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From the Director General's Desk

Intensive agricultural practices have played a significant role in achieving food security in several countries. However, the adverse effects of agro-chemicals on the environment, agro-ecosystems and human health necessitated the need for developing alternate sustainable agricultural practices to ensure food security without compromising food safety. In order to meet the challenges of food security and food safety, attempts are being made to shift from Economic Threshold Level (ETL) based IPM strategies to Agro-Ecosystem Analysis (AESA) based PHM strategies. Further Ecological Engineering for Pest Management, a new paradigm, is emerging as a strategy to enhance biological control by habitat manipulation through cultural techniques.

The significance of natural enemies in an ecosystem, both below ground and above ground, is being realized world over and there is 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. To overcome the existing lacuna there is a need to develop/modify and popularize simple mass rearing techniques of biocontrol agents among farmers. Moreover, farmers are unable to take advantage of even the existing simple mass rearing technologies. Therefore there is a need to create a pool of Master Trainers to popularize simple and low cost mass rearing techniques of biocontrol agents.

NIPHM has launched a special capacity building programme in "On-farm production of biocontrol agents to promote AESA based PHM in conjunction with Ecological Engineering for pest management". The trained Officers can easily disseminate the techniques among farmers and enable them produce the following biocontrol agents: *Trichogramma, Goniozus* spp., *Bracon* spp., *Reduviid* bugs, Spiders and *Coccinellids,* Entomopathogenic nematodes (EPNs) and microbial biopesticides such as *Trichoderma* spp., *Pseudomonas, Verticilium, Metarrhizium, Beauveria,* Nomuraea, etc. To popularize on-farm production techniques of biological control agents among farmers, NIPHM is also associating with State Governments by building capacity of the extension Officers and providing technical guidance to implement these programmes at the village level. Currently, NIPHM in association with Governments of Tamil Nadu, Maharashtra, Telangana, Andhra Pradesh, Kerala and Meghalaya is planning to promote bio-intensive strategies for pest management during the year 2014-15.

Dr. K. Satyagopal IAS,
Director General - NIPHM

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

On-farm Production of Biocontrol Agents and Microbial Biopesticides to Promote AESA based Plant Health Management in conjunction with Ecological Engineering for Pest Management

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Intensive agricultural practices and excessive reliance on agrochemicals adversely affects the delicate and dynamic balance in the agro-ecosystems impacting agriculture sustainability, the environment and human health. Heavy dependence on man-made inputs has relegated the role of bio-control agents in pest management. The current agricultural practices are not holistic and do not rely on systems approach and these practices are pushing the farmers into a pesticide trap (pesticide treadmill effect). Several studies have shown that though reliance on chemical fertilizer and chemical pesticides results in significant gains in the short term, over a period of time the adverse impacts far outweigh the gains from usage of these inputs. Studies have also shown that advisories relying on chemical pesticides will only lead to a situation where farmers spend money only to lose money.

In order to address the adverse impacts of agrochemicals on agro-ecosystems, Integrated Pest Management (IPM) has evolved further from Economic Threshold Level (ETL) based approaches to Agro-Ecosystem Analysis (AESA) based IPM. In addition to integration of various pest management strategies, the AESA based approach incorporates other plant health components. In AESA based IPM the whole agro-ecosystem, plant health at different stages, built-in-compensation abilities of the plant, pest and defender population dynamics, soil conditions, climatic factors and farmer's past experience are also considered. In AESA, informed decisions are taken by farmers after field observation, AESA chart preparation followed by group discussion and decision making. Insect zoo is created to enable the farmer understand predation of pests by natural enemies.

Ecological Engineering for Pest Management, a new paradigm, is gaining acceptance as a strategy for promoting biointensive IPM. Ecological Engineering for pest management relies on the use of cultural techniques for habitat manipulation to enhance biological control. Through ecological engineering i.e. by habitat manipulation with flowering plants, trap crops and other companion plants the population of pollinators, larvae of pollinators which are predacious, predators and parasitoids can be enhanced to manage the herbivorous insect pests by which application of chemical pesticides can be reduced. Further, to overcome the problems of pesticide resistance, pest resurgence and pest replacement there is an urgent need to rely upon biological control as a first line of defense. Reliance on biointensive strategies besides addressing the negative consequences of agrochemicals, will also enhance biodiversity and sustain agro-ecosystems as these strategies do not disrupt the balance in agro-ecosystems.

Biological control is gaining renewed interest world over because of problems encountered with the use of chemical pesticides. Compared to chemical control, the biological control and its integration in systems approach for crop protection and crop production make adoption and dissemination challenging since the ecological role and significance of natural enemies is not adequately understood even by the agricultural extension Officers. However, biological control is an option which is not only practical but also ecologically sustainable for suppressing pest populations because:

1. Conservation as well as production and application of biocontrol agents are easy and safe.
2. It is cost effective and environmentally sound method, especially compared to the chemical pesticides.
3. It helps in reduction/elimination of the use of chemical pesticides.
4. Once established, biocontrol agents are self-sustaining. 5.Biocontrol agents are target specific and generally do not impact non-target organisms. 6. Integrity of the food web and the agro-ecosystems remain undisturbed.

