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From the Director General's Desk

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Excessive reliance on chemical pesticides and chemical fertilizers are causing widespread ecological imbalances necessiating the need for promoting environmentally sustainable agricultural practices. In order to address the adverse impacts of chemical pesticides on agroecosystems, Integrated Pest Management has evolved from ETL based approach to Agroecosystem Analysis based Integrated Pest Management. In addition to integration of various pest management strategies, the Agroecosystem Analysis (AESA) based approach is holistic and incorporates other components of plant health.

Ecological Engineering for Pest Management, a new paradigm, is gaining acceptance as a strategy for promoting Biointensive Integrated Pest Management. Ecological Engineering for Pest Management relies on habitat management for enhancing population of Pollinators, Parasitoids and Pollinators, the larvae of which are predacious. Habitat manipulation can be effected through plantation of appropriate companion plants with special focus on floral trap crops and repellent crops. NIPHM is committed to create a pool of Master Trainers to promote adoption of Agroecosystem Analysis based Plant Health Management in conjunction with Ecological Engineering for Pest Management in India. The Master Trainers are also equipped with skills in production of biocontrol agents and microbial biopesticides.

There is a need to build the capacity of farmers to promote conservation of natural enemies both below ground and above ground by focusing on promoting soil health through use of organic and biofertilizers, adoption of Ecological Engineering for Pest Management and analyzing the Agroecosystems on a weekly basis to arrive at the adequacy of natural enemy population to manage the pests. In addition there is a need to promote simple and low cost mass rearing techniques of bio-control agents and microbial biopesticides so that the farmers are equipped with the skills to produce natural enemies and resort to innundative release of biocontrol agents to manage the pests.

The above strategies have been adopted in cultivation of cabbage crop in the demonstration field at NIPHM which is a guzzler of chemical pesticides. The requirement for chemical pesticides can be significantly reduced by adopting AESA based PHM in conjunction with Ecological Engineering for Pest Management, innundative release of biocontrol agents and application of microbial biopesticides and botanicals which are potential tools to manage the pests. The study has also shown the significance of EPN in insect pest management. Mustard is an important companion plant which is very effective trap crop to trap Diamond Back Moth and Leaf Webber which are major pests of Cabbage crop.

Several Programmes are scheduled during the current year to promote on farm production of biocontrol agents and AESA based PHM in conjunction with Ecological Engineering for pest management. It is hoped that the Extension Functionaries of Central and State Governments, Scientists of ICAR and SAUs will take advantage of these programmes to equip themselves with skills to popularize the simple mass rearing techniques among the farmers.

(K. Satyagopal)
Director General

Theme Article

Demonstration of Agro-ecosystem Analysis based Plant Health Management in conjunction with Ecological Engineering for Pest Management in Cabbage to reduce reliance on Chemical Pesticides

Dhana Raj Boina, P. Jeyakumar and Dr. K. Satyagopal, IAS

Cabbage crop is one of the major guzzlers of chemical pesticides and majority of cabbage growing farmers in India apply these pesticides indiscriminately, more or less on calendar-basis rather than on need basis. The existing practice leads to increased cost of cultivation, killing of natural enemies, pest resurgence, pesticide resistance in target pests, pesticide residues in the crop produce and adverse effects on the environment. This situation warrants pest management strategies that are biointensive rather than chemical intensive with safe and judicious use of chemical pesticides as a last resort. The National Institute of Plant Health Management (NIPHM) has made an effort to demonstrate whether cabbage crop can be grown by adopting Agro-Ecosystem Analysis (AESA) based Plant Health Management (PHM) in conjunction with Ecological Engineering for Pest Management and reduce reliance on chemical pesticides.

Agro-ecosystem Analysis based Plant Health Management:

Integrated Pest Management (IPM) has been evolving over the years to address the deleterious impacts of synthetic chemical pesticides on the environment, which is ultimately affecting the interests of the farmers. The economic threshold level (ETL) has been the basis for several decades for IPM but in modern IPM emphasis is given to AESA where farmers take decisions based on larger range of field observations. The health of a plant is determined by its environment which includes abiotic factors (sun, rain, wind, soil nutrients etc.) and biotic factors (i.e. pests, diseases weeds etc.). All these factors play a role in the balance which exists between herbivore insects and their natural enemies. Understanding the intricate interactions in an ecosystem can play a critical role in pest management.

Decision making in pest management requires a thorough analysis of the agro-ecosystem. Farmer has to learn how to observe the crop, how to analyze the field situation and how to make proper decisions for their crop management. This process is called the AESA. Participants of AESA will have to make a drawing on a large piece of paper (60 x 80 cm), to depict all their observations. The advantage of using a drawing is that it forces the participants/farmers to observe crop closely and intensively. It is a focal point for the analysis and for the discussions that follow, and the drawing can be kept as a record.

AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyze the field situations with regards to pests, defenders, soil conditions, plant health and the influence of climatic factors and their relationship for growing a healthy crop. The basic components of AESA are:

- Plant health at different stages
- Built-in compensation abilities of plants
- Pest and defender population dynamics
- Soil conditions
- Climatic factors
- Farmers past experience

Ecological Engineering for Pest Management:

The Ecological Engineering for Pest Management, a new paradigm, is emerging as a new pest management strategy. Ecological engineering relies on the philosophy of using cultural techniques to effect habitat manipulation and enhance biological control. Habitat manipulation aims to provide the natural enemies of pests with resources such as nectar, pollen, physical refugia, alternate prey, alternate hosts and living sites. This is because natural enemies require 1) food in the form of pollen and nectar for adults; 2) shelters such as overwintering sites, moderate microclimate etc. 3) alternate hosts when primary hosts are not present.

The significance of natural enemies in an ecosystem, both below ground and above ground, is being realized world over and there is a need to popularize these concepts among the farmers. Though there is a long history of using biocontrol agents for pest management, currently farmers do not have access to biocontrol agents at appropriate time and at affordable prices. Crop habitat manipulation (Ecological Engineering) for pest management could be both below and above ground to enhance the population of biocontrol agents naturally. The practices followed during cabbage cultivation are

Demonstration of AESA and Ecological Engineering in Cabbage Crop Ecosystem at NIPHM:

Ecological Engineering: Below ground operations for rhizosphere engineering

Crop rotation: Crop rotation was practiced by taking up the cabbage crop following the harvesting of previous season crops i.e. tomato and brinjal, in the same field. Crop rotation helps in breaking the continuity of insect pest population buildup especially the diapausing insect stages in the soil.

