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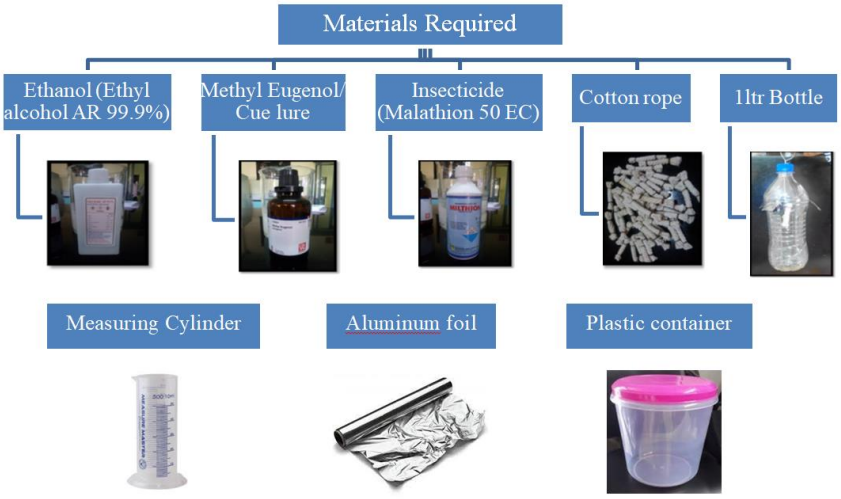
Quarterly Plant Health NEWS LETTER

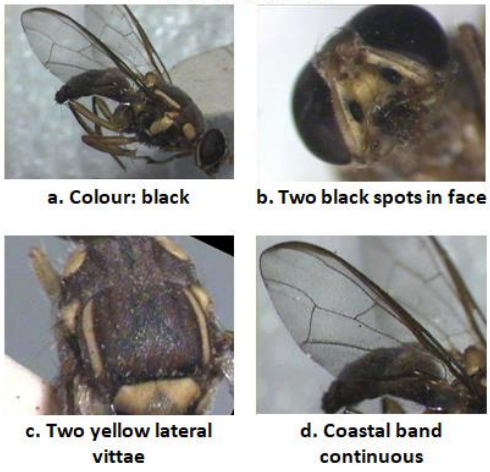
Volume: XIII Issue: 3
JULY - SEPTEMBER, 2021

THEME ARTICLE



AROUND THE WORLD

Bactrocera dorsalis



a. Colour: black

b. Two black spots in face

c. Two yellow lateral vittae

d. Coastal band continuous

WHAT'S INSIDE

SPECIAL EVENTS

Fruit flies are also called 'peacock flies' placed under order Diptera and family Tephritidae found to cause damage to many soft fruits and vegetables. About 4000 species are found to be present all over the world out of which about 5% of the species are found to occur in India. Due to wide range of hosts, high climatic tolerance and high dispersal capacity distribution range of fruit flies has covered the Asia Pacific region ranging from India to Hawaii and covering all South-East Asian countries. In India out of 176 species under Family Tephritidae, 34 belonged to the genus *Bactrocera*.

Due to their wide species diversity, polyphagous feeding habit, multivoltine life cycle and biology with high fecundity and difficulties in management, the pest has gained an important place in domestic production of fruits & vegetables and also export market access. Stringent quarantine procedures are practiced by different countries to avoid entry of exotic fruit flies. With expanding international trade, fruit flies as major quarantine pests of fruits and vegetables have taken on added importance, triggering the implementation of area-wide national or regional (transboundary) control programmes.

The Sterile Insect Technique (SIT) for fruit flies is one such area wide management programme and environment friendly technique involves the mass-rearing of male insects, sterilizing them by ionizing radiation and releasing them in the target area in numbers large enough to outcompete their wild counterparts. Sterile male insects mating with wild female insects will have result in no off-spring and the release of sterile males in adequate sterile to wild male ratios, suppresses the wild population in the targeted area. In few cases, this population suppression can lead to eventual eradication of the target population.

Being a premier institute in the country, working on capacity building in the area of plant protection with plant health management, plant quarantine, pesticide management, vertebrate pest management and plant health engineering as its core subjects, National Institute of Plant Health Management has taken up different capacity building training programs to national and international participants on area wide fruit fly management using para pheromone lure with other integrated approaches. The preparation of para-pheromone lures like methyl eugenol and cue lure and continuous trapping in the field has been promoted to manage few *Bactrocera sp* and *Zeugodacus sp*. which are attracted to these lures. The institute has trained 69 international participants from different Asian and African countries, 1326 Indian plant protection officers, 1084 Indian farmers during last 3 years. Further the trained officers have trained many farmers in their place of work in India, Afghanistan and Uganda through demonstrations, radio talks and presentations. The institute has documented such success stories received from India, Afghanistan and Uganda. The current issue deals with the importance of fruitflies..

फल मक्खी को 'मोर मक्खी' भी कहा जाता है । डिप्टेरा एवं टेफ्रिटिडे वर्ग की मक्खियां नरम फलों और सब्जियों को नुकसान पहुंचाती हैं । पूरे विश्व में लगभ 4000 प्रजातियां पायी जाती हैं, जिनमें से लगभग 5 प्रतिशत प्रजातियां भारत में पायी जाती हैं । पौध होस्ट की विस्तृत श्रृंखला के कारण, उच्च जलवायु सहिष्णुता और फल मक्खियों की उच्च फैलाव क्षमता वितरण रेंज ने भारत से लेकर हवाई तक एवं सभी दक्षिण-पूर्व एशियाई देशों को कवर करते हुए एशिया प्रशांत क्षेत्र को शामिल कर लिया गया है । भारत में टेफ्रिटिडे वर्ग के तहत् 176 प्रजातियों में से 34 जीनस बैक्ट्रोसेरा से संबंधित है ।

उनकी विस्तृत प्रजातियों की विविधता, पॉलीफैगस फीडिंग आदत, मल्टीवोल्टाइन जीवन चक्र और उच्च उर्वरता के साथ जीव विज्ञान और प्रबंधन में कठिनाइयों के कारण, पीड़क ने फलों और सब्जियों के घरेलू उत्पादन में महत्वपूर्ण स्थान प्राप्त किया है एवं निर्यात बाजार बाजार तक पहुंच है । विदेशी फल मक्खियों के प्रवेश से बचने के लिए विभिन्न देशों द्वारा सख्त संगरोध प्रक्रियाओं का अभ्यास किया जाता है । अंतर्राष्ट्रीय व्यापार के विस्तार के साथ, फल एवं सब्जियों के प्रमुख संगरोध पीड़कों के रूप में फल मक्खियों ने महत्व प्राप्त कर लिया है, जिससे क्षेत्र-व्यापी राष्ट्रीय या क्षेत्रीय (सीमा पर) नियंत्रण कार्यक्रमों के कार्यान्वयन को गति मिली है ।

फल मक्खियों के लिए स्टराइल कीट तकनीक (एसआईटी) एक क्षेत्र व्यापी प्रबंधन कार्यक्रम है एवं पर्यावरण के अनुकूल तकनीक में नर कीटों का बड़े पैमाने पर पालन करना, विकिरण को आयनित करके उन्हें स्टराइल करना एवं उन्हें लक्षित क्षेत्र में बड़ी संख्या में छोड़ना सम्मिलित है, जो वे अपने जंगली समकक्ष कीटों से मुकाबला कर सकें । जंगली मादा कीटों के साथ संसर्ग करने वाले स्टराइल नर कीटों के परिणामस्वरूप कोई वंश नही होगा । जंगली नर अनुपात के लिए पर्याप्त स्टराइल में स्टराइल नर कीटों को छोड़ना लक्षित क्षेत्र में वन्य आबादी को दबाती है । कुल मामलों में, इनकी आबादी को दमन करने से लक्षित आबादी का अंतत: उन्मूलन हो सकता है ।

देश में एक प्रमुख संस्थान होने के नाते, यह संस्थान वनस्पति संरक्षण के क्षेत्र में क्षमता निर्माण के साथ वनस्पति स्वास्थ्य प्रबंधन, वनस्पति संगरोध, पीड़कनाशी प्रबंधन, कशेरुकी पीड़क प्रबंधन एवं वनस्पति स्वास्थ्य अभियांत्रिकी जैसे मुख्य विषयों पर काम कर रहा है । राष्ट्रीय पादप स्वास्थ्य प्रबंधन संस्थान ने पैरा फेरोमोन प्रलोभन पदार्थ का उपयोग करने के साथ अन्य एकीकृत दृष्टिकोणों पर व्यापक क्षेत्र में फल मक्खी प्रबंधन पर राष्ट्रीय और अंतर्राष्ट्रीय प्रतिभागियों के लिए विभिन्न क्षमता निर्माण प्रशिक्षण कार्यक्रम शुरू किया है । कुछ बैक्ट्रोसेरा एवं जियोगोडाक्स प्रजातियों को प्रबंधित करने के लिए फील्ड में निरंतर ट्रैपिंग एवं पैराफेरोमोन प्रलोभन पदार्थ तैयार करने जैसे मिथाईल यूजेनॉल एवं क्यू लूर प्रलोभन पदार्थ बनाने के लिए बढ़ावा दिया गया है । संस्थान ने पिछले 3 वर्षों के दौरान विभिन्न एशियाई एवं अफ्रीकी देशों से आये 69 अंतर्राष्ट्रीय प्रतिभागियों, 1326 भारतीय वनस्पति संरक्षण अधिकारियों एवं 1084 भारतीय किसानों को प्रशिक्षण दिया है । इसके अलावा प्रशिक्षित अधिकारियों ने प्रदर्शनों, रेडियो वार्ताओं और प्रस्तुतियों के माध्यम से भारत, अफगानिस्तान और युगांडा में कई किसानों को उनके कार्यस्थल पर प्रशिक्षित किया है । संस्थान ने भारत, अफगानिस्तान और युगांडा से प्राप्त ऐसी सफलता की कहानियों का दस्तावेजीकरण किया है । वर्तमान मुद्दा फल मक्खियों के महत्व से संबंधित है ।

(Dr. Sagar Hanuman Singh IPoS)
Director General

STERILE INSECT TECHNIQUE (SIT) FOR AREA WIDE MANAGEMENT OF FRUIT FLIES – AN ENCOURAGING ECO-FRIENDLY APPROACH

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Abstract:

Fruit flies are tiny insects belongs to order Diptera found damaging different soft fruits and vegetables. They can cause damage to vegetable and fruits from 20 to 100 per cent. In India, fruit flies found to cause damage in wide variety of cucurbitaceous vegetables and fruit crops. Several methods are applied in the field for management of fruit flies around the world. Genetic control methods are one such kind for management of insect pests which involves in utilization of these insect pests for their own control. Sterile Insect Technique (SIT) is one of the environment friendly methods among these control methods which can be used in area wide insect pest management programmes. In SIT, the control is achieved by releasing irradiated and subsequently made sterile insects into natural ecosystem among wild populations to produce a high proportion of sterile matings and hence reduce or eradicate wild population. All over the world several attempts were made in which SIT and were highly exploited in management of fruit flies. In this article, we have described about SIT technique, its role in successful management or control of fruit flies.

1. Introduction:

Many crops in agricultural and horticultural ecosystems are being damaged by an array of insects causing significant economic harm and issues to farmers and country as a whole. For example, the pink bollworm *Pectinophora gossypiella* (Saunders), a non-polyphagous pest of cotton crop, originated in Asia and further spread to Africa, America and Australia in the 20th Century and have caused enormous economic damages (Naranjo *et al*., 2002). Presently, the pest is observed in almost all cotton growing countries, and has become an important pest of cotton crop. Another invasive pest, Fall Army Worm, *Spodoptera frugiperda* originally pest of Americas migrated to Africa and reached India in 2018 and caused enormous damage in its host crops. In similar manner, the fruit flies like Mediterranean fruit fly ('Medfly') *Ceratitis capitata* (Wiedemann) is a highly invasive generalist attacking more than 250 host plants, and is one of the world's most economically important pests.

Fruit flies are the world's most destructive fruit pests. Fruit flies are responsible for 20-40% of loss in fruits and vegetables both in the field and post-harvest scenario. In some cases the damages are caused even up to 90-100%. Fruit flies are also called 'peacock flies' placed under order Diptera and family Tephritidae found to cause damage to many soft fruits and vegetables. About 4000 species are found to be present all over the world (Norrbom et al, 1998) out of which about 5% of the species are found to occur in India (Ramani, 1998). Due to wide range of hosts, high climatic tolerance and high dispersal capacity distribution range of fruit flies has covered the Asia Pacific region ranging from India to Hawai and covering all South-East Asian countries (Peterson and Denno, 1998). In India out of 176 species under Family Tephritidae, 34 belonged to the genus *Bactrocera* (Kapoor, 1980) and now the number species has reached about 270 numbers. The tribe Dacini with the genus *Bactrocera* is of importance in India. From an economic point of view, oriental fruit fly, *Bactrocera dorsalis* (Hendel); peach fruit fly, *B. zonata* (Saunders); and melon fruit fly, *Zeugodacus cucurbitae* are important and wide spread throughout the country (Fig. 1). The first two species mainly attack fruit crops like mango and guava (Mariadoss *et al*., 2020) and other soft bodied fruits, while *Z. cucurbitae* attacks different cucurbitaceous vegetables. In Indian context, these are major fruit fly pests, especially on mango, guava, cucurbits affecting local and export markets. The crop loss due to these species varies with season and region.

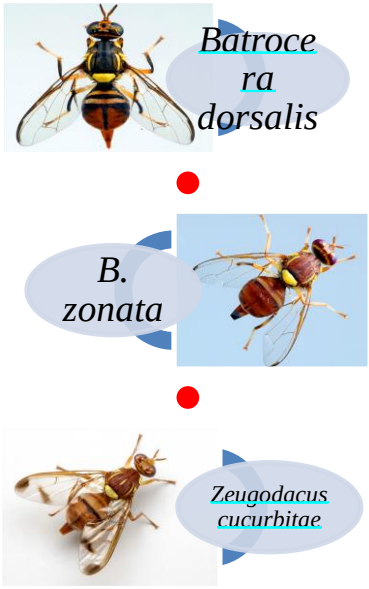


Fig. 1. Important and wide spread fruit fly species in India

Traditional pest management methods, especially chemical insecticides, have often unsuccessful to prevent the enormous damage caused by insect pests. Genetic pest control strategies involve alterations of a targeted pest's ability to reproduce or the insertion of some deleterious character into a pest population. Genetic control is a form of biological control of pest species which exploits the insect's mate-seeking expertise to introduce genetic abnormalities. Since the genetic control methods utilize insect pest for their own destruction, these are also known as autocidal methods. Genetic approaches for managing arthropods pests have been considered by scientists for more than half a century. Yet, because of recent and current emerging technologies, genetic approaches are often regarded as novel and unproven. Research and development for genetic control programme demand a long-term commitment before potential benefits can be realized. Therefore, genetic approaches are usually developed only for the most economically important pest species. The majority of the genetic control techniques have the unique property of becoming more effective as the target population is reduced in numbers. However, they tend to be less effective at high population densities.

2. Sterile Insect Technique (SIT)

The Sterile Insect Technique, best known by its acronym **SIT** and also identified as the Sterile Insect Release Method (**SIRM**), is a biologically-based method for the management of key insect pests of agricultural and medical/veterinary importance. In the FAO glossary, the Sterile Insect Technique is defined as "*a method of pest control using area-wide inundative releases of sterile insects to reduce reproduction in a field population of the same species*". It is therefore a type of "birth control" in which wild female insects of the pest population do not reproduce when they are inseminated by released, radiation-sterilized males. Sterilization is induced through the effects of irradiation on the reproductive cells of the insects. SIT does not involve the release of insects modified through transgenic (genetic engineering) processes. In this type of autocidal control, sequential releases of the sterilized insects in adequate sterile to wild male overflooding ratio's lead to a reduction in pest population numbers. Effective control using sterile insects is achieved when part of area-wide integrated pest management (AW-IPM) programmes.

SIT has been very successful against pink bollworm, Medfly, Oriental fruit fly (Augustinos, 2014) and is being improved using advances in molecular biology. It uses releases of radiation sterilized insects as part of environmentally compatible and area-wide integrated pest management. The idea of controlling by sterilizing technique was first conceived by E. F. Knipling long back during 1937 in a laboratory in Texas (USA) while working on the biology of screwworm fly, *Cochliomyia hominivorax*. He observed that the females of this fly mated only once. So if somehow the males of the fly could be sterilized then the population of the pest could be reduced. In this technique insects treated with certain mutagenic chemicals or X-rays or gamma radiations are unable to produce a normal number of living progeny. Treated insects are released into the field and are expected to mate with the normal insects, thus interfering with reproduction.

In SIT, fully competitive sterile males are released in the natural populations; it will reduce the reproductive potential of the natural populations in the same ratio as sterile to fertile**.** Using the SIT, the target insect is itself modified to become its own control agent. Large numbers of sterile males are released into the wild where they compete for mates with wild males, thereby reducing the pest population numbers in the next generation. If sufficient numbers of the sterile males are released over adequate time, the total eradication of the target species can be expected. The most spectacular success of SIT was seen with the eradication of the screwworm fly (*Cochliomyia hominivorax*) from southern US and Mexico, but it has been used with varying success against a wide range of species, not all of them insects. The key advantages to using SIT are its extreme specificity and ability to eradicate the target species over a wide area. The specificity is inherent in the mechanism, only the target females will mate with the released sterile males, so even closely related species are unaffected.

Apart from benefits to the environment from using methods such as the SIT, the monetary value of savings is accrued from minimizing usage of insecticides (Pimentel *et al*., 1992). In 1997, it was estimated that some Middle East countries would over 6 years, if current control practices prevailed, spend USD 46.7 million for insecticides to suppress the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann). This compares with USD 5.8 million that would be spent on insecticides, if pest suppression with the SIT were adopted, a benefit of USD 40.9 million in 6 years (Enkerlin and Mumford 1997). Another example of an indirect benefit is the per capita increase in fruit production. A study (Vo *et al.*, 2002), to assess the economic feasibility of fruit fly control in the Central American region using the SIT, indicated that the average per capita production of fruits was 17.2 kg/year, 4.3 times lower than the average annual per capita production in Middle East countries (73 kg/year). Effective fruit fly control in the Central American region would reduce fruit damage and increase the annual per capita production of fruits to almost 19 kg/year, equivalent to 48 600 tonnes valued at USD 25 million/year. Although this would be an improvement, the amount is still low compared with the 73 kg per capita per year produced in the Middle East. On a country basis, the amount of fruit (from fruit fly hosts) produced per capita per year is as follows: Costa Rica-85 kg, El Salvador-12.2 kg, Guatemala- 18 kg, Honduras-11.5 kg, Nicaragua-24.7 kg, and Panama-16 kg (Vo *et al*., 2002). Such programmes protect, at a relatively low cost, high-value horticulture industries, and this is a major advantage of the SIT technology when compared with more conventional pest control methods such as insecticides (Enkerlin, 2003).

