RESEARCH ACHIVEMENTS 2012-13

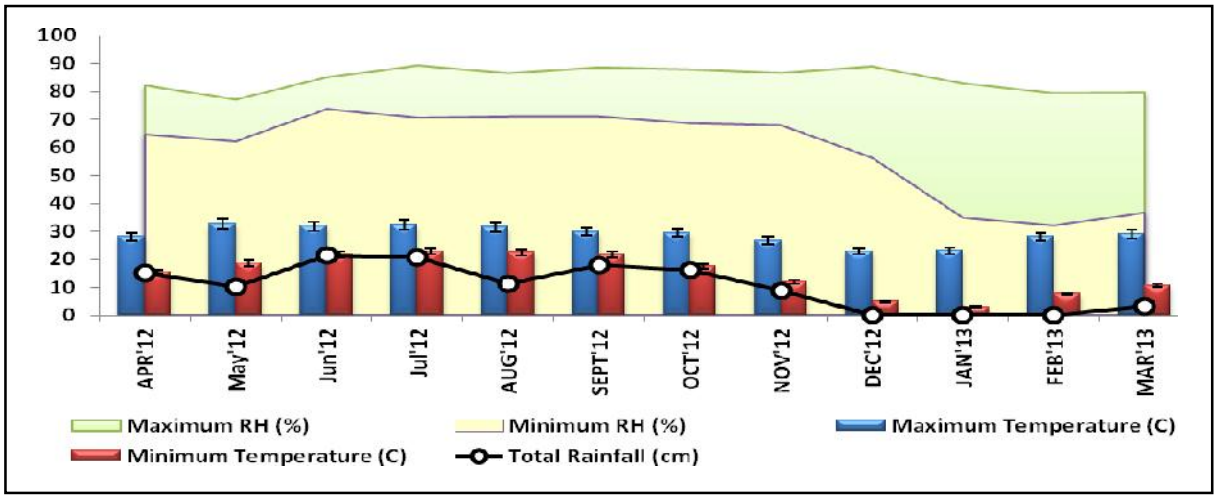
ICAR RESEARCH COMPLEX FOR NEH REGION
MANIPUR CENTRE, LAMPHELPAT, IMPHAL

WEATHER REPORT

AGRO-METEOROLOGICAL DATA (MONTHLY AVERAGE) FROM APRIL'12 TO MARCH'13

Month	Temp (^{0}C)		Relative Humidity (%)		Wind direction (deg)		Wind speed (km/h)	Cloud Cover (Okta)		Total Rainfall (mm)
	Max	Min	700h	1300h	700h	1300h		700h	1300h	
April'12	28.0	15.5	82.0	64.5	176.7	288.2	5.1	7.3	5.1	151.3
May'12	32.7	18.6	77.0	62.1	160.5	257.3	4.8	4.6	3.8	102.3
June'12	31.9	21.9	84.9	73.6	91.3	231.3	3.7	6.9	6.5	213.8
July'12	32.3	22.8	89.0	70.5	141.5	234.0	4.2	7.4	6.8	209.0
August'12	31.5	22.4	86.4	70.9	133.4	253.5	3.6	7.1	6.2	113.0
September'12	29.8	21.7	88.4	70.9	184.5	228.7	3.4	6.9	6.1	180.6
October'12	29.4	17.5	87.7	68.5	161.3	192.9	2.8	5.5	3.8	161.5
November'12	26.6	12.0	86.5	67.8	158.2	215.0	2.5	4.9	3.0	88.3
December'12	22.8	4.9	88.7	56.2	188.9	242.1	1.8	4.9	2.0	0.0
January'13	23.1	3.0	82.7	34.8	183.4	248.2	1.7	2.5	1.5	0.0
February'13	28.0	7.7	79.3	32.0	147.1	218.4	1.8	3.7	3.0	1.7
March'13	29.0	10.7	79.5	36.6	153.1	262.1	3.8	3.7	3.7	31.8

The mean maximum and minimum temperature was 28.8^{o}C and 14.9^{o}C, respectively. The maximum daily temperature (36.4°C) was recorded on 3rd and 9th July, 2012; whereas, the minimum daily temperature (-0.5^{o}C) was recorded on 11th January, 2013. Total annual rainfall observed during the year 2012-13 was 1253.3 mm. The maximum total monthly rainfall was received in the month of June, 2012 (213.80 mm) whereas, there was no rainfall in December, 2012 and January, 2013. The average maximum and minimum relative humidity during 2012-13 was 84.34% and 59.03%, respectively. Average daily wind speed of 3.27 km/hr was observed during the period.



CROP IMPROVEMENT

RICE

Rice Variety RC Maniphou 12

One newly developed short duration rice variety RC Maniphou 12 was released by the 'State Sub-committee on Crop Standard Notification and Release of Varieties, Govt. of Manipur' in October, 2012. The ceremonial release of the variety was done by Hon'ble Minister of Agriculture in the inaugural function of the Workshop on "Agriculture and Food Security in the Context of Climate

Change" cum Farmers' Fair was inaugurated on 12th October, 2012. RC Maniphou 12 (RCM-13/IET No. 22828) is a derivative of the cross Leimaphou x Akhanphou. The variety takes 75 days to reach 50% flowering and matures in about 90-105 days in summer (March-April sowing) under the valley condition of Manipur. Hence, the variety is suitable for the first crop of the double cropping rice as well as for different cropping system. The variety is 100 cm tall and 50-200 spikelet were obtained per panicle. It has desirable soft cooking (low amylose content-11.70%) quality characters preferred by the people of north eastern hill region. So far as low amylose content is concerned it has been reported in traditional land races. It is a first evolved culture having very low amylose content. The yield potential ranges between 4.5-5.0 t/ha.

RICE VARIETY RC MANIPHOU 12

CEREMONIAL RELEASE OF RC MANIPHOU 12 BY AGRICULTURE MINISTER OF MANIPUR

Rice breeding for high yield and disease resistance for main *khari*f season

Five advanced lines of rice along with three local checks were evaluated in replicated trials for their comparative performance under low land transplanted conditions of Manipur valley. MC-34-10-9-35-35-2 line was flowered in 93 days which was shorter in comparison to all three checks namely, Lungnilaphou, KD-2-6-3 and RC Maniphou 7. However, MC-34-10-3-30-16-1 showed shorter height (123.9 cm) than local check RC Maniphou 7. The lines namely, MC-34-7-5-2-75-33-19 and MC-34-10-9-35-35-2 recorded 7500 and 7167 kg/ha yield, respectively. These two lines were superior all over three local checks.

Rice breeding for high yield and medium duration for main *kharif* season

Sixteen advanced lines of medium duration rice along with two checks were evaluated in replicated trials for their comparative performance under low land transplanted conditions of Manipur valley. Out of 16 lines, 5 lines viz., MC-34-5-10-2-38-02 (94 days), MC-34-5-14-2-5-16 (94 days), MC-34-5-12-4-34-4 (95 days), MC-34-9-7-77-96-62 (95 days) and MC-34-5-8-2-19-95-26 ((97 days) showed early flowering in comparison to local check RC Maniphou 7 (98 days). Superior yield performance was recorded in the lines namely, MC-34-9-7-77-96-62 (9.0 t/ha), MC-34-7-7-17-94-60 (8.83 t/ha), MC-34-13-45-32-69-3 (8.33 t/ha) and MC-34-5-10-2-38-02-27-8 (8.25 t/ha).

Rice breeding for paddy cum fish culture during main *kharif* season

In this trial, 11 entries along with two local checks were tested in low land transplanting conditions for paddy cum fish culture in *kharif* season. All entries were superior in yield performance over both local checks. However, in terms of yield, entries namely, MC-34-7-6-2-72-92-90 (8.41 t/ha), MC-34-4-3-9-31-18 (8.16 t/ha), MC-34-1-26-28-8-4 (8.16 t/ha) and MC-34-4-1-55-1-11 (7.75 t/ha) were found be over other entries.

Crossing programme : A number of intervarietal crosses of rice were attempted during kharif 2012 for testing under upland and low land conditions. The crosses were made with the purpose to create the genetic variability and transfer of desirable of desirable traits:Akhanphou x Bhalum-3, Akhanphou x IET 18564, Phougak x RCM-13, Akhanphou x Bhalum-1, RCM-13 x RCM-23, Akhanphou x RCM-9, IR-64 x Chakhao, Swarndhan x RCM-10, Swarndhan x RCM-23 and Chakhao x Sahsarang. F_1 plants of these were raised.

Advancement of segregating generations : A number of progenies of F_4, F_5 and F_7 generations of rice were evaluated during *kharif* 2012.Fourteen F_4 progenies of MC-46 series were selected with different maturity durations ranging from 90-150 days having high yielding attributes. Similarly,357 F_5 progenies of different MC series such as 42 F_5 progenies of MC-39, 18 F_5 progenies of MC-40, 68 F_5 progenies of MC-41, 13 F_5 progenies of MC-42, 44 F_5 progenies of MC-43, 37 F_5 progenies of MC-44 and 135 F_5 progenies of MC-45 were selected on the basis of yield and its component traits. Selection was also made in F_7 generation and different progenies were selected for maturity duration, high yield and resistant to diseases. Thus, 169 F_7 progenies of rice were selected, out of them 53 F_7 progenies belongs to MC-35 series, 53 F_7 progenies belongs to MC-36 series, 21 F_7 progenies belongs to MC-37 series and 42 F_7 progenies belongs to MC-38 series.

Research Complex Regional Trial (RCRT)

RCRT on low land Rice-1 : In this experiment 18 entries including 3 checks were tested for comparative performance in low land conditions of Manipur Valley during *kharif* 2013. Out of 18 entries, one entry namely, RCPL-1-167 performed exceptionally well and recorded 9250 kg/ha yield.

RCRT on low land Rice-2 : This experiment comprises 14 entries along with two local checks namely, RCM 10 and RCM 21, were evaluated in lowland transplanted conditions in Manipur valley. Among them RCPL 1-145 revealed 7105 kg/ha yield which was better only over one local check viz., RCM-21.

RCRT on Upland land Rice-1 : Ten entries including two checks viz., RCM-5 and RCM-21 were evaluated for comparative performance under upland conditions of foot hills of Manipur during kharif 2012. RCPL-1-114 and RCPL-1-128 recorded better performance with mean yield 2416 kg/ha over only one check viz., RCM-5.

All India Coordinated Trials on Rice-2012

One upland trials of AICRIP namely IVT-U- H (12 entries) were evaluated for their comparative performance under upland (Direct seeded) conditions at Langol farm of ICAR, Manipur Centre during *Kharif* 2012. In IVT-U-H, shortest duration to reach 50% flowering was recorded with entry no. 3101 (69.5 days), followed by 3106 and 3102 (79 days); whereas, maximum duration was taken by entry no. 31012 (91 days). In terms of yield, entry no. 3106 was found to be most promising (4.03 t/ha), followed by entry no. 31010 (3.71 t/ha) and 3108 (3.69 t/ha).

MAIZE

Evaluation of maize genotypes for quantitative traits under foot hill conditions of Manipur

Seventy one genotypes of maize along with one check DS-16 (Composite variety) were evaluated for agro-morphological and biochemical characters during *Kharif* 2012. Among the different genotypes,

RCMM-6 (62 days) and RCMM 26 (62 days) were recorded the shortest duration for days to 50% tasseling whereas the shortest duration for days to 50% silking was noticed in RCMM 6 also. RCMM 10 took the least period for maturity (96 days). A wide range of plant height was revealed among maize genotypes from 172.4 to 359.5 cm. The shortest plant height was measured in RCMM 1 (159.5 cm) followed by DS 16 (188.7 cm) and RCMM 9 (170.5 cm). About all genotypes were non-lodging except RCMM 34 (B). The highest number of cobs per plant were recorded in RCMM 1 (3.2) followed by RCMM-8 (2.7), RCMM 2 (2.6), RCMM 18 (2.3) and RCMM 29 (2.3). It was observed that more than 50 lines had more than one cob. The highest number of kernels/row was observed in RCMM 35(A) (40.6), followed by RCMM 4 (40.2), RCMM 41(A) (39.4) and RCMM 38 (B) (38.4). A wide variation was observed for 100 seed weight. Maximum 100-seed weight was recorded in the RCMM 36 (A) (47.3g) whereas RCMM 1 showed the minimum 100-seed weight (10.1g). It was observed that there was not uniformity for cob length and no regular seed formation in kernel rows. Hence, seed yield was low in majority of genotypes in comparison to check DS 16. In terms of seed yield, check variety DS 16 (5506.7 kg/ha) was found to be highest yielder, followed RCMM 13 (5304.1Kg/ha) and RCMM 3 (4861.1 kg/ha). Genetic parameters of variability were studied for 11 quantitative characters in 72 germplasm lines of maize. The phenotypic coefficient of variation (PCV) was higher in comparison to genotypic coefficient of variation (GCV) for all the characters under studied. High magnitude of PCV was recorded for the characters viz., plant height, number of cobs/plant, cob length, number of kernels/row, 100-seed weight and seed yield. GCV also showed similar trends. High heritability coupled with high genetic advance for plant height and 100-seed weight. While high heritability was observed for the characters namely days to 50% tasseling, days to maturity, plant height and 100-seed weight.

Evaluation of maize gerplasm for agro- morphological and biochemical analysis

A vast diversity was observed for kernel colour. The highest number of genotypes revealed yellow kernel colour (26) followed by white (20), purple (9), red (5), Orange (1), black (1), variegated (1), grey (1) and others mixed kernel colour. However, only two types of kernel were observed such as flint and popcorn. In majority of cases flint type of kernel were recorded in studied genotypes. Green colour of silk was prominently found in maize germplasm lines. Although some lines also showed purple and mixed colour of silk. Out of seventy one lines 44 lines were observed as non-lodging and 21 lodging. It is interesting that all lines were free from banded leaf and sheath blight disease. Albeit majority of lines were infested by cob borer except RCMM 22 and RCMM 29, ranged from 20 to 100%. Grain analyses were done for 4 biochemical traits namely, protein, starch, oil and moisture in percent. Mean protein was revealed 10.38% and ranged from 7.9 to 13.4%. Maximum protein was achieved in the RCMM 8 (13.4%) followed by RCMM 42 (12.7%), RCMM 1 (12.2%) and RCMM 2 (12.2%) whereas the lowest protein (7.9%) was recorded in RCMM 12. The highest starch was noticed in RCMM 22 (77.5%) followed by RCMM 12 (73.6%), RCMM 24 (73.1 %), RCMM 20 (72.7%), RCMM 27 (72.7%), RCMM 25 (72.6%) and Sikkim primitive-2 (72.3%). Mean starch

amount was recorded 70.55% and ranged 68.2 to 77.45%. A wide range was observed for oil (3.9-10.25%) in maize lines with mean oil quantity (5.3%). Maximum quantity of oil was observed in RCMM 5 (10.3%) whereas RCMM 16 showed minimum oil (3.9%). Moisture (%) varies from 9.6 to 13.5%. Highest moisture was found to be present in RCMM 5 (13.5%), whereas lowest moisture (9.6%) was revealed in RCMM 6. Mean moisture was 12.08%.