In order to shift to biointensive strategies there is a need to develop techniques for mass production of biocontrol agents and microbial biopesticides at farm level. In addition some of the techniques which can easily be adopted at the farm level have to be popularized among the extension functionaries and progressive farmers. On-farm production of biocontrol agents can significantly help farmers in controlling arthropod pests by release of biocontrol agents produced at farm level. In addition microbial biopesticides can be produced by farmers for their own consumption which can be utilized for bio-priming and rhizosphere engineering, promotion of plant growth & health and protection from seed & soil borne diseases.

NIPHM is committed to creation of pool of Master Trainers in on-farm production of biocontrol agents and microbial biopesticides to promote AESA based PHM in conjunction with Ecological Engineering for pest management. In order to carry the initiative forward, NIPHM is also building the capacity of Agricultural Extension Officers of State Governments, which are emphasizing importance of biointensive pest management strategies. The trained master trainers in turn will be assigned the responsibility of enabling the farmers produce biocontrol agents and microbial biopesticides to meet their

requirements at required time and at an affordable price. In order to enable farmers produce biocontrol agents and microbial biopesticides NIPHM has launched a new capacity building programme and developed/modified/identified technologies which can easily be adopted with minimal facilities at low cost at farmers doorstep. The technologies cover (Imass production of parasitoids such as *Trichogramma, Chelonus, Bracon, Goniozus* etc. (ii) mass production of predators such as *Chrysoperla, Reduviid, Spiders, Coccinellids* etc (iii)mass production of microbial biopesticides such as *Trichoderma, Metarhizium, Verticillium, Beauveria, Nomuraea, Paecilomyces, Pseudomonas, Bacillus* and *(iv)* Entomopathogenic nematodes.

In pursuit of popularization of on-farm production of biocontrol agents and microbial biopesticides it has been decided to publish techniques that can be adopted at farm level by farmers on a regular basis as a series in the "Plant Health Newsletter" of NIPHM. Each issue will be covering technologies for mass production of one microbial biopesticide and two biocontrol agents at farm level. This issue is focusing on the following technologies: On-farm mass production of **Trichoderma, Bracon** and **Reduviid bugs.**

On-farm production technology for mass production of *Trichoderma* spp.

Among the several biocontrol agents, *Trichoderma* spp. are known to occur in all agroecosystems, commonly associated with root, soil and plant debris/plant organic matter. Since 1930s, *Trichoderma* species are recognized as biological agents to protect crops against several soil and air borne plant pathogens belonging to the genus *Phytophthora, Rhizoctonia, Botrytis, Alternaria, Verticillium, Colletotrichum, Fusarium, Sclerotium, Pythium, Scalerotinia, Macrophomina* etc. *Trichoderma* spp. act through rhizophere competition, antibiosis, mycoparasitism against soil borne and foliar phytopathogenic fungi, bacteria, nematodes and sometimes their efficacy on soil borne fungal disease is higher than fungicides. *Trichoderma* spp. also stimulate plant growth, enhance germination, plant survival, growth of roots & shoots.

To ensure that quality *Trichoderma* spp. 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 easily be adopted by farmers. *Trichoderma* spp. 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, autoclavable bags, PVC pipes, candle/spirit lamp, inoculation loop/spatula/glass rods, non-absorbent cotton, rubber bands, mixer grinder, sealing machine etc. In addition to the mother culture of the *Trichoderma* spp. the media in semi-solid state fermentation is needed. Semi solid media could be prepared by using sorghum, barley, rice, pearl millet grains etc. in the autoclavable bags. For mass multiplication of *Trichoderma* spp. the following steps should be followed sequentially as noted below:

1. Take about 200 gm of grains in autoclavable bags [7" (B) × 11" (H)] and add equal amount of tap water.
2. After filling the bags, keep a 1.5" inches PVC pipe at the top of the cover and tied it with a rubber band.
3. Close PVC pipe mouth using cotton plug.
4. Boil the grains in a 10-20 liter pressure cooker with water inside it for a period of 40 minutes.
5. The grains are cooled at room temperature after sterilization.
6. Transfer the bags into a wooden inoculation chamber. Spirit lamp/candle should be flamed after closing the inoculation chamber for about 5 to 10 minutes.
7. Inoculate with 1-2 bits of *Trichoderma* mother culture in each bag inside the chamber with the help of inoculation loop/spatula. Shake the bags properly for mixing the fungal culture all over the grains.
8. Keep the inoculated bags at the room temperature (25-30 °C) .
9. Observe the inoculated bags if there is mycelial growth, do not disturb the inoculated bag. If mycelial growth is not observed, shake the inoculated bag.
10. Once *Trichoderma* sporulation (green colour) takes place shake the bags every alternate day for about 5 to 7 days in order to spread and allow the *Trichoderma* growth and further sporulation.
11. Transfer the grains with fully grown *Trichoderma* mycelia & sporulation into cleaned plastic trays and cover it with blotter/newspaper. Keep these plastic trays for further sporulation and drying for about 3-4 days at room temperature. Mix the transferred *Trichoderma* colonized grains once in every day for upto 3-4 days with the help of spatula for enhancing sporulation and drying.
12. The *Trichoderma* will be ready for use as soil application or the grounded fine powder for seed treatment and or foliar application.