In current practice, the SIT involves the mass rearing of the pest species on artificial diet, exposing very large batches of individuals to radiation to cause chromosome damage, followed by their release into a target area (Fig.2.). When the released insects mate, the resulting eggs do not hatch because of the damage to genetic material in the parent's germ line. Sustained releases are required. Sufficient sterile insects must be released for a longer period to achieve a significant reduction in pest population, either suppression to a suitably low numbers or local population elimination. One important measure is a release ratio, or over flooding ratio, of released sterile insects to wild fertile insects. The SIT is species specific and so has no direct off target effects on other species in the environment, and is best suited to systems where a single species is the major cause of damage (Alphey and Bonsall, 2018).

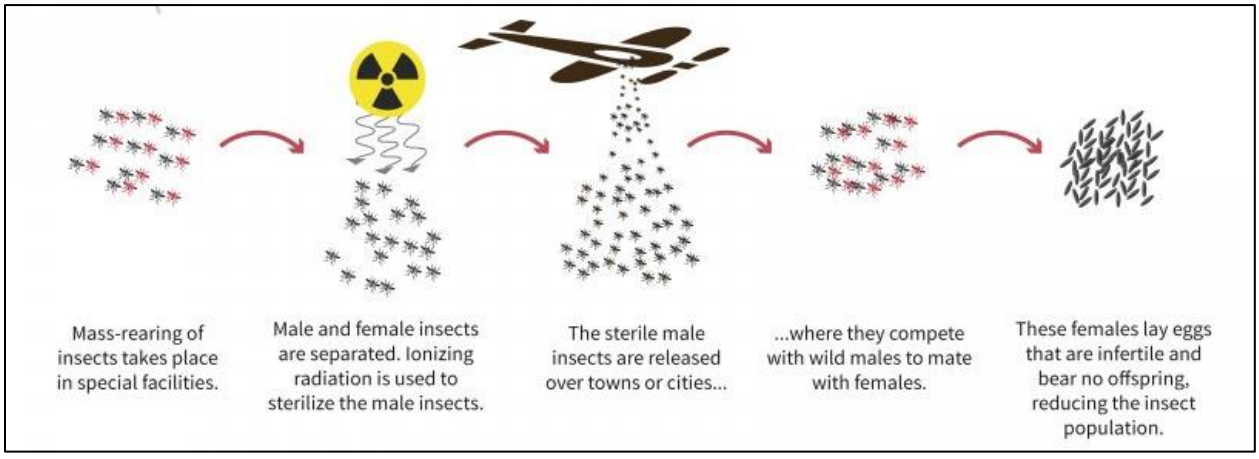


Fig. 2. Procedure of SIT technique (Source: IAEA)

3. Successful SIT programmes on different insect pests

a) The screw-worm fly (*Cochliomyia hominivorax*) was eradicated from the United States, Mexico, Central America, Puerto Rico and Libya.
b) The Mexican fruit fly (*Anastrepha ludens*, Loew) was eradicated from most of northern Mexico.
c) The tsetse fly was eradicated from Zanzibar.
d) The Mediterranean fruit fly (Medfly, *Ceratitis capitata*, Wiedemann) was eradicated from the northern part of Chile and southern parts of Argentina, Peru and Mexico. It is being suppressed by SIT in fruit-producing areas of Croatia, Israel, South Africa and Spain.
e) The codling moth (*Cydia pomonella*) is being effectively suppressed in parts of British Columbia, Canada.
f) The pink bollworm (*Pectinophora gossypiella*) eradicated from southwestern USA and north-western Mexico.
g) The false codling moth (*Thaumatotibia leucotreta*) is being effectively suppressed in parts of South Africa.
h) The cactus moth (*Cactoblastis cactorum*) was eradicated from an outbreak in Yucatán, Mexico.
i) The melon fly (*Zeugodacus cucurbitae*, Coquillett) was eradicated from Okinawa.
j) The onion fly (*Delia antiqua*) managed in onion production areas in the Netherlands.

4. Transboundary shipment of sterile insects

Transboundary shipment of sterile insects has taken place on a continuous basis for 55 years since 1963. The total number of sterile insects shipped has been estimated at more than one trillion in thousands of shipments across borders to 23 recipient countries from 50 sterile insect factories in 25 countries. During this long period and many precedents, no problems associated with possible hazards have been identified, and thus the shipment of sterile insects has never been subjected to any regulatory action. The transboundary shipments which started in 1963 with the shipments of sterile Mexican fruit fly (*Anastrepha ludens*, Loew), from Monterrey, Mexico, to Texas, USA.

5. Successful SIT programmes for management of fruit flies

The following benefits were accrued for fruit fly management using SIT as informed by Enkerlin (2021)

5.1. Fruit Fly Prevention Programme in California, USA

The Mediterranean fruit fly is a serious risk to California's economy. During the year 2002, there were losses to the tune of USD 4700 for the fruit industry alone, due to susceptible crops (USDA/NASS, 2002, 2003a, b; CASS, 2002). The rate of introduction of medfly which is an exotic pest, that can attack more than 250 different crops (Liquido *et al*., 1991), has been increasing with growing trade and tourism. Since 1975, more than USD 256 million has been spent to eradicate small and large infestations, primarily in the Los Angeles Basin and the San Francisco Bay area.

Major Achievements: The Preventive Release Program (PRP) has brought about 96% reduction in the number of wild Medflies caught in the treated Los Angeles basin, and more than a 96% reduction in the number of fly infestations were recorded. Before the shift to the PRP (1987-1993), an average of seven or eight Mediterranean fruit fly outbreaks occurred every year, costing the state approximately USD 33 million per year (USDA/APHIS 1992). Since the implementation of the PRP (1994-1998), there were 50 % reduction in overall cost of the programme and only two small Mediterranean fruit fly infestations have occurred within the boundaries of the release area. These infestations remained confined and were quickly eliminated without applying aerial sprays of toxic bait and without trading partners establishing temporary quarantines for Californian exports.

Estimated Benefits: The impact of this programme has been measured in terms of the potential economic losses that the pest would cause on the horticulture industry and home-garden fruit production if it became an established pest in California. The parameters that have been used to measure the impact are the following: yield loss in agriculture and home garden production, increased insecticide use (from 127 to 2270 tonnes/year of active ingredient), loss of export markets, and annual quarantine compliance costs (CDFA, 2002). It has been estimated that a permanent Mediterranean fruit fly infestation could cost California's economy USD 1300–1900 million annually (yield loss, control costs, quarantine compliance costs, and loss of export markets, not including the social and environmental costs), with the loss

of 14 000 or more jobs (Siebert and Pradham, 1991). The insecticide savings (amount of active ingredient not used) have been very large. If the CDFA had applied aerial toxic-bait sprays on the same 3800 km^2 area that was infested in 1994, 458 tonnes of malathion would have been used. In contrast, since implementing the basin-wide sterile Mediterranean fruit fly releases, only 19 kg of malathion were used for management (Enkerlin, 2021).

5.2. Fruit Fly Prevention/Containment Programme in Chile

An important component of the Chilean economy is the production and export of fruits and vegetables, worth about USD 2000 million annually. As a prerequisite to importing these commodities, some of the main commercial partners, e.g. USA and Japan, require that produce are grown in a certified fruit fly-free area. Except for Arica province at the northern tip of the country, and occasional outbreaks in other provinces, Chile has historically been regarded as a fruit fly-free country. Following various attempts to eradicate the Mediterranean fruit fly using baits sprays, the SIT was introduced, and after 8 years of an intensive programme, in 1995 the fly was eradicated in Arica, and Chile was declared a fruit fly-free country (MAG/SAG, 1995).

Major Achievements: Since its inception in 1980, Chile's National Fruit Fly Programme has, through effective eradication activities, successfully kept the country free of economic species of fruit flies. Chile's programme to remain fruit fly-free is one of the best in the world. Strengthening binational cooperation with Argentina and Peru, and formalizing binational cooperation with Bolivia, are cornerstones that sustain Chile's fruit fly free status.

Estimated Benefits: Since Chile was declared a fruit fly-free country, fruit exports have grown to an annual two million tonnes of fruits, mainly table grapes, apples, stone fruits, kiwis, and avocados, valued in 2002 at USD 1600 million.
Chile has achieved its fly-free status by implementing two major strategic activities:
(i) A preventive programme based on an effective national and international quarantine system (including interprovincial quarantine road stations and international quarantine at ports of entry), and an extensive and highly sensitive fruit fly trapping network to detect fruit fly introductions at an early stage as a forewarning strategy. Outbreaks of exotic fruit flies, including the Mediterranean fruit fly, have been eradicated through the effective execution of an emergency eradication plan based on detecting and eradicating infestations.
(ii) In Arica province, the ongoing Mediterranean fruit fly AW-IPM programme that integrates the SIT functions as a containment barrier to avoid the natural or artificial spread of fly populations to the main fruit and vegetable production areas in the central and southern parts of the country. For years, Chile has been subjected to increasing risks of pest introductions through more trade, tourism, and people coming from neighbouring countries. Consequently, there has been an increase in the rate of Mediterranean fruit fly detections and outbreaks. Nevertheless, the Government of Chile (through SAG) has strengthened its National Fruit Fly Programme by gradually incorporating state-of-the-art technology. This includes introducing an improved genetic sexing strain of the Mediterranean fruit fly into the mass-rearing facility in the Lluta Valley (Arica province), DNA-identification techniques to assess the geographical origin of introduced flies, updated fly-trapping systems, and X-ray machines at critical points of entry to facilitate detection and confiscation of fruit hosts of the Mediterranean fruit fly (Lindquist and Enkerlin, 2000).

5.3. Fruit Fly Containment Programme- Mexico and Guatemala

The Mediterranean fruit fly was introduced into Costa Rica in 1955. It spread across Central America, causing devastating effects on fruit production, and limiting the development and growth of the fruit industry. The pest became established in Guatemala in 1976, and in 1977 was detected in the border zone between Guatemala and Mexico. By 1979, the fly had spread to the Mexican states of Chiapas and Oaxaca, gone beyond the coffee belt along the South Sierra Madre Mountains, and threatened the states of Campeche, Tabasco, and Veracruz. If the pest had advanced beyond the Isthmus of Tehuantepec, 600 km into Mexican territory, the US government threatened to close its border to imported Mexican fruits and vegetables, and fly eradication would have been practically impossible. Gutierrez (1976) estimated that preventing the establishment of the Mediterranean fruit fly in Mexico translated into annual savings of at least USD 2000 million in direct damage (including yield loss and cost of insecticide treatment) and indirect damage (including loss of the price differential obtained from selling the produce in export markets). In addition, if the pest became established,

thousands of jobs across the production chain would be lost, and substantial environmental costs would be generated by the tonnes of insecticides that would have to be sprayed to keep the pest under control.

Major Achievements: After 4 years of intensive eradication activities (1977-1982), the first programme objective was met- the Mediterranean fruit fly was eradicated from an infested area of 640000 hectares (6400 km2) in the state of Chiapas, Mexico, using an AWIPM approach that included legal measures (e.g. quarantine regulations), chemical, mechanical, and cultural control methods, and the SIT. This was the first time that a tephritid fruit fly population was eradicated at a continental level, in a region of difficult topography, high ecological diversity, and using an environment-friendly technology (Hendrichs *et al.*, 1983). Since eradication was achieved in 1982, for 23 years (1982-2004) the programme has successfully maintained a sterile fly containment barrier. This barrier has prevented the northward spread of the pest, protecting the horticulture industries in Mexico and the USA (worth thousands of millions of dollars) (Orozco et al. 1994, Villaseñor *et al.*, 2000). In addition, the area of Peten (northern part of Guatemala) has been kept free of the Mediterranean fruit fly. This fly-free status has been recognized officially by the Mexican and US governments, and benefits small scale papaya fruit growers in Peten who can now export their produce to fruit fly free countries. Moreover, other Guatemalan fly-free areas have been certified- Quetzaltenango, where peaches are produced commercially, and Laguna de Retana, where tomatoes are produced; both commodities can now be exported to Mexico without quarantine restrictions.

Estimated Benefits: The primary impact of the Moscamed Programme has been in protecting the horticulture industries of Mexico and the USA. As a result, and under the framework of the North American Free Trade Agreement (NAFTA), Mexico's gross revenues from horticultural products have tripled since 1994 to more than USD 3500 million per year (Economist, 2004).

5.4. Fruit Fly Eradication Programme- Japan

The melon fly is the most destructive pest of cucurbit crops based on its quantum of damage and present distribution around the world. It is found in Africa, India, South-East Asia, and islands in the Pacific (including Hawaii). In Japan, it was first discovered in 1919 in the Yaeyama Islands, and between 1919 and 1970 it invaded most island groups in the south of Japan. In Okinawa, this pest found to damage more than 40 important vegetables and fruits and affected the export of these infested commodities to fly-free areas. The most important cash crop in Okinawa, sugarcane does not yielded good price for farmers due to stagnant prices and productivity, as well as increased international competition. As a result, farmers and the local government needed to diversify from monoculture sugarcane-centered agriculture into other cash crops, e.g. flowers and tropical fruits such as mango. The other promising agricultural strategy was to produce "healthy" food, and for Okinawa to become a brand name for "healthy longevity" because of its world renowned "healthy island" image. Due to this situation in Okinawa, in the early 1970s the eradication of the melon fly became the top priority project at local and country levels. The problem was urgent since the fly was rapidly spreading to other islands and, unless specific eradication measures were undertaken, might spread to mainland Japan.

Major Achievements: This was first successful use of the SIT for melon fly eradication in island communities. Eradication was achieved with no harm to the health of the public or the environment. Lifting of internal quarantine regulations to allow transport to non-infested areas resulted in significant expansion and export of major horticultural products.

Estimated Benefits: A post-programme economic assessment, prepared by the Research Institute for Subtropics (Kakazu, 2002) using the methodology described by Enkerlin and Mumford (1997), clearly shows the benefits of usage of SIT for melon fly eradication. The estimated net-benefits are those arising from the commercial shipments of commodities that are hosts of the melon fly. Not included in the assessment were indirect benefits for the island economies, such as human health and environmental protection, insecticide-free farming, preservation of natural enemies, savings in fumigation and quarantine costs, and above all preventing the insect from spreading to the mainland of Japan. Furthermore, due to data constraints, the indirect social benefits were not estimated. The programme proved to be economically viable, even though only the increase in commodity shipments was considered in the benefit equation. If the northward spread of the melon fly had not been stopped, the potential loss for farmers and the horticulture industry in general would have been very substantial, and the cost of an eradication programme would have risen enormously. As a result of the successful eradication programme, the production of Okinawa's high-valued niche products, such as bitter melon and mango, has risen sharply. Between 1990 and 2000, bitter melon production rose from 2720 to 6220 tonnes, a

2.3-fold increase. Similarly, over the same period, mango production increased from 278 to 1290 tonnes, a 4.6-fold increase; all together this is equivalent to USD 335 million in 10 years. This figure should be compared with the much lower total programme cost, USD 172 million, during the 10-year eradication period (1982-1991). In 1996, 6 years after achieving eradication in the main islands, the programme reached its break-even point and repaid the initial investment. Between 1997 and 2000, the programme cost was estimated to be USD 31 million, but gross revenues were USD 167 million from the sale of commodities shipped to mainland Japan and other countries (Enkerlin, 2021).

5.5. Fruit Fly Suppression Programme- South Africa

The Western Cape province, South Africa was being affected by the Mediterranean fruit fly and the Natal fruit fly *Ceratitis rosa* Karsch. An average of 15.5 million cartons of table grapes is exported annually from the Hex River Valley which is a major production area. Mediterranean fruit fly is the dominant and economically important fruit fly species in that area. It causes direct damage to fruit and requires costly insecticides sprays, and infested fruit results in rejections of boxed table grapes by the phytosanitary inspectors of importing countries (Barnes and Eyles, 2000).

Major Achievements: Growers and scientists now understand the benefits of applying the concept of AWIPM, and the advantages to international trade of establishing low pest prevalence areas (FAO, 2002). They also have effectively adopted the SIT technology and established the required infrastructure, which is now managed by the private sector. According to the growers in the valley, integrating the SIT to suppress the Mediterranean fruit fly has been very successful. From 1997 to 2002, insecticide use dramatically decreased, and fly mean population levels were reduced from 0.9-1 flies per trap per day, in the 3 years (1997-1999) before the release of sterile flies, to 0.1-0.4 flies per trap per day in the 3 years following the release (2000-2002) (Barnes *et al.*, 2004). These positive results have encouraged other associations of fruit growers outside the Hex River Valley to also embark on SIT activities. In 1997, a pilot project to control fruit flies using the SIT was implemented in 10,000 hectares (100 km^2) in and around the Hex River Valley. The goal was to suppress, in a cost-effective and environment-friendly manner, the Mediterranean fruit fly populations to below the economic threshold, and then create an internationally recognized low pest prevalence area (FAO, 2002).

Estimated Benefits: By using environment-friendly technology, and reducing production costs and increasing revenues, the Mediterranean fruit fly suppression programme increased the profits of the table-grape industry in the Hex River Valley. By replacing insecticide applications with a combination of aerial and ground releases of sterile male flies at hot spots, the reduction in control costs was substantial, from USD 350000/year with chemical control to USD 130000/year with the SIT. Rejections, due to fruit fly infestation, of exported cartons of table grapes from the valley were reduced approximately 50%. In 2000, a reduction of 60% in rejections of cartons by phytosanitary inspectors of importing countries represented savings of USD 150000. For the 2001/2002 season, the direct benefits totaled USD 370000/year, at a cost of USD 130000, which is equivalent to a benefit/cost ratio of 2.8:1 (Enkerlin, 2021).

6. Direct and indirect benefits

The direct benefits commonly used to measure the impact of programmes integrating the SIT are:

a) Increase in fruit yield and quality through reduced damage,
b) Reduction in production costs through a more cost-effective control method.

The indirect benefits commonly used to measure the impact of programmes integrating the SIT are:

a) Increase in fruit and vegetable export volumes, and market retention or
b) diversification, through effective control of quarantine pests,
c) Increase in export volumes through reduced rejections of commodities which do not comply with pest absence or the insecticide residue levels,
d) Increase in fruit yield through reduced secondary pest outbreaks,
e) Savings in medical costs, and occasionally deaths, through reduced exposure to insecticides, and also in legal costs arising from damage to private or public property as a result of insecticide misuse,
f) Greater protection of beehives resulting in increased fruit yield through increased crop pollination,
g) New jobs created in the horticulture industry and related businesses and services,
h) Better human nutrition due to a per capita increase in fresh-fruit intake,

i) Savings in environmental and public health costs through reduced insecticide residues in fruit, water reservoirs, and soil.

These indirect benefits are very difficult to assess and quantify, and in most cases have been accounted for only qualitatively (Pimentel *et al.* 1992).