All India Coordinated Trial on maize

Fifteen entries of hybrid maize including two local checks were evaluated for their comparative performance under foot hill conditions of Manipur during *kharif* 2012. Vivek QPM-9 registered the shorest duration for 50% pollen shedding (58 days) and 60 days for 50% silk emergence. This entry matured in 94 days. The shortest plant height was measured in Vivek Maize Hybrid 43. CMH 08-337 exhibited the superiority over both the local checks (RCMM-27 and RCMM-42) for cob length (20.5cm), ear width (16.4 cm), dry cob weight/plot (7.6 kg) and 1000-grain weight (437.4 g). The entries viz., CMH 08-337 (9746 kg/ha), KNMH 408710 (7608 kg/ha), Vivek Maize Hybrid 43 (7284 kg/ha), Vivek Maize Hybrid 25 (6898 kg/ha) and Vivek Maize Hybrid-23 (6840 kg/ha) performed well and recorded significantly higher yield than over both the local checks.

PULSES

Evaluation and advancement of segregating generations of interspecific crosses of Pigeon pea

In the present investigation, F_5 progenies of two interspecific crosses along with their parents were screened against pod borers under natural field conditions. The progenies are derivative of interspecific crosses ICPL 88034 x *Cajanus scarabaeoides* and UPAS 120 x *Cajanus scarabaeoides*. The test material was kept free from any insecticidal spray throughout the crop season. A range of mean of percent pod damage among parents was revealed 1.8 to 42.9%. Least pod damage was recorded in *Cajanus scarabaeoides* (1.8%) with low seed yield/plant (10.9 g). Out of 18 F_5 individual plant progenies were selected on the basis of yield and its attributing characters as well as pod borer infestation, 11 F_5 progenies were found promising from the cross ICPL 88034 x *C. scarabaeoides*. A promising progeny RCMP10131-1-2 showed good plant type with plant height (126cm), primary branches/plant (6), pods in cluster, least pod damage (1.03%), pod length (4.9 cm), seeds/pod (4.2), no seed damage (0.0), undeveloped seeds/pod (0.4) and seed yield/plant (20.8g). Another progeny RCMP1018-1-2 had the highest number of pods/plant (287) with seed yield/plant (86.15g), less pod damage (1.74%), desirable pod length (5.42 cm) and seeds/pod (4.6). A wide range was observed for the characters viz. undeveloped seeds/pod (0.0-1.4), pod length (4.5 to 6.1 cm) and seed yield/plant (12.79-86.15g). RCMP 10241-1-1 showed the highest seed yield/plant (50.83g) along with pod damage by pod borer (9.17%) and damaged seeds/pod (0.0) whereas undeveloped seeds/pod was observed (0.2). RCMP10239-2-2 revealed the desirable traits namely; plant height (159cm), primary branches/plant (16), long branches, semi determinate type, pod damage by pod borer (5.13%), pod length (5.3cm), seeds/pod (4.4), damaged seeds/pod (0.0), undeveloped seeds/pod (0.6) and seed yield/plant (31.6g).

MULLaRP on Summer Mung Bean

An IVT on summer mungbean comprising 17 entries was conducted for evaluating the comparative performance under valley conditions of Manipur during *summer* 2012. Out of 17 entries, SM 12-58 revealed good performance for yield attributing traits namely days to maturity (60 days), plant height (24.6 cm), primary branches/plant (5.0), SM 12-58 (4.0 g) and pods/plant (10.9).

NATURAL RESOURCE MANAGEMENT

AGRONOMY

Biomass management in cropping systems for enhancing productivity and resource use efficiency under hill regions of Manipur

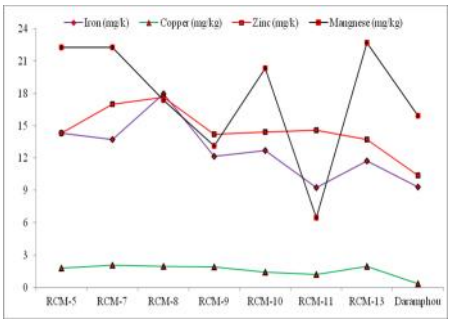
The present experiment was laid out in split-split plot design with combinations from four pre kharif green manuring treatments (control, cowpea, greengram and sesbania) in main plots. Three cropping systems [(maize sole, groundnut sole and maize + groundnut (additive series)] in sub plots and their residue recycling (kharif) treatments of were Maize/Groundnut and Maize + Groundnut (without residue and with residue) in sub-sub plots each replicated thrice. Among the green manuring sesbania followed by cowpea recorded significant effect on maize and groundnut yield under sole as well as intercrop than control treatment. Under cropping system, maize + groundnut (additive series) gave significantly 14 and 172% higher grain equivalent yield sole groundnut and sole maize, respectively. Effect of pre kharif residual green manuring and residue recycling (kharif) [maize/groundnut/and maize + groundnut] had significant effect on dry pod yield of pea. Green manuring with sesbania gave highest dry pod yield (2.05 t/ha) followed by cowpea green manuring (1.96 t/ha) than control (1.86 t/ha) treatment. Among the residue recycling (kharif) maize + groundnut residue was increased 24% dry pod yield over control.

GREEN MANURING OF COWPEA, GREENGRAM AND SESBANIA

SOLE MAIZE, SOLE GROUNDNUT, MAIZE + GROUNDNUT INTERCROPPING

Agronomic biofortification of rice with micronutrients

The seven varieties released from Manipur centre including one local variety were tested for their starch, protein, NPK and micronutrient content. Among all the varieties RCM-8 recorded highest iron (17.97 mg/kg) and Zinc content (17.63 mg/kg). RCM-9 recorded highest protein content (8.78%), RCM-13 recorded highest content of copper (1.93 mg/kg) and manganese (22.7 mg/kg) and the local variety Dharamphou recorded the highest content of starch (68.65).



Micronutrients concentration of various rice varieties

SOIL SCIENCE

Standardization of balanced nutrient management for improving productivity of maize in acidic hill soils

An experiment was initiated in 2011 to determine the effect of organic manure (FYM) and fertilizers including micronutrients (Zn, B) on performance of maize (*cv* Pusa Composite 3). The experiment was repeated during the reporting period (2012-13) for validation. There were eight treatment combinations: control (T_1), 10 t FYM /ha (T_2), 100% NPK (T_3), 100% NPKZnB (T_4), 100% NPKZnB + 10 t FYM /ha (T_5), 100% NPKZnB + 5 t FYM /ha (T_6), 50% NPKZnB + 10 t FYM /ha (T_7) and 50% NPKZnB + 5 t FYM /ha (T_8). 100% NPKZnB represented 120 kg N; 80 kg P_2O_5; 60 Kg K_2O; 5 kg Zn; 1 kg boron/ha. The results showed that different combination of organic and inorganic nutrient sources significantly increased maize grain yield over the control; mean magnitude of increase being 33.8% over the control. Similar increase in yield was also recorded in the first year 36.4%. The highest yield was recorded with T_5 (6 t/ha) followed by T_4, T_6, T_3, T_7, T_2, T_8, and T_1 (control) in decreasing order and the highest stalk yield was recorded with T_5 (11 t/ha) followed by T_6, T_4, T_3, T_7, T_8, T_2 and T_1. The results thus indicated that the integration FYM and mineral fertilizers including Zn and B was more beneficial in increasing maize yield as compared to only either FYM or inorganic fertilizers. The efficiency of balanced fertilization was also supported by higher values of yield related characters such as number of grain/row in cob, number of grain/cob and 100 grain weight and harvest index with those treatments (T_3-T_8).

Soil test based fertilizer recommendation for targeted yield of rice in acid soils of Manipur

Fertilizer adjustment equations were developed for direct seeded upland rice using the basic data. Based on theses equations, fertilizer recommendations were prescribed in the form of ready reckoner for desired target yield of 30 and 40 q/ha of direct seeded rice with different combination of NPK under rainfed upland situation of Manipur. The targeted yield equations for direct seeded rainfed upland rice and fertilizer recommendations were validated by conducting experiments in the farmers' field. The targeted yield equations for direct seeded rainfed upland rice (RC Maniphou 6) in Manipur is as given below:

Basic data and fertilizer adjustment equations for targeted yield

Basic data	**N**	**P**	**K**
Nutrient requirement (kg/q)	2.75	0.20	3.53
Soil efficiency (%)	9.63	12.15	21.34
Fertiliser efficiency (%)	52.92	13.73	126.04
Fertilizer adjustment equations			
FN = 5.19T – 0.18SN **FP** = 1.48T – 0.89SP **FK** = 2.80T – 0.17SK	*SN, SP and SK, soil available nitrogen, phosphorus and potassium (kg/ha); FN, FP and FK, fertilizer nitrogen, phosphorus and potassium required (kg/ha)*		

SEED TECHNOLOGY

Participatory Development of Rice, Maize and Rapeseed Quality Seed Production Practices for Seed Village

The project involving KVKs and famers' participatory approach aimed at developing a suitable seed production system for the NEH region in major important cops was taken up in five different districts *viz*., Imphal West, Imphal East, Churachandrpur, Tamenglong and Chandel. In the first year it was

successful in the first three districts only. Altogether twenty four famers were involved. The quality of seed produced with this programme could reach the Indian Minimum Seed Certification Standards. In rice 95%, in maize 80% and in rapeseed 92% could attain the standards. Continuous monitoring and involvement were required for initial stage. In rice, varieties RC Maniphou-7 and RC Maniphou-10, the off-types could be reduced to 0.05% (in both varieties) as compared to 3.75% under farmers' conditions. In maize too the purity of the variety could be maintained to certification standard. Seed Produced of Pusa Composite-3 with time isolation by *rabi* sowing Churachandpur District and Imphal West was maintained IMSCS to certifying level quality. In rapeseed, M-27 too, time (September to October) sowing with zero tillage technique (time isolation) could avoid bee outcrossing. Seeds stored under desiccated condition low cost RC Seed bin maintained the seed moisture throughout. Seed moisture in RC-Seed Bin was maintained at 10.5% in rice, 10.7% in maize and 8.25% in rapeseed.

Rice RC Maniphou 10 Seed Quality level under Farmers' Participatory Seed Village Approach

Standards under Indian Minimum Standard	Seed Produced under Supervision	Check
Purity (grow out 99.80%)	99.95%	96.25%
Pure seed (98%)	99.00%	94.15%
Inert matter (2.5%)	0.58%	3.75%
Weed Seed (10/Kg)	1.10	12.15
Germination (80%)	88.25%	79.15%
Moisture content (13%)	10.85% (seed bin)	13.45%

Maintenance Breeding of Locally Released Varieties of Rice and other Recommended Crop Varieties

Under the project, rice varieties released from the centre are being maintained through panicle row selection and basic seeds are being produced every year. Seeds were supplied to the framers either directly under different demonstration programmes or through state department for seed production programme. Two varieties for pre *kharif* are RC Maniphou-4 and -5 and main *kharif* varieties RC Maniphou-6, -7, -10 and -11 are taken up. During the year, altogether 7740 kg basic and 7400kg labelled seeds in rice were produced. In kharif, RC Maniphou 7 and RC Maniphou 10 were raised getting 99.98% and 99.95% purity respectively. Similarly, in RC Maniphou 6 purity was 99.67%. In addition to this, 300 local rice germplasm are also maintained. Out of these thirty genotypes are of 100-120 days, 78 are of 120-130 days and 192 genotypes are of above 130 days duration. In other crops too, maize composite variety Pusa Composite 3 has been maintained since 2005 with time isolation by sowing during *rabi*. In maize, Pusa Composite-3 was maintained with time isolation by *rabi* planting (December-January) in the valley area and 140 kg of basic seed was produced. Rapeseed variety M 27 was maintained for 7 years with purity level of 98.75% through early sowing (August-October) and selection (rouguing). In M27 60 kg of breeder quality seed and 540 Kg foundation seed were produced. In groundnut, variety ICGS 76 (160 kg seed) and in soybean, variety JS 335 (160 kg) were maintained.

Basic Seed Production in Rice during 2012-13 at ICAR RC Manipur Centre

Rice Variety	Quantity (Kg)		Total
	Basic Seed	Labelled Seed	
RC Maniphou 4 (RCM-7)	420	-	420
RC Maniphou 5 (RCM-8)	310	-	310
RC Maniphou 6 (RCM-5)	150	300	450
RC Maniphou 7 (RCM-9)	3500	1100	4600
RC Maniphou 10 (RCM-10)	450	6000	6450
RC Maniphou 11 (RCM-11)	2200	-	2200
RC Maniphou 12 (RCM-13)	710	-	710
Total rice	**7740**	**7400**	**15,140**
Soybean (JS-335)			160
Groundnut (ICGS 76)			160
Maize (Pusa Composite 3)			140
Rapeseed (M 27)			600
Total other crops			**1060**

MAINTENANCE BREEDING OF RELEASED RICE VARIERTIES

Maintenance breeding of maize Pusa Composite 3 with time isolation (rabi sowing)

Development of Seed Production Packages in Important Crops

In wetland rice, repeated sowing and planting of the same variety for 3 years could reduce the off-type level to 0.001% as compared to 0.02% by growing different variety(/ies). In other self pollinated crops like peas, soyabean, groundnut, varietal contamination was negligible. But it was clear in rapeseed and maize. As the holding sizes are small, time isolation was found to be better to maintain the purity level. In upland crops like soybean and groundnut, rainfed nature pauses the biggest uncertainty in quantity and quality. Almost all standard seed production practices are adopted for seed source, site selection, roguing, handling and storage. In outcrossed crops like maize (rabi, December-January sowing), rapeseed and mustard (Aug to Oct., depending on soil moisture), time isolation were more practicable than the distance isolation. Thus maize needs irrigation water and rapeseed M-27 can be sown with zero tillage to catch the earliness. For pre-kahrif rice seed production studies in wetland rice found that the spacing of 20cm×10cm with a gap of 0.5 m after every 1.5m favours ease in interculture and rouguing giving a seed yield of 4.2 t/ha. In pre *kharif* yield of RC Maniphou 6 was 3.75 t/ha, RC Maniphou 4 (3.54 t/ha), RC Maniphou 5 (3.15 t/ha). In *khari*f varieties, higher yields of RC Maniphou 7 (4.25 t/ha), RC Maniphou 10 (4.75 t/ha) and RC Maniphou 11 (4.45 t/ha) were also recorded. In maize good seed under *rabi* (January) sowing was obtained as intercrop with field pea (Rachana). Seed yield in pea was negligible due to the poor *rabi* rains. In rapeseed, too the early zero tillage sowing Aug-Sept. in the hill gave a yield of 0.45 t/ha. In the valley too, zero tillage sowing

during November- December gave better crop stand and seed yield (0.5-0.75t). In soyabean (JS -335) spacing of 40cm×30cm was found better over closer spacing. In groundnut early sowing during first pre-monsoon (Apr-May) was favourable better seed health and quality.