Organic fertilizers: Seven tonnes of well decomposed farm yard manure (FYM) were added, which helps in increasing below ground biodiversity as it provides food (organic matter) for the various soil inhabiting microorganisms.

Selection of healthy seeds and seed treatment: Healthy cabbage seeds (F1 hybrid-OJAS variety) were selected and were bioprimed with microbial biopesticides such as *Trichoderma harzianum* and *Pseudomonas fluorescens* before sowing in raised nursery bed. One gram of *T. harzianum* and 1 ml of *P. fluorescens* were added to 20 g of cabbage seeds and were mixed well to form a coat of biopesticides around the cabbage seeds.

Transplanting: The main field was irrigated before transplanting the seedlings. Cabbage seedlings of 23-day-old were transplanted in the main field with a spacing of 45 cm x 45 cm.

Inorganic fertilizers: The soil samples were collected and sent to the soil testing laboratory for analysis of soil fertility and the requirement for external fertilizers application. Based on the soil sample test results, 7.5 Kg urea at 76 days after transplanting and 5.0 Kg muriate of potash (MOP) at 82 days after transplanting were applied as top dressing in 1100 square meter area. The phosphatic fertilizers were not applied as the residual phosphate of the previous seasons was available in sufficient amounts for the cabbage crop season as well.

Ecological Engineering: Above ground operations

Field layout: The main field was ploughed after FYM application and field layout was prepared with 22 subplots each measuring 10 m x 5 m. Separate irrigation channels for each subplot were prepared for proper irrigation.

Companion plants: The companion plants were planted around the main cabbage crop to attract natural enemies, repel insect pests, and to provide alternate food (nectar, pollen, prey) and shelter (overwinter sites) to the natural enemies, attracting the insect pests onto them and away from main plant (trap plant). As part of Ecological Engineering for Pest Management strategies, companion plants were been planted along with main cabbage crop.

Taking into account the major pests of cabbage viz. diamondback moth, tobacco caterpillar, leaf webber, cabbage butterfly, painted bug, cabbage aphids, mustard saw fly flowering plants were planted for enhancing the natural enemies of the pests as well trap plants and repellant plants for controlling the pests.

Attractant flowering plants: Fifteen to twenty days before transplanting the cabbage seedlings in the main field, marigold, *Chrysanthemum*, gingelly/sesamum, maize, castor, *Ocimum*/tulasi, carrot, sunflower, and French bean were either sown or seedlings were transplanted on all border bunds by arranging shorter plants towards inner side and taller plants towards outer side.

Attractant/trap plants: Since mustard is a trap plant for several cabbage insect pests i.e. diamondback moth, cabbage leaf webber, cabbage head borer, mustard saw fly, cabbage aphids etc., 10-12 days prior to the transplanting of the cabbage seedlings, one row of mustard was sown as a trap crop along the inner side of border bunds as well as on bunds within the field.

Repellent plants: Onion bulbs were planted within the field @ 20-25 bulbs/subplot as an intercrop in alternate rows at 36 days after transplanting as an attractant and repellent plant. Similarly, *Ocimum*/tulasi seeds were sown as an intercrop within the cabbage field as a repellent plant for sucking pests.

AESA - Field observations:

It was decided to adopt AESA and accordingly weekly AESA observations were taken on state of crop health, pest (weeds, diseases and insect pests) status, Pest: Defender ratio (P: D ratio) etc. throughout the crop period by selecting 50 cabbage plants (1100 sq mt area) randomly. During weekly AESA, the number of insect pests and defenders were counted. The number of weeds in randomly selected one square meter area was counted and recorded. Observations on soil (dry, moist or wet) and climatic (sunny, cloudy, rainy etc.) conditions were also recorded. The various observations taken as part of AESA were analyzed and arrived at appropriate management decisions.

P: D ratio: The P: D ratio was calculated by dividing the total number of insect pests with total number of defenders. When the P: D ratio was 2: 1 or below (favourable) then the natural enemies present in the field were able to manage the insect pests attacking the crop and no management practices were resorted. When the P: D ratio was >2: 1 (unfavourable), augmentation of natural enemies was done by artificial release of parasitoids (*Bracon* spp.), predators (Reduviid bugs and *Chrysoperla* sp.), and sprayed with Entomopathogenic nematode (*Steinernema glaseri*) and neem oil.

In general, the cabbage farmers resort to pesticide applications at an interval of 15-20 days i.e. 3-4 sprays in the first 2 months (60 days after transplanting). In contrast, the cultivation practice integrating the concepts of continuous monitoring of crop through weekly AESA and increasing biodiversity through planting Ecological Engineering plants including mustard as a trap crop in and around the cabbage field helped to maintain the P: D ratio below 2: 1. As a result pest management practices were not required, up to 60 days and in turn reduced the requirement of pesticides. Mustard as a trap crop contributed to pest density reduction on cabbage crop by attracting majority of leaf webber and to some extent aphid populations onto it. After 60 days of transplanting, when the P: D ratio was

unfavourable (>2: 1) mainly due to Lepidopteran caterpillars, the pest management tactics of releasing defenders viz., *Bracon* spp., reduviid bugs, and *Chrysoperla* and/or spraying with neem-based products and EPN was practiced for effectively managing the insect pests. Subsequent to the release of natural enemies and spraying of EPN/neem based products, the P: D ratio started improving and found to be favourable for the rest of the season. The management of practices adopted when the P : D ratio is unfaourable are furnished in table 1.

Table 1. Details of pest management practices taken based on P: D ratio (weekly AESA) in cabbage crop

AESA week	P: D ratio	Major insect pests	Management decision
9	4:1	Leaf webber	*Bracon* spp. @ 200 adults
10	3.5:1	Leaf webber and tobacco caterpillar	Entomopathogenic nematode (EPN), *Steinernema glaseri* @10,00,000 IJs/litre (11 subplots) Neem oil @ 10 mL/litre (11 subplots) Reduviid bugs @ 50 nymphs
		Aphids	*Chrysoperla* @ 10 adults and 15 larvae

*The P:D ratio during other weeks were found less than 2: 1.