Disadvantages of SIT

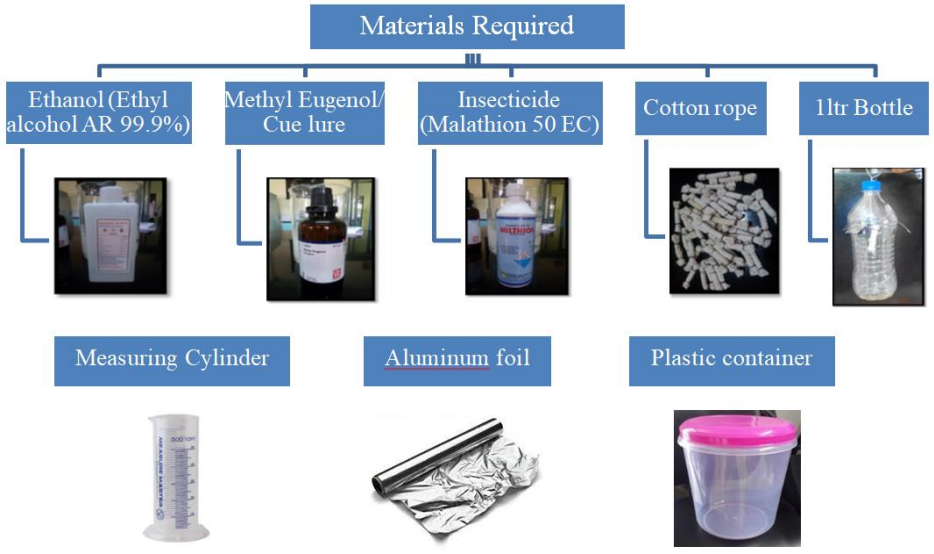
a) Naturally low population periods or repeated pesticide treatments are sometimes required to suppress population before the use of sterile insects.
b) Radiation, transport and release treatments can reduce male mating fitness.
c) This technique is species specific.
d) Mass rearing and irradiation require precision processes. Failures may occur when unexpectedly fertile breeding males were released.
f) Area wide approach is more effective, as migration of wild insects from outside the control area could re-form the problem.

7. Fruit fly monitoring and management with low cost bottle trap and lure

Among the known factors, fruit flies (Diptera: Tephritidae) are recognized in worldwide as the major threat to the horticultural industry including India. Tephritid fruit flies cause major losses in fruits as well as vegetables, which adversely affect both quantity and quality of its production and are also major impediments for export. *Bactrocera* spp. is considered as high priority quarantine pests. Because of their infestations, India has been included in the list of those countries from where fruit import to developed countries is banned; in May 2014 EU banned the exports of fresh mangoes from India due to the presence of fruit flies in import consignments.

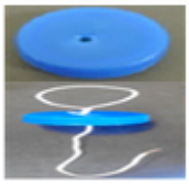
Tephritid fruit flies are responsible for postharvest losses in fresh fruits and vegetables. Damage is caused both by adults and maggots. Adult female punctures the rind of near ripe fruits with its needle like ovipositor and lays eggs. The female punctures outer wall of mature fruits with the help of its pointed ovipositor and insert eggs in small clusters inside mesocarp of mature fruits. On hatching, the maggots feed on fruit pulp and the infested fruits start rotting due to further secondary infection. The legless yellowish maggots after hatching bore and feed on fruit pulp and on maturity come out of the fruit, drop on the ground and pupate deep under the soil. Thus the maggots destroy the pulp making it foul.

The pre-harvest management by using para-pheromones is highly effective in controlling fruit flies in the field. Due to some constraints such as high cost of commercial traps/lures and their timely accessibility, the small and marginal farmers are not able to use this approach effectively in India. The use of methyl eugenol (ME) and cue lure low cost bottle traps stands as the most outstanding alternative, which attracts mostly the male flies.



Preparation of low cost bottle trap and lure:

Take 1 litre empty water bottle. Remove wrapper. Make 3 windows with a knife at 3 inches from top. Each window should be of 1 inch size



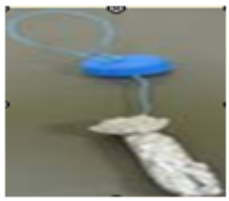
Make a small hole in the centre of the cap with needle. Take a thin wire of 10 inches length, make a knot at the centre, insert the wire from inside to outside the cap and make a loop for hanging the bottle and the other end make a hook for tying the lure inside the

Take half inch of thick cotton rope and cut the rope into 2 inches size, tie the cut ends with thin copper wire.

Mix ethyl alcohol-60 ml + lure (ME/Cue lure)-40 ml + Malathion-20 ml (i.e., in the ratio of 6:4:2)

ME: Guava, Mango, Papaya, citrus and other fruit crops
Cue lure: use in Cucumber, Gherkin, Melon, Pumpkin, Snake gourd, Ridge Gourd, Bottle gourd, Mango *etc*

Dip the cut cotton rope pieces in prepared solution (Ethyl alcohol + Lure + insecticide) for 24 hrs, wrap the lures with aluminium foil until use. The 120 ml mixture can be used for preparing 30 lures *i.e* @ 4ml /lure



Remove one third of the aluminium foil at the time of use and tie the lure to the thin wire in the lid

Hang the bottle in shade at least 3-4 feet above the ground level at different locations

- Separate containers and measuring jars are to be used while preparing the lure mixtures.
- Small pin sized holes to be made at the bottom of bottle to drain the water in rainy season
- 6-10 traps/acre are required to be used for best control.
- Lures are to be replaced once in 35-40 days
- Methyl eugenol lure can be used in all types of crops from fruit set to harvest
- Cue lure can be used in cucurbitaceous and solanaceous vegetable fields from flowering to till harvest
- For effective monitoring one trap/acre can be used after harvest throughout the year to avoid population buildup on alternate hosts.

8. Conclusion

Sterile insect technique can be used for the successful management of fruit flies as it is highly specific, can cover a large geographical area as an area-wide management tool, compatible with other pest management strategies and does not pollute the environment and is safe to pest control workers. This technology allows cost-effective suppression/eradication and also prevents the establishment of important fruit fly species in pest free areas through the use of SIT containment and prevention programmes. In the future, the SIT will contribute even more to improved food security worldwide by increasing fruit and vegetable production in a cost-effective, environmentally clean, and sustainable manner.

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Around the World

PHYTOSANITARY MEASURES FOR FRUIT FLIES

India is a leading producer of many agriculture commodities such as cereals, spices, fruits, vegetables and cotton. But it still has a moderate 2.2% share in global agriculture exports. India holds World No. 3 in production of vegetables, the export ranking of India is only 14. In fruits, India is the second largest producer in the world but export ranking is 23. (Govt.PTI -18-Aug-2020). In trade negotiations with the US, UK, EU, and Australia, the Indian side must seek the removal of trade barriers and call for better market access for its fruit and vegetable exports.

The National Agriculture Export Policy is formulated in line with the vision to double the farmers income and increase the share of agricultural exports from present ~US$ 30+ Billion to ~US$ 60+ Billion by 2022 which will help in doubling the farmers income. Keeping this view in mind India is focusing now on export of perishables like fruits and vegetables. To provide a mechanism for tackling market access barriers and deal with sanitary and phytosanitary issues fruit flies are main concerned in export particularly *Bactrocera dorsalis, Bactrocera zonata and Bactrocera cucurbitae* and many countries are asking an additional declarations as phytosanitary measures. Hence, important characters used for detection of above mentioned fruit flies are shown in below figures.

Bactrocera dorsalis

a. Colour: black

b. Two black spots in face

c. Two yellow lateral vittae

d. Coastal band continuous

Bactrocera zonata

a. Colour: Reddish brown

b. Two black spots in face

c. Two yellow lateral vittae

d. Coastal band continuous

Bactrocera* (*Z*) *cucurbitae

Colour: Reddish brown

b. Two black spots in face

c. Lateral and middle vittae

d. Brown infuscation on the cross vein

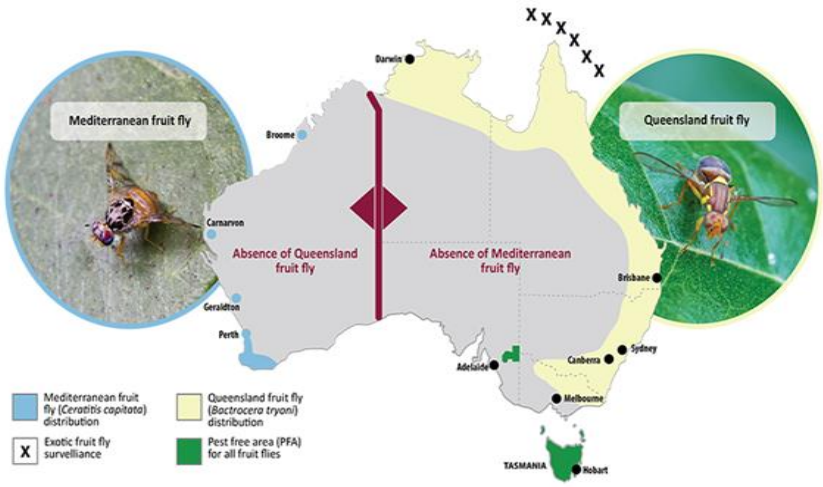
Source: Dr. Rajak, JD, DPPQS, Faridabad

The phytosanitary measure by different countries as on today required by the major importing countries is provided below. This information is useful for the exporter, researcher and scientists and progressive farmers to promote export of vegetable and fruits.

Commodity	Country Name	Phytosanitary measure required
Mango (*Mangifera indica*) Fresh fruit for consumption	Austria, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Germany, Greece, Ireland, Italy, Japan, Hungary, France, Finland, Czech Republic, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom	1. Vapor Heat Treatment- Pulp temperatures of the center of the fruits shall be 47.5°C and be kept continuously at 47.5°C or above for 30 minutes. Or 48°C and be kept continuously at 48°C or above for 20 minutes. or 2. Hot water immersion treatment- I- for 500 grams or below fruits – 48 °C water temperature for 60 min. II- for 501 grams to 750 grams fruits – 48 °C water temperature for 75 min. III- for 901 grams or above fruits – 48 °C water temperature for 90 min.
	Iran	1. Hot water immersion treatment – 46.1-46.5 ºC for 70 minutes
	New Zealand	1. Vapor Heat Treatment- Pulp temperatures of the center of the fruits shall be 48°C and be kept continuously at 48°C or above for 20 minutes. 2. Vapor Heat Treatment for export with saturated vapour in an approved Vapour Heat Treatment facility in accordance with the program of Indian Plant Quarantine Authority. Fruit pulp temperature is raised until the fruit core reaches at least 48°C for all sensors. The temperature is then maintained for at least 20 minutes in accordance with the National Standards for Phytosanitary Measures(NSPM 20).
	Australia and USA	1.. The irradiation treatment has to be endorsed on the PSC. 2. Treatment by USDA-approved Irradiation treatment facility as per Standard Operating Procedure and Operational Work Plan. 7. Approved treatment for various commodities including Mango & Pomegranate from India is IR 400 Gy

Pest Free Areas as phytosanitary measure:

Fruit flies are a very important group of pests for many countries because of their potential to cause damage in fruits and to their potential to restrict access to international markets for plant products that can host fruit flies. The high probability of introduction of fruit flies associated with a wide range of hosts results in restrictions imposed by many importing countries on accepting fruits from areas in which these pests are established. For these reasons, ISPM 26 Establishment of pest free areas for fruit flies (Tephritidae) developed which is providing specific guidance for the establishment and maintenance of pest free areas for fruit flies. A pest free area is "an area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained" (ISPM 5). ISPM 4 (Requirements for the establishment of pest free areas) describes different types of pest free areas and provides general guidance on the establishment of pest free areas. The target pests for which this standard was developed include insects of the order Diptera, family Tephritidae, genera Anastrepha, Bactrocera, Ceratitis, Dacus, Rhagoletis and Toxotrypana. Some examples of pest free areas are provided below.



Distribution of fruit fly in Australia

Pest Free Areas-Department of Agriculture, Water and the Environment, Australia

A roadside fruit fly host material amnesty bin to protect to protect Australia s pest free areas

https://www.ippc.int/en/news/eastern-australia-and-the-ord-river-australian-pest-free-areas-for-mediterranean-fruit-fly

Pest-Free Areas The following table lists countries and associated areas that meet the APHIS requirements for designated pest-free areas in accordance with 7 CFR 319.56- 5

Country	Pest(s)	Pest-free Area
Argentina	Mediterranean fruit fly (Medfly) Ceratitis capitata and Anastrepha spp. fruit flies	The Patagonia Provinces of Neuguen, Rio Negro, Chabut, Santa Cruz, and Tierra del Fuego. This includes areas along the valleys of the Rio Colorado and Rio Negro rivers and areas of the southern part of the Mendoza Province, south of the following coordinates: lat 33o 13' 40.98" S, length 69o 54' 36.86" W; lat 33o 13' 40.98" S, length 69o 04' 18.24" W; lat 33o 29' 29" S, length 68o 59' 20" W; lat 34o 02' 47" S, length 67o 57' 17" W; lat 34o 02' 47" S, length 66o 44' 06.05" W
Australia	Mediterranean fruit fly (Medfly) (Ceratitis capitata), the Queensland fruit fly (Bactrocera tryoni or QFF) and other fruit flies destructive of citrus	The Riverland district of South Australia, defined as the county of Hamley; the geographical subdivisions, called hundreds, of Bookpurnong, Cadell, Eba, Fisher, Forster, Gordon, Hay, Holder, Katarapko, Loveday, Markaranka, Morook, Murbko, Murtho, Nildottie, Paisley, Parcoola, Paringa, Pooginook, Pyap, Ridley, Skurray, Stuart, and Waikerie; and the Parish of Onley of the Shire of Mildura, Victoria
	Mediterranean fruit fly (Medfly) (Ceratitis capitata) and the Queensland fruit fly (Bactrocera tryoni)	Tasmania
	Mediterranean fruit fly (Medfly) (Ceratitis capitata)	Eastern Australia, defined as the Northern Territory, Queensland, South Australia, New South Wales, and Victoria
	Queensland fruit fly (Bactrocera tryoni)	Western Australia

Brazil	South American cucurbit fruit fly (Anastrepha grandis)	The portion of Brazil bounded on the north by the Atlantic Ocean; on the east by the River Assu (Acu) from the Atlantic Ocean to the city of Assu; on the south by Highway BR 304 from the city of Assu (Acu) to Mossoro, and by Farm Road RN–015 from Mossoro to the Ceara State line; and on the west by the Ceara State line to the Atlantic Ocean The Municipalities of Aracati, Icapuí, Itaiçaba, Jaguaruana, Limoeiro do Norte, Quixerê, and Russas in the State of Ceará, and the municipalities of Açu, Afonso Bezerra, Alto do Rodrigues, Areia Branca, Baraúna, Camaubais, Grossos, Ipanguaçu, Mossoró, Porto do Mangue, Serra do Mel,Tibau, Upanema in the State of Rio Grande do Norte
Ecuador	South American cucurbit fruit fly (Anastrepha grandis)	The area within 5 kilometers of either side of the following roads: (i) Beginning in Guayaquil, the road north through Nobol, Palestina, and Balzar to Velasco-Ibarra (Empalme); (ii) Beginning in Guayaquil, the road south through E1 26, Puerto Inca, Naranjal, and Camilo Ponce to Enriquez; (iii) Beginning in Guayaquil, the road east through Palestina to Vinces; (iv) Beginning in Guayaquil, the road west through Piedrahita (Novol) to Pedro Carbo; or (v) Beginning in Guayaquil, the road west through Progreso, Engngunga, Tugaduaja, and Zapotal to El Azucar
Guatemala	Mediterranean fruit fly (Medfly) (Ceratitis capitata)	Department of Peten

Mexico	Mediterranean Fruit fly (Medfly) (Ceratitis capitata), Mexican Fruit fly (*Anastrepha ludens*), Sapote fruit fly (A. serpentine), West Indian fruit fly (A. oblique), and South American fruit fly (*A. fraterculus*)	The Municipalities of Comondu, La Paz, Loreto, Los Cabos, and Mulegé in the State of Baja California Sur; the Municipalities of Bachiniva, Casas Grandes, Cuahutemoc, Guerrero, Namiquipa, and Nuevo Casas Grandes in the State of Chihuahua; the Municipalities of Ahome, Choix, El Fuerte, Guasave, and Sinaloa de Leyva in the State of Sinaloa; and the Municipalities of Altar, Atil, Bacum, Benito Juarez, Caborca, Cajeme, Carbo, Empalme, Etchojoa, Guaymas, Hermosillo, Huatabampo, Navojoa, Pitiquito, Plutarco Elias Calles, Puerto Penasco, San Luis Rio Colorado, San Miguel, and San Ignacio Rio Muerto in the State of Sonora
Peru	South American cucurbit fly (Anastrepha grandis), gray pineapple mealybug (Dysmicoccus neobrevipes)	The Departments of Lima, Ica, Arequipa, Moquegua, and Tacna
Republic of South Africa	Citrus black spot (CBS) (*Guignardia citricarpa Kiely*)	Magisterial districts of Bellville, Bredasdorp, Caledon, Cape, Ceres, Clanwilliam, Goodwood, Grabouw, Heidelberg, Hermanus, Hopefield, Kuilsriver, Ladismith, Malmesbury, Mitchell's Plain, Montagu, Moorreesburg, Paarl, Piketberg, Robertson, Somerset-West, Stellenbosch, Strand, Swellendam, Tulbagh, Villiersdrop, Vredenburg, Wellington, Worcester, and Wynberg of the Western Cape Province; Magisterial districts of Barkly-west/west, Gordonia, Hartswater, Hay, Herbert, Hopetown, Kenhardt, Kimberley, Namakwaland, Prieska, and Warrenton of the Northern Cape Province; Magisterial districts of Boshof, Fauresmith, Jacobsdal, Koffiefontein, and Philippolis of the Free State Province; Magisterial districts of Christiania and Taung of the North West Province

Venezuela	South American cucurbit fly (*Anastrepha grandis*)	The Paraguana Peninsula, located in the State of Falcon, bounded on the north and east by the Caribbean Ocean, on the south by the Gulf of Coro and an imaginary line dividing the autonomous districts of Falcon and Miranda, and on the west by the Gulf of Venezuela

Source : Animal and Plant Health Inspection Service U.S. Department of Agriculture

Training Programs

Plant BioSecurity Division

The Plant Biosecurity Division has organized following training programmes during the months of **July-September, 2021**.

