 and planted on 7-7-95 under Lamphelpat condition. The crosses namely are Nanangmumei × Kungeilu, RCM-6 × IRAT-141, Napnangmumei × Basmati, IRAT-141 × RCM-6, BR-1 × Basmati, Napngngmumei X napdai, Napnangmumei × KD-2-6-3, and KD-2-6-3 × Napnangmumei. Fortyone single plant were selected among the crosses for different characters.

Verietal performance of pre-kharif rice

Jai Singh and I.M. Singh

Replicated field trial was laidout with 15 varieties of rice and crop was supplied with 60 kg N, 40 kg P_2O_5 and 30 kg K_2O/ha. Grain yield data revealed that out of 15 varieties tested, Pusa - 33 produced the highest yield (49.0 q/ha) and was at per with IR-50, Annada, RCM-8, RCM-6 and was significantly superior to rest of the varieties. RCM - 6 had the largest duration (138 days) whereas Heera had the shortest (114 days). RCMP - 5 had the highest 1,000 grain weight (30.50 g) (Table 1).

Table 1. Varietal performance of pre-kharif rice

Variety	Yield (q/ha)	Duration (days)	1000 grain weight (g)
K-39-96	34.28	127	24.10
IET-7511	32.85	122	23.50
RCM-8	45.38	128	24.70
IR-50	48.28	135	26.95
RCM-7	38.18	128	24.20
Heera	34.50	114	27.50
Sarrary	31.50	128	24.00
IET-9221	34.88	128	25.20
Himalaya-II	41.33	128	23.60
Neela	39.25	121	26.90
RCMP-5	37.00	124	30.50
RCM-6	42.88	138	26.00
P-33	49.00	133	25.60
Annada	46.63	130	28.00
RCM-5	41.85	130	24.00
C.D. (0.05)	6.32		

Seed Technology

Evaluation of seed quality used by the farmers

I. Meghachandra Singh, Jai Singh and L. Ingobi Singh

In a grow out test of 10 samples of rice seed collected from the farmers of Karong village, it was found that 40% of the samples could not meet the pure seed standards (98%) with a mean of 96.54% ±4.1%. The mean insert matter content was as high as 2.28±1.16% and all the samples were beyond the standard limits. Off type was nil in one sample with an average of 4.06+7.71%. All the samples did not conform to the Indian Seed Standards. (ISS).

Effect of location on seed quality

In a study to know the effect of location of rice seed production on quality, the discolouration percent of the seed produced under Lamphelpat was significantly higher than that under Sangaipat conditions (Table 2). For seed weight, KD-2-6-3 seed produced at Sangaipat farm was 23.55/200 seeds and those produced at Lamphelpat was 17.18g. Seed discolouration of KD-2-6-3 was as high as 79.78% at Lamphelpat as compared to 25.82% at Sangaipat whereas for IRAT-141 it was 73.75% and 22.06% respectively.

Seed multiplication and varietal maintenance

Seven tonnes of breeder/quality seeds of 14 different rice varieties were produced during the Pre-kharif and main kharif (Table 3).

Integrated nutrient management in lowland rice

Kailash Kumar, Mausumi Roychaudhuri and Jai Singh

The experiment was repeated with the same treatments viz., (1) Control, (2) NPK (60 kg N, 40 kg P_2O_5 and 30 kg K_20/ha) (3) Azotobector + Phosphatica ((AP), (4) Paddy straw @ 10 t/ha (PS), (5) NPK + AP, (6) NPK + PS, (7) $\frac{1}{2}$ NPK, (8) NPK + AP (9) $\frac{1}{2}$ NPK + PS, (10) Azotobactr, (11) Phosphatica and (12) AP+K30 in RBD replicated four times. Paddy variety Laimaphou was used as test crop. The crop was sown late due to flood in the farm and yield was lower than that of previous year.

Table 2. Effect of location seed weight and discolouration percentage of two rice cultivars

Location variety	Seed weight (g/200)			Percent discoloured seed*		
	S	L	Mean	S	L	Mean
KD 2-6-3	23.55	17.18	20.37	25.82	79.78	52.83
IRAT-141	17.73	18.64	18.19	22.06	73.75	47.78
CD 5%		0.642			2.99	

* Transformed values
S - Sangaipat L - Lamphaalpat

Table 3. Quantities of quality seeds of rice

Variety	Quantity (Kg)
RCM - 7	250
RCM - 8	750
RCM - 9	2,600
Annada	450
KD-2-6-3	1,000
Akutphou	500
Pusa - 743	300
Pusa - 4433	200
Pusa - 33	10
RCM 6	80
Himalaya II	40
IR - 50	300
Prasad	134
K-39-96	400
Total	7,014

The straw yield was significantly increased by NPK+paddy straw and $\frac{1}{2}$ NPK + paddy straw treatments over control. Effect of Azotobacter and Phosphatica alone or in combination was not beter than control for straw yield. None of the treatments had any significant effect in increasing the grain yield. However, NPK, NPK+PS and $\frac{1}{2}$ NPK + PS had significantly decreased the grain yield. The experimental soil is blast prone and the application of fertilizers showed adverse effect on grain yield due to increased incidence of neckblast. There was no significant effect on N and P uptake by grains. N, P and K uptake of straw was increased by all the treatments except Azotobacter and Phosphatica either alone or in combination (Table 4).

Table 4. Effect of integrated nutrient management on yield and nutrient uptake in lowland rice

Treatments	Yield (q/ha)		Nutrient uptake by grain (kg/ha)			Nutrient uptake by straw (kg/ha)		
	Grain	Straw	N	P	K	N	P	K
Control	41.3	48.5	76.9	3.2	12.7	73.5	10.8	67.9
$N_{60}P_{40}K_{30}$ (NPK)	31.8	53.6	67.9	7.8	9.2	88.6	13.9	101.6
Azotobacter+Phosphatica (AP)								
Paddy straw @	42.6	50.6	75.4	0.3	12.7	79.4	11.5	69.5
10 t ha-1 (PS)	43.9	53.6	83.7	9.9	13.3	88.7	13.3	89.7
NPK + AP	37.0	59.2	83.9	8.9	11.5	108.1	14.8	105.2
NPK + PS	32.6	69.5	76.2	8.2	9.8	138.1	18.5	151.0
$\frac{1}{2}$ NPK	39.6	54.4	78.8	8.9	11.4	39.9	12.9	91.1
$\frac{1}{2}$ NPK+AP	40.4	57.2	86.1	9.0	12.3	98.5	13.8	101.9
$\frac{1}{2}$ NPK+PS	35.2	60.4	75.8	8.3	11.8	105.7	15.1	120.8
Azotobacter	40.3	49.3	81.9	8.6	12.8	78.7	11.4	80.1
Phosphatica	38.5	48.3	69.7	7.7	11.5	70.4	11.0	77.1
AP+K30	38.9	58.3	78.9	8.3	12.7	92.9	13.9	106.3
CD at 5% level	5.8	11.8	N.S	N.S	2.4	13.4	1.9	16.4

OILSEEDS

SOYBEAN

Jai Singh

Out of fourteen varieties of soyabean tested, variety JS-35 produced the highest yield (36.85 q/ha) and was at par with PK-471, MACS-13, JS-75-46, PK-472 and was significantly superior to rest of the varieties.

Lime, biofertilizer and phosphorus interaction

Mausumi Raychaudhuri and Kailash Kumar

The experiment was repeated in the same plots in a split-split plot design keeping three levels of lime (0, 0.25, 0.50 LR) in the main plots, biofertilizer (control and rhizobium inoculation) in the sub-plots and three levels of P (0,13 and 26 kg p/ha) in sub-sub plots. Soybean variety Pusa-16 was used as test crop.

Application of lime, phosphorus and rhizobium significantly increased the nodule weight per plant, grain yield, N,P,K, Ca and Mg uptake. Interaction of rhizobium with lime was also significant. Rhizobium inoculation significantly increased the nodule weight and N-uptake at all. All the treatments increased the rhizobium population of the soil. Soils treated with lime, Rhizobium and phosphorus contained maximum rhizobium colonies followed by the soils treated with rhizobium and phosphorus. (Table 5).

Table 5. Population of total rhizobium in the soils under different treatments

Treatments	Rhizobium x 104/g of dry soil
Control	0.46
Lime	0.87
Rhizobium	5.70
Pphosphorus	1.20
Lime + Rhizobium	14.60
Bio + Phosphorus	24.90
Lime + Bio + Phosphorus	62.00

The pH of the post harvest soil increased significantly with all the lime levels giving a maximum value of 6.00 at 0.50 LR level. Exchangeable Al^{3}+decreased significantly with all the lime levels with a minimum value of 0.037 at 0.50 LR level. Organic carbon content increased significantly with lime, rhizobium inoculation and Phosphorus application. Interaction of lime and rhizobium inoculation was also significant. Rhizobium inoculation increased the organic carbon content at all the levels of lime significantly except 0.50 LR level. Available phosphorus increased significantly with all the levels of lime and phosphorus. Interaction of lime and phosphorus was also significant. At OLR level available P increased significantly only at p_{26} level whereas, it increased significantly with both p_{13} and p_{26} levels at 0.25 LR and 0.50 LR levels.

Lime potassium interaction

Mausumi Roychaudhury and Kailash Kumar

A pot experiment was conducted in a factorial design on soybean variety MACS-13 to study its response to applied K under differet lime levels. Three levels of lime, 0, 0.25 and 0.50 LR equivalents and five doses of potassium (K) @ 0, 7.5, 15 and 22.5 and 30 mg/kg soil were combined to got fifteen treatments with three replications. Langol hill soil was taken for the experiment. N and P was added as per the recommondation in each pot (i.e. 20 kg N and 60 kg P_2O_5/ha)

The soil was taxonomically classified as Typic Kanhaplahumult with pH (1 :1), 5.0, O.C, 1.82%; CEC, exchangeable bases like $Ca^{2+}Mg^{2+}$, K^{+}, Al^{3+} as 11.2, 8.35, 0.32, 1.04 cmol (P^{+})/kg respectively and available P, 9.08 ppm. Soil texture was sandy clay loam with sand, silt clay percentages as 53.1, 13.8 and 33.1 respectively.

Table 6. Grain yield and K-uptake of soybean as effected by differetn lime and potassium levels

Lime levels	Potassium levels (mg K/kg)					
	0	7.5	15	22.5	30	Mean
			Grain yield (q/pot)			
0 LR	26	29	30	35	36	31.2
0.25 LR	31	32	37	39	39	38.3
0.50 LR	28	31	32	34	36	32.0
Mean	28.3	30.4	33.0	35.9	37.2	
CD						
Lime (L)	3.64**					
Potassium (K)	4.70**					
LXK	N.S.					
			K-uptake (mg/pot)			
0 LR	457	523	549	641	667	568
0.25 LR	494	539	623	716	722	619
0.50 LR	410	476	520	613	668	537
Mean	454	513	564	656	686	
CD						
L	55*					
K	95**					
LXK	N.B.					

* and ** denote significance at 5% and 1% level respectively.

Table 7. Performence of top 3 varieties of groundnut in different trials

Rank	Trial			
	SDABT	MDABT	DRABT	CABT
I	ICGV 92224 (28.6/106/70)	ICGV88336 (28.6/120/64)	ICGV86743 (18.4/119/62)	ICGV88376 (27.6/117/54)
II	ICGV 92255 (22.2/105/74)	ICGV 88318 (24.2/117/64)	ICGV 86708 (18.1/116/62)	ICGV 89235 (25.8/117/54)
III	ICGV 92217 (21.7/105/68)	ICGV 88311 ICGV 88379 (21.5/118/75)	ICGV86745 (17.8/116/66)	ICGV88362 (22.8/117/61)
Entries	10	10	10	10
Trial mean cd 5% (yield)	12.6	8.9	6.4	14.5

Fugures in parenthesis indicates pod yield in q/ha/days to maturity/shelling percentage respectively.

Grain yield was significantly increased by 0.25LR equivalent level; but beyond this level grain yield and K-uptake, both decreased significantly. Application of K doses had increased the grain yield and K-uptake, both significantly beyond 15 mg K/kg dose (Table 6).

Lime-K interaction was found insignificant in both, grain yield and K-uptake because of the detrimetal effect of lime in reducing the K concentration of the grains from 1.81 to 1.66% significantly. The K doses increased the K concentration of the grains from 1.60 to 1.86% significantly. The above results suggest that 0.25 LR equivalent of lime and 15 mg k/kg could be an optimum does for an optimum yield of soybean var. MACS-13 in the experimental soil.

GROUNDNUT

Jai Singh and I. M. Singh

Short duration adanced breeding trial (SDABT)

Pod yield date revealed that out of ten varieties tested, ICGV-92224 produced highest yield (28.60 q/ha) and was significantly superior to rest of the varieties. Shelling par cent was the highest (75%) in ICGV-92261 whereas 100 kernel weight was highest (63.03g) in ICGV-92218.

Medium duration advanced breeding trial (MDABT)

Out of ten medium duration groundnut varieties tested, ICGV-88336 produced highest yield (28.60 q/ha) and was at par with ICGV-88318, ICGV-88311, ICGV-88347 had highest (76%) shelling per centage and ICGV-88345 had the highest (77.72 g) 100 kernel weight.

Drought resistant advanced breeding trial (DRABT)

Out of ten varieties tested ICGV-86743 produced the highest yield (18.38 q/ha) being signigicantly superior to ICGV-87883 and was at par with rest of the varieties. ICGV-87290 was having highest shelling per cent (79.78%) and 100 kernel weight was highest in ICGV-86742.

Confectionery advanced breeding trial (CABT)

Ten bold seeded having high export grounnut varieties were tested. ICGV-88376 produced highest yield (27.56 q/ha) followed by ICGV-89235 (25.78 q/ha). Variety ICGV-88448 and ICGV-88475 had highest shelling per cent (68%). ICGV-88376 also had highest 100 kernel weight (132,91 g) followed by ICGV-89215 (126.75 g). The yield of top 3 varieties are presented in (Table 7).

Screening for resistance to ELS, LLS and rust diseases

B.P. Hazarika

Seventy genotypes were screened for resistance to early leaf spot (ELS), late leaf spot (LLS), and rust disease in 5 different screening trials with JL 24 as check variety. No disease symptoms were observed in till the 39th days after sowing (DAS).

Disease symptoms started appearing 40 DAS. The genotypes were screened at 90 DAS for ELS, LLS and rust using standard 1-9 disease rating score. Twenty one genotypes were tolarant to LLS and 13 to ELS. Other genotypes were either moderately tolerant or susceptible.

Folier disease resistance advance breeding trial

Jai Singh and B.P. Hazarika

Out of 10 varieties tested against folier diseases, ICGV 87281 sigificantly produced highest pod yield followed by ICGV 87242 and ICGV 87867. The genotypes matured between 115-119 days. Shelling percentage was highest in ICGV 87281 (76%) followed by ICGV 87867 (74%) whereas 100 kernal weight was maximum in ICGV 87291 (89.66 g) and least in ICGV 87282 (46.2 g). There was significant differences among the genotypes in scores for both ELS and LLS. Mean disease score was the highest in ICGV 87281 (6.5) and least in ICGV 87242 (3.8) with a range of 3.8-6.5 in case of ELS and in case LLS, the range was 2.0-3.5. The rust incidence was negligible in all the varieties (Table 8).

Effect of spray timings and frequency on leaf spot and rust diseases

This experiment was conducted to see the effect of spray timings and frequency on leaf spot and rust diseases of groundnut.

Spray mixture of Mancozeb 0.2% + carbandezim 0.05% i.e. Dithane M-45-2.6 g + Eavistin-1 g in a litre of water was used with 7 treatments.

An insecticidal spray was given in all the plots with Dichlorovos @ 1.5 ml/ litre of water to protect the crop from red hairy caterpillars.

The pod yield per plot was the highest in the treatment where 3 sprays were given at 35.50 and 65 DAS followed by the treatment where 2 sprays were given at 35 and 50 DAS. The percentage increase over check were 88.48 and 81.80 respectively.

The percent disease index/plot was maximum in check plot (24.56) and least in 3 sprays plots (8.50). The percent defoliation varied from 43.25 in check plot to 65.75 in 3 sprays.

Economics of spray application indicated that an amount of Rs.1,359.01 is sufficient for the tikka disease under Manipur condition (Table 9).

Intergrated nutrient management in groundnut - mustard crop sequence

Kailash Kumar and Mausumi Roychaudhury

The experiment was repeated with the same treatments namely control, lime @ 0.25LR, FTM @ 10 t/ha and lime @ 0.25LR + FYM @ 10 t/ha as main treatments and three levels of fertilizers viz.,

Table 8. Pod yield and disease reaction in folier disease resistant advance breeding lines

Entry	Pod yield (q/ha)	Duration (days)	Shelling (percent)	ELS (scors)	LLS (score)	Rest (Score)
ICGV 86023	28.6	119	68	5.0	2.3	1.0
87206	24.3	115	71	6.0	3.5	1.0
97232	29.0	117	72	4.3	3.0	1.0
97242	35.6	118	69	3.8	2.3	1.0
87281	37.6	116	76	6.5	3.5	1.0
87282	23.9	115	72	6.0	3.3	1.0
87291	18.1	117	73	4.8	3.0	1.0
87334	22.8	118	66	3.8	2.0	1.0
87817	27.6	119	72	6.0	2.0	1.0
87867	30.8	118	74	5.0	3.0	1.0
CD 5%	5.8			0.9	0.2	NS

Table 9. Effect of spray timing and frequency on leaf spot and rust diseases of groundnut

Treatments	Percent disease index	percent defoliation	Yield (q/ha)
T_1 3 sprays at 35, 50, 65 DAS	8.50 (-65.40)	65.75 (52.02)	30.79 (88.54)
T_2 2 sprays at 35 & 50 DAS	13.99 (-43.05)	64.20 (48.43)	29.68 (81.75)
T_3 1 sprey at 35 DAS	15.16 (-38.28)	57.17 (32.18)	20.00 (22.47)
T_4 2 sprey at 50 & 65 DAS	8.66 (-61.74)	55.05 (27.28)	21.75 (33.19)
T_5 1 sprey at 65 DAS	15.00 (-38.93)	51.05 (18.03)	20.10 (23.08)
T_6 1 sprey at 50 DAS	15.33 (-37.59)	48.90 (13.06)	19.37 (18.61)
T_7 No sprey	24.56 (0.00)	43.25 (0.00)	16.33 (0.00)
CD 0.05	N.S	5.60	7.05
7.05	-		

Figures in the parenthesis indicate the percentage increase or decrease over check.

1/3 NPK, 2/3 NPK and full dose of NPK as sub treatments in split plot design in the same plots on groundnut in the Kharif season and mustard in the rabi season.

The pod yield of groundnut was significantly increased by all the main treatments over control. These treatments showed significant difference for pod yield over each other. The fertilizer levels also showed significant effect over each other in increasing the pod yield of groundnut. Interaction of fertilizer levels and main treatments was significant. All the three levels of NPK showed significant effect on pod yield at each main treatment (Table 10).

The grain yield of mustard was significantly increased by 2/3 NPK over 1/3 NPK but full dose of NPK was at par with 2/3 NPK dose. FYM and Lime + FYM could increase the grain yield of mustard significantly over control however lime alone could not have a significant role on grain yield.

The date on nutrient uptake (Table 11) reveal that N,P,K,Ca and Mg uptake by groundnut was significantly increased by all the main treatments over control. The NPK levels also increased the N,P,K,Ca & Mg uptake significantly over each other. Maximum uptake of all these nutrients was under Lime+FYM and full dose of NPK. The interaction effect for all the nutrients except P was insignificant.

The pH and exch. Ca+Mg of control and FYM plots were almost same whereas liming increased the soil pH significantly to 5.6 and exch. Ca + Mg to 8.53-9.00 cmol (P+)/kg. The exchangeable Al content was significantly reduced in Lime or FYM plots. The main treatment do not have any significant effect on exch. K. The avilable P was, however, increased in limed and FYM applied plots. The NPK levels showed significant increase on soil available P. The interaction was insignificant. (Table 12).

MUSTARD

Use of Charcoal in seed storage

I. Meghachandra Singh and G.C. Munda

Germination percentage of M-27 seed stored during 1991 were declined below the national standards after the 49th month under all the storage treatments. The reduction was fastest under the ambient condition, while it was slowest (35th month) in the dry condition (92% with Silica and 86% with Charcoal desiccated). Airtight condition could retain the qualit upto the 18th month (98%).

SOIL MANAGEMENT

Physico-chemical properties of manipur hill soils.

Kailash Kumar and Mausumi Roychaaudhury

Different forms of aluminium

Different forms of Al, viz., exchangeable, extractable, amorphous, organic bound, crystalline and total were estimated in 25

Table 10 . Effect of integrated nutrient management on yield of groundnut and mustard

Treatment	Pod/grain yield (g ha -1)			
	1/3 NPK	2/3 NPK	Full NPK	Mean
Control	11.1 (3.43)	13.6 (4.43)	15.1 (4.62)	13.3 (4.16)
Lime @ 0.25 LR	13.7 (4.53)	17.0 (5.41)	18.9 (5.91)	16.5 (5.28)
FYM @ 10 t ha-1	16.1 (5.48)	20.9 (6.51)	21.9 (7.25)	19.6 (6.41)
Lime @ 0.25 LR+ FYM @ 10 t ha-1	21.0 (6.58)	22.6 (7.31)	24.8 (7.97)	22.8 (7.29)
Mean	15.5 (5.01)	18.5 (5.91)	20.2 (6.44)	

		Groundnut	Mustard
CD	Main treatment	1.0**	1.20**
	Fert. level	0.77**	0.35**
	Interaction	1.0*	N.S.

* and ** represent significance at 5 and 1 percent level respectively.
Figures in the parentheses indicate grain yield of mustard.

Table 11. Effect of intergrated nutrient management on nutrient uptake by groundnut

Treatment	Nutrient uptake (kg ha1)				
	N	P	K	Ca	Mg
Main treatments					
Control	90.3	6.25	25.9	11.3	5.8
Lime	118.0	9.09	37.5	20.6	8.5
FYM	145.1	10.67	45.8	10.8	9.1
Lime+FYM	181.8	13.09	57.4	29.1	11.7
Sub-treatments					
1/3 NPK	100.8	7.96	32.7	16.7	7.4
2/3 NPK	137.6	9.94	43.3	20.4	9.0
Full NPK	154.5	11.41	48.9	22.7	9.9
CD. (0.01)					
Main treatment	4.8	0.45	4.9	1.9	0.4
Sub-treatment	11.9	0.42	3.1	3.6	0.5
Interaction	N.S.	0.61	N.S.	N.S.	N.S.

Table 12. Effect of integrated nutrient management on the properties of the post harvest soil

Treatments	Soil properties				
	PH (1.1)	Abailable (ppm)	P Exch. Al^{3+} cmol(p^+)	Exch. Ca^{2+}	Mg^{2+} kg/ha
Main treatments					
Control	4.9	13.4	1.03	0.243	5.58
Lime	5.6	16.9	0.06	0.226	8.53
FYM	5.0	18.5	0.25	0.252	5.77
Lime + FYM	5.5	22.4	0.00	0.242	9.00
Sub-treatment					
1/3 NPK	5.4	15.3	0.34	0.231	7.27
2/3 NPK	5.3	17.9	0.33	0.240	7.21
NPK	5.2	20.2	0.34	0.252	7.18
CD (0.01)					
Maintreatment	0.4	1.5	0.09	NS	1.23
Sub-treatment	NS	1.0	NS	NS	N.S.
Interaction	N.S.	N.S.	N.S.	N.S.	N.S.

surface soils of hilly areas and presented in table 1A. The values ranged from 0-2.38, 0.03-7.56, 20.8-108.5, 2.2-33.2, 1.4-16.0 and 175-753 cmol (P^+)/kg respectively. Average percent contribution of these forms to the total A! was 0.27, 0.81, 11.68, 3.76 and 1.00 for exchangeable, extractable, organic bound, amorphous and crystalline forms respectively. The relative abundance of different forms was in the order exchangeable < extractable < crystalline < amorphous < organic bound. The values of extractable A1 were almost three times of exchangeable forms in most of the soils. Organic bound form is the major fraction of A1 in these soils which may be because of high organic matter of the soils.

Different forms of Iron

DTPA extractable, crystalline, amorphous, organic bound and total Fe content of 25 surface soil samples were analysed and data are presented in table IB. The total Fe content of the soils ranged from 2.7 to 5.62 percent. Amorphous and organic bound portions contributed more than 65 percent to the total iron content in these soils. DTPA extractable portion was the lowest among all forms and ranged from 32 mg/kg in Tupul soil to a maximum of 594 mg/kg in Sakpao. In 60 percent soils the content of amorphous iron was higher than that of organic bound.

Crop response to biofertilizers

Mausumi Roychaudhury and Kailash Kumar

The experiment was repeated in split plot design keeping control, biofertilizer, FYM @ 10 t/ha and FYM + biofertilizer in main plots and crops like maize, soybean and black gram in the sub plots with three replications. Rhizobium and Azotobacter were used for legumes and non legume respectively.

The grain yield of the crops increased significantly with all the treatments. N and P of the crops increased significantly with FYM and FYM + Bio. The crops showed significant difference in their respective yield, N and P-uptake. Interaction of different treatments and different crops was significant for grain yield and P-uptake. Grain yield of maize increased significantly with all the treatments. P-uptake increased significantly in maize and soybean with FYM and FYM + Bio whereas blackgram showed significant increase only with FYM+ Bio. (Table 13).

Relative increase in grain yield, N and P uptake was maximum in blackgram followed by maize and soybean.

The PH, organic carbon content, CEC, exchangeable bases like Ca^{2+} + Mg^{2+} and K^+ and available P significantly increased with FYM @ 10 t/ha and at par with FYM + biofertilizer whereas exchangeable Al^{3+} decreased significantly. FYM, used in the experiment contained 0.8, 0.6 and 0.9 percentages of N, P, K respectively. The results suggest that FYM contributed towards the nutrient status of the soil thus, the yield and uptake.

Nutrient dynamics of Manipur hill soils under different land uses.

Mausumi Roychoudhry and Kailash Kumar

Agroforestry/ FSR

The initial physico-chemical characteristics of the soils of three blocks under Silvi pastoral system were determined and presented in Table 5A. Block I consists of ten treatments of different species of Acacia and leoucaena, Block II consists of different species of Albizia and block III consists of *Eucalyptus teriticornis, E. citriodora, Parkia roxburghii* and *Leucaena leucocephala* tree species. All the blocks have three replications. The soils are acidic in nature, high in exchangeable Al^{3+} and organic carbon content and low in available P status. Among the three blocks the nutrient status of the soils was found to follow the trend Block II > Block I > Block III.

FRUIT

D. S. Yadav and S. P. Singh

Varietal evaluation

Eleven varieties of lime/lemons (acid group) were evaluated for their perfor-

Table 13. Effect of FYM and Biofertilizer on grain yield, N and P-uptake by different crops.

Treatments	Grain yield (q/ha)				M-Uptake (kg/ha)				P-uptake (kg/ha)			
	Maize	Soybean	Black gram	Mean	Maize	Soybean	Black gram	Mean	Maize	Soybean	Black gram	Mean
Control	23.2	14.6	2.8	13.5	26.8	73.0	8.7	36.2	2.87	5.78	0.76	3.14
Biofertilizer	31.2	17.2	4.4	17.6	41.7	90.7	14.7	49.0	3.78	6.74	1.17	3.90
FYM @ 10t ha-1	40.1	20.5	7.4	22.6	61.0	116.2	26.6	67.9	7.90	10.28	2.13	6.88
FYM+Biofertilizer	57.5	21.4	9.6	29.6	91.1	132.6	37.4	87.0	10.50	10.93	2.99	8.03
Mean	38.0	18.5	6.1		55.1	103.2	21.9		6.26	8.43	1.76	
CD at 5% & 1% level												
Treatments	3.06**				14.89**			1.31**				
Crops	4.06**				12.77**			1.12**				
Crop X Treat.	8.13*				N.S.			2.24**				

* and ** reprsents significance at 5% and 1% level respectively.

Table 14. Growth Characters of different varieties of lime/lemons (Acid group)

Varieties	Height (m)	Girth of stem (cm)	Plant Spread(m)		Primary branches per plant
			N x S	E x W	
Kachai lemon	2.78	7.39	2.17	2.03	9.86
Citron	1.89	3.49	1.63	1.68	7.66
Adajamir	2.08	5.82	1.12	1.15	9.00
Katajamir	2.21	4.70	1.86	2.20	8.00
Pati lemon	1.86	5.90	2.53	2.33	8.33
Heizang (citron)	3.15	7.84	2.58	2.25	8.83
Kagzi lime	1.44	3.14	1.48	1.50	8.00
Sohsyteng	3.02	7.82	2.57	2.71	6.67
Eureka lemon	1.32	3.63	1.27	1.34	6.0
Rough lemon	2.46	5.28	0.95	0.89	6.00
Assam lemon	1.35	2.63	1.07	1.14	5.50
CD at 5%	1.016	1.619	0.736	0.721	N.S.

mance. Growth performance (Table-14) indicated that Heizang (citron) recorded maximum plant height (3.15m) and average stem girth (7.84cm) followed by Sohsyteng. Maximum plant spread (2.57 × 2.71) was recorded in sohsyteng followed by Heizang (citron). Average number of primary branches were recorded in the range of 5.5 to 9.86 per plant. Kachai lemon recorded maximum number of primary branches. Most of the plants of kachai lemon have started showing the symptom of decline.

Sohsyteng (Table-15) recorded maximum number of fruits (75/plant) followed by Eureka lemon and Adajamir respectively. Maximum fruit size was obtained in Heizang (citron). Kachai, Eureka and Pati lemon recorded the highest percentage of T.S.S., where as maximum ascorbic acid was recorded in Eureka lemon followed by Kachai lemon. Maximum acidity was recorded in Kachai lemon followed by Eureka, sohsyteng, Pati lemon and Kagzi lime respectively.

Nutritional trial on Eureka lemon : A nutritional trial consisting of 4 levels of nitrogen and 3 levels of phosphorus was

Table 15. Fruit character

Varieties	Av. No. of fruits plant	Length of fruit (cm)	Girth of fruit (cm)	T.S.S	Acidity	Ascorbic acid mg/100gm
Kachai lemon	33.66	4.90	5.12	8.02	6.59	29.9
Citron	11.33	7.14	6.60	7.60	5.26	24.2
Adajamir	39.99	8.60	5.50	7.78	4.68	10.8
Katajamir	32.00	7.29	4.95	7.80	5.69	24.10
Pati lemon	26.00	10.60	6.20	8.00	5.88	22.50
Heizang (Citron)	22.00	13.00	8.17	7.10	5.40	17.80
Kagzi lime	18.00	4.88	4.60	6.73	5.80	25.00
Sohsyteng	75.00	10.00	5.68	7.13	5.82	12.10
Kureka lemon	42.33	5.49	5.28	8.20	5.96	32.00
Rough lemon	5.67	-	-	-	-	-
Assam lemon	20.00	10.00	5.68	7.13	5.82	12.10

started. Performance of Kinnow mandarin : Out of 3 budded plants, only one plant came to bearing this year 16 fruits were recorded.

Growth observations

Plant No.	Height (cm)	Girth of stem (cm)	Spread (cm)
1.	176.00	4.48	84.40
2.	170.00	4.36	83.5x45
3.	70.00	1.48	30x20

GUAVA

Growth character

Growth performance of six Guava varieties indicated that plant height ranged 215.00-445.000 cm and was found maximum (443.00 cm) in variety L-49 followed by Allahabad Safeda (386.66cm). Girth of main stem was recorded maximum 96.66mm in Allahabad Safeda followed by L-49 (88.33mm). It was found minimum (33.33mm) in cultivar Apple shape. Number of main branches found maximum (5.00) in cultivar Allahabad Safeda followed by L-49, Seedless and Hybrid (3.33). Girth of sub branches found maximum (78.33mm) in variety L-49 followed by Hybrid (36.66mm) Number of sub branches found maximum (27.33 mm) in variety Allahabad Safeda and L-49, some, whereas it was found minimum 10.33 in variety Apple shape. Plant spreading N-S was found maximum (374.00cm) in variety Allahabad Safeda followed by L-49 (366.33cm). Whereas it was found maximum (375.33cm) in E-W of variety L-49 followed by Allahabad Safeda (339.66cm). Minimum plant spreading (N-S x E-W) was recorded (148.33 x 90.33cm) in variety Apple shape.

Fruit character

The Plants came into flowering in last week of March '95 and harvesting was started in second week of September, 95. Several harvesting has been done upto month of November. Maximum (266.66) no. of fruit/plant was observed in variety L-49 followed by Allahabad Safeda (259.33). It found minimum 152.33 no. of fruits in variety seedless. Weight of fruit/plant (yield) was found maximum (20.37 kg) in variety L-49 followed by Allahabad Safeda (16.30 kg). It was found minimum (13.00 kg) in variety seedless. Length of fruit was found maximum (67.30 mm) in variety L-49 followed by Allahabad Safeda and hybrid (59.30 and 55.00 mm) respectively. Girth of fruit was also found maximum (65.00mm) in 4.49 followed by Allahabad Safeda and Hybrid. Maximum TSS 12.26% was found in Banarasi followed by Allahabad Safeda and L-49 (11.40 and 11.40 and 11.06%) respectively. Minimum (10.10%) TSS was observed in variety sedless.

Effect of biofertilizer on growth and other characters

Maximum (40.00 cm) plant height was recorded in variety Banarasi treated plant. wheras maximum (75.00mm) stem girth was observed in L-49 treated plant followed by Allahabad Safeda. No significance differences was found in number of main branches. Maximum (5.33) number of branches was found in variety Banarasi followed by control plants (3.00) of same variety. Maximum girth (56.67mm) was found in variety L-49 and Banarasi. Maximum girth (56.67mm) was found in variety L-49 and Banarasi. maximum plant spreading towards N-S x E-W (520.67 x 457.67cm) was found in variety L-49 respectively. Minimum spreading N-S x E-W (290.67 X 257.67cm) was found in control plant of Hybrid and Banarasi respectively.