Impact of AESA and Ecological Engineering:

Pest management: The insect pest management decisions were taken based on estimated Pest: Defender ratio (P: D ratio). 45 days after transplanting, when the P: D ratio was unfavourable (>2:1) appropriate pest management practices were undertaken. For instance, at the 9th week AESA, the P: D ratio was unfavourable mainly because of higher leaf webber infestation on mustard trap plants, so *Bracon* adults (200 individuals) were released. At the 10th week AESA, the P: D ratio was unfavourable mainly because of higher leaf webber infestation on mustard trap plants and tobacco caterpillar and aphids on cabbage crop, so one block of field (11 subplots) was sprayed with entomopathogenic nematode (EPN), *Steinernema glaseri* @10,00,000 Infective Juveniles (IJ)/litre and another block (11 subplots) was sprayed with neem oil @ 10 mL/litre.

In addition, 50 nymphs of reduviid bugs (for caterpillars) and 10 adults and 15 larvae of *Chrysoperla* (for aphids) were released (Table 1). Irrigation was provided to the crop on weekly basis. Two hand weeding were done at 22 (4th week) and 56 (8th week) days after transplanting as the weed incidences were >50 weeds/sq mt area following AESA.

Increased abundance of natural enemies: Owing to the enhancement of biodiversity by the Ecological Engineering plants, increased numbers and activity of natural enemies (predators were visually observed and parasitoids were indirectly observed by collection and preservation of several parasitized larvae on cabbage plants and mustard trap plants, which facilitated the emergence of adult parasitoids) as well as parasitized bodies (mummified) of aphids were observed on the main (cabbage) crop as well as companion plants during the entire crop season. This is partly attributed to the availability of nectar, pollen, alternate prey (insects) etc. The details of insect pests and their natural enemies observed and the effect of habitat manipulation and companion plants on these insects are given in Table 2.

Summary and conclusion:

The current study demonstrated that the cabbage crop normally grown by the farmers with intensive use of chemical pesticides could be successfully grown by adopting AESA based IPM in conjunction with Ecological Engineering for Pest Management by continuous monitoring of crop, increasing biodiversity in the crop ecosystem by Ecological Engineering with special focus on mustard as a trap crop, which attracted majority of leaf webber and to some extent aphid populations onto it. The combination of above eco-friendly pest management practices resulted in reducing the pest density up to 60 days after transplanting which helped in maintaining the favourable P: D ratio. Whenever, the unfavourable P: D ratios were observed during mid crop growth stage appropriate biointensive management tactics were adopted such as release of natural enemies (*Bracon* spp., reduviid bugs, and *Chrysoperla* sp.) as well as application of bio/botanical pesticides (EPN and neem).

The current practice of farmers relying excessively on chemical pesticides is not only resulting in increased cost of production for the farmer but also having deleterious impacts on agro-ecosystem. Bio-intensive approaches in cabbage crop ecosystem not only reduces the cost of cultivation, but also minimizes pesticide residues in crop produce, conserves and increases the natural enemies of pests and protects the environment while reducing the cost of cultivation for the farmers.

Table 2. Details of the pests and natural enemies recorded on companion/tap plants sown/planted in and around the cabbage field

Plant*	Sown/planted	Insects attracted/repelled	
		Pests	**Natural enemies**
Mustard (A/T)	Border bunds/ bunds within the field	Leaf webber, aphids, mustard saw fly	*Cotesia* spp., *Aphelinus* spp., hover flies, *Bracon* spp.
Maize (A)	Border bunds		Ladybird beetles, lacewings, preying mantids
Marigold (A)	Border bunds		Spiders, hover flies, minute pirate bugs, big eyed bugs (*Geocoris* spp.), ladybird beetles, *Bracon* spp., preying mantids
Sesame/ gingelly (A)	Border bunds		Spiders, hover flies, wasps, ladybug beetles, preying mantids
Onion (R)	Intercrop	Tobacco caterpillar (repelled)	Lacewings, ladybird beetles, spiders, hover flies
Ocimum/ tulasi (R)	Intercrop/	Tobacco caterpillar (repelled)	Spiders, preying mantids
French bean (A)	Border bunds	Aphids	Ladybird beetles, hover flies, lacewings, preying mantids, big eyed bugs (*Geocoris* spp.), red ants
Sunflower (A)	Border bunds	Tobacco caterpillar	Ladybird beetles, lacewings, hover flies, preying mantids, spiders, predatory thrips, big eyed bugs (*Geocoris* spp.), mirid bugs, minute pirate bugs
Carrot (A)	Border bunds		Spiders, ground beetles
Chrysanthemum (A)	Border bunds		Spiders, preying mantids, ground beetles, ladybird beetles, hover flies, mirid bugs
Castor (A/T)	Border bunds	Tobacco caterpillar	Ladybird beetles, lacewings, spiders, preying mantids
Note *: A= Attractant plant, T = Trap plant; R= Repellent plant			