Capacity Building Programmes:

Name of The Programme	**Duration**	**Date**	
		From	**To**
Plant Biosecurity Division (PBD)			
Stored grain Pest management and Fumigation for CWC officers-**Payment Program**	15 Days	20.07.2021 to 03.08.2021	
Fumigation as a Phytosanitary Treatment (Methyl Bromide and Aluminium Phosphide Fumigation)-**Payment Program**	15 Days	26.07.2021 to 09.08.2021	
Forced Hot Air Treatment (FHAT)-**Payment Program**	5 Days	26.07.2021 to 30.07.2021	
Stored grain pest management and fumigation for CWC officers **(Payment Programme)**	15 days	17.08.2021 to 31.08.2021	
Pest Surveillance	5 Days	23.08.2021 to 27.08.2021	
Fruit fly: Surveillance and Management	5 Days	30.08.2021 to 03.09.2021	
Stored grain pest management and fumigation for CWC officers (**Payment Programme**)	15 Days	14.09.2021 to 28.09.2021	
Quarantine pathogens: Seed Health Testing and Molecular Diagnostic Techniques	5 Days	20.09.2021 to 24.09.2021	
WTO & Agri Exports for Agriculture & Horticulture officers of Madhya Pradesh	3 Days	28.09.2021 to 24.09.2021	
Vertebrate Pest Management (VPM)			
Rodent Pest Management in Food Grain Warehouses	5 Days	05.07.2021 to 09.07.2021	
Non-Insect Pest Management – Mites, crabs, snails, slugs and avian	3 Days	14.07.2021 to 16.07.2021	
Certificate Course on Urban Integrated Pest Management	15 Days	02.08.2021 to 16.08.2021	
Rodent Pest Management	5 Days	23.08.2021 to 27.08.2021	

PBD Farmers Programmes		
Stored grain pest detection, identification and management to the farmers of Vizianagaram district, Andhra Pradesh	1 Day	09.08.2021
Interactive meet in collaboration with Department of Agriculture, Andhra Pradesh on Banana Pest Management (Sigatoka leaf spot) to the farmers of Andhra Pradesh (Kadapa, Kurnool and Chittoor)	1 Day	18.08.2021
VPM Farmers Programmes		
Vertebrate Pest Management to the farmers of Puthukottai District, Tamil Nadu	1 Day	01.07.2021
Rodent Pest Management to the rice growing farmers of Khowai District, South Tripura	1 Day	12.07.2021
Webinar		
Phytosanitary Strategies for Food Security and Market access of Fruits and Vegetables	1 Day	26.08.2021
Grains Management – Regulatory Approaches in Indian and Australian Agriculture	1 Day	22.09.2021

A. Details of Training Programmes (Govt. Officials & Private sector)

1. **Stored grain Pest Management and Fumigation for CWC officers**: Three On Campus programmes for 15 days duration on "Stored grain pest management and fumigation" were organized exclusively for the technical officials of Central Warehousing Corporation on payment basis from 20.07.2021 to 03.08.2021 (total 28 participants), 17.08.2021 to 31.08.2021 (total 29 participants), 14.09.2021 to 28.09.2021 (total 25 participants).


Practical Exposure for the Participants

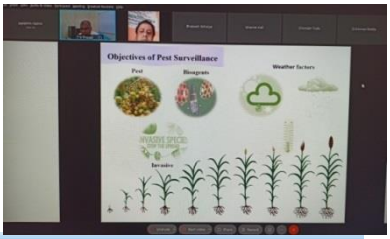

Director General addressing the participants during valedictory session

2. **Fumigation as a Phytosanitary Treatment (Methyl Bromide and Aluminium Phosphide Fumigation)**: An On Campus programme for 15 days is being conducted from 26.07.2021 to 09.08.2021 on payment basis and a total 20 participants are attending the programme. The participants got familiarized with physical and chemical properties of Phosphine and Methyl bromide, safety precautions to be followed while handling fumigants, mode of action of fumigants, principles of fumigation, monitoring the fumigant concentration, appropriate use and NSPM-11, 12 (MBr fumigation) and NSPM-22 (Phosphine fumigation) to conduct appropriate fumigation procedures as well as the accreditation procedure of fumigation operators prescribed by the DPPQ&S. maintenance of fumigants and safety equipments. The participants were made to understand the guidelines laid in The trainees gained hands-on practical experience in creating gas-tight enclosure, laying gas supply and monitoring lines, use of vaporizer, fan, leak detector and gas concentration monitor.


3. **Forced Hot Air Treatment (FHAT)**: An on campus programme with 5 days duration is being organized on payment basis from 26.07.2021 to 30.07.2021 and a total 38 participants are attending the programme. Training covered requisites associated with Solid wood packing material (SWPM), its associated pests (fungi, insects and nematodes), phytosanitary treatments, design and construction of FHAT, equipments and their specifications, accreditation and audit protocol and calibration of sensors and treatment procedures. NIPHM is the only resourceful institute specialized in offering training on FHAT in accordance with ISPM-15 and NSPM-9.

4. **Phytosanitary Inspection Training for Phytosanitary Service Agency and Phytosanitary Service Provider for Inspection of Plants/ Plant Products & other Regulated Articles in Export**: An exclusive thirty days training programme was organized to impart training pertained to NSPM-23 as per the approved curriculum by PPA and structured to impart technical skills and competency in performance of phytosanitary inspection and certification. A valedictory programme was conducted on 14.07.2021 in the presence of Director General, Dr. S.H. Singh, IPoS and Dr. PS Nain, JD (PQ), DPPQ&S.

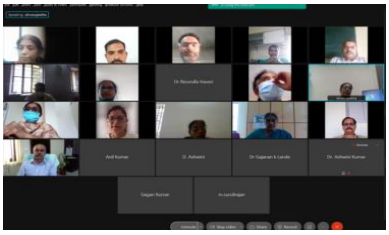
5. **Pest Surveillance**: Pest Surveillance plays a substantial role in promoting plant health which has become a trade policy issue. Pest surveillance provides insights into the health status of a country's agriculture and strengthens the stakeholder's preparedness for preventive actions both in addressing the problems due to domestic pests of serious concern as well as in protection of native agricultural biodiversity from the incursion threats of exotic pests. The participant learned



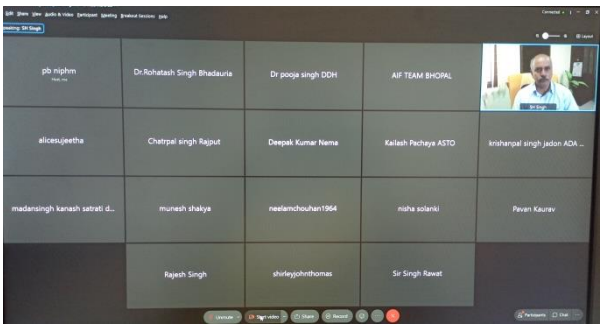
different strategies (detection, monitoring and delimiting survey), tools required for surveillance of target pest including basic procedure to set up Pest Free Areas (PFA) and Area of Low Pest Surveillance (ALPP). Trainees learnt adequate use of various methodologies, online tools, traps and lures to carry out surveillance practices for insects, pathogens, weeds, rodents and fruit fly. This programme is conducted through virtual mode from 23.08.2021-27.08.2021 wherein 57 participants attended from across the country.

6. **Fruit fly: Surveillance and Management:** A five days programme organized through virtual platform. 51 participants were participated from Agriculture/Horticulture Universities, ICAR Institutes, KVK's, and State Departments. Experts have been invited and different lectures were organized for identification & detection of fruit fly species, lure preparation and other different aspects of fruit fly surveillance and management.

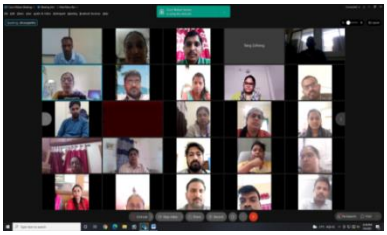
7. **Quarantine pathogens: Seed Health Testing and Molecular Diagnostic Techniques**: A five days training program on "Quarantine pathogens: Seed health testing and molecular diagnostic techniques" is conducted through virtual platform from 20-24, September, 2021. Seed health testing is an important tool for the management of seed-borne and seed-transmitted pathogens. Thirty nine participants from State Agricultural universities, State Departments of Agriculture and officials from DPPQ&S attended the online program and acquired knowledge on different seed health testing methods in order to safeguard Plant Biosecurity and to facilitate safe export of seeds.



8. **Customized training programme on "WTO and Agri Exports" for Madhya Pradesh**: A 3 - Days online programme was organized for agriculture and horticulture officers of Madhya Pradesh from 28.09.2021 to 30.09.2021was. Different lectures were scheduled in such a way that all the 34 officers get well acquainted with procedures for export of agri commodities as per the requirement of the country and obligation towards IPPC and other organizations involved in global trade.



9. **Rodent Pest Management in Food Grain Warehouses**: An exclusive 5 days programme was organised to the FCI, CWC and State Warehousing officials from 5th to 9th July, 2021 through virtual platform and 53 officers from across the country were participated. The programme aimed to address various aspects vis-à-vis major rodents pests in urban and storage premises, biology and morphology of rodents, breeding biology of rodents, rodent borne diseases, inspection procedure for rodent pests in storage godowns, rodenticides and mode of action and non-chemical management of rodent pest in storage godowns etc.



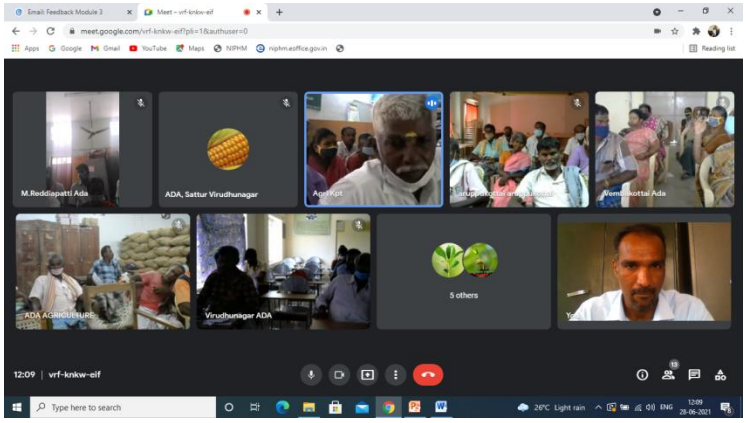
10. **Non-Insect Pest Management – Mites, Crabs, Snails, Slugs and Avian:** A 3 days online programme on non-insect pest management to practice different measure to manage at various levels was conducted from 14.07.2021 to 16.07.2021 and attended by 37 officers from various departments.

11. **Certificate Course on Urban Integrated Pest Management:** An on campus 15 days certificate course on Urban Integrated Pest Management is organized from 02.08.2021 to 16.08.2021 wherein 20 participants attended across the country. The participants were acquired knowledge on biology and management of various pests such as rodent, cockroaches, termite, birds, bedbug etc.

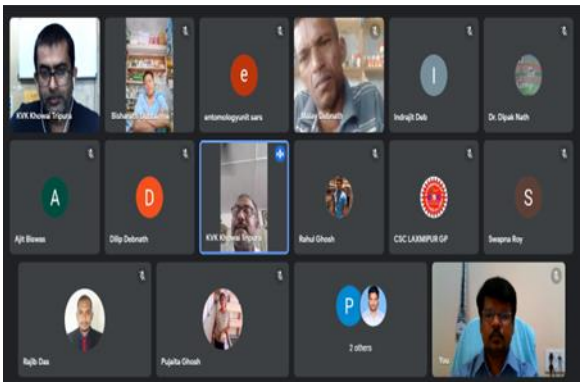
12. **Rodent Pest Management:** A 5 days programme on Rodent Pest Management is organized from 23.08.2021 to 27.08.2021 in which 28 extension officers / scientists from SAUs, ICAR, IARI and KVK were participated. The participants gained knowledge on various aspects related to major rodents pests in Agricultural and Horticultural ecosystem, biology and morphology of rodents, breeding profile of rodents, rodent borne diseases, non-chemical and chemical management of rodent pest etc.

B. Farmers Programmes

1. **Vertebrate Pest Management to the farmers of Virudhunagar District, Tamil Nadu & Vertebrate Pest Management to the farmers of Pudukottai District, Tamil Nadu**: An online farmer's programmes of one day duration were conducted in collaboration with JAD of Virudhunagar and Puthukottai District Department of and 01.07.2021, respectively. Total 143 farmers (80 from Virudhunagar were attended the programme.

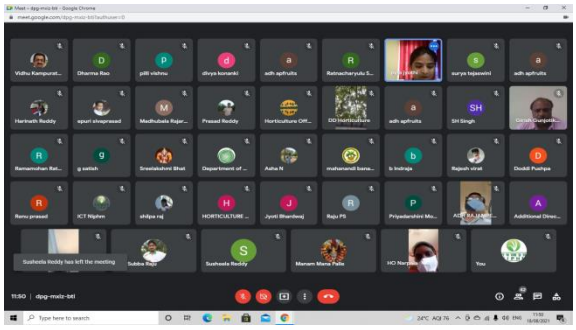


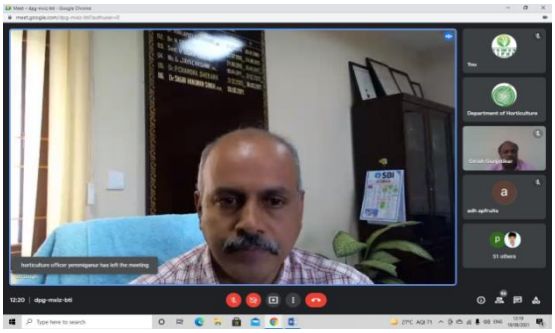
2. **Rodent Pest Management:** A farmer's training programme was conducted in collaboration with KVK, Khowai, Tripura to the rice growing farmers on 12.07.2021 and 42 farmers attended.



3. **Stored grain pest detection, identification and management to the farmers of Vizianagaram district, Andhra Pradesh:** A one day off campus programme was organzied on 09.08.2021 in Farmers Training center, Vizianagaram to the farmers of various Mandals in Vizianagarm District in Andhra Pradesh and a total of **60 farmers** were attended.

4. **Interactive meet in collaboration with Department of Agriculture, Andhra Pradesh on Banana Pest Management (Sigatoka leaf spot)**: This meet was organized in collaboration with the Department of Horticulture, Andhra Pradesh on Banana Pest Management (Sigatoka leaf spot) through virtual mode to the farmers of Andhra Pradesh (Kadapa, Kurnool and Chittoor) on 18.8.2021. It was conducted under the chairmanship of Dr S.H. Singh, DG, NIPHM and Dr S.S. Sreedhar, IFS, Commissioner of Horticulture. The faculty from NIPHM, officers from Department of Horticulture and also progressive farmers were participated. Around **62 members** were attended. Special emphasis was given on **Sigatoka Disease management** in Banana.





C. Webinars

1. A webinar on **"Phytosanitary Strategies for Food Security and Market Access of Fruits and Vegetables"** was organized on 26.08.2021 and 325 participants from across the country participated. In the light of International Year of Fruits and Vegetables 2021,as declared by the UN General Assembly, NIPHM has conducted this webinar and during the programme different issues relevant to plant quarantine policies, phytosanitary measures and trade challenges has taken in consideration. An emphasis was given for urgent need to address the significant and serious shortcomings in the key aspects of export and control system.
2. A webinar on "**Grains Management – Regulatory Approaches in Indian and Australian Agriculture**" was conducted in collaboration with the Australian Government Department of Agriculture, Water and the Environment under the auspices of the Australia-India Grains Partnership on 22.09.2021. 53 participants from Govt. of Australia, DPPQ&S, NIPHM, Rice exporters, Warehousing officials etc. were attended.

Forthcoming Programmes of PBD & VPM (October-December, 2021)

S. No.	Division	Name of the programme	No. of Days	From	To
1.	**PBD**	Irradiation as a Phytosanitary Treatment	5 Days	04.10.2021	08.10.2021
2.		Invasive Alien species: Introduced and emerging pests	3 Days	16.11.2021	18.11.2021
3.		Advance techniques for identification of Quarantine pathogens	5 Days	29.11.2021	03.12.2021
4.		Plant Quarantine Procedures for Import and Export	5 Days	13.12.2021	17.12.2021
5.		Forced Hot Air Treatment (FHAT) **Payment Programme**	5 Days	22.11.2021	26.11.2021
6.		Fumigation as a Phytosanitary Treatment (Methyl Bromide and Aluminium Phosphide Fumigation) **Payment Programme**	15 Days	29.11.2021	13.12.2021
7.		Scientific and Safe Fumigation Practices for Practitioners (**Off Campus for officers)**	3 Days	12.10.2021	14.10.2021
8.		Orientation for PSC Issuing Authority **(Off Campus for officers)**	3 Days	01.11.2021	03.11.2021
1.	**VPM**	Vertebrate Pest Management – Wild boar, Monkey and Birds	03 Days	06.10.2021	08.10.2021
2.		Rodent Pest Management in Food Grain Warehouses	5 Days	08.11.2021	12.11.2021
3.		Certificate Course on Urban Integrated Pest Management **(Payment Programme)**	15 Days	01.12.2021	15.12.2021

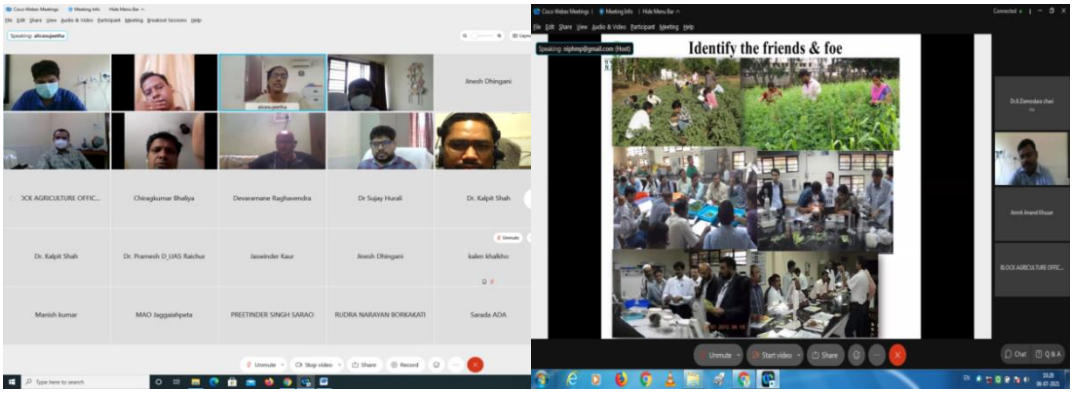
Plant Health Management Division

S No	Name of the programme	No. of Days	From	To
I.	**Officers programme**			
1.	AESA and Ecological engineering in pest management	5	05.07.2021	09.07.2021
2.	Production Protocol for Predators and Parasitoids	5	12.07.2021	16.07.2021
3.	Production Protocol for biofertilizers	5	23.08.2021	27.08.2021
4.	Desert Locust Pest Management	3	06.09.2021	08.09.2021
5.	On- Farm Production of Bio-control Agents and Microbial Bio-pesticides	5	13.09.2021	17.09.2021
6.	Training to Tobacco Board officials	5	20.09.2021	24.09.2021
II.	**Farmers training programme**			
1.	On-farm production of bio fertilizers and bio control agents	1	30.07.2021	--
2.	Management of Plant Parasitic Nematodes in Polyhouse and Guava orchards	1	17.08.2021	--
3.	Telangana State Farmers training on On-farm production of biocontrol agents	3	16.09.2021	18.09.2021
4.	Training to sericulture farmers on on-farm production of biofertilizers & Biopesticides	1	24.09.2021	--
III.	**Webinars**			
1.	International webinar on Desert locust *Schistocerca gregaria* (Forskål) International scenario and a potential threat to India	1	02.07.2021	--
2.	International webinar on ‘Biological Control A global sustainable approach for eco-friendly agriculture	1	24.09.2021	--
IV.	**Special programmes**			
1.	First biannual subcommittee meeting of ‘National Network of Plant Health Experts’	1	22.07.2021	--

A. Details of Training Programmes (Govt. Officials & Private sector)

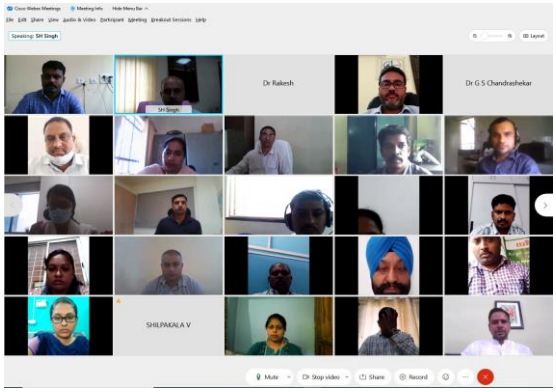
1. AESA and Ecological Engineering in Pest Management

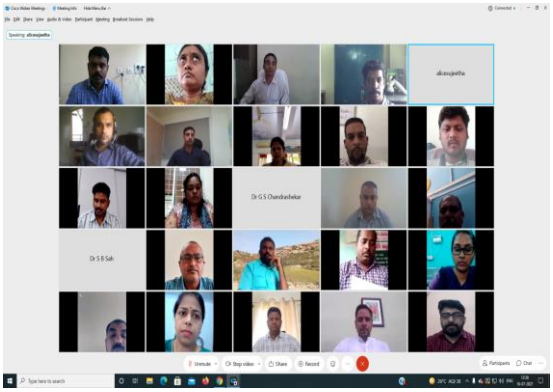
The training program on "***Agro Ecosystem Analysis (AESA) and Ecological Engineering for Pest Management***" conducted from 05th to 09th 2021(5 days) at NIPHM. A total of **30** participants from different organizations have attended. During this training programme, different topics like Principles and concepts of Integrated Pest Management, Introduction to Biological Control -Principles and Concepts Principles Ecological Engineering for pest management, Rhizospheric Engineering for Plant Health Management, Agro ecosystem analysis (AESA) Concepts & AESA in different crops, On farm mass production of important predators & parasitoids, On-farm production of bacterial Bio fertilizers and application methods, Trap Crops, Intercropping and Companion Planting in Pest management are underwent through virtual mode.