Seed Production of Soybean (JS 335) and Groundnut (ICGS 76) At Langol Hill Research Farm, ICAR-Manipur Centre

Regional Workshop on Seed Programme for NEH States

NATIONAL AGRICULTURAL INNOVATION PROJECT (COMPONENT III)

During the *kharif* season, 2012-2013 the progamme "Quality Saved Seed Production" was taken up in the four cluster villages *viz.* Noney, Reangkhong, Awangkhul and Tupul Charoi Chagotlong in rice, groundnut and soybean. The average yield of RC Maniphou-10 during the season ranged from 3.0 t/ha in Awangkhul village to 4.0 t/ha in Noney village as against the local check yield of 2.9 t/ha. The recorded yield of groundnut (var. ICGS-76) was 1.25 t/ha cultivated in 1 ha adopting 10 total no of farmers. Soybean gave a satisfactory yield of 1.87 t/ha. Though agriculture in the district was mono-cropped keeping the lands mostly fallow during the *rabi* season, zero tillage technique in rapeseed M 27 allows farmers to plant 15 days earlier than usual. Since the cost of land preparation is nil, it generated higher net income. During rabi 2011-12 rapeseed M-27 under zero tillage was in 180 ha area in four villages of the cluster by 249 farm families. Thirty eight bee boxes were also distributed to the farmers in order to generate additional income to the farmers and to increase the oil yield. Potato was also cultivated in a total area of 31 ha adopting 301 farm families in the three cluster villages of Project sites. 120 farm families were adopted pea cultivation in 5.70 ha area and crop performed good under minimum tillage practices in cluster villages. An area of 2.0 ha for cabbage cultivation *var.* Rareball was adopted by 43 farm families with an average yield of 9.28 t/ha. In the model mini polyhouse established at 3 cluster villages with farm families, 110 nos of capsicum plants (var. California Wonder) and 90 nos. tomato plants (var. Nidhi) were planted. Nine training programme on different topics were conducted at different villages of NAIP cluster villages by the scientist of ICAR RC, Manipur Centre for the benefits of the farmers.

Pig, goat and poultry farming: ***A tool to promote sustainable livelihood in Tamenglong District of Manipur :*** A total of 21 farm families of four cluster villages viz. Marangching, Noney, Reangkhong and Awangkhul have been selected. The adopted farmers started rearing with cross breed Hampshire piglets with initial body weight of 7.0 to 8.0 ± 2.0 kg where the distribution were made @ 3 piglets (2F + 1M) to each beneficiary. An average net return of Rs 65,438.00 per farm family could earn through rearing of improved Hampshire pigs and improved the livelihood of poor farmers. A total of 60 nos (one male and two female kids per beneficiary) of Black Bengal goats (4-5 months old) were distributed with a body weight approximately 5-7 kg. Average daily weight gain was 29.25 g. Dressing percentage was 45.00±0.50 and average milk yield/day was 0.30 kg. A minimum of two kids were achieved from goat with a litter size of 2 kid/kidding. Distribution of the farmer's income according to their annual rearing through goat husbandry was that half (50%) of the farmers had earned more than Rs. 8500/ year through goat husbandry. The farmers annually earning up to

Rs.5000/- through goat husbandry were 30%. Remaining 20% farmers earned Rs.5001 to Rs.8500/year. A total of 600 Vanaraja chicks (4-5 weeks age) were introduced with 20-25 chicks per family in four villages. The result in field conditions indicated that Vanaraja male attained average body weights of 0.90 kg, 1.60 kg, 2.75 kg, 3.15 kg while Vanaraja female attain 0.82 kg, 1.15 kg, 2.25 kg, and 2.60 kg at the ages of 8 weeks, 10 weeks, 20 weeks and 40 weeks, respectively. The average age of sexual maturity was 171 days and average egg production of 147 eggs/hen /annum with an average egg weight of 58g. The pullet weight was 2.55 kg. The percentage of fertility and hatchability was 71.13% and72.7% respectively. Farmers could generate incomes between Rs.10,000-15,000/- per farm family by selling of Vanaraja eggs and birds.




NATIONAL INITIATIVE ON CLIMATE RESILIENT AGRICULTURE (NICRA)

Effect of submergence tolerance of growth and yield of rice

Submergence tolerance study was continued on five rice varieties *viz.*, RC Maniphou-6, RC Maniphou-4, RC Maniphou-7, Taothabi and Akutphou, during *kharif*, 2012. The varieties with 60, 50, 35 and 25 days old seedling were half submerged for 5, 10 and 15 days and full submergence for 5, 10 and 15 days. For grain yield (kg/plant), 60 days old seedling RC Maniphou-6 gave the highest grain yield of 0.041 kg/plant under half submerged condition for 15 days. However, RC Maniphou-7 and Taothabi had the higher average rate of survival. For plant height, Taothabi had the highest plant height of 136.0 cm followed by RC Maniphou-4 with 135.0 cm in 60 days old seedlings half submerged for 15 days. In RC Maniphou-4, the longest panicle was found in 15 days half submerged condition in 60 days old seedlings. Full submerged 50 days and 60 days old seedling had almost similar panicle length. In most of the varieties, 50 days old seedling had longer panicle length than 60 days old seedlings in both half and full submerged conditions. Longest panicles (27.3 cm) were found in Taothabi with 5 days half submerged 50 days old seedling, followed by 15 days half submerged 50 days and 60 days old seedlings (25.7 cm and 25.0 cm, respectively). Highest tiller number was reported in Taothabi under 5 days half submerged 50 days old seedlings.

Screening of local maize genotypes for cold tolerance

In order to find out the suitability of maize varieties for early sowing to adjust with the untimely rains cold tolerance study was carried out with 11 local genotypes with Pusa Composite-3 as check. The genotypes collected from Ukhrul (*viz., Tharathei, Khamathei white, Khamathei yellow, Khamanuthei, Angjianchu* and *Vekla*), Chandel (*viz., Chechata* and *Kumpuchecha)* and *Churachandpur (viz., Vaiminphei, Vaiminmaan* and *Kaunvok*), were sown on three different early dates with an interval of 5 days after each sowing. Among the genotypes Tharathei, *Khamathei white, Khamathei yellow, Angjianchu and Vaiminmaan* sown on 28th Dec, 2011 (late sowing) has higher plant height than early sowing on 19th and 23rd Dec, 2011. *Khamathei* yellow was the tallest (228.0 cm) followed by *Tharathei, Vaiminphei, Chechata and Vekla.* Vekla required shortest duration (102 days) to reach 50% flowering; whereas, Kumpuchecha requires the longest duration (167 days to reach 50% flowering). *Angjianchu was earliest* to 50% silking (102 days), followed by *Khamathei white* (122

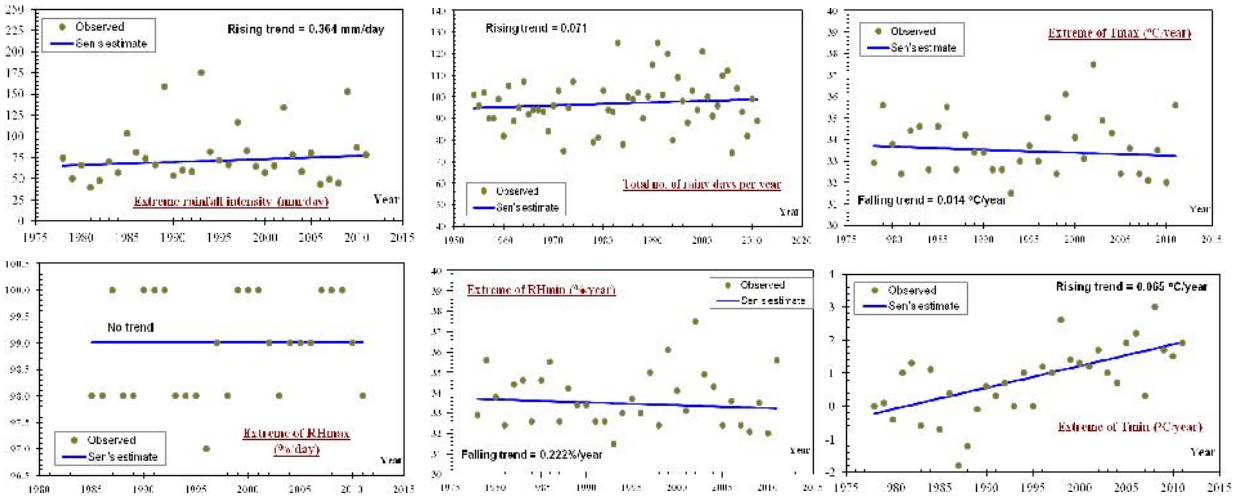
days); while the *l*ongest 50% silking was recorded with *Kumpuchecha* in all the sowing date. In terms of ear length (cm), *Vaiminmaan* has the shortest ear (10.52cm) while *Kaunvok* has the longest (23.46 cm) ear followed by *Vekla (21.94 cm). Vaiminmaan* bears higher number of kernels per diameter (18.2), but has the lowest no. of kernels per row. Kaunvok has the highest no. of kernels per row higher than the check Pusa Composite-3. *Kumpuchecha* has the longest duration with 204 days, 202 days and 199 days sown on 19th, 23rd and 28th Dec, 2011 respectively. All the other local varieties are almost in the similar maturity range of 170-185 days. The germplasms *viz., Khamathei white, Vaiminphei and Chechata* are found better suited for cold conditions. From the study germplasm *Khamathei white, Vaiminphei* and *Chechata* were found to give the higher grain yields (3.38, 2.29 and 2.47 respectively) over other varieties under the minimum temperature ranges of 1.9 to 11.5^{0}C in the first sowing, 2.1 to 11.5 ^{0}C in second sowing and under 1.0 to 11.5 ^{0}C in third sowing.

Impact of Climatic Factors on Production and Productivity of Tomato

The experiment was undertaken with 10 tomato genotypes under three growing conditions viz. natural field condition (exposure to frost), low-cost poly house condition (exposure to drought) and 50% agro shade net condition (exposure to low light intensity) to study the different growing conditions on tomato as well as to identify suitable genotype under different growing conditions. The high temperature and drought condition under poly house has resulted 37.21% decline in fruit yield as compared to natural field condition. During rabi season, tomato variety Manikhamnu and Manileima (1.96 & 1.95 kg/plant) has been found to be tolerant against frost condition; whereas, Kashi Hemant (2.53 kg/plant) has performed better over other genotypes under low light condition. Tomato variety RC Manikhamenashinba 1 (Selection 9A) has shown tolerance to drought and high temperature (1.97 kg/plant). During kharif season, tomato variety Manikhamnu (1.75 kg/plant) has been found to be suitable under natural field condition, followed by Selection 11 (1.70 kg/plant). RC Manikhamenashinba 1 (Selection 9A) has shown tolerance to drought and high temperature (1.30 kg/plant); whereas, under agro-shade net condition, Kashi Anupam (2.04 kg/plant) has been found to be most suitable.

MANILEIMA **KASHI HEMANT** **KASHI ANUPAM** **SELECTION 9A**

For efficient crop planning and water management under the existing trend of global climate change, the trend analysis of extreme weather variables namely extreme maximum rainfall (1978-2011), total no. of rainy days (1954-2011), extreme maximum and minimum temperature (1978-2011) and extreme maximum and minimum relative humidity (1985-2011) at ICAR Research Complex for NEH Region, Manipur Centre (24^{o}45'N, 93^{o}54'E, 774 m above MSL) using Mann-Kendall test and Sen's slope method, showed varied annual trends. Rising trend has been observed for extreme maximum rainfall (0.364 mm/day), total no. of rainy days (0.071/years) and extreme minimum temperature (0.065^{o}C/year); whereas, falling trend has been noticed for extreme maximum temperature (0.014^{o}C/year) and extreme minimum relative humidity (0.222%/year). No trend has been observed for extreme maximum relative humidity.



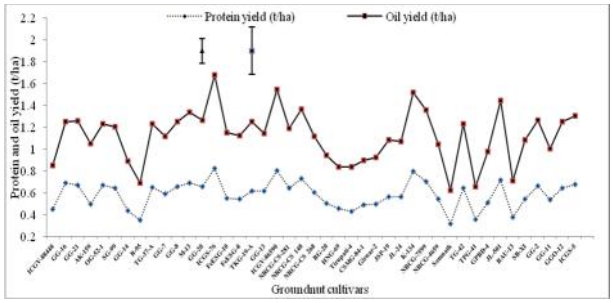
Trend Analysis of Extreme Weather Variables of Imphal Region

Influence of micronutrients and mulching on carbon sequestration in maize based cropping system under climate change of Manipur

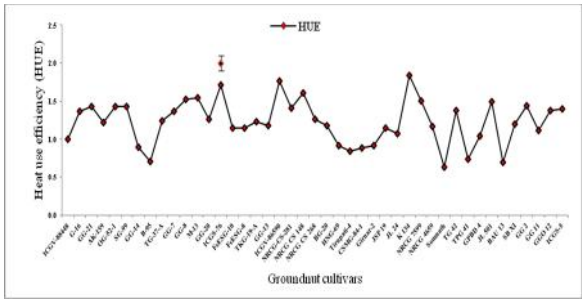
The experiment was laid out in split-split plot design with combinations from four micronutrients treatments (Control, Boron, Zinc and Boron + Zinc) in main plots. Two residue recycling treatments were (With maize residue and without maize residue) in sub plots. Five cropping systems (Mustard sole, Pea sole, Lentil sole, Mustard + pea and Mustard + lentil) in sub-sub plots. Application of boron and zinc together gave significantly higher maize yield (4. 55 t/ha) than Boron (4.11), Zinc (4.01 t/ha) and control (3.74 t/ha) treatments. Residue recycling had also significant effect on next season crops (mustard, pea and lentil as well as their intercropping system). Maize residue recycling on an average increased the 12-15%, 13-16% and 9-12% grain yield of mustard, pea and lentil, respectively under sole and intercropping system. The cropping system had significant effect on mustard grain equivalent yield of mustard under pea sole (2.4 t/ha) followed by mustard + pea (2.0 t/ha).

Evaluation of production potential, profitability and quality vis-à-vis accumulated heat unit requirement of groundnut (*Arachis hypogaea* L.) cultivars in acidic soils of Eastern Himalayan Region

The treatments consisted of 43 groundnut cultivars, which were replicated thrice in randomized block design. Among all the cultivars, ICGS-76 followed by ICGV-86590 was the best performing variety in acid soils and recorded the significantly higher in respect of dry pod yield (3.4 t/ha), protein yield (0.82 t/ha) and oil yield (1.68 t/ha). From the results it was observed that some cultivars used heat more efficiently. Under NEH Region heat tolerant cultivar K-134 (1.8) and ICGV-86590 (1.8) had significantly highest HUE followed by ICGS-76 (1.7) than other cultivars. The lowest HUE was observed in Somnath (0. 6) and B-95 (0.7).