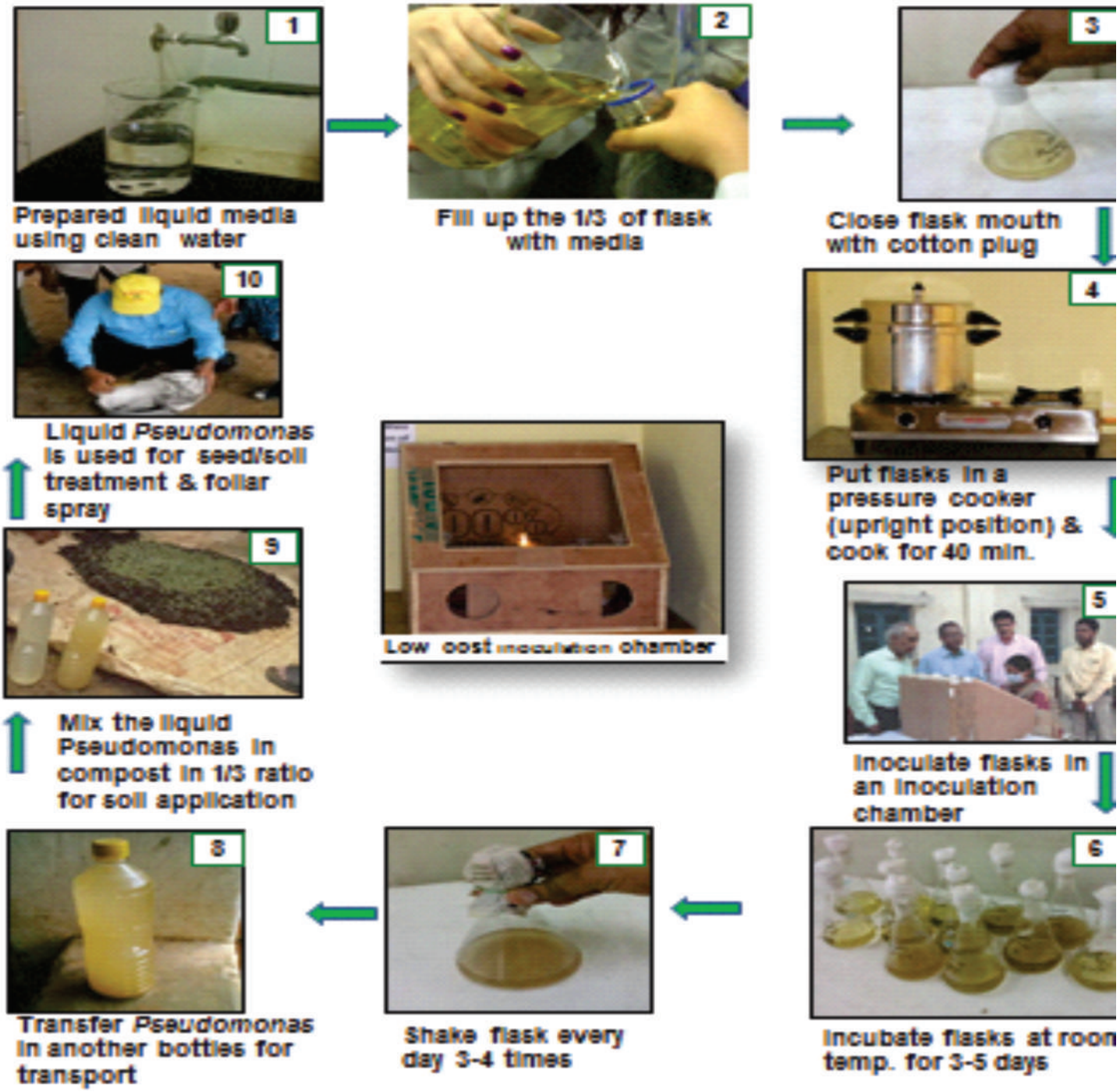
On-farm production technology for mass production of *Pseudomonas fluoroscens*.

Among the several biocontrol agents, *Pseudomonas fluorescens* is known to occur in all agro-ecosystems, commonly associated with root, soil and plant debris/plant organic matter. *P. fluorescens* act through rhizosphere competition, antibiosis and induces resistance to protect crops against several soil borne and foliar plant pathogenic fungi, bacteria and sometimes their efficacy on plant disease is higher than fungicides. *P. fluorescens* also stimulate plant growth, enhance germination, plant survival, growth of roots & shoots and post harvest shelflife.

To ensure that quality biopesticides are available to the farmers, NIPHM is popularizing an easy, low cost and simple on-farm production (OFP) technology for mass production of biopesticides which could be easily adopted by farmers. *P. fluorescens* can be produced at the farm level for which the requirements include an exclusive room, gas stove, 10-20 liter pressure cooker, wooden inoculation chamber, plastic trays, conical flasks/ glass bottles, candle/spirit lamp, inoculation loop/spatula/glass rods, non-absorbent cotton, rubber bands, sealing machine etc. In addition to the mother culture of the *P. fluorescens* the media in liquid state fermentation is needed. For mass multiplication of *P. fluorescens* the following steps should be followed sequentially as noted below:

1. Take about 20 gm of jaggery and 5 gm of yeast extract and mix them in one litre of drinking water.
2. Take glass conical flask and fill them 1/3 level and close the mouth of the conical flasks using cotton plug.
3. Sterilize the bottles with media in a 10-20 liter pressure cooker with water inside it for a period of 40 minutes. The flasks with media are cooled at room temperature after sterilization.