2. Production Protocol for Predators and Parasitoids

As scheduled in NIPHM training calendar 2021-22, a training programme on **"Production Protocol for Predators and Parasitoids"** was organized at NIPHM from **12th to 16th July, 2021** (5 days). In this programme total 72 officers/ scientist from different states and organizations are attended. During this training programme, the topics such as Introduction to biological control – principles and concepts, Importance of host insect to rear and promote natural enemies, Biological control of crop pests by parasitoids, Mass production techniques of important insect predators, Ecological engineering for insect pest management, Management of mealybugs using bio agents, Mass production techniques of important parasitoids, Field release techniques of natural enemies, Success case studies of biological control ,assignment on successful case studies of biological control in India.



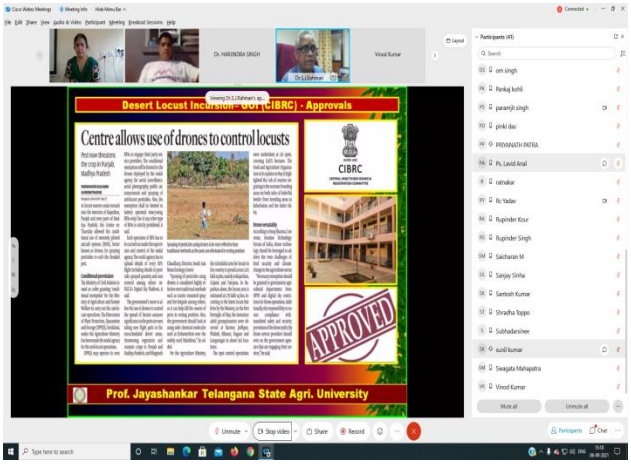


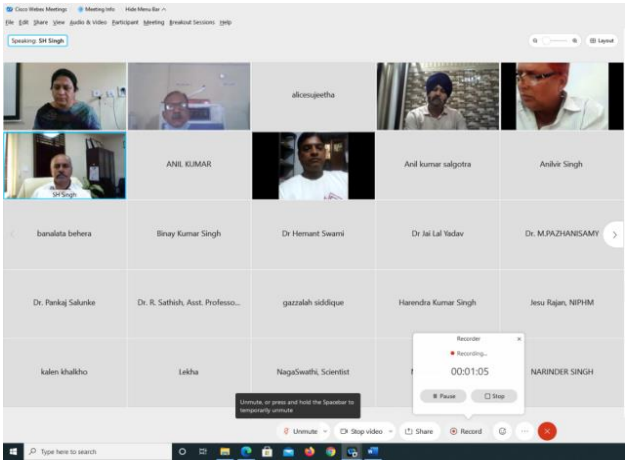
3. Production Protocol for biofertilizers

As scheduled in the NIPHM training calendar 2020-21, an online training programme on 'Production Protocol for Biofertilizers' was organized at NIPHM from 23.08.2021 to 27.08.2021 (5 days). In this programme total of 42 officers/scientists from different states & organizations have participated. The participants underwent various aspects of the Production Protocol for Biofertilizers such as Role of Biofertilizers in Plant Health Management, Protocol for the establishment of Biofertilizer production unit as per FCO 1985, Isolation & purification of microbial isolates used in biofertilizer production, mycorrhizae biofertilizers for sustainable Agriculture. Isolation & identification of Mycorrhiza, characterization of microbial isolates used in biofertilizer production. Protocol for production of carrier-based biofertilizers & liquid-based biofertilizers, the role of PGPR bacteria in rhizosphere management, Quality Control of Biofertilizers, and low-cost On-farm production of biofertilizers, Rhizosphere Engineering, etc.

4. Desert Locust Pest Management

As scheduled in the NIPHM training calendar 2020-21, an online training programme on 'Desert locust pest management' was organized at NIPHM from 06.09.2021 to 08.09.2021 (3 days). In this programme total of 45 officers/scientists from different states & organizations have participated as mentioned below. The participants underwent various aspects of the Desert locust pest management such as an insight into the potentiality of desert locust threat in India, Surveillance of desert locusts, Management of desert locusts using chemicals, an introduction to desert locust pest: Historical perspective and current status, desert locust biology, behavior and critical factors leading to locust outbreak, Classification, distribution and diversity of locusts, Mechanical control methods and biological control of desert locust, etc. During the online sessions, shown the videos on desert locust attacks in India, some of the mechanical, chemical and new control technology followed and shown behavioral changes, oviposition and important sites of desert locust information to participants. Some of the participants shared their field-level experiences.



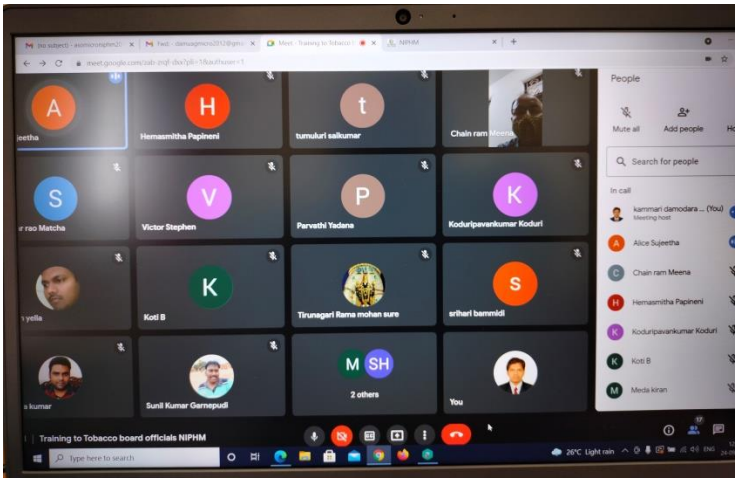


5. On- Farm Production of Bio-control Agents and Microbial Bio-pesticides

The training program on "On-Farm Production of Bio-control Agents and Microbial Bio- Pesticides" conducted from 13.09.2021 to 17.09.2021 through online mode by NIPHM. A total of 25 participants from different organizations have attended this programme. During this training programme, different topics such as Biological Control: Introduction to biological control, Principles, and concepts, Parasitoids as biocontrol agents, Role of Ecological engineering in pest Management, Host Corcyra mass production, *Trichogramma* mass production, Mass multiplication of predators (Coccinellids, green lacewing and anthocorid bugs, On-farm mass production of biopesticides (*Trichoderma & Pseudomonas*), On-farm mass production techniques of EPF, on-farm production of biofertilizers etc. are covered.

6. Training to Tobacco Board officials

An online training programme on 'Training to Tobacco Board officials' was organized by NIPHM through virtual mode from 20.09.2021 to 24.09.2021 (5 days). In this programme total of 19 officers from different auction platforms of Tobacco board, Andhra Pradesh have participated. In this training programme, the topics like AESA and Ecological Engineering concept in Tobacco for pest management, Good agricultural Practices for Tobacco crop Production Importance of biofertilizers in Integrated Nutrient Management in Tobacco, Mass production of predators, Mass production and application of Biopesticides (*Trichoderma & Pseudomonas*) in Tobacco crop, Mass production of parasitoids, Weed management in Tobacco crop with focus on *Orobanche* weed, Steps involved in residue analysis in Tobacco leaves, Nematode management in Tobacco, Rhizosphere engineering for Plant Health Management, Pesticide application techniques, Integrated Disease Management in Tobacco, Role of EPF and NPV in tobacco pest management.



B. Details of Training Programmes (Farmers)

1. On-farm production of bio fertilizers and bio control agents

An online training programme on on-farm production of bio fertilizers and bio control agents to the Telangana farmers is conducted on 30.7.2021. During this programme explained about different technologies for on-farm production of biofertilizers and biopesticides.

2. Management of Plant Parasitic Nematodes in Polyhouse and Guava orchards

An online farmers training programme on Management of Plant Parasitic Nematodes in Polyhouse and Guava orchards was organized on 17.08.2021.Plant-parasitic nematodes (PPNs) are one of the most important and difficult to manage pests of crops grown in protected cultivation. To create awareness among farmers training programme was organized on "Management of Plant Parasitic Nematodes in Horticultural Crops". In this training total of 25 participants (Horticulture farmers and officials have participated from Ranga Reddy district. The objective of the training programme was to provide practical based knowledge on plant-parasitic nematodes management in poly-house and main fields and their control measures.

3. Telangana State Farmers training on On-farm production of biocontrol agents

As scheduled in the NIPHM training calendar 2021-22, a physical farmers training programme on Telangana State Farmers Training programme on on-farm production of Biocontrol agents (3 days). In this programme total 29 farmers from Muklanoor cooperative society, Karminagar district and two farmers from Ranga reddy district have participated. The farmers underwent various theory and hands-on training practical classes on AESA and EE in IPM, vermicompost production, preparation of lures and pheromone traps, Rodent pest management, on-farm production of biofertilizers, *Trichoderma*, predators and parasitoids, conducted a visit to the PHE workshop.




4. Training to sericulture farmers on on-farm production of biofertilizers & Biopesticides

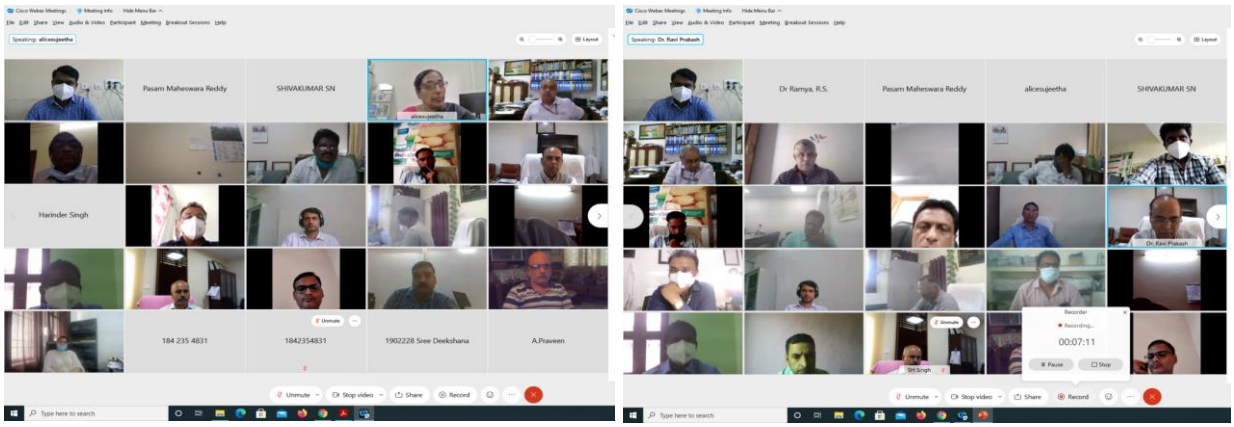
A physical farmers training programme to sericulture farmers from Siddipet district, Telangana on on-farm production of Biofertilizers & Biopesticides (one day) was organized at NIPHM on 24.09.2021. In this programme total of 30 progressive farmers were participated. Demonstrated NIPHM techniques like on-farm production of biofertilizers, *Trichoderma*, *Pseudomonas,* and their application methods in mulberry and other crops.


I. Webinars:

Webinar 1: International webinar on 'Desert locust *Schistocerca gregaria* (Forskål): International scenario and a potential threat to India

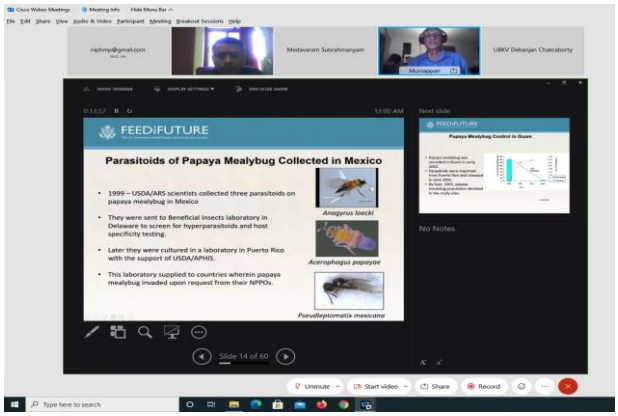
Plant Health Management division organized an International webinar on 'Desert locust *Schistocerca gregaria* (Forskål): International scenario and a potential threat to India' on 02nd July, 2021**.** In this webinar a total of 648 participants from agriculture and horticultural extension functionaries, scientists from ICAR and state agricultural and horticultural universities, KVK's, officials from Ministry of Agriculture and Farmer's Welfare, Government of India, students and other stakeholders are participated.

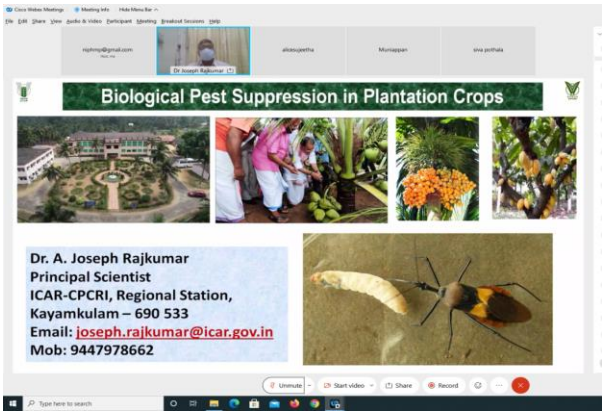
In this webinar three eminent resource persons were arranged to deliver their ideal topic related to the webinar. Desert Locust Crisis- Global Scenario presented by Mr. Keith Cressman, Senior Locust Forecasting Officer-FAO: He has clearly explained that desert locust is most dangerous migratory pests in the world due to their ability to change behaviour and form swarms that consume everything in their path and also he explained survey methodology, data collection units (e-locust data collection). Preparedness plan in India to fight against desert locust presented by Dr. N. Sathyanarayana, Joint Director (PP), Locust Division, Directorate of Plant Protection Quarantine and Storage (DPPQS): He explain about Indian locust divisional setup, objective, functions, locust awareness training programmes, establishment of locust control room and maintenance of ULV sprayers, control vehicle, aerial control capacities, pesticides, survey methodology, data collection units and desert locust situation bulletin. Desert locust situation in India and its management presented by Dr.K.L.Gurjar, Deputy Director (PP), DPPQ&S: He explain about desert locust biology and life cycle, breeding sites, forecast, control operations and also he explained list of approved pesticides for control of desert locust.



Plant Health Management division organized an International webinar on 'Biological Control: A global sustainable approach for eco-friendly agriculture' on 24th September, 2021. In this webinar three eminent resource persons delivered the content. Total of 378 participants from agriculture and horticultural extension functionaries, scientists from ICAR and state agricultural and horticultural universities, KVK's, officials from Ministry of Agriculture and Farmer's Welfare, Government of India, students and other stakeholders participated in the webinar. During this webinar, eminent speakers from different organizations are invited. The resource persons had delivered very efficient concepts on biological control i.e Biological Control in Integrated Pest Management: An Ecological Approach? By Dr. R. Muniappan, Director, IPM Innovation Lab, Virginia Tech, USA, Biological Pest Suppression in Plantation Crops by Dr. A. Joseph Rajkumar, Principal Scientist, ICAR-CPCRI, Kayamkulam, Kerala , Integrated Nematode Management in Horticulture Crops by Dr. R. Uma Maheshwari, Senior Scientist, Division of Crop Protection, ICAR-IIHR, Bangalore:

Webinar 2: International webinar on 'Biological Control: A global sustainable approach for eco-friendly agriculture'





Special programme

First biannual subcommittee meeting of 'National Network of Plant Health Experts

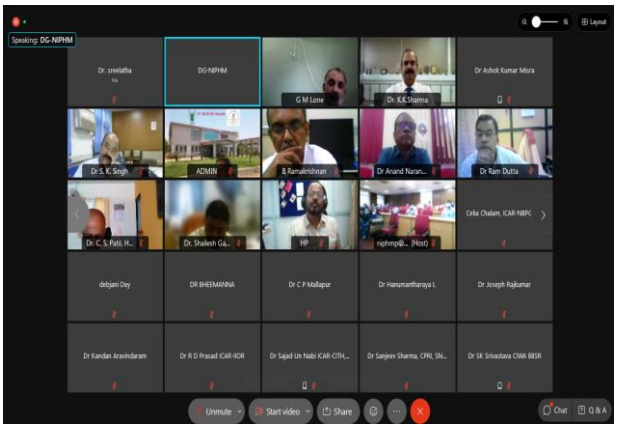
As per approval at 14th GC meeting, Plant Health Management division organized the first biannual subcommittee meeting of 'National Network of Plant Health Experts' via semi online mode (scientist belongs to Hyderabad were physically present at NIPHM, Hyderabad) on 22nd July, 2021 from 9:30am to 13:30pm. The inaugural session was chaired by Dr. Sagar Hanuman Singh, Director General NIPHM. Dr. J. Alice. R. P. Sujeetha, Director PHM *i/c* welcomed the dignitaries and participants. For this meeting four eminent resource persons were arranged to deliver their ideal topic related to the meeting. In this meeting a total of 74 scientists from ICAR's and state agricultural and horticultural universities have participated in the meeting. During this meeting the following discussions held.

