TECHNOLOGIES FOR DOUBLING FARMERS' INCOME IN NEH REGION

ICAR-AGRICULTURAL TECHNOLOGY APPLICATION RESEARCH INSTITUTE
UMIAM, MEGHALAYA-793103
(AN ISO 9001:2015 CERTIFIED ORGANISATION)

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Technologies for doubling farmers' income in NEH Region

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Preface

ICAR-Agricultural Technology Application Research Institute (ATARI), Umiam, Meghalaya with its 43 Krishi Vigyan Kendras (KVK) across 5 North Eastern states, viz. Manipur, Meghalaya, Mizoram, Nagaland and Tripura has been working as a frontline extension education organization with a mission to bring out behavioral changes among the farmers and other stakeholders for technology-led growth in farming and allied sectors in the region. KVKs of the region are addressing the location specific problems of the respective districts and providing the need based solution to such problems with utmost sincerity and dedication. To fulfill the mandates of technology assessment and demonstration, a number of technologies developed by ICAR Institutes, SAUs, CAUs and such other R&D organization including ITKs are being tested through OFT/FLD in each of the districts in the region and the tested technologies are recommended/released for their large scale application in the farmers' field by the line departments of the respective states. This publication is one of such documents that incorporate the latest technologies tested by the KVKs through OFT/FLD during 2014-2018.

This publication, if used may act as a technology basket for the line departments of the North Eastern Hill states and the technologies incorporated in this publication may be disseminated to the farming community through their regular and flagship programmes. We sincerely acknowledge the services rendered by the staff of the KVKs of the region and ICAR-ATARI, Umiam including the RAs/ SRFs/ DEOs for their input in bringing out this publication in time.

(Bidyut C. Deka)
Director

CONTENTS

Single Bud Transplanting Technique of Ginger & Turmeric to Reduce Seed Cost

Introduction

Due to high seed requirement (15-20 q/ha) of ginger and turmeric the cost of production increases rapidly. Around 40-45% of total cost of cultivation is incurred for procurement of seed in these crops and this is one of the major constraints for large scale cultivation of these two crops. Considering this constraint, a single bud cutting technology developed by ICAR- Indian Institute of Spices Research, Kozhikode, Kerala was tested by KVK Ri-Bhoi during 2017-19 in two villages' viz., Umeit and Khodongulu covering one hectare area in 18 farmers' field each year in the district of Meghalaya. In this technology, the disease free seed rhizomes of ginger (variety Nadia) and turmeric (variety Megha turmeric 1) were cut into small pieces of 5-6 gm containing a single bud. These buds were treated with Trichoderma viridae @ 2g/litre, sown in pro-trays using suitable growing media prepared by mixing sand: soil: FYM @ 1:1:1 in the month of March and pro-trays were kept under polyhouse covering with straw/ dry weed mulches to protect the same from wind and heavy rain. Life saving watering was done as and when required. After 30-40 days, the germinated and well developed seedlings were transplanted in main field in the month of April –May with mulching to enhance survivability in the main field by maintaining a spacing of 25 cm x 30 cm.

Single bud transplanting technique of ginger and turmeric

Source of Technology and year of release

ICAR-Indian Institute of Spices Research, 2014

Outcome and impact

The data in the Table revealed that the single bud transplanting technique of ginger and turmeric produced healthy crop with faster growing with higher yield (235.5 q/ha in ginger and 287.6 q/ha) within shorter period and eventually reduced the cost of cultivation by 54.97 and 50.6 per cent in ginger and turmeric, respectively. The farmers are happy with the single bud transplanting technique of ginger and turmeric due to reduced cost of production.

Table : Comparison of single bud rhizome transplanting and conventional planting of ginger and turmeric

Parameter	Single bud rhizome (5-6 g) transplanting @ 5-6q/ha		Conventional planting method @15-20q/ha	
	Ginger	Turmeric	Ginger	Turmeric
Survivability (%)	90	92	100	100
Sprouting (days)	18-20DAP	15-18DAP	20DAP.	20DAP.
Tillering(days)	2 MAP	1½ – 2 MAP	3 MAP	3 MAP
Rhizome development(days)	Starts from 3 ½ MAP	Starts from 3 MAP	Starts from 5 MAP	Starts from 5 MAP
Rhizome maturation(days)	6½-7 MAP	6-7 MAP	7½-9 MAP	7-9 MAP
Yield (q/ha)	235.45	287.6	200.55	202.3
Cost (Rs/ha)	65611	53946	145713	109105
Net Return (Rs/ha)	377677	371542	21717	172645
B:C ratio	5.41	5.43	2.47	2.59
Cost saving (%)	54.97	50.6	-	-

Productivity and profitability in maize based intercropping system

Introduction

Maize is one of the important cereal crops in Manipur. It is grown mainly in homestead gardens and as border crop for consumption of green cobs. The elevated areas in the valley and its foot hills which remain underutilized are very suitable for cultivation of maize. KVK Imphal West, also made efforts to introduce and popularize HYVs of maize and scientific package of practices for increasing the farmers' income. Realizing the potential of maize as important component of animal feed, KVK conducted an OFT on maize based cropping system in three locations of Imphal West with 4 different cropping systems, viz., a. Maize, b. Maize+ Groundnut 1:2, c. Maize+ Cowpea 1:1 and d. Maize + soya bean 1:2.

Source of the Technology and year of release

GB pant University of Agriculture and Technology, Pantnagar, 2012

Outcome and impact

Maize + Groundnut 1:2 (T_1) cropping systems recorded the highest yield of 28.91q/ha with the BC Ratio of 2.16 followed by Maize + Cowpea 1:1 (T_2) and Maize + Soya bean 1:2 (T_3) cropping systems having the yield of 24.60 and 23.24 q/ha respectively. Therefore, Maize + Groundnut (T_1) based cropping systems with two rows of groundnut after one row of maize was recommended for large scale adoption in the district.

Maize + Groundnut at Mapao village

Maize + Cowpea at Leikinthabi village

Table: Evaluation of productivity and profitability in maize based intercropping system

Treatments	Cropping system	Maize equivalent yield (q/ ha)	Gross return (Rs)	Cost of cultivation/ ha (Rs)	BC Ratio
T_1	Maize + Groundnut 1:2	28.91	86,730	40,000	2.16
T_2	Maize + Cowpea 1:1	24.60	73,800	36,000	2.05
T_3	Maize + Soya bean 1:2	23.24	69,720	34,000	2.05
T_4	Maize	20.00	60,000	30,000	2.00

The technology was further popularized in 3 villages through FLD programme with great success. Now, the farmers are growing maize intercropped with pulses/ oilseeds after realizing its benefits. Keeping in view of the ever increasing demand for animal feed in the district in particular and state as whole, farmers are expanding the area under maize. The technology has so far been spread to more than 9 neighbouring villages of the district covering an area of 60 ha.

Use of Pusa Hydrogel for management of moisture stress in direct seeded Onion

Introduction

The rice fallow lands offer a great scope to grow vegetable crops during rabi season and some of the farmers of West Garo hills of Meghalaya utilize their rice fallows for cultivation of onion. Onion being a shallow rooted crop its yield is affected significantly by temperature and moisture content of soil during seedling, vegetative growth and bulb development. The farmers need to give 25-30 nos. of irrigation, but due to limited availability of irrigation water they usually face problem and have to arrange water from external sources. The problem of moisture stress during the bulb formation stage reduces the yield which is the main problem in growing onion in West Garo hills of Meghalaya. To get rid of this problem, application of polymer based bio-degradable gel is an answer to meet the water requirement at the time of urgent necessity. Looking into its effectiveness, KVK, West Garo hills conducted an OFT on "Use of Pusa Hydrogel for management of moisture stress in direct seeded Onion".

Pusa Hydrogel is an environmental friendly and semi- synthetic super absorbent polymer developed by Indian Agriculture Research Institute, New Delhi. It is in granular form and is used with various crops for the saving of water. The application of Pusa Hydrogel in soil reduces the moisture stress to the crop. It acts like a sponge and it absorbs irrigation water and releases it slowly to the plants depending on suction pressure of the root system. So, crops in the field get sustained supply of moisture for growth. When it absorbs water, it swells/ expands; when it releases moisture it shrinks. Water absorbed Pusa Hydrogel is released as useable moisture in the root zone. Thus, it keeps the soil moist and loose by repeatedly, expanding and contracting. It will slowly degrade in the soil into harmless soil matter over time.

Pusa Hydrogel was applied as basal @ 1-1.5 kg per acre at the time of final ploughing just below the soil surface (1 to 4 inches) mixed with fertilizer. It reduces the irrigation frequency required supplying moisture in the root zone.

Source of technology and year of release:

IARI, New Delhi, 2012

Outcome and impact

Application of Pusa Hydrogel for effective management of moisture stress in onion has revealed that the farmers got the highest pay back net return of Rs. 3,09,540/ ha with good benefit cost- ratio of 3.56 and higher yield as compared to the local farmers practice as shown in Table. In Selsella block of West Garo hills district where an area of 0.5 ha of land was demonstrated, an increase in yield attributes of onion viz. girth of the bulb (4.12 cm), weight of the bulb (102 g) and yield (215 q/ha) were observed. In Garo Hills, the farmers usually apply 25 numbers of irrigation in cultivation of direct seeded onion, but after incorporation of pusa hydrogel in the soil and fertilizer, a reduction in frequency of irrigation was observed during the cropping season.