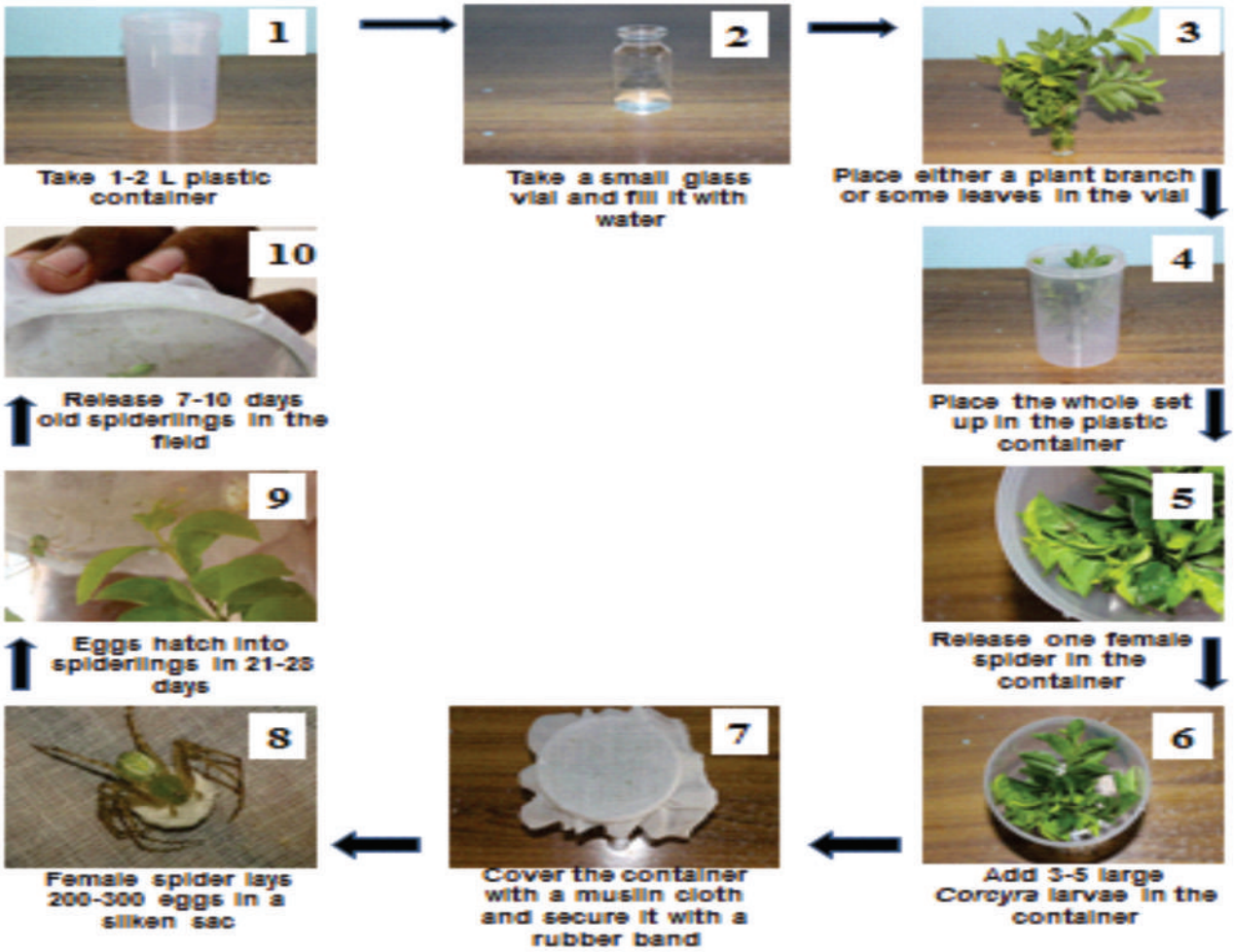
4. Transfer the bottles into a wooden inoculation chamber. Spirit lamp/candle should be flamed after closing the inoculation chamber for about 5 to 10 minutes.
5. Inoculate with *P. fluorescens* mother culture in bottles inside the chamber with the help of inoculation loop/spatula. Shake the bottles properly for mixing the bacterial culture all over the grains.
6. Keep the inoculated bottles at the room temperature (30- 35 °C) .
7. Observe the inoculated bottles if there is increase in turbidity. Once bacterial growth starts, shake the bottles at every 4-6 hours for about 3 to 4 days in order to spread and allow the bacterial growth. After 3-4 days
8. After 3-4 days *P. fluorescens* will be ready to use. Transfer the liquid media with bacterial growth into cleaned plastic trays and add fine compost materiel @ 1:3 (bacterial media : compost).
9. Mix the material properly and allow them to dry at room temperature.
10. The mixed formulation will be ready for use as soil application or for seed treatment and or foliar application.



On-farm production technology for mass production of Spiders

Spiders are a diverse arachnid order, all are obligate predators, and many feed upon herbivorous pest insects. Spiders can lower insect densities, as well as stabilize populations, by virtue of their top-down effects, microhabitat use, prey selection, polyphagy, functional responses, numerical responses, and obligate predatory feeding strategies. Several studies have shown that insect populations significantly decreased, in fields released with spiders. Spiders have been successfully used as biocontrol agents in two groups of crop ecosystems throughout the world, orchards, primarily apple and rice. Spiders need to be conserved by 1) providing hedges; 2) collecting and covering the spider egg sacs with hay near the standing crop; 3) placing mulches which provide required humidity and shelter for spiders; and 4) placing straw bundles in rice fields. Spider population can be augmented in the field through mass production and releasing of young spiderlings. Following are the steps for mass production of spiders, the following steps given below

1. Take a rearing container with ample space to enable free movement of spider
2. Place a piece of branch or leaves with bottoms dipped in a glass syringe vial with water to create natural environment
3. Place a small piece of absorbent cotton dipped in water in the container for maintaining humidity and for water intake by spiders.
4. Maintain room temperature range of 20-30 °C.
5. Add one female spider per container and cover it with muslin cloth and secure it with a rubber band.
6. Supply ample amount of food continuously i.e. Corcyra larvae or adults, Tribolium larvae, fruit fly adults, house fly adults, etc.
7. Females should be provided with ample amount of food before egg sac development for proper egg sac development
8. Keep the container clean by removing the dead prey and changing the cotton and other materials once in 3-4 days
9. The female spider lays around 200-300 eggs in a silken sac (3-4 such egg sacs in its life span), which hatch into spiderlings in 21-28 days
10. Maintain the spiderlings in the same container for a week by providing ample amount of food (smaller Corcyra larvae)
11. After a week, either transfer the spiderlings individually into separate plastic containers and rear them or release them in the field for management of insect pests.



For more details, for undergoing training and to procure mother culture / low cost media and technologies, interested participants / parties can visit NIPHM website http://niphm.giv.in and can contact Registrar email: registrarniphm@nic.in

Special Events: Demonstration of "Biointensive IPM strategies in Tobacco" with Tobacco Board

Based on the initiative of Dr. K. Satyagopal, IAS, Director General, NIPHM and Dr. K. Gopal, IAS, Chairman, Tobacco Board a joint collaboration programme was launched to promote biointensive strategies for tobacco during 2013-14. Under this programme, NIPHM is extending technical help to Tobacco Board to demonstrate the technologies for managing the insect-pests and diseases through biointensive approaches using eco-friendly methods and safe and judicious use of pesticides.

A meeting between Dr. K. Satyagopal, IAS, DG NIPHM & Dr. K. Gopal, IAS, Chairman Tobacco Board was held at NIPHM on July 8th 2014 to discuss the progress of the Scheme in Andhra Pradesh and Karnataka and future plan. The Chairman Tobacco Board along with DG NIPHM and Senior Officials of Tobacco Bord and NIPHM visited the biocontrol production facilities such as on farm production of *Trichoderma, Pseudomonas*, Entomopathogenic Nematodes, Bracon, Reduviid, Spiders Mycorrhiza experiment and the pesticide appliances developed by NIPHM like Low Cost light trap – Friendly to natural enemies, low-volume back pack sprayer, granular applicator and duster. Dr. K. Satyagopal, IAS, DG NIPHM presented on the benefits of Ecological Engineering for pest management, on-farm mass production of biocontrol agents, biopesticides along with Mycorrhiza through video and power point presentations.