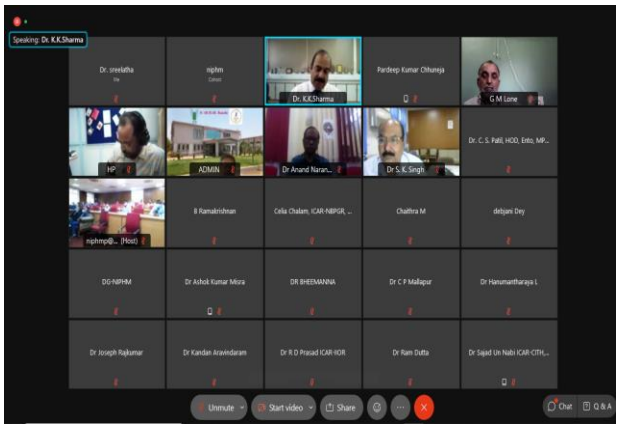
Microbial interventions in soil health management presented by Dr. B. Ramakrishnan, Principal Scientist, Division of microbiology, ICAR-IARI, New Delhi: He has clearly explained about that urbanization of the planet, human attitudes towards soil, Global soil organic carbon map, soil biodiversity, microbial diversity, e-platforms, microbial carbon fixation pathways, plant and microbe cooperation with suitable examples, challenges to improve the health of the agricultural soils, evidences and scientific reports on soil microbes.

Pest surveillance and forecasting presented by Dr. TVK Prasad, Principal Scientist, ICAR-CRIDA, Hyderabad: He explained in detail about the objectives, basic components, purposes and types of surveillance and survey and also differentiated between them. He also clearly explained about the process of e-pest surveillance system with examples, objectives of monitoring, record keeping, forecasting and forecasting models present in Indian conditions.

Building farmers resilience for better plant health presented by Dr. Vijay Kolekar, Agronomist at project on Climate Resilient Agriculture (PoCRA), Pune, Maharashtra: He explained about the climate change in Indian context, its impact on agriculture, crop specific impacts, project objectives and scopes, PoCRA approaches in involvement of community, public and extension system, building farmers resilience through advisory portals and PoCRA-Farmers Field School App. He also gave details on weather forecast, block level and agro met advisory to farmers, on farm production of quality inputs, biofertilizers and vermicompost and their strategic partnership with central institutes.

Pesticides residues and food safety presented by Dr. K.K. Sharma, Network Coordinator, Project Coordinating Cell, AINP on Pesticide Residues ICAR-IARI, New Delhi, India. He clearly explained about the food security, safety and trade in India, generation of quality residue data, status of NABL accreditation, detail procedure of label claim of residues in India, reasons of pesticide residues in food commodities and monitoring it at national level and critical parameters for risk assessment and MRL fixation.





Forthcoming Training Programmes

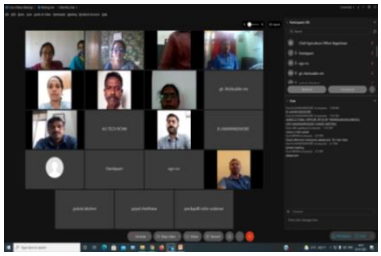
S No	Name of the programme	No. of Days	From	To
I.	**Officers**			
1.	PHM In Protected cultivation	5	04.10.2021	**08.10.2021**
2.	Quality control of microbial biopesticides	5	20.10.2021	24.10.2021
3.	Plant Health management strategies in In different crops	21	02.11.2021	22.11.021
4.	On-Farm production of biocontrol agents and microbial biopesticides	5	08.11.2021	12.11.2021
5.	Training programme on indiscriminate use of pesticides and fertilizers in agriculture	3	15.11.2021	17.11.2021
6.	Conservation of insect pollinators in Agriculture	3	22.11.2021	24.11.2021
7.	Production Protocol for microbial and bio pesticides	5	29.11.2021	03.12.2021
8.	Integrated Soil Nutrient and Rhizosphere Management	5	06.12.2021	10.12.2021
9.	Sustainable Pest Management programme for District levels	3	28.12.2021	30.12.2021
II.	**Farmers training programmes**			
1.	On -farm production of Biofertilizers and Biocontrol agents	3	06.10.2021	08.10.2021
2.	On -farm production of Biofertilizers and Biocontrol agents	3	11.10.2021	13.10.2021
3.	On -farm production of Biocontrol agents for Promotion of sustainable agriculture	3	01.11.2021	13.11.2021
4.	Vermi technology	3	22.12.2021	23.12.2021

Pesticide Management Division

During July to September 2021, the PM Division has conducted three offline and two online training.

Sl. No.	Name of the programme	No. of Days	From	To
1.	Inspection and Sampling under Insecticide Act, 1968	3 (online)	05.07.2021	07.07.2021
2.	Pesticide Formulation Analysis	60 (offline)	09.08.2021	07.10.2021
3.	Refresher program on Pesticide Formulation Analysis w.r.t new pesticide	3 (online)	10.08.2021	12.08.2021
4.	Inspection, Sampling and Prosecution Procedure under Insecticide Act, 1968	5 (offline)	20.09.2021	24.09.2021
5.	Laboratory Quality management System and Internal Audit as per ISO/IEC 17025:2017	5 (offline)	27.09.2021	01.10.2021

Inspection and Sampling under Insecticide Act, 1968



This program is designed for the Insecticide Inspectors working in state department of Agricultures and Central Insecticide Inspectors to understand on various salient features of the Insecticide Act 1968 and the Insecticide Rules 1971 and helps the Inspectors in understanding their duties and responsibilities. A three days online training programme on "**Inspection and Sampling under Insecticide Act, 1968" was conducted from 5th to 7th July, 2021.** A total of 27 officials were participated from various state department of Agriculture (Andhra Pradesh, Jammu and Kashmir, Maharashtra, Puducherry and Uttarakhand).

Another training on "**Inspection, Sampling and Prosecution Procedure under Insecticide Act, 1968"** was conducted from **20th to 24th Sept 2021** through offline mode**.** A total of **5 officials** were participated from state department of Agriculture Tamil Nadu and Uttar Pradesh.

Pesticide Formulation Analysis:

"**Pesticide Formulation Analysis" program for 60 days** was conducted through offline mode from **9th Aug to 7th Oct 2021** at new PMD laboratory**.** A total of **9 officials** were participated from various state department of Agriculture (Bihar, Haryana, Maharashtra, and Tamil Nadu). The program is designed for the Insecticide Analyst working at state Pesticide Testing Laboratories (PTLs) / Regional PTLs / Central Insecticide Laboratories. This training focuses more on practical classes rather than theory to learn and perform on various techniques such as volumetric, spectroscopic and chromatographic methods as per the BIS method.

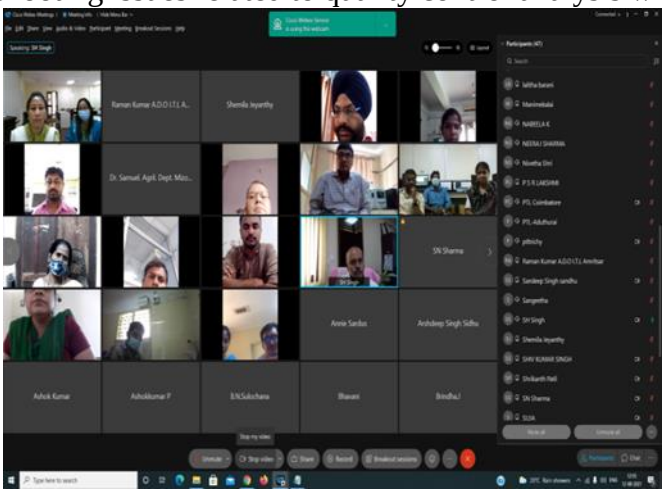
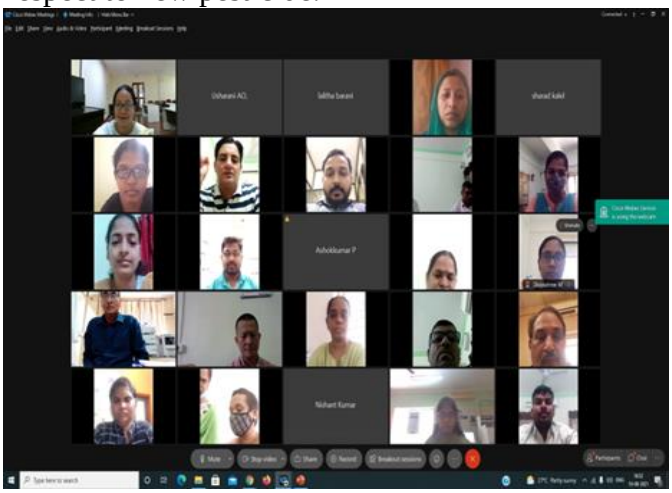
The training is to build the capacity of Insecticide Analysts undertaking the Quality Control analysis of Pesticide Formulations on different analytical technique such as volumetric analysis, Chromatographic and Spectroscopic techniques using High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), UV-Vis Spectrophotometer and Fourier-transform infrared spectroscopy (FT-IR) as per Bureau of Indian Standard method.

Pesticide Formulation Analysis training


Valedictory PFA (07.10.2021)

Refresher program on Pesticide Formulation Analysis w.r.t new pesticide

A "**Refresher program on Pesticide Formulation Analysis w.r.t new pesticide**" was conducted from **10th to 12th Aug 2021** through online mode**. A total of 32 participants** were participated from different state pesticide testing laboratory (Andhra Pradesh, Rajasthan, Maharashtra, Karnataka, Kerala and Tamil Nadu). The training designed for Insecticide analyst who undergone training on "Pesticide Formulation Analysis-60 days". The training focuses more on analysis of new pesticides which were not covered during 60 days training on Pesticide Formulation Analysis and discussion on troubleshooting issues related to quality control analysis with respect to new pesticide.

Laboratory Quality Management System and Internal Audit as per ISO/IEC 17025:2017

Training on "**Laboratory Quality Management System and Internal Audit as per ISO/IEC 17025:2017"** was conducted from **27.09.2021 to 01.10.2021** through offline mode**. A total of 20 Participants** were participated from different state pesticide testing laboratory (Maharashtra, Uttar Pradesh, Haryana, Madhya Pradesh, Punjab and Tamil Nadu). The basic idea of the training is to understand the general requirement for testing and calibration laboratory as per International Standard ISO/IEC 17025 2017. This will be benefited to maintain the quality of testing and validity of the test report. The training focuses more on each clauses of the International Standard ISO/IEC 17025 2017 to understand clauses such as terms and definition, general requirements, structural requirements, resource requirements, process requirements and management system requirements and the practical knowledge of process of Internal Audit.

Laboratory Quality Management System and Internal Audit as per ISO/IEC 17025:2017

Forthcoming Training Programmes:

Sl. No.	Title of the Programme	Duration	From	To	Eligibility Criteria
1.	Documentation procedures for NABL accreditation for PTLs and PRLs	4 days	25.10.2021	29.10.2021	Analysts / Scientists / Technical Staff with training on ISO/IEC 17025 working in Laboratories of State Govt./ Central Govt / ICAR / Govt. Universities
2.	Method validation and Measurement of Uncertainty in Pesticide Formulation and Residue Analysis	5 days	08.11.2021	12.11.2021	Analysts working at SPTLs / RPTLs/CIL and other Government Labs engaged in Pesticide Formulation Analysis (PFA) with training on Pesticide Formulation Analysis (PFA) of NIPHM.

3.	Testing of Physicochemical properties of Pesticide formulations	5 days	22.11.2021	26.11.2021	Analysts working at SPTLs / RPTLs / CIL and other Government Labs engaged in Pesticide Formulation Analysis with training on Pesticide Formulation Analysis (PFA) of NIPHM
4.	Inspection, Sampling and Prosecution Procedures under Insecticide Act, 1968(ISPP)	5 days	06.12.2021	10.12.2021	Agricultural / Horticultural Officer (or equivalent position) working in State Department (or) designated Insecticide Inspector (Central / State)
5.	Sampling of Fruits, Vegetables and other items and Calibration of laboratory equipment for Pesticide Residue Analysis	5 days	13.12.2021	17.12.2021	Science Graduate Analysts / Scientists / Technical Staff working in testing labs of State Govt. / Central Govt. / ICAR / Govt. Universities
6.	Sampling of Fruits, Vegetables and other items for Pesticide Residue Analysis	2 days	13.12.2021	14.12.2021	Science Graduate Analysts / Scientists / Technical Staff working in testing labs of State Govt. / Central Govt. / ICAR / Govt. Universities

Plant Health Engineering Division

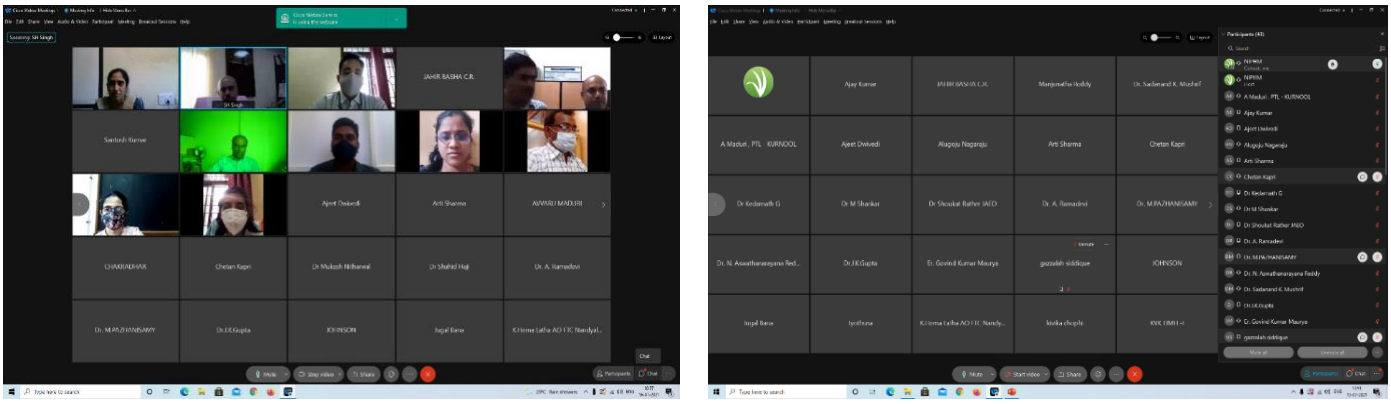
Training programmes

S No	Catogory	Name of the programme	No. of Days	From	To
1	Officer	Pesticide Application Techniques & Safety Measures	05	12.07.2021	16.07.2021
2	Officer	Irrigation Systems and Advancements	03	10.08.2021	12.08.2021
3	Officer	Pesticide Application and Safety Measure (Collaborative programme with EEI, Nilokheri)	05	03.08.2021	07.08.2021
4	Officer	Pesticide Application Techniques & Safety Measures	05	13.09.2021	17.09.2021
5	Officer	Post-harvest management and storage techniques	05	20.09.2021	24.09.2021
6	Farmer	Farm Machinery and Equipment for Plant Health Management	01	09.07.2021	09.07.2021
7	Farmer	Pesticide Application Techniques	01	19.07.2021	19.07.2021
8	Farmer	Pesticide Application and Safety Measure	01	04.08.2021	04.08.2021
9	Student	Pesticide Application and Safety Measure (Students)	01	02.08.2021	02.08.2021

Officers Programmes

i. Pesticide Application Techniques & Safety Measures:

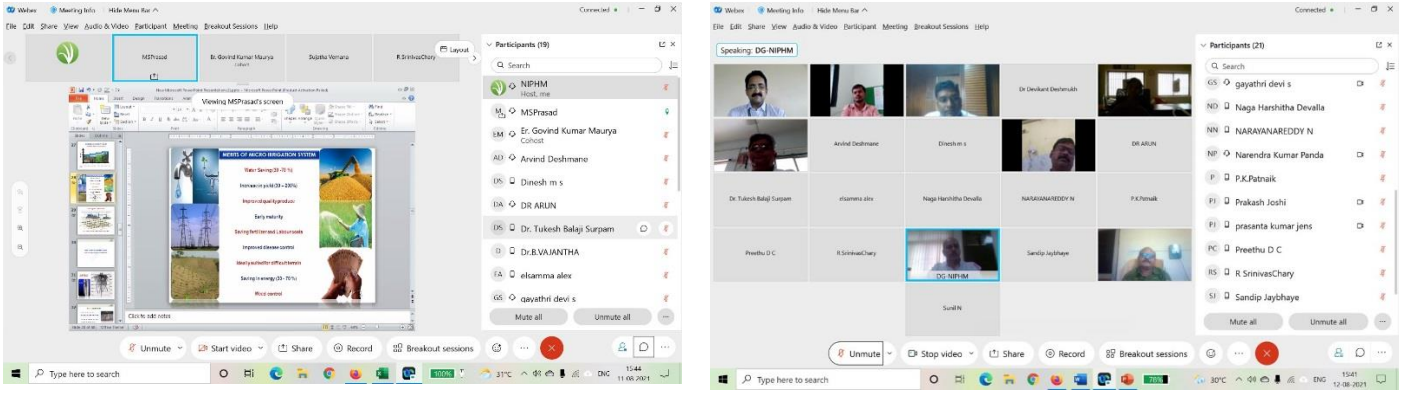
The success of pest management operations depends on proper technique of application of pesticide and the equipment used. Selecting the right equipment for pesticide application is vital for successful pest control to ensure safe and judicious use of pesticides. Huge amounts of pesticides are wasted or unnecessarily applied, and persons involved in spraying are exposed to serious risks of pollution. Application of pesticides is being done mostly by untrained operators and they also take most of the decisions in the field themselves. Further, managing the various types of nozzles used, applicator selection, safety precautions etc are also important and needs to be educated to all stakeholders. In this context, a five-day training programme on Pesticide Application Techniques and Safety Measures was organized to trainers who in turn will be imparting training / applying the knowledge gained to other stakeholders Total 38 officers, 28 male and 10 female participants attended the programme from 11 states of country.



Glimpses of training programme

ii. Irrigation Systems and Advancements

Total 23 officers, 16 male and 07 female participants attended the 3-day programme, conducted during 10th to 12th August 2021. Lectures were arranged on topic viz., An overview of Irrigation Techniques and Discussions, Design of Micro Irrigation systems with case studies, Water and Nutrients Management with Fertigation, Technologies for Increasing Water Productivity in Agriculture, Cost estimation and subsidy in pressurized irrigation systems, Care and Maintenance of Micro-Irrigation systems and Advancement in irrigation technology. Three guest speakers were invited to deliver lectures: Dr. C.L. Verma, scientist from ICAR-CSSRI, Lucknow, Mr. M. Prasad, Chief Agronomist from Jain Irrigation Systems Private Limited and Dr. Abdul Hakeem, Professor, KAU, Kerala. Pre and post evaluation along with assignments on various sessions were given to assess the knowledge transfer. Good appreciation received from the participants.