13. From 1 kg sorghum grains approximately 500 gm dried biomass of *Trichoderma* including grains can be produced, which could be utilized directly for soil application for one hectare after mixing in 100 kg of well decomposed compost or Farm Yard Manure (FYM). The dry biomass powder along with 0.5% Carboxy Methyl Cellulose (CMC) can be utilized for seed treatment @ 10 g/kg seed.

Farm based Low Cost Mass Production Technique for *Trichoderma*

On-farm production technology for mass production of larval parasitoids, *Bracon* spp.

Bracon hebetor and *B. brevicornis* are highly polyphagous gregarious ecto-larval parasitoids of several Lepidopteran insect pests of field and horticultural crops as well as stored grains. It attacks the larval stage of the insect host and lays eggs on the surface of the host insect. Larvae upon hatching start feeding on host body fluids by inserting their mouth parts into the host. From each host larvae, two or more parasitoid larvae develop and pupate. The egg period is 1-2 days, larval period is 2-4 days, pupal period is 3-7 days and adult lives for 20-63 days. The total developmental period (egg to adult emergence) on larvae of *Corcyra* is 6-12 days. The eggs are laid singly or in groups of 2-8. A female is capable of laying 229 eggs (142-345) on 14-32 host caterpillars during its life span. Female lays on an average 2-27 eggs/day. Female lays maximum number of eggs during the first ten days of oviposition period. *Bracon* spp. can control important insect-pests (by releasing 2000-5000/ha). For mass multiplication of *Bracon* spp. the following steps should be followed sequentially as noted below:

1. *Bracon* spp. are mass produced on *Corcyra cephalonica.*
2. Take a wide mouthed glass jar and place a cotton swab dipped in 10-50% honey solution on inner side of the jar.
3. Release 30-50 freshly emerged adults inside glass jar.

4. Immediately cover the jar opening with a muslin cloth and tie with a rubber band.
5. Place 10-15 grown up larvae (fourth and fifth instars) of *C. cephalonica* of more or less similar size above the cloth for oviposition by *Bracon.*
6. Place another muslin cloth over the larvae and secure with a rubber band (larvae sandwiched between two layers of muslin cloth).
7. Keep the jar a side for two days.
8. After 48 hrs remove parasitized larvae and transfer to a Petri dish and maintain separately for larval development and pupation.
9. Repeat the procedure for obtaining continuous supply of *Bracon.*
10. In this method, 50-100 adults can easily be obtained from each jar for every two days.

On-farm production technology for mass production of predatory Reduviid Bugs

The reduviid bugs (*Rhynocoris marginatus*/*R. fuscipes*), also known as assassin bugs, are predators of insect pests. Two reduviid bugs, *Rhynocoris marginatus*/*R. fuscipes*, are important and effective predators of insect pests in many agro-ecosystems (soybean, groundnut, pigeonpea, cotton, castor, rice, cabbage, tobacco, pumpkin, okra, citrus, sugarcane, sesbania, apple etc.). Predaceous reduviids are of considerable economic importance because they reduce the pest population by killing the host quickly with their highly proteolytic saliva. The effectiveness of the reduviids as biocontrol agents has been demonstrated and the field releases usually resulted in quick and effective control of the target pests. Adult bugs often range from 4 to 40 mm in length. They commonly have an elongated head with a distinct narrowed neck, long legs, and a prominent, segmented tube for feeding (rostrum/beak). Most species are dark in colour with hues of brown, black, red, or orange. In the laboratory, reduviid bugs are mass produced using rice moth, *Corcyra cephalonica*, larvae as hosts. Egg period is 7-10 days, nymphal period is 45-50 days, and adult period is 180-200 days. For mass multiplication of reduviid bugs the following steps should be followed sequnetially as noted below:

1. Take a clean, dry plastic tub/container and add sterilized sand to a depth of 2 cm.
2. Place a cotton swab dipped in 10-50% honey solution on the inside wall of the tub/container.
3. Place a piece of corrugated white paper for oviposition. Add 2-3 grown up larvae (4^{th}- 5^{th} instars) of *Corcyra*.
4. Release 2-3 pairs of young adults (M:F in 1:1 ratio) into the tub/container. Immediately cover the tub/container with a muslin cloth and secure it with a rubber band.
5. Change the cotton with honey solution and add *Corcyra* larvae every two days.
6. The females lay eggs on the corrugated white paper in clusters of 40-50 eggs. Collect the egg masses from the white paper by cutting out the paper with eggs on it.
7. Place the paper with egg mass in a Petri dish and cover it with lid. Eggs hatch into nymphs in 7-10 days.
8. Maintain the nymphs in the same Petri dish for a week by adding 3 to 4, 1^{st}/2^{nd}/3^{rd} instar *Corcyra* larvae or as needed.
9. After a week, transfer all the nymphs to a plastic tub/container (10-20/container) with sand (2 cm thickness) at the bottom and a piece of corrugated white paper and cover the container with a muslin cloth.
10. Place a cotton swab dipped in 10-50% honey solution on the side wall of container. Add 3-5 fourth/fifth instar *Corcyra* larvae daily in the container.
11. Replace the *Corcyra* larvae and cotton dipped in honey solution every 2 days. Maintain the nymphs in this way for 40-45 days or until they become adults (increase the number of *Corcyra* larvae added as the nymphs grow). During this period, nymphs go through five nymphal instars.
12. Collect the adults and release a pair of adults (male and female) in a clean, dry tub and repeat the procedure for mass production of reduviids under laboratory conditions.
13. The first and second nymphal instars can consume one small size host caterpillar/day; third and fourth nymphal instars can consume 2 to 3 medium size host caterpillars/day; fifth nymphal instar and adult can consume 3 to 4 big size host caterpillars/day depending on the requirement nymphs/adults can be released in the field.

Mass Production of Reduviid Bugs

Fill tub with 2 cm depth sterilized sand

Place a honey cotton swab

Place a corrugated paper

Add 4-5 *Corcyra* larvae

Add a pair (M: F @ 1: 1) of adults

Cover the tub with a muslin cloth

Collect the egg mass in a Petri dish

Maintain the 1st instars in a Petri dish

Transfer the 2nd instars to a tub

Adults develop in 45-50 days

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: Collaboration on "On-farm production of biocontrol agents to promote AESA based PHM in conjunction with Ecological Engineering for Pest Management (EE for PM)" with Deptment of Agriculture, Tamil Nadu

Based on the initiative of NIPHM a delegation from Tamil Nadu led by Dr. M Rajendran, IAS, Director of Agriculture, visited NIPHM on 16th to 17th April, 2014. The visit was aimed for establishing collaboration with NIPHM to promote bio-intensive pest management practices in Tamil Nadu. The team visited Centre for Biological Control, Pesticide Formulation Analysis, Pesticide Residue Analysis, Plant Health Engineering, Agro-Eco System Analysis and Ecological Engineering Fields at NIPHM. In the meeting held under the Chairmanship of Dr. K. Satyagopal, Director General, NIPHM it was decided that, Department of Agriculture, Government of Tamil Nadu and NIPHM will jointly promote bio-intensive pest management practices in select crops, which are currently being grown by farmers and relying excessively on chemical pesticides.

Accordingly NIPHM organised a series of training programmes on "On-farm production of biological control agents to promote AESA based IPM in conjunction with Ecological Engineering for pest management" and trained 152 Agricultural Officers from April to June 2014. The participants were trained in AESA & Ecological Engineering for pest management and on-farm production of biocontrol agents & biopesticides such as *Bracon* sp., *Chaelonis* sp., *Reduviid, Spiders, Trichogramma* sp., *Trichoderma* sp., *Pseudomonas* sp., *Bacillus subtilis, Metarhizium* sp. *Verticillium* sp. *Paecilomyces* sp. *NPV,* and Entomopathogenic Nematodes. The mother cultures of Biocontrol agents & biopesticides were provided to the each participant for mass production at Farmers self-help groups (SHGs). The main objective of the initiative is to enable the Agricultural Extension Officers to popularize AESA based Plant Health Management in conjunction with Ecological Engineering for Pest Management and establish

on-farm biocontrol agents production centres in select villages for production of parasitoids, predators, microbial biopesticides and entomopathogenic nematodes with the backup support from NIPHM.

Training cum Workshop on AESA and Ecological Engineering based Plant Health Management for the Officials of KVKs' (4th to 6th June)

Training cum workshop was organized to discuss the activities with respect to plant health management with minimal use of pesticides, as well as to provide an overview on knowledge and skills in AESA and Ecological Engineering based PHM, mass production of biopesticides, predators & parasitoids, on-farm production techniques of Biocontrol Agents.

Special Events: International Training Programme on Plant Biosecurity & Incursion Management in Collaboration with USDA

Rapid globalization and advancements in transport, travel, tourism coupled with liberalization of trade pose increased risk of introduction of exotic and invasive pests. The far reaching consequences of entry, establishment, and spread of various kinds of pests are fearsome especially to a country like India due to its varied agroclimatic zones and due to its primary dependence on agriculture. In the past many plant pests have gained entry into the country and are still causing devastating, economic damage to many cultivated crops & forests. Most of the exotic plant pests are well established and became widespread in India, due to lack of awareness among stakeholders and due to inadequate official surveillance, containment and eradication programmes. NIPHM has taken a lead role in organizing an International Training Programme on "Plant Biosecurity & Incursion Management" in collaboration with USDA from 8th to 28th April 2014.