NIPHM scientists and Tobacco Board officials conducted 11 farmers field demonstrations on the field soil application of *T. harzianum* and *P. fluorescens* in 11 auction platforms under Mysore and Periyapatna regions on 6th and 7th May where the demonstration were conducted on seed treatment and potting mixture treatment. A total of 440 ha area has been coverded under the demonstration. Farmers were interested and satisfied for the adoption of these technologies. 150 growers were actively participated in the actiovity.

For the consecutive second year and in continuation with the promotion of the biointensive strategies, five demonstrations on nursery application were conducted on the 20th and 21st August 2014 under various auction platforms in Model Project Villages (MPA) in West Godavari district Andhra Pradesh to cover 320 ha field area. About 100 farmers were trained.

Special Events: Inauguration of New Hostel building by Shri M. Venkaiah Naidu Honrable Union Minister of Urban Development and Housing & Urban Poverty Alleviation

Shri M. Venkaiah Naidu Hon'ble Union Minister for Urban Development, Housing & Urban Poverty Alleviation and Parliamentary Affairs, Government of India inaugurated New Hostel Building on 17th August 2014. The new hostel building has 35 spacious air conditioned rooms with attached restroom and equipped with a remote-controlled television can accommodate 70 persons. The hostel possess modern and fully-equipped kitchen and a large enough dining hall. During his visit an exhibition was organized to highlight the technologies being popularized by NIPHM to promote Agro-Eco System Analysis (AESA) based Plant Health Management (PHM), in conjunction with Ecological Engineering for Pest Management. Hon'ble Union Minister had detailed discussion and evinced interest for promoting organic cultivation on end to end basis. In addition, the issue of Agricultural Biosecurity was brought to the notice of the Hon'ble Union Minister by Dr. Korlapati Satyagopal, IAS, DG, NIPHM and explained that in view of multiple borders being shared by India, India's Agriculture Biosecurity can be protected only when the entire South Asian Region adopts appropriate measures. The Hon'ble Union Minister emphasized that, there is a need for India to take a lead role in building capacity in Agriculture Biosecurity among the South Asian Countries, particularly in the context of special focus being given by the Hon'ble Prime Minister in promoting cooperation among the South Asian Countries. The role of NIPHM in promoting export of ornamental plants from Kaidyam as well as seeds from Telangana State was explained.

Special Event: Greater Awareness Among Farmers: On-farm Production of Biocontrol Agents

NIPHM has developed simple methodologies with the available low cost inputs for the mass production of biocontrol agents and microbial biopesticides at farm level. It is offered as 10 days training programme to the extension officials from April 2014 onwards. Subsequently based on the request from State Agriculture Departments / NGOs'. NIPHM is offering this training to the farmers for 3 days duration. The training mainly focuses on the mass production of host culture Corcyra, Parasitoids viz., *Trichogramma, Chelonus, Gonioses, Bracon* and Predators such as *Reduviids, Spiders* and Microbial Biopesticides such as Trichoderma, Pseudomonas, Entomopathogenic fungi and Entomopathogenic Nematodes (EPN), Vesicular Arbuscular Mycorrhiza (VAM) and vermicompost.

The farmers were trained in production of biocontrol agents and microbial biopesticides thorough hands-on-practices. The concepts of Agro-Ecosystem Analysis and Ecological Engineering for Pest Management were explained during field visits. NIPHM has trained 295 farmers from different states from July to September, 2014 including 46 Women farmers from Aurangabad (Maharashtra) (from 31st July to 2nd August), 150 farmers from Dharani Sugars Unit I, Tiruvannamalai (Tamil Nadu) from 10th to 12th & 15th to 17th & 25th to 27th September, 39 progressive farmers from Telangana foundation, Rangareddy, (Telangana) from 18th to 20th September, 23 farmers from Jattu NGO, Vijayanagaram, Andhra Pradesh from 22nd to 24th September and 37 farmers from Bala vikasa NGO on farm of production agency (Andhra Pradesh) from 29th and 30th September, 2014.

NIPHM is also extending its help by providing mother cultures of microbial biopesticides and biocontrol agents in establishing on-farm biocontrol production units at their villages.

Capacity Building

Orientation training programme for Phytosanitary Certificate Issuing Authorities (7th to 11th July)

Training was organized for the notified authorities in order to promote safe agricultural export. The aim of this training programme is to make the participants acquaint with standard operating procedures for Phytosanitary certification and to minimize the non-compliance in export consignments. 22 participants from State Agriculture/ Horticulture Department, SAUs and DPPQ &S were trained.

Stored grain pest and their management including Khapra beetle for FCI and CWC officials (14th to 19th July)

The training was designed and organized to cater the needs of FCI & CWC officials and warehouse managers. During the training programme, 10 officials were trained on methods in detection and identification of stored grain pests including Khapra beetle, use of pheromones and traps for monitoring and management of stored grain insect pests employing scientific fumigation practices.

Pest Risk Analysis (28th July to 2nd August)

To create the expertise in conducting Pest Risk Analysis, this training programme was organized. Nine participants were trained in International conventions & National regulations, PRA concepts & practices with added emphasis on risk assessment process involved in assessing the likelihood of pests being associated with the pathway, transport, its direct and indirect impact on various factors in the event of pest establishment and the risk management option to minimize such event to happen.

Forced Hot Air Treatment (4th to 8th August)

The training programme was tailored for Phytosanitary treatment service providers in the area of Forced Hot Air Treatment. 16 private industry participants and two government officials were trained on critical requirements for establishing FHAT facilities and conducting the treatments in accordance with ISPM – 15 and NSPM – 9.

Rhizosphere Engineering' (8th to 12th August)

Seven participants were trained in concepts of AESA and Ecological Engineering, interventions for Rhizosphere improvement, Mass multiplication of *Trichoderma*, Mycorrhizae, and other microbial inoculants for stainable agriculture.

FFS Methodology (22nd to 26th August).