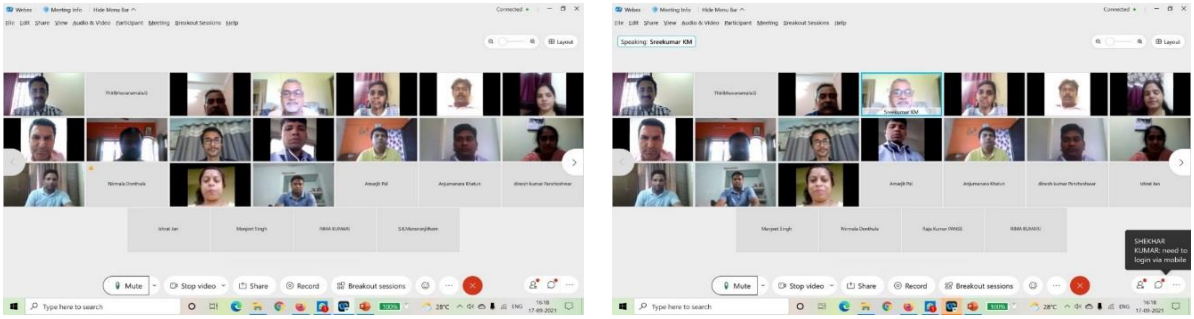
Glimpses of training and valedictory session

iii. Pesticide Application Techniques and Safety Measures (Collaborative programme)

An online training program in collaboration with Extension Education Institute, Neilokheri on "Pesticide Application Techniques and Safety Measures" was organized through google meet platform. A 5-day training on "Extension Strategies for Application of Techniques and Safety Measures" was moduled by EEI, Neilokheri in which NIPHM collaborated and provided training on Pesticide Application Techniques and Safety Measures. Total 28 participants (Male - 22, Female - 6) attended the training program. The participants were from 7 different states. The participants were trained on different aspects such as basic principles of spraying, different spraying techniques, selection of sprayer, nozzles and its classification, selection of nozzle, calibration of sprayers and nozzles, safety precautions and safe handling of pesticides.

iv. Pesticide Application Techniques and Safety Measures:

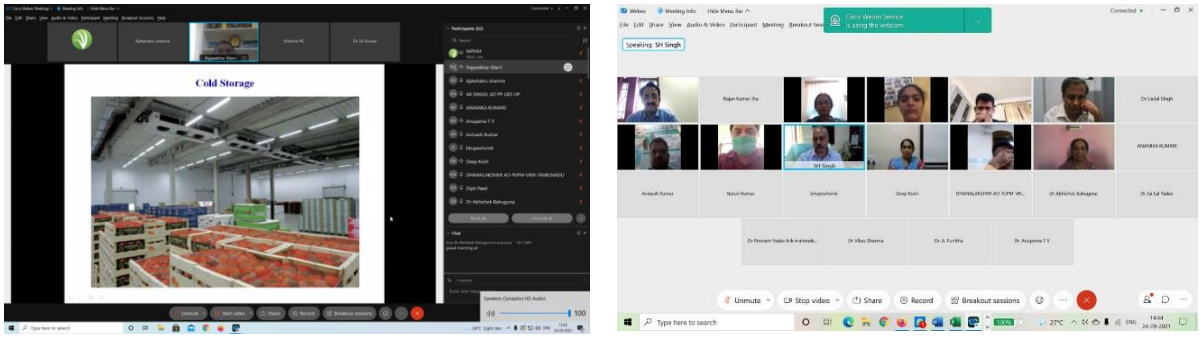
Total 44 officers, 30 male and 14 female participants attended the 5-day programme, conducted during 13th to 17th September 2021. Lectures were arranged on topic viz., different aspects such as basic principles of spraying, different spraying techniques, selection of sprayer, nozzles and its classification, selection of nozzle, calibration of sprayers and nozzles, pesticide formulations and compatibility, safety precautions and minor maintenance of pesticide application techniques. Pre and post evaluation along with assignments on various sessions were given to assess the knowledge transfer. Good appreciation received from the participants.



Glimpses of training and valedictory session

v. Post-Harvest Management and Storage Techniques:

Total 66 officers, 43 male and 23 female participants attended the 5-day programme, conducted during 20th to 24th September 2021. Lectures were arranged on topic viz., Post-harvest losses of Agricultural commodity, Post-harvest losses of fruits and vegetables, Cleaning and grading of agricultural commodities, fruits and vegetables, Drying and storage for Agricultural commodity, Drying and dehydration for fruits and vegetables, Storage and transportation facilities for fruits and vegetables, Import and export facilities for agricultural commodities, Packing methods and material, Machineries used for processing and Alternative processing methods. Four guest speakers were invited to deliver lectures: Dr. S Bhuvaneswari, Principal Scientist IIHR, Dr. M Rajasekhar, Associate Dean, CoH, Mojerla, Dr. Shankaraswamy, Ast. Prof. CoH, Mojerla and Dr. Anand Kumar, Ast. Prof, IIFPT. Pre and post evaluation along with assignments on various sessions were given to assess the knowledge transfer. Good appreciation received from the participants.

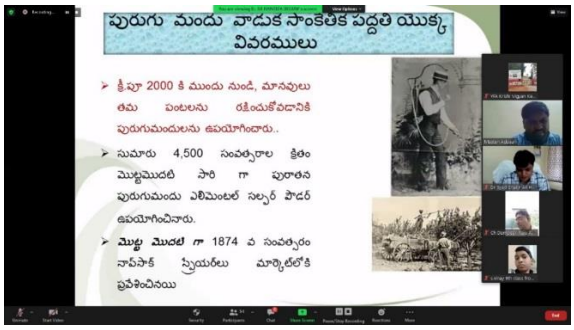


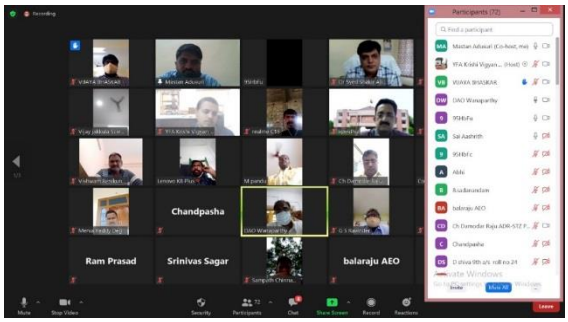
Glimpses of training and valedictory session

Farmers programmes:

i. Farm machinery and Equipment for Plant Health Management

A farmer training programme in virtual mode in collaboration with YFA-Krishi Vigyan Kendra, Mahabubnagar- 1 was organized on 09.07.2021. Total 65 farmers attended the programme. The training emphasis on selecting the right equipment for pesticide application, weeding for successful pest control, serious risks of envornmental pollution, advances in farm machinery and operational safety precaution.

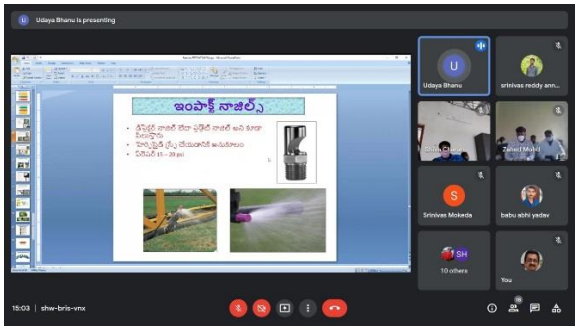




Glimpses of training programme

ii. Pesticide application Techniques

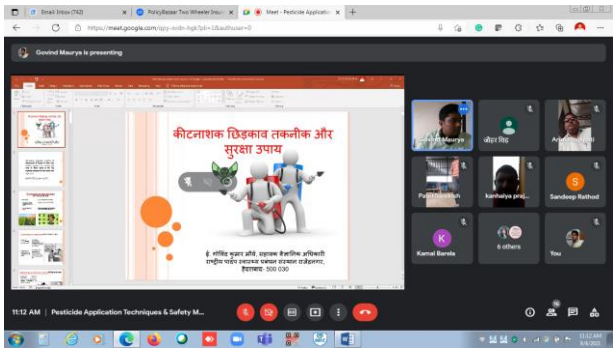
A one-day virtual training programme on “Pesticide Application Techniques” was organized on 19-07-2021 for farmers of Konaraopet Mandal, Rajanna Sircilla district A total of 22 participants attended and got benefitted in the training program. The training was conducted in Telagu covering all the aspects of plant protection technology viz. Nozzle selections, safety measures and care & maintenance of PPE.

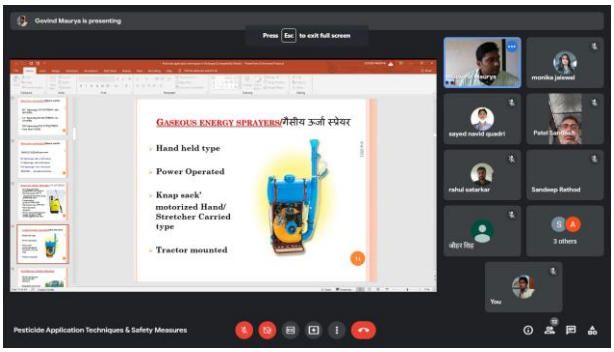


Glimpses of training programme

iii. Pesticide application Techniques and Safety Measures

A one-day virtual training programme on “Pesticide Application Techniques” was organized on 04-08-2021 for farmers of Burhanpur district, Madhya Pradesh. The programme was organized in association with KVK, Burhanpur. A total of 30 participants attended and got benefitted in the training program. Basic spraying principles & Techniques and Safety precautions were emphasized in the programme. The farmers were also briefed about the types of nozzles and the importance in selecting a nozzle. They were also explained how to calibrate a nozzle to know its wear and tear. The importance of safety precautions while handling chemicals was explained. The demonstration with safety gadgets was made with a farmer. The Dos and Don’ts while handling chemicals is explained.





Glimpse of Farmers Training

Special training programme :

Pesticide application Techniques and Safety Measures

A request-based training programme of one day on "Pesticide Application Techniques and Safety Measures" for Post Graduate students of Forest College and Research Institute, Mulugu was conducted on 2nd August 2021. The one-day program was moduled in such a way that both theory and practical are covered. The practical on different high-volume sprayers, low volume sprayers and ultra- low volume sprayers were carried out. In high volume sprayers, the practical was conducted for lever operated sprayer, battery operated sprayer and power sprayer. In low volume category, the practical was conducted for NIPHM developed low volume sprayer and Mist blower. In ultra-low volume category, the practical was conducted for Battery operated handheld ULV sprayer.

Glimpses of Demonstration and practical

Educational Programs:

Diploma programme (Session 2020-21):

Regular theory and practical classes were conducted for the students. In the second semester, PGDPHM has only one course and remaining is project work. The mid term and final examination as per the schedule was conducted for the session. The final project viva also was conducted and reviewed based on the results.

Diploma programme (Session 2021-22):

The advertisement for the new session of 2021-22 was released on 14th July 2021. The application deadline to session was on 16th Aug 2021. Total 78 students applied for the programme. The entrance examination was conducted on 31st August 2021. Total 55 students qualified for the examination. Among the qualified students, 20 confirmed for joining the programme.

The registration process of the programme was conducted on 24th Sept 2021. The inaugural ceremony was convened on 27th sept 2021. Hon. Director General inaugurated the programme. Course Director briefed about the programme. Advisors wished the students on the occasion. Director General motivated the students for a bright and dynamic study environment at NIPHM. The academic brochure was released during the function.




Forthcoming Training Programmes

S. No	Title of the Programme	Division	From	To	Eligibility criteria	Course Coordinator & e-mail
1.	Efficient use of water resources	**PHE**	**20.10.2021**	**22.10.2021**	Extension officers from State Dept. of Agri./ Horti., soil survey, soil conservation, Watershed Project, Scientists of ICAR/ SAUs , etc.	Er. Govind Kr Maurya asopheniphm1-ap@nic.in
2.	RS & GIS applications in Plant Health Management	**PHE**	**08.11.2021**	**12.11.2021**	Extension officers from State Dept. of Agri./ Horti., soil survey, soil conservation, Watershed Project, Scientists of ICAR/ SAUs , etc. working on GIS	Er. M. Udaya Bhanu sopheniphm2-ap@nic.in

3.	Plant Protection Techniques for Plant Health Management	**PHE**	**03.12.2021**	**23.12.2021**	Extension officers from State Agriculture and Horticulture departments, Scientists of ICAR, SAUs and officials from KVKs, DPPQs. NGOs	Dr. Vidhu Kampurath Poduvattil, Joint Director-PHE jdenggniphm-ap@nic.in Er. Govind Maurya asopheniphm1-ap@nic.in
4.	Pesticide application techniques and safety measures	**PHE**	**06.12.2021**	**10.12.2021**	Extension officers from State Agriculture and Horticulture departments, Scientists of ICAR, SAUs and officials from KVKs, DPPQs NGOs	Dr. Vidhu Kampurath Poduvattil, Joint Director-PHE jdenggniphm-ap@nic.in

Special Events

Parthenium awareness week at NIPHM

Parthenium, also known as carrot grass, is a problematic and aggressive weed posing a serious threat to agriculture, the environment and human health. It causes health hazards like skin allergy (dermatitis), hay fever and asthma in human beings, and is also toxic to livestock. It threatens native biodiversity besides the loss to crop productivity. It is a nuisance in public amenity areas like parks, residential colonies and orchards. It harbors other pests like mosquitoes, cockroaches, rodents, etc. in an urban area. The weed squeezes grasslands and pastures, hence reducing the fodder supply. In view of the above, an awareness week was observed at NIPHM from 16-22 August 2021. The programme was inaugurated by Director-General, Dr.Sagar Hanuman Singh, IPoS on 16.08.2021. On this day a guest lecture on *Parthenium* and its control measures was arranged for all the staff of NIPHM, trainees, and students. An awareness programme was organized in Mohammed Nagar village of Medak District, involving farmers and college students and explained the growth habit of *Parthenium*, its impact on the environment, agriculture and its management. Mass removal of *Parthenium* weed from the NIPHM campus and staff quarters by all staff members was organized under the leadership of the Director-General, NIPHM and emphasized *Parthenium*-free campus.




Free Medical Check-up camp was conducted by M/s. Germenten Hospital, Attapur, Hyderabad at NIPHM on 09.07.2021 from 2:30PM to 05:30 PM. The camp comprises Doctor Consultation and Orthopedic, General health checkup, Dental health checkup, Checkup by Gynaecologist, Checkup by Dermatologist (Skin Specialist) and Checkup by Orthopedic. The camp utilized by all the staff of NIPHM.


- The 75th Independence Day has been celebrated at NIPHM on 15.08.2021. Dr. Sagar Hanuman Singh, IPoS, Director General, NIPHM has hoisted the National Flag in the office campus. Following the flag hoisting ceremony, the quiz competitions were conducted among the officer/staff working at NIPHM on 15.08.2021.




- Dr. Abhilaksh Likhi, IAS, Additional Secretary (Plant Protection), Directorate of Plant Protection, Quarantine & Storage, DAC&FW visited NIPHM on 03.09.2021.





- The Hindi Fortnight - 2021 was organized from 31.08.2021 to 14.09.2021 by conducting various competitions in Hindi. Hindi Diwas was celebrated on 14.09.2021 at NIPHM wherein, all the officers and staff of NIPHM have participated.







Research & Development

The Pesticide Formulation and Residue Analytical Centre (PFRAC) of Pesticide Management Division under Central Sector Scheme "*Monitoring of Pesticide Residues at National Level (MPRNL)*" collected and analyzed about 280 samples (Fruits, vegetables, cereals, pulses, milk and water) for pesticide residues. Sixty samples viz. Apple and Tomato were analyzed under "*How Safes are Your Veggies*" program. During the period, 35 samples (leafy vegetables-30 nos, river water-5 no.) were tested for heavy metals. A total of 29 botanical bio-pesticides samples were received from different state of Bihar, Gujarat, Telangana and Karnataka Insecticide Inspector and the samples were tested for pesticide contamination.

Proficiency Testing Center (PTC), Pesticide Management Division initiated PT program on pesticide formulation analysis during May to June (PTC/PF/01, 02 & 03/2021-22). The Final report of this program viz. imidacloprid technical (Active ingredient), tricyclazole technical (Active ingredient), pretilachlor -EC (Active ingredient) were prepared and sent. PT-PRA program on Pesticide Residue Analysis initiated in the month of July for Rice and Cabbage samples are dispatched to 31 participants (Govt. Laboratories).


Sample extraction & Analysis (Pesticide Residues Analysis)

1. **Deciphering The Mechanism of Resistance to Root Lesion Nematode in Chickpea by Using Genetic and Genomic Approaches**

   Project progress during this quarter:

   - Soil samples were analyzed received from the farmer's field to get Root lesion nematode (*Pratylenchus thorni*) for the chickpea germplasm screening. We could not get the required species of nematodes for the experiments same is discussed with other collaborators from JNKVV Jabalpur MP/ TNAU Coimbatore and planned to send the Technical assistant (Nematology) after appointing to collect the soil samples infested with root-lesion nematode in chickpea crops with official permission.. Procurement of

consumables in the DST-SERB funded project submitted for purchase through GEM PORTAL was completed.

- Recruited Technical assistant (Nematology). Explained project proposal to the newly joined Technical Assistant (Nematology) on 29th July 2021 in the project. Analyzed 3 soil samples from banana ecosystem for the infestation of Root Lesion Nematodes (RLN). Scrutinized Chickpea germplasm accessions (core collections) received from ICRISAT (Total no: 208). Had E-mail communication with scientist at ICRISAT regarding detailed plan of experiment
- Collected soil samples from ICRISAT field to check RLN infestation. Soil samples were analyzed for RLN infestation. Prepared the glass house for experiment. Prepared temporary mounts for RLN genus identification
- Communicated for the collection of RLN from sick plots from JNKVV Jabalpur MP on 20th September. Arranged accommodation and vehicle to move to the Root Lesion Nematode infested locations in the University (JNKVV) and to collect the nematode culture

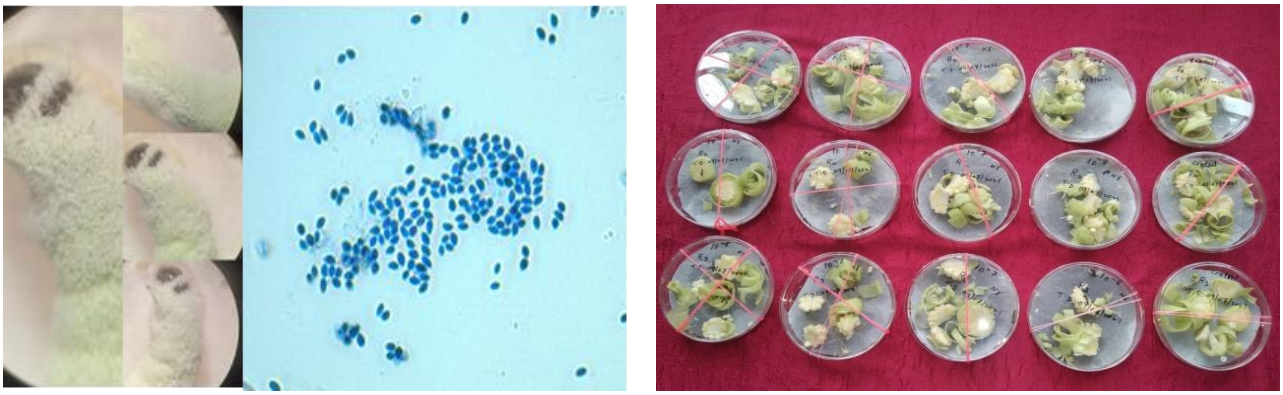
2. AICRP on Biological Control of Crop Pests (ICAR-AICRP-BC)-NIPHM, Hyderabad (Volunteer Centre)

a. Evaluation of NIPHM white media for production of *Nomuraea rileyi (Metarhizium rileyi)* NIPHM MRF-1 strain for management of Maize Fall Army worm (*Spodoptera frugiperda*)

This project aimed for the production of *Metarhizium rileyi* two media viz. NIPHM White media and broken rice were used. To standardize the production technology, the media under test were made into six treatments (Broken rice (without yeast extract), Broken rice (with yeast extract), 1% NIPHM white media, 2% NIPHM white media, 3% NIPHM white media, 4% NIPHM white media)and for each treatment two replications were maintained.

