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From the Director General's Desk

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Several studies highlighted that insect pests are responsible for significant crop losses, with some studies pointing that the insect pests are destroying nearly 20% of the world's crop production annually. Crop losses are caused by insect pests both above and below ground, with some insect pests causing severe damage to the roots and there by affecting the yields. Significant crop losses are noticed notably in sugarcane, groundnut, cardamom, potato, maize and strawberry etc. Termites, white grubs and millipedes are the major groups of soil pests that are widespread and of economic importance. However, there is paucity of information on distribution, abundance and impact of root feeders on plant health. Management of root-feeding insects is complex and hampered by the difficulties of timely detection, access and limited understanding of belowground herbivory. Belowground herbivory causes negative impacts on root biomass and associated changes in plant health. The magnitude of damage depends on the pest species and crop, besides plant nutritional status and plant defenses.

Chemical pesticides are being excessively relied for insect pest management (both above and below ground) in spite of the adverse impact of agrochemicals on soil, air, water and the agro-ecosystems. Problems of pest resurgence, insecticide resistance, pest replacement and impact of chemical pesticides on natural enemies, resulted in increased interest to seek options that are efficient & sustainable. Agro Ecosystem Analysis based IPM strategies, Inundative and Inoculative biocontrol strategies, Ecological Engineering for Pest Management to enhance ecosystem service of pest regulation etc are gaining importance. Efforts for biological control of soil borne insect pests for long were insignificant and only in the last couple of decades Entomopathogenic nematodes(EPN) are being exploited to control insect pests.

EPNs are lethal pathogens of wide variety of insects. Biological control with the help of EPN is a very efficient organic insect control method. EPNs belonging to the families Heterorhabditidae and Steinernematidae are by far the most widely used group. Due to a mutualistic association with bacteria belonging to the genera *Photorhabdus* (Heterorhabditidae) and *Xenorhabdus* (Steinernematidae), EPNs are able to kill a diverse array of insects. EPNs have a single free-living stage, the infective juvenile (IJ), that carries bacteria in its gut. On entering the insect host, the IJ releases cells of its bacterial symbiont from its intestine into the haemocoel of the insect host. The bacteria proliferate in the nutrient-rich insect haemolymph resulting in death of the insect normally within 24–48 hours. The IJs recover from their arrested state and feed on the proliferating bacteria and digested host tissues. EPN and bacteria are harmless to humans and other organisms. EPN are found to be most efficacious in habitats that provide protection from environmental extremes, and in cryptic habitats. EPN are also used as a foliar spray to control sucking pests and other foliar insects in several countries.

There is growing interest in our country to use EPN as a biocontrol agent for management of soil borne grubs that are adversely impacting crops particularly sugarcane, groundnut and cardamom.

The reasons for non-utilization of EPN as a biocontrol agent in general are lack of awareness, non-availability of EPN at reasonable cost and lack of mass production technologies of EPN that are simple, low cost and feasible at farm level. In order to strengthen the ongoing efforts launched by ICAR and select SAUs, NIPHM is committed to popularizing EPN through special capacity building programmes for scientists, extension officers and interested progressive farmers with special focus on States such as Maharashtra, Tamil Nadu, Andhra Pradesh, Telangana etc. Through research initiatives, innovators of NIPHM have developed simple low cost technologies for mass multiplication of EPN that can be adopted by farmers as well as by commercial establishments. Several programmes are scheduled during the current year to promote soil borne and foliar insect pest management with EPN. 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 same among the farmers.

(K. Satyagopal)
Director General

Theme Article

Entomopathogenic Nematodes for the Biological Management of Insect-pests

Dr. B.S. Sunanda* and Dr. Korlapati Satyagopal, IAS**

Entomopathogenic nematodes (EPN) are beneficial nematodes parasitizing insect pests and are being effectively used as a biocontrol agent against a wide variety of insect pests. The impressive attributes of EPN have stimulated strong commercial interest in nematodes as biological control agents and are being considered increasingly as a viable alternative to chemical pesticides. EPN have many attributes, which make them a good and promising biocontrol agent (Ahmad et al., 2005a, b; Ali et al., 2005c),& can be easily incorporated as a component of IPM programme. They have the ability to search the target insect in soil, plant surface, partly embedded insects in plant tissues. They ensure quick kill of the target insect through release of bacteria.

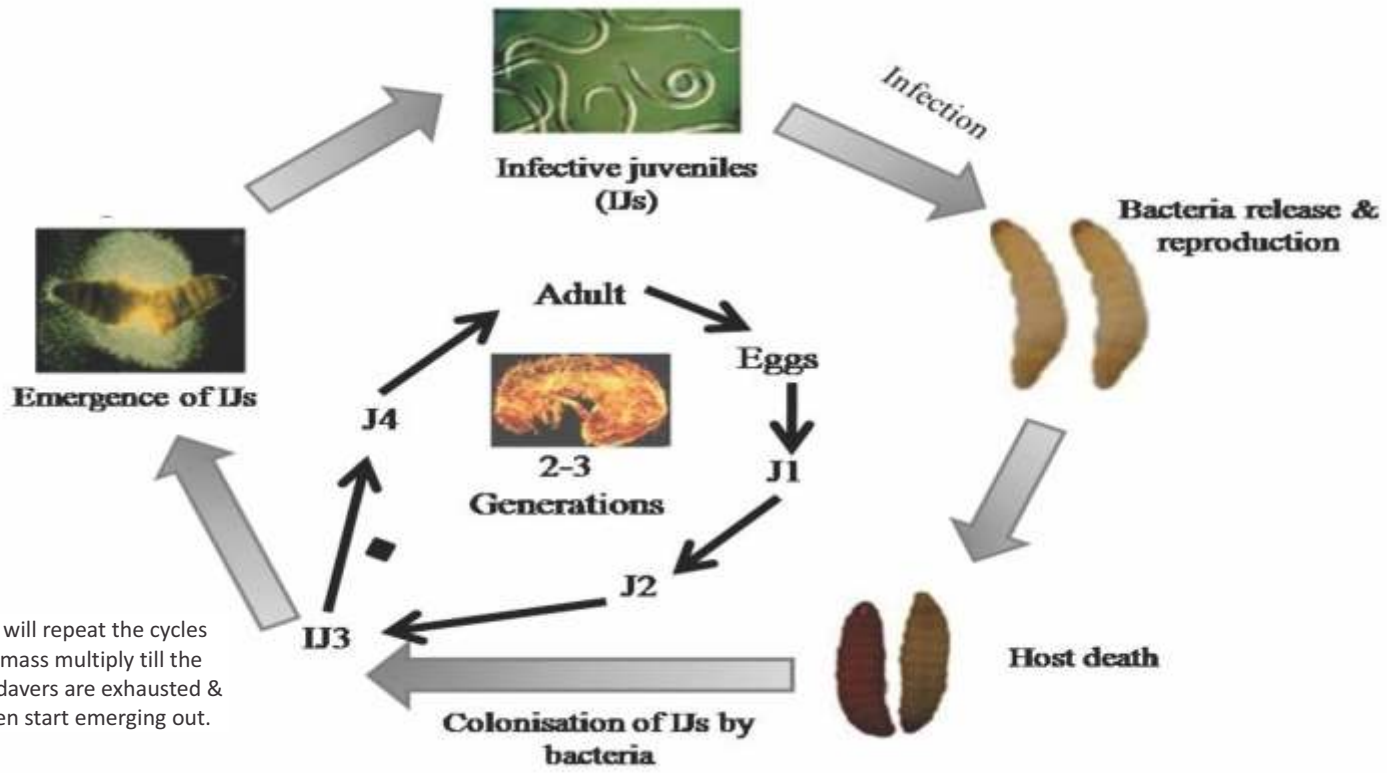
They have broad host range &can be recovered from soil and mass multiplied on artificial diet or living hosts and can be stored for a long period in soil or cadaver. EPN can be formulated as dust, sprays, capsules, granules, etc. and can be applied through spraying suspension or through irrigation system.The bacteria-nematode symbiosis can be described as a cyclic association that starts and ends with the infective juveniles in the soil (Gaugler 2001). Nematodes have been applied successfully against soil inhabiting insects (as soil application) as well as above-ground insects (foliar spray) in cryptic habitats (Arthers et al. 2004). Entomopathogenic nematodes do not appear to have any significant harmful effects on beneficial organisms or other non-target organisms. They do not attack or cause disease in birds, mammals or fish (Boemare et al. 1996; Georgis et al. 1991). Entomopathogenic nematodes are currently being used to a limited extent in greenhouse, nursery, and small fruit operations to better manage insect pests. They are currently used for the control of soil and cryptic pests in North America, Europe, Asia and Australia.