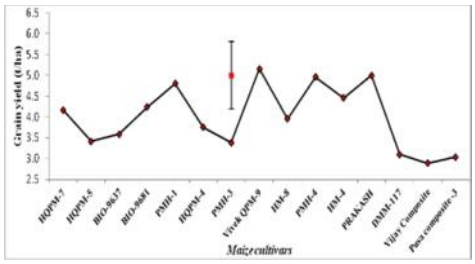
Protein and oil yield of groundnut cultivars
(*Vertical bar represents L.S.D. (P = 0.05) significant level)*



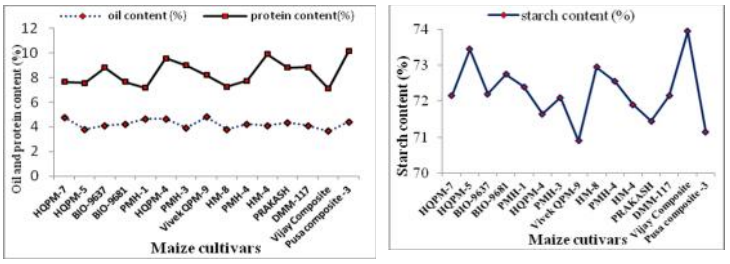
HUE of various groundnut cultivars
(*Vertical bar represents L.S.D. (P = 0.05) significant level)*

Evaluation of Production Potential, Profitability and Quality of Maize (*Zea mays L.*) Cultivars in Acidic Soils of Eastern Himalayan Region

Among all the cultivars, Vivek QPM-9 followed by Prakash was the best performing variety in acid soils and recorded the significantly higher in respect of grain yield (5.15 t/ha). The quality parameters (protein oil and starch content) were analyzed by *FOSS grain analyzer (Infratec-1241).* The oil content was higher in Vivek QPM-9 (4.8%) followed by HQPM-4 (4.65%) than other cultivars (Fig. 1). The protein content was higher in Pusa composite-3 (10.15%) followed by HQPM-4 (9.55%) than other cultivars. However, the starch content was maxim in Vijay composite (73.95%) followed by HQPM-5 (73.45%).



Grain yield of various maize cultivars
(Vertical bar represents L.S.D. (P = 0.05) significant level).



Quality of various maize cultivars
(Oil, Protein and starch content)

Performance of cross bred piglets (Hampshire & Yorkshire) under agro-climatic conditions of Manipur

The Performance of 15 CB piglets (Yorkshire & Hampshire) distributed among beneficiaries of Imphal west (Four) and Tamenglong (three) were assessed to evaluate unique characteristics of the animals (Productive and reproductive traits). The average body weights at different ages recorded in the valley district of (Imphal West) and hilly district of (Tamenglong).

Tamenglong District								
Genetic group	Av. Body weight (kg)							
	At 2 mth.		At 3 mth.		At 4 mth.		At 5 mth	
	Male	Female	Male	Female	Male	Female	Male	Female
Hampshire CB	8.48	7.53	9.49	9.39	9.91	9.63	10.62	10.25

Imphal West								
Genetic group	Av. Body weight (kg)							
	At 2 mth.		At 3 mth.		At 4 mth		At 5 mth	
	Male	Female	Male	Female	Male	Female	Male	Female
Yorkshire CB	9.15	9.12	9.43	9.48	10.97	9.85	11.96	10.43

Growth rate was better in valley district of Imphal West, this indicated better availability of food resource from various source like hotel waste, kitchen waste etc and provided better nutrition. Average daily weight gain in male is 14 g / day at 3 to 4mth and in female is 4 g/day in Hampshire CB and 51g/day in male and in female is 12 g/day HSR X YSR. Average daily weight gain in male is 23 g / day at 4 to 5mth and in female is 20 g/day in Hampshire CB and 33g/day in male and in female is 19 g/day HSR X YSR.

Prophylactic measures like deworming and vaccination were given .The piglets were vaccinated against Hog cholera and FMD. De-worming for internal parasite was accomplished with Piperazine liquid and Albendazole. There was no mortality upto 4 month .The overall morbidity % recorded was 55% and major clinical conditions recorded were Anorexia-7 (55%) followed by Diarrhoea- 3 (15%) and Skin disease- 1(5%). Cocidiosis and ascariasis are common GI parasitism among the piglets.

Studies on breeding behavior of *Channa punctata* and *Pangia pangio* in different temperature regime

Breeding of *Channa punctata* is generally occurring in the month of April to June with the onset of monsoon. An experiment was conducted to study the breeding behavior, fertilization and hatching of this fish species in different temperature levels. The matured brooder (male and female) were collected from the rearing tank. Prior to breeding, they were fed with pelleted feeds containing 50% protein. On the eleventh day they were injected with 0.7 ml/kg dose of Wova-FH. Injection was given intramuscularly into the dorso-lateral region of both males and females and release in fibre glass tanks having different water temperature i.e. 24°C, 26° and 28°C using thermostat heaters. The fishes show different latency period 8 to 10 hours. Rate of fertilization and number of fertilized eggs were different in different temperature. Hatching occur after 48 hours of spawning and highest survival rate were obtained in fishes maintained at 26° C and 28°C respectively Breeding and hatching performance of *Pangia pangio* were studied in different temperature i.e., 22°C, 24°C, 26° and 28°C respectively. Matured *Pangia pangio* brooders having body weight of 2.5±0.2 g (male) and 1.7±0.2g (female) being 1.7g were selected at the ratio of 2:1 (Male:female). A series of plastic tanks having (360×310×130) mm with a water depth of 8cm were taken in duplicate and maintained temperature at ., 24°C, 26° and 28°C respectively. Water quality such as temperature, pH, dissolved oxygen, carbon dioxide, nitrates, nitrites, phosphates etc of the spawning tray were analyzed by using water testing kits Aquacheck (Rankem). Fishes were given hormone injection at same dose of 0.05ml/100g of fish. A good chasing behavior was observed among the brooders kept in the temperature 24°C, 26° and 28°C. The fishes maintained at 22°C showed no active movement or courting. The fishes remain hiding in shaded areas of the tank. Highest number of egg released and fertilization were observed in fish kept at 26°C. Fishes maintained at water temperature of 28°C released low number of eggs and fertilization rate were also low i.e, 45% of total eggs released. From the results, it is evident that normal spawning of *P. pangia* occurred at close 26°C a lower temperature such as at 22°C, no spawning was observed. Again a higher temperature of 28°C, a very low spawning was seen. The percentage of fertilization and hatching rate of *Pangia pangio* were influence with the range of temperature. Highest percentage of fertilization (97.8%) was noticed in *P. pangia* at 26°C.

HORTICULTURE

Tomato Variety RC Manikhamenashinba 1

One newly developed high yielding tomato variety RC Manikhamenashinba 1 was released by State Sub-committee on Crop Standard Notification and Release of Varieties, Govt. of Manipur during October, 2012. Ceremonial released of the variety was done by Hon'ble Minister of Agriculture, Govt. of Manipur on 12th October, 2012. The variety is a progeny of the cross Punjab Chhuhara x Marglobe and was bred with the objective of developing HYV having resistance to biotic and abiotic stresses. The variety is suitable for rainfed/irrigated and paddy fallow (life saving irrigation). Good quality seed can be easily produced without any special problems as it is open pollinated variety. The variety has a yield potential of 425 q/ha under good management practices. The fruits have smooth fruit surface, soft firmness, juicy pulp, 6.7^{o}Brix TSS and good shelf life at proper storage condition. The variety is moderately resistant to bacterial wilt and tolerant to leaf curl disease. Under NICRA, the variety has also been found to be tolerant to moisture stress; and hence it is relatively free from fruit cracking which is a major problem in tomato due to imbalance of water.

BEARING PLANTS AND HARVESTED FRUITS OF TOMATO VARIETY RC MANIKHAMENASHINBA 1

CEREMONIAL RELEASE OF TOMATO VARIETY BY AGRICULTURE MINISTER OF MANIPUR

Tomato improvement programme for high yield and resistance to biotic and abiotic stresses

Four advanced lines of tomato along with one check were evaluated in replicated trials for their comparative performance under Manipur valley. In terms of yield, RCT-1 was found be most promising (48.27 t/ha), followed by RCT-2 (38.70 t/ha) and TMC-2 (34.74 t/ha); as compared to check variety DVRT-2 (33.76 t/ha).

Taro improvement programme for high yield and resistance to biotic and abiotic stresses

Ten high yielding clones of colocasia (RCMC-1 to -10) along with one check (Muktakeshi) were evaluated in replicated trial under terraced condition. Among the genotypes, maximum yield (37.05 t/ha) was recorded with RCMC-9; followed by RCMC-10 (35.25 t/ha) and RCMC-4 (33.93 t/ha) as compared to check variety Muktakeshi (19.70 t/ha).

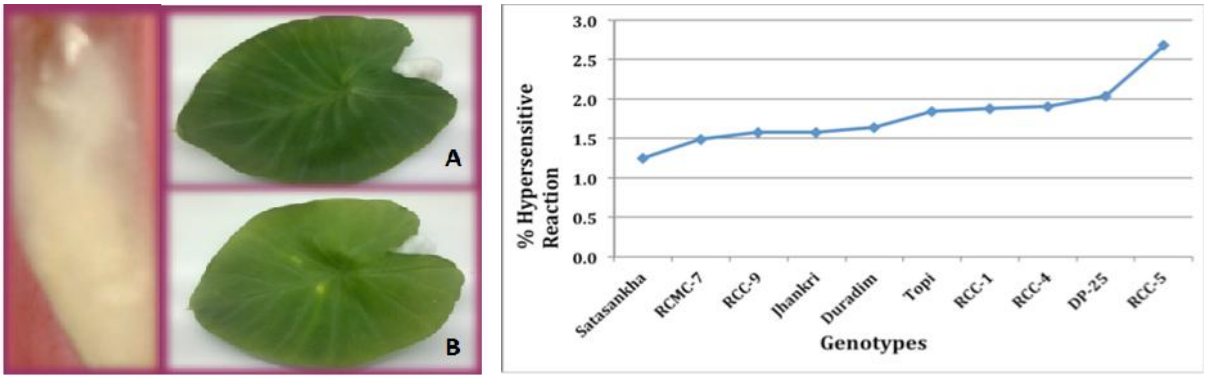
Taro Clone RCMC-9

Taro Clone RCMC-10

Taro Clone RCMC-4

Screening of taro genotypes for *Phytophthora* leaf blight

A sizeable population comprising of 62 genotypes of taro genotypes has been collected from different parts of Manipur; ICAR-RC-NEHR, Nagaland Centre and RC CTCRI, Bhubaneswar. The genotypes were screened *in vitro* for *Phytophthora colocasiae* using cell wall glucan elicitor inoculation technique. Elicitor has been prepared from the harvested mycelia mats of *Phytophthora colocasiae* Racib. through blending, filtering and homogenizing with chloroform, methanol and acetone. Ten microlitres of glucan elicitor was injected in the *Colocasia* leaves and the Hypersensitive Response (HR) was observed. The taro genotypes were screened based on the degree of HR.



Hypersensitive response in susceptible (A) and tolerant (B) genotype of taro

Popularization of tuber crops in Manipur through training, demonstration and entrepreneurship development

Attempt has been taken to popularize advanced tuber crops technologies through training, demonstration and development entrepreneurship in Manipur. Under this programme about 90 farmers in the village Thoyee, Riha and Khonglo in Ukhrul district have been trained with scientific cultivation practices of different tuber crops. Quality planting materials of cassava and taro has been distributed amongst the progressive farmers for successful demonstration of these two important tuber crops. Training programmes for the extension functionaries and entrepreneurs have also been organized for scientific management, value addition and commercialization of tuber crops based products in the state. Under this programme, starch extraction plant and chipping plant have been proposed to be set up in the ensuing season. A tuber crop growers' association comprising of 100 progressive farmers, 50 SHG members and 25 RYs has been constituted for successful production, value addition and marketing of tuber crop products for higher profitability.

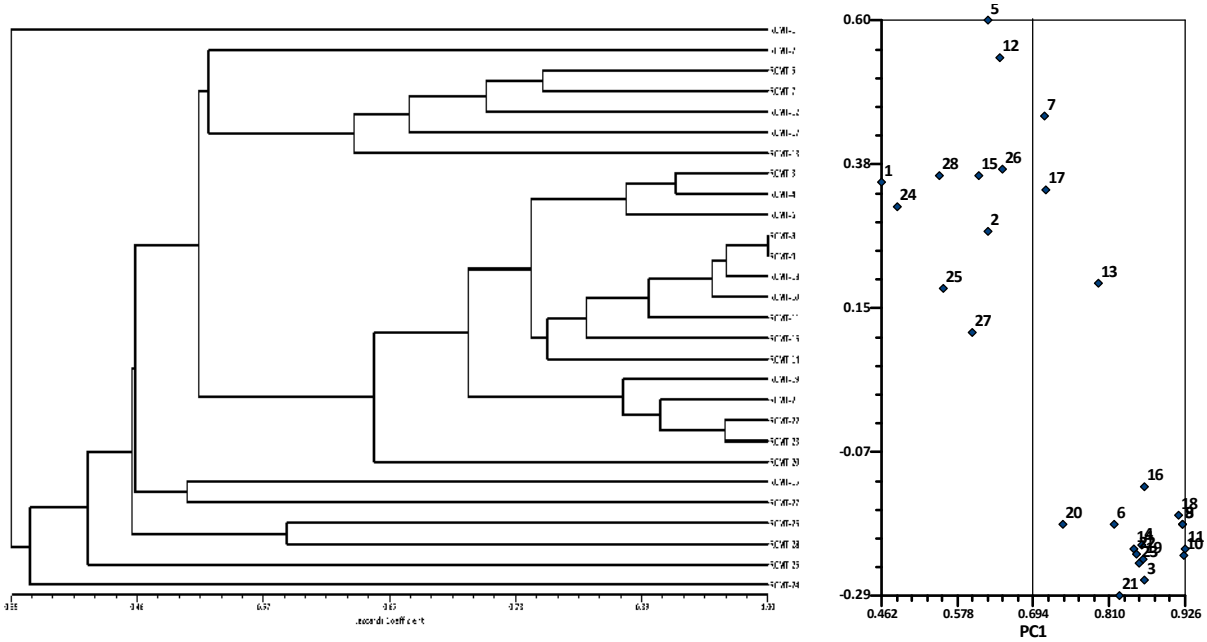
Dissemination of tuber crops technologies through training to farmers, SHGs and extension functionaries

Distribution of quality planting materials of Cassava and *Colocasia* at Thoyee village of Ukhrul

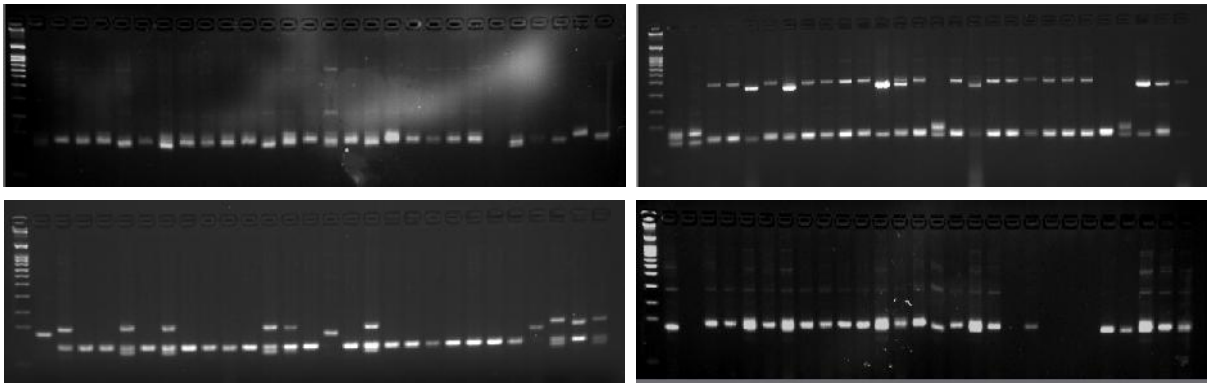
Spices Improvement Programme : Characterization of Local Turmeric and Ginger Germplasm of Manipur

Turmeric : Twenty eight turmeric germplasm were collected from different parts of Manipur. The germplasm were characterized at molecular level using 18 SSR primers. Clustering of the 28

germplasm using the dominant scoring (presence/absence) of bands based on UPGMA separated them into main groups at the Jaccards similarity coefficient – 0.77. Group A formed the major group within the dendogram by accommodating 14 germplasm of same geographical origins, in which a set of identical (synonymous) accessions were detected. Rest of the accessions was the sole members of the group. An overview of the clustering pattern indicates that the grouping of the accessions was by and small and dependent of the place of collection. The genetic similarity coefficients among the 28 germplasm amplified using 18 SSR markers ranged from 0.35 to 1.0. The highest value (1.0) corresponded to (RCMT-8 and RCMY-9) accessions that generated identical fingerprints across the markers studied. Principle component analysis was also done to visualize genetic relationships among the germplasm. The results were similar to UPGMA results. Based on study the large range of similarity values for related cultivars using microsatellites provides greater confidence for the assessment of genetic diversity and relationships.