The participants were imparted training on various aspects of Farmers Field School for effective organization of the FFS. They were also trained in concept of AESA and Ecological Engineering for pest management, mass production of biocontrol agents, biopesticides and mycorrhizae.

Phytosanitary treatment (MBr and ALP) (11th - 25th August)

NIPHM is one of the notified institutes to impart training , and improve the skills and competency of the trainees on Methyl Bromide and Phosphine fumigation. 17 participants including phytosanitary treatment service providers and officers from DPPQ&S were given hands on training in MBr and ALP fumigation, handling of equipment involved in fumigation, their specifications, calibrations, maintenance and other safety precautions.

CPGDPHM Kerala State Govt. Officials (15th to 29th September)

The NIPHM organized contact classes for 2nd Semester of P.G. Diploma in Plant Health Manangement – Off Campus Programme for 34 Officers of State Department of Agriculture, Kerala at NIPHM. Three courses viz.1) Ecological Engineering for Plant Health Management, 2) Agricultural Input Management, 3) Pest Surveillance, Detection and Diagnosis were taken up during these contact classes. Under guidance of NIPHM faculty the officers also prepared the synopsis of their Project work, to be carried out at their respective work places.

Sampling and Prosecution Procedures under 2014 Insecticide Act 1968 (3rd to 10th July)

A training programme for the Insecticide Inspectors of State Department of Agriculture was conducted for imparting the procedures for inspection, sampling and prosecution procedures under Insecticides Act 1968.

Capacity Building

Sampling of fruits, Vegetables and other items for Pesticide Residue Analysis (PRA) and calibration of equipment used in PRA" (16th to 23rd September)

Participants were trained in Internationally accepted QuEChERS and other methodes of extraction and clean-up for pesticide residue analysis and determination by GC-ECD, GC-MS/MS and LC-MS/MS for various matrices. They were also trained in calibration of analytical instruments and measuring glasswares to increase the precision and accuracy in analysis.

Pesticide Formulation Analysis (26th August to 30th October)

A 66-day training programme which is mandatory training under the Insecticide Act-1968 and Rules 1971 for the Analysts of Government Pesticide Testing Laboratories was organized. 14 participants were trained in the techniques involved in both volumetric and instrumental analysis method of pesticide formulation.

On-farm Production of Biocontrol Agents and Microbial Biopesticides to Promote AESA based PHM in conjuction with Ecological Engineering for Pest Management (4th to 13th August; 1st to 10th September)

Two 10-day trainings were organized in which eight State Agri.Horti. Department Officials and Seventeen Extension Officers from Sugarcane Industry Tamil Nadu were trained in AESA & Ecological Engineering for pest management and on-farm prodution of biocontrol agents & biopeticides such as *Bracon* sp., *Chaelonis* sp., *Reduviid, Spiders, Trichogramma* sp., *Trichoderma* sp., *Pseudomonas* sp., *Metarhizium* sp., *Paecilomyces* sp. *NPV,* and Entomopathogenic Nematodes, Mycorrhiza and botanicals. Mother culture of biopesticides and biocontrol agents were provided to them to establish on-farm production unit and for further training to the farmers.

Safe and Judicious Use of Pesticides (19th to 26th August)

18 Officers were trained in safe and judicious use of pesticides, application techniques, nozzles and its importance, calibration, 3 Reductions & 3 Gains, quality control of pesticides and insecticide analysis, judicious use of rodenticides, use and on-farm production of bio-control agnets etc. Practical sessions on above concepts were organized.

In-Plant Training on Pant Health Engineering (1st to 10th September)

10 B.Tech Agricultural Engineering students from College of Agricultural Engineering, Bapatla on Plant Health Engineering for four months from 1st June to 30th September 2014.

The students carried out project works under the guidance of Er. G. Shankar, JD (PHE) and Dr. K. Satyagopal, IAS, DG-NIPHM on:

1. Design and fabrication of "Disco Weeder" to reduce the drudgery of paddy farmers in SRI cultivation.
2. Design and fabrication of "Tomato Crusher" to help the tomato growing farmers to process their produce at farm level at low cost.

Appropriate Pesticide Application Techniques and Farm Level Storage Practices (1st to 8th July)

Nine participants were trained in safe and judicious use of pesticides, pesticide application techniques, pesticide formulation and compatibility, judicious use of rodenticides, storage problems of food grains & their management, modern storage structures at farm level. Practicals on application techniques, selection and operation of the equipment, selection of suitable nozzles and calibration of the sprayers.

Capacity Building

Certificate Course on Urban Integrated Pest Management (8th to 22nd September)

9th Certificate course was organized in which nine PCOs were trained on biology and management of mosquitoes, termites, flies, cockroaches, rodents, stored insect pests besides exposures on pesticide toxicity, safe & judicious use, application techniques and food safety. They were also exposed to zoonosis and their role for emergency prepared ness, safe and judicious pesticide application techniques. The participants took assignment works in groups on biology and management of major urban pests.

Refresher Training on Rodent Pest Management (5th to 11th August)

13 middle level extension functionaries from state department of agriculture and horticulture were trained on ethological principles, non-chemical and chemical approaches for rodent pest management. Participants prepared the action plans for organizing mass rodent control campaigns for their respective areas.

International Training on Pest Risk Analysis

An International training on Pest Risk Analysis was organized from 1st to 5th September, 2014 at NIPHM in collaboration with USDA. Dr. K. Satyagopal IAS, DG NIPHM inaugurated the programme. A total of 49 participants out of which 15 international participants representing Nepal, Sri Lanka, Bangladesh, Bhutan, Ethiopia, South Africa, Botswana and Zambia and 34 National Participants from ICAR Institutes, SAUs, DPPQ&S and NIPHM participated in the training programme. The programme provided competency to conduct Risk Analysis in line with ISPMs to facilitate safe import and export.

Trainees / Alumni Forum

NIPHM is providing this section for the Trainees who have gained benefits from the training organized at NIPHM in terms of further strengthening their knowledge and hands-on experience skills and in turn they have got further success in their respective field of duties/service. Trainees may send their experience in the form of success stories, article, training details etc. for publishing under this section.