EPNs are the most widely used biocontrol agents for control of caterpillars, sawflies, and leaf beetles in leafy vegetables. The main target insects of commercial entomopathogenic nematodes currently are *B. difformis, Palpita indica,* and *S. litura* in root vegetables, *Pl. xylostella, M. brassicae, A. nigrisigna, S. litura, S. exigua, A. rapae, Hymenia recurvalis, Pha. brassicae,* and *Phy. striolata* in leaf vegetables in greenhouse.(C. Dolinski 2012)They have been proved safe to plants non-toxic to humans, relatively specific to their target pest(s). They are exempted from Pesticide registration in USA & many other countries.

Life cycle of Entomopathogenic nematode:

EPNs complete most of their life cycle in insects with an exception of infective juveniles, the only free-living stage found in soil.

- Infective juveniles of both Steinernema and Heterorhabditis locate a host and enter through its natural body openings such as mouth, anus or spiracles.



Ij3 will repeat the cycles to mass multiply till the cadavers are exhausted & then start emerging out.

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- Infective juveniles of Heterorhabditis also enter through the intersegmental members of the host cuticle.
- Infective juveniles then actively penetrate through the midgut wall or tracheae into the insect body cavity (hemocoel) containing insect blood (haemolymph).
- Once in the body cavity, infective juvenile releases symbiotic bacteria from its intestine in the insect haemolymph.
- Bacteria start multiplying in the nutrient-rich haemolymph and infective juveniles recover from their arrested state (dauer stage) and start feeding on multiplying bacteria and disintegrated host tissues.
- Toxins produced by the developing nematodes and multiplying bacteria in the body cavity kill the insect host usually within 48 hours.
- These bacteria also produce a plethora of metabolites, toxins and antibiotics with bactericidal, fungicidal and nematicidal properties, which ensures monoxenic conditions for nematode development and reproduction in insect cadaver.
- Heterorhabditid and Steinernematid nematodes differ in their mode of reproduction. For example, in heterorhabditid nematodes, the first generation individuals are produced by self-fertile hermaphrodites (hermaphroditic) but subsequent generation individuals are produced by cross fertilization involving males and females (amphimictic). In Steinernematid nematodes with an exception of one species, all generations are produced by cross fertilization involving males and females
- Depending on availability of food resource, both EPN generally complete 2-3 generations within insect cadaver and emerge as infective juveniles to seek new hosts.
- Generally, life cycle of entomopathogenic nematodes (from infective juvenile penetration to infective juvenile emergence) is completed within 12- 15 days at room temperature. The optimum temperature for growth and reproduction of nematodes is between 25 and 30^{o}C.

Host-Finding Strategies of EPN:

The choice of an entomopathogenic nematode depends on the target insect-pest. In general, nematodes of the genus Steinernema are used against insect-pests whose immature stages spend most of their time at or near the soil surface, and they tend to be highly mobile. The host-finding strategy of most Steinernemais to ambush for highly mobile, surface dwelling hosts. In contrast, nematodes of the genus Heterorhbditis actively seek out or hunt for their prey, sometimes several inches below the soil surface, and stay in one spot for an extended period of time (Cambell and Gaugler 1993; Lewis 2002; Lewis *et al*. 1992).

Successful stories of EPNs used in soil and cryptic pests: Though the host range of EPN is very wide, significant gains have been reported against pests detailed below

Sweet potato weevils: Several weevils attack root and tuber crops, among them those of the genus Cylas and Euscepes species are the most important on sweet potato and cassava in Brazil and other South American countries. Most nematodes were more virulent to larvae than to pupae. S. carpocapsae and *H. bacteriophora* were shown to reduce weevil damage upto 83% and 81% on plants treated with the two species, respectively (Jansson *et al*., 1990).

Armyworms, Cutworms and Earworms: Several species of cutworms, *Agrotis* spp., *Spodoptera frugiperda, S. exigua and S. litorallis* cause serious problems to agricultural, vegetable and forage crops, worldwide. It is reported that cutworms are highly susceptible to a number of EPN species and strains (Morris & Converse, 1991). Larvae and pupae of armyworms are found to be very susceptible to EPN (Kaya & Grieve, 1982). Richter &Fuxa (1990) reported 33-43% infection of *S. frugiperda* by *S. carpocapsae* in field corn. They also found that spraying of nematodes onto corn ears caused up to 71% infection of *S. frugiperda*

The corn rootworms, *Diabrotica* spp., are important pests of corn. In North America *D. virgiferavirgi fera*and *D. barberi* are the two dominant species that cause significant economic losses to maize. Field studies, revealed that S. carpocapsae significantly reduced maize root damage (Ellsbury *et al*., 1996), reduced rootworm larval population (Jackson, 1996), and rootworm adult emergence (Ellsbury *et al*., 1996).

Black vine weevil in ornamentals: The black vine weevil, *Otiorrhynchus sulcatus*, is the major pest of the potted plant industry; worth over $10 billion annually worldwide.Studies showed that larval stage is most susceptible to EPNs (Bedding & Miller, 1981b). Suspensions of various Heterorhabditis species applied to the surface of soil within pots usually results in complete control.

Apple borer moth: The worst pest of China's one million hectares of apples is a moth (*Carposina niponensis*). *Steinernema carpocapsae* IJs sprayed beneath apple tree canopies just after the first summer rains (a signal for the caterpillars to migrate from their over winter sites deep in the soil to near the surface to pupate) results in well over 95% control

Fruit Flies: Several species of fruit flies (Diptera: Tephritidae) are important pests of fruits and vegetables throughout the world.Studies indicate that fruit fly larvaeare highly susceptible to entomopathogenic nematodes, but the pupae and puparia are generally less susceptible (Stark& Lacey 1999, Gazit *et al*. 2000). In field trials, an averageof 87% mortality of the Mediterranean fruit fly was obtainedwith an application of *S. carpocasae* (Mexican strain) at 500infective juveniles/ cm2 (Lindegren *et al*. 1990).

The codling moth *(Cydia Pomonella* [L.]) is a serious pest of apples worldwide and is of critical concern in commercial apple production. Codlingmoth larvae near the soil surface are more susceptible to nematode applications than those in cocoons on the tree trunk. Infective juveniles were applied at night before, during, or after a rainfall event using a backpack sprayer at a rate of 600 million infective juveniles/acre/20 gallons of water.

Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae), which is an important pest of maize, sorghum, cotton, and soybean is susceptible to *H. megidis* (Molina–Ochoa *et al*., 2003b). White grubs, which are pests of maize, beans, sorghum, wheat, potato, tomato, chili, pineapple, mango, sugarcane, etc., may be managed by a combination of H. bacteriophora and an entomopathogenic fungus, *Metarhizium anisopliae* (Metch.) (Ruiz-Vega and Aquino-Bolaños, 2002). The lethal time to kill 50% (LT50) of the white grubs was 2.3 weeks. Moreover, *S. feltiae* controlled white grubs in blue agave plantations.

Rhinoceros grub *Oryctes rhinoceros*: Hoy (1954) reported, EPN is effective against soil dwelling stages of pests, spraying infective juvenile suspension in breeding sites is recommended for effective control of the pest. (Gaugler and Kaya, 1990). Pathogenicity trials at Central Plantation Crops Research Institute indicate that *H. indica* isolate is more virulent to O. rhinoceros than steinernema.

Red palm weevil, *Rhynchophorus ferrugineus*: EPNs Heterorhabditis sp. were found to be pathogenic against the larvae and adults of *R. ferrugineus.*

Cardamom Root Grub, *Basilepta fulvicorne*: A native species of EPN, *Heterorhabditis indica* (strain ICRI 18) extracted from cardamom soil, was found to be highly pathogenic and virulent on cardamom root grub. EPN was found to reduce 70-100% of the pest in field condition.(Varadarasan, 2013)

EPN has been tested on various pests under field conditions. It is highly pathogenic on lepidopteron pests attacking Brinjal, Cabbage etc. Sunanda *et al* (2012): Studies on Diamondback Moth (DBM), *Plutella xylostella* (Yuponomeutidae). Reported maximum (55.00) per cent mortality of DBM with 1billion IJs/plot followed by (42.50) @ 0.5 b IJs/plot and (36.00) @ 0.25 b IJs/plot respectively,

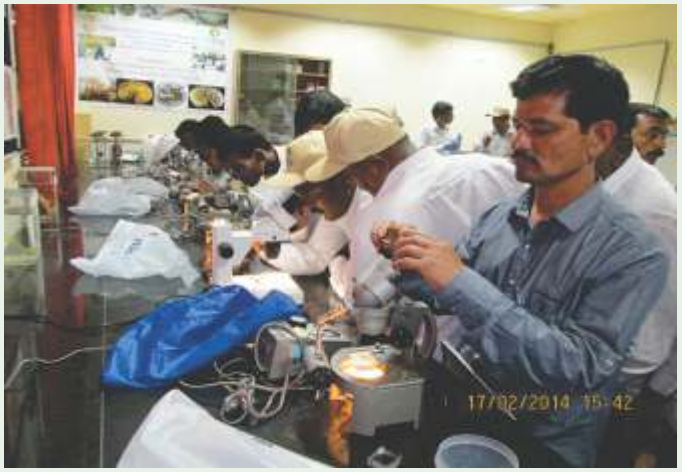
Sarav *et al* (2008) tested the pathogenicity of a local isolate of *Steinernema carpocapsae* against 3rd, 4th and 5th instar larvae of, *Spodoptera litura*.Cent per cent mortality was obtained after 96 hrs.in all instars at all doses.

Umamaheswari *et al* (2006) tested efficacy of *Heterorhabditisindica* and *Steinernema glaseri* on *Spodoptera litura* under glasshouse and microplot conditions on black gram (*Vigna mungo*). The nematodes were found effective at all the doses tested: 1.25x109, 2.5x109 and 5x109 infective juveniles (IJ)/ha. Insect mortality increased with increasing dosage levels and exposure time. The maximum mortality was observed with *H. indica* at 5x109 IJ/ha after 72 h of treatment under glasshouse (75.6%) and microplot (50.6%) conditions. The pod damage was also found minimum with *H. indica* at 5x109 IJ/ha both under glasshouse (27%) and microplot (34.33%) conditions. *H. indica* was found more effective than *Steinernema glaseri* in the management of *S litura.* Native strains were tested for their virulence against common cutworm, *S. litura*. (Umamaheswari *et al* 2004) *H. indica* (TNAU-EPN-Hi 1 to 6), *S. siamkayai* (TNAU-EPN-St 1 to 3) and *S. glaseri* (TNAU-EPN-Sg), *H. indica* isolate TNAU-EPN-Hi-3 was highly virulent against *S. litura* (LC50-3.53 IJ/larva) and caused 50% mortality of *S litura* larvae in a minimum time of 34.52 hrs.

Comparison between chemical pesticide management of root grubs & management with EPN:

For management of white grub in sugarcane Phorate 10G @ 25kg/ha or Carbofuran 3G @ 25kg/ha or Quinalphos 5G @ 25kg/ha or Carbaryl 4G granules are applied to soil. Chlorpyriphos 20EC @ 10ml/l is used for drenching, 500 liters a solution is used for drenching for one hectare. For management of white grub in sugarcane chemical management will cost Rs. 1800 /ha for each application of either phorate or carbofuron or carbaryl. As it requires 3 sprays for entire season of the crop the total cost of chemical management for root grub in sugarcane will be Rs.5400 per hectare. However, the management of root grub by using EPNs (If produced at farm level) will cost less than Rs. 1000-1500/ha @ 10 billion EPN for 3 sprays. The effect of chemical application will persist for a short period, but EPNs will remain active until all the host is killed completely and they undergo resting till the new hosts are found resulting in recycling. The chemical management of root grubs results in pollution of soil and water and also kill other rhizosphere engineers in soil such as earth worms. EPNs have target specific action and act only on white grubs and are safe to animals, human beings and environment.

Efforts of NIPHM in popularizing EPN as potential bio agents in the country in different crops



In spite of the significant benefit of EPN in managing insect pests, particularly soil borne insects, utilization of EPN in our country is very low. There is a need for building awareness on role of EPN as biological control agents among the extension functionaries and farmers. NIPHM has started to popularize the use of EPN with special focus on management of root grub in sugarcane. Root grub is major pest which feeds on sugarcane roots. It is damaging thousands of sugarcane fields in Maharashtra NIPHM steps to popularize EPN as an alternative strategy for root grub management in sugarcane. It opened a new chapter in management of root grub this area. Initially EPNs culture was supplied to sugarcane belt of Sangli district. Best practices of EPNs application were demonstrated. Farmers were also trained in EPN mass rearing technology for root grub management. NIPHM is with the assistance of district agriculture officer successfully demonstrated in farmers' fields the way forward in mitigating the menace caused by root grub with EPN. Based on the success in management of root grub with EPN, farmers co-operatives in Sangli& Kolhapur districts have established a laboratory for in vivo production with technical support of NIPHM.

Mass production of EPNs:

Entomopathogenic nematodes are currently mass-produced by either *in vivo* or *in vitro* (solid and liquid culture). Methods *In vivo* production system is based on the White trap (White, 1929), which take advantage of the IJ's natural migration away from host cadaver upon emergence. The most common insect host used for *in vivo* production is the last instar of the greater wax moth (*Galleria melonella*), because of its high susceptibility to most nematodes, ease in rearing, wide availability and ability to produce high yields. Insect hosts are inoculated on a dish or tray lined with absorbent paper. After approximately 2-5 days, infected insects are transferred to the White traps.

In vitro culturing of EPNs is based on introducing nematodes to a pure culture of their symbiont in a nutritive medium (contains peptone, yeast extract, eggs, soy flour and lard). A liquid medium is mixed with foam, autoclaved, and then inoculated with bacteria followed by the nematodes. Nematodes are then harvested within 2-5 weeks by placing the foam onto sieves immersed in water.