Effect of biofertilizer on yield and fruit characters

Maximum No. (251.00) of fruit was observed in variety L-49 followed by Allahabad Safeda (250.33). Maximum yield 18.33 kg (weight of fruit/plant) was observed in variety L-49 followed by Allahabad Safeda (15.83 kg/plant). Minimm yield (14.50 kg) was observed in variety Banarasi. Maximum (65.33mm) length was observed in varity L-49 followed by Allahabad Safeda (59.33 mm). Maximum (64.00mm) girth was also observed in variety L-49 followed by Hybrid (57.67 mm). maximum TSS 12.23% was observed in variety Banarasi followed by Allahabad Safeda (11.33%). Minimum TSS (10.80%) was recorded in variety Hybrid.

MANGO

Growth performance of Seventeen (17) mango genotypes was recorded fourth year after planting collected from differ-

ent parts of the state. Maximum plant height (283.33cm) was observed in genotype BG-4 followed by SPS and THY-SP-3 (3) (266.67 and 240.00 cm) respectively. Minimum plant height 120.33 was recorded in genotype MDCH-2 (Table 23). Girth of main stem was found maximum (71. 80 mm)in genotype BO-4 followed by SPS (68.65mm) and RBD-TH-S (65..00mm) respectively. Number of main branches found maximum 5.33 in genotype MDCH-2 followed by MDCH-1 (4.67) It was found minimum 1.33 in genotype BID-SP-1. Girth of main branches ranged 14.53-46.00mm and was found maximum (46.00mm) in SKD-TH-3(3) follwed by MDCH-1 (39.90mm) and STH-1 (33.33mm) respectively. Number of sub branches found maximum 19.33 in genotype SPS followed by SKD-TH-3(2) (19.00). Plant spreading N-S was found maximum (280.00cm) in genotype THY-SP-3 followed by SKD-TH-3(2) (238.67cmz) and SPC (233.33cm) respectiely whereas maximum (260.00cm) plant spreading towards E+W was found in genotype SPS followed by THY-SP-3 (200.00 cm). Minimum 71.00cm plant spreading M-S was found in genotype NCS-2 whereas it was observed minimum (68.33cm) in NCS-2 genotype.

Fruit characters in foothill condition

Genotype MDCH-1, MDCH-2, STM-1 came in flowering second week of Feb., 1995 in this year. Other genotype like NCS-1 and 2, IBS, SKDTH-3 (1), BIB-SP-1, BID and SPS came in flowering second to third week of march, 1995. Maximum number 18.33 of fruit per plant was observed in genotype MDCH-1 followed by STH-1 (11.66) and MDCH-2 (7.33) respectively. Minimum number of fruit 1.33 was observed in genotype NCS-1. Weight of fruit/plant (yield) was also found maximum (3.82 kg) in genotype MDCH-1 followed by STH-1 (2.33 kg) and IBS-TH-2 (1.21 kg). Weight of fruit ranges from 143.33-296.66 gm/fruit in genotype BIB-SP-4 and MDCH-1 respectively. Length of fruit was also found maximum 114.00 mm in genotype MDCH-1 followed by BID-SP-1 (113.33 mm) and IBS-TH-2 (109.33 mm). Girth of fruit was found maximum (84.65 mm) in BID-SP-1, followed by IBS-TH-2 (67.33 mm). Width of fruit was found maximum (78.33 mm) in genotype IBS-TH-2 followed by BID-SP-1 (76.33 mm). Weight of peel ranges 23.33-34.66 gm/fruit in genotype BIB-SP-4 and BID-SP-1. Weight of pulp was found maximum 218.33 gm per fruit in genotype MDCH-1 followed by SID-SP-1 (205.66 gm) and IBS-TH-2 (205.00 gm) respectively. Weight of stone ranges 23.33-47.66 gm/ fruit in genotype MDCH-2 and IBS-TH-2. Maximum TSS (16.50%) was found in genotype STH-1 followed by MDCH-1 (16.00%) and MDCH-2 (15.90%). Fruit nature from June 2nd week in genotype BIB-SP-1 and harvested upto August third week in MDCH-1 and STH-1. Several harvesting has been done in the month of July and August. No fruit was retained in 5 genotype.

Growth charactes in valley condition

Growth characters of 17 (seventeen) mango genotypes grown in valley condition of Manipur indicated that maximum (516.33 cm) was recorded in genotype RBD-TH-5 followed by CHD-TH-4 (437.67 cm) and STH-1 (432.67 cm). Girth of Main stem ranged 25.68-103.00 and was found maximum (103.00 mm) in genotype RBD-TH-5 followed by SID-SP-2 (85.20 cm) of main branches found maximum 9.33 in genotype CHD-TH-4 followed by IMPM (8.00) and RBD-TH-5 (6.00) respectively. whereas number of sub branches found maximum (36.67) in genotype RBD-TH-5 followed by CHD-TH-4 (25.00) and IMFM (18.00 mm) respectively. Girth of main branches ranged 15.17.-30.00 mm in genotype THS-SP-2D and BID-SP-1 respectively. Plant spreading towards N-S was found maximum (456.00 cm) in genotype RBD-TH-5 followed by CHD-TH-4 (338.00 cm). It was found minimum 102.33cm in genotype MDCH-2. Plant spreading towards E-W was also found maximum (446.33cm) in genotype RED-TH-5 followed by CHD-TH-4 (318.67 cm) and IBS-TH-2 (2280.00 cm). Minimum (100.67 cm) spreading of plants as E-W was found in genotype THS-SP-2.

Fruit characters in valley condition

Most of the genotype came in flowering in last week of March and first week of April, 1995 in valley condition. Flowering was slightly delayed in valley condition in most of the genotype. Maximum (14.66) no. of fruits was found in genotype MDCH-1 and NCS-1 (12.66) and RBD-TH-5 (11.00). Weight of fruit/plant was found maximum (3.53 kg) in RBD-TH-5 followed by genotype NCS-1 (2.54 kg) and MDCH-1 (2.06 kg). Weight of fruit per fruit ranges 193.33-333.33 gm in genotype THS-SP-2D and RBD-TH-5. Length of fruit was observed maximum 114.33mm in genotype IBS followed by IBS-TH-2 (110.00 mm) and MDCH-1 (108.66 mm) respectively. Girth of fruit found maximum (71.33 mm) in genotype RDB-TH-5 followed by IBS (69.66 mm) and THS-SP-3 (68.00 mm). Width of fruit recorded maximum (86.00 mm) and THS-SP-3 (68.00mm). Width of fruit recorded maxium (86.00 mm) in genotype RBD-TH-5 followed by IBS (82.00 mm). Weight of peel ranges 20.67-41.67 gm in genotype NCS-1 and MDCH-1 and RED-TH-5 respectively. Weight of pulp was found maximum 233.33 gm/fruit in genotype RBD-TH-5 followed by IBS-TH-2 (230.00gm). Weight of stone ranges 28.33-56.67 gm/fruit in genotype NCS-1 and RBD-TH-5. TSS was found maximum (15.00%) in genotype STH-1 followed by MDCH-1 (12.00%) and THS-SP-2 (11.50%) genotype NCS-1 and IS-TH-2 came first in maturity and harvesting starts from June 3rd week. STH-1 and MDCH-1 mature later and harvesting was started from July 3rd week to September last week in both the genotype. No fruit was found in six genotype out of 17 (seventeen) genotype.

Growth characters of Mango genotype in Pot condition :

Being highly dwarf in nature plant was planted in plastic pot data was re-

corded in 4th year after planting. Maximum (267.00 cm) plant height was recorded in genotype 4PH-3 followed by MOG (253.00 cm). Minimum (47.00 cm) plant height was observed in genotype YKH-DW followed by MDCH-DW (89.00 cm). Girth of main stem ranged 7.00-50.00 mm in genotype YKH-DW and MOG, 4PB-3 and 4PB-4. No. of main branches ranged between2.00-6.00 and was found maximum (6.00) in genotype YKH-BSP-1 and MOG. Number of sub-branches ranged 2.00-13.00 and was found maximum in MDCH-2. Girth of main branches found maximum (21.50 mm) in MOG and 4PB-3. Minimum 5.00 mm girth was found in genotype YKH-DW. Plant spreading towards N-S was found maximum 299.00 cm in genotype MOG and 4PB-3 followed by MDCH-2 (122.00 cm). Minimum plant spreading towards N-S and F-W was found 38.00 x 31.00 cm respectively in genotype YKH-DW. Maximum (158.00 cm) plant spreading E-W was found in genotype MDCH-4 followed by 4PB-2 (128.00 cm) and MOG (123.00cm).

Fruit characters in pot condition

Most of the Genotype came into flowering 2nd week of March'95 and flowering was found upto April 1st week in genotype THB-92 and YKH-DW. Genotype NLH-DW came early first week of February. Maximum number (10.00) of fruit/plant was observed in genotype MDCH-DW followed by MDCH-5 (8.00) 4PB-1 (8.00), MDCH-3 (8.00). Weight of fruit (yield per plant was found maximum (2.00 kg) in genotypes MDCH-3, MDCH-5 and MDCH-DW followed by 4 PB-1 (1.76 kg). Weight of per fruit ranges 120.00-275.00 gm per fruit in genotype MOG and MDCH-3 respectively. Length of fruit was found maximum 121.00 mm in genotype 4PB-1 followed by YKH-DW (115.00mm) and MDCH-3 (115.00mm). Girth of fruit ranged between 49.00-66.00 mm in genotype MOG and THB-92. Width of fruit found maximum (72.00 mm) in genotype MDCH-3 followed by THB-92 and 4PB-2 (70.00 mm). Width of fruit foudn maximum (72.00 mm) in genotype MDCH-3 followed by THB-92 and 4PB-2 (70.00 mm). Weight of peel ranges 20.00-50.00 gm/ fruit in genotype MOG and 4 PB-1 and MDCH-3. Weight of pulp per fruit was found maximum (190.00 gm) in genetpe YKH-BSP-1 followed by MDCH-3 (185.00 gm) and YKH-BSP-2 (180.00 gm) respectively. Weight of stone/fruit ranged 30.00-60.00 gm and was found maximum in 4PB-1. TSS of fruit found maximum (16.50%) in genotype MDCH-5 and 4PB-2. Minimum TSS (10.50%) was found in genotype 4PB-1. Genotype THS-SP-2 and 4PB+3 did not flower and there was no fruit retainsion in genotype NLH-DW. Fruit started maturing from third week of July in genotype 4PB-2 and several harvesting has been done in most of the genotype in month of August, 1995. Ganotype YKH-BSP-1 and MDCH-3 fruit mature upto 1st week of September, 1995.

AONLA

Performance of varieties under foot hill conditon

Maximum (213.00 cm) plant height was observed in variety NA-7 followed by Chakaiya (161.00 cm). Maximum (40.00 mm) girth was also recorded in variety NA-7. Maximum (4.00) no. of branches was also found in Chakaiya and Francis. Maximum plant spreading towards N-S x E-W (183.00 x 144.00 cm) was found in variety NA-7 followed by Francis (100.00 x 126.00 cm). Minimum (64.00cm) plant spreading towards N-S was found in variety Krishna and F-W (38.00 cm) in variety Chakaiya respectively. Out of five varieties Kanchan plants were died in the present year. Plants did not come in flower in current season.

Effect of Biofertilizer on growth characters of Mango Genotype at Langol hill condition.

Azotobactor and Phosphatica was used as biofertilizer in Mango genotype of MDCH-1 and MDCH-2 with control plants at different rows. Maximum (221.67cm) plant height was recorded in treated plants of genotype MDCH-1 in row no. 2 followed by MDCH-2 (203.33 cm) in row no. 6 of treated plants. Maximum (64.02 mm) stem girth was found in genotype MDCH-2 of row no. 6. Minimum (31.62mm) was also found in control plants of genotype MDCH-2. Number of main branches ranges 2.33 to 5.33mm in both the genotype. Number of sub branches found maximum (21.67) in genotype MDCH-1 of row no. 1. It was found minimum (11.7) in same genotype of row no.2. Plant spreading found maximum (173.33x173.67cm) towards M-S x E-W in control plants of genotype MDCH—1 in row no. 3 and treated plants of same genotype in row no. 2 respectively. Minimum (103.67x111.67cm) plant spreading was found in control plant of genotype MDCH-2.

Effect of Biofertilizer on fruit characters of Mango genotype at Langol Hill condition.

Maximum (69.00) no. of fruit set was observed in genotype MDCH-1 of row no. 2 in treated plants followed by same genotype in row no. 2 (57.67) of treated plant. Maximum (16.67) number of fruit was dropped in treated plant of MDCH-1 (15.33 and 12.33) in row no. 1 and 2 respectively. Maximum (14.00) no. of fruit was retained in MDCH-1 of treated plant of row no. 2. Minimum fruits was retained in genotype MDCH-2. Weight of fruit ranges from 196.67-326,67 gm per fruit in control plant of MDCH-2 in row no. 7 and treated plant of MDCH-1 in row no. 1 respectiely. Maximum (3.91 kg) yield of fruit per plant was observed in treated plant of MDCH-1 in row no. 2 folowed by same genotype in trcated plant of row no. 1 (2.83 kg). Minimum (0.83 kg) yield was recorded in control plant of MDCH-2 in row no. 9. Maximum pulp weight 248.33 gm and 231.67 gm was also found

in same genotype of MDCH-1 of treated plant at row no. 2 and 1 respectively. Weight of stone ranges 35.00-42.33 gm/ fruit in genotype MDCH-2 and MDCH-1 respectively. TSS also ranges 14.50-20.00% in control plant of genotype MDCH-2 and treated plant of MDCH-1 in row no. 7 and 2 respectively.

VEGETABLE

BRINJAL

Germplasm maintenance and evaluation: Fifteen brinjal genotypes were maintained and evaluated for their performance under terraced land condition. The results (Table 16) indicated that variety PPC came to flowering in 39 days after planting and was found to be earliest among all the genotypes followed by Arka Nishi, Arka, Neel Kantha, Nurki, ARU-2C Pant Samrat and KT-4 respectively. The genotype Manipur local took maximum number of days for flowering and recorded maximum height of the plants (111.66 cm). Pant samrat gave the highest yield of 138.88 q/ha which was at a par with Arka Keshav. The varieties like PPC, ARU-2C and KT-4 were found moderately resistant to bacterial wilt disease. The genotype Nagaland local had the least damage of fruit borer.

Breeding for wilt resistance and better plant type : Seven promising lines have been developed through hybridization breeding. These selections were evaluated in a replicated trial. The resultes (Table-17) indicated that Sel-1 (7x8) came to flowering in 41.75 days after planting and was found to be the earliest. The plant height ranged from 98.05 cm to 107.80 cm. Maximum fruit length was recorded in the Sel-1 (7x8) followed by Sel-7 (4x9). Sel-2 (4x7) which bears oval type fruits recorded maximum girth. Sel-1 (7x8) and Sel-4 (3x8) recorded maximum number of fruits. All the above lines are clustered type, high yielding and resistant to bacterial wilt disease which is a major problem in this region. These entries have shown encouraging performances at ICAR Nagland Centre also and are ready for release to the farmers.

Production of F_2 Seeds : Three promising F_1 hybrids developed and evaluated last year were put again in the field for making selction from them. 4 bulk selections were made from these crosses.

TOMATO

Maintenance of germplasm and evaluation : Thirty indigenous as well as exotic lines and twenty standard varieties were maintained and evaluated separately for their performance. A wide range of variation was observed in number of fruits/plant. Yield per plant, T.S.S., number of locules, fruit size and reaction to diseases. T.S.S. was recorded in the range of 4 to 7.4 percent and number of locules in the range of 2.-8 per fruit. The maximum fruit size was recorded in the genotype margloble. The entries like EC-

Table16. Performance of brinjal genotypes

Genotypes	Days to 50% flowering	Height (cm)	No. of branches	Yield q/ha.	Reaction bacterial wilt.
PPC	39.00	77.00	7.33	81.02	MR
Arka Nidhi	41.33	79.00	6.66	114.81	R
Arka Keshav	47.33	75.66	7..00	126.38	R
Arka Neelkantha	42.00	81.00	9.66	111.80	R
MLG-1	53.33	109.33	8.66	103.14	R
NLG-1	53.00	107..66	10.33	115.74	R
BWR-54	52.33	101.33	7.33	121.06	R
ARU-2C	42.33	104.00	6.66	87.17	NR
KT-4	43.00	89.66	6.33	121.75	MR
Pant Samrat	42.33	93.66	7.33	138.88	R
Silchar local	56.00	110.00	7.66	124.99	R
Nurki	41.00	89.66	6.00	118.05	R
Manipur local	59.00	111.66	7.33	109.49	R
8701 (Pink)	44.00	77.66	6.33	101.85	R
8702 (Green)	45.00	78.66	6.66	99.53	R
CD at 5%	0.884	1.928	2.435	11.851	

Table 17. Performance of some promising brinjal selections

Selections	Days to Flowering	Plant Height (cm)	Length of fruits) (cm	Girth of fruits (cm)	Av. No. of fruits/ plant	Yield q/ha
Sel -1 (7x8)	41.75	107.80	22.83	2.47	42.00	210.07
Sel -2 (4x7)	48.75	104.15	13.15	5.77	30.50	195.02
Sel -3 (5x9)	45.00	109.97	17.08	4.25	33.00	214.70
Sel - 4 (3x8)	45.75	98.05	13.90	3.52	41.50	230.90
Sel - 5 (1x7)	48.25	102.37	17.92	2.80	32.50	168.98
Sel - 6 (3x9)	45.25	104.15	16.77	4.47	34.00	151.04
Sel - 7 (4x9)	49.00	105.75	20.25	3.80	22.25	183.45
CD at 5%	0.786	2.141	1.034	0.179	2.545	13.286

Table 18. Performance of tomato hybrids

Name of Hybrids	Length of fruit (cm)	Girth of fruit (cm)	Mean fruit weight (gm)	T.S.S.	No. of locules	Yield q/ha
Rajani	5.37	4.85	59.00	3.60	3.50	121.14
Rupali	5.65	5.05	81.25	4.62	3.25	152.12
Rashmi	5.40	4.55	59.00	4.27	2.00	108.22
IAHS-88	8.32	3.82	70.75	4.05	2.00	302.08
Vaishali	5.51	5.52	68.50	3.90	4.00	230.51
Naveen	5.20	4.82	64.25	5.50	4.00	169.58
CD at 5%	0.447	0.717	12.93	0.880	0.814	22.487

160193 and EC-163622 and variety Shakti were found resistant to bacterial wilt disease. Same entries have shown tolerance to folliage disease like late blight. These lines can be used for effecting hybridization to develop disease resistant hybrids/varieties.

Evaluation of F_2 : F_2 families were evaluated in the valley condition and thirteen bulk selections were made. Seeds were collected for further gerneration advancement and selection.

Hybridization : Twenty six single crosses were attempted involving wilt resistant and blight tolerant lines with an objective of evolving F_1 hybrids/varieties resistant to diseases.

Evaluation of Hybrids : Six (F_1) Indo-American tomato hybrids were evaluated in a replicated trial under valley condition. The results (Table 18) indicated that IAHS-88 recorded maximum length of fruit where as maximum girth and mean fruit weight was recorded by Rupali. The T.S.S. was recorded in the range of 3.60 to 5.50%. The maximum numer of loculus were recorded in Naveen and the least by Rashmi and IAHS-88. The highest yield (302.08 q/ha) was recorded in IAHS-88 followed by Rupali.

INVISTIGATOR

S. P. Singh

Jack Bean

Three varieties of jack bean were sown in Langol hill. Maximum yield 210.00 q/ha was recorded by MNP Local followed by Meghalaya local (200.00 q/ha).

Mucuna Bean

Two variety of Mucuna bean were sown in Langol hill. Maximum yield of 310.00 q/ha recorded by MN variety.

SPICES

D. S. Yadav

Turmeric

Varietal evaluation : A replicated trial with 27 entries was conducted for the third time under terraced land condition. The results indicated a wide range of variation in yield and other yield contributing trials. Plant height was recorded in the range of 131.53 cm to 146.06 cm. Meghalaya local (1) recorded maximum plant height. Length of rhizobium was recorded in the range of 5.1cm to 7.16cm and was found nonsignificant. Significant differences were found in width of rhizobium, length and girth of primary fingers respectively. Width of rizobium was recorded in the range of 2.86 to 16.66 cm, length of primary fingers from 4.46 to 6.6 cm and girth in the range of 1.44cm to 2.26 cm respectively. The yield differences where significant. It was recorded in the range of 92.85 q/ha to 183.21 q/ha. Variety G.L. Puram gave the highest yield (181.21 q/ha) followed by Duggirala No. 325 and PCT-11. Dry matter recovery was recorded in the range of 16.53 to 19.3%. Variety Kasturi Tanaa being the lowest yielder recorded highest percentage of dry matter recovery.

Response of turmeric varieties to doses of nitrogen

An experiment with 4 levels of nitrogen (N-0, N-40, N-80, N-120 kg/ha) and 2 varieties namely G.L. Puram (V1) and PCT-15 (V2) was carried out for the 2nd time under terraced land condition. The results indicated that there was no significant differences found within the varieties. Heighest yield (178.86 q/ha) with the variety G.L. Puram with an application of 20 kg N/ha which was at a par with 80 kg N/ha. The yield was increased in both the varieties by increasing doses of nitrogen application. The crop was supplied a basal application of 60 kg P_2O_5 and 60 kg K_2O/ha.

Response of turmaric to phosphorus and Potash : An experiment with 4 levels of phophorus (P-0, P-30, P-60 and P-90 kg/ha) and 3 levels of Potash (K-0, K-40 and K-60 kg/ha) was conducted under terraced land condition. G.L. Puram was used as the subjected variety. Nitrogen @ 60 kg N/ha was applied in all the treatments. The results revealed that there was significant effect of phosphorus on the fresh rhizobium yield of turmaric. The highest yield was recorded with the application of 90 kg P_2O_5/ha. However the differences withing 30, 60 and 90 kg P_2O_5/ha were found to be non significant. Application of potash did not show any significant effect on yield. The highest yield was recorded with the application of 60 kg K_2O/ha. The interaction effects of PxK was found to be significant.

GINGER

Varietal evaluation : An experiment consisting of 21 entries was carried out

for the third year under terraced land condition. A wide range of variation was observed among all the characters studied. Plant height was recorded in the range of 40.93 cm to 60 cm. Variety Ernad recorded maximum plant height (60 cm) followed by Thinglaidan and Rhiodegeneiro. The number of suckers/plant were observed in the range of 2.53 to 4.40/plant. Length of rhizome was recorded in the range of 312 cm to 6.03cm and width of rizome was recorded in the range of 312 cm to 6.03 cm and width of rhizome was recorded in the range of 7.17cm to 10.83 cm (Wynad). Maximum dry matter recovery was obtained with the variety Rhidegeneiro (20.06) which was at a par with Poona and Thinglaidan. The rhizome yield was recorded in the range of 94.43 q/ha to 146.67 q/ha. Variety Suprabha recorded the highest yield which was at a par with Poona, Thingpui and Deomali local respectively.

AGROFORESTRY

Ramesh Singh, D.S. Yadav and Th. Raghumani Singh

Collection of different multipurpose tree species

This was the third year of investigatin. Treatments comprised of 21 different tree species were planted along the contour lines with 3x3m spacing. Out of these only 17 varieties were survived.

Plant Height

Plant height was maximum on E. citriodora (10.12 m) followed by 7.63, 6.96 and 5.90m respectively in *E. teriticornis, A. auriculiformis* and *A. falcateria.* It was minimum in *A. procera* (1.80 m).

Collar and B.H. diameter : Maximum diameter was recorded with E. citriodora (13.30, 10.50 cm) followed by (10.30, 8.00), (9.10, 6.80) and (8.10, 5.90 cm) respectively with E. *teriticornis* , *C. simes* and A. *falcataria,* A. *procera* with (1.70, 1.00 cm) recorded minimum.

Total biocmass : Maximum biomass was also recorded with E. *citriodora* (51.50 kg) with minimum no. of branching (38.00 no.) followed by E. *teriticornis* (26.30 kg). with 18.00 branches and C. simea (18.00 kg) with 25 nos. of branches.

Dry matter (%) of leaves : Maximum dry matter percent was recorded with A. *ferruginea* (64.53%) followed by A. *sundra* (58.03%).

Canopy : Maximum spread upto 3.2m was recorded with A. falcateria followec by 3.1, 2.6, 2.3m respecctively in E. *citriodora* (3.1).

Root biomass of different tree s pecies

Roots of twenty two different tree species planted in July, 1992 were collected for study of fine root biomass from different soil depths. Upto 50cm depth, fine roots were widely raised among the tree species. Highest root biomass was recorded with *E. citriodora* (6350.0 gm/m²) followed by *C. simea* (4233.0 g/m²) and the lowest was recorded with L. *polyantha* (90.0 g/m²). A. *sundra, A. falcateria* and *L. leucocephala* x L. *pulvirulenta* showed slow decline in fine root biomass with increasing soil depth. The roots were evenly distributed in the soil profile in *C. simea* and *E. citriodora* thus exploiting the whole profile. About 74.07% fine root in *A. leveophloca,* 64.28% in *L. leucocephala* IGFRI 23-1, 58.98% in *Grewia oppositifolia,* 52.98% in *S. saman* were found at 0-10 cm depth.

The distribution of fine root biomass of *M azadirach, P. roxburghii. C. simea, E. ceriticornis* and *E. citriodora* are found maximum among tree species ranging from 215 g/m² to 1100 g/m² at 30-40 cm depth and *E. citriodora, C. simea, E. teriticornis* and *M. azadirach* were found ranging from 170 g/m² to 600 g/m² at 40.50 cm depth. Thus root competition between crops and the tree species can be expected to arise when they are intercropped.

Collection and evaluation of casuarina species

Out of eleven different casuarina species received from Tree Seed Centre, Australia only five species were survived. Saplings were transplanted during September, 1992 at contour bunds at 5m interval.

Plant Height : After three years of planting, maximum height was recorded

Table 19. Performance of MPTS in arboretum

Species	Mean wt. (m)	Mean C.H.D. (cm)	Mean D.B.H. (cm)	Mean Bole wt. (m)	No. of branches	Canopy (m)
A. auriculiformis	5.72	5.06	4.14	1.92	16.06	1.73
S. pendreda	1.91	4.96	1.52	0.84	3.60	0.80
Q. dealbata	2.86	4.42	2.32	1.15	11.00	1.25
B. purporea	3.54	5.50	2.80	0.98	9.00	1.25
B. variegata	3.92	4.54	2.98	1.35	7.60	1.09
G. arborea	3.63	7.74	3.50	1.30	10.00	1.74
M. azadirach	5.37	6.86	5.18	2.20	5.20	2.18
Mean	3.85	5.72	3.20	1.39	9.0	1.43

with *C. glauca* E.C. 326191 (16363) (4.13m) and minimum was recorded with *C. cunninghamiana* E.C. 316194 (17186 (1.90 m).

Collar and B.H. diameter : Maximum collar and breast height diameter was recorded with *C. cunninghamiana* EC 326195 (15574) (4.02 cm and 2.80 cm) follwed by *C. glauca* EC 326191 (16363) and minimum was recorded with *C. cunninghamina* EC 316194 (17186) (2.00 cm and 1.20 cm).

Brnaching : Maximum number of branches was recorded with *C. cunninghamiana* EC 326195 (15574) (29) numbers followed by 26 number in C. glauca EC 326191 (16362).

Canopy : Maximum spreading upto 1.97 m with C. *glauca* EC 326191 (16363) was recorded EC 316194 (17136) exhibited minimum (1.12 m).

Studies on growth performance of MPTS in Arboretum

Seven tree species were maintained along the slope in an area having 30% slope. The investigation was started in July, 1992. The performance is shown in Table 19.

Provinance of *Parkia roxburghii*

Fifteen provinances collected from five districts were transplanted during October, 1992. The following are the details of different characters for all provinances.

Plant Height : Maximum height upto 4.438 m was recorded with Prov. No. 4 followed by Prov. No. 2 (4.256). The minimum was recorded with Prov. No. II (2.178m).

D.B.H : After three years of planting, maximum diameter upto 5.44 cm was recorded with Prov. No. 3 followed by Prov. No. 2 (5.14cm). The minimum was recorded with Prov. No. 12 (2.26 cm).

Bolel Height : Maximum bole height upto (2.34m) was recorded with prov. No. 3 followed by Prov. No. 2 (2.274m) and minimum of 1.03m was recorded with Prov. No. 12.

Branching : Maximum no. of branches was recorded with Prov. No. 2 (7.2 no.) followed by prov. No. 1 (6.2 no.). The minimum was recorded with Prov. No. 12 (1.4 no.)

Canopy : Spreading of branches was maximum with Prov. No. 2 (2.11m) followed by Prov. No. 1 (2.04 m). The minimum was recorded with Prov. No. 12 (0.62 m) followed by Prov. No. II (0.82 m).

Development of suitable mangement practices for different agroforestry system with reference to their productivity and sustainability.

Ramesh Singh, M. Roycaudhury and Th. Raghumani Singh

Agri-silvi-pastoral System

Nine different tree species and fodder crops of NB-21 were planted on terrace raisers and agricultural crops viz.,

Table 20. Agri-silvi-pastoral system (growth pattern)

Species	Mean Ht (m)	Mean C.H.D (cm)	Mean D.B.H. (cm)	Mean bole Ht (m)	Canopy (m)	Yield of Napier grass (t/ha/yr)	Yield of Maize (q/ha)
B. variegata	3.412	6.08	3.66	1.398	1.292	50.25	37.50
P. roxburghii	4.610	8.24	6.0	2.448	2.02	49.50	39.39
L. polyantha	2.334	3.44	1.70	0.846	1.47	40.43	36.08
S. *wallichii*	2.754	7.14	4.06	0.914	2.03	63.25	38.13
A. *integrifolia*	3.010	5.58	3.32	0.874	1.65	70.65	39.13
M. *azadirach*	7.804	15.11	10.64	2.132	5.10	62.40	27.09
E. *citriodora*	7.010	9.5	6.68	2.632	3.914	60.80	32.26
A. *auriculiformis*	7.880	10.72	8.68	1.60	4.02	65.45	28.23
E. *teriticornis*	5.986	6.85	3.94	2.16	1.86	60.25	15.25
Mean	4.97	8.07	5.40	1.66	2.70	58.10	32.56

red gram and maize were planted in alternate years aso sole crops in all terraces. The growth pattern are shown in Table 20.

Yield of napier grass (NB-21) : Maximum fodder yield upto 70.65 t/ha was recorded in combination with A. *integrifolia* followed by 65.45, 63.25 t/ha respectively in A. *auriculiformis* and S wallichii. Minimum was recorded with L. polyantha (40.43 t/ha) and P. *roxburghii* (49.50 t/ha).

Yield of maize : Maximum yield upto 39.39 and 39.13 q/ha were recorded in combination with P. *roxburghii* and A. *intergrifolia* followed by 38.73, 36.50 q/ha respectively in S. *wallichii* and B. variegata. Minimum was recorded in combination with E. *teriticornis* (15.25 q/ha) and M. *azadirach* (27.09 q/ha).

Agri-horti-pastoral system

An experiment on ten terraces constructed in 1990 at Krishnagiri farm, Langol hills by planting orange in June, 1991 and pineapple in June/July, 1992 (45-50 and 30-40 cm) on terrace bunds. Fodder crops NB-21 was also planted at raiser at 1m x 1m spacing. Agricultural crops viz., groundnut was planted as sole crop in all terraces.

Yield of pineapple, agricultural crops and performance of orange plants are given below :

Pineapple yield : Maximum yield of 35.39 t/ha was recorded with terrace No. 6 followed by 32.32, 31.63, 31.33 t/ha respectively in terrace No. 5, 1 and 7. And minium was recorded with terrace No. 9 (16.00 t/ha).

Juice percentage and T.S.S. : Maximum juice percent was recorded with terrace No. 10 (76.88) and with a minimum of 62.69 at terrace No. 1 whereas maximum T.S.S. was recorded with 15.50 (Terrace No. 4) followed by terrace No. 2 (16.50). Minimum was recorded with terrace No. 8 (12.80).

Fodder Yield : Maximum fodder (NB-21) yield was recorded with terrace No. 1 (61.0 t/ha/year) followed by 58.1 and 51.7 t/ha/year respectively in terrace No. 7 and 8. Minimum was recorded with terrace No. 4 (34.7 t/ha/year).

Groundnut yield : A pod yield upto 4.50 t/ha was recorded with terrace No. 2 followed by 4.25 and 4.00 t/ha respectively in terrace No. 1 and 3. Minimum pod yield was recorded with terrace No. 10 (1.25 t/ha).

Height of Orange Plant : Maximum plant height upto 1.462m was recorded with terrace No. 5 followed by 1.460 and 1.358 m respectively in terrace No. 2 and 6. Minimum was recorded with terrace No. 9 (0.670 m).

Collar Diameter : Collar diameter of 2.36 cm was recorded with terrace No. 2 followed by 2.26 and 2.08cm respectively in terrace No. 5 and 6.

Branching : Maximum number of branches was recorded with terrace No. 6 followed by 8.04 and 7.20 respectively in terrace No. 6 and 8.