Beneficiaries field of onion applied with Pusa Hydrogel

Table : Effect of application of pusa hydrogel in yield attributes and yields of direct seeded onion

Parameters on assessment	Technology	Farmers practice
Days to harvest	140	145
No. of irrigations	10	25
Girth of bulb (cm)	4.12	3.60
Weight of bulb (g)	102	81
Yield(q /ha)	215	182
Net income (Rs./ha)	3,09,540/-	2,45,550/-
B:C ratio	3.56	3.07

Use of scientific knowledge in a sustainable way in onion cultivation has spread over a larger area leading to higher productivity, efficient utilization of soil moisture, food security and increased income to farmers. The application of Pusa Hydrogel helped the farmers to reduce the number of irrigations given in onion crop which in turn helped in improving the economy of the farmers. The positive attribute of applying the gel helped in dissemination of technology in and around the villages in paddy fallow areas of Garo Hills, Meghalaya. The farmers of the district had encouraged the fellow farmers to utilize fallow lands for cultivation of vegetables during rabi season for livelihood security and income generation.

Integrated Pest Management in rice

Introduction

Stem Borer, Leaf folder and Case worm are the major pests of rice in Ukhrul district of Manipur followed by Gandhi bug, Brown Plant Hopper, Hispa, Grasshopper and Gall Midge *etc.* Chemical pesticides are used by farmers to control these pests, but the results were not very encouraging. Looking into the financial and accessibility criteria, KVK, UKhrul conducted an OFT on Integrated Pest Management (IPM) in rice (Variety: RC Maniphou-12) in three locations with the following IPM module.

1. Seed treatment with Imidaclorprid @ 2ml/kg seed
2. Management of spacing @ 25 x 20 cm
3. Releasing *Tricogramma chilonis* @ 50,000 parasitized eggs/ha after 30 days after transplanting
4. Installation of pheromone traps @ 20 traps/ha after 35 days after transplanting with changing of lure at every 20 days interval
5. Spraying with Thiamethoxam 25 WG @ 100 gm/ha when needed

Source of the Technology with year of release

Central Agricultural University, Imphal, 2013

Outcome and impact

Through IPM practices it was observed that the stem borer infestation reduced significantly (3.2 %) compared to farmer's practice (7.06%) of using chemical pesticide alone. Similarly, the infestations of case worm and leaf folder were reduced by 0.05 and 0.16 insect pest per hill, respectively having better yield with B:C ratio of 1.26.

Light Trap

Weeding using cono weeder

Table: Evaluation of IPM in rice

Sl. No.	Parameters	IPM	Farmers Practices
1.	Stem borer	3.2% Dead hearts on average	7.06 % Dead hearts on average
2.	Case worm	0.05 insect /hill on an average	3.02 insect /hill on an average
3.	Leaf folder	0.16 damage leaf/ hill on average	2.05 damage leaf/hill on average
4.	Yield lose due to infestation	6.25%	38.4 %
5.	Yield	40.3 q/ha	21.5 q/ha
6.	B:C ratio	1.26	0.75

Most of the farmers have accepted this IPM module at Thoyee and Sihai Village of Ukhrul District and now this IPM practice is being followed in more than 50 ha area of the locality.

Integrated weed management in rice

Integrated weed management in rice (RC Maniphou-7)

Introduction

Weeds are one of the major constraints in rice production system. The development and adoption of proper integrated weed management strategies must form an integral part of sustainable rice production. Integrated weed management is a combination of two or more weed control measures at low inputs in order to reduce weed competition in rice below an economical threshold level.

An OFT was conducted in 4 locations of Chandel district of Manipur with Glyphosate and Butachlor @ 1.25 kg/ha as pre-emergence weedicide during pre-puddling tillage followed by one hand weeding at 30-35 days after transplanting with hand weeding as control in paddy field having the variety "RC Maniphou-7" developed by ICAR Research Complex, Manipur centre.

Source of the Technology with year of release

ICAR research Complex for NEH Region, Umaim, 2007

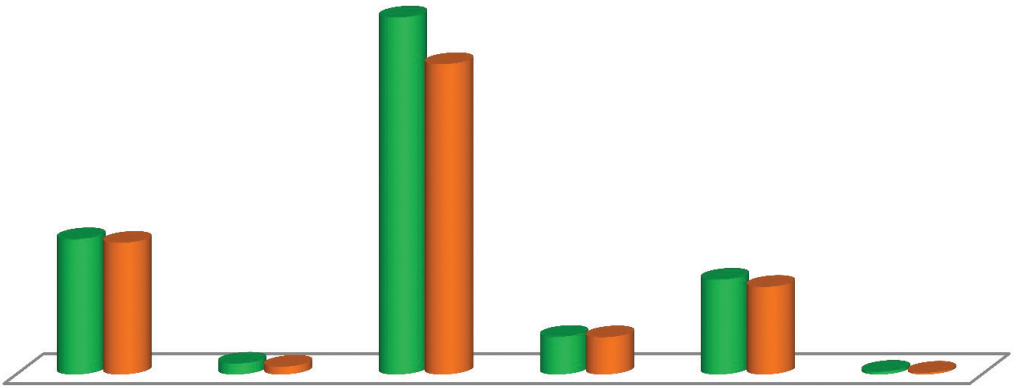


Fig: Performance of Integrated weed management in Rice

Outcome and impact

Pre-puddling tillage with Glyphosate combined with post-plant pre emergence Butachlor 1.25 kg/ha resulted in increased rice grain yield of 6.1 t/ha with higher net income and B: C ratio of 1.75. The cultivation of rice variety "R-C Maniphou-7" through integrated weed management proved to be economically viable. It provided substantial benefits to farmers from the standpoint of the farmers, the community and the economy as a whole as the average yield of paddy was increased by 8.17 % over hand weeding. Many of the farmers of the district have taken keen interest to grow this improved rice variety with the integrated weed management.

Management of Shoot borer and termite in sugarcane

Introduction

Early shoot borer (*Chiloinfus catelus*) and termite (*Odontotermus obesus*) are the major pests in sugarcane crop impending cane production and juice quality. Soil application of chemical insecticides is being recommended for the management of early shoot borer and termite. It is reported that Thiamethoxam 75% SG as soil drench can manage the early shoot borer and termite in Sugarcane. Moreover, the available report suggests that *Metarhiziuman isopliae* can also check the population built up of termite in later stages of crop. Looking into the efficacy of the treatments as per report, an OFT was conducted in three locations of Thoubal district.

Thiamethoxam 75% SC@ 200 ga.i/ha and other check chemical Imidachloprid 70% WG (Farmers' practice) were drenched separately on the sets of different bed using a water volume of 1200 lt/ha. At the same time, *Metarhiziuman isopliae* (cfu 10^9) @ 500 g/ha was also applied at termite mounds after dissolving @ 10 g/litre water for checking secondary spread of termite.

Source of the Technology with year of release

Tamilnadu Agricultural University, Coimbatore, 2011

Outcome and impact

Various parameters like percent germination, early shoot borer damage was recorded at 30, 60 and 90 DAP. Termite damage was assessed at fortnight interval starting 30 days after planting upto 75 days after planting.

Table: Percent early Shoot borer damage in sugarcane as influenced by the test chemicals

S l . No	Treatment	Germination %	Shoot borer damage%			Yield (q/ha)
			30 DAP	60 DAP	90 DAP	
1	Thiamethoxam 75% SG 200 ga.i/ha	97	2.67	1.03	0.19	384
2	Imidachloprid 70% WG 200 ga.i/ha	83	3.73	2.00	0.86	371
3	Untreated check	66	13.56	7.45	4.75	352

Table: Percent termite damage on sugarcane as influenced by the test chemicals

Sl.No	Treatments	Termite damage %			
		30 DAP	45 DAP	60 DAP	75 DAP
1	Thiamethoxam	1.6	2.4	1.2	1.98
2	Imidachloprid	3.3	3.5	2.4	3.11
3	Untreated	18.0	16.0	14.0	8.2

Early shoot borer damage was lowest in treatment with Thiamethoxam 200 g a.i/ha during 30, 60 and 90 DAP recording 2.67, 1.03 and 0.19 percent damage respectively in comparison to Imidachloprid and control. Termite damage was also lowest in Thiamethoxam 200 g a.i/ha treated plots. *Metarhiziumanisopliae* gives good result in reducing the termite mound. Looking into its success the farmers of Laipham Lotnung, Wabagai, Keirak and Irengband villages of Thoubal have started cultivating sugarcane in large scale using this technology.

Shoot borer and termite management in sugarcane

Integrated nutrient management in soybean

Introduction

Soybean is grown in substantial areas in Imphal West district of Manipur, but yield is very low due to improper nutrient management practices adopted by the farmers. The crop is grown without any FYM or fertilizers causing nutrient mining and low yields. The soil of Manipur is also acidic in nature which hampers growth and multiplication of rhizobium. In this context, the present OFT entitled **Integrated nutrient management in soybean** was undertaken to work out the economics of INM practices in soybean cultivation.

Source of the Technology with year of release

Indian Agricultural Research Institute, New Delhi, 2004

Outcome and impact

Application of Rhizobium 200 g/kg of seed + 20:60:40 NPK kg/ha + FYM 10 t/ha + furrow liming @ 500 Kg/ha was found beneficial for enhancing the yield with the crop variety JS-335. The treatment recorded the yield of 16 q/ha with benefit cost ratio of 1.33 as compared to yield of 10.35 q/ha having B.C. Ratio of 1.04 in control.

Table: Integrated nutrient management in soybean

Treatment	Technology	Yield (q/ha)	Gross Cost of cultivation/ ha (Rs)	Gross return (Rs)	Net return (Rs)	B.C. Ratio
T-1	Rhizobium 200 g/kg of seed + 20:60:40 NPK kg/ha + FYM 10 t/ha + furrow lime 500 Kg/ha	16.00	60,000.00	80,000	16,000	1.33
T-2	Farmers' practice- No fertilizer & soil amendments.	10.35	45,000.00	46,575	1,036	1.04

The technology was accepted by the farmers of 3 villages where OFT was conducted and farmers were convinced about the role of integrated nutrient management in enhancing yield of soybean. Looking into its acceptability, the technology was popularised through Front Line Demonstration Programme of the KVK in 5 villages of the district.