Formulation of EPNs:

Nematodes can be stored and formulated in different ways including the use of polyurethane sponge, water-dispersible granules, vermiculite, alginate gels, micronized vermiculite, and an aqueous suspension of nematodes and baits. Bait formulations and insect host cadavers can enhance EPN persistence and reduce the quantity of nematodes required per unit area. Formulated EPNs can be stored for to 7 months depending on the nematode species and storage media and conditions.

Application of EPNs: can be applied through the following methods

- Foliar application; Soil application; Broadcasting; Spray; Drip Irrigation; Drench Optimum moisture (30% field capacity) temperature (25-30°) soil type (lighter soils) should be checked
- **Dosages:** Use of 1billion nematodes per acre as soil application at planting time is found to be highly effective in managing root grub in sugarcane, 2-4 infected cadavers of *Galleria mellonella* per plant is optimum.

Limitations of existing techniques & formulations

- The in vivo multiplication method viz. White trap method (1927) is utilized in laboratories, glass house studies etc.
- Though the technology is simple the short comings are
- It requires specialized training.
- Requirement of huge space and large quantity of glass wares for mass production.
- Requirement of close monitoring for ensuring infection of the host,
- Requirement of high cost of production,
- Requirement of good laboratory facilities for large scale mass production
- Additional efforts required for preparation of EPN formulation.

New technologies developed by innovators of NIPHM

Dr. Korlapati, Satyagopal IAS and Dr. B.S. Sunanda of NIPHM, explored the possibilities for simplifying the *n-vivo* technique for mass multiplication of EPN for laboratory use & commercial (field) use. New Technique "New Method for In vivo Culturing of Entomopathogenic Nematodes" was developed for low cost simpler means rearing of EPN for laboratory use and another technique "A Novel Technique for Mass production and Formulation of Entomopathogenic Nematodes"was developed for mass production of EPN & formulation at the farm level or for commercialization.

The salient features of the new technology are:

1. It is an integrated unified method for mass production of EPN as well as production of EPN formulation.
2. The new method is a low cost method requiring less capital investment and labour.
3. The new method requires less space for production. The materials used are very low cost and easily available and the method does not require costly items like Petri plates, What man filter paper etc. (The new method utilizes low cost inputs viz., plastic tub, sponge sheet, muslin cloth and sodium alginate).
4. In the new method the host larvae are infected at least 24 hours earlier than in White trap method & is a quicker method for mass production of EPNs. Emergenceof IJs will commence from 3rd or 4th day earlier by 2 to 3 days than in White trap method.
5. The new method does not require periodic inspection to prevent the host larvae to escape from infection from IJs.
6. The new method will also result in higher yield by about 15-25%.
7. There will be no need of harvesting the IJs on daily basis to avoid crowding effect. All the IJs can be harvested in a single day since there will be no crowding effect in the new method.
8. The new method can be learned by farmers easily.
9. Easy to scale up and maintain the operations.
10. 100% infection of insect larvae is ensured by infective juveniles in the new method
11. The carrier material keeps the infective juveniles viable up to more than 3 months
12. An easy to mass produce, highly effective, durable bio-control formulation.

There is a need for popularizing the use of EPN for insect pest management both soil borne and foliar insect pests. Utilization of EPN by the farmers can be increased only when production of EPN is feasible at farm level besides reduction in cost of production for commercial operators. The agricultural extension officers should be imported with knowledge on the role of EPN in insect pest management. Reliance on EPN for management of soil borne insect pests will also result in significant reduction of chemical pesticides and ensure that soil health of agroecosystems is protected. NIPHM is committed to build the capacity of different stake holders to popularize means production of EPN and their utilization as an alternative to excessive reliance on chemical pesticides, the usage of which is detrimental to soil health.

Special event: National Workshop cum Exhibition on "Popularization and commercialization of Low Cost Agricultural Technologies" held at NIPHM, Hyderabad (From 4-6 February, 2015)

Significant gains have been made in enhancing agriculture production to ensure food security in the country, overcoming the challenges of increased population and not so remunerative agricultural systems. Technological innovations have played a significant role in realizing the above gains. Innovations and products which aim at promoting sustainable agriculture have been developed by scientists, agricultural functionaries, enterprising individuals and progressive farmers. However, many of the innovations/products have not reached the farm level through they are low cost and can promote sustainable agriculture.

To bridge the gap between the innovators & farmer and to bring the technologies to the door steps of the farmers a three day workshop on "Popularization and Commercialization of Low Cost Agricultural Technologies" was organized at NIPHM from 4th to 6th February 2015 in collaboration with MANAGE. This workshop provided a platform to the innovators to display and demonstrate their low cost agri-technologies.

Dr. K. Satyagopal, IAS, Director General, NIPHM inaugurated the workshop, addressed the gathering on the occasion and explained the genesis and objectives of the workshop.

Agricultural Scientists from ICAR and SAUs, Agriprenuers, NGOs and Progressive farmer Innovators from Delhi, Haryana, Gujarat, Maharastra, Chhattisgarh, Karnataka, Andhra Pradesh and Telangana States participated and demonstrated their innovations/ farm technologies at the workshop. Some of the innovations include multi-purpose drum seeder, solar operated light trap, stingless bee rearing/ production techniques, zero tillage maize rolling marker, solar operated sprayers, bicycle weeder, low cost vermin-composting, granule application gun, insect sampling, collecting and rearing devices, low cost pheromone traps, vegetable electric drier, Chrysocard production, wheel hoe, cono weeders, wet land power weeders, bio-fermentors for mass production of microbial products etc.

About ten agriprenuers of MANAGE representing various States have showcased their technologies and consultancies services offered by them. These include bio-control attractants, baiting and repellent technology, seed grain preservation, soil pH adjustment technology, equipment for dispensing granules/ fertilizers with precision, double action compost, low cost chaff cutter, Bajra lassi production, pre-harvest nutrient enhancers, paddy weeder, portable sprayers, high clearance solar sprayer, sugarcane bud chipper, charger pumps, solar operated farm implements, bamboo precision farming, banana fibre extraction and microbial and botanical pesticides.

International (ICRISAT) and several National institutes such as IIRR, IIOR, NIRD, IICT, MANAGE, WALMTARI, Agricultural Universities of Telangana & Andhra Pradesh, State Cooperatives (AP AGROS), NGOs (Pallesrujana) and private organizations also participated in the workshop. Several high yielding pest resistant crop seed varieties, low cost crop production techniques, pheromone techniques for pest monitoring and control, low cost soil testing kits, smart techniques to improve water use efficiency were displayed and demonstrated at the workshop. Castor based rodent repellents, micro nutrients, low cost water harvesting tarpaulin structures, shade and green house nets, vegetable seeds and gardening tools were also made available to the visiting farmers through private entrepreneurs.

NIPHM also displayed and demonstrated various pest management technologies developed at the Institute. These include on farm production technologies of microbial bio-pesticides (*Trichoderma, Pseudomonas, EPN and Mycorrhiza)* and bio-control agents (Trichogramma, Bracon, Goniozus, Chelonis, Spiders, Reduvids), rodent taxidermy specimens, community trap barrier system, local traps, burrow smoker, sack granule applicator, natural enemy friendly light trap, trolly mounted solar sprayers, low volume back pack sprayer, disc weeder, hand shaking duster, high moisture grain storage bin, solar drier, low cost media for culturing of microbials, low cost fruit fly traps and lures etc.