Table 21. Silvi-pastoral system

Tree species	Mean Ht. (m)	Mean BHG (cm)	Mean Bole Ht	Canopy (m) (m)	Yield of P.*pedi-celatum* (t/ha/ cutting)	Grass Broom-grass (t/ha/ cutting)	Flowering of Broom grass
L. leucocephala	8.278	25.50	2.473	3.66	29.167	5.53	29.74
E. teriticornis	21.167	69.50	7.449	3.41	28.417	5.00	30.00
E. citriodora	20.27	68.30	10.438	4.52	27.50	2.93	40.16
P. roxburghii	7.476	39.47	2.141	3.69	35.00	3.28	43.33
Mean	14.29	50.69	5.62	3.82	30.01	4.18	35.80

Canopy : Maximum spreading upto 0.482 m was recorded with terrace No. 2 followed by 0.436 and 0.414 m respectively in terrace No. 5 and 3.

Agri horti-pastoral System

Lemon plants were planted at 5m interval along the contour bunds (sizes 65x50x30 cm contour trenches) at 2m vertical interval (April, 1994). Two rows of fodder grass (Guinea grass) were planted (50x50 cm spacing) on bunds raiser. Agricultural crops viz., Rice bean, grounnut and soybean were also planted in between the two contour trenches.

Yield : Yield upto 6.20, k 6.90 and 6.00 q/ha were recorded in rice bean, grounnut and soybean respectively. Fodder yield upto 29.68 t/ha was also recorded in one cutting. 25% gape filling at Lemon and Guinea grasses were made in July, 1995.

Spacing trial of E. *teriticornis* with thatch Grass

Experiment in spacing trial on E. teriticornis was conducted having slope percent about 30-40%. Thatch grass are allowed to grow naturally this year.

After five years, maximum height was recorded with treatment No. 5 (12.65m). There was no much affect of spacing upto 5 years of planting and also on the thatcg grass yield.

Silvi-Pastoral System

The seeds of P. *pedecelatum* was broadcast directly in all treatments. Three to four slips of broom grass were planted at 1m spacing along the contour bunds and another row was in between the two trenches. The Table 21 shows the performance of trees and fodder yield.

Physico-chemical properties of soil : Initial physico-chemical properties of soils under this system with 4 treatments and three replications were determined and presented in Table 22. The soil was acidic in nature with a very high content of organic mater and exchangeable aluminium. The available phosphorus, exchangeable calcium and magnesium and potassium contents were found to be very low in this block compared to other blocks.

Table 22. Initial Physico-chemical Properties of soil. (Silvi-Pastoral System)

Tree species	PH (1:!)	O.C (%)	Av.P. (ppm)	Exchangeable cation [cmol (p+) kg^{-1}			
				Na^{+}	K^{+}	Ca^{2+} Mg^{2+}	Al^{3+}
P. roxburghii	5.04	1.16	3.02	0.215	0.16	5.1	1.324
E. teriticornis	5.09	1.19	5.47	0.235	0.16	4.5	0.954
E. citriodora	5.06	1.28	3.43	0.206	0.17	5.0	1.096
L. leucocephala	4.97	1.15	3.40	0.215	0.18	5.2	0.982
Mean	5.04	1.19	3.83	0.217	0.168	4.95	1.089

Table 23. Silvi-pastoral system (*Albizzia* Sps.)

Treatment	Mean Height (m)	Mean C.H.D. (cm)	Mean Bole Ht (m)	Mean D.B.H. (cm)	No. of branches	Canopy (cm)
A. lebbeck	2.105	2.46	1.033	1.127	2.133	0.80
A. amara	2.739	2.907	1.403	1.90	4.00	1.43
A. procera	1.03	2.137	0.295	0.249	1.133	0.69
A. falcataria	4.641	10.28	1.823	7.833	6.933	2.60
Mean	2.62	4.44	1.13	2.77	3.54	1.38

Table 24. Initial physico-chemical properties of the Silvi-Pastoral System

Treatment	Ph (1:1)	O.C %	Av.P. (ppm)	Exchangeable cation [cmol (p+) kg^{-1}			
				Na^+	K^+	$Ca^{2+}Mg^{2+}$	Al^{3+}
A. lebbeck	4.91	2.06	6.37	0.283	0.560	11.6	2.01
A. amara	4.86	2.15	6.04	0.283	0.435	11.0	2.00
A. procera	4.84	2.07	5.95	0.297	0.530	11.5	2.30
A. falcateria	4.91	2.20	5.58	0.283	0.542	11.4	2.01
Mean	4.88	2.12	5.99	0.287	0.517	11.4	2.09

Table 25. Silvi-Patoral System (*Acacia* and *Leucaena* spp.)

Treatment	Mean Ht. (m)	Mean C.H.D. (cm)	Mean D.B.H. (cm)	Bole Height (m)	No. of branches	Canopy (m)
A. leucophloca	0.318	1.08	-	0.108	4.8	1.52
L. leucocephala IGFRI 23-1	2.324	2.55	1.40	1.074	8.2	0.98
A. ferruginia	0.847	1.46	-	0.185	8.3	0.52
L. leucocephala K (636) X	3.325	3.40	2.213	1.492	11.47	1.36
L. diversifolia (K 156)	3.325	3.40	2.213	1.492	11.47	1.36
L. leucocephala X *L. pulveralenta*	2.281	2.793	1.46	1.025	8.667	1.05
A. sundra	1.459	1.935	0.483	0.585	7.45	1.18
L. leucocephala IGRFI-96	1.997	1.93	1.022	0.825	4.935	0.71
Mean	1.78	2.16	1.31	0.75	7.68	1.04

Silvi-pastoral system (*Albizzia* Spp.)

Four *Albizzia* Spp. were planted on pits of 30x30x30cm sizes along the contour trenches of 1m vertical interval in August, 1992. Fodder grass will be introduced in 1996 during the rainy season. (Table 2 .

A *falcateria* dominated in all respects viz., diameter, canopy and no. of branches. The plant even reached upto 10.28 cm collar diameter in 3 years with maximum spread upto 2.60m and 6.93 number of branching.

Physico-chemical properties of soil

Samples collected from the Silvi-Pastoral System are given in Table 24.

Silvi Pastoral system (*Acacia* and *leucaena* spp)

Ten different *Acacia* and *leucaena* spp. were maintained among 10 species, three species viz. (i) *A. planifron*, (ii) *p. juliflorm* and (iii) *A. nilotica* were not survived (Table 25).

Physico-chemical properties of soil : Surface soil samples were collected from the Silvi-Pastoral System of Langol farm having 10 treatments and 3 replications. This soils were acidic in nature, pH ranged between 4.72-5.01. Soils were found to be rich in organic matter, O.C.% ranged between 1.50-2.02 and exchangeable aluminium (Al^{3+}) ranged between 1.28-2.09 cmol (P^+)/kg^{-1}. High content of exchangeable Al^{3+} in the soil decreased the availability of phosphorus in the soils. The values as determined ranged between 3.31 ppm to a maximum of 5.62 ppm. Exchangeable potassium rated high in these soils, values ranging between 0.315 to 0.372 cmol (P^+)/kg^{-1}.Exch. $Ca^{2+}Mg^{2+}$ ranged between 9.6-10.8 cmol)P^+) kg^{-1}. About twenty seven thousand nursery plants of 14 different tree species for wider studies of tree species were maintained.

TRANSFER OF TECHNOLOGY

KVK Manipur centre

Training for practising farmers

Forty four training courses were organised as detailed below :

Discipline	Number of courses	Number of participants			Number of SC/ST trainee
		Male	Female	Total	
Agronomy	9	106	13	119	43
Agril. Engg.	4	37	7	44	17
Home Science	10	-	131	131	41
Horticulture	7	41	43	87	41
Animal Science	10	93	36	129	15
Multidisciplinary	4	36	16	52	-
Total	44	316	246	562	140

For rural youths 12 trainings were conducted in six disciplines where 119 trainers participated (57 male and 62 female) of which 58 belongs to SC/ST.

For extension function 4 training courses were imperted involving 61 participants (31 male and 30 female) in horticultures, multi-disciplinary and agri-cultural engineering.

Demonstration

FLD in oilseeds and pulses

Crop	Familier	Area (ha)	Yield (q/ha)		% increase
			Demonstration	Outside demonstration	
Groundnut (JL 24)	31	9.9	16.6	8.2	205
Soybean	33	9.6	7.7	4.5	171

LLP

Crop	Families	Performance (yield q/ha)		
		Institute demonstration	Outside demonstration	% increased
Main kharif paddy	40	38.2	24.5	155.8
Rabi pea	30	9.5	6.0	158.3
Rabi vegetable Cabbage	10	510.0	225.0	226.7

On farm trials

Trial	Variety treatment	Family	Area (ha)	Performance (yield q/ha)	Farmers reaction
Varietal trial paddy	5	5	2.0	RCM-9 38.4 q	+VC
Performance of RCM-8 rice variety	7	3	0.07	38.63	+ VC
Varietal trial on mustard	5	2	0.03	Failed	- VC
Varietal trials on brinjal	5	3	0.19	1x9 Set-1 295 q	+ VC

Training/Seminars/Meeting/Workshop attended

Scientist	Particular	Vanue	Date
Shri Jai Singh JT. Directer & I/c	Course on Man Power Planning + in Agriculture	NAARM, Hyderabad	14-23 Sept.,1995
	Seventh National Workshop on KVKs and TTCs	ARKVK, Tirupati	)-12 Sept.,1995
	7th Manipur Science Congress	Imphal	4-6 Dec., 1995
Dr. D.S. Yadav, and	_do_		-do-
Dr. S.P. Singh, S	-do-		-do-
Dr. S.P. Singh, S	Training course in Production, Protection CISH, and PHT of Horticultural crops		4 Oct to 2nd Nov., 1995

PUBLICATIONS

Chandra, Krishan., Mukherjee, P.K. and Singh Jai (1995) Evaluation of local strain verses recommended strain of rizobium cultures for soybean crop at the hills of Manipur. *J. Hill Res.* : 232-234.

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Kishan Chandra, J.B. Karmakar and S.P. Singh. Effect of single strain verses multistrain inoculation Soybean (*Glycine* max) and pea (*pisum sativum*) crop in Acidic soils. *Journal of Hill Research* : 242-246.

मिजोरम (कोलासिब)

MIZORAM (KOLASIB)

INTRODUCTION

ICAR Research Complex, Mizoram centre was established at Kolasib to cater the research needs of the state in the field of agriculture, livestock and horticulture land use as an alternative to shifting cultivation. The farm has 40 hac. of land, located at an altitude varying between 600 to 700 msl. It comprises of steep to mild hill slopes within between gorges and streams

The various exprimental findings of expriments conducted during 1995-96 on field crops, oilseed, spices and fruit crops are summcrised.

SUMMARY

The annual rainfall received was 2021.3m which was quite conducive for agricultural operatios. U 23 and VL 206 in upland and Jaya and RCPL 3-6 in lowland were the best performing rice varieties. Out of 20 local rice germplasm evaluated, LP-5-25 yielded the highest. In Soybean, the performance of PK 472, MACS 124, Pusa 20 and JS 80-21 was better. ICGV 87119, ICGV 87187 and ICGV 87160 were identified as high yielding groundnut varieties. Three turmeric varieties viz. Sugandham, Aswinigandhe and Chaya Pushpa were found to be high yielding.

Almost all fruit trees planted performed well under integrated farming system. Dairy cattle gave good performance in terms of milk production.

SCIENTIFIC STAFF

1. Dr. K.A. Pathak i/c Joint Director
2. Dr. S.S. Mane (PP) - Scientist

WEATHER

Maximum temperature was recorded in May (29.68°C) and minimum temperature recorded was 14.0°C in December. Maximum humidity (80.1%) was recorded in July and minimum (48.5%) in March. Annual rainfall recorded during 1995-96 was 2021.3 mm. with a maximum of 376 mm in August. The minimum rainfall was 1.5 mm in January while in December there was no rainfall. (Table 1).

RICE

K.A. Pathak and S.S. Mane

Evaluation of advance lines from segregating population (upland)

Out of 17 lines selected from segregating population (U-47, U-21, U-25, L-36, U-18, U-23, U-15, U-10, U-22, L-58, VL-206, U-20, U-13, Khwangmam, L-61 and U-4) U-23 and VL-206 yielded the highest (10.11 and 10.91 q/ha, respectively). Wide variability with respect to days to 50% flowering (71 to97 days), days to maturity (110 to 120 days), height (105 to 144 cm) and no. of grains/panical (105 to 228) was observed.

Table 1. Meteorological data of Kolasib (1995)

Month	Temperature in C°		Relative Humidity in %		Rainfall
	Min	Max	8 hrs.	14 hrs.	in (mm)
January	141.3	20.5	81.0	59.8	1.5
February	16.5	21.3	77.8	57.3	23.0
March	21.3	27.6	66.4	48.5	113.8
April	23.9	29.4	80.1	62.5	152.5
May	25.4	29.7	87.4	70.5	301.5
June	25.7	29.2	90.6	81.1	214.5
July	25.4	29.2	91.3	82.2	214.5
August	24.4	29.4	91.7	81.3	376.0
September	25.1	29.4	89.1	78.9	349.5
October	23.4	28.0	89.6	74.8	154.0
November	20.5	26.0	87.4	76.9	128.0
December	14.0	23.0	87.2	70.1	-
Total					2021.3

Yield trial of early varieties (Lowland)

Under lowland, trial with six varieties of (Jaya, Ngoba, VL-206, DR-92, RCPL-87-1-8 and Rungtei) were evalated. Jaya had given the highest yield of 64.9 q/ha.

Yield trial of segregating population (Lowland)

Under yield evaluation trial of lowland segregates of (L-9, L-26, L-22, L-11, L-35 and L-50), the segregate, L-50 had given the maximum yield of 19.41 q/ha.

Yield trial of early maturing segregate (Lowland)

Under the lowland trial of early maturing segregates (L-1, L-55, D-5, L-43 and L-41), the line L-41 yielded the highest (21.66 q/ha).

Yield trial of late maturing varieties (Lowland)

Out of five varieties (RCPL-3-6, Govind, Pantdhan, RCPL-3-7 and RCPL-3-8) evaluted, RCPL-3-6 had given the maximum yield of 38.9 q/ha.

Evaluation of local germplasm

Twenty local rice germplasm (KS-2,LP-7, LT-4, LP-5, LT-3, ZL-1, LP-9-15, LP-18, LP-5-25, LP-2 SP-1, LT-6, LT-6-15,LP-5-15, LT-5, KS-1, MP-2, LP-8-15, KS-215 and LP-1) were collected. The local germplasm LP-5-25 yielded the highest (53.43 q/ha), whereas KS-2 yielded the lowest (17.5 q/ha). Wide variation among number of tillers (3 to 8), days to 50% flowering (60 to 105), height of plant (81 to 151 cm) and yield (17.5 to 53 q/ha) was observed.

OILSEEDS

Soybean

Seventeen varieties of soybean (Punjab-1, PK-472, PK-262, MACS-124, Bragg, JS-75-46, JS-335, PS-564, Monneta, Pusa-16, PK-416 Pusa-20, NRC-2, MACS-13, DS-182-1-76, MACS-58 and JS-80-21) were evaluated. The varieties PK-472, MACS-124, Pusa-20 and JS-80-21 performed better with the yield of 6.04, 6.5, 6.04 and 7.83 q/ha. The lowest yield was obtained in case of variety MACS-13.

Groundnut

Eleven varieties of groundnut (NRCG-1407, Girinar-1, NRCG-1191 ICGV-5953, ICGV-37, ICGV-87187, RCG-3, RCG-24, ICGV-89119, ICGV-87160 and JL-24) evaluated for their yield. ICGV-87119, ICGV-87187 and ICGV-87160 performed well with the yield of 22.5, 21.7 and 20.2 q/ha., respectively.

SPICES

Turmeric

Eighteen varieties of (Sangali local, G.L. Puram, Meghalaya local -II, PCT-13, Lakadang, Sugandham, PCT-12, PCT-II, Kasturi tunaka, Sangali local - II, PCT-8, Chaya pushpa, PCT-15, No. 24, Meghalaya local-I, Aswinigandha, Aswinigandha-2 and Jorhat local -I) were evaluated. Three varieties Sugandham, Aswinigandha and Chaya puspa performed well with the yields of 282.7, 226.5, 251.6 q/ha respectively. The wide variation among height of plant (62 to 105 cm), shoots/plant (10 to 13) and average weight of clump (100 to 244 g) was observed.

FRUIT

Khasi mandarin

Khasi Mandarin planted during 1986, in three blocks started bearing from 1993. The averge fruits/plant in block I, II, III were 210, 187 and 126, respectively.

Guava

Allahabad Safeda variety planted in 1987 yielded around 80 fruits/plant with average weight of 160g. In addition to Khasi manderin and guava, a good number of plants of banana, pineapple, mango, arecanut, coconut, local fruit trees, Assam

Lemom and teak were also grown. The performance of some of the crops was quite satisfactory.

Seed Production

The centre has taken up the Central Sector Seed Production Scheme on Spices.

Technology Extension Programmes on Agroforestry, Pilot Project on "Alternative to Shifting Cultivation" has also been taken up under Technology Development, Extension and Training 'Scheme'.

Integrated Farming Sytem

Agriculture - Annual Crops-Rice, Maize, Oilseeds, Pulses, Fodder crops.

Agroforestry - Teak, Oranges, Local trees etc.

Dairy Cattles - 5 milking cows are maintained as one of the dairy unit component of Integrated Farming System. The breed of the animals is neither pure jersey nor purely local.

Maximum milk production was 8.0 litres per day with an average of 5.99 litre in the entire milking period.

नागालैंड (झरनापानी)
NAGALAND (JHARNAPANI)

INTRODUCTION

The hill state of Nagaland is situated between 93.95 E longitude and 25.27 N latitude. The alititude ranges from 194 to considerable topographical variation. Therefore, when the research centre was set up for the state, two different locations were planned-one at Yiesmyong near Mokokchung for taking up problems of high altitude areas and the other at Jharnapani for taking up of the problems of Low altitude areas. Presently the centre is functioning at Jharnapani about 27 km from Dimapur. Research activities for high altitude areas are now carried out at Pfutsero. The centre is presently working in rice, maize, oilseeds, plant protection and transfer of technology programme through KVK.

SUMMARY

Application of FYM @ 20 t/ha significantly yielded higher yield in rice. Highest rice yield was also recorded by application of 40 kg N/ha through urea + 40 kg N/ha through azolla. The local rice varieties viz. Nyayii and Khonema were found to be high yielding varieties whereas amongest improved varieties the performance of RCPL 1-4 and IR 65 was outstanding.

Groundnut crop during third and fourth week of September significantly gave higher pod yield. Screening of 23 groundnut lines for diseases indicated that incidence of late leaf spot disease was more than the early leaf spot disease in Nagaland condition. Two short duration extra early determinate genotypes pigeon pea (ExD 1 and ExD 4) and two extra early nondeterminate genotypes (ExN 2 and ExN 8) were identified. Dimethoate 0.09% and monocrotophos 0.04% were found effective insecticides for controlling mustard aphids. Agroforestry activities were conducted in 5 villages to replace shifting cultivation. Three thousand nursery plants of black pepper were supplied to farmers for intercropping with timber plants, rubber and arecanut. Early weaning proved beneficial for commercial swine production due to good growth and more littres/sow/year.

Fifty seven training courses were organised covering 946 perticipents in crop production, horticulture, home Science and animal production technologies. The result demonstration under LLP covered 35 families. Mushroom cultivation and bee keeping were found to have a great source of subsidiary income for the farmers.

SCIENTIFIC, AND ADMINISTRATIVE TECHNICAL PERSONNEL

Dr. S. V. Ngachan, Joint Director I/C.
Dr. Naresh Babu, S (Horticulture)

Dr. P. Venkateswarlu, S (Entomology)
Dr. P. P. Rohilla, S (Animal Production)
Shri B. D. Rawat, S (Horticulture)
Dr. R. C. Verma, T-6 (Horticulture)
Shri. H. D. Singh, T-6 (Horticulture)
Mrs. K. A. Solo, T-6 (Home Science)
Miss V. Kenny Naleo, T-6 (Home Science)
Dr. W. R. Singh, T-6 (Animal Science)
Shri A. K. Khan, T-6 (Crop Production)
Shri. S. H. Nongbri, Asstt. Administrative Officer.

RICE

Effect of different manures and fertilizer on yield

G. P. Singh and A. K. Khan

Maximum yield of 31.87 q/ha was recorded in the plots treated with FYM 20 t/ha, which was significantly higher than the other treatments. There was no significant difference in yield between the other treatments and control . (Table 1).

Table 1. Effect of FYM and fertilizer on yield of rice

Treatment	yield (q/ha)
Control	21.45
Azolla @ 10 t/ha, after transplanting	23.43
N. P. K. @ 80 : 60 : 40 kg/ha	25.10
F. Y. M. @ 20 t/ha	31.87
Green manure	23.95
Azolla @ 10 t/ha, before transplanting	22.80
S. E.	2.69
C. D. 5%	5.73

Effect of bio-fertilizer and chemical fertilizer on transplanted rice

G.P. Singh and A.K. Khan

Although there was no significant difference among the treatments, application of 40 kg N through urea+40 kg N through Azolla gave the highest yield of 22.4 q/ha against 19.0 q/ha of control.

Evaluation of local varieties of Nagaland

S. V. Ngachan

Twelve varieties of paddy collected from different parts of Nagaland were evaluated for their growth and yield. The results shows that maximum yield (40.4 q/ha) was recorded from Nyajii followed by Khonema (35.7 q/ha). The variety Ngaurich was recorded tallest (164.5cm) among all the varieties whereas Nyajii variety was found to be drawf (110.4cm) followed by Khonema (111.1cm). They were found resistant to blast and sheath blight.

Performance of paddy varieties in Nagaland.

H. S. Gupta and S. V. Ngachan.

Performance of fourteen varieties of RCPL series of paddy were done under Nagaland conditions. RCPL 1-4 recorded the highest yield of (53.7 q/ha) followed by IR 65 (47.9 q/ha)

OILSEED

GROUNDNUT

Effect of spacing and date of sowing *Arachis hypogarea*)

A. K. Khan, G.P. Singh and S. V. Ngachan

A field experiment was conducted wih 'JL-24' to assertain the effect of date of sowing and planting distance on the production potential during pre-rabi season. The crop was sown in (i) third week of Sept., (ii) fourth week of Sept and (iii) third week of October with three spacings (30x20, 30x15 and 30x10 cm).

The crop sown during the third and fourth week of September gave significantly higher pod yield over the third week of Oct. The drastic reduction in pod yield in delayed sowing may be due to fall in temperature during the pod filling phase. The mean pod yield for third and fourth week of September was 13.94 and 13.55 q/ha which was 129.2% and 122.8% higher over the third week of October (6.08 q/ha). The pod yield averaged over date of sowing did not differ much on spacing. However, higher yields were recorded in case of closer spacings. The mean pot yield was 10.44, 11.20 and 11.93 q/ha for 30x20, 30x15 and 30x10 cm planting distances respectively (Table 2).

Screening for resistance to early leaf spot (ELS), late leaf spot (LLS) and rust diseases

S.V. Ngachan and Sangit Kumar

Twenty three varieties of groundnut were screened. The results for ELS and LLS are presented in Table 3.

Table 2. Effect of sowing dates and spacings (cm) on pod yield of groundnut.

Date of* sowing	Pod yield (q/ha)			Mean
	spacings(cm)			
	30x20	30x15	30x10	
III week September	12.7	13.7	15.43	13.94
IV week September	13.29	15.55	11.81	13.55
III week October	5.33	4.36	8.55	6.08
Mean	10.44	11.20	11.93	

* 16 Sept., 30 Sept., 16 Oct. and 31 Oct.

	sowing	spacing	Interaction
S.Em +	0.75	1.01	1.75
CD at 5%	2.08	2.20	3.82

Table 3: Screening groudnut genotypes for early leaf spot (ELS) and late leaf spot (LLS) disease

Entries	Mean disease ELS	Score(0-9) LLS
ICGS 76	2-0	5-0
ICGS 65	2.5	7.0
ICGS 1	2-0	6-0
AIS 9107	3.5	6-5
AIS 9104	4-0	6-5
AIS 9211	3-5	7-5
AIS 9209	3-0	7-5
INS 9115	4-0	5-5
ISN 9220	3-0	6-0
INS 9113	2-0	7-5
INS 9112	2-0	7-0
TG 27	4-0	5-0
TG 19A	3-0	6-5
IES 9107	5-0	6-5
IES 9102	4-5	7-5
IES 9108	3-5	7-0
AIIS 9208	4-5	7-5
ICGV 86259	4-0	6-5
ICGV 86188	2-0	6-5
ICGV 86191	4-5	6-5
Dh 8	3-0	8-0
RCG 2	3-0	6-5
JL 24 (Ch)	2-0	7-0
Trial mean	3-2	6-6

PULSES

S. V. Ngachan

Two short duration trials of extra early determinate types with 14 genotypes and extra early nondeterminate with 8 genotypes were conducted. In determinate types Entries EXD1 and EXD4 yielded maximum (7.9 and 7.0 q/ha) having matured in 153 days.

VEGETABLE

Tomato

Ten tomato varieties viz. H.S. 101, Arka Vikas, PED, Shakti, Pusa Ruby, La-Bonita, Punjab Chhuhara, Mutant (PR), BT-3 and Marglobe supreme were tested. Significant variation in plant height was observed for all the cultivars. Heighest plant height (52.80 cm) was observed for Pusa Ruby followed by Shakti and La-benita and the lowest height (41.09cm) was recorded for PED. Maximum number of branches (8.47) were observed in Shakti variety followed by BT-3. Poor branching was found in H.S. 101 (5.25). However, H.S. 101 took minimum number of days (67.67) for first picking followed by Arka Vikas, PED, Shakti, Pusa Ruby, La-Bonita (at par with each other). Mutant (PR) took 69.33 days. Maximum weight per fruit was recorded in variety Mutant (PR) followed PED and Shakti, but the difference was not

Table 4. Physical characteristics of tomato cultivars

Cultivars	Plant height (cm)	No. of branches	Days taken for first picking	Av. single fruit wt. (g)	Total number of fruits	No. of locules
H. S. 101	48.47	5.23	67.67	42.14	59.44	4.61
Arka Vikas	44.65	5.80	70.33	46.33	67.32	3.78
PED	41.09	8.20	72.33	53.06	74.30	3.81
Shakti	52.65	8.47	73.00	53.05	114.82	3.74
Pusa Ruby	52.81	6.50	72.67	42.56	64.34	4.55
La-Bonita	51.40	6.90	72.00	40.37	65.09	3.89
Punjab chhuhara	42.62	6.37	98.32	49.50	51.00	2.78
Mutant (PR)	48.19	5.73	89.33	171.42	22.44	4.54
B.T.-3	51.26	8.40	96.32	40.32	123.00	2.44
Marglobe supreme	48.53	5.87	122.00	41.47	48.78	3.44
S.E. m+	4.65	0.41	3.46	3.76	6.24	0.34
CD at 0.05	9.77	0.86	7.26	7.91	13.11	0.71

significant from other varieties. Highest number of fruit were borne by BT-3 and next best was in Shakti. More number of locules was found for Hybrid selection 101 (4.61) (Table 4).

POTATO

Evaluation of yield from true potato seeds

S. V. Ngachan and B.D. Rawat

The nursery was raised from the true potato seeds (TPS) of HPS-11/3 variety. Twenty two days old seedlings were transplanted at 30x15 cm. distance on ridge in the month of December. The crop was harvested 100 days after transplantation. The average yield was found to be 50.5 t/ha with 47 g average tuber weight. The tubers were stored at ambient temperature for sowing in next seson and storage studies.

FRUIT

Collection and evalution of germplasm

B. D. Rawat and S.V. Ngachan

Amla :

Four genotypes viz. Chakiya, Narendra Amla-6, Narendra Amla-7 and Narendra Amla-10 of amla were collected.

FLORICULTURE

Gerbera

Fifteen genetypes (RCG-1, RCG-3, RCG-5, RCG-8, RCG-9 RCG-10, RCG-11, RCG-12, RCG-13, RCG-15, RCG-16, RCG-17, RCG-18, AND RCG-19) were collected and evaluated. RCG-3, RCG-10, RCG-11 and RCG-17 genetypes were found promising for commercial cultivation in Nagaland.

Bougainvillea

The Hard wood cuttings of Lady Marry Barin, Cherry Blossom, Thima Variegata, Subhra, Hahra and Million Dollar varieties were collected. These varieties are under propogation.

Coclocasia :

Eighteen different genotypes based on shape and size of corms were collected. Two genotypes of suran (Angroo-1, Mangroo-2) having less astringent were collected.

AGROFORESTRY

Nursery preparation :

In order to find alternative to Jhuming, agroforestry was worked out in five villages namely viz. Phesama, Medziphema, Sevima, Setheikiema and Pfuchama. Nursery preparation are in progress for lemon, black pepper, papaya, tree bean, litchi, peach and plum. About 3000 nursery plants of black pepper were supplied to the beneficiaries at Pfuchama for intercropping with shado plants of Gaman, Hollok, Arecanut and Rubber Plant etc. At phesama, plantation of Hollock, Alder, Neem, Ghamari has already been under taken.

In Midziphema, supply of pineapple slip/Sucker for inter cropping with Gamari, Lemon, Litchi, Tree bean was being under taken.

In the first year of Jhuming, citronella/nappier grass, were grown across the slope to prevent soil erosion. Plantation of rubber plant, tree bean and litchi (under horticulture and gamari, teak under silvi pastoral system) was under taken. Turmeric inter cropping with other horticultural fruit crops such as guava and citrus is in progress.

. In wasteland areas of Sovima and Seithekiema survey work and farm plan are in progress. About 100 suckers of banana were already planted in Sovima.

MUSTARD

Evaluation of various insecticides on mustard aphid

P. Venkatashwarlu

A field experiment was carried out to evaluate various insecticides on mustard aphid. Experiment was conducted in rice fallow with mustard variety M 27. There were nine chemicals with two schedules of application. An untreated control was also kept for comparision.

The recommended insecticides viz., monocrotophos 0.04%, Phosphamison 0.05%, endosulfan 0.07%, dimetoeate 0.09%, malathion 0.05%, quinalphos 0.05%, methys demeton 0.05%, dichlorvos 0.10%, and chlorpyrifos 0.02%, were sprayed first at 45 days and later at 60 days of sowing. After two days of each spray, the aphid mortality was estimated in each treatment.

All the treatment were significantly superior to the control in reducing the aphid population (Table-5). Maximum mortality (82.20%) was recorded in plots treated with methyl demeton 0.05% followed by dimethoate 0.05% treated plots. However, there was no significant difference in aphid mortality among all the insecticides tested.

Yield was significant in all the treated plots than in the untreated plot. Maximm yield was obtained in plots treated with dimethoate 0.09% (7.48 q/ha) followed by methyldemeton 0.05% (7.22 q/ha) and monocrotophos 0.04% (7.17 q/ha). There was no significant difference in yield between the treatments. Net profit of Rs. 1880/ha was obtained from plots treated with dimethoate 0.09% Based on cost benefit

Table 5. Effect of different treatments on aphid mortality

Treatments		Aphid mortality (%)			Yield
		I spray	II spray	Average	(q/ha)
T-1, Monocrotophos	0.04%	86.2 (68.1)	67.0 (55.1)	76.6 (61.0)	7.2
T-2 Phosphamidan	0.05%	88.1 (69.8)	70.6 (57.2)	79.3 (62.9)	7.0
T-3 Endosulfan	0.07%	81.5 (64.5)	65.6 (54.0)	73.5 (59.07)	6.9
T-4, Dimethoate	0.09%	87.1 (69.0)	74.5 (59.7)	80.8 (64.0)	7.5
T-5 Malathion	0.05%	85.4 (67.5)	67.9 (55.5)	76.6 (61.1)	6.7
T-6 Quinalphos	0.05%	83.4 (65.8)	62.0 (51.8)	72.7 (58.4)	6.8
T-7 Methyl demeton	0.05%	88.3 (69.9)	76.1 (60.8)	82.2 (65.0)	6.9
T-8 Dichlorvos	0.10%	85.6 (67.4)	72.7 (58.5)	79.1 (62.9)	6.9
T-9 Chlorpyribos	0.02%	85.7 (67.7)	71.4 (75.8)	78.2 (62.3)	7.0
T-10 Control		7.1 (15.4)	10.8 (19.1)	8.9 (17.4)	5.0
S.E. m ±		2.7	2.5	2.6	0.5
CD at 0.05		8.1	7.3	7.7	1.5

Figures in parenthesis are angular transformed values.

ratio, dimethoate 0.09% and monocrotophos 0.04% were found most effective insecticides to control mustard aphids.

PIG

Effect of early weaning on growth of Hampshire Pigs

P.R. Rohilla

The pigs were weaned at 4-week, 5-week and 6 week of age and the average birth weights were recorded as 867. 14, 871.87 and 885.71 g respectively. The post-weaning performance of the pigs weaned at 4-week of age was observed to be much satisfactory in comprison to those weaned at 5-week and 6-week of age. The over all average body weight gain was calculated as 173.60, 158.90 and 193.55 g/d, respectively for 4-week, 5 week and 6-week weaning gropus. It was inferred that the early weaning would prove beneficial for commercial swine producers due to good growth and more litters per sow per year (Table 6).

POULTRY

One unit of 100 White Leghorn birds obtained from Lembucherra are maintained for demonstration purpose at, the unit. The following parameters were recorded from the birds :

i) Average age at 1st egg = 148 days
ii) Average body weight (20-week)
cock = 1440gm.
Hen = 1220 gm
iii) Average body weight (40th - Week)
Cock = 1975 gm.
Hen = 1350gm
iv) Average egg weight (4th-week) = 54 gm
v) Average egg production/year = 164 eggs/year.