Demonstration of INM in Soybean in farmer's field

Use of Trichoderma viridae for controlling Rhizoctonia rot in pea

Introduction

Garden pea is one of the vegetable crops cultivated in large scale in the district, but due to the high incidence of pests and diseases the yield and the return of the crop is very poor. Among the diseases, *Rhizoctinia* rot of pea was found to be the major disease faced by the farmers. It was observed that the farmers in the selected villages were not following any management practices for controlling the diseases in their field which resulted in high mortality percentage. Therefore, an OFT on use of *Trichoderma viridae* for management of *Rhizoctinia* rot in pea was conducted in 3 locations of East Khasi hills. The pea seeds were treated with Trichoderma @ 5-10 g /kg of seeds before sowing the seeds, soil treatment @ 6-8 Kg/ha of land and foliar application @ 5-10 kg/l of water at the early stage of the crop.

Source of the Technology with year of release

State Biological Control Laboratory, Upper Shillong, 2008

Outcome and impact

The result revealed that the use of bioagents in pea recorded a higher yield of 65 q/ha with a net return of Rs.1,31,649 as compared to control with an average yield of only 30 t/ ha and a net return of Rs.69,895. The B:C ratio was also found to be higher (3.1) in treatment with *Trichoderma viridae* compared to control (2.3).

Table : Performace of *Trichoderma viridae* for controlling *Rhizoctonia* rot in pea

Treatment	Yield-kg/ha	Net return (Rs./ha)	Disease incidence (%)	B:C Ratio
Farmer's Practice: No management	3,000 kg /ha	Rs.69,895	17.5%	2.3
Treatment: seed treatment @ 5-10 g /kg of seeds before sowing the seeds, soil treatment @ 6-8 Kg/ha of land and foliar application @ 5-10 kg/l of water at the early stage of the crop	6,500 kg /ha	Rs.1,31,649	3.5 %	3.1

The use of *Trichoderma viridae* to control *Rhizoctinia* rot of pea has led to a reduction in disease incidence. The results show that only 3-4% of the disease incidence has been reported whereas upto 30% of the disease incidence has been identified in control. The result also shows that there has been an increase in yield of about 41.5% in the demonstrated field over the local check. The farmers expressed that they have a keen interest in adopting this technology and are willing to replace the use of chemical pesticides with the use of *Trichoderma* since it is safe, eco-friendly and compatible to use with other bio fertilizers, compost and FYM.

OFT of pea in farmers' field

Biological management of late blight disease in Potato

Introduction

Potato is cultivated in rice fallows, but pre monsoon showers and erratic rainfall leads to infestation of late blight disease in potato. With organic mission on its way in Meghalaya, the farmers who are dependent on chemical fungicides for managing the disease are left stranded. After detail discussion in SAC meeting, an OFT on Biological management of late blight disease in potato had been taken up by KrishiVigyan Kendra, Jaintia Hills to minimize the disease incidence and increase the yield of potato.

Before sowing the potato tubers, the seed tubers were treated with *Trichoderma viride* @ 5 g/kg seed. A prophalytic spray was done at 45 days after sowing followed by 2 sprays at 15 days interval during the vegetative stage @ 5g/L water.

Table: Performance of Potato under Biological management

Parameters	Farmer's practice	Treatment with *Trichoderma viride*
No. of tubers/ plant	7-8	9-10
Weight/ plant(kg)	0.4-0.7	0.5-0.8
Size of tubers	Small- medium	Small- medium
Yield (q/ha)	149	160

Source of the Technology with year of release

State Biological Control Laboratory, Upper Shillong, 2008

OFT of Potato in farmers' field

Outcome and impact

Seed treatment with *Trichoderma viride* gives good sprouting and vegetative growth. Moreover, the treatment had reduced the disease incidence from 19.5% to 16.9%. The B:C ratio was found to be 1.9. Prophalytic spray with *Trichoderma viride* gave better yield (160 q/ ha) compared to control (149 q/ ha). The technology has so far been spread to 12 villages due to its eco-friendly benefits and improvement in soil condition.

Harvested potatoes

Indigenous Traditional Knowledge (ITK) for management of Gundhi bug in rice

Introduction

Rice (*Oryzasativa* L.) is the most important crop and a primary source of food for the people of Jaintia hills. The farmers usually grow local varieties of paddy like Lieh Khynriam, Khosoo, *etc* and usually practice organic agriculture without any use of chemicals pesticides. However, during milking stage, the crop is infested with gundhi bug which results into chaffy grain, thereby reducing the yield drastically. The farmers of the state have adopted a traditional method of managing the pest by using baffle traps with rotten craps, fish or meat as bait. Sometimes jack fruit is also used as a trap because of its adhesive property by placing pieces of the cut fruit in the field. All these method are eco-friendly and reduces the load of chemicals in the food and soil. Looking into its positive impact, KVK, Jaintia hills conducted an OFT to fine tune this ITK for better results.

A baffle trap with rotten craps/ fish @ of 50-100 traps /ha was used together with seed treatment by using *Pseudomonas fluorescens* @5 ml/L/kg seed before sowing in nursery and seedling root dip treatments with *Pseudomonas fluorescens* @5ml/L/kg before transplanting in the main field.

Observation recorded	No. of effective tillers	No of grains/ panicle	No. of gundhi bug/ trap	Yield (q/ ha)	B:C ratio
ITK	6-8	55-65	2-3	43	1.55
Modified ITK	6-8	65-70	2-3	52	1.70

Source of the Technology with year of release

Farmers' ITK

Outcome and impact

The yield of rice had increased to 52 q/ha with the modified ITK compared to 43 q/ ha in farmer's practice (trap alone). An extensive effort had been made by the KrishiVigyan Kendra, Jaintia Hills to promote this ITK practices together with use of bio-pesticides which had resulted in good germination percentage and vegetative growth .This technology is gaining popularity among the farmers in 7 villages because of its eco-friendly and sustainable nature.

Performance of French Bean Var. Arka Anoop & Arka Suvidha

Introduction

Cultivation of pole type bean under rainfed condition is popular in Aizawl district of Mizoram which involves arrangement of poles (bamboo/wire staking) which increases the cost of cultivation. In order to overcome this problem bush type French bean varieties Arka Anoop & ArkaSuvidha were tested under Aizawl condition for cultivation.

Source of the Technology with year of release

Indian Institute of Horticultural Research, Bangalore, 2007 and 2010

Outcome and impact

The yield and yield attributes parameters showed that highest number of pods/plant, length of pod and pod yield were recorded in Arka Anoop followed by Arka Suvidha which is at par with the Farmers' variety. The B: C ratio was higher in ArkaAnoop (3.0) followed by Arka Suvidha (2.7) compared to control (2.2).

OFT in French Bean

Table: Performance of bush type varieties over pole type

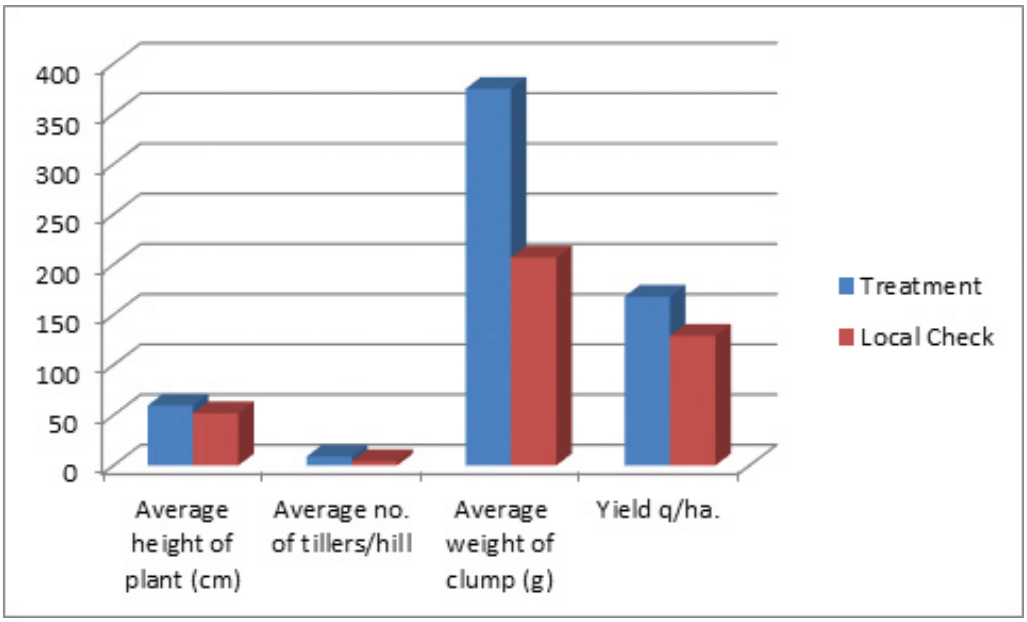
Sl. No.	Parameter	ArkaAnoop	Arka Suvidha	Farmers Variety
1.	Number of pods/ plant	17.3	16.8	14.5
2.	Pod length (cm)	16.9	15.3	12.6
3.	Pod yield (q/ ha)	160	151	121
4.	C: B Ratio	3.0	2.7	2.2

The shift in the variety from pole type to bush type has significantly reduced the cost of cultivation of French bean which influence the neighbouring farmers from 10-12 villages in the district of Aizawl.