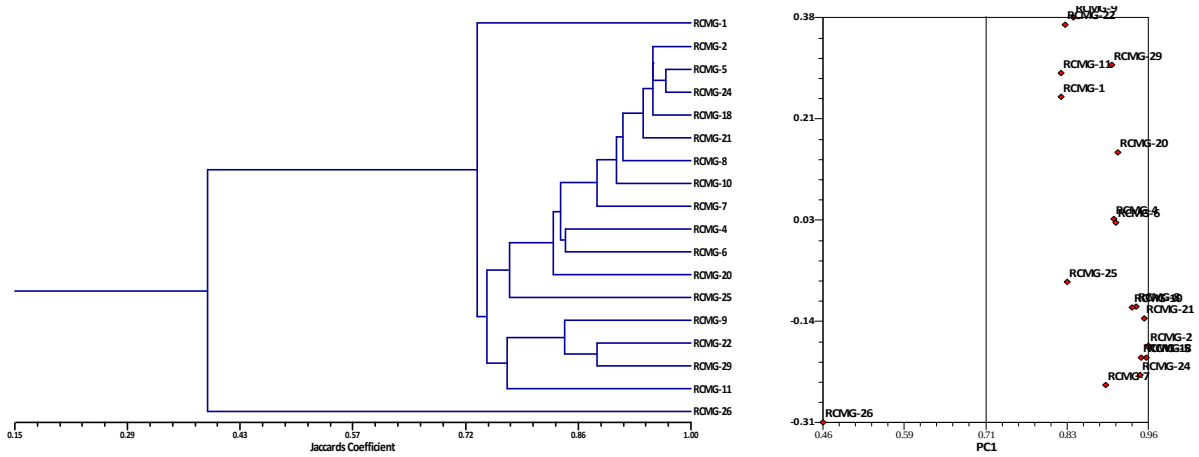
Cluster Analysis and Principle Component Analysis of Local Turmeric Germplasm based on Pooled SSR Markers



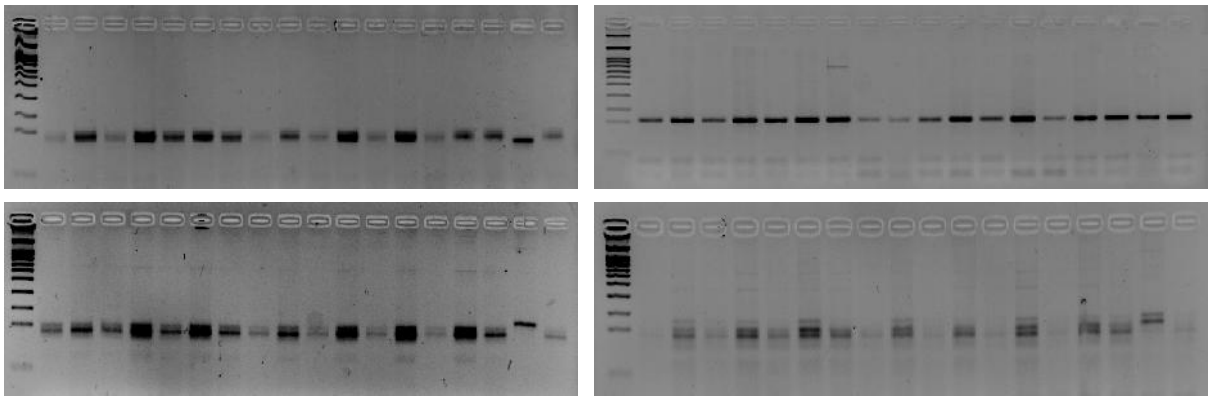
Lane 1 : **DNA ladder 1.5 Kb,** Lane 2 : **RCMT-1,** Lane 3 : **RCMT-2,** Lane 4 : **RCMT-3,** Lane 5 : **RCMT-4,** Lane 6 : **RCMT-5,** Lane 7 : **RCMT-6,** Lane 8 : **RCMT-7,** Lane 9 : **RCMT-8,** Lane 10 : **RCMT-9,** Lane 11 : **RCMT-10,** Lane 12 : **RCMT-11,** Lane 13 : **RCMT-12,** Lane 14 : **RCMT-13,** Lane 15 : **RCMT-14,** Lane 16 : **RCMT-15,** Lane 17 : **RCMT-16,** Lane 18 : **RCMT-17,** Lane 19 : **RCMT-18,** Lane 20 : **RCMT-19,** Lane 21 : **RCMT-20,** Lane 22 : **RCMT-21,** Lane 23 : **RCMT-22,** Lane 24 : **RCMT-23,** Lane 25 : **RCMT-24,** Lane 26 : **RCMT-25,** Lane 27 : **RCMT-26,** Lane 28 : **RCMT-27,** Lane 29 : **RCMT-28**

Ginger : All total local 18 ginger germplasm were collected from different district of Manipur and characterized for their genetic diversity using 73 SSR primers. Clustering of the 18 ginger accessions using the dominant scoring (presence/absence) of bands based on UPGMA separated them into five

main groups at the Jaccards similarity coefficient – 0.79. Group A comprised of one germplasm RCMG-1. Eight germplasm are combined in group B and become a major group within the dendrogram from same geographical origins. RCMG-9, -11, -29 and -22 are the collections of group C. RCMG-26 is most diverse species accession that the dendogram is showing. An overview of the clustering pattern indicates that the grouping of the accessions was by and small and dependent of the place of collection. The genetic similarity coefficients among the 18 accessions amplified using 73 SSR markers ranged from 0.15 to 1.0. Principle component analysis was also done to visualize genetic relationships among the elite breeding lines. The results were similar to UPGMA results.



Cluster Analysis and Principle Component Analysis of Local Ginger Germplasm based on Pooled SSR Markers



Lane 1 : **DNA ladder,** Lane 2 : **RCMG-1,** Lane 3 : **RCMG-2,** Lane 4 : **RCMG-4,** Lane 5 : **RCMG-5,** Lane 6 : **RCMG-6,** Lane 7 : **RCMG-7,** Lane 8 : **RCMG-8,** Lane 9 : **RCMG-9,** Lane 10 : **RCMG-10,** Lane 11 : **RCMG-11,** Lane 12 : **RCMG-18,** Lane 13 : **RCMG-20,** Lane 14 : **RCMG-21,** Lane 15 : **RCMG-22,** Lane 16 : **RCMG-24,** Lane 17 : **RCMG-25,** Lane 18 : **RCMG-26,** Lane 19 : **RCMG-29**

Organic Production Package for Passion Fruit based Cropping System

Planting of passion fruit on the ridges of the terraces at a distance of 5 m provides entire terraces for cultivation of intercrops without hampering the yield of main crop. Organic mulch and life saving irrigation through bamboo drip (3 ltrs. water/plant at 3 days interval) during lean season and 4 placing bee-box/ha was found to be effective in enhancing the productivity. Suitable intercrops have been identified for passion fruit based cropping system. Both main crop (passion fruit) and different intercrops were grown organically. In terms of yield, pineapple (39.15 t/ha) and ginger (22.89 t/ha) were found to be most suitable. However, in terms of economics, maximum gross return (Rs. 14.54 lakhs/ha) was recorded with passion fruit + capsicum; followed by passion fruit + ginger (Rs. 9.13 lakhs/ha). The bio-oragnic inputs has been standardized for passion fruit based cropping system.

Among different combinations tried application of Vermicompost (6.5 t/ha) + *Azospirillum* (20 kg/ha) + PSB (20 kg/ha) + AM (65 kg/ha) was found to be most suitable. This bio-organic combinations resulted in maximum yield of passion fruit (23.63 t/ha), ginger (28.45 t/ha) and capsicum (9.27 t/ha); as well as enhance the quality of passion fruit (30% juice content, 16.30^{o}B TSS, 17.50 mg/100 g Ascorbic acid, 4.75% reducing sugar and 8.43% total sugar).

Application of Pyrethrum, *Pseudomonus fluorescence* and Bio-tarcel was found to be effective to control major insect-pests and diseases of passion fruit.

Horticulture Mission for North Eastern and Himalayan States (Mini Mission I)

Standardization of horticulture based sustainable cropping model for small and marginal farmers of Manipur

Horticulture based sustainable cropping system models were standardized under foothill condition of Manipur. Of the cropping models tested, the relay cropping sequences in vegetables *i.e.,* Spinach-Radish-Cabbage-Onion-Tomato-Carrot-Okra-Bittergaurd-Garlic has registered highest B:C ratio (6.4) with 9 fold increase in cropping intensity. However, the B:C ratio in mono cropping and double cropping system was observed to be in the range of 1.3 to 6.4.

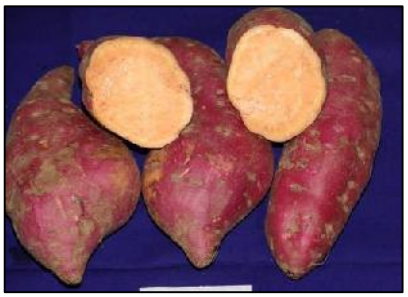
The relay cropping in vegetables was found profitable in the foot hill conditions of Manipur. In addition, one small scale mushroom production unit, one vermicomposting unit, one composting unit and one water harvesting unit have been included in the system. Micro-irrigation system has also been installed to provide life saving irrigation during lean period.

Standardization of spacing and fertilizer dose in sweet potato var. Gauri under foothill condition of Manipur

A trial was undertaken on sweet potato *var.* Gouri with two level of spacing *viz.* 60x20 cm (S_1) and 60x30 cm (S_2) under three fertilizer doses (F_1:60:40:60; F_2:75:50:75; F_3:90:60:90). The tuber yield was recorded to be highest in the treatment combination S_1F_2 (33.0 t/ha) followed by S_2F_3 (32.7 t/ha) and S_2F_1 registered lowest yield (19.82 t/ha).

Selection of suitable varieties of onion and garlic for Manipur condition

Two experiments were undertaken for selection of suitable onion varieties for Manipur. In the present study, eight varieties of onion were evaluated along with local check. In terms of yield, Agrifound Light Red (34.63 t/ha) has been found to be the most suitable for Manipur condition, followed by Bhima Raj (34.41 t/ha) and Bhima Super (34.12 t/ha). Similarly, among the five garlic varieties, Yamuna Safed 4 has been found to highest yielder (18.65 t/ha), followed by AF White (13.99 t/ha).



Sweet Potato var. Gouri

Onion var. Agrifound Light Red

Garlic var. Yamuna Safed-4

Product development through value addition in underutilized horticultural crops of Manipur

Different value added products of underutilized horticultural crops have been developed. The list of the products are as given below:

Kachai lemon	**:**	Juice, RTS beverage, Squash, Pickle, Powder
Passion fruit	**:**	Juice, RTS beverage, Squash, Jam, Cake, Ice cream, Powder
Pineapple	**:**	Squash, RTS beverage, Powder
Sohiong	**:**	Squash, RTS beverage, Jam, Powder
Jamun	:	Squash, RTS beverage, Jam
Guava	**:**	Juice, RTS beverage, Jelly
Carambola	**:**	Squash, RTS beverage
Japanese Silverberry	**:**	Squash, RTS beverage
Indian Gooseberry	**:**	Juice, RTS beverage, Candy
Oyster Mushroom	**:**	Pickle
King Chilli	**:**	Pickle
Blended Juice	:	Carambola + Passionfruit, Japanese Silverberry + Passion fruit, Guava + Passion fruit, Guava + Khashi Cherry/Sohiong, Orange + Ginger, Lemon + Ginger
Blended Jam/Jelly	**:**	Guava + Passion fruit, Guava + Khashi Cherry/Sohiong

Blended Jam and Jelly from Underutilized Fruit Crops

Jamun Jam and Jamun Squash

Use of botanicals for eco-friendly pest management in cabbage under Manipur condition

Cabbage butterfly (*Pieris brassicae*) and Diamond back moth (*Plutella xytostella*) are two major insect pests of cabbage which cause considerable loss to the crops. Given this backdrop, the experiment has been undertaken to assess the effectiveness of six bio-insecticides in reducing the prevailing insect pest population in cabbage under Manipur condition. The bio-insecticides includes three plant extracts (*Lantana camera, Artemisia nilagirica* and *Melia Azadirach*), two commercial botanical formulations (Pestoneem and Eliminix) and cow-urine extract. The plant extracts and cow-urine extract was applied @ 25 ml/lit of water; whereas Pestoneem (*Azadirachta indica*) and Eliminix *(Vitex negundo*) was applied @ 2 ml and 3 ml per litre of water, respectively. Chemical insecticide Imidacloprid @ 1ml/litre of water was included as control. Recommended package of practices has been followed to manage the crop. Among the different botanicals tried, maximum yield (33.42 t/ha) was associated with the spraying of Imidacloprid; closely followed by PESTONEEM (33.35 t/ha).

Standardizing the dose of arbuscular mycorrhiza and microbial inoculants for sustainable production of vegetable crops in Manipur valley

The experiment was undertaken to identify the most suitable bioorganic inputs for broccoli (*Brassica oleracea* var. *Itlica*), bell pepper (*Capsicum annuum*) and false coriander (*Eryngium foetidum* L.) grown as intercrop in grape plantation under naturally ventilated polyhouse.