Dr. D. S. Srivastava (SMS-Plant Protection) from KVK Sitapur who had participated in a 3-day training cum workshop on "AESA and Ecological Engineering based Plant Health Management" held from 4th to 6th June 2014 at NIPHM. To transfer the knowledge and the skills he gained at NIPHM he organized an one day joint farmers training programme at village Kemhara Khurd (Sitapur) and trained 74 farmers on the importance and method of AESA, production of biocontrol agents, biopesticides, soil health improvement, production of vermicompost and weed management practices for sustainable agriculture.

To create awareness among farming community at large scale the PHM training information were also published in various local news papers.

Around the World

Tomato leaf miner, Tuta absoluta; A looming threat for solanaceous vegetables in India

Tomato leaf miner, *Tuta absoluta* (Lepidoptera: Gelechidae) is a serious pest of tomato, Capsicum, potato, tobacco and many other solanaceous plants. It is native to Peru and it is widely distributed in South America, Asia, Europe, Africa, Central America and Caribbean. In Asia it is present in Iran, Iraq, Israel, Japan, Jordan, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen. *T. absoluta* causes the loss of 50-100% in tomato plantations during favorable condition and attacks all phases of the crop from the seedling stage. During last 5 years *T. absoluta* has been introduced and established in 14 countries.

T. absoluta is not present in India but it can make its entry through the import of whole plant/ cutting, stem, leaves, flowers and fruit and can become invasive because its host plants are widely grown in India. Presently India is importing Solanum muricatum (melon pear) cuttings/plants for propagation from Italy, Spain and Israel and T. absoluta is widely present in these countries. This insect can be of serious threat to India due to abundance of wide range of host plants and the congenial temperature throughout the year.

The Quarantine officials at the port of entry, officials involved in Post Entry Quarantine activities and State Agriculture Extension officials need to be vigilant to prevent any possibility of entry and establishment of this pest.

T. absoluta can be easily detected on host plants, as it prefers the apical buds, flowers or new fruits, where the black frass is visible. Young larvae produce large galleries in leaves, burrow into stalks, apical buds, and green and ripe fruits, causing considerable damage and yield loses.

Adult moths are grey-brown; approximately 6 mm in size and newly hatched caterpillars are small (0.5 mm) in size and yellowish. When maturing, caterpillars turn yellow-green and a black band develops behind the head. Fully-grown caterpillars measure approximately 9 mm with a pinkish color on their back. Pupae are light brown and approximately 6 mm.

Tribal Farmer's Welfare Programme in Araku Valley, Vishakhapatnum

Based on an initiative taken by Director General NIPHM, a MoU between National Institute of Plant Health Management (NIPHM) and Vikasa, a NGO in Visakhapatnam, Andhra Pradesh, was signed to launch the Tribal welfare programmes in Araku Valley, Vishakhapatnum. An exploratory survey with farmers was conducted on 30th June and 1st July by NIPHM and Vikasa officials and to understand the insect-pest problems and to decide the sustainable solution for the farmers. Based on exploratory survey a 3-day training-cum-demonstration programme on *"on-farm mass production and use of microbial biopesticides and biocontrol agents"* was conducted from the 15th to 17th September, 2014 in Nandiguda village, Chompi Panchayat, Araku Valley, Visakhapatnam. 30 farmers were trained in "on-farm mass production of *Corcyra*, *Trichogramma* (Trichocard preparation), *Bracon* (both sandwich and tub methods), reduviid bug, spider and *Trichoderma harzianum* and *Pseudomonas fluorescens*. The NIPHM and VIKASA officers and Araku farmers also made a farmers field visit to observe and identify the insect pests, diseases and natural enemies in crops like chillies, cabbage, groundnut, mango and sapota. The insect- pests like diamondback moth, tobacco caterpillar on cabbage, tobacco caterpillar on chillies, leaf webber, scales, and sooty mould on mango, and sooty mould on sapota and the natural enemies like spiders, ladybug beetles, lacewings, earwigs, dragon flies, cranes, mynahs etc were observed during the visit. The farmers were given necessary advices on non-chemical methods of pest management. The application of *T. harzianum* and P. *fluorescens* was demonstrated through seed treatment, nursery and soil application. The main benefits of treating seed and nursery beds with biopesticides are 1) reduction in the incidence of fungal and bacterial diseases mainly damping off, wilts, rots etc.; 2) induction of systemic resistance and improved plant growth; 3) enhanced uptake of nutrients from the soil mainly phosphorous; 4) reduction in the amount of fungicides used resulting in less pesticide residues in the crop produce. The farmers were of the opinion that the training was very much useful and they have learned a lot of new information on biointensive and non-chemical pest management options, they learned identification of differentiate pests and natural enemies, mass production of microbial biopesticides and biocontrol agents on locally available materials etc.

हिंदी पखवाडा आयोजन – 01-09-2014 से 14-09-2014

राजभाषा कार्यान्वयन प्रोत्साहन हेतु दिनांक 1-9-2014 से 14-09-2014 तक संस्थान में हिंदी पखवाडा आयोजित किया गया। इस दौरान हिंदी में काम-काज को बढावा दिया गया व दिनांक 05-09-2014 को हिंदी प्रतियोगिताओं का आयोजन किया गया हैं । दिनांक 12-09-2014 को महानिदेशक महोदय की अध्यक्षता में हिंदी दिवस मनाया गया । जिसमें संस्थान के सभी अधिकारीयों व कर्मचारियों ने भाग लिया। इस अवसर पर महानिदेशक महोदय ने सभी से कार्यालय में राजभाषा के क्रियान्वयन व उपयोग करने का आह्वान किया । इस अवसर पर राजभाषा कार्यान्वयन के संबंध में 'कृषि मंत्री की अपील' पढ़कर सुनाया गया।

Independence Day was Celebrated by NIPHM officers with great enthusiasm. Dr. K. Satyagopal, IAS, Director General NIPHM hoisted the National Flag on this eve.

Delegates from Coromandal Fertilizers Limited company visited NIPHM. They had a meeting with Director General NIPHM for future collaboration and had visited to see training and R&D facilities of NIPHM.

Director General NIPHM with officials participated in the Prime Minister's Clean India Campaign on October 2nd. All officals took pledge to maintain cleanness at workplace & to devote at least two hours every week for this nobel cause.

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