Effect of in situ green manuring with soy bean on Ginger production in terraces

Introduction

The traditional practice of Ginger cultivation, usually carried out in Jhum field, has detrimental effect to the environment and causes soil erosion due to loosening of top soil at the time of harvesting, resulting in increased run-off of fertile top soil. Moreover, continous ginger cultivation in rain-fed terraces reduce the crop yield beyond second year. Though, chemical fertilizers are at the reach of most of the farmers, supplementation for organic manure is the major problems as FYM/ organic manure are not easily available. Therefore, an alternative and affordable form of organic matter supplementation is the immediate need of the farmers so as to improve the soil health. To address this issue, an OFT entitled "**Effect of *in situ* green manuring with soy bean on Ginger production in terraces"** was conducted so as to enhance the soil health by reducing the ill effect of prolonged use of chemical fertilizers, and also to assess its suitability for adoption in the district.



Effect of green manuring in ginger

The treatment details are as follows.

- Spacing of ginger is maintained at 45cm x 30cm (row-row x plant-plant).
- Soybean seeds are sown in lines, 2-4inches apart, between the inter row spaces of ginger after 45days of sowing of ginger.
- Incorporation of soybean into the soil just before flowering and at the time of 2nd earthing-up of ginger.

Source of the technology and year of release

ICAR Research Complex for NEH Region, Umiam, 2009

Outcome and Impact

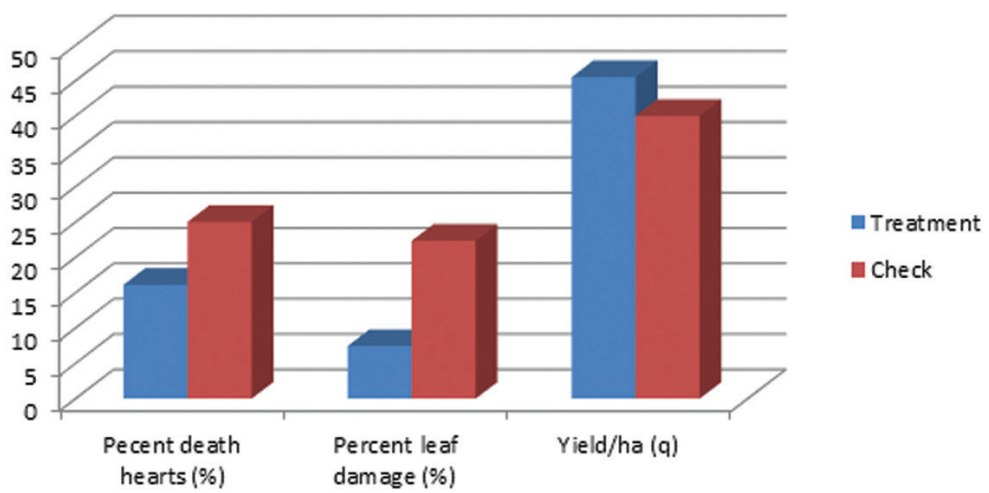
The average yield of ginger was found to be 168 q/ha, which was much higher than ginger alone. As evident from the results/data recorded, this technology assessed through OFT showed positive results and is being recommended for adoption to certain ginger growers of the district. However, percentage of adoption is still very low, as rain-fed terrace cultivation is being carried out by a few farmers in some locations of the districts only. Traditional system of cultivating ginger in *jhum* fields is still the dominant practise in the district.

Integrated Pest Management (IPM) practices for Stem borer & Leaf folder in Rice

Introduction

Kolasib District is one of the most potential districts of Mizoram in terms of area and production of paddy especially lowland or wetland rice cultivation (WRC). However, the productivity per unit area is very low (<25q/ha.), due to various factors, pest infestation being one of the most important contributing factors for low productivity. Among the various insect pest and diseases, Stem borer and Leaf Folder are the two most serious insect pests which are prevalent in all the rice growing areas of Kolasib district. An integrated and eco-friendly approach is necessary for managing these particular insect pests. As such, this technology "Integrated Pest Management (IPM) practices for Stem borer & Leaf folder in Rice" was assessed as On Farm Trials (OFT) in WRC areas of Kolasib District. The technology involves the release of *Trichograma japonnicum* @ 50,000/ha; light trap and spraying of Cartap Hydrochloride 50% SP @ 1000g/ha. @ ETL as per the following details.

- 1st release of *Trichogramma japonicum* is at 30days after transplanting (tillering stage).
- Subsequent release of *Trichogramma japonicum* is done at weekly interval after the first release, for six successive times (6 releases).



Effect of IPM practices in rice

- Spray Cartap Hydrochloride 50 % S.P @ 1000 g/ha at economic threshold level.
- Light trapping using Malathion @ 2ml per liter of water.
- Clipping off of leaf tips of seedlings before transplanting

Source of the technology and year of release

NCIPM, IARI Campus, New Delhi, 2012

Outcome and impact

The IPM practices for stem borer and leaf borer have resulted in a significant reduction in percentage dead hearts by 16.1% compared to control (25%). Similarly, the percentage leaf damage was reduced by 7.44% compared to 22.34 %. The average yield recorded was 45.5 q compared to 40.0 q in check.

Farmers have been motivated by the IPM practice applied in the FLD and majority of the farmers of the selected village had adopted this technique to check the pest infestation level which has resulted in increase in net returns to the farmers.

Rejuvenation of Citrus orchard

Introduction

Lunglei District has a wide range of climatic condition, moderate in summer and not very cold in winter with adequate amount of rainfall. Thus, most of the crops are grown mostly under rain fed condition and a large number of horticulture crops such as fruits, vegetables, flower, spices and condiments, plantation etc are grown in different regions of the district. Among fruit crops, Mandarin (*Citrus reticulate* Blanco*)* is one of the most important commercial fruit crops grown in the district and it occupies maximum area amongst fruit crops in the District. The citrus orchards are very old and unproductive; in order to improve the quality and yield potential rejuvenation of old and unproductive orchard is the best way for improving the economic yield. Looking into the importance of the issue, an OFT was conducted with the following treatments to rejuvenate the declined orchards in three locations.

1) Cutting and pruning of water sprout, diseases/dried twigs and making of half-moon terrace/tree basin for placement of manure and fertilizers was done in the month of Dec-Jan.
2) Application of slaked lime @3kg/tree and 30kg FYM/tree/year in the month of Feb-March.
3) 3) Application of 650g Urea+1220g SSP+450g MOP/tree three times in a year in the month of April- May, June-July and Oct-Nov.
4) Application of Bordeaux paste/Blitox-50 on tree trunk and spray of Bavistin (1g/L)+ Monocrotophos (1 ml/L) on new flushes and Spray of Micronutrient on new flushes in the month of April.
5) Pasting of tree trunk with 1% Carbaryl 50 WP(20g/L) and collection and destruction of Citrus trunk borer in the month of May.
6) Spraying of Bavistin(1 g/L) + Monocrotophos (1 ml/L) on new flushes and after 15 days, spray with Bordeaux mixture (1%) or Blitox-50 (3 g/L). Spraying of Micronutrient on new flushes in the month of June-July and August-September.
7) Application of Bordeaux paste/Blitox-50 on tree trunk upto 60 cm height from ground level and to kill Trunk borer grubs, clean the bored holes of the infested trunk and insert a cotton swab soaked in petrol/Dichlorvos or inject 5ml of Dichlorvos @ 0.2% (2ml/L)and plug with mud in the month of Aug-Sept.

8) Spraying of Malathion @2 ml/L to prevent fruit fly egg laying in the month of Oct-Nov.

9) Mulching, moisture conservation and irrigation during dry season.

10) Weeding at regular interval.

Rejuvenated orchards at Hnahthial, Thiltlang and Muallianpui villages

Source of the technology and year of release

ICAR Research Complex for NEH Region, AP Centre, Basar, 2008

Outcome and impact

The average yield of rejuvenated orchard was 125 q/ha with the average net returns of Rs.2, 20,000 in the district while the average yields of declined orchard was only 43.75 q/ha with the average net return of Rs.0.55 lakhs/ ha. The technology intervention is simple, practicable and easily adopted by 70% of Citrus growers which resulted in increased production. The technology intervention has

provided an economic benefit to the farmers with a B:C ratio of 3.2 as compared to the control (2.1). The technology has been popularized through FLD in the district and many of the farmers have adopted this.

Table : Mandarin yield of rejuvenated orchards

Sl.No	Parameters	Technology demonstrated	Farmer's practice
	Average Fruit weight (gm)	142.85	130.48
	Average no. of fruit/plant (nos)	250.12	100
	Yield (q/ ha)	125	43.75
	Net return (Rs/ ha)	220000.00	55000.00
	B:C ratio	3.2	2.1

High density planting of banana var. Giant Cavendish

Introduction

Banana is second most important fruit crop grown in Mamit District. It is grown in 646 ha area with production of 7501.21 t. The average productivity of banana is 11.61 t/ha (2013-14). There are several factors associated with low productivity of banana and one of the factors is wide spacing practiced by banana growers. Considering the constraints, an OFT on "High density plantation of banana var. Giant Cavendish" was conducted in different locations of Mamit with the following details.

- Planting spacing: 1.2 X 1.8m.
- Treatment of planting material with Carbofuran (Furadon 3 G) @ 40 g/plant, pit size 45 X 45 X 45 cm filled with mixture of 12kg FYM and top soil.
- NPK was applied @ 110g, 33 g and 330 g each plant.