Broccoli, Capsicum and False Coriander Intercropped in Grape Plantation under Natural Ventilated Poly-house

Different combination of vermicompost, *Azospirillum*, Phosphate Solubilizing Bacteria and Potash Solubilizing Bacteria were applied during planting. No chemical fertilizers were applied to the crops. Among the different bio-organic combinations tried, application of Vermicompost (6.25 t/ha) + *Azospirillum* (1.0 lit/ha) + Potash Solubilizing Bacteria (250 ml/ha) + Arbuscular Mycorrhiza (2 tablets/plants) was found to be most suitable for broccoli (21.00 t/ha), bell pepper (7.30 t/ha) and false coriander (24.50/ha).

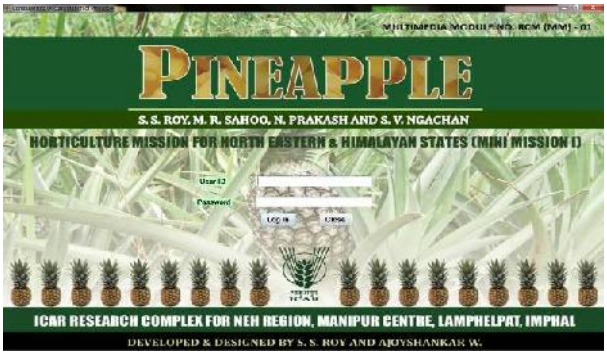
Outreach activities under Horticulture Mission (MM-I)

Sl.	Title of the Programme	Training	FLD	Others
1.	Improved Production and Rejuvenation Package for Khasi Mandarin, Kachai Lemon and Heiribob	1	5	--
2.	Improved Production Technology of Kiwifruit	--	1	--
3.	Scientific Production Technology for High Value Vegetables and Off-season Vegetable Farming	1	7	--
4.	Mushroom Production Technology	--	5	--
5.	Improved Production Package of Turmeric and Ginger	--	1	--
6.	Value Addition of Fruits and Vegetables	6	--	--
7.	Farmers' Field Day on Oyster Mushroom	--	--	1
8.	Farmers' Fair	--	--	1
	Total	**8**	**19**	**2**

Outreach Programmes under Horticulture Mission (Mini Mission-I)

Multimedia Module on Pineapple and Passion Fruit

Two Multimedia Modules on 'Pineapple' and 'Passionfruit' were developed in collaboration with LB-Institute of Technology and Management, Imphal. The user friendly modules are windows based applications for disseminating the scientific production package of the crops in an attractive way. The modules can be effectively used in Expert Systems Software and ICT kiosks.



National Network on Integrated Development of Jatropha

Under the R&D programme, local exploration was conducted for collection of local genotypes of jatropha in Manipur. All total 21 local germplasm (MNJ-001 to MNJ-021) have been collected, out of which, three accessions (MNJ-001, MNJ-006 and MNJ-017) were found promising in terms of seed oil content (> 40%). Field evaluation of 16 local genotypes of jatropha was carried out under Local Trial. Based on seed yield and seed oil content, accession MNJ-001 (1052.04 kg seed/ha and 40.77% oil content), MNJ-002 (990.53 kg seed/ha and 40.87% oil content) and MNJ-006 (974.04 kg seed/ha and 40.34% oil content) were found to be promising. The results indicate a large scope for exploitation of superior accessions of Manipur for further improvement. Different trials namely progeny trial, zonal trial, multilocational trial, national trial I, national trial III and local trial are being conducted and promising accessions have been identified. The summary of the trial programme during 2012-13 is as given below:

Name of the Trial	Promising Genotype(s)
Progeny Trial	MNJ-002, TFR-01, JIP-13 and JIP-17
Zonal Trial	JIP-13 and JIP-17
National Trial I	TFRI-01 and PJ-02
Local Trial	MNJ-001, MNJ-002 and MNJ-006

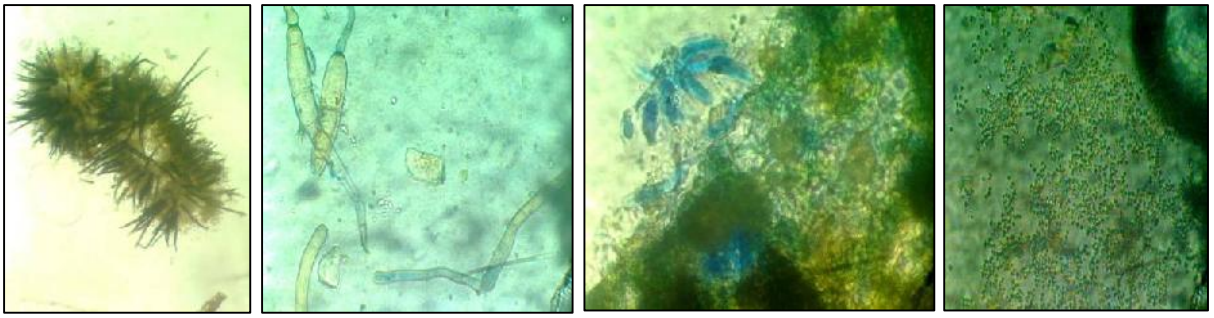
Oil content of different accessions was analyzed at NOVOD Board Laboratory. Maximum oil content (46.55%) was recorded in accession PJ-01, followed by JIP-15 (44.12%). The plants under multilocational trial and national trial III are still at vegetative stage. In addition, research was undertaken to standardize the package of practices for jatropha under Manipur condition. Under spacing trial, planting distance of 2m x 3m was found to be most suitable under hill slope of Manipur (1231.67 kgs fruits/ha and 813.33 kgs seed/ha). The plants under pruning trial are still at vegetative stage. However, pruning height of 100 cm was found to be the most suitable in terms of number of branches and collar diameter tested over 7 genotypes. In fertilizer trial, application of Urea, SSP and MOP @ 150, 250 and 50 g/plant respectively resulted in maximum collar diameter, whereas maximum number of branches was recorded with Urea, SSP and MOP @ 100, 250 and 50 g/plant respectively. The plants are yet to flower to draw any conclusion. The horti-silvicultural trial has been conducted to select the suitable intercrops for jatropha plantation. Among the different crops evaluated, sweet potato (Gouri), tomato (Megha Turmeric) and Soybean (JS-335) have been found to be the most suitable intercrops for jatropha under foothill condition of Manipur.

PLANT PROTECTION

PLANT PATHOLOGY

Studies on diseases of King chilli (*Capsicum chinense*) and their management

The survey was carried out in localities around Imphal to assess the incidence of different fungal and viral diseases. The fungi isolated and identified from kingchilli are *Cercospora capsici*, *Colletotrichum capsici*, *Glomerella cingulata*, *Corynespora cassicola*, *Phoma destructive*. The symptoms on infected plants were in the form of leaf spots, necrosis of leaves and dying back of twigs and branches.



Colletotrichum capsici ***Corynespora cassicola*** ***Glomerella cingulata*** ***Phoma destructiva***

There is sporadic occurrence of virus diseases in the field. The symptoms consisted of inward rolling of leaves, shoestring, yellow mosaic and necrotic rings on leaves. To identify the viral diseases, Direct Antibody Sandwich ELISA (DAS-ELISA) was carried out using antisera against *Potato virus Y* (PVY), *Cucumber mosaic virus* (CMV) and *Bean common mosaic virus* (BCMV), *Tomato leaf curl virus* (TYLCV), *Tomato mosaic virus* (TomV), *Pepper veinal mottle virus* (PVMoV*)* and *Pepper mild mottle virus* (PMMoV) using both positive and negative controls (healthy samples). On the basis of comparison of the absorbance readings of the negative controls (healthy samples) with that of samples, none of the plants were infected with PVY, CMV ,BCMV, TYLCV, TomV, PVMoV. The kingchilli samles in wells B3-B10, C3-C10, D3-D10 had *Pepper veinal mottle virus* (PVMoV) infection as revealed by DAS ELISA. The crude virus extract of PVMoV infected samples subjected to Transmission Electron Microscopy revealed the presence of presence of flexuous virus particles which means that the virus belonged to genus *Potyvirus* of family Potyviridae.

A field trial on evaluation of fungicides against fungal diseases of king chilli was laid out in April 2012. The fungicides evaluated were Bayleton @ 1g/lit, Section @ 2g/lit, Derosal @ 1g/lit, Antracol @ 3g/lit and control. Four fungicide sprays were done at an interval of 15 days each. 3 sprays of pestoneem were done for control of aphids. Bayleton was most effective in reducing the *Colletotrichum* fruit rot and increasing the yield. The yield and disease incidence was 100.53 Q/ha and 18.51% respectively with 167.09% increase in yield and 54.01 % decrease in disease incidence as compared to control It was followed by Derosal with productivity and disease incidence of 176 q/ha and 22.22% respectively with 22.22% increase in yield and 44.79% decrease in disease over control.

The viral disease incidence was low in plots (18.5%) which were surrounded by maize on all sides, whereas in plots without maize as barrier crop. The disease incidence varied from 48.14to 51.85%.

Evaluation of Rice Germplasm Against Neck Blast Diasese under the DBT Sponsored Project "Identification and Molecular Mapping of a Novel Neck Blast Resistance Gene(S) from Local Land Races and Introgression Lines of Oryza"

Four hundred twenty two entries of rice germplasm were screened for their reaction to neck blast under field conditions on 0-9 SES scale . The neck blast reaction in different entries varied from **1** (Kerebe Phek, China-1, Taothabi, Ching Phouren, Allechisho, Haosil Mah, Rezose Phek, Shangshak Local, Remi, Jungu Phek, Maneh Jang(Wonder Rice), Im Satang Makokchung, Thekrulha, Ronga-1, Koya Jang, Meitidak, Akutphou, Rukhatang, Talong Maha, Bali White, Tengu Be Phek, Kuki Muso, Weshelora, Chingphou Angouba, Rulotsia, Hotung, Asupa, Masia Jang, Khangambra, Hokha Tsok, Yanjo Epya, Otsok Khira, Kimin, Mutruk, Ehunyo (Makhapui Kalay), Duikung Mei, Mesao Tsuk, Chandel Exhibition, Moirangphou Khongnembi, Ruchitra, Moirangphou, Ngonolashia, Leikhamumei, Zunheboto Ghisul, Kezu, Meche Tssok, Rcm-21, Chakhao Angoubi, Chandel, Chakhao, Tamenglong) to **3** (Kumta Mah, Matamaha, Chakhao, Mainong Kangbu, Dharam Phou, Azoghi, Chalh Tssia, Arunachal-1, Moir Angphou, Ching Chakhao, Moirangphou Khongnembi, Phouren Kaichang, Champraphou(Prakash Utlou), Et Saro, Moirangphou Angouba, Kapang Rangla, Jaksemla, Pnal Jong, Chingphou, Kba Stem, Leimaphou, Ginphou, Chapali, Niphvthokpi, Mangghoomei, RCM-13, Changluima, Phouren Amubi, Rodziia Kakra, Lam Jang, Langphou(From Imphal West) to 5 (Thekrulaha, Bhuman Ccpur, Rcm-12, Meron Tssok, Pumpha Mah, Retu Masojang, Matruk Kiphre, Wr-1-9-1-1, Phatsen, Senebumap, Chakhao Local, Ereima, Chinapati, Rcm-10, Rcm-11, Pariphou, Japanphou, Rcm-9, Rcm-22, Langphou Angouba, Chakhao Amubi, KD-263, Athamah, Machang Kazik, Chingtui Makarei, Mukhok Mujeh, Khongmei Mah, Napthmei , Kheikhoma, Champrama, Moirangphou, Phouren, Mikrotho) to **7**(Runya, Kong epya, Sumi special, Dzukemum, Meghalay lafara, Phouren, Sanayanbi, Maritchitpi, Changlei, Nagaphou, Nungshangphou, Nongrangphou, RCM-12, Langphou, Chakhao amubi from Thoubal) to **9 (**RCM-10, RCM-16, Chinaching, Jakherpati , Charongphou, Charongphou, Chakhao poireiton from Thoubal, Chakhao from Ukhrul). Rests of the entries were free from neck blast. The leaf blast was observed only in entries Kba Jawai(1), Akutphou(1), Et Saro(4), Chakhao Local(4), Rulotsia(4), Yanjo Epya(4). 17 Near Isogenic Lines (NILs) namely DM-360(Pi9), BL-122(Pi1+Pi2), BL-142 (Pi1+Pi4), A57-115-4, C101Lac(Pi1), C101A51(Pi2), C101PKT(Pi4a), IRBL1-CL(Pi1), IRBL11-Zn(Pi11), IRBL12M(Pi12), IRBL8-CP4(Pi3) , IRBL5M(Pi5), IRBL9W(Pi9), IRBL9-C(Pia), IRBL6-B(Pib), IRBLI-F5(Pii) and IRBLKm-Ts(Pikm) were also screened under filed condition. The incidence of leaf or neck blast was not observed on any of the NILs.

Screening of Rice Entries under National Screening Nursery (NSN–H) against Multiple Diseases

Eighty two entries (NSN-H) sent by DRR Hyderabad were screened for multiple diseases. The leaf blast score varied from 1 in entries (2504), 2 (2610, KD 263, Vikramarya), 3 (2814), 4 (2908), 5 (Ajaya, Benibhog), 6 (2906, HR-12, Rasi), 7 (2603). The neck blast score in different entries varied from 1 (3104, 3106, 3109, 3112, 2610, 2804, 2702, 2704, KD 263, 2707, 3009, 2902, 2505, 2513, RP-2421, HPR-2143) to 3 (KD 263, 2615, 2807, 2809, 2708, 2501) to 5 (2606, 2609, 2808, 2812, 3001, 2908, 2504, 2511) to 7 (2601, 2613, 2906, IR-50, Rasi) to 9 (2811, HR-12). Rests of the entries were free from blast. All the entires were free from sheath blight and sheath rot and rice tungro diseases. The disease score for brown spot disease varied from 2 (KD 263, 2802, 2812) to 3 (3104, HPR-2143) to 4 (2611, 2814, IR-64, Ajaya,) to 5 (3004) to 6 (2902,) to 7 (3111, 3002). The remaining entries were free from brown spot infection. All the entries were free from leaf blast. The

neck blast score varied from 7 in RASI and Improved Samba Mahsuri to 5 in Vikramarya, CH45 and entry 3007 (VL31618) to 1 in entries 3510 (VL8094), 3009 (VL31577), 3306 (VL31726), and 3310(SKAU 410). The Bacterial blight reaction in different entries varied from 9 in 3510(VL 8094) to7 in entries 3508 (VL8051), 3604 (VL8292), KD 263, 3102 (HPR2589), 3108 (VL31450), HPR2143, Improved Sambha Mahsuri and RASI. The entries exhibiting score of 1 were 3509 (VL8116), 2801 (HPR 2529-4), 2808 (VL31449), 3401 (VL7954), 3407 (VL7852), 3602 (VL8204), 3610 (HPR2645), 3206 (VL31401), 3207 (VL31348), 3004 (UPR3575-11-2-2), 3006 (VL31616), 3007 (VL31618), 3011 (HPR2615), 3301 (VL31724), 3304 (UPR3573-4-2-1), 3305 (VL31600), 3308 (VL31611), 3314 (HPR2612), 3105 (VL31452), Sukaradhan-1, Vivekdhan-154 and IR-50. The disease score for brown spot varied from 7 in entry HPR 2656 to 6 in HPR 2143 followed by 5 in HPR 2618 to 4 in entry RP2421 and KD 263. The reaming entries were either free from brown spot or exhibited a score of 1. All entries were free from sheath rot and *Rice tungro virus*.