The event was covered by print and electronic media. A team of experts comprising scientists from ICAR and SAUs evaluated the technologies displayed at the workshop.

The workshop was attended by about 2100 farmers (including 300 women farmers) from Telangana, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra.

Special event: Income Enhancement through establishment of Eco friendly IPM Model Villages at Tamil Nadu

Department of Agriculture, Tamil Nadu in collaboration with NIPHM has taken an initiative to develop an integrated approach for Plant Health Management through increased use of biopesticide. Under this initiative the Government of Tamil Nadu has launched a programme to enhance the income through establishment of Eco friendly IPM model in 150 villages covering 56 blocks in 16 districts.

The programme was inaugurated by Shri. P. Vaithilingam, Honourable Minister of Housing Urban Development and Agriculture, Tamil Nadu, which was presided over by Smt. Santha Sheela Nair, IAS (Rtd.), Vice Chairperson, State Planning Commission, TN, Dr. K. Satyagopal, IAS, DG, NIPHM, Shri. Rajesh Lakhoni, IAS, Secretary Agriculture, Tamil Nadu and Dr. M. Rajendran, IAS, Director Agriculture, Tamil Nadu attended. The programme was followed by two days training on on-farm production of insect predators, parasitoids, microbial pesticides, bio-fertilizers (mycorrhiza) and preparation of low cost fruit fly traps and lures. About 298 Officials from Department of Agriculture, participated in the programme.

Off campus training in "On-farm production of biocontrol agents and microbial biopesticides to promote AESA based PHM in conjunction with Ecological Engineering for pest management" (16- 18 Feb)

To promote large scale implementation of low cost & simple technologies that are developed and refined by NIPHM on large scale NIPHM has signed the MOU with various KVKs and NIPHM is organizing Off-campus Farmer's Training programmes. A total of 50 progressive farmers and agricultural supervisors participated in the training organized at KVK Sangaria, (Rajasthan). Farmers were provided hands-on-practices in low cost techniques of mass multiplication of *Spider, Reduviid, Bracon, Trichogramma, Trichoderma, Pseudomonas*, and Mycorrhiza. Mother cultures of these biocontrol agents and biopesticides were provided to KVK

and farmers by NIPHM for method demonstration, further multiplication and application at farmers' fields. Farmers were given insights on the importance of soil health management Agro Ecosystem Analysis (AESA) and ecological Engineering for Pest Management for sustainable agriculture.

Dr. Anup Kumar, Programme Coordinator KVK thanked Dr K Satyagopal IAS, Director General NIPHM for promotion of sustainable agriculture through AESA and Ecological Engineering for Pest Management and supporting the KVK Sangaria in organizing this programme. Dr. Anup Kumar assured to implement and popularize the concept of Ecological Engineering for Pest Management and on-farm production of biocontrol agents & biopesticides at farmers' fields. About 10 farmers' Self-Help Groups have established the on-farm production units for Trichoderma.

Creating awareness among farmers through popular articles in various local news papers.

Popularization of Low-cost Traps and Lures for Fruit fly control

Fruit flies are one of the economically important plant pests affecting fruits & vegetable production in India. It is estimated that 20-30 % loss in fresh fruits & vegetables is due to fruit flies. In addition to causing direct damage, fruit flies are major bottle neck for export of high value fruits & vegetables into developed countries.

Area wide control of fruit flies is one of the important approaches in management. Though many types of commercial traps & lures are available in the market, they are not well accepted & adopted by large section of farmers.

NIPHM has developed a very low cost trap & lures that a farmer or farmer association can prepare themselves at very low cost. This concept has been very well received by both Agricultural Extension officials as well as progressive farmers in the "Workshop on Low –cost technologies" at NIPHM during 4-6 February 2015.

Fruit fly Management: Low-cost Traps & Lures Preparation

The above mentioned lures are to be prepared in well ventilated room wearing disposable hand gloves. Separate containers and measuring jars are to be used while preparing the lure mixtures. Cost of ME and Cue lure is approximately Rs.35/- for one bottle trap. 6-10 traps are required per acre for best control. Lures are to be replaced once in 30-40 days

For details visit website www.niphm.gov.in or contact: Scientific Officer, Plant Biosecurity Division, NIPHM, Hyderabad, Telangana. Mobile:08978778729. Email: sopraniphm2-ap@nic.in

Phytosanitary Treatments - MBr and ALP (12th to 27th January)

Phytosanitary Treatments often serve as one stop solution at the end point of export. The increased trade in agricultural products is accompanied by the increased risk of entry of inadvertently transporting quarantine pests to countries or regions. Quarantine pests can seriously disrupt trade of fresh agricultural products not only between countries, but also between geographical areas within countries unless accepted post-harvest quarantine treatments are available. Phytosanitary treatments are helpful in safeguarding biosecurity and also in gaining market access.

NIPHM is one of the notified Institutes under Insecticides Rules 1971 Chapter III -10, (3a) (iii) for imparting training for commercial pest control operators on fumigation using Methyl bromide and Phosphine. The training provides hands on experience on Methyl Bromide and Aluminium Phosphide fumigation, handling of equipment involved in fumigation, and various safety precautions while doing the fumigation process. The participants learnt the use of approved fumigants, their physical and chemical properties, mode of action and safety precautions to be followed while handling fumigants, principles of fumigation, monitoring the fumigant concentration, appropriate use and maintenance of fumigants, and accreditation procedures for Methyl Bromide and Phosphine fumigation. The participants had hands-on experience on use of safety equipments, fumigation equipments and calibrations to improve their skills and competency in doing Methyl Bromide and Phosphine fumigation.

Orientation Training for the International participants and Officers of NI MSME, Hyderabad (16th February)

One day orientation programme for International participants and officers of National Institute of Micro, Small and Medium Enterprises (an organization under Ministry of MSME, Govt. of India) was organized on 16th February 2015. The delegates were given the broad view of Plant Biosecurity, WTO-SPS, IPPC and other international treaties in interactive sessions. The scope of IPR's in Plant Biosecurity was specifically discussed and elaborated. Total 21 participants including 10 international participants from Ethiopia, Tanzania, Myanmar, El Salvador, Bangladesh and Iraq were attended the programme.

Plant Quarantine Procedures for Import and Export (2nd to 6th February)

Training programme on Plant Quarantine Procedures for imports and exports was conducted from 2nd to 6th February, 2015. The training programme covered various aspects of international conventions, national standards and procedures to be followed while importing & exporting of plants & plant materials for propagation & consumption, germplasm, biocontrol agents, soil, peat and sphagnum. Trainees were imparted hands-on experience in on-line registration through PQIS.

Forced Hot Air Treatment (off – campus) (19th to 24th February)

Forced Hot Air Treatment (FHAT) is an important treatment employed in disinfestation of wooden packaging material as envisaged in ISPM-15 and NSPM-9. NIPHM organised an off-campus training course for the Officials of Indian Institute of Packaging (IIP), Ministry of Commerce, at Mumbai from 19-24 February, 2015. Ten officers were trained on the various intricacies of FHAT operations. In addition to class room lectures, a real time hand on training was imparted on an operational facility.

The participants learned about the economic and efficient designing of FHAT chamber, sources of heat, optimal heat delivery systems, importance of phytosanitary security of the commodity, pests associated with soft wood packaging material. The importance of compliance with regulations such as calibration and placement of sensors, identification of coldest point, reading temperatures at core and other sensor points, through audits etc. and practiced the skills related to documentation, analysis of facility to identify non-conformities, stamping of the commodity etc.