Source of the technology and year of release

Assam Agricultural University, Jorhat, 2007

Outcome and impact

Results obtained from OFT showed that due to adaptation of high density plantation of banana var. Giant Cavendish yield was increased. Under High density plantation (HDP), an yield of 49.25t/ha yield was recorded against 16.55 t/ha in control plot. It was also observed that under HDP, banana crop matures earlier as compared to normal density plantation. Days taken to shooting & shooting to harvesting was recorded less (259days and 115 days respectively) in HDP as compared to traditional system of planting (266 days and 121 days respectively).

Table: High density plantation of banana var. Giant Cavendish

Particulars	High density planting	Control (traditional method)
Days taken to Shooting	259	266
Shooting to harvesting interval	115	121
Average bunch weight (kg)	11	15
Yield (t/ha)	49.25	16.55
B: C ratio	1.59	1.42

Fig: High density plantation of Banana

After seeing result of this OFT, farmers of the area realized that adoption of high density planting of banana is helpful in increasing productivity of this crop. Some progressive farmers of nearby villages are adopting this technology. After adoption of this technology, yield of their banana plantation increased significantly.

Cultivation of tomato under protected condition

Introduction

Tomato is an important vegetable crop grown in Mamit District during Rabi season, but during off-season higher incidence of insect pest and diseases are the major limiting factors in cultivation of tomato under open field condition leading to low productivity. Protected cultivation of tomato is one of the options for successful cultivation of tomato during off-season. Therefore, an OFT on protected cultivation of tomato was conducted during kharif season in three locations of the district using the latest variety " Arka Rakshak".

Source of the technology and year of release

Cultivation of tomato under protected condition

CIARI, Port Blair, 2007

Outcome and impact

It was clearly evident from the result of OFT that under protected cultivation farmers got more no. of fruits/plant, higher fruit weight and more yield (20 nos., 58

g and 62t/ha respectively) as compared to open field condition (13 nos., 41 g and 24t/ha respectively). The B:C ratio was found to be higher (3.28) under protected condition compared to cultivation in open field (1.52).

Table: Results of OFT on protected cultivation of tomato

Parameters	Improved practices (Protected cultivation)	Farmers practices (Open field cultivation)
No. fruits /plant	20	13
Av. Fruit wt.	58g	41g.
Yield (t/ha)	62.0	24.0
B: C ratio	3.28	1.52

Progressive farmers of different villages of the district are now cultivating tomato as off season crop in their net houses and low cost poly houses and getting very good price of their produce in the market.

Integrated nutrient management to boost the yield in Mustard.

On Farm Trails onMustard (TS-38).

Introduction

An OFT was carried out to assess the performance of mustard variety TS-38 subject to application of fertilizer (NPK) @ 60:40:30 kg/ha and vermicompost @ 2 t/ha. Before preparation of field for cultivation, soil samples were collected in random and soil analysis was done in the mini soil laboratory. The results show that the available nitrogen and available potassium were low and available phosphorous was medium. The pH of the soil was recorded as 4.5 which indicated that the soil was highly acidic. Nitrogen fertilizer @ half dose of 30 kg/ha in the form of urea, full dose of 40 kg/ha phosphorous in the form of single super phosphate, full dose of 30 kg/ha potassium in the form of muriate of potash and 2t/ha vermicompost was applied at the time of final land preparation. Another half dose 30 kg/ha nitrogen was applied as top dressing.

Source of the technology and year of release

Indian Agricultural Research Institute, New Delhi, 2010

Outcome and impact

There was a significant increase in available Nitrogen, Phosphorus and Potash

in the soil compared to control. The N, P and K in the soil were increased by 7%, 19.8% and 16.3%, respectively. There was an increase in yield with application of NPK @ 60:40:30 kg/ha and vermicompost @ 2 t/ha by 25% compared to control. The yield advantage and boost up of soil heath condition through INM practice motivated many farmers of the village and adjoining villages to adopt INM in their field.

Table: Effect of INM in Mustard

Parameters	Technology demonstrated (INM)	Control	% increase over the control
Available 'N' in soil	390.8kg/ha	365.3kg/ha	7
Available 'P' in soil	14.5kg/ha	12.1kg/ha	19.8
Available 'K' in soil	210.8kg/ha	198.4 kg/ha	6.3
Yield	6.75 q/ha	5.0 q/ha	25
BC ratio	2.0	1.6	25

Enhancing the livelihood security through Gerbera production under protected condition.

Introduction

Floriculture has emerged as an alternative source of livelihood for small and marginal farmers in Longleng District of Nagaland. North East has very good scope and potential in the flower trade with moderate climate throughout the year besides cheap availability of land and labour for producing gerbera on commercial scale for export. Though a wide array of gerbera cultivars are grown in north east region, it has become inevitable to evaluate new potential cultivar for their qualitative and quantitative characters. To identify and recommend the suitable cultivars for the agro-climatic condition of Longleng District Nagaland, the present OFT was undertaken to study the performance of different cultivars of gerbera under protected condition with the following details.

The OFT was in two different villages *i.e.* ,Hukphang and YoangYimchen during the year 2016-17. Four Gerbera hybrids *viz,* Stanza, Silvester, Rosalin and Brilliance were evaluated for their vegetative, flowering and quality attributes.

Source of the technology and year of release

ICAR research Complex for NEH Region, Nagaland Centre, Jharnapani, 2012

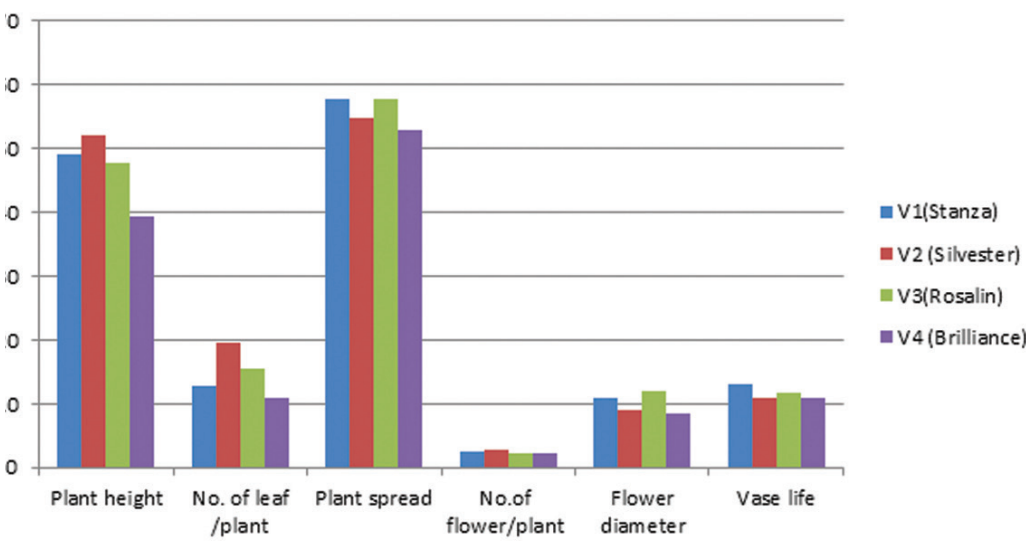
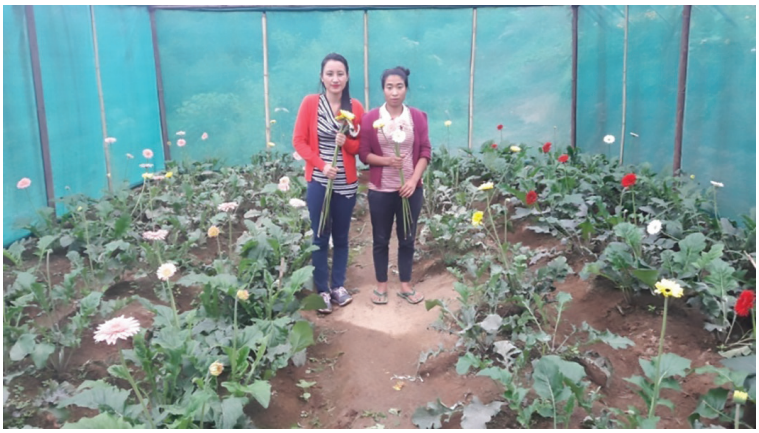


Fig.Vegetative Characters, flowering characters, Flower quality characters under protected condition



Cultivation of Gerbera cultivars at Longleng District, Nagaland

Outcome and impact

The data revealed that Rosalin recorded maximum plant spread (57.82 cm), flower diameter (12.04 cm), whereas Stanza recorded maximum vase life (13.2 days), Silvester recorded maximum plant height (52.04 cm) and no. of leaf/plant (19.6 nos.) and no. of flowers/plant (2.8 nos.) Cultivars Rosalin, Silvester and Stanza appears to be the better cultivars under Longleng condition as compared to and Brilliance in terms of vegetative, flowering and quality attributes.

From the result it was observed that No. of marketable/ commercial flower harvested between Feb–Aug was 960 stalk, net return was recorded as Rs 14,800/- for the first 6 months whereas Benefit cost ratio was recorded as 1.92.

The crop diversification helped the farmers to get good returns from flower cultivation throughout the year under protected structures which has led to economic empowerment of the farming community of the District.

Improved Maize Production Technology using var. NMH-1247

Introduction

Rice is considered as staple food for the farmers of Tuensang district and Maize is considered indispensable crop as Maize grains are sold to buy rice. Maize crop being nutrient exhaustive crop usually performs well in current *Jhum* field compared to second year fallow and this usually pushes the farmers to grow only in the first year of *Jhum*. The local cultivars have better yield potential with long duration (up to 8 months) resulting increased cost of cultivation per unit area per season and thereby delays rabi crops production with lower cropping intensity per year.