Seminar/Symposium/Workshop Attended

Name of Scientist/Staff	Particulars	Venue and date
Dr. P. Venkataswarlu Dr. S. V. Ngachan Shri. A.K. Khan	Work shop on Project Diagnois and planning	IETC, Medziphema 23-30 August, 1996
Dr. S.V. Ngachan Dr. R.C. Verma Dr. Naresh Babu Dr. Anamika Sharma Sri H. D. Singh	Seminar organised by 'Coconut Devlopment Board	Dimapur 26 March 1996

Table 6. Average daily body weight gain (g/day) of pigs under different groups

Weaning group	Average birth weight (gm)	1st Fortnight	2nd Fortnight	3rd Fortnight	4th Fortnight	5th Fortnight	6th Fortnight	Overall average
1st (4 week)	867.14 ±39.23	125.00[a] ±3.63	150.00[a] ±8.19	169.00[a] ±7.12	188.75[a] ±8.95	202.50[a] ±7.90	205.83[a] ±10.99	173.60[a] ±7.79
2nd (5-week)	871.87 ±34.19	113.34[b] ±1.89	124.52[b] ±2.38	142.87[b] ±3.51	166.9[b] ±2.87	188.32[b] ±5.26	218.57[b] ±4.65	158.08[b] ±3.39
3rd (6-week)	888.71 ±60..35	160.28[c] ±6.18	193.32[c] ±11.49	221.67[c] ±10.54	209.43[c] ±5.54	193.33[c] ±4.38	183.60[c] ±2.53	193.55[c] ±6.77

Note : The means with different superscripts differ significantly ($P < 0.05$) among themselves.

TRANSFER OF TECHNOLOGY

S.V. Ngachan, R.C. Verma, H.D. Singh, A.K. Khan, A. Solo, V. Kenny and Anamika

A total of 57 training courses were organised covering 946 participants (463 male and 483 female) under Crop Production, Horticulture, Home Science and Animal Science. The Front Line Demonstration on oilseeds and pulses were also undertaken covering an area of 29 ha under groundnut, soybean, linseed, mustard etc. The area under linseed, mustard, soybean and groudnut was increased in the foot-hills area of Dimapur. Among the oilseed crops, linseed (Neelàm) and mustard (M-27) are widely accepted by the farmers.

The result demonstration under LLP covered 35 families under various crops of vegetable, paddy, animal husbandary etc. Strong linkage with the state Deptt. of Agriculture and Krishi Vigyan Kendra, ICAR was established. Works under NWDPRA, IPM, NOVOD, spices cultivation were coordinated by the centre. Supply of inputs for paddy (for low and mid altitude), ginger, turmeric, banana suckers, lemon, rabbits, piglets were made to farmers under Lab to Land programmes.

The Krishi Vigyan Kendra had undertaken demonstrations of Agro-forestry in five villages in terms of hill farming in wasteland areas. The mushroom cultivation training programmes created impact among the educated youth in rural areas. Two units of spawn production started at Mokokchung and Chumukedima.

In addition, the KVK hillock farm maintained about 10 ha. under agro-horti-silvi culture, horti-silvi pastoral, agro-horticulture. About 4 hectares of waste area were under horti-silvi pastoral system based on micro-watershed hill farming system. Besides dairy demonstration, poultry, rabbitry, piggery etc are being maintained. Bee-keeping has also been found a great source of subsidiary income for the farmers and supply of bee box to the farmers has been a great help to poor and marginal farmers.

सिक्किम (टडोंग)

SIKKIM (TADONG)

INTRODUCTION

The Sikkim centre of the complex is located at Tadong, 5 km. from Gangtok at an altitude of 1200-1400m msl and started functioning in 21.5 ha area. The land was handed over by the Gove. of Sikkim in 1976. The farm was properly developed for faciliating research on all potential crops and livestock. The net cropping area available is 14 ha. The centre is well equipped with laboratory cum office building scientists dormitory and residential accommodation. At present the research activities in the centre are carried out in crop improvement soil management plant protection, agricultural and horticultural crops, agroforestry, animal nutrition and animal health. The research findings have been transferred to the farmers by the scientists through KVK attached to the centre under transfer of technology programme. It is the only research centre in the country concentrating research on large cardamom.

SUMMARY

The fungicide Bean 0.04% was first best in reducing leaf plant disease and increasing the yield of rice. The maize grain yield increased by the continuous application of 60 kg K/ha and FYM @ 10 t/ha. Bavistin. Blitox 50 and Cumon L were found very effective fungicides to control leaf spot disease of blackgram and increased yield to 44-55%. The application of 10 t FYM/ha gave profound effect on radish yield. The continuous application of N (500 g/tree) and FYM (20 kg/tree) to the 12 years mandarin trees gave maximum fruit yield/tree. Intercropping of mandarin with ginger and bhindi gave good productivity. The addition of limestone and FYM significantly increased the ginger rhizome yield. Bhaise, Gorubathane, Suikhimachera and Chakrella were found high yielding ginger varieties. Application of 20 t FYM/ha gave significantly higher yield of turmeric. Golsey was found tolerant variety to both the viral diseases of large cardamom. A number of training were organised for the farmers and extension workers under ISPS programme on ginger and other horticultural crops along with advisory services rendered.

SCIENTIFIC AND TECHNICAL PERSONNEL

Dr. K.C. Mishra, joint Director
Dr. L.S. Srivastava, SS (PP)
Dr. D.K. Gupta, SS (PP)
Dr. Patiram, SS (Soils)
Dr. R.C. Upadhyay, SS (Hort)
Shri. I.P. Pradhan, SS (AF)
Dr. G.S. Karibasappa, S (Hort)
Shri S.B. Singh, T-7
Shri V.K. Sachan, T-7
Shri V.K. Gorg, T-7
Shri S.N. Mehta, T-6

RICE

L. S. Srivastava

Evaluation of fungitoxicants against rice blast

Seven fungitoxicants were evaluated against blast under field conditions. All

the fungicides included in the trial reduced the disease intensity and increased the yield significantly as compared to control. Beam was found best in reducing the leaf blast and increasing the yield. However, in reducing neck blast, Beam, Kitazin, Topsin-M and Hinosan were at par to each other. Maximum yield was obtained (3.20 t/ha) through application of Beam 0.04% as compared to control (1.39 t/ha). PDI (neck blast) was 4.8 and neck infection was 0.5% against 50.4 PDI and 17.7% neek infection of control.

MAIZE

Response to potassium and farmyard Manure

Patiram

During the third year, the maize grain yield increased significantly by the continuous application of potassium and FYM (Table 1). The optimum amount of K was 60 kg/ha and the same yield was obtained by the addition of 10 t FYM/ha only. Almost similar trend was observed with maize stover yield.

Table 1. Response of maize to potassium and FYM

Treatments	Grain yield (t/ha)	Stover yield (t/ha)
K kg k/ha		
0	3.94	7.92
30	4.83	9.04
60	5.54	10.24
90	5.15	9.60
FYM t/ha		
10	5.45	9.64
20	6.37	11.44
CD (P=0.05)	0.94	1.91

PULSES

Black gram

L. S. Srivastava

Evaluation of fungitoxicants against *Cercospora* leaf spot

Nine fungitoxicants were evaluated against Cercospora leaf spot of black gram under field conditions. All the fungitoxicants included in the trial reduced the disease intensity significantly as compared to control. Bavistin, Blitox-50 and Cuman-L at par to each other were superior to others. From yield point of view Bavistin, Cuman-L and Tilt were at par with each other were superior (Table-2).

The yield obtained by application of Bavisitin, Cuman L and till were 13.8, 12.0 and 12.7 q/ha respectively with PDI 5.2, 8.9 and 12.3 against 8.8 q/ha yield and 43.6 PDI of control.

VEGETABLE

Response to fertilizer potassium

Patiram and R.C. Upadhyay

During this year the response of radish to applied potassium and FYM

was significant (Table 2). The application of 10 t FYM/ha gave the profound effects as compared to various levels of K. The interaction FYM x K was non-significant.

Table 2. Mean effect of K and FYM on radish root yield (q/ha)

K,kg/ha	FYM0	FYM10	Mean
0	55	141.33	98.17
25	94.33	149.67	122.00
50	132.67	161.67	147.17
75	153.67	183.00	168.34
100	1161.10	186.67	173.86
Mean	119.35	164.47	141.91
CD (P=0.05)	K	FYM	
	43.13	27.30	

FRUIT

CITRUS

R. C. Upadhyaya and Patiram

Nutritional trial : The continuous application of N and FYM to the 12 years mandarin trees, gave the maximum yield of 25.3 and 34.3 kg fruit/tree when N and FYM applied @ 500 g N+20 kg FYM/tree in the third and fourth years respectively (Table 3.) The application of N and FYM alone also resulted profound effect on the fruit productivity. The fruit attributing characters, average weight, length, diameter were also influenced by the application of N and FYM. Others characters remained almost unaffected. The acidity of fruit juice was low in 1994-95 as compared to 1995-96, which was due to less rainfall during the maturity of fruit in the former year. The smaller size fruit had the higher concentration of acidity, juice % as compafed to larger sized fruits.

Intercropping trial : The maximum yield of 37.2 and 45.6 kg fruit/tree was found during the fourth year of continuous trial under clean cultivation (Table 4). The intercropping with ginger and bhindi gave the higher productivity of mandarin. Almost similar trend in average weight, length and diameter of fruit was observed. Other qualities of fruit remained almost unaffected by intercropping.

Management trial : During the fourth year of continuous trial, all recommeded management practices gave the maximum yield of fruit/tree followed by plant protection measures and horticulture management only (Table 5). All the recommended management practices also influenced the average weight, length and diameter of fruits accompanied by an incerease of fruit acidity. Other qualities of fruit did not influence by different management practices.

Micronutrients status of mandarin orchards

Patiram and R. C. Upadhyay

The leaf analysis of 32, twenty years old mandarin orchard indicated that the

Table 3. Nutritional trial of Mandarin orange at Bermick (Sikkim)

Treatments	Yield/ kg/tree	Juice %		No. of seeds per fruit	T.SS %	Acidity		Rmd thickness	
		Large	Small			Large %	Small %	Large	Small
Control	7.7	45.90	46.9	13.4	10.4	0.78	0.78	0.37	0.18
10 kg FYM/tree	10.4	47.8	49.6	14.7	10.5	0.67	0.73	0.35	0.21
20 kg FYM/tree	15.4	47.6	48.1	19.6	10.5	0.67	0.81	0.37	0.24
250g N/tree	13.0	46.3	49.2	12.5	10.9	0.66	0.77	0.36	0.22
250g N+10 kg+FYM per tree	18.1	46.6	47.8	12.6	10.7	0.66	0.78	0.37	0.21
250g N+20 kg FYM/tree	21.8	48.6	49.5	11.2	10.6	0.67	0.77	0.36	0.23
500g N/tree	16.6	47.5	50.1	11.2	10.3	0.67	0.70	0.37	0.22
500g N+10 kg FYM/tree	24.5	48.1	49.7	11.9	10.6	0.68	0.71	0.37	0.21
500g N+20 kg FYM/tree	34.3	48.0	48.3	12.2	10.4	0.66	0.79	0.36	0.19
750g N/tree	14.2	44.3	48.9	11.2	10.2	0.67	0.68	0.34	0.20
750g N+10 FYM/tree	15.6	41.7	47.7	11.7	10.4	0.58	0.86	0.36	0.21
750g N+20 kg FYM/tree	11.8	62.3	46.5	11.1	10.3	0.72	0.83	0.36	0.21

Table 4. Inter cropping management trial in the mandarin Orange Orchard at Bermick

Treatments	Yield/ tree (kg)	Av. wt. per (g) fruit	Juice %		No. of seeds per fruit	T.SS %	Acidity %		Rind thick-- ness (cm)		Yield other crops (q/ha)
			Large	Small			Large	Small	Large	Small	
Control (No. crop)	45.6	93.9	49.2	49.9	11.4	0.9	0.60	0.68	0.28	0.19	
Maize	32.4	86.1	49.5	49.0	12.2	10.3	0.66	0.77	0.29	0.18	13.6
Turmeric	31.1	85.4	47.6	48.5	11.6	10.4	0.54	0.89	0.31	0.19	141.6
French bean	38,5	88.9	46.1	47.8	12.7	10.6	0.48	0.75	0.30	0.20	39.7
Bhindi	42.8	91.3	49.6	48.9	12.9	10.5	0.52	0.68	0.29	0.20	45.2
French bean+ Mustard	39.7	90.2	51.3	51.4	13.3	10.5	0.50	0.82	0.33	0.19	31.6 +2.30 F.B.+Mustard
Bhindi+ Mustard	41.4	89.6	50.2	49.9	11.7	10.1	0.59	0.72	0.36	0.17	36.1+2.80 Bhindi+Mustard
Soybean	40.2	92.2	48.3	48.6	10.9	10.9	0.63	0.81	0.32	0.22	Destroyed by rodent
Ginger	34.7	87.6	47.9	49.1	14.1	9.9	0.70	0.88	0.33	0.20	69.2

Table 5. Management trial of Mandarin Orange at Bermick

Treatments	Yield kg/ tree	Av. wt. per fruit (g)	Juice %		No. of seeds per fruit	seeds wt. per fruit (g)	Acidity %		Rind thick- ness (cm)		T.SS %
			large	small			large	small	large	small	
No management	21.0	72.3	46.9	49.8	12.0	1.48	0.62	0.56	0.30	0.22	10.4
Farmers practices	24.6	78.7	47.3	49.2	13.3	1.75	0.65	0.54	0.33	0.19	10.5
Plant protection measures only	36.2	86.8	48.5	49.0	12.5	1.71	0.57	0.58	0.34	0.21	10.1
Horticultural management only	39.8	88.5	51.6	51.4	11.9	1.53	0.61	0.70	0.33	0.18	9.8
All recommended management only	60.9	91.5	50.0	51.2	13.9	1.88	0.64	0.76	0.37	0.22	10.2

C.D. at 5%

concentration of Zn, Cu, Mn and Fe varied from 19-46, 5.5-24.0, 16-80.5 and 100-370 ppm, respectively. The concentration of Zn and Mn was low in 5 orchards where it was below 20 ppm. The content of soil organic carbon, exchangeable Ca, Mg and K had the negative relationships with these micronutrients concentration of the mandarin leaves. The concentration of micronutrients of the leaves were positively correlated wwith each other.

SPICES

GINGER

Patiram and R.C. Upadhyaya

This experiment was conducted with four levels each of limestone and FYM on the productivity of ginger (Var. 'Bhaise'). The addition of limestone and FYM significantly increased the ginger rizome yield (Table 6) and optimum yield was obtained at 4 t/ha limestone and 40 t FYM/ha. Their interaction was non-significant.

Evaluation of varieties

R. C. Upadhyaya

Among the 13 ginger varieties tried during the year, Bhaise gave the highest yield (157.5 q/ha) followed by Gorubathane (116.2 q), Suikhimachera (96.2 q) and Chakrella (91.5. q). Lowest yield was obtained with Chonsa local (39.2q) abd Bahraich (40.5).

Varietal performance against rhizome rot complex

L. S. Srivastava

Twenty two genotypes of ginger were evaluated against rhizome rot complex. Not a single genotype was found resistant to the disease. However the disease

Table 6. Effect of limestone and FYM on ginger rhizome yield (t/ha)

Limestone (t/ha)	FYM (t/ha) 0	20	40	80	Mean
0	5.26	8.23	12.07	14.80	10.29
2	8.03	12.53	16.40	15.80	13.22
4	10.93	17.80	21.50	23.93	18.54
6	13.80	21.00	24.40	23.27	20.60
Mean	9.51	14.92	18.79	19.45	15.67
CD at 5% (Limestone and FYM)		3.97			

incidence was comparatively less in Gorubathan. Bhaise, Rajgarh. SG-666 and SG-551.

Turmeric

Effect of farmyard manure

Patiram and R.C. Upadhyay

The application of 20 t FYM/ha gave the significantly higher yield as compared to control and over 50, 0, 50 kg NPK/ha (Table 7)

Table 7. Yield of turmeric (t/ha) as affected by FYM application

FYM, t/ha	Turmeric yield (t/ha)
0	3.80
10	5.52
20	9.60
30	9.40
40	10.20
50.0.50 kg NPK/ha	6.20
CD (P=0.05)	2.232

Performance of varieties

R. C. Upadhyaya

Among the four varieties of turmeric, G. L. Puram, Lakadang and RCT-1 gave almost similar yield of 159-142 q/ha RCT 13 gave the lowest yield (122 q).

Screening of genotypes against major diseases

Nine genotypes of turmeric were screened under field conditions against three major diseases leaf blotch (*Taphrina maculans*), leaf spot (*Colletotrichum capsici*) and leaf spot/blight (*Phaeodactylium alpinae*). Not a single variety was found resistant to all the three diseases. However, RCT-1, RCT-13, Lakadang and G.L. Puram were resistant to leaf blotch and leaf spot. PTS-10 yields maximum followed by PTS-19 and PTS-24.

Evaluation of fungitoxicants against leaf blight (Phaeodactylium alpinae)

Seven fungicides were evaluated against leaf blight of turmeric. All the fungicides included in the trial reduced the disease intensity significantly and increased the yield as compared to control. All the fungicides were at par to each other. From yield point of view Bavistin was superior followed by Topsin-M with an yield of 25.3 t/ha and 24.4 t/ha, the increase being 42.9% and 38.2% respectively.

LARGE CARDAMOM

Evaluation of fungitoxicants against Anthracnose disease of Large cardamom

Anthracnose (*Glomerella cingulata*) is an important foliage disease of large cardamom. The itensity of this disease was found in 'Golsey' which is tolerant to Chirkey and Foorkey. Eight fungicides were evaluated against this disease. All the fungicides included in the trial reduced the disease significantly as compared to control. Cuman L (0.2%), Dithane

M-45 (0.2%) and Kavach (0.1%) recorded an yield of 23.2 t/ha, 24.0 t/ha and 23.4 t/ha with PDI 14.1, 12.8 and 13.3 against 17.7 t/ha yield and 35.2 PDI of control (Table 8).

Identifying tolerant types to two virus diseases of large cardamom and evolving control measures

Under this project 500 seedling each of the four cultivars of large cardamom were planted in the year 1988 to screen against two viral diseases Chirkey and Foorkey. Cultivar 'Golsey' was found tolerant to both the viral diseases. The two viral diseases were increasing.

TRANING AND ADVISORY SERVICES

Training programmes were conducted for the farmers and Extension workers of the State Agriculture/Horticulture Department, Govt. of Sikkim under ISPS programmes on ginger and other horticulture crops. The field orientation workshop was organised by ISPS.

Advisory services were rendered to the Horticulture Department on the rejuvenation of citrus orchards and growing of Kiwi fruits under mid hill conditions of Sikkim. The review on ginger pest was prepared to help ISPS project. Selection and management of mandarin orange nursery was supervised with state officials.

Table 8. Evaluation of fungitoxicants against Anthracnose disease of large cardamom

Treatment	% conc.	PDI	% Disease control
Bavistin	0.1	12.0 (20.17)*	70.9
Cuman-1	0.2	5.2 (13.05)	87.4
Dithane M-45	0.2	7.1 (15.34)	82.8
Topsin-M	0.1	9.9 (18..24)	75.9
Kavach	0.1	8.4 (16.75)	79.6
Captaf	0.2	17.3 (24.45)	58.0
Foltaf	0.2	16.7 (24.01)	59.5
Blitox-50	0.3	15.6 (23.30)	62.1
Control	—	41.2 (39.93)	
CD 5%	—	4.11	

* Figures in Parentheses are angular transformed values.

त्रिपुरा (लेम्बूचेरा)

TRIPURA (LEMBUCHERRA)

INTRODUCTION

Tripura Centre established at Lembucherra, about 14 km away from Agartala, started functioning in 1976. Due to the presence of sub-tropical climate, a variety of Kharif crops are generally grown in Tripura. Cropping intensity is exceedingly high in lowlands, locally known as 'lungas'. On the other hand, uplands covering 60% of total geographical area display a low cropping intensity. Soil moisture becomes one of the foremost limiting factors in crop growth in uplands particularly during, winter months. In contrast with hilly terrains, a good soil depth is present even in slopy areas.

In order to generate research information, the centre is presently engaged in research on rice, oilseeds, pulses, vegetable, spices, horticulture, goat, poultry, agroforestry and farming systems. Krishi Vigyan kendra situated at Birchandramanu in South Tripura is performing transfer of technology programme.

SUMMARY

The weather was conducive for both kharif and rabi crops. The total rainfall received was 2475mm from 88 days of rain. Mean monthly minimum and maximum temperature varied from 8.2-23.7°C and 23.4-33.6°C respectively. Relative humidity ranged from 80-90% in the morning and 39.72% in the evening. Potential evapotranspiration (PET) was computed for 10 years for prediciton of crop water requirement.

Change in soil properties and P uptake by rice were estimated. Soil pH and electrical conductivity were not much influenced either by fertilizer treatment or rice varieties. Bacterial inoculation produced considerably high P-recovery. Zn-polyphosphate containing 21.45%. Zinc could produce 67% increase in grain yield of rice. All forms of organic applied in soils produced significant increase of grain yield in rice from 37.2 to 82.2%. Baromalati was found to be a good yielder among all local rice varieties. Nineteen rice genotypes were found to be tolerant to P. stress.

Addition of 30 kg P_2O_5/ha produced 23-28% increase in seed yield of pigeonpeas. Mulching of *Acacia* leaves produced 74-142% increase in grain yield of blackgram.

TRC-til-12 and RAUSU 17-4 were identified as most promising season genotypes of sesamum. Early leaf spot disease incidence was more than late leafspot in groundnut. Most of the groundnut genotypes were tolerant to late leaf spot.

Contents of soil moisture present in upland, mid-land and low land toposequences were estimated.

Probhani Kranti and Tripura local were found to be promising varieties of lady's finger. Two selections of other (LS-

1 and LS-2) were made. EC 89259 and 177669 in summer and EC 76915 and EC 52060 in winter were the highest yielding tomato varieties. Third month after planting date was most suitable month for fresh garlic harvest.

Effect of splitted does of N, foliar application of N, biofertilizer, optimum level of micronutrients, tube rose were studied. Optimum spikelet length for longer vase life and harvesting for floral spike were also standardised. Connal production efficiency resulted into 3 groups of gerbera cormel productive varieties.

After 8 years of planting, *Gmeline arborea* attained maximum basal girth and girth at base height. Regression equation to estimate the production of fresh biomass in tree species were worked out. *G. arborea* produced maximum amount of fire wood on prunning. Assam lemon planted in the interspaces of *Acacia auriculiformis* showed enhanced growth.

Two white leghorn strains were subjected to selection under Tripura condition. Bulox (R) (Deltamathrin) at 25 ppm with 2 consecutive treatments at an interval of 10 days was found highly effective against *Boophilus microplus* of cattle. Average birth weight of the goat kids born during winter was more than the kids born in summer season.

Altogether 14 training courses involving 146 trainees were organised. Demonstration on fruit orchards, vegetables, soil and water conservation, fishery and livestock wer also made. One hundred four first line demonstration on groundnut, sesamum and soybean were conducted and 27 diagnostic services were organised.

SCIENTIFIC AND TECNICAL PERSONNEL

Dr. S. K. Nanda, Joint Director i/c
Dr. M. Dutta, SS (Soils)
Mrs. S. Sardana, SS (PB)
Mr. T. K. Sengupta, SSS (PP)
Mr. C. K. Sharma, SSS (Hort)
Mr. D. Barman, S (Hort)
Dr. B. K. Bhattacharya, S (SWCE)
Mr. L. C. De, S (Hort)
Dr. S. K. Ghosh, S (AS)
Mr. B.K. Mishra, T-6 (FM)
Mr. A. S. Singh, T-6 (KVK)
Dr. A. Chakravorty, T-6 (AS)
Mr. T.D. Barman, T-5 (KVK)
Mr. T.A. Khan, T-5 (KVK)
Mr. G.P. Kar, T-5 (KVK)

WEATHER

M. Datta and B.K. Bhattacharya

The mean monthly meteorological information is presented in Table 1. Total annual rainfall was 2475 mm. The maximum monthly rainfall was received in June followed by August and July. A delay in onset of monsoon was also observed. Mean monthly maximum and minimum temperature varied from 23.4 to 33.6°C and 8.2 to 23.7°C, respectivily. Relative humidity varied from 80 to 90% and 39 to 72% in the morning and afternoon respectively. A wide variability in relative humidity was recorded in the afternoon thus indicating low humidity in the winter months. Evaporation, on an average, varied from 2.1 to 6.3 mm/day. Summer months generally showed higher rate of evaporation than that recorded in winter months. Months from March to June showed comparatively high wind velocity than the remaining months.

Soil Temperature : Soil temperature was higher in the afternon than that of the morning. Soil temperature gradually increased in the morning but on the contrary declined in the afternoon with depths.

Potential evapotranspiration : Potential evapotranspiration (PET) form

Table 1. Agrometeorological data for I.C.A.R. Research Complex, Tripura Centre, Lembucherra

Month	Temperature (°C)		Relative humidity (%)		Wind speed	Sunhours (sunshine)	Evaporation (mm)	Total Rainfall (mm)
	Max.	Min	Mor	Aft	(k/h)			
Jan	23.	8.9	81	38.9	5.6	7.5	2.1	0.0
Feb	26.8	12.8	83.7	43.3	5.0	7.1	2.7	37.0 (2 days)
Mar	31.0	16.4	79.9	35.1	7.5	8.6	5.2	35.6 (4 days)
Apr	31.4	21.2	87.2	46.7	11.3	9.0	5.7	149.4 (3 days)
May	33.6	23.7	90.4	58.8	11.4	3.5	6.3	234.4 (6 days)
June	32.2	23.3	90.4	69.7	7.6	5.0	4.8	578.2 (10 days)
July	31.3	23.1	89.3	71.9	4.4	4.4	3.5	419.0 (16 days)
Aug	31.6	22.6	89.6	69.4	1.8	4.2	3.7	466.5 (21 days)
Sept	32.1	23.0	87.5	66.1	1.1	4.6	3.5	209.3 (16 days)
Oct	31.6	21.7	84.3	54.9	-	7.4	3.3	201.4 (6 days)
Nov	28.5	16.3	85.6	53.6	-	6.7	3.7	144.0 (4 days)
Dec	26.2	8.2	87.0	40.1	-	8.7	4.6	0.0
Av/total mm								Total rainfall - 2474.8 (88 days)

which crop water requirement can be predicted was computed for 10 years on the basis of pertinent climatological data by the modified Penman equation (PET 1), Blaney Criddle method (PET 2) and Thornthwaite formula (PET 3). From March to June, PET 1, 2 and 3 varied from 4.3 to 5.6, 4.4 to 7.4 and 4.4 to 5.4mm/day respectively. From July to October, PET 1, 2 and 3 varied from 3.4 to 4.4, 4.7 to 7.9 and 4.3 to 5.3 mm/day respectively. From November to February, PET 1, 2 and 3 varied from 2.3 to 3.6, 2.7 to 3.9 and 3.5 to 4.0 mm/day respectively. This indicated low PET values in winter months as compared to those in summer months. Aerodynamic factor used in Penman's equation might have reduced its impact on the estimates of evapotranspiration in rabi seasons. Moreover, mean monthly temperature declining in winter months could lead to decrease in PET values computed by Blaney Criddle and Thornthwaite.

PET estimated by Penman equation did not differ significantly from pan evaporation as revealed from 't' test. Moreover, Penman's PET were positively and significantly correlated (r = 0.680** to 0.714**) with open pan data. PET could easily be predicted from the linear regression models

PET 1 = 2.269 + 0.555 pan ... ... Pre-kharif

PET 1 = 0.991 + 0.863 pan ... ... Kharif

PET 1 = 0.776 + 0.861 pan ... ... Rabi

On the other hand, the two simple PET equations, Blaney-Criddle and Thornthwaite could be utilised in prediction of pan data with 21.8 to 31.7 per cent variability.

Pan = 2.658 - 0.875 PET 2 + 1.478 PET 3 (R^2 = 0.317) ... Pre-Kharif

Pan = 2.992 + 0.331 PET 2 - 0.371 PET 3 (R^2 = 0.218) ... Kharif

Pan = -0.896 + 0.317 PET 2 + 0.659 PET 3 (R^2 = 0.292) ... Rabi

The water balance diagram relating the monthly PET (Penman's equation) and rainfall averaged over 10 years is depicted in Fig. 1. The length of dry period was extended to five months from Jan to March and Nov and Dec where PET far exceeded rainfall received and was critical to the growth of plants in the absence of irrigation. The month of April was considered as moist period and in the remaining months from May to Oct water surplus condition prevailed.

RICE

M. Datta and B.K. Bhattacharya

Efficacy of phosphates and phosphobacteria

A field experiment was conducted with upland rice during the pre-kharif season of 1994 on an Ultisol of Lembucherra. The upland rice cultivars sown were AR-11, TRC-87-251, REPH-3-7, IRAT-141 and Chanmuri (local). The

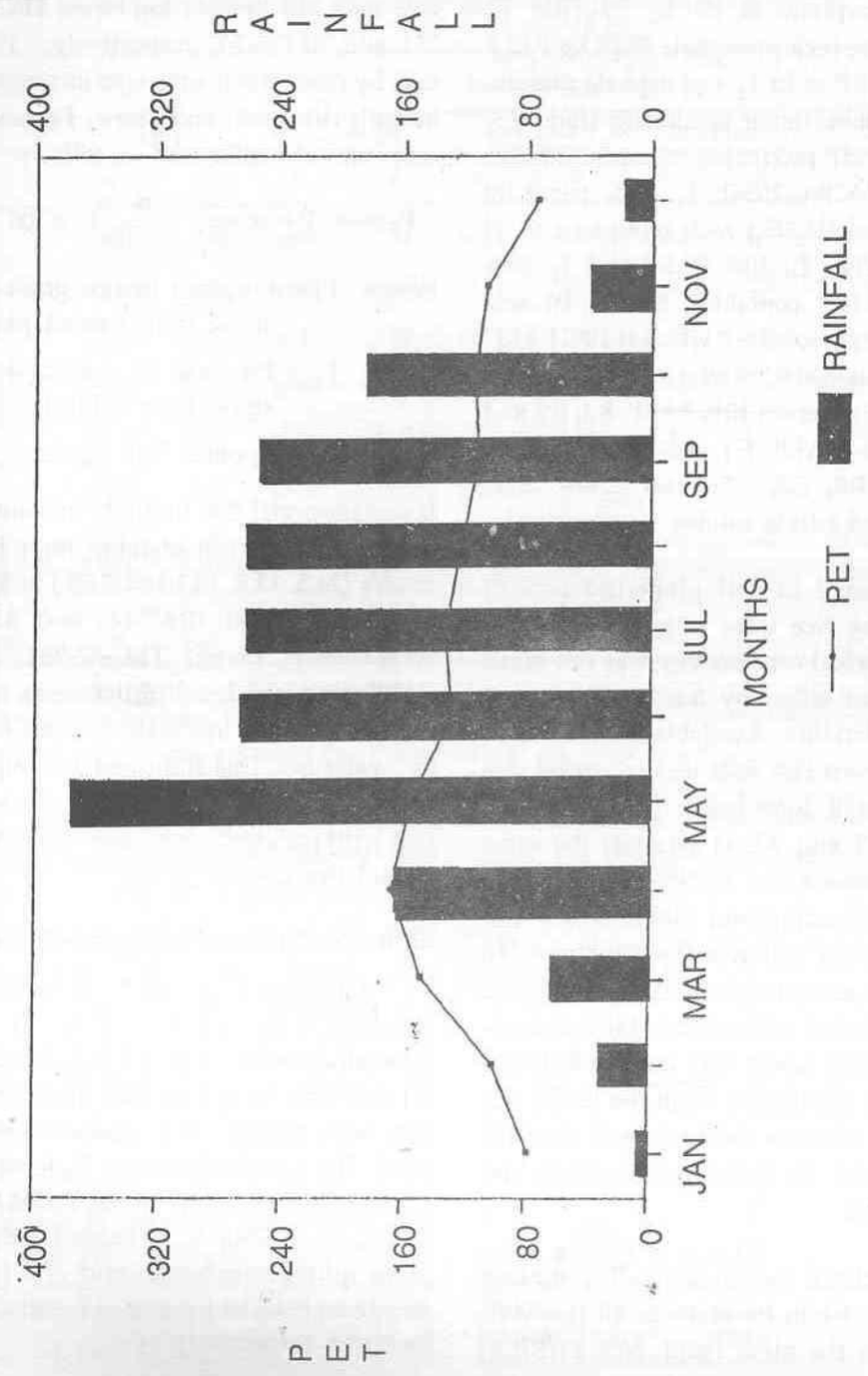

Figure 1. Monthly PET and rainfall (mm) average over 10 years.

treatments were To, Control; T_1, singles superphosphate @ 30 kg P_2O_5/ha; T_2, Mussoorie rock phosphate @ 30 kg P_2O_5/ha; T_3 MRP as in T_2 + phosphate dissolving phytohormone producing (Indole-3-acetic acid) producing bacteria, *Bacillus firmus* (NCIM 2636); T_4, 10% partiallly acidulated (H_2SO_4) rock phesphate @ 30 kg P_2O_5/ha; T_5, 30% PARP and T_6, 50% PARP. MRP contained 8.2% total and 0.45% citrate soluble P whereas 10% PARP. MRP contained 8.2% total and 0.45% citrate soluble P whereas 10% PARP, 8.1, 0.2 and 0.87, 30% PARP, 6.1, 0.30 and 1.52 and 50% PARP, 5.8, 0.56 and 2.30% total, water and citrate soluble P, respectively.