Orientation training on Market Access –Supply Chain Management for Horticulture Produce (13th to 14th March)

A two days orientation training from 13th to 14th March 2015 was organized at NIPHM for the participants of MANAGE, Hyderabad. Total 23 participants from various states department of agriculture and agriculture marketing were attended the training programme. The training covered various aspects of Biosecurity, plant quarantine and phytosanitary requirements for the export and import, phytosanitary treatments, Market access issues etc. Trainees were also given hands-on exposure of stored grain pests, fruit flies and field pests.

Capacity Building

Efforts by Government of Andhra Pradesh

Government of Andhra Pradesh came forward to adopt the simple, low-cost bottle trap and lure for effective control fruit flies in major mango growing belts. One day training-cum- awareness programme was organized at 5 locations Tuni, Eluru, Nuzividu, Bangarupalem and Koduru to popularize the concept among the farmers. Nearly 400 farmers participated in the awareness programme and 50 Horticulture Officers were trained on preparation of lures and traps. The Govt. of Andhra Pradesh is keen to adopt low-cost technologies for area-wide control of fruit flies specifically in Mango growing belts.

On-farm Production of Biocontrol agents and Microbial Biopesticides to promote AESA based Plant Health Management in conjunction with Ecological Engineering for Pest Management (28th to 30 Jan) for Tobacco Growers

NIPHM has developed simple methodologies with the available low cost inputs for the mass production of biocontrol agents and microbial biopesticides at farm level. Fourteen tobacco growers from Andhra Pradesh were imparted skills and hands-on-practices in on-farm production of biocontrol agents Parasitoids viz., *Trichogramma, Chelonus, Goniozus, Bracon* and Predators such as *Reduviids, Spiders* and Microbial Biopesticides such as *Trichoderma, Pseudomonas,* Entomopathogenic fungi and Entomopathogenic Nematodes (EPN), Vesicular Arbuscular Mycorrhiza (VA M) and vermicompost.

Fundamentals of PHM for Plant Health Doctors (20th Jan to 9th Feb)

This training programme was organized to create a pool of master trainers "Plant Health Doctors" with enhanced skills in the area of field and laboratory diagnosis of biotic and abiotic problems in different crops and offer environmentally sustainable solutions.

The nine officers were trained in identification of plant health problems (abiotic & biotic), AESA based Plant Health Management in conjunction with Ecological Engineering for pest management. They were taught about promotion of rhizosphere engineering in sustainable agriculture, GAP principles and practices, Integrated soil nutrient and weed management, Integrated Rodent Pest Management, Pesticide application technology, Safe and judicious use of pesticides. Hands-on experiences were provided on On-farm production of Biocontrol agent (predators & parasitoid) & microbial biopesticides anolg with biofertilizers.

AESA based Plant Health Management in conjunction with Ecological Engineering for Pest Management: RKVY-Project (Meghalaya) (25th February to 17 th March)

This training programme was organized under the RKVY project on "Adoption of Agro-ecosystem Analysis based Biointensive Pest Management Strategies and Promotion of Decentralized Biocontrol Agents and Biopesticides Production Centres through Farmer Self Help Groups in Meghalaya". The aim of the programme is to create a pool of master trainers in AESA based Plant Health Management in conjunction with Ecological Engineering for Pest Management with enhanced skills in the area of field and laboratory diagnosis of biotic and abiotic problems different crops and offer environmentally sustainable solutions as well as on-farm production of biocontrol agents and microbial biopesticides. Twelve officers were imparted skills in identification of plant health problems (abiotic & biotic), AESA based Plant Health Management in conjunction with Ecological Engineering for pest management. They were taught about promotion of rhizosphere engineering in sustainable agriculture, GAP principles and practices, Integrated soil nutrient and weed management, Integrated Rodent Pest Management, Pesticide application technology, Safe and judicious use of pesticides. Hands-on experiences were provided on On-farm production of Biocontrol agent (predators & parasitoid) & microbial bio-pesticides & biofertilizers including VAM and vermicomposting, fruit fly traps.

On-farm Production of Biocontrol Agents and Microbial Biopesticides to promote AESA based Plant Health Management in conjunction with Ecological Engineering for Pest Management (09th to 18th March)

The Officers from SAUs and State Department of Agriculture/ Horticulture were imparted skills and hands-on-practices in on-farm production of biocontrol agents, Parasitoids viz., *Trichogramma,Chelonus, Goniozus, 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.

Crop-specific Agro-ecosystem Analysis and Ecological Engineering for Pest Management in Rice/Pulses
(10 Dec 2014 to 08 Jan 2015)

A 30-day training programme on 'Crop-specific Agro-ecosystem Analysis and Ecological Engineering for Pest Management in Rice/Pulses' was conducted. Participants were imparted training on practice of new pest management concepts such as agro-ecosystem analysis (AESA) based PHM in conjunction with ecological engineering for pest management in rice ecosystem. They also learned the concepts of insect zoo, plant compensation ability etc. They were imparted training on mass production of important biological control agents such as *Trichogramma*, *Bracon*, *Chelonus*, *Chrysoperla*, *Goniozus*, spider, reduviid bug, entomopathogenic nematodes etc. and host insects such as *Corcyra*, *Helicoverpa* and *Spodoptera* as well as mass production of microbial biopesticides such as *Trichoderma*, *Pseudomonas* and entomopathogenic fungi such as *Beauveria*, *Metarhizium*, *Nomuraea*, *Lecanicillium* etc. Trainees have also learned the Farmers Field School methodology, its structure, curriculum, groups dynamics etc. as well as rice cultivation under System of Rice Intensification (SRI).

Refresher Program on New Molecules of Pesticides
(3 to 12 February)

The participants were imparted training in the analysis of new pesticide molecules giving major focus on instrumental methods of analysis besides refreshing their knowledge of spectroscopy (UV-VISs & FTIR), chromatography (GC& LC), their operation and maintenance. A special emphasis was given on trouble shooting during the analysis of Gas Chromatographs and Liquid Chromatographs.

Method Validation in Pesticide Residue Analysis and Measurement of Uncertainty
(4 to 9 March)

The participants were imparted training in the principles & techniques of method validation. They were introduced to terminologies used in the measurement of uncertainty, identification and measurement of uncertainty, practical exercises in measurement of uncertainty in the analysis. Principles of method validation, hands on experience on method validation using different sample matrix was provided.

Pest Risk Analysis
(16th to 21th February)

To create the expertise in conducting Pest Risk Analysis, this training programme was organized. Nineteen 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.

Pesticide Formulation Analysis(PFA)
(20 Jan to 26 March)

This training is mandatory for quality control chemist /insecticide analysts working in pesticide testing laboratories under Rule 21(b) of insecticide Rules 1971. The participants from various Sate Pesticide Testing Laboratories attended 66 days program and were trained on pesticide management, Insecticide Act 1968 and Rules 1971, pesticide formulations, physico- chemical properties of pesticides, principles of volumetric analysis and different type of titrations, volumetric and instrumental methods of analysis for quality control of pesticides. The participants were also trained in operation and maintenance of UV-VIS & FT IR spectroscopic methods and Gas Chromatographic & Liquid Chromatographic methods. The participants were also exposed to laboratory quality system management and internal audit as per ISO/IEC 17025-2005.