Performance of NMH-1247 during 2016 in farmers' field (under OFT)

Reducing the cost of cultivation per unit area, shortening the crop duration by replacing with shorter duration high yielding crop varieties and increasing the cropping density could be the best probable solution based on the present system of cultivation. Keeping the identified problems in focus and to introduce shorter duration high yielding varieties with higher yield potential, an **On Farm Trail** was conducted on 'Improved Maize production technology using improved variety NMH-1247 (Dragon).

NMH-1247

Source of technology and year of release

ICAR-Indian Institute of Maize Research, Ludhiana, 2015

Outcome and impact

The technology under OFT performed very well with average yield of 7.26 t/ha with 53.48% increase in yield over the local check with the B: C ratio of 2.52 in the first year. Based on performance, NMH-1247 was

recommended for production in high altitude during Kharif season under early sowing during Rabi over its recommended sowing date in un-irrigated condition semi temperate type of climate (1200msl and above) to avoid moisture stress in hills under Tuensang situation.

The performance of the technology in the demonstration area outperformed the locally cultivated cultivar with an average yield of 49.50 q/ha against an average yield of 38.67 q/ha. The increase in yield of the technology (NMH-1247) was 28.05% with 1.90 B: C ratio and a net return of Rs. 20270/- per hectare in the first cropping season. The new variety also reduced incidence of lodging as it is shorter in height.

The duration of NMH-1247 is shorter with 4-5 months in comparison to local cultivars which is 8-9 months making it possible for farmers to opt for sequential cropping. In the same cropping year Soyabean, Var. JS 9305 was taken as double crop after NMH-1247. The yield from the succeeding crop (Soyabean) was 22.10q/ha bringing an additional net return of Rs. 11573/-

Table: Performance of NMH-1247 over the local varieties

Treatment	No of cobs/ plant	Yield kg/ha	Net return (Rs./ha)	B:C Ratio
Improved cultivation practices + Improved maize Var: NMH-1247 (**Kharif Season**)	1	7,260	35,080/-	2.52
Local cultivar	1	4,730	19,400/-	2.05
Improved cultivation practices + Improved maize Var: NMH-1247 (**Rabi Season**)	1	3,140	30,600/-	2.85
Average Yield in the district (Both Kharif and Rabi season)	1	5200	-	-

With the success of the technology under OFT, large scale frontline demonstration was initiated in the succeeding year (2017) in Chendang village involving 10 numbers of farmers in five different locations covering an area of 5 hectare.

Frontline Demonstration during 2017

In the current year (2018), 1500 kg of NMH-1247 has been supplied to the farmers covering more than 100 hectares in 15 villages of the district. The anticipation of increasing the Maize production per hectare in the district is evident which is expected to enhance the income of the farmers in the district. This technology intervention can be viewed as one solution towards fulfilling the very vision of doubling the Farmers' income by 2022.

NMH-1247 (Dragon) in the farmer's field, Chendang village 2018

Performance of Soyabean Variety JS 95-60 under Tuensang

Introduction

Most of the farmers of Tuensang district grow soyabean as pulse crop. It is consumed after fermenting which is considered a delicacy in different traditional dishes. Soyabean in Tuensang is mainly cultivated in warmer areas experiencing sub-tropical type of climate. However, farmers in higher altitude also cultivate soybean despite its low productivity and longer cultivation period due to higher return per kg (Rs. 50 to 80 per kg). The average productivity of soyabean in the district is 12.42 q/ha covering an area of 2100ha (*Statistical hand book of Nagaland, 2013)*.

To disseminate improved cultivation technologies for increasing the crop production per unit area and also to introduce short duration high yielding varieties with higher yield potential, an OFT was conducted on 'Performance of Soyabean Variety JS 95-60' in three locations of the district as per the following details.

Season : Kharif

Date of sowing: 11th Aug'17

Date of harvesting: 15th Dec'17

Source of technology and year of release

Rajmata Vijayaraje Scindia Krishi Viswa Vidyalaya, Gowalior, 2011

JS 95-60 in the farmer's field at Chingmelin, 2017

Outcome and impact

The variety 'JS 95-60' tested through OFT recorded an average yield of 24.8q/ha with the B: C ratio of 2.20 bringing a net income of Rs.14,453.00/ ha. The yield obtained was 37.77% higher than the local cultivars grown by the farmers. Looking into the performance, Soyabean var. JS 95-60 was recommended for production in higher altitude of Tuensang district during kharif season (delayed sowing from July to early August than the usual farmers' practice of early sowing in the month of May-June).

Performance of Soyabean Variety over Local Variety

Treatment	Yield kg/ha	Net return (Rs./ha)	B:C Ratio
Soyabean Variety JS 95-60	2480	14453/-	2.20
Local cultivar	1803	7200/-	1.6

The variety JS 95-60 has been widely accepted by farmers due to its short duration, bolder clean seed and better yield characteristics. So far 15 villages have adopted this variety covering an area of 25 ha.

Performance of tomato var. Kashi Amrit and Swarna Sampada in Wokha

Introduction

Tomato is an important crop of Wokha District and it is consumed on a daily basis. But people of the District has to depend on neighbouring states for supply as the farmers grow only local variety which has low yield and poor keeping quality. In order to keep pace with the demand, tomato varieties Kashi Amrit and Swarna Sampada were tested under Wokha condition in four locations of Wokha district.

Source of technology and year of release

IIVR, Varanasi, 2007 and ICAR Complex for Eastern India, Patna, 2008

Outcome and impact

It was observed that the number of fruits per cluster was higher in local variety compared to the improved varieties. But, the fruits of the local variety are comparatively smaller in size with an average fruit weight of 14 gm only where as Kashi Amrit and Swarna Sampada recorded an average fruit weight of 55.4 gm and 62.4 gm respectively. The yield of the local variety is 45.6 q/ha where as Kashi Amrit and Swarna Sampada recorded an average yield of 84.5 q/ha and 109 q/ha with the B:C ratio of 2.2, respectively under organic management practices. The net return recorded was Rs.47800.00 and Rs.37400.00 per ha in Kashi Amrit and Swarna Sampada, respectively against Rs.16,580.00/ ha in local variety.

OFT cultivation of tomato var. Kashiamrit and SwarnaSampada

Promotion of High Yielding Paddy Variety RC Maniphou-10 in Mid Altitude Hill Ecosystem

Introduction

The farmers in Ri-Bhoi district of Meghalaya are growing local traditional tall, long duration and low yielding varieties resulting low income. Based on the needs of the farmers, a number of high yielding varieties of rice were tested by KVK, Ribhoi in last few years. In order to introduce double cropping, ICAR Research Complex, Manipur Centre developed a semi dwarf (115 cm), glutinous, moderately resistant to gall midge, stem borer, blast and BLB, shorter duration (120 days) HYV variety RC Maniphou-10 in 2008. The average potential yield ranged from 6.0-6.5t/ha. Since, the variety fulfilled the needs of the farmers, a number of demonstrations with RC Maniphou-10 was conducted by KVK Ri-Bhoi in more than 15 villages viz, Mawbri, Khweng, Thadnangiaw, Kodongulu , Liarkhla, Kyrdem, Umeit, Margnar, Umwang, Bhoirymbong, Nonglakhiat, Pahamsyiem, Umrleng, Nongthymmai, Mawlasnai by covering more than 100 hectare and 250 farmers during 2016-19 in the district to enhance productivity, income and cropping intensity.

Source of Technology

ICAR Research Complex for NEH Region, Manipur centre, 2008

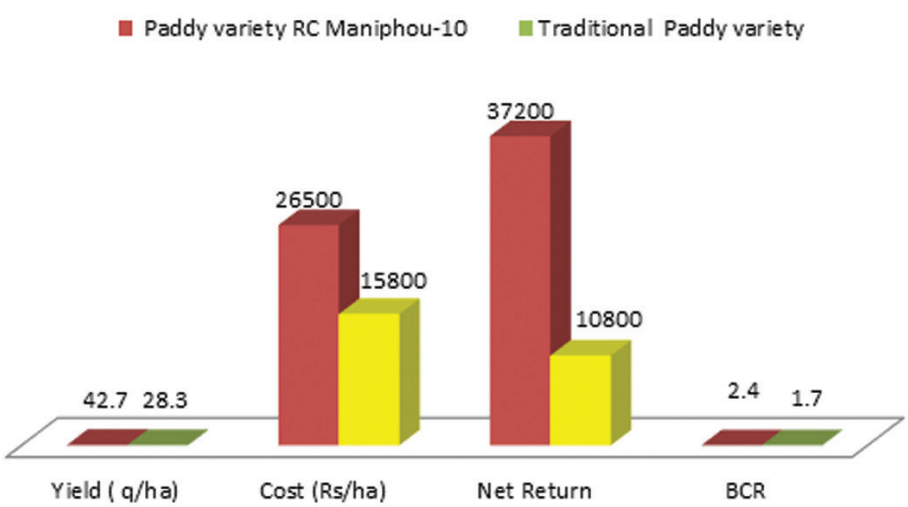


Fig. 1 Performance of paddy variety RC Maniphou-10 over traditional variety

Bumper crop of paddy variety RC Maniphou-10

Outcome and impact

The result revealed that the productivity was found to be 51 per cent higher than traditional variety which also provided opportunity to grow second crop. The average yield was recorded 42.7 q/ha as compared to traditional variety with 28.3 q/ha. The net return was also found Rs.37200/ha with benefit cost ratio of 2.4. The farmers were very happy with the high yield, taste and duration of the variety as it helped them to increase the cropping intensity in the district. More than 100 hectare area was covered benefiting more than 250 farmers in different parts of the district in Meghalaya.