Change in soil properties and P-uptake by rice were estimated. Soil pH and electrical conductivity was not much influenced either by fertilizer treatment or rice varieties. Available P (Table 2) in post harvest rice soils was increased due to bacterial inoculation in TRC-87-251, REPH-3-7 and AR-11 whereas the same was increased due to 50% PARP in AR-11 and chanmuri and due to 30% PARP in IRAT-141 followed by chanmuri. In other cases increase in available P was marginal and inconsistent. Microbial P-solubilizing power was increased due to bacterial inoculation in all the tested rice varieties whereas the increase of the same due to other treatments was irregular and inconsistent.

Bacterial inoculation in T_3 produced tangible rise in P-uptake in all rice varieties. On the other hand, 50% PARP in T_6 raised P-uptake in grain from 2.78 to 8.21 and 6.01 to 7.42 kg/ha in TRC-87-251 and REPH-3-7, respectively. P-uptake by other treatments was inconsistent in both rice grain and straw. Percent P-recovery was estimated as follows :

$$\text{Percent P-recovery} = \frac{P_1 - P_0}{P} \times 100$$

Where P_1 = P-uptake in rice grain and straw from treated plots

P_0 = P-uptake in rice grain and straw from control.

P = Applied P in kg/ha.

It was observed that bacterial inoculation in T_3 produced considerably high P-recovery (24.5, 23.3, 19.3 and 7.6%) in TRC-87-251, Chanmuri, IRAT-141 and AR-11 respectively. Except TRC-87-251, 50% PARP produced less in P-recovery than that of bacterial inoculation in all other rice varieties. This indicated the superiority of bacterial inoculation in combination with rock phosphate over acidulated phosphates in acid soils.

Eifficacy of slow-releasing Zn-fertilizer

An experiment was conducted in lowlands with variety TRC-216-14 and three zinc sources, viz., Zn SO_4, Chelated Zn and zinc polyphosphate in combination with normal NPK doses were applied. The treatments were : T_0 (control); T_1 (5 kg Zn So_4/ha); T_2 (10 kg ZnSo4/ha); T_3 (Chelated Zn); T_4 (Chelated Zn); T_5 (zinc ploy phosphate) and T_6 (zinc polyphosphate) at the rate of 5 and 10 kg $Zns0_4$/ha respectively.

Table 2. Effect of different phosphate sources and phosphate dissolving bacteria on available phosphate and microbial P-solubilizing power of rice cultivars

Treatments	Rice cultivars									
	AR-11		TRC-87-251		REPH-3-7		IRAT-141		Chanmuri	
	A	B	A	B	A	B	A	B	A	B
T_0	20.31	1.68	15.61	1.78	16.21	1.33	16.43	2.70	20.99	1.53
T_1	21.67	1.00	14.89	1.95	15.22	1.18	15.99	2.25	21.67	2.33
T_2	20.99	0.80	12.31	2.25	12.19	1.55	14.70	2.20	15.83	2.00
T_3	23.70	2.50	20.51	2.23	19.64	1.80	15.56	3.00	20.99	2.00
T_4	20.99	2.20	12.19	1.23	10.83	2.68	15.13	2.13	23.70	1.53
T_5	18.28	1.75	14.89	1.84	12.42	1.80	18.16	1.63	31.15	2.20
T_6	27.09	2.45	14.89	1.91	13.54	2.15	12.11	2.15	33.86	2.38
Mean	21.9	1.8	15.04	1.89	14.15	1.78	15.44	2.29	24.0	1.99
CV (%)	11.9	35.3	17.02	16.8	19.4	26.5	11.1	17.8	24.3	16.3

Initial soil : 17.4 kg P/ha

A - Available P in kg/ha

B - Microbial P - solubilizing power (mg P solubilized/25 mg added P/g soil).

Due to heavy precipitation received in Kharif seasons, rice yield was very low and both $ZnSO_4$ and chelated zinc failed to produce significant increase in grain yield. On the other hand, Zn-polyphosphate containing 21.45% Zn is a sparingly soluble fertilizer and could produce 67.71% increase in grain yield over control.

Response of upland rice to P-fertilizer

In soils containing medium in P-status, an experiment was conducted with 0, 15, 30 and 45 kg P_2O_5/ha (SSP) in upland rice (cv. AR-II). Grain and straw yield are reported in Table 3.

Table 3. Effect of P-doses on rice (q/ha)

Treatment (kg P_2O_5/ha)	Grain yield	Straw yield
Control	9.05	28.62
15	11.67	31.89
30	11.50	29.95
45	10.17	35.14
SE (+)	1.13	2.14
CD (5%)	2.41	NS

It was observed that 15 kg P_2O_5/ha could produce the maximum increase in grain yield from 9.05 to 11.67 q/ha.

Effect of organic materials on upland rice

In upland soils, an experiment was conducted to find out the comparative efficacy of various organic materials and rice (cv. VL-163) was grown as test crop. The treatments were : T_o (control); T_1 (5 t cowdung/ha); T_2 (20 t cowdung/ha); T_3 (10t dry groundnut haulm/ha); T_4 (20t dry groundnut haulm/ha); T_5 (5t poultry manure/ha); T_6 (20t poultry manuure/ha); T_7 (5t gobar gas slurry/ha); T_8 (20t gobar gas slurry/ha); T_7 (5t gobar gas slurry/ha); T_8 (20 t gobar gas slurry/ha); T9 (20t til oil cake/ha) and T_{10} (20t groundnut oil cake/ha).

It was observed that all forms of organics applied in soils produced significant increase from 37.2 to 81.2% in grain yield over control. The maximum rise in grain yield was recorded in T_9 after the application of 20 ton til oil cake/ha which also produced an increase in straw yield from 20.83 to 39.45 q/ha. Groundnut oil cake produced 70.8% increase in grain yield but maximum increase in straw yield from 20.83 to 49.87 q/ha was noted. As compared to cowdung and its slurry, poultry manure was more responsive to rice. Groundnut haulm though requiring about 2 months for its decomposition in soils also produced 37.2 to 47.0% increase in grain yield.

Performance of varieties

Of 13 varieties tested, a wide variability in grain yield as well as plant height was observed. Garomolati produced the maximum grain yield of 13.75 q/ha and the least grain yield was recorded in Ful Badum (4.44 q/ha). Plant height varied from 70.8 to 122.5 cm. Not much variation was noted in no. of tillers (3.5 to 5.6) and maturity (103 to 117 days).

Screening of local varieties for P-stress

Sixty five varieties were sereened for P-stress under 2 levels of fertilizer NK and NPK. The dose of N, P_2O_5 and K_2O were 80, 40 and 40 kg/ha.

The results indicated that 19 genotypes viz. Aduma, Badia, Batteswar, Begam, Damodhar, Dhup Amri, Gua Sai, Garomalati, Harinarayan, Imp Sona, Kali Khasha, Kangpui, Kanchali Bitchi, Kartik Sail, Latka, Rellong, Subashi and Tahkur Bhog. The remaining showed a decline in grain yield after P-application were tolerant to P-stress condition in acid soils. The remaining genotypes were observed to be responsive to P-application.

PULSES

M. Dutta

Pigeonpea

Response to phosphate

An experiment was conducted to find out the response of pigeonpea to phosphate fertilizer and seed yiled. (Table 4).

Addition of 3 kg P_2O_5/ha produced 23 and 28.6% increase in seed yield over control in ICPL-87059 and ICPL-88009 respectively. On the other hand, 60 kg P_2O_5/ha produced 60% increase in seed yield over control thus indicating comparatively high response of phosphate to local variety.

Table 4. Response of pigeonpea to phosphate

Variety	Seed yield (q/ha)		
	Control	30 kg P_2O_5/ha	60 kg P_2O_5/ha
ICPL-87059	10.5	12.92	10.09
ICPL-88009	6.67	8.58	7.40
Local	5.59	8.84	9.0
CD (5%) variety	2.61		
Phosphate	2.61		
Variety x phosphate	2.03		

BLACKGRAM

Effect of mulch

Precipitation, though plenty is unevenly distributed and soil moisture stress is sometimes created even in summer months. So an experiment was conducted to find out the effect of mulch on the productivity of black gram. Three types of mulches, viz., M_1 (*Glyricidia maculata* leaf), M_2 (*Acacia auriculiformis* leaf) and M3 (chan grass) were used and three black gram cultivars, viz., V1 (B-12-4-4), V2 (B-3-8) and V3 (T-9) were grown (Table 5).

Acacia leaf produced the maximum increase (74.5 to 142.7%) in grain yield of all the black gram varieties. *Glyricidia* leaf, though decomposing at a faster rate performed much better than chan grass in increasing both grain yield and harvest index of black gram.

Mulching could not produce any marked change in phenology of black gram as depicted from germination to maturity (Fig 2). Above ground biomass as recorded from 8 to 61 days of growth of black gram is shown in Fig. 3. A

Table 5. Grain yield (q/ha) and harvest index of black gram

Variety	Control	Harvest index	mulch		
			Glyricidia	Acacia	Chan grass
B-12-4-4	2.55	0.44	6.01(0.46)	6.19(0.46)	4.59(0.43)
B-3-8	3.8	0.39	5.73 (0.49)	7.23(0.47)	3.92(0.43)
T-9	4.0	0.34	5.88(0.47)	6.98 (0.48)	4.59 (0.44)
CD (5%) variety NS					
Mulch 2.32					

change from around 2 to 380 g dry biomass/m² was noted. Not much variation in biomass productivity was recorded after mulching during the growth stage from germination to pod formation. But at 61 days of growth period, *Acacia* leaf produced the maximum increase in biomass from nearly 100 to 380 g/m² followed by *glyricidia* leaf and chan grass. Leaf area index (LAI) varying from 0.05 to 1.6 gradually incrased upto 61 days of growth and there after sharply declined. Mulching could maintain an increase in leaf area index over control during the growth stage from vegetative to yellowing (Fig. 4). Glyricidia leaf was highly efficient in increasing the leaf area index over two other mulch. Surface (0.5 cm) soil moisture was recorded at various growth stages and widely varied from nearly saturation (around 20%) to wilting point (around 1.5%).

Mulching concomittantly increased the soil moisture content over control from 10 days and onwards till the maturity of the crop.

OILSEEDS

SESAMUM

Performance of varieties

Out of 9 sasamum varieties, TRC-til-12 recorded the maximum grain yield (11.0 q/ha) followed by RAUSS-17-4 (10.8 q/ha). The genotypes matured in 90-100 days.

GROUNDNUT

Effect of NPK

Under medium soil fertility, an experiment was conducted with six NPK doses in groundnut (cv. ICG 87128). It was observed that NPK (60 : 30 : 30 kg/ha) produced only 11% (32.0 q/ha) increase in pod yield over control (28.8 q/ha). The low response of NPK to groundnut was mainly due to inherent soil fertility.

Effect of *Glyricidia* leaf

An experiment was conducted in groundnut (cv. JL-24) after the application of fresh *glyricidia* leaf @ 5 and 20 t/ha.

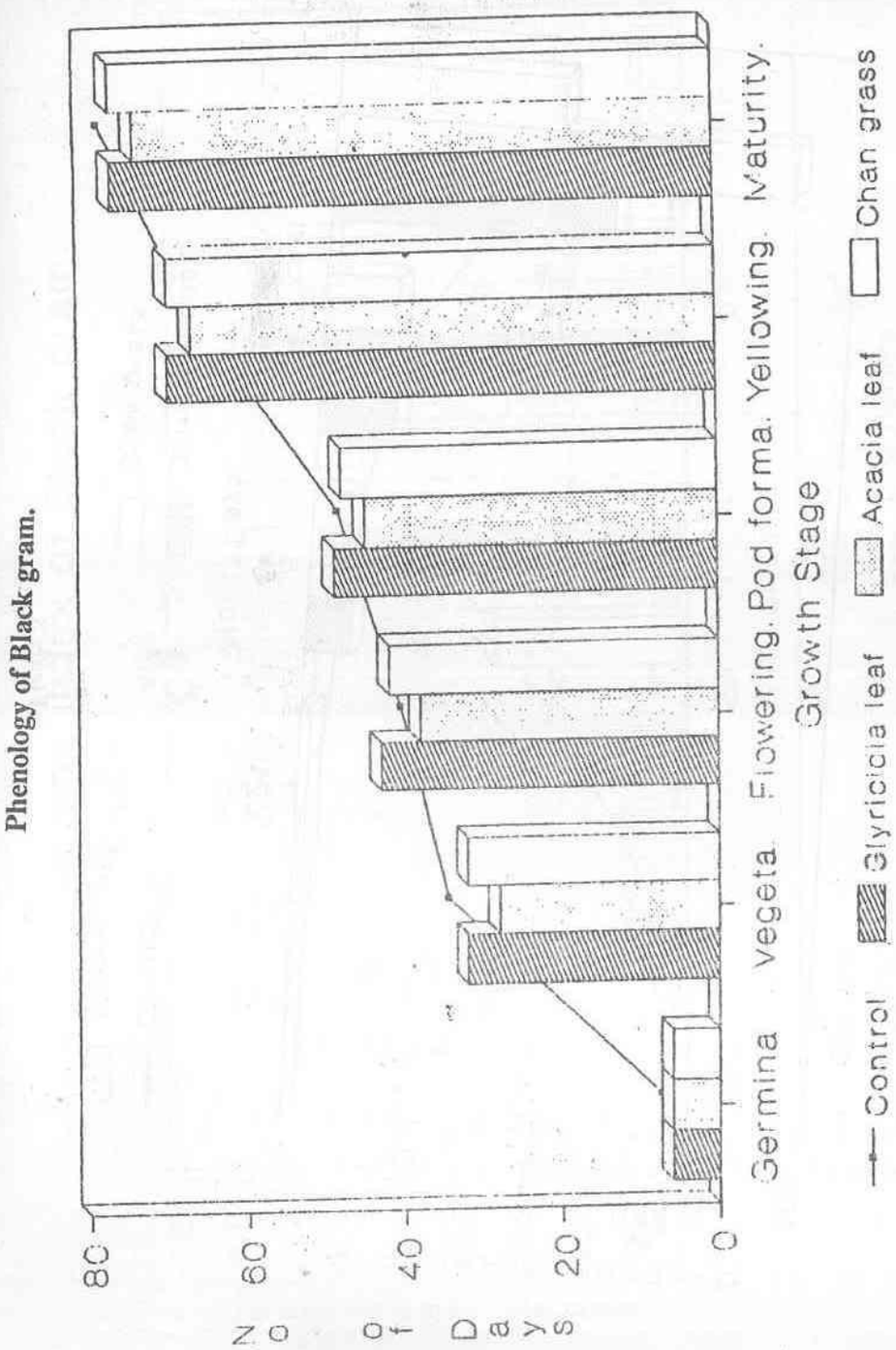

Figure 2.

Above ground Biomass of Black gram.

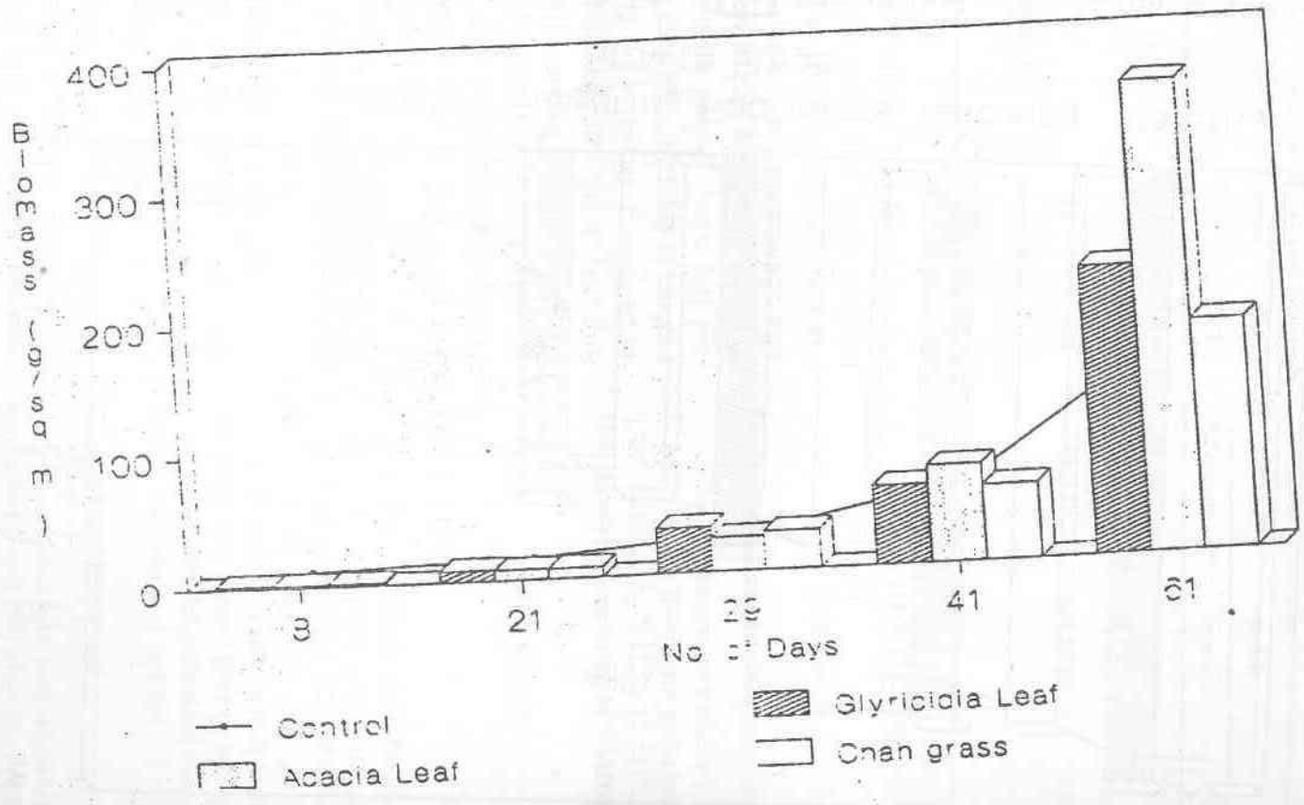

Figure 3.

Leaf area index of Black gram.

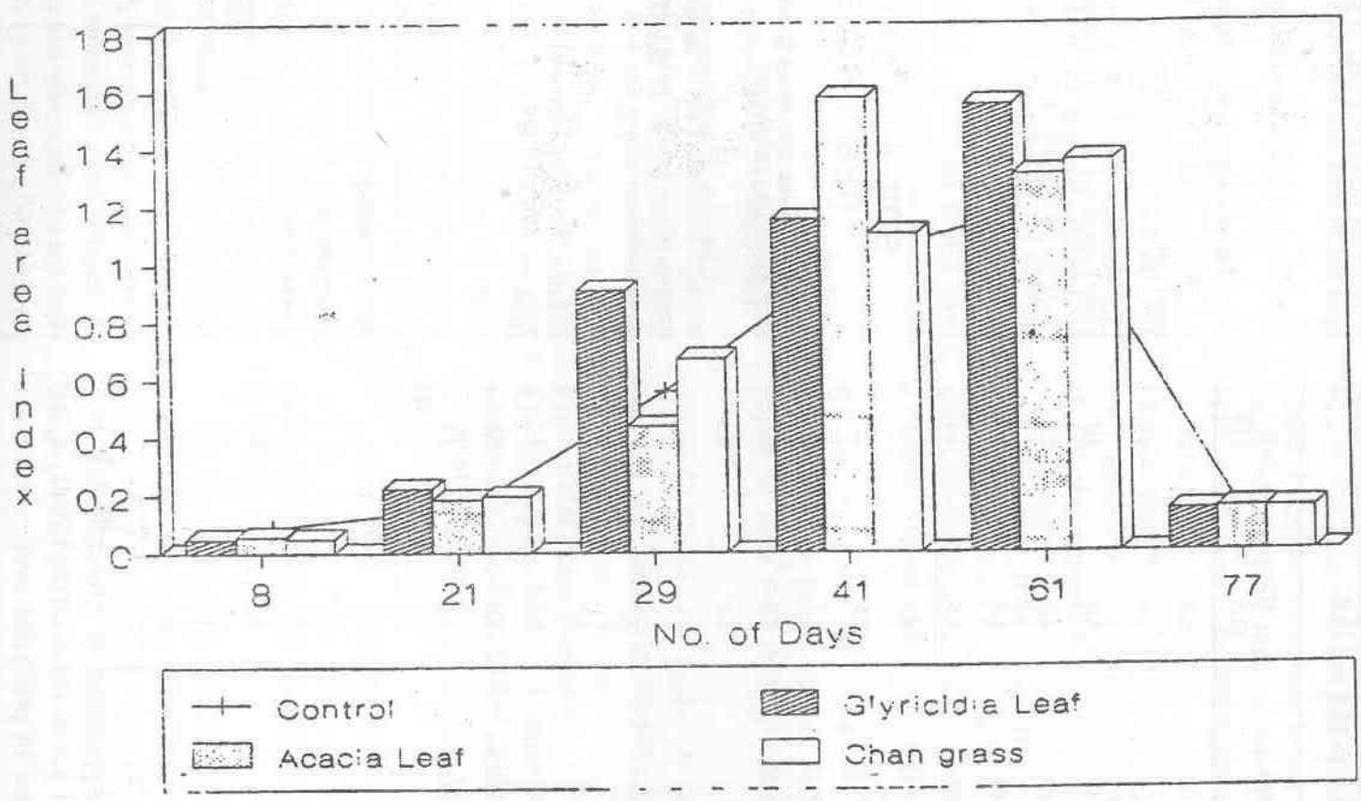

Figure 4.

Table 6. Screening of groundnut genotypes to ELS and LLS

Genotype	Disease score (0-9) ELS	LLS
ICGV 76	3.5	2.5
ICGV 65	4.5	3.5
ICGV 1	5.0	4.0
AIS 9107	4.0	3.0
AIS 9104	4.5	3.0
AIS 9209	4.5	4.0
IOVS 9115	4.5	2.5
IOVS 9220	4.5	4.5
IOVS 9113	4.5	4.0
IOVS 9112	4.0	4.5
TG 27	4.0	4.0
TG 19A	3.5	3.5
IES 9107	3.5	4.5
IES 9102	4.5	3.5
IES 9108	5.0	3.5
ICGV 86259	5.0	3.5
ICGV 86188	4.5	4.5
ICGV 86191	4.0	4.0
ICGV	5.0	3.0
Dh 8	4.5	2.5
RCG 3	4.5	4.0
JL 24 (Ch)	5.0	3.0
Mean	4.4	3.6

Application of glyricidia leaf produced 8.3 to 11.1% (27.3 to 28.02 q/ha) increase in pod yield over control.

Screening for resistence to early leaf spot (ELS) and late leaf spot (LLS)

T. K. Sengupta, S. Chandra and B.K. Sarma

Twenty three varieties were screened for ELS and LLS on 0-9 scale (Table 6). The results indicated that incidence of LLS was less than ELS. Genotypes were moderately tolerant to moderating susceptible for ELS and moderately tolerant to LLS.

SOIL AND WATER RESOURCES

Soil moisture retention

Contents of soil moisture present in upland, midland and lowland toposequences were estimate along the soil depth from 0 to 60 cm for a week interval in all months. M onthly average values varied from 12.9 to 13.9, 13.4 to 13.8 and 1.37 to 14.3% in upland, midland and lowland respectively. On the other hand, mean values along the soil depth (0-60 cm) indicated that soil moisture was low in January and February and thereafter concomittantly incrased from March to August folowed by a decline in the reamaining months. Though soil moisture was comparatively high in September and October due to residual contents and occasional precipitation, winter months from November to February were the critical periods of moisture stress prevailed in soils.

VEGETABLE

Lady's finger

C.K. Sharma, D. Barman and L.C. De

Germplasm evaluations : Five okra accessions (7 Dhari, Tripura Local, Pavan Kranti, Parbhani Kranti & harbajan) were evaluated for various desirable traits of economic significance.

Fruit yield : Prabhani Kranti gave maximum fruit yield followed by Tripura Local 7 Dhari.

Root yield : Among all accessions, Prabhani Kranti exceeded all in dry root yield/plant followed by Tripura local.

Fibre yield : Harbajan and Tripura local were found to be the highest fibre yielder.

Stem yield : Tripura local and Prabani Kranti were observed to give much more stem yield.

F_1 Hybrid evaluations : A total of 19 biparental hybrids synthesized during previous years out of 5 parents were evaluated alongwith their parents.

Fruit characters : F_1 hybrids of parental combinations like Tripura local x Pavan Kranti, Prabhani Kranti x 7 Dhari (14.33), 7 Dhari x Pavan Kranti (21.33), Pavan Kranti x Harbajan (18.33), 7 Dhari x Tripura local (113.67) exceeded in fruit yield in number/plant over their both parents (5.50-12.55). Fruits of F1 hybrids of parental combinations such as Prabhani Kranti x 7 Dhari (20.28 gm), Purbhani Kranti x Tripura local were much more longer than that of their parents (11.03-14.86 cm). Weight/10 immature edible fruits from F_1 hybrids with parental combination like Tripura local x Pavan Kranti (28.5 gm), Parbhani Kranti x 7 Dhari (27.00) also improved.

Dry root yield : Dry root yield/plant of F_1 hybrids of parental combination like Pavan Kranti x *Hibiscus*, Harbhajan x *Hibiscus*, 7 Dhari x Pavan Kranti, Tripura local x Prabhani Kranti, Harbhajan x Pavan Kranti, Pavan Kranti x Harbhajan, Harbhajan x 7 Dhari (57-150 gm) also improved over their both parents (31-52.33 g).

Fibre yield : F_1 plants of several parental combination (7 Dhari x Pavan kranti, Harbhajan x Pavan Kranti, Pavan Kranti x Harbhajan, Harbhajan x Prabhani Kranti, Tripura local x 7 Dhari) were identified to yield more fibre yield/plant (36.50-61.69 g) over that of their parents (15.14-32.06 g).

Stem yield : Eight parental combinations yielded more stem yield/plant (1220-2880g) over that of their parents (770-1083 g).

Two selections LS-1 (Parbhani kranti x 7 Dhari) and LS-2 (Tripura local x Parbhani kranti) were made out of selfed F_2 populations of 19 bi-parented crosses which yielded 351.5 g and 167.7 g edible fruit.

Study revealed that okra seed germinability was suscesptable to allelopathy of the trees being maximum to that of blue green tree. Leaf leachates of individual tree (Australian wattle or Blue green tree) and their combination (Australian wattle + Blue green tree) stopped entirely emergence of plumule but not radical. Germination percentage dropped from 80% in plain water to 12.5% in blue green tree leaf leachate, 52.50% in Australian wattle leaf leachate and 37.50% in their combinnned leaf leachate.

TOMATO

D. Barman, C.K. Sharma and L.C. De

Twenty nine exotic accessions of tomato were evaluated.

Bacterial wilt : Initial observations on plant mortality due to bacterial wilt indicated that plant mortality was always more in rainy(43.75-82.19%) and summer season (35-41-81.25%) than in winter (15-59.88%). Thus EC 89248 for rainy, EC 163711 for summer and EC50559 and 89259 for winter season were best for minimum loss of fruit yield due to plant mortality.

Fruit yield : Furit yield in terms of number of fruits/plant indicated that fruit yield in all the accession had dropped from 14-35 during winter to 5-18.33 during summer season. EC-89259 followed by 177669.in summer and 76915 followed by 52060 in winter seasons were found to be the highest yielder.

Garlic

C.K. Sharma, D. Barman and L.C. De.

Influence of bio-mulches on growth and development.

Preliminary results indicated that mulches were significantly useful for better plant height, more nos of cloves/bulb yield and lesser stress of weeds. Bulb under litchi, Australian wattle and Madurai shade tree mulches were significantly heavier (4.33-4.75 g) than those under remaining mulches and no mulch. Australian wattle and litchi mulches gave markedly higher bulb yield (254.64-238.74 gm/m^2) than that of no mulch, mast and Madrai shade tree mulches. Australian wattle mulch resulted in appreciably more number of cloves/bulb (10.57) over that of control, mast and Madhurai shree tree mulches. Plants under all mulches barring Australian wattle mulch were always taller (38.09-38-38.71 cm) than those under no mulch. Weeds under no mulch condition appeared to be heavy robber of soil as was clear from their significantly more dry weight over that of mulches. However, mulches attempted appeared to be of no use for remaining agronomical characters of the crop (bulb diameter, bulb length, soil moisture retention) in this preliminary trial.

Effect of different levels of foliage retention on growth and development of bulb.

Preliminary analyzed data on various characters of growth and developmennt of bulb indicated that retention of minium three leaves/plant was essential for bulb formation while retention of 5 or all leaves was must for further full growth and development of bulb. There was significant reduction in clove production in number per bulb from 15.17-17.67 in 5 or all leaved plants to 7.76 in three leaved plants. Similarly, bulb weight(gm) also markedly declined from 4.69-5.16 gm in 5 or all leaved plants to 1.54 gm in three leaved plants. Consequently, bulb yield/6 plants also appreciably reduced from 337-371.5gm in 5 or all leaved plants to 110.88 gm in three leaved plant. Five or all leaved plants also produced numerically longer bulb of more diameter than three leaved plants. However, appreciably more heavier bulb and more yield was obtained from all leaved plants only.

Standardization of optimum month of harvesting for green garlic production

Average data from third year trial on this aspect confirmed that third month after planting date was appropriate month for green garlic harvest. In third month of planting date, plants were adequately tall (41.71cm) having 7.04 nos. of leaves of 33.71cm length and 1.10 cm width bearing greenish bulb of 3.44 gm weight. Green garlic bulb yield at 72 plant population in a square plot in third month was 247.68 gm with exclusion of green leaves while alongwith leaves (green garlic sold alongwith foliages) yield was 3941.72 gm. After 3rd month of planting date, new leaf formation was rare and leaf lengthening ceased, they advanced to senescence and bulb became white in fourth month. Green garlic harvest could be extended upto 15th of fourth month.

It was also observed that (a) garlic kept on vigourously growing upto 3rd month of planting date and then growing process slowed down. (b) Clove primordium occured only in second month (c) bulb formed in third month and kept on increasing in length, girth upto mid of 5th month (d) after mid off 5th month, there was no growth and leaves started drying up.

FLORICULTURE

C.K. Sharma, D.Barman and L.C. De

Tuberose

Effect of split doses of nitrogen on growth and flowering of tuberose (*Polianthus tuberosa* L)

Data collected on various floral and vegetative traits revealed that splitted form of nitrogen application was beneficial for amelioration in maximmum traits barring a few (earlier flower spike emergence and higher planting stock).

Among splitted nitrogen application, 25% at planting time and 75% after one or three month of planting was best for earlier maximum floral spike yield (Nos of floral spike yield m^2 : 25.33-28.33)by 50% at planting time and 50% after 3 months of planting (Nos of floral spike yield m^2 : 26.33). However, mximum number of floral spike (28.33) of maximum

spike and ratches length were harvested from 75% nitrogen application after one month. No considerable decline in remaining important characters of floriculture interest (ratches length, nos of florets/apike, corolla tube length, petal and width length) were found to exist between above ways of nitrogen application and remaining ones. Hundred per cent nitrogen application at planting time yielded maximum bulb yield (Nos of bulb m^2 185).

Effect foliar application of nitrogen .

Among various ways of standard dose of nitrogen (200 kg/ha) application (soil or foliar and their combinations) 25% by soil and 75% by foliar application was observed to be the best for harvest of maximum quantity of longest (101.14 cm) flower spike/square metre (Nos of floral spike m^2 : 27.43) alongwith longest ratches (14.79 cm) and maximum number of floret/spike (27.16). Next best was of nitrogen application in order was hundred per cent nitrogen application by foliar application wherein no considerable deterioration in flower spike quantity (nos of flower spike m^2 : 25.43), spike length (100.60 cm), corolla tube length (4.02 cm) and nos of florets/spike was recorded. Hundred per cent nitrogen application by soil was found better in respect of certain traits including spike yield over some combination of soil foliar applications. Same was also noted best for maximum harvest of planting stock (nos of bulbs/m^2:77.43).

Effect of bio-fertilizer (Phosphobacterin) on growth, planting stock and flowering.

Phosphobacterin in combination with NPK and FYM (NPK+FYM+Phosbacterin culture) promoted earlier flower spike emergence, increased number of leaves/ plant and enhanced spike length.

Standardization of optimum combination of level of micro-nutrients.

Among various level combinations of micro-nutrients, following micro nutritional combinal order of Zinc Sulphate+Boric acid + Sodium molybdate were found economical for that characters given below:

Level combination of Micro-nutrients	Character
1500 + 400 + 150 mg/m_2	Enhanced floral spike yield (Nos of floral spikes m^2 : 15.67) and earlier flower spike emergence (within 77 days)
500 + 400 + 150 mg/m^2	Enhanced planting stock (Nos of bulb m^2 : 75.33)
500 + 200 + 100 mg/m^2	Longer floral spike (spike length : 83.48 cm)
500 + 100 + 150 mg/m^2	Longer ratch (14 cm) with more nos of floret (25.96)
500 + 200 + 100 mg/m^2	Longer corolla tube (4.50 cm)
500 + 200 + 200 mg/m^2	Wider petal (0.70 cm).

Standardization of optimum spike length for longer vase life

Among various length, floral spike length of 60 cm was found best for longer vase life with floret opening for longer period with 32.66 nos of florets opened and 98 nos of unopened florets for blooming further. But nos. of florets opened in full floral spike kept fresh for longer and florets kept on flowering upto end. Full length floral spike also appeared more fresh and nos. of florets kept longer and florets kept on opening upto end. Shortening floral spike length below than 60 although retained more nos of unopened florets (some where more and some where little less) but most of them almost ceased to bloom and dropped unopened.

Standardization of optimum harvesting stage of floral spike for longer vase life

Preliminary data on above aspect of experimentation suggested that floral spikes with creamy white floret bud or one floret opened were best for longer vase life while with green or greenish white floret bud were excellent for distant marketing. Florets on Two floret opened harvested floral spikes opened quickly in more number and in lesser days with their quicker subjection to senescence them on floral spikes containing greenish or greenish white floret buds.