Documentation for NABL
(6 to 9 January)

The Insecticide Analysts working in State Pesticide Testing Laboratories who have started implementing Good Laboratory Practices in pursuit of acquiring NABL Accreditation were imparted the skills in preparing different kinds of documents, forms and formats. The participants were given introduction to documentation, documentation on organization and its structure, infra structure & housekeeping etc, methods of analysis and SOPs, Store Procedures and records for procurement etc., equipment, AMCs and calibration etc., flow of work (sample receipt to disposal), quality control, ILC and PT, internal audit and corrective action, records as per the requirement of laboratory quality system management and internal audit as per ISO/IEC 17025-2005 so as to help the participants to prepare for the accreditation of their laboratories.

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Capacity Building

Inspection Sampling and Prosecution Procedures under Insecticide Act 1968 (From 21 to 28 January)

Insecticide inspectors from various state departments of agriculture who are appointed under the insecticide act 1968, for enforcement of quality control of pesticides were trained to equip themselves with the salient features of the act, rules and their implementation giving emphasis on the role of quality control inspectors, duties & responsibilities. The procedures for sampling, filling mandatory forms & dispatching of samples to SPTL & RPTL interpretation of the analytical reports, procedures for prosecution etc., were dealt in detail.

Refresher Training Programme on Agripreneurship in Sustainable Agriculture under Agri-Clinics and Agri-Business Centres Scheme (16 to 20 Feb. 23 to 27 Feb.; 16 to 20 March; and 23 to 27 March)

Four Refresher Training Programmes of 5-days duration on "Agripreneurship in Sustainable Agriculture under Agri-Clinics and Agri-Business Centres Scheme" were conducted. In these training programmes, 84 participants have been acquainted with the new concepts of pest management i.e. Agro-ecosystem Analysis for Plant Health Management in conjunction with Ecological Engineering for Pest Management. They have been given hands-on experience on mass production of various biological control agents, microbial biopesticides and biofertilizers. They were also trained in vermicompost preparation, seed treatment with microbial biopesticides (biopriming), fruit fly trap and lure preparation, pesticide application techniques, rodent pest management etc.

Farmers Field School Methodology (5 to 9 January)

Training on FFS Methodology was organized in which 9 officers from various states were imparted training in Concept of FFS, AESA Based PHM, role of Ecological Engineering in pest management, Biological Control & IPM concept. During the course, participant were also exposed to on farm production of BCA Biopesticides and mycorrhiza.

Good Agriculture Practices (GAP) (From 23 to 27 Feb.)

The training on GAP was organized in which nine officers from various states were imparted training in Concept of IndiaGAP, AESA, Ecological Engineering for pest management, living soil concept, IPM etc. During the course, participates have been exposed to on farm production of BCA and Biopesticides, mycorrhiza, Phytosanitary and Pesticides & Food Safety issues in relation to GAP.

Training in Rhizosphere Engineering (From 16 to 20 February)

A training course on Rhizosphere Engineering was organized wherein 7 participants from different states were trained in AESA, ecological engineering, living soil concept, improvement of rhizosphere by enhanced soil microbial activities and hands-on-practical's. During the course, participants were also exposed to techniques of on farm production of mycorrhiza, BCAs, Biopesticides, etc.

National Workshop on 'Farmers Field School' was organized jointly by NIPHM and MANAGE from 6 to 7 Feb. 2015 at NIPHM. The workshop was attended by 58 senior extension officers from different States. During the workshop, it was deliberated gaps between the FAO concept for organizing Farmers' Field School (FFS) and actual methodologies adopted by field functionaries for conducting FFS in rendering Farm Advisory services shall be reduced to nil. It was also discussed to assess the possibilities of broad basing extension activities through Farmers' Field Schools, and suggested measures for strengthening the skills of extension functionaries in organizing Farmers' Field School.

Appropriate Pesticide Application Techniques and Farm Level Storage Structures (02 to 09 January)

Appropriate pesticide application techniques and equipment selected for applying pesticide are vital to the success of pest control operations. This complex process requires a high level of knowledge and understanding, practical skills, well maintained and calibrated equipment, and probably most importantly a desire or will to protect the environment. The main purpose of pesticide application technique is to achieve maximum efficacy with minimum side effects on non-target organisms. The knowledge on farm level storage structures enhances the farmers to safely store the produce and also can sell it when there is a better market price. The participants gained knowledge on use of high volume, low volume and ultra-low volume spraying techniques, nozzle selection, calibration of the equipment, pesticide formulation and compatibility, judicious use of pesticides, storage problems of food grains at commercial / farm level. The participants learnt the importance of suitable equipment selection and operation of the equipment, selection of suitable nozzles and calibration of the sprayers. A field visit was organized for the participants to Puppalaguda village to create awareness on various activities of the institute.

Safe and Judicious Use of Chemical Fertilizers and Chemical Pesticides (02-09 March 2015)

Pesticides are poisonous substances and they can cause harm to many living organisms, therefore their use must be very judicious. The application techniques ideally should be target oriented so that safety to the non-targets and the environment is ensured. Spray drift and the risks associated with the application of pesticides in agriculture are attracting increasing attention. In this regard, safe use of chemical fertilizers and chemical pesticides, appropriate selection of spraying technique such as high volume, low volume, ultra-low volume and proper selection of nozzles, dosage requirements plays a vital role in pest management apart from judicious use of pesticides.

In this program, the participants learnt to select the right type of sprayer & nozzles based on high, low and ultra-low volume techniques, based on droplet size, calibration of nozzle and calibration of sprayers, dosage requirements, label claim of pesticides, precautions to be taken while spraying and storing the pesticides. Practical knowledge on care and maintenance of the sprayers is also covered. A field visit was organized for the participants to Aziznagar village to create awareness on various activities of the institute.

Around the World

Mediterranean fruit fly: An important looming threat to India through fruit import

Mediterranean fruit fly (*Ceratitis capitata*) is native to African Continent, considered as one of the world's most economically important pest of fruit crops. It is an invasive pest, tolerant to cooler climate, in addition to causing economic damage on wide range of plants, it has become an impediment for export of fruits from countries where it is prevalent.

Hosts: Main hosts for Medfly are Citrus, Coffee, Apple, Stone fruits; Guava, Cocoa, Bell pepper etc., Fruits imported from countries where it is known to occur serve as pathway for entry of the pest into India. Most of the susceptible host crops are cultivated in India and the Medfly poses an imminent threat for fruit cultivation as well as export of fruits from India.

Regulations: As of now, the commercial import of fruits are regulated through Plant Quarantine (Regulation of Import into India) Order, 2003 with specific phytosanitary measure such as either procurement from pest free area or cold treatment to prevent the pest from countries wherever the pest is reported to occur and no such conditions from countries where the pest is not known to occur. The pest is now reported in countries such as Chile, Puerto Rico and some parts of Argentina which were earlier declared as pest free areas. Therefore regulations related to fruit imports need to be reviewed to prevent the pest entry.

Invasiveness: Medfly has invaded into many countries in Europe, parts of West Asian Countries, Australia, North America, Central and Southern America's. Many countries have taken serious measures to eradicate the pest due to its invasive nature and the devastating effect on agricultural and horticultural commodities and the market access issues.

Impact: Damage to fruit crops is frequently high and may reach 100%. In Central America, losses to coffee crops were estimated at 5-15% and the berries matured earlier and fell to the ground with reduced quality. In Mediterranean countries, it is particularly damaging to citrus and peach.