Paddy Cum Fish Farming in Ri-Bhoi District of Meghalaya

Introduction

Monocropping of paddy in low land valley ecosystem with low system productivity and income from single enterprise with 35 per cent severity are major bottleneck in Ri-Bhoi district of Meghalaya. Paddy-fish integrated farming system complement each other with utilization of different ecological niches and function together which last for 6-8 months depending upon availability of water. Fish lives in between the dense paddy which helps as a hideout against birds, in return fish provides fertilizer with their droppings, eat insect pests and help to circulate oxygen around the paddy field resulting in paddy yield enhancement. Realizing the importance of paddy-fish farming the technology was standardised by Division of Fisheries, ICAR Research Complex, Umiam so as to enhance the farm income of the farmers. KVK Ri-Bhoi undertook OFT at three different villages viz., Kyrdem and Umsawriang covering one hectare area in five different farmers' field during 2018-19 to enhance the system productivity and income of farming community in the district. Modifications in the paddy field were done by digging canals or trenches in various forms at least 0.5 - 0.6 m deep and 1 m wide which serve as refuge for fishes. The dykes was elevated with gentle slope which can retain or withstand if water level rises and installed with inlet and outlet protected with fine screening. Depending on the location, fencing with netting material used to prevent fish from escaping during heavy rains. Transplantation of paddy was done when the field was ready. After two weeks of transplantation, fingerlings of Amur common carp (main species), catla, rohu, mrigal, silver carp, grass carp, gonius with stocked @ 6000-7500 nos/ha of paddy area were released. The fish fed minimally with rice bran and mustard oil cake in the ratio of 1:1 if needed. Paddy and fish harvested at the same time or depending on the availability of water.

Source of the Technology and year of release

ICAR Research Complex for NEH Region, Umiam, 2013

Outcome and impact

The result revealed that the paddy cum fish integrated farming system produced 63.33 q/ha as compared to monocropping of paddy yield with 15q/ha. The net return fetched was Rs 127550/ha with the integration of paddy and fish with benefit cost ratio of 3.1 as compared to mono-cropping of paddy. The farmers were happy with the integration of fish with paddy as compared with mono-cropping of farming in terms of yield, income and system productivity.

Details of Technology	Yield (q/ha)	Cost (Rs/ unit)	Net Return (Rs/ha)	BC Ratio
Paddy cum Fish Equivalent Yield	63.33	**62450**	**127550**	**3.1**
Monocropping Paddy	15.0	**20750**	**24250**	**2.16**





Paddy cum fish integrated farming system

Nutrient supplementation and deworming practices on growth and reproduction performance of Hampshire crossbred pigs

Introduction

Piggery plays an important role in improving the standard of living by creating employment opportunities, providing a source of food and generating income for majority of the rural people of Manipur because of its fast growth rate, highly prolific, short generation interval, high dressing percentage, reducing food waste and garbage, low maintenance cost *etc*. Farmers are not getting optimum returns from pig farming due to unscientific management and imbalance of feeding practices. Hence, planning is required to maintain the pigs on locally available feed ingredients to cut down the cost in pig feeding without affecting the performance of pigs. Parasitic infestation adversely affects pig. Balanced feeding coupled with regular deworming will bring excellence in pig production.

The feeding trial in farmer's field as OFT was carried out on two groups of Hampshire crossbred pigs with an objective to see the effect of addition of mineral mixture and regular deworming and reproductive performance of sows with the following treatments.

Diet 1 (T_1): 40% kitchen waste + 30% crush maize +30% rice bran with regular deworming at 2 months interval and inclusion of 2gm mineral mixture daily during gestation period.

Diet 2 (T_2): 40% kitchen waste + 30% crushed maize + 30% rice bran without deworming and minerals mixture.

Four farm women families from Chandel district of Manipur were selected

Scientific rearing and management of cross breed Hampshire pigs

to conduct the study. They were divided into two groups having 2 members in each group. They were provided with three Hampshire crossbred pig comprising of two female and one male. Out of the two groups, 6 pigs of first group were maintained on diet 1 (T_1) and another 6 pigs of second group were maintained on diet 2 (T_2).

Source of the Technology with year of release

ICAR Research Complex for NEH Region, Umiam, 2010

Outcome and impact

The results revealed that the treatment (T_1) with 40% kitchen waste + 30% crush maize +30% rice bran with regular deworming at 2 months interval and inclusion of 2gm mineral mixture daily during gestation period was found much better than T_2 with the B: C ratio of 1.95.

Sl.No.	Parameter	T_1	T_2
1.	Age at sexual maturity	8.05	9.00
2.	Age at first furrowing	12.12	13.50
3.	Litter size at birth	10.50	9.25
4.	Litter size at weaning	9.85	7.50
5.	Litter weight at birth (kg)	13.65	10.64
6.	Litter weight at weaning(kg)	76.50	52.50
7.	Mortality	6.19	18.92
8.	B:C ratio	1.95	1.35

The nutrient supplement and deworming practices resulted in good returns with pig farming through increased reproductive performance, reduced morbidity and mortality. Utilization of locally available feed ingredients reduced the cost of feed. It resulted in improvement of the socio-economic status of rural people through better livelihood and nutritional security.

Feeding management of broiler White Pekin duck

Introduction

Duck rearing for egg or meat is commonly practised by the local farmers in backyard poultry farming system. But, due to high cost of feed scarcity of conventional feed ingredients, duck rearing becomes cumbersome. Therefore, intensive and continuous efforts are being made to reduce the cost of production without jeopardising the profitability of duck production by replacing the costly ingredients in duck ration.

In spite of tremendous scope available for duck rearing in the specified pockets and high demand of duck meat, this enterprise is not massively undertaken by the local farmers, mainly because of un-availability of safe water pools throughout the year, high cost of standard commercial ration, and the high mortality during growing period. Looking into these constraints, an OFT on "Feeding management of broiler white Perkin Duck" under the semi-range system with swimming facility at 3 levels of feed composition in the diet was conducted across 3 locations of Imphal West.

Source of the Technology with year of release

Directorate of Poultry Research, Hyderabad, 2010

Outcome and impact

The average body weight of 3.41kg was recorded at 12th week with 14.01 kg of feed having 30% standard concentrated mixture + 50% rice bran + 20% of egg shell and green grass.

White pekin duck unit at mayang imphal and sekmai villages

Maximum gain in body weight of 3.41 kg was attained with minimum feed conversion ratio of 3.01 with better weekly growth rate. Percent eviscerated weight at 12 weeks of age was highest in ducks fed with the same treatment.

Standard Conc. Mixture 30% + Rice Bran 50% + egg shell, green grass, snails 20% (T1) was therefore, recommended as the profit per duck was Rs.647.00 with highest net returns having the B:C ratio of 2.08.

Table: Feeding management of broiler White Pekin duck

Treatment		Average body wt. (Kg) at 12 wk	Feed conversion ratio(kg of feed / kg body weight gain	Feeding cost (30 duck) (Rs)	Gross Cost	Gross return (Rs)	Net return (Rs)	B.C. Ratio
T1	Standard Conc. Mixture 30% + Rice Bran 50% + egg shell, green grass, snails 20%	3.41	3.5	9240	12240	25575	13335	2.08
T2	Standard Conc. Mixture 15% + Rice Bran 65% + egg shell , green grass, snails 20%	2.5	2.75	6720	12240	18750	6510	1.53

With this intervention, meat production was enhanced by 75 to 80 percent in the villages. The annual net return was also enhanced at 50 per cent per unit in comparison to local practice and thereby, providing employment generation of 158 mandays per family.

Feeding of home-made ration to cross-bred pigs

Introduction

Pigs are reared in the backyard and graze as scavenging animals among the human dwellings. There is a large gap between the demand and availability of pork due to the poor productivity of the native pigs. Non-availability of improved / superior germplasm of pigs in the locality, exorbitant feed cost and poor network of communication, difficult terrain, lack of adoption of sustainable practices in management and feeding are the major limiting factors for low growth in animal production in Tamenglong district of Manipur. Moreover, the readymade concentrated feeds are not available in the locality and even if it is available, they are very expensive.

Looking into these constraints, an OFT on feeding of Home–made ration (cheap feed) prepared from locally available ingredients was conducted in 4 locations of the district.

Sixteen 50 % crossbred (HSR X YSR) piglets at 1:3 (Avg. age 60 days, avg. body weight of 8.7kg) were divided into 4 groups of four (4) piglets in each group. Randomly, one group was maintained under Technology Option *i.e.* scientific feeding practices with facility to scavenge as and when required. The other three groups were distributed to three pig farmers maintaining their units under different traditional feeding practices with semi-range method of rearing.

Piglets of Technology Option (TO) were offered homemade ration-1 (HR-1) containing Maize 40 parts+ Rice Bran 32 parts+ Kitchen Waste 40 parts by weight to fulfil the nutrient requirements. Under traditional feeding system adopted by respective farmers, piglets were randomly fed with Rice Bran (RB) & grain by-products (GP), Tuber/Plantain (TP), and Kitchen Waste (KW), *etc.* and RB & GP mixed in the ratio of 100 : 3 (KW).

Fig.1 Homemade made ration feed
(Maize, Rice polish/ Bran, Grains by-products, Kitchen /Hotel waste,)

Homemade ration prepared from above feed components under TO was made half boiled and fed to the animals @ 2 to 3 kg /day in two equal doses, *ie.* Morning and evening besides trace amounts of vitamins, mineral mixture. Likewise, farmers also fed their pigs with locally available grasses/garden by products and kitchen waste, *etc.* @2 to 3 kg /day in two equal doses morning and evening.