AGRICULTURAL ENTOMOLOGY

Impact of weather parameters on population build-up of aphids on cruciferous crops and their management

Field experiment was conducted at ICAR Research Complex for NEH Region, Manipur Centre, Langol Farm, Imphal during 2012 to study the "Impact of weather parameters on population build-up of aphids on cruciferous crops and their management". The experiment was laid out in randomized block design with nine treatments of biopesticides viz. Racer (*Beauveria bassiana)*@ 5g/lt, Lipel (*Bacillus thuringiensis)* 5g/lt, Derisom (karanjin) @ 2ml/lt , Derisom (karanjin WP) @ 2g/lt , Anosom (Anonin) @ 2ml/lt , Anosom (Anonin WP) @ 2g/lt, Margosom (Neem 0.15% EC) @ 5ml/lt and Margosom (Neem 0.15% EC) @ 10ml/lt, including one chemical insecticide Imidacloprid 17.8%SL @ 0.5ml/lt of water and control.

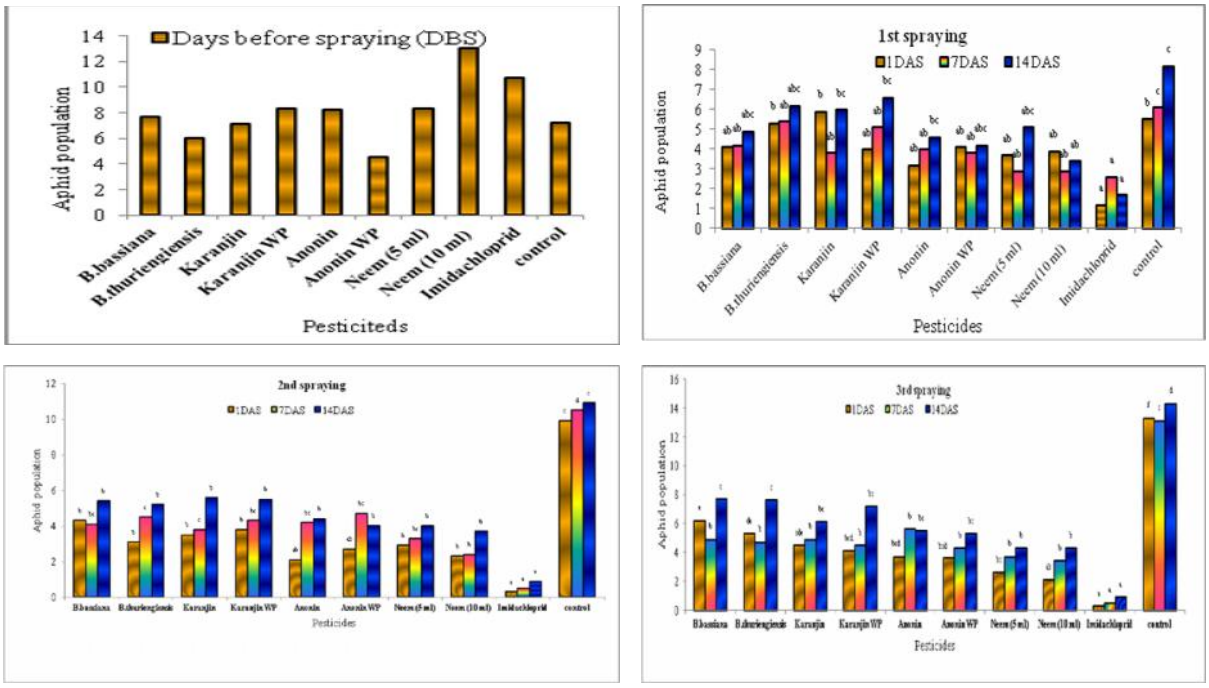
Mustard : There was no significant difference on aphid population days before spraying of pesticides. The significant differences were obtained in aphid population due to spraying of pesticides at different stages as compared to control. The significantly lower aphid population was recorded on 1st spraying under Neem 5% (0.9), *Bacillus thuringiensis* (1.9) and Imidcloprid (1.7) after 1 DAS (days after spraying), 7 DAS and 14 DAS, respectively. In 2nd spraying, there were no significant differences in aphid population at 1 DAS and 7 DAS except 14 DAS. The significantly lowest aphid population was observed under Neem 10% (3.5) followed by Neem 5% (6.5) and AnoninWP (6.9) as compared to other treatments at 14 DAS. In 3rd spraying, Imidacloprid was significantly more effective to minimize the aphid population at 1 DAS, 7 DAS and 14 DAS as compared to other treatments. Among the biopesticides, neem 5% was more effective in reducing the aphid population in mustard.

Broccoli : The significant differences were obtained in aphid population due to spraying of pesticides at different stages as compared to control. The significantly lower aphid population was recorded on 1st spraying under Neem 5% (0.9), after 1 DAS (days after spraying) and 7 DAS, while Imidacloprid recorded the significantly lowest population at 14 DAS. In 2nd spraying, the significant differences in aphid population were recorded at 7 DAS and 14 DAS under Neem 10% except 1 DAS. In 3rd spraying, Neem10% was significantly more effective to minimize the aphid population at 1 DAS, 7 DAS and 14 DAS as compared to other treatments. Among the biopesticides, neem 10% was more effective in reducing the aphid population in broccoli.

Cabbage : There was no significant difference on aphid population days before spraying of pesticides and 1 day after spraying. The significantly lower aphid population was recorded on 1st spraying under Imidachlorpid at 7 DAS (6.2) and 14 DAS (4.5) than other treatments. Application of Imidachlorpid

on 2nd spraying at 1 DAS, 7 DAS and 14 DAS reduce the aphid population 300.8%, 345% and 551%, respectively over control treatment. The aforesaid treatment was also significantly more effective than other treatment in 3rd spraying at 1 DAS, 7 DAS and 14 DAS. Among the biopesticides, neem 5% and 10% were more effective at 1st, 2nd and 3rd spraying after 1, 7 and 14 DAS in reducing the aphid population of cabbage.

Cauliflower : There was no significant difference on aphid population days before spraying of pesticides. The significantly lower aphid population was recorded on 1st spraying, 2nd spraying and 3rd spraying under Imidachlorpid at 1 DAS, 7 DAS and 14 DAS than other treatments. Among the biopesticides, neem 10% was found better to reduce the aphid population as compared to other treatments.



Ranks are given based on DMRT test i.e. representing L.S.D. (P = 0.05) significance level of various treatments. For most effective treatments ranks are given a, b, c subsequently.

Impact of weather parameters on population build-up of aphids on cruciferous crops : Aphid population in cabbage, cauliflower and broccoli was negatively and significantly correlated with a morning relative humidity and afternoon relative humidity. In mustard crop, there was no correlation with weather parameter and aphid population.

Aphid Population	Temp (°C)		R Humid (%)		Wind Direc (Deg.)		Wind Speed (km/hr)	CC (Okta)	
	Max	Min	700h	1300h	700h	1300h		700h	1300h
Cabbage	-0.007	-0.41	-0.665*	-0.824**	-0.594	0.287	-0.25	-0.509	0.202
Cauliflower	0.237	-0.483	-0.809**	-0.878**	-0.315	0.155	-0.348	-0.72	0.016
Broccoli	0.067	-0.563	-0.663**	-0.825**	-0.467	0.112	-0.347	-0.599	-0.035
Mustard	-0.078	-0.151	0.246	-0.11	-0.624	0.341	0.209	0.088	0.002

Note: **, ** Significant at 0.05 and 0.01 probability levels, respectively*

Natural enemies of cruciferous crops : Natural enemies, especially, predators of aphid *viz*., coccinellid beetles *(Coccinella septumpuncata* and *C. transvarsalis*), syrphids flies and spiders and the parasitoid *Diaeretiella rapae* were recorded in this ecosystem

ANIMAL SCIENCE, POULTRY AND FISHERY

ANIMAL SCIENCE

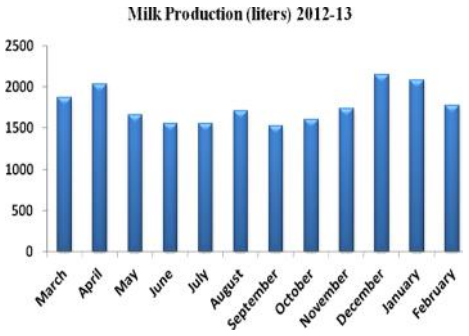
Monitoring and surveillance of antibiotic resistant pathogens from livestock and its by products

Three hundred and fifteen samples viz., chicken meat (n=50), beef (n=10), pork (n=20), milk (n=50), faecal samples from pig (n=100), cattle (n=80) and diarrhoeal dogs (n=5) were collected from various locations of Imphal West District. Using chromogenic media's, *Escherichia coli* (n=90), *Klebsiella* spp. (n=30), *Staphylococcus aureus* (n=20), *Aeromonas* spp. (n=20), *Enterococcus* spp. (n=50) and *Salmonella* spp. (n=5) were isolated.

Phenotypic characterization of the isolated organisms : Antibiotic sensitivity assay of all the organism revealed that majority of the isolates were resistant to penicillin, methicillin, streptomycin and clindamycin, and sensitive to nitrofurantoin, gatifloxacin and imipenem respectively. Minimum inhibitory concentration using five antibiotics ampicillin, chloramphenicol, streptomycin, sulfisoxazole and tetracycline for all the isolates ranged between 0.0018 µg/ml to 1.024 µg/ml, 0.02 µg/ml to 2 µg/ml, 0.001 µg/ml to 3 µg/ml , 2.0 µg/ml to >240 µg/ml and 0.01µg/ml to 1.0 µg/ml respectively. VRE Alert Kit detected Vancomycin-resistant Enterococcus (VRE) in sixty percent (n=30) of the *Enterococcus* spp.

Dairy Demonstration Unit

A dairy demonstration unit was maintained to impart knowledge on exotic cross-bred dairy cattle (Local x Jersey and Local x HF) and farm management to the farmer's. Beside these, milk produced from the dairy unit has been made available to the staff at a nominal rate, and moreover FYM is made available to all the disciplines of this centre. Whenever there is surplus of heifer or bull, preference is given to the farmers at a nominal rate to disseminate the exotic cross-bred at the field level.



Animal Health Camp

The "Animal Health Camp cum Awareness Training Programme" was held in six different villages covering five districts of Manipur. During this programme, medicines, vitamins and mineral supplements, anthelminthics were distributed to the farmers. Besides, vaccination programmes were conducted and as many numbers of livestock's and pet dogs were vaccinated against important diseases.

Location	No. of Partici-pants	No. of animals vaccinated					
		Cattle	Buffalo	Pig	Sheep	Goat	Dog
Marangching village, Tamenglong District	60	30	10	100	4	20	45
Laiphrakpam Village, Imphal West district	100	25	3	90	-	-	30
Lungshang Aze Village, Ukhrul district	80	5	-	95	-	-	30
Japhou Village, Chandel district	60	80	10	70	2	10	20
Pearsonmun Village, Churachandpur district	80	-	-	80	-	-	60
Kokchai Village, Mayang Imphal, Imphal West	80	50	-	200	-	-	50
Total	**460**	**190**	**23**	**635**	**6**	**30**	**235**

An interactive session between the farmers and the experts from ICAR-RC NEH Region Manipur centre and veterinary officers from the state veterinary department Manipur was also conducted to give awareness programme on animal health. The feedback from the farmers was very positive and they were hoping that such type of programme should be conducted every year. The scope of animal husbandry in Manipur is very promising and in the future vaccination camp should be held regularly to control economically important diseases of livestock's in this region which will safeguard the livestock's health and at the same time safeguard public health.

POULTRY

Poultry Seed Project

At present 471 nos. of second batch parent stock at the age of 69 weeks and the third batch foundation stock (16th weeks old) of 2077 nos. (Vanaraja-1267 & Gramapriya - 810) are being maintained in the Institute's farm. The supply of quality germ-plasm was increased by 143 % over previous year. Performance on various traits revealed that Vanaraja attained average body weight (g) of 41.98, 421.44, 1591.51, 2356.45, 2469.81, 2775.39 and 2922.63 respectively at day 1 and subsequently at 6, 16, 24,32, 40 and 58 weeks of age . While at the same age, Gramapriya was 39.13, 332.25, 1213.30, 1691.62, 1964.05, 2216.95 and 2843.55 respectively. Mortality was 10.15 % and 13.99 % in Vanaraja and Gramapriya respectively up to 24 weeks of age. The average age at sexual maturity (ASM) was 169±2 and 163±2 days, respectively. The egg weight (g) at 28, 40 and 50 weeks were 44.89, 50.86 and 51.35 g in Vanaraja while in Gramapriya 48.52, 52.73 and 52.94 g. respectively.

Performance under Backyard conditions (Farmers field) : The village records showed that an average weight of 352.71 g and 339.46 g was achieved by male and female chicks at four weeks. The average survivability up to the end of 6 weeks was 87.57 % (*Vanaraja* – 88.73 % and *Gramapriya*– 86.42 %). The average age at sexual maturity (ASM) for *Vanaraja and* Gramapriya birds was 169 and 172 days from the records of 125 adults and the average body weight of female at the corresponding age was around 1529.41 and 1274.91 g. The birds laid on an average of 20 eggs (246 birds) per month with tinted brown colour during peak period. The egg weight (g) at 28, 40 and 58 weeks of age were 45.24, 47.61 and 50.76 in Gramapriya while 41.77, 44.39 and 48.36 in *Vanaraja*, respectively. The above level of production was achieved by providing 50 percent of daily requirement through home-made feed mixtures of ground maize, rice bran, oilcakes, household waste, agricultural by-products with supplementary feeding of shell of snails, lime powder etc. as source of calcium during laying period in the semi-intensive rearing systems at the villages.