Chrysanthemum

D. Barman, C.K. Sharma and L.C. De.

Germplasm evaluation : Thirteen chrysanthemum accession/varieties were evaluated. KS-5 and KS-17 were seen to be highest flower yielder . Yellow anemone and pompon KS 10 and KS 17 were also found good for flower yield bedding and pot culture.

All characters pertaining to growth and flowering of all four varieties barring a few were benefitted by enhanced dose/ level of nitrogen but difference between some higher and lower doses of nitrogen did not appear to be pronounced.

Germination percentage, length of plumule and raddicle of sown annual chrysanthem seeds at 5 and 11 days interval indicated that increasing exposure of seeds to leaf leachate of Australian wattle and resulted in lowering seed germinability and reducing growth of plumule and radicle with maximum exposure (14 hours).

Seed germinability droppd from 57.25 and 61 in zero hours exposure to 3.67 and 9.67 in 14 hours exposure at 5 and 11 days interval respectively. Similarly, plumule length at 5 and 11 days interval reduced to 1.16 and 2.60 cm in zero level exposure to 0.64 and 1.64 , respectively under 14 hours exposuure. Radicles ceased to grow in length beyond 0.67-0.75 cm in case of seed exposure to leaf lachata for 14 hours.

Gladiolus

D.Barman, C.K. Sharma and L.C. De.

Cormel production efficiency of 50 varieties of gladiolus in terms of percentage was studied based on number of corms planted and number of cormels produced by planting 348 corms of all varieties under similar agronomical practices.

From 348 corms of 50 gladiolus varieties gave 4224 cormels/daughter corms of all varieties. Cormel production efficiency in all varieties ranged from 0-58%. Cormel production efficiency resulted into 3 categories.

Highly cormel productive varieties : RCG-2, Tropic Seas, Sunset, American Beauty, Morelina, Moon Magic, Poonam, Vinkis Glory, Chipper white, Her Majesty, Sylvia, Beleviana ,and Cream white.

Medium cormel productive varieties: Red Majesty, Wine Rose, Powder Puff, Summer Pearl, Dresdon Poll, RCG-4, Blow Lilia and Snow Princes.

Low comel productive varieties : Apple Blossom, Pacifica, Oscar, Apsara, Big Time Supreme, P-2, Blue Lilac, Sapna, RCG-3, RCG-1, 56, Tiger Flame, Sunset Sky, Baverty Anne, Thombolina, Friendship.

AGROFORESTRY

M Datta

Growth performance of tree species

Basal girth (BG) at 10cm from the ground girth at breast height (GBH) at 1.2m from the ground and height of multipurpose tree species as recorded in the abroratum are presented here under.

Table 7. Average growth parameters of tree species

Tree Species	Basal girth (cm)	Girth at breast height (cm)	Height (m)
Acacia auriculiformis	67.96	52.53	13.84
Leucaena leucocephala	22.57	17.96	6.65
Samania saman	59.58	46.13	7.72
Dalbergia sisso	32.70	26.78	6.46
Azadirachta indica	33.38	23.61	5.00
Eucalyptus hybrid	50.83	41.33	12.46
Michelia champaca	41.53	34.49	6.89
Gmelina arborea	69.43	56.55	10.91
Tectona grandis	41.83	34.08	7.79
Morus alba	26.77	19.54	4.65
Glyricidia maculata	26.68	20.85	5.62
Albizzia lebbek	47.2	37.55	7.48
CV (%)	35.15	36.36	35.19

After 8 years of tree planting, *Gmelina arborea* attained the maximum BG (69.43 cm) and GBH (56.55cm) followed by *Acacia auriculiformis, Samania Saman, Eucalyptus hybrid, Albizzia lebbek* and *Michelia champaca*. The lowest girth was noted in *Leucaena leucocephala*. On the other hand, *Acacia* attained the maximum height (13.84 m) followed by *Eucalyptus, Gmelina, Tectona, Samania* and *Michelia. Morus alba* had the lowest height (4.65 m). Coefficient of variation (35.15 to 36.36%) was more or less same in all the three growth parameters noted among the forest tree species.

Predicition of biomass productivity

Leaf, twig and branch biomass were estimated for 20 tree samples in each tree species and correlated with their growth parameters. Besides *Glyricidia, Samania, Tectona, Albizzia* and *Dalbergia*, correlation of biomass with growth parameters were significant in all other tree species. Regression equations to estimate the productivity of fresh biomass in tree species were also worked out.

Regression models could account 54.3 to 67.2, 77.3 to 89.3, 46.6 to 59.5, 48.2 to 53.8, 49.5 to 82.9 and 52.2 to 76.7 per cent variation in biomass productivity of *A. auriculiformis, L. leucocephala, A. indica, E. hybrid, M. champaca* and *M. alba* respectively. Basal girth at breast height and height combindly gave a good fit for the regression models computted for forest tree species. In the remaining 6 tree species, regression models were not significant accounting only 2 to 26 per cent variation in biomass productivity.

Production of firewood

Forest tree species on pruning could produce a variable quantum of firewood

G. arborea produced the maximum amount of firewood (12.6 t/ha) followed by *Acacia* (8.3t/ha) and*Samania*, (7.9t/ha). *Eucalyptus, Michelia* and *Tectona M. Alba* was not pruned and *G. Maculata* could not produce a sizeable quantity of firewood.

Sunlight intensity under the shade of tree species

Under the shade of forest tree species, light intensity was measured both before and after pruning.

A wide variability in light intensity was noted under the shade of forest tree species before their pruning. Pruning increased the light intensity and only 8.2% coefficient of variation was observed in tree species. In comparison to open space, 47.7% light was, on an average available in tree species before pruning but light availability was increased to 84.1% after pruning.

Maintenance of silvi-horticultural system

In the interspaces of 12 tree species, pineapple (cv.Kew) was planted. Assam lemon was also planted in 1994.

Table 8. Average growth parameter of Assam lemon

Tree Species	Diameter (mm)	Hight (cm)	No. of branches/ lemon plant
Tectona grandis	2.63	83.92	9.4
Acacia auriculiformis	2.98	119.17	14.4
Mean	2.81	101.55	11.9
CV (%)	6.2	17.4	21.0

It is observed that Assam lemon planted in the interspaces of *T. grandis* and *A. auriculiformis* showed enhanced growth in the letter (Table 8).

Growth parameters of bamboo species.

Out of 7 bamboo species, No1 Barak attained the maximum height (12.9 m) followed by Mritinga, Makal, Konkiss etc. The highest and the lowest girth were noted in Mritinga and Muli respectively. Muli though possessing the lowest girth and height showed the highest internode distance (31.5 cm).

POULTRY

S.K. Nanda

Improvement of While leghorn strains : Two whiteleghorn strains were subjected to selection under Tripura climatic condition during the current year. The parenters measured for selection were egg number upto 280 days of age, egg weight at 40th week of age, age at sexual maturity and body weight at 20th and 40th weeks of age. The selection of superior individuals were made utilising family index. The mean values of different traits are presented(Table 9). The egg number upto 280 days of age were 83.3 and 79.8 respectively for IWH and IWI strains with egg weight of 50.5g and 50.2g respectively. The age at sexual maturity declined very less with improvement of egg numbers and were 155 and 160 days for IWH and IWI strains. The body weights were 1280 and 1785 for IWH strains in 20th and 40th week of age and were 1230 g and 1792g respectively for IWI strain.

Performance of broiler strains under Tripura climate : Two pure breed broiler strains of male and female lines were subjected to selection in Tripura climate during the current year. The body weight at 6th, 8th and 10th week alongwith mortality and FCR were measured for each line. (Table 10) The male line showed superiority over the female line in growth survivability and FCR. The females of each line showed less growth rate than the males. The 6th, 8th and 10th week body weights of males were 1240 g, 1695g and 2080g respectively and of females

Table 9. Mean value of different parameters of White leghorn strains

Year/strain	Egg no.upto 280 days of. age	Av.egg wt. (gm)	Agg at sexual maturity (days)	Body weight at 20th week (gm)	Body weight at 40th week (gm)
IWH	83.3	50.5	155	1280	1785
IWI	79.8	50.2	160	1230	1792

Table 10. Performance of broiler strains under Tripura climate

Year/genetic group	Body weight 6th week M (gm)	Body weight 6th week F (gm)	Body weight 8th week M (gm)	Body weight 8th week F (gm)	Body weight 10 week M (gm)	Body weight 10 week F (gm)	Mortality (%)	FCR
Pure breeds								
Male line	1240	1180	1695	1623	2080	1950	4.95	2.48
Female line	1200	1153	1591	1504	1910	1835	5.12	2.53

were 1180, 1623 and 1950g respectively of male-line and 1200 g, 1591g, 1910g of males of females line and 1153g, 1504g and 1835g of females of line.

The hatchability out of total eggs set were 97.97% for IWI whiteleghorn strain, 97.30% for IWI WLH strain, 67.84% for Broiler Male-line and 72.82% for Broiler female line respectively. The broiler male and female lines procured from Bareilly and Hyderabad were 67.09% and 62.73% respectively.

Farm management and maintenance: Two strains of egg type chickens and four strains of meat type chickens were maintained reproduced and subjected to further selcetion and improvement. Routine vaccination, preventive and curative measures were takenup to reduce, mortality and improve health. Regularity of feeding and proper feed could not be maintained due to non availability of feed ingredients in Tripura.

One hundred twenty five whiteleghorn chicks were sold to Divyodaya K.V.K. Chebri and 519 sold for breeding purpose. 227 breeding whiteleghorn cocks were sold and 62 broiler chicks were sold for breeding purpose.

CATTLE

Parasitic infestation

Subrata K Ghosh

A small crossbred cattle farm has been maintaining in our livestock farm under semi-intensive system of farming. Cattle were found heavily infested with ticks which caused itching, irritation and emaciation which ultimately reduced the production level of milk in milching cow in the cattle farm of the centre. The skin damage caused by the ticks was further aggravated by some secondary bacterial infection. Among the ticks collected *Boophilus microplus* was the predominnt ticks recorded during August to September. All the infested cattle was treated with Butox(R) (Deltamethrin) at a concentration of 25 ppm (2 ml/litre of water) locally with two consecutive treatment with an interval of 10 days and was found highly effective against *Boophilus microplus*. This drug made the animals completely free from tick infestation within 15 days.

For endoparasitic infestation, regular de-woming was being done.

Reproductive performance

During the period from March'95 to February'96, 8 calving were obtained and all were single calving and parturition was normal. Of 8 calves born, the male and female calves were 1 and 7, respectively which was highly profitable for milching cow. The average gestation period was 279 days. Natural service was given to the cows because of lack of facility for artificial insemination. The average post partum period was 58 days. The average natural service per conception was 2. Only one cow of about 5 years old having one calf was not coming in heat since 5 months after parturition. A large cyst on the left ovary was palpated on perrectal examination but the other genitalia and right ovary were normal and luteal cyst was confirmed by repeated perrectal examination. Lutalyse (R) (Dinoprost, 5mg/ml) was given intramascularly twice @ 5 ml per injection on 11 days interval and natural service was given 12 hours after standing heat. The pregnancy was confirmed 50 days after natural service and the cow is now pregnant.

GOAT

Productive and reproductive traits

Subrata K. Ghosh

During the year under report 11 kiddings obtained (single kidding 5 and twin kidding was 6) but there was no triplet kidding. All the kiddings were normal.

Out of 11 kiddings, 6 kiddings were obtained during the winter season and 5 during the summer and rainy seasons. Of 17 kids born, the number of male and female kids were 6 and 11 respectively. The average gestation period was 148 days.

Average birth weight of the kids born during the winter season was more than the kids born during the summer and rainy seasons. The average birth weight of the kids born during the winter and the summer and rainy seasons irrespective of sex were 1.17 and 1.05 kgs, respectively. The average birth weight of male and female kids were 1.15 and 1.09 kgs, respectively. The average birth weight of kid born in single kidding was more than the twin kidding irrespective of sex.

Parasitic infestation

A total of 20 skin scrapings were taken from 20-different goats for diagnosis of skin infection. Out of 20 samples, 14 samples were positive for mange infestation and identified as sarcoptic mange. All the positive animal had been treated with ivermectin (1% w/v) @ 0.1 ml/ 5 kg body weight subcutaneously and the same dose was repeated 10 days after first injection. The treated goats became symptom-less 20 days after first dose of treatment. Skin scraping from all the treated goats were taken 15 days after the second dose of treatment and did not find any positive case. For endoparasite, routine deworming was being done.

TRANSFER OF TECHNOLOGY

P.K. Sarma, A. Chakravorty, A.S. Singh, T.D. Barman, T.A. Khan and G.P. Kar

Training : On and off campus training were organised among the practising farmers, rural youths and school going students according to their training needs. Altogether 14 courses were conducted in the different field of Agronomy, Agril. Extension. Horticulture, Agril. Engg and Live stock, in which 106 male and 40 female trainees participated out of which ST/SC trainees were 82.

Demonstration : Different types of fruit orchards has been established at K.V.K. farm and the package of practices were exposed to the trainees through demonstration in order to utilised the tilla land under the reporting period. 12 different improved varieties of fruits were planted in different blocks which cover 5.30 ha. out of which most promising crop Amrapalli mango attracted the farmers most.

Summer and winter vegetables were grown extensively and package of practices were exposed to the farmers. The promising hybrid variety of tomato 'Madhuri', Rye (Manipuri) and Knol Khol White Viena performed well on the tilla land of South Tripura condition. The average yield of these crops were 49t/ha, 7t/ha and 30t/ha respectively.

As a soil and water conservation measures for appropriate land use system, topographic survey was initiated and 7 Micro-watershed were developed covering an area of 10.77 ha. The area of each micro-watershed were being used in mixed cropping pattern and exposed to the farmers through demonstration.

In fishery 0.17 ha. water area were utilised for integrated fish farming system with livestock. Both exotic and indegenious crops were introduced and demonstrated to the trainees along with application of micro nutrients to get more fish production.

The livestock unit comprising cattle (heifer-Holstein-1 and Jersey-1), (cow - Jersey-2 and calf-2), piggery (Hampshire-2), goats (Black Bengal 41) and poul-try (WLH-66) were reared and management practices were demonstrated to the farmers. So far 24 farmers adopted the techniques of hatching of eggs.

First Line Demonstration : Three first line demonstrations were initiated under Kharif with ground nut, sesamum and soybean. In all 104 demonstrations (48 on groundnut, 53 on sesamum and 3 on soybean) were conducted covering an area of 25.7 ha. The average yield of ground nut, sesamum and soybean were 9.6 qtl/ha, 4.3 qt/ha and 4.2 qt/ha respectively.

Diagnostic Services : Twenty seven diagnostic services were organised at KVK farm and farmers field. The farmers expressed their farming problems which were solved by staff and scientists of KVK and the centre.

Other Extension Activities :

Five hundred thirty one farmers visited the KVK to collect inputs and discussion of problems related to various farming systems. Two radio talks were also delivered on groundnut and mustard cultivation.

PUBLICATION

Datta, M : Response of Mung Beans (*Vigna radiata*) to phosphate application in Ultisol of Tripura - I.P-Availability Indices, *J. Indian Soc. Soil Sci.* 42: 588-591.

Datta, M: Response of Mung Beans (*Vigna radiata*) to phosphate application in Ultisol of Tripura - II. Quantity Intensity Relation, *J. Indian Soc. Soil Sci.* 42 : 591-594.

Datta, M and Laskar. S: Influence of phosphate enriched poultry manure on rice- groundnut rotation in an acid soil of Tripura. *J. Hill Research,* 8 : 125-127.

Sharma, C.K., Barman, D., Singh, I.P. and De, L.C. Effect of spacing on Tuberose (*Polianthus tuberosa* L). *J. Hill Res.* 8 : 271-273.

M. Datta : IV th Binnial conference Aagaratala 18.2.95 organised by Tripura Chemical Society.

Distinguished visitors

Name	Designation	Date
Sh. Sudhir Ranjan Mazumder	M.P.	07-06-1995.

वार्षिक - प्रतिवेदन

1995-96

मुख्य उपलब्धियां

विषय सूची

मेघालय

भारतीय कृषि अनुसंधान परिषद की एक इकाई के रूप में उत्तर पूर्वी पर्वतीय अनुसंधान परिसर की स्थापना वर्ष 1975 में हुई जिसका मुख्यालय प्रारंभ में मेघालय की राजधानी शिलांग में बनाया गया तथा वर्ष 1991 में इसे बड़ापानी में ले आया गया जहां कि परिसर का मुख्य अनुसंधान प्रक्षेत्र स्थित है। यह संस्थान, परिषद के संस्थानों में एकमात्र ऐसा शोध संस्थान है जहां पर कृषि, बागवानी, पशु विज्ञान, मत्स्य पालन तथा कृषि अभियांत्रिकी पर शोध कार्य किया जा रहा है ताकि पूर्वोत्तर क्षेत्र की कृषि समस्याओं को समग्र रूप में जाना जा सके और यहां की अनुसंधान आवश्यकताओं की पूर्ति की जा सके। पूर्वोत्तर के पर्वतीय राज्यों के अतिरिक्त सिक्किम को भी इस संस्थान के अंतर्गत सम्मिलित किया गया है। इस संस्थान के 6 केंद्र पूर्वोत्तर के विभिन्न राज्यों में खोले गए है जो कि बसार (अरूणाचल प्रदेश), इंफाल (मणिपुर), कोलासिब (मिजोरम), झरनापानी (नागालैंड), टडौंग (सिक्किम) तथा लेम्बूचेरा (त्रिपुरा) में स्थित हैं। इसके अतिरिक्त विभिन्न अनुसंधान केंद्रों से समबद्ध कृषि विज्ञान केंद्र भी तकनीकी प्रचार व प्रसार में सतत संलग्न है। समस्त पूर्वोत्तर पर्वतीय राज्यों की अनुसंधान आवश्यकताओं की पूर्ति के लिए झरनापानी (नागालैंड) में एक प्रशिक्षक-प्रशिक्षण केंद्र की भी स्थापना इस संस्थान के अंतर्गत की गई है। विभिन्न कृषि जलवायवीय खंडों की कृषि समस्याओं व जरूरतों को जानकर उनका निदान खोजने के उददेश्य के तहत इस संस्थान के केंद्रों को अलग अलग उंचाइयों पर स्थापित किया गया है जिसमें बड़ापानी समुद्र सतह से 980 से 1080 मीटर की ऊंचाई पर स्थित है तो झरनापानी 500 से 550 मीटर की ऊं चाई पर। त्रिपुरा का लेम्बूचेरा स्थित केंद्र 60 से 75 मीटर ऊँचाई पर स्थित है तो वहीं सिक्किम का टडौंग स्थित फार्म 1200 से लेकर 1400 मीटर तक की ऊँचाई पर बसा हुआ है। अरूणाचल में स्थित बसार व मिजोरम का कोलासिब फार्म 750 से लेकर 800 मीटर तक की ऊँचाई पर अवस्थित हैं।

अनुसंधान केंद्रों की स्थापना संपूर्ण पूर्वोत्तर पर्वतीय क्षेत्र को एक इकाई मानकर की गई है और केंद्रों की स्थापना करते समय इस बात को ध्यान में रखा गया है कि इस संपूर्ण क्षेत्र के कृषि जलवायवीय खण्डों तथा विभिन्न ऊँचाई पर स्थित भू-स्थलों को उचित प्रतिनिधित्व मिल सके और वैज्ञानिकों को दोहरे कार्य से बचाकर गहन अनुसंधान के लिए उनका विवेकपूर्ण उपयोग किया जा सके और साथ-साथ संस्थान द्वारा खोजी गई महत्वपूर्ण उपलब्धियों का इस क्षेत्र के सभी राज्यों के लिए ऊँचाई व भूस्थलाकृति के आधार पर समुचित प्रयोग किया जा सके। बड़ापानी स्थित मुख्यालय का 101 हेक्टेयर का फार्म अधिकतर पहाड़ी ढलानों पर स्थित है जो कि 25^0 30^0, उत्तर तथा 91^0 51^0 पूर्व में गुवाहाटी शिलांग रोड तथा उमरोई रोड के संगम पर स्थित बड़ापानी डाइक (प्रकृतिक झील) से

लगभग 1.5 कि. मी. की दूरी पर स्थित है। शिलांग शहर से इस स्थान की दूरी लगभग 22 कि.मी. है। इस जगह की भू-स्थलाकृति कहीं पर मध्यम से तीव्र ढलान वाली तो कहीं पर सपाट घाटीयुक्त है जो कि सभी प्रकार की भू-स्थलाकृति का प्रतिनिधित्व करती है। इन पहाड़ियों पर मृदा एवं जल संरक्षण के लिए अनेक प्रकार के उपाय किए गए हैं जिनमें मध्यम ढलान वाली भूमि पर बैंच टैरेस, तीव्र ढलान वाली पहाड़ियों पर कंटूर बंडिंग तथा अर्ध चंद्राकार वेदिकाएं बनाई गई है। वर्षा के पानी को कृषि कार्य के लिए उपयोग में लाने के लिए मिट्टी के बांध बनाए गए है तथा खाइयां (ट्रैंचेज) बनाई गई है। वर्तमान में खेती के अंतर्गत 60 हेक्टेयर भूमि का उपयोग किया जा रहा है। इस संस्थान के प्रमुख उद्देश्य निम्न हैं :

1. विभिन्न कृषि जलवायवीय खंडों तथा आर्थिक-सामाजिक दशाओं में स्थाई खेती पद्धतियों को विकसित करना तथा प्रचलित पद्धतियों में सुधार लाना।
2. खाद्यान्न फसलों, पशुधन तथा मत्स्य पालन में सुधार लाना तथा कृषि उत्पादकता बढ़ाने के लिए संसाधनों के प्रबंधन के लिए स्थानीय लोगों में दक्षता विकसित करने के लिए उन्हें प्रशिक्षण प्रदान करना।
3. भविष्य की योजनाओं के लिए आंकड़ों का रखरखाव, विश्लेषण तथा उनका प्रक्षेपण (प्रोजेक्ट) करना।
4. समुन्नत खेती तकनीकों का इस क्षेत्र में परीक्षण करना तथा उनके प्रसार के लिए राज्य सरकारों के संबंधित विभागों के साथ सहयोग करना।
5. अद्यतन तकनीकी प्रशिक्षण केंद्र के रूप में कार्य करना।
6. पूर्वोत्तर पर्वतीय क्षेत्र की विभिन्न खेती पद्धतियों के सूचना संग्रहणालय के रूप में कार्य करना।
7. उपरोक्त उद्देश्यों की प्राप्ति के लिए राष्ट्रीय तथा अंतराष्ट्रीय संस्थाओं से सहयोग करना।
8. कृषि से संबंधित सलाह व सूचनाएं प्रदान करना।

आठवीं पंचवर्षीय योजना के दौरान अनुसंधान के निम्न लक्ष्यों पर प्रमुख रूप से विशेष ध्यान दिये जाने की योजना है।

* पूर्वोत्तर क्षेत्र के पर्वतीय इलाकों के लिए उपयुक्त एकीकृत खेती पद्धति का विकास करना ताकि झूम खेती की प्रचलित पद्धति को बदल कर बढ़ती उत्पादकता प्राप्त की जा सके।
* सिट्रस (निंबु कुल) वृक्षों में सुधार लाकर इस उद्योग की पुर्नस्थापना।
* विभिन्न पशुधनों के लिए खाद्य व चारा संसाधनों का विकास जिसमें स्थानीय संसाधनों पर आधारित खाद्य व चारा सम्मिलित करने को प्रमुखता प्राप्त हो।
* धान्य, दालों, तिलहनों, बागवानी तथा अन्य आर्थिक फसलों पर अनुसंधान करके विभिन्न प्रकार की फसलों की संपूर्ण उत्पादकता में बढ़ोत्तरी लाना।
* पशु स्वास्थ्य पर उचित ध्यान देना तथा पशु धन उत्पादन प्रणाली में सुधार लाना।

कृषि संबंधित विभिन्न विषयों पर अनुसंधान के लिए संस्थान में 15 विभिन्न विषयों पर अनुसंधान कार्य जारी है जिसमें 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 सम्मिलित हैं। इसी प्रकार उपरोक्त विषयों पर वर्तमान में 32 शोध परियोजनाओं पर कार्य किया जा रहा है। संस्थान में कुल कार्यरत अधिकारियों कर्मचारियों की संख्या 610 है। संस्थान की स्टॉफ संख्या नीचे दी जा रही है।

वर्ग	स्वीकृत	भरे	रिक्त
वैज्ञानिक	192	91	101
तकनीकी	326	262	64
प्रशासन	167	126	41
ऑक्जीलरी	96	66	30
सपोर्टिगं	149	145	4
कुल	930	690	240

संस्थान परिसर में एक अधुनातन शोध पुस्तकालय भी स्थापित है जिसमें अब तक 13,791 पुस्तकें, प्रतिवेदन, बुलेटिन तथा श्रंखला प्रकाशन के 7045 पिछले वॉल्यूम्ज उपलब्ध है। 42 विदेशी तथा 122 भारतीय जर्नल पुस्तकालय में इस वर्ष के दौरान मंगवाई गयी। पुस्तकालय अपने वैज्ञानिकों तथा अन्य आगंतुक सदस्यों को नियमित सेवायों प्रदान करता है।

पुस्तकालय ने एन.आई.एस.एस.ए.टी. परियोजना के अंतर्गत विज्ञान व तकनीकी निदेशालय दिल्ली से प्राप्त सी डी एस/आई एस आई एस (बर्जन 3.01) पैकेज पर आधारित डाटा बेस विकसित करना भी प्रारंभ किया है। इसके साथ ही 6 स्थानीय व राष्ट्रीय दैनिक पत्रों की सहायता से "पूर्वोत्तर भारत के पर्यावरणीय ह्रास" पर कम्प्यूटरीकृत आंकड़ों के संचयन का कार्य भी प्रारंभ किया जा चुका है। पुस्तकालय "निकनेट" से संबद्ध होने के कारण अपने वैज्ञानिकों को आई.ए.एस.आर.आई. दिल्ली में उपलब्ध अंतराष्ट्रीय डाटा बेस सूचना सेवाएं भी प्रदान करने में सक्षम है तथा ई-मेल सेवायें भी पुस्तकालय से प्रदान की जा रही हैं।

वर्ष 1995-96 के लिए संस्थान का बजट इस प्रकार है:

बजट	आवंटित	व्यय
योजनागत (प्लान)	225.00	208.31
योजनेतर (नॉन प्लान)	572.33	580.46

राजभाषा कार्यान्वयन के लिए संस्थान में हिंदी प्रकोष्ठ स्थापित है जो कार्यान्वयन के साथ साथ कर्मचारियों को निजी स्तर पर हिंदी प्रशिक्षण देने का प्रयास कर रहा है। वर्ष के दौरान राजभाषा गोष्ठियां, हिंदी सप्ताह का आयोजन तथा कार्यशालाओं का संचालन भी किया गया। इसके साथ ही वैज्ञानिकों को अपने लेख हिंदी में लिखने की ओर अभिप्रेरित करने के उद्देश्य से "पूर्वोत्तर पर्वतीय कृषि" नामक विशेषांक भी प्रकाशित

किया गया जिसमें कई वैज्ञानिकों ने अपने लेख हिंदी में प्रस्तुत किये। इसके साथ ही फल-फूल, खेती व कृषि चयनिका में भी वैज्ञानिकों को लेख लिखने की ओर अभिप्रेरित करना तथा इस कार्य में अनुवाद व टंकण की सुविधा प्रकोष्ठ द्वारा प्रदान की जा रही है। इस वर्ष केंद्रीय सचिवालय हिंदी परिषद द्वारा आयोजित विज्ञान लेख प्रतियोगिता के अंतर्गत संस्थान के वैज्ञानिकों को पुरस्कृत किया जा चुका है। राजभाषा हिंदी के प्रति कर्मचारियों की रुचि विकसित करने के लिए 1500 हिंदी पुस्तकें उपलब्ध हैं तथा दैनिक हिंदी समाचार पत्र व पत्रिकाएं भी मगंवाई जा रही हैं।

प्रस्तुत वार्षिक प्रतिवेदन, वर्ष1995-96 की अवधि में संस्थान में किए गए अनुसंधान, परीक्षण तथा प्रसार गतिविधियों का एक रामग्र विश्लेषण है जिसमें केंद्रों तथा कृषि विज्ञान केंद्रों में किए गए कार्य को भी सम्मिलित किया गया है। अनुसंधान से प्राप्त मुख्य उपलब्धियों को हिंदी में सारांश के रुप में नीचे प्रस्तुत किया जा रहा है।

मुख्य उपलब्धियां

प्रतिवेदित अवधि के दौरान बड़ापानी में 180 वर्षा दिवसों में कुल मिलाकर 2433.7 मि. मी. वर्षा रिकार्ड की गई । कुल वर्षा का 91 प्रतिशत मई से अक्टूबर के बीच प्राप्त हुआ। वर्षा की दृष्टि से यह वर्ष फसलोत्पादन तथा उपज के अनूकूल पाया गया। वर्षा की अति तीव्रता के कारण अगस्त में मृदा क्षरण सूचकांक सर्वाधिक पाया गया। भूमि में नमी की कमी अप्रैल माह में सबसे अधिक देखी गई जिसके फलस्वरुप अंत: फसलों में प्रतिबलता (स्ट्रेस) पाई गई। मार्च और अप्रैल में सर्वाधिक धूप (सनसाइन) 7.6 घंटे प्रतिदिन रही। इस वर्ष वायु वेग इतना अधिक नहीं था जिससे खड़ी फसलों को कोई विशेष हानि पहुचें। अत्यधिक मासिक तापमान का मध्यमान जनवरी में 17.2° से. तथा मई में 28.3° से पाया गया। न्यूनतम मासिक तापमान का मध्यमान जनवरी में 5.4° से . पाया गया। फरवरी से लेकर मई तक तापमान में निरंतर वृद्धि पाई गई जो अगस्त तक स्थिर रही तत्पश्चात इसमें गिरावट आई जो कि जनवरी तक जारी रही। अधिकतम व न्यूनतम तापमान जनवरी में सर्वाधिक तथा जुलाई में सबसे कम पाया गया ।

इस अवधि के दौरान धान के 220 जननद्रव्यों का रख रखाव व मूल्याकंन किया गया तथा 17 एकल संकरण भी किये गए और इस प्रकार संकरण से प्राप्त बीजों को संग्रहीत किया गया। एफ$_4$ के 42 तथा एफ$_5$ के 7 धान की किस्मों का निचली भूमि में लगाने के लिए मूल्याकंन किया गया। डी. आर. 92, अंगोबा, बाली, पिन्नी, आई.ई.टी 13481, 13483, 13484, 13485 तथा आर. सी. पी. एल 1-87-8 को धान की संभाव्य किस्मों के रुप में पाया गया। आई.आर.ए.टी. 144 धान में सर्वाधिक हेड राइस रिकवरी प्रतिशत पाया गया जबकि मिलिंग (निष्पीड़न) तथा हुलिंग(तुषीकरण) प्रतिशतता आर. सी. पी.एल.1-87-4 में सर्वाधिक पाई गई। अत्यधिक ऊंचाई वाले स्थानों के लिए आई. आर. 3941-22, मेघालय-1, एन.ई.एच. मेघा-1, एन ई.एच, मेघा-

2 तथा आर.सी.पी.एल. 1-10 को धान की सर्वाधिक अच्छी किस्में पाया गया। आई. आर. आर. आई. की ब्रीडिंग लाइन आई. आर-36 के प्रोटोप्लास्ट विलयन से पुर्न उत्पन्न निषेचित पौधों के आदि रुप (प्रोटोकाल)विकसित किये गए। सामान्य रुप से रोपे गये धान के खेतों में जैव उर्वरक अजोला के एक प्रयोग में पाया गया कि आर. सी. पी.एल. 87-8 में सर्वाधिक उपज प्राप्त हुई। पौधों के बीच 20×30 सें.मी. की दूरी रखने तथा साथ में 1.5 कि.ग्रा. अजोला के प्रयोग से सर्वाधिक उपज प्राप्त हुई। बंड की ऊँचाई का उपज पर पड़ने वाले प्रभाव के एक प्रयोग में पाया गया कि बंड की ऊंचाई 15 सें.मी. रखने पर अधिक उपज प्राप्त होती है। धान के कल्चर आई. आर. ए.टी.144 तथा 1512 को पर्णीय प्रध्वंश (फोलियर ब्लास्ट)के प्रति रोधी व नेक ब्लास्ट इंफेक्शन के प्रति सहिष्णु पाया गया। पर्णीय प्रध्वंश के अन्य प्रतिरोधी संवर्द्धों में आर. सी. पी. एल.1-4 तथा यामुक को पाया गया।

मक्के की अति उपज देने वाली किस्मों में "मेघालय लोकल ह्वाइट", आर.सी.एम.1-1, आर.सी.एम. 1-3, डी.एम.के-वी-126,डी.एम.आर.-वी-149 तथा डी.एम.आर.-वी-158 प्रमुख थी। डी.एम.आर.श्रेणी की किस्मों से सामान्यत: अत्याधिक उपज प्राप्त हुई जो प्रति हेक्टेयर 48.6 क्विंटल से 108.1 क्विंटल के बीच थी। प्रति हेक्टेयर 100 कि.ग्रा. नाइट्रोजन के प्रयोग से मक्के की उपज में उल्लेखनीय वृद्धि देखी गई ।

सामान्य विधि की तुलना में नाली बनाकर (फरो) बीज बोने से अधिक उपज प्राप्त हुई। अन्य किस्मों की तुलना में कॉब बोरर का प्रभाव आर.सी.एम. 1-2 में न्यूनतम पाया गया जो कि 5 प्रतिशत था। अगेती मक्के की फसल जो कि अप्रैल अंतिम सप्ताह में बोई गई हो पर फली बेधक का बिल्कुल भी प्रकोप नहीं पाया गया। मक्के की प्रत्येक दस लाइंस पर सोरघम की तीन लांइस को लगाना, मक्के में कॉब बोरर से बचने का सफलतम तरीका पाया गया ।