The objective of the programme was to provide a comprehensive account of Biosecurity concepts, impact of alien pests introduced, exotic pest threats, plant biosecurity strategies that need to be employed at pre-border, border and post-border to minimize the association of exotic pests through imported commodities, decision making tools such as Pest Risk Analysis to identify potential pests of concern to South Asia & Africa, pest surveillance, diagnostic techniques, international market access issues and pest incursion management strategies, through class room lectures, laboratory practical sessions, simulated exercises, case studies and mini-project presentations.

Dr. Parul Patel and Dr. Kristian Rondeau experts from UDSA-APHIS handled various technical sessions along-with NIPHM and national guest faculty. Dr. Bahiru Duguma Director Office of Food Security, USAID, India, Dr. Lou Vanechanoos Director Asia – Pacific Region, USDA China, Mr. Scott D Saxe USDA Attaché, India and Ms. Srivalli, USAID India also addressed the participants.

11 participants from Sri Lanka, Nepal, Bangladesh, Ethiopia and Nigeria and 31 from ICAR Institutes, SAUs, State Departments of Ag. & Hort. and Directorate of PPQS attended the programme.

NIPHM - USDA Collaboration Review Meeting

To strengthen the NIPHM's capacity in training, research & policy issues in the area of Plant Health Management, Plant Biosecurity and Pesticide Management, the NIPHM has entered into collaboration with USAID/ USDA with approval of Department of Agriculture and Cooperation (DAC) and Ministry of External Affairs (MEA) under the frame work of MoU on Agricultural Cooperation and Food Security between GOI and USAID.

A review meeting was held under the Chairmanship of Dr. K. Satyagopal, DG NIPHM on 28th April 2014. The meeting was attended by Dr. Bahiru Duguma, Director Office of Food Security, USAID, India, Mr. Scott D Saxe USDA Attaché, India, Dr. Parul Patel USDA and Dr. Kristian Rondeau USDA, Ms. Srivalli, USAID and Dr. N. Sathyanarayana, Director -Plant Biosecurity, NIPHM. The progress achieved in the identified areas of work plan for the year 2013-14, as well as plan of action for the future activities for the year 2014-15 were deliberated.

Special Event: International workshop on Seed and Seedling-borne Diseases of Vegetable Crops in Collaboration with USAID & Virginia Tech

An international Workshop on "Seed and Seedling-borne diseases of vegetable crops" was organized by National Institute of Plant Health Management, Hyderabad in collaboration with Integrated Pest Management Innovation Lab, Virginia USA, a Feed the Future Collaborative Research program funded by USAID at NIPHM campus, Hyderabad, India from June 2nd to 5th, 2014. IPM Innovation Lab plant pathologists and virologists from India, USA, Indonesia, Bangladesh and Cambodia and other invited speakers, including representatives from NIPHM, and multinational seed companies and other stakeholders held discussions on the current status of research, education, regulations, seed chain and extension relevant to the management of plant virus and other diseases transmitted through seeds. Thirty six participants, representing cross section of industry and Government stakeholders attended the Workshop.

Special Event: Biointensive Approaches in Tobacco Cultivation in Collaboration with Tobacco Board

Based on the initiative of Dr. K. Satyagopal, IAS, DG, NIPHM and Dr. K. Gopal, IAS, Chairman, Tobacco Board, a programme was launched to promote biointensive pest management strategies in tobacco cultivation among farmers. This includes demonstration on the use of microbial biopesticides and other biocontrol agents for managing the insect pest and diseases of tobacco. Taking cue from the positive results obtained with the use of *T. harzianum* and *P. fluorescens* for tobacco seed, nursery, and main field treatments in Rajahmundry, Ongole & other areas in Andhra Pradesh the Tobacco Board had decided to take up similar programme in Model Project Area (MPA) villages covering 440 hectares area of main field in Mysore and Periyapatna regions in Karnataka.

The NIPHM scientists and Tobacco Board officers conducted eleven field demonstrations on seed, nursery seed beds treatment with *T. harzianum* and *P. fluorescens* from 11th to 14th March covering fields of 11 auction platforms under Mysore and Periyapatna regions including Cangahalli, Undavadi, Jaragankoppal, Muntikoppal, Sakkare, and Thammadahalli, Kothavalli, Badekyathanhalli, Madapura/Ramanapura, Kundenahalli and Adagur. A total of about 200 farmers were trained. The application of *T. harzianum* and *P. fluorescens* through seed treatment (10 g formulated product/Kg of seed each) and field application [1 Kg formulated product in farm yard manure (FYM) each for 120 square meters nursery area (sufficient for transplanting in 1 hectare main field) + 288 Kg coir pith treatment for the pro-trays] methods was demonstrated to the farmers. The farmers have also been acquainted with the usefulness and mass production of *B. hebetor*, and predators such as spiders and reduviid bugs. Farmers were very much interested and enthusiastic about the adoption of these technologies.

NIPHM scientists & Tobacco Board Officers also conducted 11 field demonstrations on main field application of *T. harzianum* and *P. fluorescens* on 6th and 7th May, 2014, covering 11 auction platforms in MPA villages where previously seed & nursery treatment were applied and demonstrated. A total of 180 farmers were trained. The application of FYM containing *T. harzianum* and *P. fluorescens* helps the plants to withstand against wilt, sore shine (root rot), black shank diseases.