Table: Composition of ration

Sl. No.	Preparation of ration *				
	Ingredients	Homemade Ration (HR-I)	F-I (RB & GP)	F-II (TP)	F-III (KW)
1.	Maize	40 parts	Approx. 60 parts RB & 40 parts GP	Approx. 80 parts & 20 parts RB	Approx. 60 parts, 20 parts RB, 20 parts TP
2.	Rice polish/ Bran,	30 parts			
3.	Grains by-products, etc.	10 parts			
4.	Kitchen / Hotel waste	20 parts			
5.	Tuber/ Plantain	-			
6.	Vitamins, Min. mixture	As required	As required	As required	As required
7.	Green leaves etc.	Ad. Lib.	Ad. Lib.	Ad. Lib.	Ad. Lib.

Mixture of the ingredients were fed to the animals

Source of the Technology with year of release

NRC on Pig, Rani, Guwahati, 2014

Outcome and impact

The daily growth rate varied from 168 to 210 g with an average of 194g/day in case of TO while daily body weight gain varied from 141 to 196 g up to the age of 240 days was 171g / day under farmers practise. Feeding of homemade ration helped in enhancing body weight from 5 to 6.11 kg in comparison to farmers practise and enhanced income of Rs.900.00 to Rs.1021.00 per animal. Thus, a beneficiary adopted with the technology earns Rs.17, 225.00 per pig.

Table: Performance of the pigs at different ages under village condition

Age (days)	Body weight (kg)			
	TO (HR-I)	F-I (RB & GP)	F-II (TP)	F-III (KW)
Initial (60 days)	8.61	8.56	8.45	8.50
At 120 days	18.01	16.72	17.11	17.33
At 180 days	30.60	28.77	29.02	28.05
At 240 days	45.33	39.68	38.97	39.01
Av. Feed Conversion Efficiency	1:4.62	1:3.89	1:3.37	1:3.66

Fig.2 Cross Breed (HSR X YSR) of 4 months

Vanaraja poultry for increasing farmers' income

Introduction

Backyard poultry is a source of livelihood among the farming communities. However, low egg production and weight gain of indigenous birds was the major problem in backyard poultry. KVK Longleng conducted an OFT during the year 2014-16 with Vanaraja breed. The improved feeding and brooding practices were also demonstrated to reduce mortality. Apart from this, regular observations were carried out to record the data on body weight and overall growth performance for assessment of their performance.

Source of the technology and year of release

Directorate of Poultry Research, Hyderabad, 2013

Outcome and impact

The Vanaraja poultry bird was found to be suitable and well adapted to the climatic condition of Longleng district. The average body weight gain of Vanaraja at 5 months was recorded 2864±472.03 g against 1175±4.7 g in indigenous local birds. The average egg production per hen per year of Vanaraja and indigenous local bird was recorded as 154 and 37 eggs, respectively. The BC ratio in Vanaraja and local breed was found to be 2.30 and 1.026, respectively.

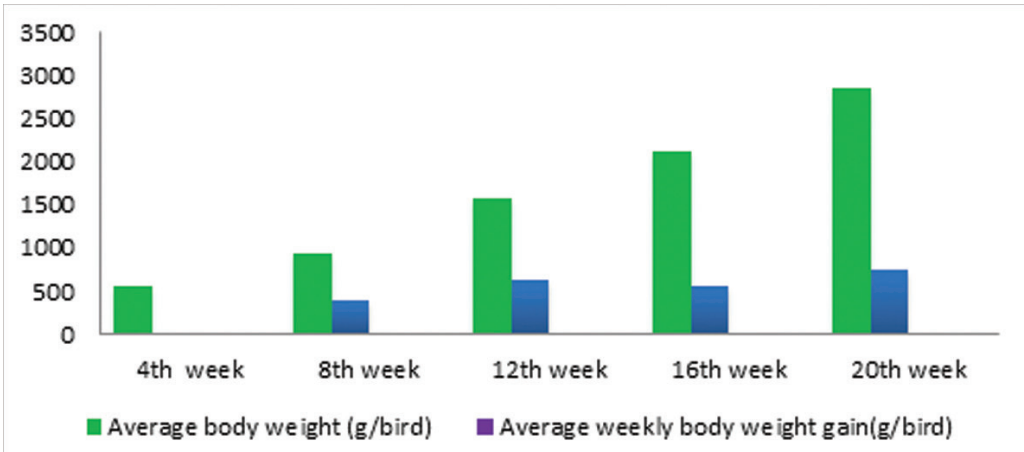


Fig: The average weekly body weight and weight gain (g/bird)

Dual purpose poultry bird-Vanaraja farm in Longleng district.

Vanaraja bird has been accepted by the farmers of Longleng district due to its similarity with indigenous birds, less diseases occurrence, faster growth rate, hardy and can be reared in backyard condition, thereby enhancing income of the farmers. The demand for the bird has been increasing yearly and few progressive farmers are coming forward for large scale production.

Low cost feeding rack for goats

Introduction

Low cost wooden feeding rack for goats is suitable to satisfy their browsing nature in intensive system as well as semi-intensive system of rearing for stall feeding practice. It is also appropriate for the browsing goats during adverse climatic conditions to facilitate feeding at stalls. It is easy to carry and transport which prevents wastage of fodder. It prevents soiling of fodder with dung and urine. It increases the feed intake level among goats. One rack is sufficient to feed 8 goats. It can also be made by bamboo to reduce further cost which is affordable by all categories of farmers to rear the 'Poor man's cow' in real sense. Looking into its importance, this technology was tested by KVK, Khowai through OFT during the year 2017-18 and popularized through Front Line Demonstration during 2018-19.

Source of the technology and year of release

Tamil Nadu Veterinary and Animal Sciences University, 2016

Outcome and impact

Outcome in terms of fodder requirement, wastage, net saving per goat per month and benefit-cost ratio of technology as well as farmers practice are given bellow.

Fodder wastage per month/Goat		Fodder required /Goat/Month		Net Saving (Rs/ goat/month		B:C Ratio	
Tech	F P	Tech	F P	Tech	F P	Tech	F P
5.5 Kg	20 Kg	60 kg	80kg	7.5	0	1.38	1.1

* *Tech. : Technology; FP: Farmer's Practice*

Instant adoption of the technology by the goats was observed during the testing period. It solved the problem of browsing or tethering requirement of goats at field. Initially the technology was demonstrated to only three nos. of farmers of three different villages in trial mode. The members of farmer's club of these villages observed the suitability of the technology and subsequently several of them adopted it. In later stage Frontline Demonstration was conducted at 10 farm families in a tribal village where also several other members of farmer's club adopted the technology and readymade racks were purchased from the local artisan who was trained to prepare the racks for sale.

Popularization of duck breeds for egg purpose in Wokha district of Nagaland

Introduction

Duck farming in Wokha district is being practised since long back where the farmer rear 3-5 ducks under low input system. However, most of the duck reared by the farmers are of local breed which are of low productivity. The farmers also lack scientific system of rearing and many a times high mortality is recorded due to improper management like housing, health, nutrition and vaccination. KVK Wokha conducted an OFT with Cherra chambli bred of duck at two selected villages namely Longsachung and New Wokha village of the district. The farmers were given 20 (twenty) nos. of ducks each. The parameters assessed were average body growth gain, adaptability, mortality and productivity.

Source of technology and year of release

SIRD, Guwahati

Outcome and impact

Average body weight gain recorded was 1.6 kg in 10 months period with 90 nos. of eggs. The gross return per unit of 20 ducks was Rs.5987.00 with net return of Rs. 4370.00 per unit. The benefit cost ratio recorded was 1.37.

This OFT revealed that the duck breed 'Cherra chambli' under low input system of farming can be a beneficial option for the farmers with no extra labour. After seeing the performance of the breed, many farmers of the district have shown interest to rear the duck breed in their village as well.

Duck breed for egg purpose at Wokha district of Nagaland

Controlled Breeding of Common carp to intensify seed production

Fish farming in East Khasi Hills

Introduction

Common carp spawns throughout the year in tropical climate with 2 peak breeding periods, one during the month of Jan-Mar and other in Jul-Aug. Although Common carp breeds naturally, to intensify the seed production several techniques are adapted in many countries for their captive breeding. As most of the areas of East Khasi hills district, Meghalaya are being categorised as mid altitude, breeding of this species is difficult due to low temperature regime during the breeding season. Moreover, breeding of other species of carps, *i.e.* IMCs and Exotic carps is possible only in established hatcheries through induced breeding technique. But for seed production only Common carp breeding is feasible in the farmer's field. Hence, an OFT **Controlled Breeding of Common carp to intensify seed production** was conducted in three locations of East Khasi hills district.

Happa breeding system, an age-old practice was introduced in the district with the following details.

Size of breeding happa – 1.8 m x 0.9 m x 0.9m

Eggs collector - 2 kg/ 1 Kg female brood

Synthetic inducing agent such as ovaprim, Ovatide/Gonopro- FH was administered @ 0.2 ml/ kg body wt. only to the female brood. The brood fishes were removed after spawning and the eggs were incubated till they hatch out.

Breeding of Common carp was carried out in the farmer's field in Nohron, Wahlyngkhat and Shella villages of East Khasi Hills District. It had been observed that the average

body weight of the fish was recorded as 1 kg in case of female and 0.75 in case of male fishes. The latency time was 16 hrs. The percentage survival was 80%. The total no. of fingerlings produced per unit was 1 lakh nos.

Source of the Technology with year of release

ICAR Research Complex for NEH Region, Umiam, 2006

Outcome and output

The production of fingerlings had increased significantly. The people have learnt the scientific method of fish seed production and have realised the potential benefit through fish seed production and spawn rearing using "Happa" breeding system. Moreover, common carp was reported to perform better in composite culture system in the mid-altitude conditions, thereby contributing to the overall fish productivity per ha.