Life Cycle: Under optimum conditions, Medfly can complete its life cycle (adult, egg, larvae & Pupae) within 21 days. Medfly is found to be most active during optimal temperature *viz.* 20-25˚C. Adult activity is reduced or suspended at higher temperatures around 30°C, and cannot survive in sub-zero winter temperatures. Eggs are deposited under the skin of fruit which is just beginning to ripen. Several females may use the same deposition hole with 75 or more eggs clustered in one spot. Larvae hatch within 2-4 days (up to 16-18 days in cool weather). The kind and condition of the fruit often influence the length of the larval stage. In citrus fruits, especially limes and lemons, it appears to be longer i.e. 14 to 26 days to reach maturity in a ripe lemon, as compared with 10 to 15 days in a green peach. Larvae leave the fruit and pupate in the soil or whatever is available. The adults emerge after 6-13 days (24-26°C; longer in cool conditions) and they live for up to 2 months.

Monitoring: India is free from Medfly and import large quantity of fruits such as Apple, Citrus, Peach, Grape, Pear, Guava etc., from various countries, which could serve as pathway for the entry of this pest into India. It is important to monitor for Medfly at strategic hot spots such as Delhi, Mumbai, Chennai, Kolkata, Bangalore, Hyderabad etc. where most of the fruits are imported and consumed. Adult Medfly male can be trapped by using 'Trimed lure' or 'Capi-lure'. The female and male can also be trapped by using food-baits. Early detection and prompt mitigation action can help in preventing establishment of the pest at its entry level itself. The Plant Quarantine officials, Agriculture extension official and Entomologists need to keep a vigil to prevent the entry of this pest.

Alumni Forum

Awareness Among the Farmers through KVK, Jhalawar, Rajasthan on Low Cost Traps & Lures

The subject Matter Specialist (SMS) Mr. Meena from KVK, Jhalawar, Rajasthan who attended training programme at NIPHM has initiated the awareness & popularization of low cost traps and lures among the farmers in collaboration with NIPHM. The fruit flies are major problems in Mandarin, Pomegranate and cucurbitaceous crops at Jhalawar, Rajasthan. The NIPHM provided the traps and lures and Mr. Meena has organized a number of awareness programmes for more than 850 farmers and students on low cost lures & traps in managing fruit flies in different crops.

Awareness Among Farmers at Azhikode, Kerala

Mr. C.V. Jidesh, Agricultur Officer (Agri), Azhikode, Kannur, Kerala, a participant in the PGDPHM at NIPHM (2014-16 batch) was trained in preparation of low-cost bottle trap and lures for fruit fly control. He has taken initiative to popularize the use of low-cost bottle trap and lure among the farmers in in Azhikode, Kerala. The demonstration has drawn attention of many farmers due to the trapping of very high numbers of fruit flies. As per the request of number of farmers NIPHM provided low cost lures and traps, which received a positive and enthusiastic response from farmers in adopting the low cost technology.

Arbuscular Mycorrhiza-effect on Growth and Yield Parameters in Uma and Njavara Paddy varieties (Deepti M, Kerala PGDPHM student)

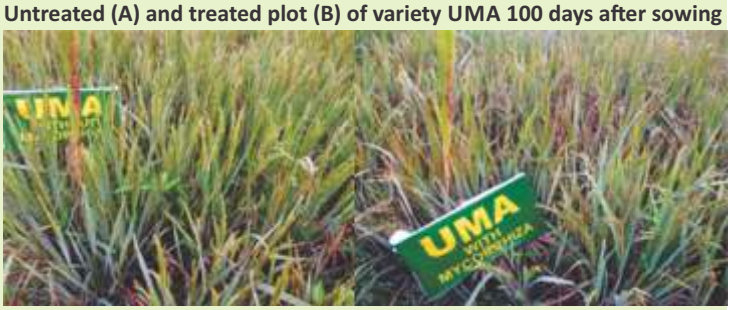
Arbuscular Mycorrhiza (AM) fungi are a symbiont which increases growth, enhances uptake of water, nutrients and enhance drought and disease tolerance in crop plants. In this regard, a field trail was carried out at in Katayikonam, Kazhakoottam and Plavode ela Pulimath by Smt. Deepti Manjula, Off Campus PGDPHM student Department of Agriculture Kerala to evaluate the effect of Arbuscular Mychorrhiza on two rice varieties i.e. 1) Njavara a local Kerala variety and 2) Uma (MO-13).

The mycorrhizal culture was applied to the nursery at the time of sowing at the rate of 100 g per sq.m. 30 days after sowing it was noted that there is a profound increase in root length (50%), plant height (50%) and number of leaves (40%) in treaded plants with mycorrhiza as compared with untreated plants.

The comparative data of the trail reveal that application of VAM enhanced root growth, number of leaves, tillers, panicles, and the plant height in both the varieties.

Untreated (A) and treated plot (B) of variety UMA 100 days after sowing

Untreated (A) and treated plot (B) of variety UMA 100 days after sowing



Growth parameter	Njavara (at the time of harvest)			UMA (100 days after sowing)		
	C	T	Increase over control (%)	C	T	Increase over control (%)
Root length (cm)	15	18	20	11	14	27.3
No. of tillers	27	30	11.1	12	19	58.3
No. of panicles	16	22	37.5	13	18	38.5
No. of leaves	65	93	43.1	65	93	43.1
Plant height (cm)	125	144	15.2	83	90	8.4

राजभाषा कार्यान्यवन समिति की चतुर्थ बैठक (वर्ष 2014-15) एवं एक दिवसीय हिन्दी कार्यशाला का आयोजन

दिनांक 23-01-2015 को डॉ. के. सत्यगोपाल, भा.प्र.से., महानिदेशक, एनआईपीएचएम की अध्यक्षता में दिनांक 01-10-2014 से 31-12-2014 तक की हिन्दी तिमाही प्रगति रिपोर्ट की समीक्षा हेतु राजभाषा कार्यान्यवन समिति **(राकास)** की चतुर्थ बैठक आयोजित की गई। महानिदेशक ने धारा 3(3) के अनुपालन को सुनिश्चित करने तथा अधिकारियों एवं कर्मचारियों को पत्रों एवं फाइलों पर हिन्दी में सहज एवं सरल छोटी-छोटी अभ्युक्तियां एवं टिप्पणियां लिखने के लिए निदेश दिए, ताकि संस्थान के कार्यालयीन कामकाज में राजभाषा हिन्दी को बढ़ावा दिया जा सके। संस्थान के अधिकारियों एवं कर्मचारियों के लिए १९ जनवरी, २०१५ को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। डॉ. के. सत्यगोपाल, भा.प्र.से., महानिदेशक एनआईपीएचएम ने कार्यशाला का उद्घाटन किया एवं उपस्थित प्रतिभागियों को संबोधित करते हुए इस बात पर बल दिया कि राष्ट्रीय एकता के लिए हिन्दी एवं अन्य भाषाओं का अपना- अपना महत्व है। हिन्दी कार्यशाला के अतिथि वक्ता डॉ. जे. रेणुका, सहायक निदेशक (राजभाषा), राष्ट्रीय कृषि अनुसंधान प्रबंध अकादमी, हैदराबाद ने राजभाषा हिन्दी के नीति, नियम एवं राजभाषा के प्रति सरकारी कर्मचारियों की जिम्मेदारियों की विस्तारपूर्वक जानकारी दीं। उन्होंने प्रशासन अनुभाग तथा वैज्ञानिकों के तकनीकी एवं व्यवहार से संबंधित हिन्दी कार्यशाला आयोजन किए जाने हेतु महत्वपूर्ण सुझाव भी दिए। कार्यशाला में संस्थान के 26 अधिकारियों एवं कर्मचारियों ने भाग लिया।

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

Shri Avinash K. Srivastava IAS, Additional Secretary, DAC, Ministry of Agriculture Visited NIPHM

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