Special Event: On-farm Production of Bio-agents to Promote AESA based PHM' under CROPSAP PROJECT

For creating awareness among farmers and provide advisory to bridge the gap between Research and Extension and to develop a scientific approach to pest surveillance system, a comprehensive project on Crop Pest Surveillance and Advisory Project (CROPSAP) was initiated by the Govt. of Maharashtra. Under this project, Department of Agriculture has deputed officials to NIPHM for training in Plant Health Management during 2013-14. In view of the utility of the programme, the Govt. of Maharashtra has further permitted and funded NIPHM to impart training to village level extension personnel. In compliance to that, the training programmes on 'On-farm production of bio-agents to promote AESA based PHM' under CROPSAP PROJECT- **IPM village concept** were organized as pre-season training for field level staff of State Department of Agriculture, Maharashtra. The programme was organized in three batches from 9th to 13th June, 16th to 20th June and from 23rd to 27th June, 2014 (5 days each). The programmes were attended by 65 Agriculture Assistants. During the training programme, participants have learnt concepts of AESA and Ecological Engineering for pest management, biological control of pests, farm level production techniques for biocontrol agents, biopesticides and Mycorrhizae.

Capacity Building

Quarantine Pest Detection and Identification (8th -28th May)

The programme covered various aspects of plant quarantine regulations, import and export procedures for plants and planting material, impact of introduced pests, seed health testing methods and detection and identification methods used for quarantine pest. This training imparted hands on experience in diagnostic methods viz., dry seed examination, different incubation methods, serological and nucleic acid based methods.

Quarantine Pathogens- Seed Health Testing and Molecular Diagnostic Techniques (15th to 22nd May)

Participants were trained in various methods of seed health technologies, dry seed examination, agar plate and incubation methods, ELISA and PCR.

Quarantine Insects – Detection and Identification (22nd – 28th May)

Theory and practical sessions on detection and identification of insect pests of quarantine significance including Khapra beetle were conducted.

Plant Quarantine National Regulations and Procedures (8th to 14th May)

The programme covered various aspects of international conventions, national standards and procedures to be followed for import & export of planting materials for propagation including germplasm, consumption material, bio-control agents, soil, peat and sphagnum.The programme also imparted hands-on-skills in on-line registration through PQIS.

Ambrosia Eradication using Integrated Approaches including Microbial Biopesticides

An invasive weed *Ambrosia psilostachya* is recorded in Turuvekere Taluk, Tumkur District, Karnataka. NIPHM in association with other stakeholders has initiated eradication of the weed. A special programme for the farmers from *Ambrosia* weed infested area in Karnataka was organized at NIPHM from 26th to 28th June 2014. 15 farmers were trained in production techniques of *Trichoderma* spp. *Pseudomonas* spp. and a bioherbicide - *Phoma* spp. for Ambrosia. Farmers were also given exposure on mass production of parasitoids and predators viz., *Trichogramma* spp., *Bracon* spp., *Chelonus* spp., *Goniozus* spp., *Reduviids* and Spiders. It is expected that this will help them to produce these biocontrol agents locally to mitigate the pest problems faced by them in rice and coconut crops.

Pesticide Residue Analysis (28th April to 27th May)

Participants were trained in Internationally accepted QuEChERS and other methods of extraction and clean-up for pesticide residue analysis and determination by GC-ECD, GCMS/MS and LCMS/MS for various matrices.

Capacity Building

Analysis of New Molecules of Pesticides (22nd to 31st May)

Programme is open only for Pesticide Analysts already trained by NIPHM in PFA programme to equp them with skills required for analysis of new molecules of pesticides registered after 2005.

Calibration of Glassware and Laboratory Equipment - Pesticide Formulation Analysis / Quality Control (20th to 27th June)

The Analysists from SPTLs were trained for calibration of GLC, HPLC, UV cum Visible Spectrophometer and various measuring glassware to increase the precision and accuracy in analysis.

Production Protocol for Biocontrol Agents and Quality Analysis and Quality Management of Microbial Biopesticides (23rd May to 12th June)

In a 21 days training the participants were trained in Production of biocontrol agents & biopesticides such as Bracon sp., *Chaelonis* sp., *Reduviid, Spiders, Trichogramma* sp., *Trichoderma* sp., *Pseudomonas* sp., *Bacillus subtilis, Metarhizium* sp. *Verticillium* sp. *Paecilomyces* sp. *NPV, B. thuringiensis,* and Entomopathogenic Nematodes. Participants were also trained in registration and quality analysis of microbial biopesticides.

Safe and Judicious Use of Pesticides (17th to 24th June)

Participants were trained in AESA based plant health management, 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 etc. Practical sessions were organized on pesticides application techniques, selection and operation of suitable equipment, selection of suitable nozzles, calibration of the sprayers, ecological engineering, on-farm mass production of *Trichoderma, Pseudomonas*, Bracon, *Trichogramma,* spiders, *Chrysoperla* and Redviid bugs.