अरहर की आई.सी.पी.एल. 90052 तथा आई.सी.पी.एल.90039 किस्में अच्छी पाई गई। राइसबीन की 70 लाइंस का रखरखाव किया गया। उरद की आर.सी.यू.6-1 को सबसे अच्छी किस्म पाया गया। राइसबीन के संपूर्ण फसल काल में इसे नुकसान पहुंचाने वाले लगभग 16 प्रजाति के कीट व व्याधियों का प्रकोप देखा गया। इसके प्रमुख कीट व रोगों में पल्स बीटिल, आलमंड मोथ, कट-वर्म, लीफ रोलर तथा पॉड बग आदि मुख्य रुप से सम्मिलित हैं। जैकबीन के हानिकारक 35 कीट व रोग प्रजातियों में से 19 प्रजातियों के कीट इस फसल को गंभीर रुप से हानि पहुंचाते पाये गए। फ्रेंचबीन की 44 किस्मों की कीट व रोगों के प्रति स्क्रीनिंग की गई जिसमें पोल टाइप को स्टेम फ्लाई के प्रति सहिष्णु पाया गया। मटर की 19 किस्मों की स्टेम फ्लाई के प्रति स्क्रीनिंग में इसका प्रभाव "रचना" में सबसे कम देखा गया।

तिलहनी फसलों के अंतर्गत सोयाबीन की सबसे अच्छी उपज देने वाली किस्मों में जे. एस.80-21, एन. आर.सी. 25, टी.ए.एस. 9203, जे.एस.(एस.एच.) 89-99 तथा एम.ए.सी. एस. 728 को प्रमुख पाया गया। अति ऊंचाई वाले स्थानों पर देर से ली जाने वाली (21 जून के बाद) सोयाबीन की उपज में काफी कमी पाई गई।

मूंगफली के 600 से अधिक जनन-द्रव्यों का मूल्याकंन तथा रखरखाव किया गया जिनसे प्राप्त उपज प्रति हेक्टेयर 143-380 कि.ग्रा. के बीच पाई गई। अर्ली लीफ स्पॉट (अगेती पर्णिल धब्बों) के लिए मूंगफली की 550 लाइंस की स्क्रीनिंग की गई जिनमें से 22 को इसके विरुद्ध प्रतिरोधी पाया गया। मूंगफली की जे. एल. 24, टी.जी. 27 तथा आई. सी. जी. एस. 76 को अति उपज देने वाली किस्में पाया गया।अल्यूमिनियम विषाक्तता के प्रति 100 मूंगफली की किस्मों की स्क्रीनिंग की गई जिनमें आई. सी. जी. वी. 1697, 5305, 86644, 3098, 4747, 76, जे एल.24, टी.ए.जी 24 तथा टी. जी. 22 ने अम्लीय मृदा वाली भूमि में, बिना चूने के प्रयोग के भी अच्छी संभावनाएं प्रर्दशित की। उन्नतिशील प्रजनन गुणों वाली मूंगफली की 62 किस्मों के एक अन्य सेट की भी अल्यूमिनियम विषाक्तता के प्रति स्क्रीनिंग में पाया गया कि आई.सी.जी.वी. 2167, 86742, और 86518 ने अच्छा प्रर्दशन किया। इस प्रयोग के परिणामों से पता चला कि "गिरनार-1" तथा आई. सी.जी.वी. 76 दोनों ही किस्मों ने 600 मि.ली. बॉयोजाइम प्रति हेक्टेयर पर अच्छी संभावनाएं प्रर्दशित की तथा इनसे प्राप्त उपज क्रमश: गिरनार-1 में 20.1 क्विंटल थी। आई. सी. जी. एस. में फलियों की संख्या 18 कि.ग्रा. बॉयोजाइम को दाने के रुप में प्रयुक्त करने पर 24.6 किवंटल प्रति हेक्टेयर पाई गई। "बेसिलस पॉलीमिक्सा" सूक्ष्मजीव के साथ 50 कि. ग्रा. पोटाश (एस.एस.पी. के रुप में)का प्रयोग करने पर मूंगफली में सर्वाधिक फलियां प्राप्त की गई तथा प्रति हेक्टेयर 19.3 कि. ग्रा. उपज पाई गई। अर्ली लीफ स्पॉट के प्रति रोधी मूंगफली की किस्मों में डी. एच.-8, आई.सी.जी.वी.-86031,83252,86259,86388,तथा 86393 को उल्लेखनीय पाया गया। आई. सी. जी. वी. 86259, ए. आई.जे.9211, आई. सी. जी. वाई. 65, आई. सी. जी. एस.। और ए. आई.आई. एस. 9208 को लीफ फोल्डरों से पूर्णतया मुक्त पाया गया जबकि आई. सी. जी. वी. 88390 पर इसका प्रभाव बहुत कम देखने को मिला।

रेपसीड सरसों की "वरुणा" किस्म के 100 एकल पौधों तथा म्युटेंट एम$_{27}$ के 777 पौधों का विभिन्न गुणों की जांच के लिए वरण किया गया जिसमें फलियों व शाखाओं की संख्या, फली लंबाई, प्रति फली बीजों की संख्या तथा प्रति वृक्ष उपज सम्मिलित है। इन गुणों के आधार पर "वरुणा" के 19 तथा म्यूंटेट एम$_{27}$ के 28 पौधों का वरण किया गया। द्रव के रुप में 600 मि.ली. प्रति हेक्टेयर की दर से जैव उर्वरकों को 20:60:40 कि.ग्रा. नाइट्रोजन, फॉस्फोरस तथा पोटाश के साथ प्रयुक्त करने पर एम$_{27}$ तथा टी.एम.-4 से अधिकतम उपज प्राप्त हुई।

सिंचित व वर्षापोषित दोनों ही दशाओं में अलग-अलग दूरी अपनाते हुए सरसों की संभाव्य किस्म एम$_{27}$ पर इन दशाओं के प्रभाव का अध्ययन किया गया जिससे पता चला कि सरसों की उपज में सिंचाई तथा अलग अलग दूरी पर पौध लगाने का महत्वपूर्ण असर होता है। सिंचित फसल से सर्वाधिक उपज 5.28 क्विंटल प्रति हेक्टेयर मिली जबकि वर्षा पोषित दशाओं में यह 4.22 क्विंटल प्रति हेक्टेयर पाई गई। दुहरी कतार की दूरी पर लगाई गई सरसों से सर्वाधिक उपज प्राप्त हुई जो 7.63 क्विंटल प्रति हेक्टेयर थी जबकि प्रति कतार 30 से.मी. की दूरी पर क्रमश: 4.52 तथा 4.30 क्विंटल उपज प्रति हेक्टेयर प्राप्त हुई। दुहरी कतार वाली स्पेसिंग से छिटक कर बीज बोने की तुलना में उपज वृद्धि 118 प्रतिशत अधिक पाई गई।

वर्षाकाल में *राइजोबियम* कल्चर के प्रभावी स्ट्रेन की जांच के लिए किये गए एक प्रयोग में मूंगफली की जे. एल. 24 का वरण किया गया और पाया गया कि इस कल्चर के प्रयोग से फलियों की उपज में वृद्धि होती है। एन.सी.-92 स्ट्रेन के प्रयोग से मूंगफली में प्राप्त सर्वाधिक उपज 21.7 क्विंटल प्रति हेवटेयर थी जबकि सामान्य दशाओं में यह मात्र 14 क्विंटल पाई गई। सिंगल सुपर फॉस्फेट के रुप में प्रयुक्त 60 कि. ग्रा. फॉसफोरस प्रति हेक्टेयर के प्रयोग से मूंगफली में वड़े आकार की फलियां प्राप्त हुई।

फसल पद्यति अनुसंधान के अंतर्गत किए गये एक प्रयोग में पापॅकार्न को मूंगफली के साथ 1:2 के पंक्ति अनुपात में लगाने पर सर्वाधिक मक्का तुल्यांक उपज प्राप्त हुई जबकि इस क्रम में दूसरा स्थान पॉपकार्न व सोयाबीन के संयोग से प्राप्त हुआ।

6 वर्ग मीटर के तालाब में प्रति फसल 5 कि.ग्रा. कंपोस्ट तथा 1 कि.ग्रा. सिंगल सुपर फॉस्फेट को प्रति तालाब प्रयुक्त करने पर प्रत्येक माह में 24.5 कि.ग्रा. अजोला की प्राप्ति हुई जिससे एक हेक्टेयर में 367 क्विंटल अजोला प्राप्त किया जा सकता है जो कि 1468 कि.ग्रा. नाइट्रोजन के तुल्य है।

नींबू प्रजाति के पौधों में 600 ग्राम नाइट्रोजन तथा पोटाश के प्रयोग से प्राप्त फ़लों की संख्या में उल्लेखनीय वृद्धि पाई गई। मंडारिन के बागों में अत: फसलों के एक प्रयोग में अदरक से सर्वाधिक उपज प्राप्त होती दिखाई दी। नींबू प्रजाति की कुछ किस्मों में नये कोपल (फ्लश) , पुष्पावलियों तथा पुष्पों के विशिष्ट लक्षणों तथा जड़ वृद्धि आदि का भी अध्ययन किया गया। नींबू की "*सिट्रस रेटीकुलाटा*" में पोषक जड़ बायोमास सर्वाधिक पाया गया। एक प्रतिशत यूरिया + 50 (पी. पी. एम.) जी. ए. + 0.2 प्रतिशत जिंक सल्फेट के मिले जुले छिड़काव से पौधों की औसत ऊंचाई, प्रति वृक्ष पत्तियों की संख्या, तना व जड़ का व्यास तथा द्वितीयक जड़ें सर्वाधिक संख्या में पाई गईं।

फलों को डंठल के थोड़े से भाग के साथ तोड़ने पर फलों के भार में हाने वाली कमी न्यूनतम पाई गई। इस प्रकार तोड़े गये फलों में

जहां एक ओर कम नुकसान पाया गया वहीं उन्हें 20 दिनों तक अच्छी स्थिति में रखा जा सकता है। नींबू की एक प्रजाति में प्ररोहों के क्रम-प्रसरण का भी अध्ययन किया गया। नींबू के नये बागों से लिये गए "साइन" को कागजी व रंगपो लाइम में कलम करने पर 30 प्रतिशत तक सफलता प्राप्त की गई। "सिट्रस स्केब" को इस क्षेत्र में सबसे खतरनाक बीमारी के रुप में पाया गया जिसे अप्रैल व सिंतबर में 1 प्रतिशत बोर्डो मिश्रण के दो छिड़काव द्वारा निंयत्रित किया जा सकता है। मोनोक्रोटोफॉस (0.07 प्रतिशत)के एक छिड़काव से सिट्रस मिलीबग की जनसंख्या को प्रत्येक प्ररोह में 2 से 24 क्रॉलर तक नीचे लाने में सफलता प्राप्त की गई । *सिट्रस सीलिस, सिट्रस सिला, सिट्रस एफिड, ट्विग बोरर, ट्रंक बोरर* तथा *सिट्रस फ्रूट* बग इस क्षेत्र में नींबू के प्रमुख हानिकारक कीट पाये गए। 15 मार्च से 15 अप्रैल के बीच अमरुद में की गई "पैच-बडिंग" में सर्वाधिक सफलता पाई गई जबकि आडू में सर्वाधिक सफलता 15 अगस्त से 15 सितंबर के बीच "साफ्ट वुड ग्राफ्टिंग" द्वारा मिली।

शाक वर्गीय फसलों में फ्रेंच-बीन की तीन संभाव्य लांइस आर. सी. एफ, पी पी 1, 2 व 3 को पाया गया। पातगोभी की "प्रासड आफ फूली" तथा फूल गोभी की स्थानीय किस्मों ने अच्छा प्रदर्शन किया। कोल फसलों में फॉस्फोरस व पोटाश को 60 कि.ग्रा. प्रति हेक्टेयर की दर से प्रयोग करने पर अधिकतम उपज प्राप्त हुई। कंदीय फसलों के 139 जननद्रव्यों का रखरखाव इस अवधि के दौरान किया गया।

कोलोकेसिया मे आई.बी.एम.293, सी-226 तथा शकरकंद में आर. एस.111-2 आर.एस.111-3 को अति उपज देने वाली किस्में पाया गया। पशुओं के चारे के लिए "पत्ती पत्तियों " को सबसे अच्छा पाया गया तथा तने द्वारा इनका संवर्द्धन भी काफी आसान पाया गया। चारागाहों में *ट्राइकोस्ट्रजीलस* के एल-3 तथा *हीर्मोकस* से क्रमशः 400 से 500 कि.ग्रा. घास प्राप्त की गई।

"*परकिया गेवानिकां*" में अच्छी वृद्धि पाई गई। कृषि-बागवानी पद्यति के अंतर्गत अमरुद के वृक्षों पर दूरी के अंतर का कोई विशेष प्रभाव नहीं देखा गया किंतु अधिक दूरी पर लगाये गए वृक्षों के बीच अंत:फसल के रुप में ली जाने वाली फसल से प्राप्त उपज अधिक पाई गई। अमरुद+ अन्ननास+ हल्दी को साथ साथ लगाने पर भूमि तुल्यांक अनुपात(एल. ई. आर) अधिक पाया गया। कृषि-बागवानी पद्यति के अंतर्गत अलग अलग दूरी पर लगाये गए मंडारिन के फलवृक्षों से प्राप्त उपज में उल्लेखनीय अंतर दिखाई दिया। "एल्डर" वृक्ष की छाया में उगाये गए चाय के वृक्षों में अच्छी वृद्धि पाई गई क्योंकि यह प्रणाली स्वंय में एक अनुकुल सूक्ष्म-जलवायु का सृजन करती है जिससे प्रति हेक्टेयर 5.2 कि.ग्रा. लिटर जड़ बायोमास के द्वारा मृदा उर्वरता में वृद्धि प्राप्त हुई।

रेशम कीट पालन आधारित कृषि वानिकी पद्धति के अंतर्गत टी.आर.-4 तथा टी.आर.-10 को अच्छा पाया गया। संकर चाय की किस्मों में पी $_5$ × के पी जी (बी) तथा एन बी 18 ×पी$_5$ से अधिक मात्रा में रेशम की प्राप्ति हुई जबकि

बीवोल्टाइन नस्ल एन बी-18 तथा एन बी 7 की प्रति इकाई पत्ती से अच्छे किस्म के कॉकूनों की प्राप्ति हुई जिनसे अच्छी किस्म का कच्चा रेशम प्राप्त किया जा सकता है।

रेशम कीट पालन आधारित तीन कृषि वानिकी पद्यतियों का भी अध्ययन किया गया जिसमें फल वृक्षों व घास के साथ रेशम कीट पालन, खेतिहर फसलों के साथ रेशम पालन तथा धान की खेती के साथ साथ रेशम पालन शामिल है।

प्लूरोटस फ्लेबेलेटस (बी) से महीनों तक अच्छी उपज प्राप्त की गई तथा इसे विभिन्न तापक्रम पर उगाया गया। प्लूरोटस प्रजाति की विभिन्न प्रजातियों की मॉइसीलियल वृद्धि के लिए 25° से. तापमान को राबसे अच्छा पाया गया।

बहते पानी में पाली जाने वाली मछलियों की वृद्धि दर प्रति मीटर पानी में स्टॉक वृद्धि के साथ कम होती पाई गई।

किसानों को उन्नत सुअरों के वितरण तथा उनकी गुणवत्ता को बरकरार रखने के लिए उन्नमें अन्त: स्थाने संसर्ग (इंटर-से मेटिंग) करवाया गया। धान भूसी पर पोषित सुअरों का शरीरिक भार अधिक पाया गया जबकि नेटिव घास पर पोषित सुअरों का स्थान इस क्रम में दूसरा पाया गया। पशुओं से पृथक किए गए *सल्मोनेला ऑइसोलेट्स* के एंब्रियोग्राम अध्ययन से पता लगा कि उनमें संवेदना का घटता बढ़ता क्रम पाया जाता है। इस अवधि के दौरान 689 सुअरों के प्रतिदर्शों की जांच की गई जिसमें से 10.15 प्रतिशत को "*ऍस्केरिस सुम*" के प्रति बहुत सकारात्मक (पॉजीटिव) पाया गया।

ब्रॉयलर आहार में 10 प्रतिशत तक राइसबीन चारे तथा मूंगफली के छिलकों का प्रयोग किया जा सकता है। मेघालय में आर्थिक लाभ की दृष्टि से "वेनक्रोब ब्रॉयलर स्ट्रेन " को पाला जा सकता है । अधिकतर *सल्मोनेला आइसोलेट* को जेंटामाइसिन (1मि.ग्रा.) तथा क्लोरेमफीनॉल (30मि.ग्रा.) के प्रति सुग्राही पाया गया।।

प्रथम प्रसव के समय आयु तथा दो प्रसवों के बीच अंतराल में खरगोशों की दो प्रजातियों *न्यूजीलैंड व्हाइट* व "*सोवियत चिनसिला*" के बीच काफी अन्तर पाया गया। खरगोश की इन दोनों नस्लों के गर्भकाल में भी उल्लेखनीय अंतर देखा गया। अंगोरा प्रजाति से प्राप्त ऊन की गुणवत्ता काफी ऊँची पाई गई। जांच किये गए 66 प्रतिदर्शों में सिर्फ 1 को "सल्मोनेला" के प्रति पॉजीटिव पाया गया। तीन विभिन्न आयु वर्गो के 938 प्रतिदर्शो के "*काक्सीडियल इंफेक्शन*" के एक परीक्षण में सिर्फ 25 पशुओं को इससे कम स्तर पर ग्रसित पाया गया। बरुथी (माइट्स) से ग्रसित पशुओं को 50 पी पी एम तथा 75 पी पी एम सांद्रता के ब्यूटॉवस का प्रयोग कर "*सोरकोप्टस स्केबी*" तथा "*सोरोप्टस कुनीएनली*" का सफलतापूर्वक उपचार किया गया।

पशुओं में एंटीबॉयोग्राम अध्ययन से इस बात के संकेत मिले कि *एमोक्सीलीन* (78 प्रतिशत), *स्ट्रेप्टोमाइसिन* (61 प्रतिशत) तथा *पेनसिलीन* (65 प्रतिशत) पशुओं से पृथक किए गए *मेस्टीटॉइटिस* के विरुद्ध अत्यन्त प्रभावी एंटीबॉयोटिक दवाएं है। विभिन्न परिस्थितियों में आंशिक फार्म बजटिंग तकनीक अपनाने से पशुओं में गेस्ट्रोइंटेस्टाइनल परजीवियों का प्रकोप देखा गया। पशुओं के परजीवी रोगों से संबंधित एक डॉटा बेस कंप्यूटर प्रोग्राम विकसित किया गया तथा पशुओं में *हेमेंकस* प्रकोप के बारे में विस्तृत जानकारी प्रदान करने के लिए एक *" एक्सपर्ट सिस्टम"* भी तैयार किया गया।

जल संभरो (वाटरशेड) के लिए एक इस प्रकार का मॉडल विकसित किया गया जिससे तूफान में बह जाने वाले पानी की वास्तविक मात्रा का पता लगाया जा सके। पानी की सीपेज की रोकथाम के लिए प्रयुक्त प्लास्टिक फिल्म (एल.डी.पी.ई) का मूल्यांकन किया गया। चूना, फॉस्फोरस व कंपोस्ट के मिले जूले प्रयोग का फसलों की उपज, भूसे व भंडारित अनाज पर विशेष प्रभाव पाया गया। जलाने की क्रिया का अदरक व हल्दी के प्रकंदों की वृद्धि तथा उपज पर अच्छा प्रभाव देखा गया।

बड़ापानी में चूहें की *"बेंडीकोटा बंगालेंसिस"* प्रजाति प्रमुख रुप से पाई गई। जिंक फॉस्फूइड मिश्रित मेज स्पॉन का चुग्गा मशरुम में चूहों की रोकथाम के लिए कारगर सिद्ध हुआ। चूहों द्वारा पहुंचाया जाने वाला नुकसान धान की फसल के बढ़ने के साथ साथ बढ़ता जाता है और इसमें पुष्पन तथा फसल की परिपक्वता के साथ ही नुकसान की मात्रा भी बढ़ती हुई पाई गई। यह देखा गया कि पानी के आस पास वाले स्थानों को चूहे अपने बिल बनाने के लिए ज्यादा पंसद करते हैं तथा इस कार्य के लिए वे तुलनात्मक रुप से चौड़ी मेड़ों को चुनते हैं।

मिश्रित वन ब्लाक (एफ.एस.डब्ल्यू 2) की 12 वर्ष पुरानी वृक्ष प्रजातियों में *माइकेलिया ऑब्लोगा* में आधार घेर (बेसल गर्थ) तथा मध्य घेर (ब्रेस्ट गर्थ) सर्वाधिक पाया गया। सूक्ष्म जल संभरों के जलवैज्ञानिक व्यवहार से पता लगा कि 148.16 मि.मी. मूल बहाव तथा 13.27 मि.मी. सतही बहाव के परिणामस्वरुप कुल 161.43 मि. मी. कुल जल की प्राप्ति हुई।

बकरी उत्पादन के लिए रेशम कीट पालन व चारागह पद्धति (एफ .एस .डब्ल्यू 3) के अंतर्गत सूक्ष्म जल संभर के जलीय व्यवहार अध्ययन में मूल व सतही बहाव क्रमश: 34.53 व 5.97 मि. मी. पाया गया। कृषि चारागाह पद्धति (एफ .एस .डब्ल्यू 4) के अंतर्गत जैविक खेती में अदरक, सोयाबीन व सरसों में महत्वपूर्ण सुधार देखा गया।

हल्दी के 5 पूर्व परिचित क्लोनों में टी सी-2 से सर्वाधिक प्रकंद 17.99 कि.ग्रा. प्रति 2.7 वर्ग मीटर प्लाट तथा 47.5 टिल प्रति हेक्टेयर उपज मिली जबकि जहां तक करक्यूमिन का प्रश्न हैं वह टी-17 में अधिक पाया गया। कमरे के सामान्य तापक्रम पर हल्दी की गॉठों को सुखाने पर उनसे सर्वाधिक हल्दी पाउडर की प्राप्ति हुई जो 20.2 प्रतिशत थी जबकि करक्यूमिन का प्रतिशत 6.96 पाया गया।

हल्दी की टी सी-33, 17, 41, 44 तथा 36 को *"कलेक्टोट्राइकम कैप्सिकी"* के विरुद्ध प्रतिरोधी पाया गया जिनसे पत्तियों में धब्बे बन जाते हैं। अदरक की फसल को *डाइकोक्रोसिस पंचरालिस* (लीफ फीडर) से नुकसान पहुंचा जो कि इसकी पत्तियों को खा जाते हैं। अदरक के प्रंकदों की सड़ने के लिए *"राइजोम फ्लाई"* को उत्तरदाई पाया गया।

जरबेरा के आठ मुक्त परागण वाले चयनों में आकर्षक रंग पाया गया जिसमें प्रति वृक्ष पुष्पों की संख्या 30 से 44 के बीच तथा पुष्प वृंत की लंबाई 45 से. मी. पाई गई। *"सिमबिडियम जिर्गेटम"* आर्किड के बीजों के कल्चर को 0.5 प्रतिशत बी ए पी के साथ एम एस मीडिया में रखने पर 4 से. मी. लंबाई के अधिकतम संख्या में प्ररोह प्राप्त हुए।

मधुमक्खियों की *"एपिस मेलिफरी"* प्रजाति के लिए बड़ापानी की जलवायु विशेषकर नवंबर माह में संतोषजनक नहीं पाई गई तथा इस दौरान मात्र 50 प्रतिशत कालोनियों का प्रदर्शन ही संतोषजनक रहा।

सुअरों के अवशिष्ट से विकसित बायोगैस में मीथेन की प्रतिशतता पर्याप्त मात्रा में नहीं पाई गई । एक ओरियेंटेड ट्रे-ड्रॉयर बनाया गया जो वायु को उर्ध्व दिशा में परिचालित कर देता है।

कृषि अभियांत्रिकी विभाग द्वारा एक "पुश एंड ट्विस्ट टाइप" तथा "होल्ड एंड ट्विस्ट टाइप" फल तोड़ने के लिए यंत्रों का आविष्कार किया गया। बीज बोने के साथ साथ खाद भी डालने के लिए एक व्हील हो सीड कम फर्टिलाइजर ड्रिल भी विकसित किया गया जो कि पहले से प्रचलित व्हील हो सीड ड्रिल का उन्नत रुप है। इंपेक्ट कटिंग के सिद्धांत पर एक बुश कटर को भी विकसित किया गया।

अरूणाचल प्रदेश

अरुणाचल प्रदेश, पूर्वोत्तर भारत का सबसे बड़ा पर्वतीय राज्य है जहां, कृषि व पशुधन दोनों ही क्षेत्र में उत्पादन की अपार संभावनाएं विद्यमान है। इस राज्य की अनुंसधान आवश्यकताओं को दृष्टिगत रखते हुए उत्तर पूर्वी पर्वतीय कृषि अनुंसधान संस्थान के शोध केन्द्र की स्थापना सियांग जिले के बसार नामक स्थान पर की गई है जो कि समुद्र सतह से लगभग 800 मीटर ऊँचाई पर अवस्थित है। इस शोध केन्द्र का गोरी अनुंसधान फार्म लगभग 40.5 हेक्टेयर भूमि में फैला हुआ है तथा कृषि विज्ञान केन्द्र के अनुदेशात्मक फार्म के पास 4.1 हेक्टेयर भूमि उपलब्ध है। गोरी फार्म पर केन्द्र के अनुंसधान कार्य प्रगति पर है जबकि बमे स्थित फार्म को कृषि विज्ञान केन्द्र का फार्म व कैंपस के लिए विकसित किया गया है। अनुसंधान हेतु आधारभूत सुविधाएं उपलब्ध होने के बावजूद इस केन्द्र पर अधिकांशत: वैज्ञानिक उपलब्धता नगण्य रही। फिर भी, यहां धान, दालों मूगंफली, बागवानी, जल संसाधनों, खेती व सस्य पद्धतियोँ तथा तकनीकी हस्तांतरण के क्षेत्र में शोध कार्य जारी है। पशु विज्ञान के वैज्ञानिकों की अनुपलब्धता उपलब्धियां के कारण इस क्षेत्र में कोई शोध कार्य नहीं किया जा सका है।

प्रतिवेदित अवधि के दौरान खरीफ व रबी दोनों फसलों के लिए मौसम अनुकूल रहा तथा कुल 2553.1 मि.मी. वार्षिक वर्षा रिकॉर्ड की गई जिसमें 150 वर्षा दिवस सम्मिलित है। औसत अधिकतम व न्यूनतम तापमान क्रमानुसार 26.4° से. तथा 19.1° से. पाया गया।

मीठे संतरों में "*सोहनियांग रियांग*" नामक किस्म से अधिकतम फलों की प्रप्ति हुई जबकि मंडारिन संतरे के अंतर्गत"*क्लियोपेट्रा मंड़ारिन*" तथा "*कमला आस्ट्रेलिया*" किस्मों से सर्वाधिक संख्या में फल प्राप्त हुए "*सिट्रस वोल्कानारियाना*" में अधिकतम स्तंभ घेर (ट्रंक गर्थ) तथा प्रति वृक्ष औसत फलों की प्राप्ति हुई जबकि "*सिट्रस लेटीपीज*" में फल भार तथा प्रति फल जूस की अधिकतम मात्रा प्राप्त हुई।

उपज व गुणवत्ता की दृष्टि से हल्दी की *आर सी टी-1* तथा *नाडिया* किस्में अच्छे परिणामों वाली पाई गई। पातगोभी, पालक, गाजर तथा मूली को बसार की जलवायु के अनुकूल पाया गया।

केन्द्र के बांस गृह में उपलब्ध 35 बांस प्रजातियों के तुलनात्मक वृद्धि के अध्ययन में पाया गया कि *बैंबू टुल्डा* (ई जो 111), *बी, टुल्डा* (ई जोब), *बी. टेरास, बी. वैराइगाटा, डैंड्रोकैलिमस हूकरी, शाइमान बैंबुश गिफिथियान, बी.पैलिडा, बी.माने, स्यूडोस्टकम पालीमारफर्म*

तथा *बी.कचारेसिग* में (क्लंप्स) गुच्छन की संख्या अधिक पाई गई। वृक्षों के बीच खाली स्थान अधिक होने पर क्लेप्स परिधि में सीधी पाई गई। खाद्यान्न फसलों, चारा घासीय फसलों, पशुधन, बागवानी तथा गृह विज्ञान से संबंधित 24 प्रशिक्षणों का आयोजन किया गया जिसमें 257 प्रशिक्षणार्थियों ने सहभागिता निभाई। प्रयोगशाला से खेतों तक कार्यक्रम के अंतर्गत दो गांवों के 15 किसान परिवारों को अपनाया गया। तिलहनों के अंतर्गत सोयाबीन व सरसों पर दो गांवों में निदर्शन आयोजित किए गए। कृषि विज्ञान केन्द्र के अनुदेशात्मक फार्म पर निदर्शनों के अतिरिक्त चारा घासीय फसलों पर तकनीकी हस्तांतरण के फील्ड निदर्शन, फील्ड डे सह सामुदायिक परिचर्चा, सलाहकार सेवाएं, रेडियों वार्ताएं आदि का प्रसारण भी किया गया।

मणिपुर

मणिपुर राज्य पूर्वोत्तर के सुदूर पूर्व में स्थित है तथा समुद्र सतह से 51 मीटर से लगभग 2500 मीटर की ऊँचाई तक फैला हुआ है। राज्य के कुल भौगोलिक क्षेत्रफल का दसवां भाग घाटी है तो शेष पहाड़ियों से घिरा हुआ। घाटी के उपजाऊ क्षेत्र में कृषि उत्पादन की अपार संभावनाएं है। मणिपुर केन्द्र पर अनुसंधान परियोजनाएं मूलत: राज्य की कृषि व पशुधन आवश्यकताओं को ध्यान में रखकर चलाई जा रही है। केन्द्र का प्रयोगिक फार्म समुद्र तल से 750 से 800 मीटर ऊँचाई वाले लम्पेलपट में स्थित है तथा दूसरा प्रक्षेत्र 800 से 850 मीटर ऊंचाई पर लंगोल पहाड़ियों में स्थित है। इस केन्द्र पर वर्तमान में धान, मकई, दालों, तिलहन, बागवानी फसलों तथा मत्स्य पालन पर अनुसंधान कार्य चल रहा है। इस केन्द्र से सम्बद्ध कृषि विज्ञान केन्द्र द्वारा तकनीकी हस्तांतरण के अंतर्गत कृषि प्रसार कार्य किया जा रहा है।

मुख्य उपलब्धियां

प्रारंभिक खरीफ मौसम (फरवरी-मार्च से जून-जुलाई)के बीच उगाई जा सकने वाली उपयुक्त धान संबद्धों का एक एफ$_7$ व एफ$_8$ जेनरेशन से चयन किया गया। मुख्य खरीफ के लिए अति उपज देने वाली, प्रध्वंश प्रतिरोधी, ग्लूटेनिन युक्त तथा अच्छी गुणवत्ता वाली धान की चार लांइन्स को इन मौसम के लिए अच्छा पाया गया। आर. सी. एम-5, आर.सी.एम.-6 तथा केडी-2-6-3 को गामा किरणों से उपचारित कर उनसे प्राप्त एम$_3$ संतति को फार्म पर उगाया गया। इनमें से केडी-2-6-3 के 11, आर.सी.एम-5 के 3 तथा आर.सी.एम. के 1 एकल पौधे का चयन किया गया जिन्हें अगले मौसम में परीक्षण हेतु सुरक्षित रखा गया है।

बीज संवर्धन तथा प्रजाति रखरखाव ट्रॉयल के अंन्तर्गत धान की 14 विभिन्न किस्मों से 7 टन ब्रीडर सीड (प्रजनन बीज)का उत्पादन किया गया।

सोयाबीन की जे.एस. 35, पीके 471, एमएसीएस 13, पीके 472 तथा जेएस 75-46 को अत्याधिक उपज देने वाली किस्में पाया गया। सोयाबीन में चूना,फॉसफोरस और राइजोबियम के प्रयोग से प्रति वृक्ष फलियों के भार, उपज तथा पौधों द्वारा एन पी के तथा कैल्शियम व मैगनीज उद्ग्रहण में महत्वपूर्ण वृद्धि पाई गई। राइजोबियम तथा चूने का पारस्परिक प्रयोग काफी लाभदायक पाया गया। सोयाबीन की फसल पर चूने व पोटेशियम के पारस्परिक प्रभाव के एक ट्रॉयल में 0.25 एल. आर.तुल्यांक स्तर (एल.आर.इक्विलेंट लेबेल)से सोयाबीन की सकल उपज में वृद्धि पाई गई किंतु इस स्तर के बाद उपज व पोटेशियम उद्ग्रहण में काफी कमी देखी गई। पोटेशियम डोज के प्रयोग से कुल उपज में वृद्धि तथा पोटेशियम उदग्रहण 15 मि.ग्रा. पोटेशियम प्रति बैग पाया गया।

अल्प अवधि की एडवांस ब्रीडिंग ट्रॉयल में मूंगफली की दस किस्मों के परीक्षण में आई.सी.जी.वी.-92224 से सर्वाधिक उपज प्राप्त हुई जो कि प्रति हैक्टेयर 28.60 क्विंटल थी जबकि इसी प्रयोग में सर्वोधिक शैल प्रतिशतता आई.सी.जी.वी-92262 में प्राप्त हुई जो 75 प्रतिशत पाई गई। आई. सी. जी. वी-92218 में मानक गिरी भार सर्वाधिक (63.03)ग्राम पाया गया जबकि मानक के रुप में 100 गिरी सम्मिलित किए गए।