FISHERIES

Standardization of breeding and culture techniques for potential indigenous ornamental fishes of Manipur for commercialization

Pangia pangio : The eel-loach or Kulhi loach, *Pangio pangia* known as *Nganap* in Manipuri is an important ornamental fish. It is bottom feeders, omnivorous and eat worms and insect larvae. *Pangio pangia* juveniles were collected from Khumbong, Imphal west of Manipur in the month of October, 2011. The fishes were transported in oxygenated bags and maintained in the laboratory in FRP tanks having water capacity of 3 t with water recirculation system. The fishes were fed with live feeds (worms, daphnia, Cyclops) and formulated pelleted diet. Induced breeding of *Pangio pangia* were carried out successfully in utility tray having (360l×310w×130h) mm with a water depth of 8cm in the laboratory. The water temperature, dissolved oxygen and pH of the breeding trays were maintained at a water temperature of 25±3.0°C, pH, 7.5±0.2; dissolved oxygen, 6.0±2.0 ppm and total alkalinity at 110ppm respectively. Aeration was given continuously during breeding operation. Three different doses of Wova-FH were tested e.i 0.5ml, 0.7ml and 0.9ml/kg body weight on the dorsal muscles above the lateral line near the dorsal fin. Three sets of brood stocks were selected at the ratio of 1:2 (female: male) each dose of hormone was given to each set. After the injection, the breeding sets were released in different utility trays in duplicate manner. Spawning occur after 21hrs of injection. After spawning, fecundity of each female was determined by randomly taking representative samples of eggs A varied degree of response of different doses of Wova-FH was observed. Spawning response varied from 19-21 hours. The highest rate of fertilization was obtained in fish set given Wova-FH dose @ 0.7ml/kg body weight. Fertilized eggs were slight yellowish in colour, spherical, translucent and demersal measuring to 0.6-0.7 mm in diameter. Unfertilized eggs were paler and opaque. Within 1½ hours twitching movement of the embryo was observed. Hatching was preceded by movement of the larvae inside the egg shell. Fertilized eggs were hatched out after 3 hours of fertilization. The newly hatched larvae were measured at 0.7- 1.5 mm long. The young ones did not take exogenous food for about 48 hrs at 25°C. From the results, it is evident that highest spawning of *P. pangia* occurred at close 0.7ml/kg. A lower dose of 0.5ml/kg was given and spawning was moderately low. Very few eggs were released in fish set given @ 0.9ml/kg. Fertilization rate (40%) and hatching rate (45%) were also lower those set given 0.7ml/kg and 0.5ml/kg body weight respectively. From these results, it is evident that the doses of hormone affected the spawning, percentage of fertilization and hatching rate. The young ones were dark brown in colour and very active swimming in their environment. About 1-2": of the bottom of the rearing tanks were filled with fine sand. Well aerated clean water was maintained. Fishes were fed with worms, tubifex and sinking type pellets. The fishes can attained body weight of 1.0g in 2 months.

Hormone injection

Fertilized egg

10 days old juvenile

15 days old juvenile

Schitura fasciatus : *Schitura fasciatus* known as *Leingoiphon or Ngatup* in Manipur were collected from Izei river, Tamenglong district of Manipur in the month of June 2011. *S. fasciatus* is community fish, and does very well living with other non-aggressive community fish like guppies, neons, platys, and other bottom dwellers. They undoubtedly got their name by their bright orange and black stripped

looks, and their very interestingly curious, and cute behaviors. These fishes are bottom dwellers, but they do also swim in the middle of the tank and to the top occasionally though. They make very fine additions to any community aquarium. They are schooling fish and like to be kept 4-5 individual together in a tank. Sex were differentiated. Males were having swollen anterior body, triangular head and faintly coloured vertical bars especially visible from the middle of the dorsal fin to the base of the caudal fin whereas females have well distinct marked vertical bars. The dorsal surface of males is straight horizontally and with a well develop prominent dorsal adipose crest. The anterior dorsal profile of females are well arched and the adipose dorsal crest not prominent as in male. Ratio of male and female brooder was 1:1. Plastic tanks (360×310×130) mm having water depth of 8cm. Water quality of the spawning tray was analyzed by using water testing kits Aquacheck (Renkem). The breeding tanks were maintained at temperature, 25±3.0°C; pH, 7.5±0.2; dissolved oxygen, 6.0±2.0 ppm and carbon dioxide at 0.0ppm. A mild current of water was arranged inside the tanks using aerators. Three sets of brooder were selected for the breeding experiment. Three different doses of Wova-FH i.e. 0.5ml, 0.7ml and 0.9ml/kg body weight were given to each set. After the injection, the breeding sets were released in three breeding tanks. Spawning occur after 21-23 hrs of injection. After spawning, effective fecundity of each female was determined by randomly taking representative samples of eggs in a 10 ml graduated measuring cylinder from the total eggs in 1ml was counted and multiplied with total volume of egg released. The fertilization rate of egg was determined by randomly taking a sample of approx. 45 eggs. Fertilized eggs were slight yellowish in colour, spherical, translucent and demersal measuring to 0.7-0.8 mm in diameter. Unfertilized eggs were paler and opaque. Within 5 hours twitching movement of the embryo was observed. Hatching was preceded by movement of the larvae inside the egg shell. Fertilized eggs were hatched out after 8-9 hours of fertilization. The hatchlings were yellowish in colour.The newly hatched larvae measure 0.8- 1.5 mm long. The young ones did not take exogenous food for about 48 hrs at 25°C.

Breeding tank

Fertilized egg

4 days old embryo

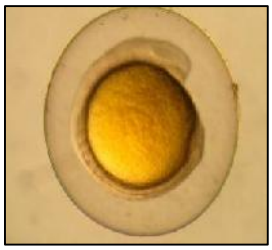
5 days old spawn

Schitura fasciatus

Danio dangila : Forty five numbers of *Danio dangila* commonly known as Moustached Danio was collected from a hill stream from Barapani, Meghalaya and maintained at ICAR Manipur centre, Imphal. Breeding of *Danio dangila* is one of the easiest egg scatterers to breed. These fish is sexually mature when they reach 2.5" and will spawn only when kept in schools. A good ratio for spawning was 2 males and 1 female with lots of plant. For this experiment 2 males weighing 2.76g and body

length of 5.6mm and one female having bodyweight 3.5g and 5.9 mm in length were selected. Fishes were injected hormone Wova –FH @ 0.05g/100g fish. Latency period was 24 hrs. The fishes bred eggs after 24hours of hormone injection at 26°C. About 300eggs were laid and scattered by a female. Hatching was preceded by movement of the larvae inside the egg shell. Hatching takes approximately 36 hours and the fry should be free swimming after 5 days. The newly hatched larvae measure 0.5-6.5 mm long. The young ones did not take exogenous food for about 48 hrs at 26°C. The fries were fed with brine shrimps and micro worms.

Danio dangilla



Fertilized egg

4 days old embryo

2 days old spawn

Carp Seed Production

Species	Spawn production	Fingerlings
Cyprinus carpio	18 lakh	60,000
Ctenopharyngodon idellus	10lakh	40,000
Osteobrama belangeri	10 lakh	30,000
Bangana dero	1 lakh	15,000
Clarias magur	0.60 lakh	15,000
Others	12 lakh	40,000
Total	**51.60 lakhs**	**2,00,000**

SOCIAL SCIENCE

Role of mass media in farm technology dissemination among the farmers in Manipur state

The study was undertaken to explore the media contribution in dissemination of agri-allied technology in the context of Manipur and to analyse the extent of adoption of technology by the valley and hill farmers disseminated through mass media in Manipur. The specific objective is to analyze the socio-economic condition, information utilization, and to investigate the relationship between independent variables with extent of adoption. The findings were intended to enhance the dissemination system of agri allied activities in general and through mass media in particular. Two valley districts Imphal west, Thoubal and two hill districts of Ukhrul and Churachandpur was taken for analysis. Two villages from each district with the sample size of 15 each totalling to 120 samples is done randomly for investigation. Due consideration was taken to include women respondent in the investigation. The interview schedule incorporated the agricultural programme disseminated via All India Radio, Doordarshan in six months duration between Jan to June 2011 was taken for analysis. The interview schedule was pre-tested to the size of 10 % of the sample in Imphal west district. Majority (64 per cent in valley and 68 per cent in hills) of the farmers are in age group of 30-50 years in both hills and valley districts). 85% of the farmers know Manipuri and 75% know English. Majority (73%) of the farmers have farming experience of more than 10 years. Long farming experience is an advantage for increase in farm productivity since it encourages rapid adoption of farm innovation (Obinne, 1991).

Power is one of the major inputs for agriculture. The data reveals that the 90 per cent of farmers in valley and 66 per cent of the farmers in hills opine that they have less than 5 hours of power supply. Further 25 per cent in hills state that there is no power supply or electrification has not reached the remote areas of the district. 55-61 per cent of the farmers are the members of farmers club. Relatively same per cent of the farmers are having <5 years of experience in farmers club. 70 per cent of the farmers in valley and 40 per cent in hills have high interest in farming and allied activities. Due to hilly terrain, the high input cost (for eg: fish fingerling which is Rs.2 at valley areas will cost Rs.5-8 after transportation costs are added) makes their commodity less remunerative and in turn make their farmers lose their interest. The information utilisation of the farmers is Radio followed by family members>T.V> Friends and neighbour> training by valley farmers where as Radio, Friends and neighbour > KVK-ICAR> family members>Demonstration is the information source utilized by hill farmers. The preference of mass media varies for valley and hill farmers. The valley farmers prefer Radio>T.V.>Newspaper>Mobile and in case of hills the preference is Radio> Radio +farmers club>Mobile. The regression analysis reveals that the extent of adoption of technology is contributed by 68 per cent of the variables. Further, the variables namely power supply, information sources, listening/viewing/reading of agricultural programme are positively and significantly contributed for the extent of adoption at 1 per cent level. The variables viz., education and farmers club are negatively contributed for the extent of adoption at 5 per cent and 1per cent respectively. It means irrespective of education and the members of farmers club the adoption of technology is similar. Awareness of the programme broadcasted in AIR, Doordarshan should be popularized through leaflet/ folder specially to hill farmers as the awareness is 28 and 3.5 percent respectively.More and more farm programmes should be broadcasted in AIR (only 18 programmes in 6months duration) as the percent of hearing programme is more than 50 per cent in both hills and valley. Moreover, farmers prefer radio in hills because of poor power supply. The information need of the farmers vary between hill and valley farmers. The valley farmers ranked field crops and pest and disease management as the most important information need. Animal husbandary and mushroom cultivation as the most important information need for hill farmers.

Impact Assessment of the Demonstrated Technologies through KVK in Manipur State

The objective of this study is to identify the socio economic characteristics of the FLD and non FLD farmers under study. To analyse the perceived relevance, adoption and modification of the technology demonstrated by the KVK to the FLD farmers. To assess the awareness and adoption of the technology demonstrated by the KVK to the non FLD farmers. To document the benefits and to probe into the reasons influencing adoption and non adoption of the technology. The secondary data from five KVK is collected with regard to the FLD conducted between 2006-11. The data on the no of FLD, reveals that among the FLD conducted, oilseeds (308) occupied the largest share followed by FLD on horticultural crops (296), followed by FLD on Rice (155) followed by FLD on pulses (104) and FLD on animal husbandry (51). Further to analyse the socio economic characteristics of the farmers and to meet the other objectives interview schedule is prepared and was pretested in the Imphal West district.

Technological Intervention through Adoption of Integrated Farming System for Livelihood Improvement of the Farmers in Manipur

The objective of the study is to develop an environmentally sustainable, economically viable and socially acceptable integrated farming system in selected districts of Manipur, to improve the livelihood status of the farming community & to ensure the ecological sustainability through scientific management of natural resources. For this five district viz., Chandel, Churachandpur, Ukhrul,

Tamenglong and Senapathi have been selected for the interventions. The selected farmers are Kagungai, Peace land, Tamenglong district, Henkhapao Haokip of Tolen village, Churachandpur district, Somi of Nungshong village, Ukhrul district, Th. Bimola of Monsang pantha, Chandel district and R. D. Peter of Purul Akutpa village, Senapati district.

Workshop on "Agriculture and Food Security in the Context of Climate Change" cum Farmers' Fair

The Workshop cum Farmers' Fair was organized at ICAR Research Complex for NEH Region, Manipur Centre, Imphal during 12-14 October, 2012. The Workshop cum Farmers' Fair was inaugurated by Mohammed Abdul Nasir, Hon'ble Minister of Agriculture, Govt. of Manipur as Chief Guest of the inaugural function on 12th October, 2012; while Shri Rajesh Agarwal, IAS and Commissioner of Agriculture, Govt. of Manipur and Dr. S. V. Ngachan, Director, ICAR Research Complex for NEH Region, Meghalaya acted as Guest of Honour and President, respectively. Directors of state department of agriculture, veterinary and fisheries were also partcipated during the function. Hon'ble Minister of Agriculture, Govt. of Manipur also released new rice variety RC Maniphou-12 and tomato variety RC Manikhamenashinba-1, developed by ICAR, Manipur Centre. Seeds of newly released varieties of rice and tomato were also distributed to the farmers at the occasion. ICAR, various line departments, agro-industries, NGOs, SHGs, Farmers' groups and KVKs actively participated in the farmers' fair and showcased different agricultural technologies. More than 2000 farmers from different districts of the states have participated in the 3 days farmers' fair. One Farmers-Scientists interaction programme was also organized during the programme on 13th and 14th October, 2012. Prizes were awarded for best exhibition in the farmers' fair by ICAR. Along with the Farmers' Fair, one Workshop on "Agriculture and Food Security in the Context of Climate Change" was also organized during the period. Scientists from ICAR Research Complex for NEH Region, Meghalaya; National Research Centre on Pigs, Guwahati, Assam; Central Agricultural University, Imphal; Manipur University, Imphal; Officials from different line departments; SMS from different KVKs, Extension workers from different NGOs also participated in the workshop. The workshop and farmers' fair was co-sponsored by NICRA, Horticulture Mission (Mini Mission I) and NABARD.

Tribal Sub-Plan 2012-13

***Enhancing farm income of tribal farmers in manipur through seeds of crops and animals* :** Efforts were given to sustain the own quality save seed production at tribal farmers' level. Altogether, 8 (Eight) major crops were taken up in Rabi and Kharif season's of 2012-13 in 5 (Five) different Hill and one valley districts of Manipur. During the Rabi programme Quality Seed Production of Lentil,

Rapeseed and Pea were taken up on the Farmers' Fields of the districts during *rabi* 2012-13. Under this project, more than t400 ribals farmers covering 271 hectares area in five district of the state were covered and around 805.83 tonnes seed of different crops was produced through participatory approach. Regarding animal sed production, 35 farmers were involved and all total 44 male and 88 female piglets were produced.

Livelihood Improvement of the Tribal Farmers of Manipur through Adoption of Integrated Farming System **:** The major objectives the programme are to provide holistic growth of the farming sector through an area based strategies which include participatory technology dissemination with specific focus on integrated farming system through a seamless blend of traditional wisdom and modern scientific knowledge; enhancement in acreage, coverage and productivity through diversification from traditional cropping pattern to integrated farming system and improvement of agricultural resource use efficiencies in farming system mode. Under the prgramme, five vlages in hill districts namely Chandel, Churachandpur, Senapati, Tamenglong and Ukhrul were selected. Seed, planting materials, animals, poultry birds, fish fingerlings and other critical inputs were distributed to more than 500 farmers. Community based natural resource management was undertaken for scientific soil and water conservation measures. Emphasis was given on secondary agriculture like mushroom production, bee keeping, value addition etc. to empower the tribal women and unemployed rural youths. Workshop, training and demonsration are being conducted through farming system mode for enhancing productivity, profitability and sustainability of the system. Besides, five different models of intensive integrated farming system (IIFS) are being developed at five district of Manipur. The programme created a good impact among the farmers of beneficiary villages.

Intensive Integrated Farming System at Farmers' Field

Outreach Activities under Tribal Sub-Plan

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