Fundamentals of Plant Health Management for Plant Health doctors (4th to 24th April)

A 21 days training programme to create a pool of master trainers on various issues of Plant Health Management was organized. The trainees were exposed to AESA based plant health management in conjunction with Ecological Engineering for Pest Management, detection and diagnosis of pests, integrated disease management, integrated nematode management, integrated weed management, mass production of Biocontrol agents and Microbial Biopesticides.

The participants visited the field and practiced AESA procedures in different crops such as rice and vegetables and observed the P:D ratio, plant compensation ability, insect zoo studies, etc. They visited the Ecological Engineering models in Rice and Cabbage fields at NIPHM farm and also worked out the models of Ecological Engineering for different crops in their region based on the literature available on attractant/repellent plants. They were trained in differentiating biotic and abiotic damage symptoms as well as detection and diagnosis of damage by insects, diseases, nematodes, etc. They also learnt the on-farm production of *Corcyra, Trichogramma, Chelonus, Goniozes, Chrysoperla, Reduviids*, Spiders, *Trichoderma, Pseudomonas*, Entomopathogenic Fungi (EPF). They also learnt techniques of mass production of entomo-pathogenic nematodes (EPN) as well as VAM and AM which aids in Rizosphere Engineering and in turn promotes the Plant Health Management.

Appropriate Pesticide Application Techniques and Farm Level Storage Practices (22nd to 29th April)

Participants were trained in AESA based plant health management, 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 and production of bio-pesticides were conducted.

Capacity Building

Certificate Course on Urban Integrated Pest Management (2nd to 16 April)

8th Certificate course was organized in which 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.

Refresher Training on Rodent Pest Management (23rd to 29th May)

An off campus training was organized in collaboration with OUAT, Bhubaneswar, for agricultural extension functionaries on major rodent pest species, breeding profiles of rodent pests, rodent seasonal calendar and ethological parameters in relation to their management. They were exposed to rodent problems in food godowns and their management through prevention as well as safe and judicious application of rodenticides.

Around the World

Potato wart disease, caused by the soil-borne fungus *Synchytrium endobioticum*, affects a number of *Solanum* species including cultivated potato. Wart disease is prevalent in India and confine to Darjeeling hills of West Bengal. Domestic Quarantine is in force to prevent further spread of the disease to other States. India produces 42.6 Million Mt per annum and has potential to export. However, potato wart disease is one of the limiting factors for potato export. Potato wart disease, though previously present in USA, is now declared eradicated. Similarly, Austria, now has declared that the fungus, *Synchytrium endobioticum* has been eradicated. Since the pathogen presence is confined to small area, India may try to eradicate the disease.

EPPO suggests that for eradication of wart disease, infested fields should not be used for potato production for twenty years. Furthermore, employing other practices viz., sanitation, long crop rotation, growing resistant and immune varieties may also be employed for eradication.

New Biocontrol Agent for Control of Lantana Weed

Lantana (*Lantana camara*) is a terrestrial weed of South and Central American origin, has become invasive in many countries and now wide spread in India. Its negative impact on agricultural, horticultural and forestry are well documented. Many control efforts in the past including use of biocontrol agents have been futile so far. Now a new biocontrol agent, flower-galling mite (*Aceria lantanae*) of Caribbean origin, is showing great promise in biological control of Lantana in South Africa. The flower-galling mite is reported to be host-specific and causes Lantana to produce vegetative galls instead of flowers and thus reduces seed production (seed-set). The BCA was released in South Africa in 2008 and the post-release observations revealed that the mite has established at several sites at altitudes ranging from 10 to 1400m and dispersed to 50 Kms from the place of its initial release. It is continuing to spread and is causing significant reduction in flowering (up to 90%) in some of the introduced areas.

Fig.1. The tiny mite (adult is about 0,15 mm long).

Fig.2. Severely infested plant flower parts (Mite feeding induces the flower bud to develop into a green, broccoli-like gall, about 20 mm in diameter) (Photo: Lin Besaans (2012) © ARC)

The information can be obtained from:http://www.dargleconservancy. org.za/documents/ problemplants/ sapia/ SAPIA% 20NEWS%20No. %2032.pdf.

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.

Mr. N. Gopinath, Horticultural Officer & Farm manager, State Horticulture Farm, Doddabetta, Nilgiris, Tamil Nadu who was trained in a 30 days training on "Crop Specific AESA and Ecological Engineering for Pest Management in vegetables" held at NIPHM from 4th September to 3rd November 2013. With result of his knowledge and practical skills improvement in this training especially on farm production of *Trichoderma,* he has successfully organized two farmer's trainings on "On-farm production of *Trichoderma*" for the benefit of Tamil Nadu farmers & Women Self-help Groups at at Gudalur, Nilgiris on 21.11.2013 and at Mathukkarain Coimbatore Dist. on 12.01 2014. dist.