मध्यम अवधि के एडवांस ब्रीडिंग ट्रॉयल में भी मूंगफली की दस किस्मों का परीक्षण किया गया जिसमें मूंगफली की आई. सी.जी.वी.-88336 से सर्वाधिक उपज(28.80 क्विंटल)प्राप्त हुई। अन्य समकक्षी किस्मों में आई. सी. जी.वी.-88318, 88311, 88379 तथा 88342 पाई गई।

सूखा प्रतिरोधी एडवांस ब्रीडिंग ट्रॉयल में आई.सी.जी.वी.86473 से सर्वाधिक उपज (18.38 क्विंटल प्रति हेक्टेयर)प्राप्त हुई। इनमें सर्वाधिक शैल प्रतिशतता आईसीजीवी-87290 में पाई गई जबकि मानक गिरी भार आईसीजीवी-86742 में सर्वाधिक पाया गया जो कि 79.78 प्रतिशत था।

कंफेक्शनरी प्रयोग हेतु एडवांस ब्रीडिंग ट्रॉयल में भी मूंगफली की दस अति उत्तम किस्म की निर्यात गुणवत्ता वाली किस्मों के परीक्षण में आईसीजीवी-88376 से सर्वाधिक उपज प्राप्त हुई जो की 27.56 क्विंटल प्रति हेक्टेयर पाई गई। इस परीक्षण में सर्वाधिक शैल प्रतिशतता (68 प्रतिशत)आईसीजीवी-88448 तथा आई सी जी वी-88475 में पाई गई जबकि सर्वाधिक मानक गिरी भार (132.91 ग्राम आई सी जी वी)88376 में पाया गया।

अर्ली लीफ स्पॉट, लेट लीफ स्पॉट तथा रस्ट रोग के लिए मूंगफली के 70 जीन रुपों की स्क्रीनिंग की गई। पांच विभिन्न परीक्षणों में से जे एल 24 को चेक किस्म के रुप में लिया गया। इस परीक्षण में पाया गया कि बोने के 39 दिन तक इन पर रोग का कोई लक्षण नहीं दिखाई पड़ा। 40 वें दिन से इनमें रोग के लक्षण दिखना प्रारंभ हुए। इन को बोने के 90 दिन तक उपरोक्त रोगों के प्रति स्क्रीनिंग के लिए रखा गया और पाया गया कि इनमें से 21 लेट लीफ स्पॉट तथा 13 अर्ली लीफ स्पॉट के प्रति सहिष्णु थे।

पर्णीय रोग के प्रति रोधी किस्मों के अग्र प्रजनन ट्रॉयल के अंतर्गत 10 किस्मों का परीक्षण किया गया जिसमें आई सी जी वी 87281 में सर्वाधिक फलियां प्राप्त हुई। इस क्रम में आई सी जी वी 87242 तथा 87867 का स्थान क्रमश: दूसरे व तीसरे नंबर पर पाया गया। मूंगफली के इन जीन रुपों ने 115-119 दिन तक परि पक्वता प्राप्त की। इनमें सर्वाधिक शैल प्रतिशत आई सी वी 87281 में पाया गया जो 76% था जबकि मानक गिरी भार आई सी जी वी 87291में सर्वाधिक (89.66 ग्राम)पाया गया। लीफ स्पॉट तथा रस्ट रोग की रोकथाम के लिए *मैकोजेब* 0.2 प्रतिशत +कार्बेडेजिम (0.05ब) *डॉयथेन* एम-

450-2.6 ग्राम + *बैविस्टीन* 1 ग्राम प्रति लीटर पानी का क्रमशः फसल बोने के 35,50 व 65 दिन बाद छिड़काव करना लाभ दायक पाया गया तथा इससे अधिक फलिंया प्राप्त हुई। 2/3 एन पी के ,के प्रयोग से सरसों में 1/3 एन पी के से तुलनात्मक रुप से अच्छी उपज पाई गई। जबकि एन पी के की पूर्ण खूराक 2/3 एन पी के डोज के समतुल्य थी। कंट्रोल की तुलना में कंपोस्ट व चूना + कंपोस्ट के मिले जुले प्रयोग से सरसों की उपज में महत्वपूर्ण वृद्धि पाई गई जबकि केवल चूने के प्रयोग द्वारा उपज में कोई उल्लेखनीय वृद्धि नहीं पाई गई। मणिपुर के पर्वतीय भागों से 25 सतही मृदाओं में अल्यूमिनियम के विभिन्न रुपों जिनमें परिवर्तनीय, निष्कर्षणीय, अक्रिस्टलीय, कार्बनिक तत्व युक्त, क्रिस्टलीय तथा कुल अल्यूमिनियम तत्व का आंकलन किया गया तथा पाया गया कि उनमें अल्यूमिनियम क्रमशः 0.27, 0.81, 11.68, 3.76 तथा 1.00 विभिन्न रुपों में विद्यमान है।

इसी प्रकार 25 सतही मृदा नमूनों में लौहे तत्व की विभिन्न रुपों में उपस्थिति का पता लगाया गया तथा मृदा में लौह तत्त्व का विस्तार 2.76 से 5.62 प्रतिशत के बीच पाया गया। इन मृदाओं में आक्रिस्टलीय तथा कार्बनिक पदार्थ के रुप में कुल लौह तत्व की उपस्थिति 65% से अधिक पाई गई। मक्का, सोयाबीन तथा उरद की उपज में कंपोस्ट खाद तथा कंपोस्ट के साथ जैव उर्वरकों के प्रयोग से जहां उपज वृद्धि पाई गई वहीं नत्रजन व पोटाश उद्ग्रहण में भी महत्वपूर्ण असर देखा गया। विभिन्न भूमि उपयोग पद्धतियों के अंतर्गत मणिपुर की पर्वतीय मृदा के पोषक तत्वों का पता लगाया गया।

खट्टे प्रकार के नींबू व लैमन की 11 किस्मों के मूल्यांकन में *हैजांग* किस्में सर्वाधिक वृद्धि (3.15) मीटर रिकार्ड की गई जबकि (7.84 से.मी) था। इस क्रम में दूसरा स्थान सोहसिटोंग था। नींबू वर्गीय फलों के अंतर्गत''सोहसिटेंग'' में प्रतिवृक्ष सर्वाधिक फल पाए गए जबकि इस क्रम में दूसरा स्थान''*यूरेका लेमन*'' व''*अदाजमीरे*''का था। सर्वाधिक आकार वाले फल *हैजोंग (सिट्रोन)*किस्म से प्राप्त हुए। कचाई, यूरेका तथा पाती लेमन में कुल घुलनशील शर्करा(टी एस एस) सर्वाधिक पाई गई, जबकि सर्वाधिक एस्कारबिक अम्ल की मात्रा''यूरेका'' से प्राप्त हुई। अमरुद की एल-49 को इस क्षेत्र के लिए सर्वाधिक अच्छी किस्म पाया गया। अलग अलग जलवायवीय स्थितियों में आम की 17 किस्मों के वृद्धि कारकों का अध्ययन किया गया। बैंगन की ''पंत सम्राट'' किस्म सबसे अधिक उपज देने वाली पाई गई जबकि ''अर्का केसर'' इस क्रम में दूसरे स्थान पर थी। विल्ट प्रतिरोधी तथा अच्छे पौधाकार की 7 बैगन की किस्मों को विकसित किया गया। टमाटर की 30 किस्मों का प्रवेशन व रखरखाव किया गया जिस में आई ए एच एस 88 को सर्वाधिक उपयुक्त संकर किस्म पाया गया। हल्दी में जी एल पुरम, डिंजिराला 325 तथा पी सी टी 11 तथा अदरक की सुप्रभा, पूना, थिंगपुई तथा दियोमाली लोकल

की अच्छी किस्मों के रुप में पहचान की गई। हल्दी की ताजी गाठों पर फास्फोरस का अच्छा प्रभाव पाया गया।

बहुउद्देश्यीय वृक्ष प्रजातियों के तुलनात्मक अध्ययन के अंर्तगत *ई.सिटिओडोर* में सर्वाधिक पादप उंचाई, कॉलर हाइट, बी एच डी, शाखाएं व कुल जैव मात्रा तथा जड़ जैव मात्रा पाई गई। वृक्ष बीज केंद्र, आस्ट्रेलिया से प्राप्त 11 किस्मों में से 5 ही मणिपुर की जलवायु में शेष बची हैं। इन्हें सितंबर,1992 में 5 मीटर के अंतराल पर कंटूर बंडो में लगाया गया। उपरोक्त 5 वृक्ष प्रजातियों में तीसरे वर्ष के दौरान सी-ग्लोका(ई सी 326191) में सर्वाधिक पादप उंचाई 4.13 मीटर पाई गई. कॉलर, बी एच ब्यास, शाखाएं, वितान आदि *सी.कनिंघामियाना* प्रजाति में पाए गए।

मणिपुर के 5 जिलों से एकत्र किए गए 15 स्थानीय वृक्षों में *पारकिया राक्सबरघी* के 15 उद्गम जनकों(प्रोवेनेस) के वृद्धि कारकों का अध्ययन किया गया। विभिन्न भूमि उपयोग पद्धति के अंतर्गत खाद्यान फसलों व वृक्ष प्रजातियों की वृद्धि तथा मृदा के भौतिक-रसायनिक गुणों का भी अध्ययन किया गया।

प्रतिवेदित अवधि के दौरान 44 प्रशिक्षण कार्यक्रम, 2 अग्रपंक्ति निदर्शन, 3 प्रयोगशाला से खेतों तक कार्यक्रम के प्रदर्शन, धान, सरसों तथा बैगन पर 4 आन फार्म ट्रॉयलों का आयोजन किया गया।

मिजोरम

झूम खेती के विकल्प के रूप में कृषि, पशुधन व बागवानी आधारित भूमि उपयोग पद्यति अपनाने तथा राज्य की कृषि समस्याओं के वैज्ञानिक समाधान हेतु उत्तर पूर्वी पर्वतीय अनुसंधान परिसर, बड़ापानी के मिजोरम केन्द्र की स्थापना ऐंजावल से 85 कि. मी. दूर कोलासिव में की गई है। इस केन्द्र के फार्म का क्षेत्रफल लगभग 60 हेक्टेयर है जो समुद्र तल से 600 से 700 मीटर की ऊंचाई के बीच अवस्थित है। मध्यम से तीव्र पहाड़ी ढलानों के बीच महाखण्डों व झरनों युक्त भूस्थलाकृति के बीच बसा है यह केन्द्र। धान, तिलहन तथा मसालों पर हुए शोध कार्य से संबंधित सूचनाएं इस प्रतिवेदन में सम्मिलित की गई है।

मुख्य उपलब्धियां

यह वर्ष कर्षण क्रियाओं के लिए अनुकूल रहा। वर्ष के दौरान प्राप्त वार्षिक वर्षा 2021.3 मीटर रिकार्ड की गई। इस दौरान रिकार्ड अधिकतम तापमान मई में 29.68° से. था जबकि न्यूनतम तापमान 14° सें माह दिसंबर में पाया गया। सर्वाधिक वर्षा 376 मि.मी. अगस्त माह में रिकार्ड की गई जबकि 1.5 मि.मी. न्यूनतम वर्षा जनवरी माह में प्राप्त हुई।

धान की यू $_{23}$ तथा वी.एल. 206 किस्म उपरिभूमि के लिए तथा जया व आरसीपीएल 3-6 को निचली भूमि के लिए उपयुक्त पाया गया। यू $_{23}$ तथा वी. एल से प्राप्त उपज क्रमश: 10.11 तथा 10.91 क्विंटल प्रति हेक्टेयर थी । धान के 20 स्थानीय जनन-द्रव्यों का मूल्याकंन किया गया जिसमें एलपी-5-25 से सर्वाधिक उपज प्राप्त हुई।

तिलहनों के अंतर्गत सोयाबीन में पीके 472, एमएसीएस 124,पूसा 20 तथा जे.एस.80-21 अच्छी किस्मों के रुप में चिन्हित की गई। मूंगफली की अति उपज देने वाली किस्मों में आईसीजीवी 87119, 87187 तथा 87160 को संभाव्य किस्मों के रुप में पाया गया।

हल्दी की तीन किस्मों स्वगंधम, अश्विनगंधी तथा छाया पुष्प को अति उपज देने वाली किस्मों मे दर्ज किया गया।

एकीकृत कृषि पद्यति के अंतर्गत रोपे गए फल वृक्षों में अधिकतर सभी को भली प्रकार फलते-फूलते देखा गया तथा फार्म पर उपलब्ध पशुओं से प्राप्त दूध की मात्रा भी संतोषजनक रही।

नगालैण्ड

पूर्वोत्तर का पर्वतीय राज्य नागालैंड 93.95° पूर्वी रेखांश तथा 25.27° उत्तरी अक्षांश पर स्थित है। समुद्र सतह से इसकी ऊँचाई 194 से 3840 मीटर तक फैली हुई है तथा इस राज्य की भूस्थलाकृति में काफी विविधता पाई जाती है, इसीलिए इस राज्य में शोध केंद्र की स्थापना के समय दो विभिन्न स्थान चुने गए जिनमें मोकोकचुंग के निकट यसमियांग केंद्र ऊँचे पहाड़ी क्षेत्रों की कृषि समस्याओं तथा झरनापानी स्थित केंद्र को नीची ऊँचाई वाले क्षेत्रों की कृषि समस्याओं के अनुसंधान कार्य के लिए चुना गया। वर्तमान में दीमापुर से 27 कि.मी. की दूरी पर स्थित ''झरनापानी'' केंद्र में शोध कार्य चल रहा है। अधिक ऊँचाई वाले क्षेत्रों के लिए अनुसंधान कार्य वर्तमान में ''फुटसेरी'' में संपादित किया जा रहा है। इस केंद्र पर वर्तमान में धान, मकई, तिलहन तथा पादप संरक्षण का कार्य मुख्य रुप से किया जा रहा है तथा तकनीकी हस्तांतरण का कार्य कृषि विज्ञान केंद्र की देखरेख में संचालित किया जा रहा है।

मुख्य उपलब्धियां:

धान की फसल में 20 टन प्रति हैक्टेयर की दर से कंपोस्ट खाद का प्रयोग करने पर उपज में अच्छी वृद्धि पाई गई। यूरिया के रुप में प्रति हेक्टेयर 40 कि.ग्रा. नत्रजन तथा अजोला के रुप में भी नत्रजन की इतनी ही मात्रा के प्रयोग से धान की उपज में आशातीत वृद्धि पाई गई। नागालैंड के विभिन्न भागों से एकत्रित धान की 12 किस्मों के मूल्यांकन व वृद्धि कारकों के अध्ययन में पाया गया कि धान की स्थानीय किस्म ''न्यायी''से सर्वाधिक उपज 40.4 क्विंटल प्रति हेक्टेयर प्राप्त हुई। इस क्रम में दूसरा स्थान''खोनेमा'' का रहा जिससे प्राप्त उपज प्रति हैक्टेयर 35.7 क्विंटल रही। स्थानीय धान की किस्मों में''नगाउ रच'' सर्वाधिक लंबी किस्म (164.5 से.मी.)तथा ''न्यायी'' सर्वाधिक बौनी किस्म (110.4 से. मी.)पाई गई।

धान की विकसित किस्मों के अंतर्गत आर.सी.पी.एल श्रेणी की 14 किस्मों का नगालैंड की जलवायु के अंतर्गत अध्ययन किया गया जिसमें आर. सी. पी. एल. 1-4 से सर्वाधिक उपज प्राप्त हुई जो कि 53.7 क्विंटल प्रति हैक्टेयर पाई गई। इस क्रम में आर. आर 65 दूसरे नंबर पर थी जिससे प्राप्त उपज 47.9 क्विंटल प्रति हैक्टेयर थी।

आंवला के चार जीन प्ररुप *चाकिया, नरेंद्र आंवला*-6,7 तथा 10 का संचयन किया गया जिनका पूर्वोत्तर की जलवायु में अध्ययन किया जा रहा है।

सितम्बर के तीसरे व चौथे सप्ताह में बोई गई मूंगफली में, अक्टूबर के तीसरे सप्ताह में बोई गई मूंगफली की तुलना में अधिक फलिंया प्राप्त हुई। मूंगफली की 23 जीन-प्ररुपों की रोगों के

प्रति स्क्रीनिंग में पाया गया कि नगालैंड की जलवायु के अंतर्गत लेट लीफ स्पॉट का प्रकोप अर्ली लीफ स्पॉट की तुलना में अधिक पाया गया।

अरहर की फसल में अल्पावधि वाले दो अति अगेती निर्धारी जीन प्ररुप(एक्स्ट्रा अर्ली डिटरमिनेंट जीनोटाइप) एक्स डी, व एक्स डी 2 के 14 तथा दो अति अगेती अनिर्धारी जीन (एक्स्ट्रा अर्ली नॉन-डिटरमिनेंट जीनोटाइप) के 8 जीन प्ररुपों की पहचान की गई। सरसों में एफिडस (इल्ली) की रोकथाम के लिए डॉयामेथोएट 0.09 प्रतिशत तथा मोनोक्रोटोफॉस फिड 0.04 प्रतिशत का छिड़काव अति प्रभावी पाया गया।

झूम खेती के विकल्प के लिए 5 गावों में कृषि वानिकी गतिविधियों का संचालन किया गया। इस दिशा में नींबू ,काली-मिर्च, पपीता, ट्री-बीन, लीची तथा नाशपाती व प्लम के पौधालयों को विकसित करने का कार्य जारी है। इस दौरान किसानों को 3,000 कालीमिर्च के पौधों का वितरण किया गया ताकि वे इन्हें इमारती वृक्षों, रबर तथा सुपारी के पेड़ों के बीच अन्त: फसल के रुप में लगा सकें।

सुअर उत्पादन को व्यापारिक रुप देने के लिए सुअर के बच्चों को जन्म के शीघ्र बाद ही मां का दूध छुड़ाकर अलग रखने के अच्छे परिणाम पाए गए। देखा गया कि ऐसा करने से जहां बच्चों में अच्छी वृद्धि होती है वहीं प्रति वर्ष प्रजनन द्वारा अधिक संख्या में बच्चों की प्राप्ति भी संभव है।

खाद्यान्न उत्पादन, बागवानी, गृह विज्ञान तथा पशुधन-उत्पादन पर प्रतिवेदित अवधि के दौरान 57 प्रशिक्षण कार्यक्रमों का आयोजन किया गया जिसमें 946 प्रतिभागियों ने सम्मिलित होकर लाभ उठाया। दाल व तिलहन पर 29 हैक्टेयर क्षेत्रफल में मूंगफली, सोयाबीन, अलसी तथा सरसों पर अग्र पंक्ति निर्दशनों का भी आयोजन किया गया। दीमापुर की पर्वतीय तलहटियों में तिलहनों के अंतर्गत क्षेत्रफल बढ़ रहा है तथा किसानों द्वारा सरसों की *एम-27* तथा अलसी(लिनसीड) की *नीलम* किस्म को काफी रुचिपूर्वक अपनाया जा रहा है।

प्रयोगशाला से खेतों तक कार्यक्रम के अंतर्गत शाक-भाजी, धान व पशुधन पर 35 परिवारों को शामिल करते हुए प्रदर्शनों का आयोजन किया गया तथा राज्य सरकार के कृषि विभाग तथा अनुसंधान केंद्र के बीच समन्वय बढ़ाने का भी प्रयास किया गया ताकि तकनीक हंस्तांतरण को प्रभावी बनाया जा सके।

ग्रामीण क्षेत्रों के शिक्षित युवकों को मशरुम उत्पादन के लिए प्रशिक्षित किया गया तथा ''*मोकोकचुंग*''व ''*चुमुकेडिमा*' में स्पॉन उत्पादन की दो इकाईयों की शुरुवात की गई। परती भूमि में पर्वतीय खेती प्रारंभ करने के लिए पांच गावों में कृषि विज्ञान केंद्र के सौजन्य से प्रदर्शनों का आयोजन किया गया।

मधुमक्खी पालन को यहां के लिए अतिरिक्त आय का एक अच्छा स्रोत बनाया जा सकता है तथा इस क्रम में गरीब व सीमांत कृषकों को मधुमक्खी पालन के लिए मुफ्त बक्सों की आपूर्त्ति की गई।

सिक्किम

भारतीय कृषि अनुसंधान परिषद के उत्तर पूर्वी पर्वतीय कृषि अनुसंधान परिसर का सिक्किम केन्द्र, गंगटोक से पांच कि.मी. की दूरी पर टाडोंग में समुद्र सतह से 1200 से 1400 मीटर की ऊँचाई पर स्थित है। इस केन्द्र को राज्य सरकार द्वारा वर्ष 1976 में 21.5 हेक्टेयर भूमि हस्तांतरित की गई थी। इस फार्म को इस क्षेत्र की महत्वपूर्ण खाद्यान्न फसलों तथा पशुधन पर शोध कार्य के लिए विकसित किया गया है तथा इस कार्य के लिए प्रयोगशाला, प्रशासनिक भवन, वैज्ञानिक डारमेटरी व आवासीय सुविधाएं उपलब्ध की गयी हैं। केन्द्र के पास उपलब्ध कुल 21.5 हेक्टेयर भूमि में से 14 हेक्टेयर भूमि फसलों पर ट्रयाल्स हेतु सुरक्षित रखी गई है। वर्तमान में यहां फसल सुधार, मृदा प्रबंधन, पादप संरक्षण, सस्य व बागवानी फसलों, कृषि उद्यानिकी, पशु पोषण तथा पशु स्वास्थ्य पर कार्य संपादित किया जा रहा है। इस केन्द्र से जुड़े कृषि विज्ञान केन्द्र द्वारा तकनीक हस्तांतरण कार्यक्रम के अंतर्गत वैज्ञानिकों द्वारा विकसित शोध तकनीकों को किसानों तक पहुँचाने का कार्य किया जा रहा है। यह देश का एक मात्र शोध केन्द्र है जहां बड़ी इलायची पर गहन शोध कार्य किया जा रहा है।

मुख्य उपलब्धियां

धान के पर्णीय प्रध्वंश रोग के निदान के लिए 0.04 प्रतिशत ''बीम'' फफूंदीनाशक को सर्वोत्तम पाया गया तथा इसके छिड़काव में उपज से भी वृद्धि देखी गई ''नैक-ब्लास्ट'' रोग की रोकथाम में बीम, काइटाजिन, टॉपसिन-एम व हिनोसान को एक दूसरे के समतुल्य पाया गया। पोटेशियम व कंपोस्ट खाद के मकई पर प्रभाव वाले परीक्षण में लगातार तीसरे साल भी यह देखा गया कि प्रति हैक्टेयर 60 कि.ग्रा. पोटाश तथा 10 टन कंपोस्ट के लगातार प्रयोग से मकई की उपज में वृद्धि देखी गई।

उरद में ''जरकोस्पोरा लीफ स्पॉट'' की रोकथाम के लिए बैविस्टीन, क्यूमन-एल तथा टिल्ट को काफी प्रभावी पाया गया साथ ही इससे उपज में भी 44-55 प्रतिशत तक की वृद्धि पाई गई।

मूली की पैदावार के लिए प्रति हैक्टेयर 10 टन कंपोस्ट खाद के प्रयोग करने पर पोटेशियम के विविध स्तरों की तुलना में सकारात्मक प्रभाव देखा गया। 12 वर्षीय मंडारिन वृक्षों में 500 ग्राम नाइट्रोजन तथा 20 कि. ग्रा. कंपोस्ट खाद का प्रयोग करने से प्रति वृक्ष फलों की संख्या में सर्वाधिक वृद्धि पाई गई। मंडारिन संतरे के वृक्षों के बीच अदरक व भिंडी को अंत: फसल के रुप में लेने पर अच्छी उत्पादकता पाई गई। अदरक की अधिक उपज देने वाली किस्मों में *भाइसे, गोरुबथाने, स्यूखीमेचेरा* तथा *चकरेला* प्रमुख पाई गई जिनसे प्राप्त उपज क्रमश: 157.5, 110.2, 96.2 तथा 91.5 क्विंटल प्रति हैक्टेयर थी। इस क्रम में सबसे कम उपज देने वाली किस्में चौसा

लोकल तथा बहराइच थीं जिनसे क्रमशः 39.2 तथा 40.5 किंवटल प्रति हैक्टेयर उपज प्राप्त हुई।

अदरक के 22 जीन-प्ररुपों का राइजोम रॉट कांप्लेक्स (जटिल प्रकंद सड़न) रोग के लिए मूल्यांकन किया गया किन्तु कोई भी इसके प्रतिरोधी नहीं पाई गई। तुलनात्मक रुप से कम प्रकोप वाली किस्मों में *गोरुबथान, भाइसे, राजगढ़ एस.जी-666 तथा एस.जी.-551* प्रमुख थीं।

प्रति हैक्टेयर 20 टन कंपोस्ट खाद का प्रयोग हल्दी की अधिक उपज लेने के लिए लाभदायक पाया गया।

बड़ी इलायची के प्रमुख वाइरस रोग "*चिरके*" तथा "*फुरके*" के प्रति "*गोलसे*" किस्म को सहिष्णु पाया गया।

आई.एस.पी.एस योजना के अंतर्गत अदरक व अन्य औद्यानिक फसलों पर किसानों व प्रसार कार्यकर्ताओं के लाभार्थ कई प्रशिक्षण कार्यक्रमों का संचालन किया गया। संतरे के बागानों के पुनरुद्धार व सिक्किम की मध्यम उंचाई की पहाड़ियों पर "*किवी*" फल उगाने के लिए सलाह सेवाएं भी प्रदान की गई।

त्रिपुरा

उत्तर पूर्वी पर्वतीय कृषि अनुसंधान परिसर, बड़ापानी का त्रिपुरा केन्द्र अगरतला से लगभग 14 कि. मी. की दूरी पर लेम्बूचेरा में स्थित है। उपोष्ण जलवायु के कारण यहां सामान्यतया विभिन्न प्रकार की फसलें खरीफ के अंतर्गत उगाई जाती हैं। निचली भूमि जिन्हें स्थानीय भाषा में "लुंगा" कहते हैं में "फसल तीव्रता" बहुत अधिक है जबकि ऊपरी भूमि जो कि कुल भौगोलिक क्षेत्रफल का लगभग 60 प्रतिशत है में फसल तीव्रता कम है। विशेषकर शीतकाल में उपरिभूमि में मृदा में नमी की कमी सबसे बड़ी बाधा है जबकि इसके विपरीत पहाड़ी भूभागों में ढलानों पर भी मृदा गहराई काफी अधिक पाई जाती है।

शोध सूचनाओं को वैज्ञानिक रूप में एकत्र व व्यवस्थित करने के उद्देश्य से इस केन्द्र पर वर्तमान में धान, तिलहन, दालों, शाक-भाजी, मसाले, औद्यानिक फसलों, कृषिवन, फार्मिंग पद्यति तथा पशुविज्ञान के अंतर्गत बकरी एवं कुक्कुट पर शोध कार्य प्रगति पर है। दक्षिण त्रिपुरा के बीरचन्द्रामनु में स्थित कृषि विज्ञान केन्द्र से तकनीकी हस्तांतरण के कार्य का संचालन किया जाता है।

मुख्य उपलब्धियां

वर्ष के दौरान खरीफ व रबी दोनों ही फसलों के लिए मौसम उपयुक्त रहा। इस अवधि में 88 वर्षा दिवसों से 2475 मि.मी. वर्षा रिकार्ड की गई। न्यूनतम तथा अधिकतम मासिक तापमान का मध्यमान क्रमशः 8.2 से 23.7° सें तथा 23.4 से 33.6° सें रहा। आपेक्षिक आर्द्रता प्रातःकाल 80 से 90 प्रतिशत तथा सायंकाल में 39.72% तक पाई गई। फसलों की पिछले 10 वर्षों के वाष्पन-वाष्पोत्सर्जन विभवता (पी इ टी) का आंकलन किया गया ताकि सस्य जल आवश्यकता का पूर्वानुमान किया जा सके।

मृदा अनुपातों में परिवर्तन एवं धान द्वारा फास्फोरस उद्ग्रहण का भी आंकलन किया गया। मृदा पी एच मान तथा विद्युत संचालकता पर उर्वरक या धान की किस्मों का कोई विशेष प्रभाव नहीं पाया गया। जीवाणु इनोकुलेशन से अत्यधिक पोटाश की पुर्नप्राप्ति हुई। जिंक पॉलीफास्फेट जिसमें 21.45% जिंक था के प्रयोग से धान की उपज (ग्रेन यील्ड) में 67 प्रतिशत वृद्धि देखी गई। धान में प्रति हेक्टेयर 15 कि. ग्रा. सुपर फास्फेट ($पी_2$ $पी_5$) के प्रयोग से धान की उपज में सर्वाधिक वृद्धि देखी गई। मृदा में कार्बनिक पदार्थों के किसी भी रुप में प्रयोग से धान की उपज में 37.2 से 81.2 प्रतिशत की वृद्धि पाई गई। धान की स्थानीय किस्मों में गारोमोलाती किस्म से सर्वाधिक उपज पाई गई। धान के 19 जीन रुपों को फास्फोरस प्रतिबल के प्रति सहिष्णु पाया गया।

प्रति हेक्टेयर 30 कि.ग्रा. की दर से सुपर फॉस्फेट (पी2 औ5) के प्रयोग से लोभिया का

बीज उपज में 23 से 28 प्रतिशत की वृद्धि देखी गई। एकेशिया पत्तियों को मल्चिंग के रुप में प्रयोग करने से उरद की उपज में 74 से 142 प्रतिशत तक की वृद्धि पाई गई. तिल के जीन रुपों में टी आर सी-तिल-12 और आर ए यू एस एस-17-4 को सर्वाधिक संभाव्य किस्मों के रुप में पाया गया। मूंगफली में लेट लीफ स्पॉट की तुलना में अर्ली लीफ स्पॉट का प्रभाव अधिक पाया गया। अधिकतर मूंगफली के जीनरुपों को लेट लीफ स्पॉट के प्रति सहिष्णु पाया गया।

उपरिभूमि, बीच की भूमि तथा निचली भूमि में मृदा नमी की आंकलन किया गया।

''परभनी खरीफ'' तथा ''त्रिपुरा लोकल''ओकरा की किस्मों में अच्छी पाई गई। ओकरा के दो सेलेक्शन (एस एस 1 तथा एल एस-2 का चयन किया गया। टमाटर की किस्मों में ई सी 89259 तथा ई सी 177669 को ग्रीष्मकालिन तथा ई सी 76915 तथा ई सी 52060 को शीतकाल के लिए सर्वाधिक उपज देने वाली किस्में पाया गया। रोपण के तीन माह बाद लहसुन को ताजे फसल के रुप में लेने का सर्वाधिक उपयुक्त समय पाया गया।

पोलिएंथस ट्यूबरोजा पर नाइट्रोजन के स्पिलिट, डोज(विभक्त खुराक) नत्रजन का पर्णीय प्रयोग, जैव उर्वरक तथा सूक्ष्म पोषकों के इष्टतम स्तर का अध्ययन भी किया गया। फूलों के स्पाट्इक्स की तुड़ाई व उन्हें लम्बी अवधि तक सुरक्षित रखने के तरीकों का प्रमाणीकरण भी किया गया।

गुलदाउदी के 50 किस्मों की कार्मल उत्पादन दक्षता (%) का अध्ययन किया गया। इस प्रकार इन किस्मों के 348 कार्म से 4224 कार्मल संतति प्राप्त हुई जिन्हें तीन श्रेणियों में यथा अत्यधिक कार्मेल उत्पादक किस्मों, मध्यम कार्मल उत्पादक किस्मों तथा न्यूनतम कार्मल उत्पादक किस्मों में वर्गीकृत किया गया।

रोपण के 8 वर्ष के बाद *ग्मेलिना आरबोरिया* में सर्वाधिक आधार घेर या परिधि तथा बेसल ऊँचाई पर अधिकतम परिधि पाई गई। वृक्ष प्रजातियों में ताजी जैव मात्रा (बायोमास) के उत्पादन का रिग्रेशन समीकरण द्वारा आंकलन किया गया। कटाई-छंटाई द्वारा *जी. अरबोरिया* से सर्वाधिक ईंधन प्राप्त हुआ। *एकेशिया ऑरिकुली फारमिस* के मध्य अंत:फसल के रुप में रोपे गए आसाम लेमन में अच्छी वृद्धि देखी गई। त्रिपुरा के अनुकूल मुर्गे की दो प्रजातियों का चयन किया गया। पशुओं के *बूफिलस माइकोप्लस* रोग के लिए बुटाकवस (आर) (डेल्टामेथ्रिन) 25 पी पी एम 2 मि.ली. लीटर पानी का दस दिन के अंतराल पर लगातार दो बार प्रयोग काफी सार्थक पाया गया। यह भी पाया गया कि गर्मी में पैदा हुए बकरी के बच्चों का जन्मभार सर्दियों में पैदा हुए बच्चों की तुलना में अधिक होता है।

प्रतिवेदित अवधि में कुल मिलाकर 14 प्रशिक्षण कार्यक्रमों का आयोजन किया गया जिसमें 146 प्रशिक्षणार्थियों नें भाग लिया। फल बागानों, शाक सब्जियों, मृदा व जल संरक्षण, मत्स्य व पशुधन पर प्रदर्शनों का भी आयोजन किया गया। इसी अवधि के दौरान मूंगफली तिल और सोयाबीन पर 140 अग्र पंक्ति निदर्शनों को आयोजन किया गया तथा 27 निदानात्मक सर्वेक्षण भी किए गए।