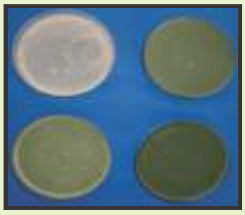
A total of 100 farmers were trained. As a backup support, NIPHM has provided the design of wooden inoculation chamber and the Mother culture of *Trichoderma.* With the result of this training programme the farmers were not only able to understand the importance, use, mechanism of *Trichoderma* but also they have become self-confident in on-farm production of *Trichoderma.* Among them the women self-help group (WSHGs) showed much interest and they were ready to do it jointly.

Dr. Umesh Kumar SMS, KVK, Gramotthan Vidyapeeth, Sangaria, Distt. Hanumangarh, Rajasthan, who was participated in the 21 days training on "Fundamentals of PHM for Plant Health Doctors" held from 17th January to 6th February 2014. He organized one day farmers training on AESA and use of biological control agents in pest management at KVK, Sangaria on 15th March 2014. 50 farmers were trained in AESA methodology, P: D ratio and use of biological control for pest management in Rabi crops with emphasis on wheat crop. The trained farmers were able to reduce one chemical pesticide spray in wheat crop against aphid pest. In the past they used to apply one chemical pesticide spray at the initial crop stage but this year the farmers took the AESA into the consideration and conserved natural enemies.

NIPHM Patents

1. Novel Media for growing fungi and Bacteria with its production technology (No. 1753/CHE/2014 A/ IC-C12N)

The invention relates to development of a culture medium for the growth of microorganisms such as *Trichoderma* spp., *Pseudomonas* spp., *Paecilomyces* spp., *Metarhizium* spp., EPF etc.



Inventors: Dr. AG Girish and Dr. K. Satyagopal

2. Novel Technique using GS-1 and GS-II media for mass multiplication of fungal and bacterial biocontrol agents (No. 1572/CHE/2014A/ IC-A01N63/00)

This invention relates to New method of mass multiplication of fungal and bacterial biocontrol agents using a novel medium.

Inventors: Dr. K. Satyagopal, Dr. AG Girish & Dr. S.K. Sain

3. Paddy Dryer (2MT) (No. 1754/CHE/2014A/ IC-f26b)

Scientific on-farm drying of high moisture paddy for farmers even when harvested during rains.

Inventor: Er. G. Shankar

4. Natural Enemy Friendly Light Trap (No. 1755/CHE /2014A/ IC-ao1m)

A low cost Natural Enemy Friendly Light Trap which will be useful in trapping lepidopteran pests while the natural enemy population (small beneficiaries) escape back to the field.

Inventors: Dr. K. Satyagopal and Er. G. Shankar

Interested parties may contact :
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Forthcoming Events

Pesticide Management Division

- Inspection, Sampling and Prosecution Procedure under IA1968 (1) : 27 October to 3 November
- Laboratory Quality System Management and Internal Audit as per ISO/IEC 17025-2005: 6-11 August
- Pesticide Formulation Analysis: 26 August to 30 October
- Sampling of Fruits, Vegetables and other items for Pesticide Residue Analysis & calibration of Laboratory Equipment-PRA(1): 16-23 September
- Calibration of glass ware and lab equipment- PFA: 13-20 October
- Pesticide Residue Analysis: 28 October-26 November

Plant Biosecurity Division

- Pest Surveillance: 9-16 October
- Forced Hot Air Treatment (FHAT): 26-30 August
- Quarantine Pests: Detection and Identification: 8-28 September
- Quarantine pathogens: Seed Health Testing Methods and Molecular Diagnostic Techniques: 11-18 September
- Refresher Training Programme Plant Biosecurity: 22-29 September
- Phytosanitary treatments (MBr& ALP): 11-25 August
- Emergency Preparedness & Incursion Management: 4-9 August
- International training programme on Pest Risk Analysis: 1-5 September
- Workshop on *Ambrosia* eradication programme: 7-8 October
- Workshop on Review of import & export procedures of BCA's: 20-22 October
- SPS awareness programme for Senior officers: 27-29 October

Plant Health Management Division

- Crop specific AESA & Ecological Engineering for Pest Management in vegetables: 28 October-11 November
- On-Farm production of biocontrol agents to promote AESA based Plant Health Management: 9-18 October
- Farmer Field Schools Methodology: 22-26 September
- Good Agricultural Practices: 1-5 September
- Rhizosphere Engineering: 8-12 September
- Economic importance of plant Parasitic & entomopathogenic nematodes: 15-20 September & 6-11 October
- AESA & Ecological Engineering for Pest Management: 28 October to 11 November
- Integrated Soil Nutrient and Weed Management (ISNWM): 28 October to 03 November
- Rodent Pest Management in Store Houses of Food Grains: 27-31 October
- Certificate Course on Urban Integrated Pest Management: 8-22 September
- Integrated Rodent Pest Management in Urban environs: 9-13 September
- Safe and judicious use of pesticides: 19-26 August
- Appropriate pesticide application techniques and farm level storage practices: 14-21 October

For training programmes schedule and details please visit: http://niphm.gov.in
Nominations may be sent by Email to:- niphm@nic.in

On-farm Production of Biocontrol Agents

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