Project progress during this quarter:

- Single spore germination of *Nomuraea* on 2% water agar was tested. Preparation of stock of Nomureae by counting spores on haemocytometer for performing Bio-assay on *Spodoptera frugiperda* and bio assay performance.
- Bio-assay Observation recorded (Dead, Live and escape for different concentration). Sporulation on *Nomuraea* infected *Spodoptera frugiperda* larvae seen. Sporulating *Nomuraea* isolated from infected *S. frugiperda* maintenance in SDA media slants and sub cultured on SMAY Broth for spore suspension preparation which will be further inoculated in 2% White media for quality check. Inoculation of sporulating *Nomuraea* in SMAY Broth (spore suspension) into 2% White media for quality check. Sporulation of *Nomuraea* in 2% white media and quality check of *Nomuraea* by performing serial dilution. Performing CFU test for quality check and Mass multiplication of *Nomuraea* on Corcyra waste. Soaking and sterilization of *Corcyra* waste. Subculture of 5ml of *Nomuraea* mother culture broth in 200 g of *Corcyra* waste for mass multiplication of *Nomuraea.*



***Nomureae* Bio-assay on *Spodoptera frugiperda* larvae Observations**

Inoculation into 2% White media for quality check

Mass multiplication of *Nomuraea* on *Corcyra* waste (4DAI)

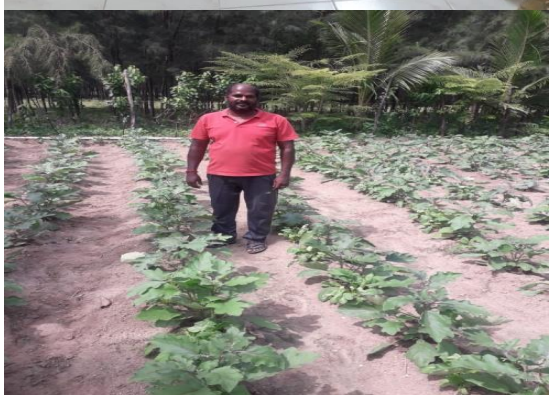
3. **IPM model villages under Tamil Nadu Irrigated Agriculture Modernization Programme (TN-IAMP)**
NIPHM and Department of Agriculture, Tamil Nadu has entered into a MoU for take up project on '*Model IPM village'* under the scheme of TNIAMP with objectives like to provide technical assistance to all beneficiary farmers in 20 IPM villages under the Lower Palar Sub basin for establishment of cost effective sustainable Bio-control Agents' production units in Kancheepuram District, Tamil Nadu, to train the farmers in understanding of Good Practices in production and quality maintenance, to provide the mother culture and media initially based on the existing norms of the institution.
Project progress during this quarter:

- Success stories collected from progress farmers. Planning of Kharif 2021 field trials of biocontrol agents (biofertilizers and biopesticides) was discussed to senior consultant. Started mass production of Biofertilizers and biopesticides are produced by farmers group for Kharif 2021 (Guided and monitor by senior consultant). During visits to each cluster, SOP instructions given by senior consultant. Virtual meeting was conducted through online mode for production of bioagents for upcoming season.

- As per the approved schedule, production of bioagents and field trials was conducted. Project progress report collected from senior consultant and guided on further activities. Field trials of biopesticides and biofertilizers are conducted at Chenkalpattu and Kancheepuram, Tamil Nadu. Monitored by senior consultant. Send media and mother culture to the host farmers under scheme of the project.





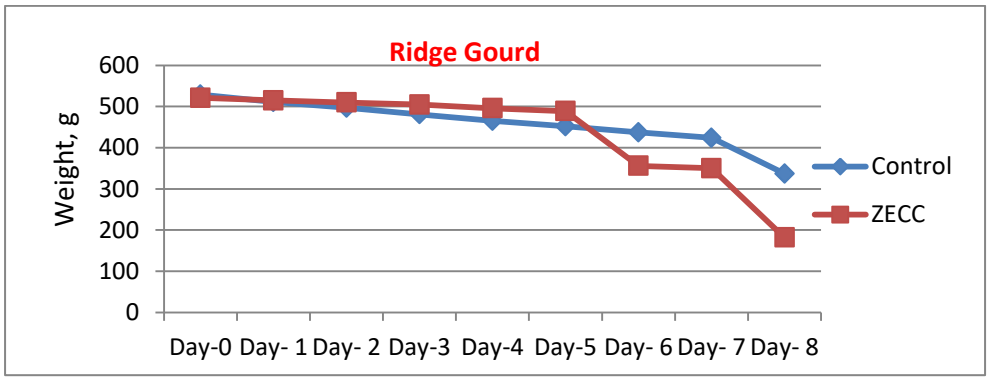



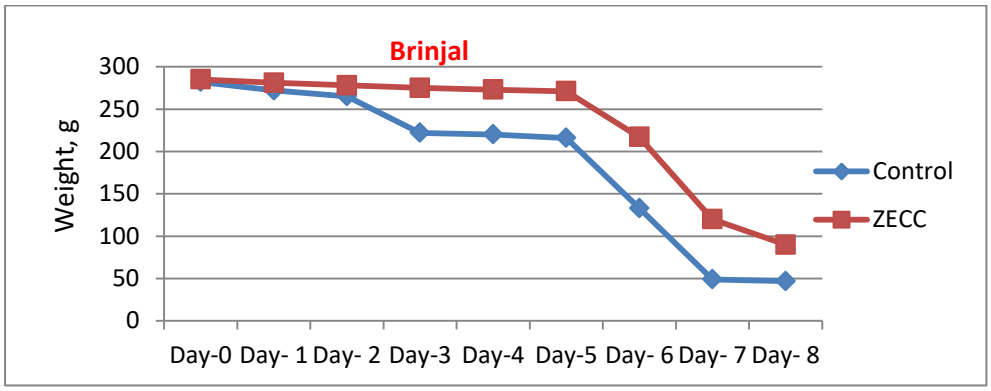
Construction and Evaluation of Zero energy cool chamber

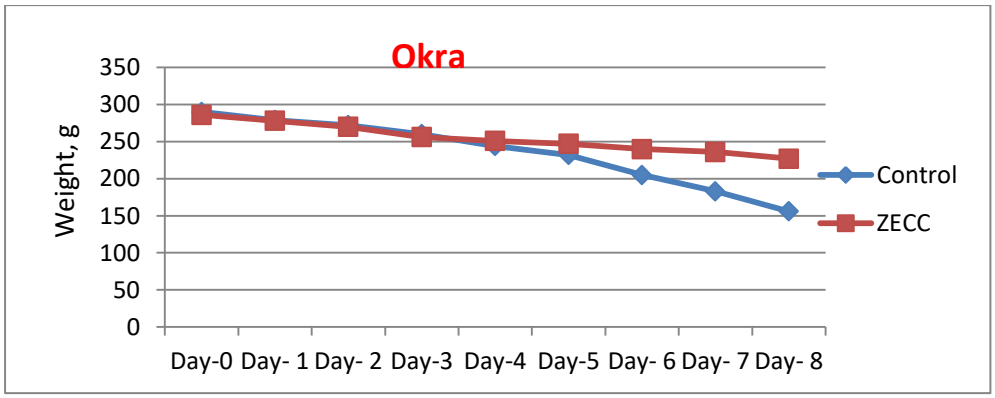
Zero Energy Cool Chamber is an eco-friendly storage system that doesn't require any type of energy to be adopted. This system is developed by IARI. This system maintains low temperature and high relative humidity inside the chamber based on the principles of passive evaporative cooling mechanism. It can be constructed easily with locally available materials like bricks, sand, bamboo, straw, gunny bag etc., with a source of water at field level. This chamber is ideal for storage for a short period and helpful for small and marginal farmers to store their fruits and vegetables. A cool chamber was designed and constructed for the purpose of demonstration to trainees.


The performance evaluation of ZECC is under process to optimize the parameters of the chamber. The inside and outside temperature and RH are measured to evaluate the ZECC.


For evaluation of ZECC, the shelf life of commodities grown at NIPHM field were taken to evaluate the shelf of commodities outside and inside ZECC. The commodity selected were Ridge gourd, Brinjal and Okra.







Variation of Weight loss(gm) in ZECC and control for different vegetables

i. Study on Wear Characteristics of Sprayer Nozzles

To study wear of nozzle, three of different materials plastic, brass and stainless steel were taken. In these three materials hollow cone, flat fan and flower nozzle were taken and operated at normal operating pressures i.e. 40, 25 and 40 PSI were taken respectively. The data were collected for wear of different materials, increase in flow rate, profile of worn nozzles at 25 hours interval up to wear of nozzles.

The wear of nozzles is being compared with different carriers, i.e., bore water and municipal water.

ii. Feasibility studies on conversion of pack house into cold storage and establishment of facility at Institute:

As a part of project, visited Ansh Agronomy Pvt Ltd, Chinnarevalli village, Balanagar Mandal, Mahabub Nagar district, to see the active packhouse operations and facilities available. In the packhouse, cleaning and grading are performed by manual labour. Precooling, ripening and cold storage facilities were available in packhouse. Here, they are processing herbal plants, vegetables, leafy vegetables and fruits, after processing they are exporting the commodities to UK, Germany and other countries.


Extension Activities / Village Adoptions

Extension activities:
Village adoption, special activities at adopted village

As per the approval of the competent authority, NIPHM staff Ms.Lavanya, SO (BP&BC), and Dr.K.Damodara Chari, ASO (Micro) made a visit to the Mohammed village along with Ekalavya Foundation, KVK, Medak staff on 17.08.2021 and organized an awareness programme on *Parthenium* weed to the students and farmers. In the KVK campus, mass removal of *Parthenium* activity was done. Later explained and demonstrated compost preparation with Parthenium by using *Trichoderma* formulation.

Institutional Visits by the faculty:

As per the request by centre of Excellence, Mulugu, NIPHM staff visited and observed different nursery seedlings at Centre of Excellence. The CoE staff, Shri Bagylashmi, ADA, Mr. Padbhanabam, AD, and Horticultural officers interacted. The observations made during visit are, the sandal wood seedlings are facing nutrient deficiencies like Fe & Zinc, No diseases are diagnosed in sandal wood seedlings, Tomato seedlings also in good condition, they are recommending chemical sprays for nutrient deficiency symptoms, Suggested organic method of seedling nursery growing and process explained, created Knowledge about NIPHM bio products availability and mechanisms,

Given some bio products of NIPHM and given information regarding usage in sandal wood and other seedlings (Tomato etc.)

Chilli farmers meeting:

NIPHM team visited the Minister's meeting on chilli nursery management at Raghunathapuram, Khammam district. Our team explained biological disease management in chilli crop during the nursery stage and demonstrated different types of bio inputs usage in chilli crop.

Village adoption: A collaborative training programme conducted with a participation of 65 farmers. Farm equipment for plant health management was covered in one day training programme on 09-07-2021. Good appreciation received from the participants. KVK extended all help and support for continuing the village level project of spray awareness to farmers. Dr. Vidhu Kampurath, JD(PHE) and Er. Govind Kumar Maurya, ASO (PHE) visited KVK Mahaboobnagar and discussed in detail for starting the project. Roles and responsibilities defined for a minimum 3 season data collection.

Faculty Achievements

Faculty achievements (Publications / trainings / webinar-seminar / Awards etc)

Webinar/Seminar

i. Er. Govind Kumar Maurya, ASO(PHE) attended National Workshop on Water Budgeting: An approach for Sustainable water resources management in Rajasthan organized by MPUAT, Rajasthan

ii. Dr. Vidhu Kampurath P, JD(PHE) and Er. Govind Kumar Maurya, ASO(PHE) attended the first biannual meet of National Network of Plant Health Experts, conducted at NIPHM on 22nd July 2021. Four expert lectures were delivered in the area of plant health management.

iii. Dr. Vidhu Kampurath P, JD(PHE) attended and actively participated in the IEI Technical webinar-E Waste- A Challenge for Sustainable Development on 3rd July 2021.

iv. Dr. Vidhu Kampurath P, JD(PHE) Participated in webinar on 'Adoption of improved tools and technologies for rural women' on 22nd July 2021, conducted by India Science, Technology and Innovation, under DST, GoI
v. Dr. Vidhu Kampurath and Er. Govind Maurya participated in the International Webinar on "Sustainable Groundwater Management: Current Challenges Around the Word" organized by Department of Soil and Water Engineering, CTAE, MPUAT, Udaipur, on 2nd August 2021.
vi. Dr. Vidhu Kampurath P attended as Special Invitee in the Academic Council Meeting of VFSTR Deemed to be University on 3rd August 2021.
vii. Dr. Vidhu Kampurath P & Er. Govind Maurya attended webinar on Challenges of intellectual propert right, conducted by MPUAT Udaipur on 6th August 2021.
viii. Dr. Vidhu Kampurath attended the Prof. K. N. Nag Memorial International Webinar Series 'My Professional Journey- Experience Sharing & Lessons of Life' on 08-08-2021.
ix. Er. Haneefa Begum attended ICC Agri Exports Conclave on 18.08.2021.
x. Dr. Vidhu kampurath participated in the International Webinar on Emerging Technologies in Agricultural Engineering for Food Safety and Security, conducted under NAHEP-IDP programme by Acharya NG Ranga Agricultural University, Bapatla, AP, during 25th to 27th Aug 2021.
xi. Dr. Vidhu Kampurath P participated in the World Water Week lectre series, organized by KSCSTE-CWRDM during 24th to 27th August 2021.
xii. Dr. Vidhu Kampurath attended 7th foundation seminar of PJTSAU.
xiii. Er. Govind Maurya attended webinar on " Land modification based on integrated farming system models for reclamentionand Mgt for watershed salt affected soil for India.
xiv. Er. M Udaya Bhanu attended webinar on Agriculture Technology by *Kisanmitr* programme.
xv. Er. Govind Kumar Maurya attended Transboundary waters webinar conducted by IWMI, MEWF.
xvi. Dr. Vidhu Kampurath and Er. Govind Kumar Maurya attended webinar on "Roadmap on Agriculture Mechaniztion in state of Madhya Pradesh" organized by CIAE Bhopal.

Other Activities

Other Significant Activities:

a. Online course on Plant Biosecurity (MOOCs): The sixth batch is started on 01.09.2021 with 35 candidates are attending the course.

b. Massive Open Online Course (MOOCs) in Rodent and Household Pest Management: The fourth programme is started on 01.09.2021. Twenty two participants are undertaking the course.

c. Farmers Advisory Cell:

i. The advisories related to pest management and related trainings to the farmers were provided through phone calls/visits.
ii. The information related to fruit fly traps, UIPM training, pruning of Mango Orchids, septoria leaf spot of Tomato, Guava fruitfly trap were sought through phone calls/visitors by farmers.

d. One of the faculty delivered a guest lecture on SPS Measures in Directorate of Marketing and Inspection on 20 Sept, 2021.

e. One of the faculty delivered a guest lecture on "Pest management in the Changing Climate Scenario" in MANAGE, Hyderabad.

f. One of the faculty delivered a guest lecture on "fruit fly surveillance and management in horticultural crops" to the students and scientists of Punjab Agricultural University on 02.09.2021.

g. Two faculties from NIPHM visited the farmers at Pamenu village, Chevella and also the snail infested fields on 06.08.2021 for providing advisories on snail management in vegetable crops i.e. carrot, beetroot, cabbage, cauliflower, bottle gourd and tomato and also demonstrated tobacco decoction for snail management.

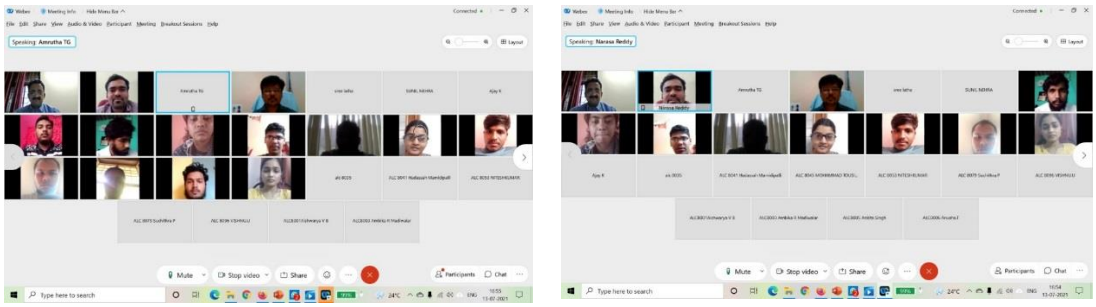
h. One of the faculties attended a meeting with Chilli Nursery growers at Raghaunathapalem Rythu Vedika, Khammam. The meeting was inaugurated by Honourable Agriculture Minister, Shri. Singireddy Niranjan Reddy. NIPHM has demonstrated the technologies viz. on farm production of bio-fertilizers and bio-pesticides to farmers.

Demonstration of NIPHM technologies to the Minister of Agriculture

Demonstration to the farmers

Other activities:

i. New Post-Harvest machinery proto types were purchased by PHE division for upcoming training programme.
ii. As nodal officer in insecticide dealers course for Gujarat state, several new batches started under KVK, Kutch.
iii. Two lights traps were sold to farmers, amount collected and submitted to accounts.
iv. A virtual tour to Agricultural students of University of Agricultural Science, Bangalore was conducted on 13th July 2021. The activities of the Institute were detailed to students and visiting faculty in a 2-hour session for 95 participants.



Glimpses of virtual tour

v. A meeting was conducted with M/s Marut Drones, a start-up companay who are dealing with drone related projects including spraying, who are already having association with PJTSAU / ICRISAT. NIPHM will have a collaboration for training, research works etc.

vi. Discussion held further with M/s Navariti Innovation, where technical personnel from company visited the campus. A proposal for 3-5 lines of polyhouse with moisture sensor installed along with environmental parameters for controlling irrigation is planned. Another demo model in front of the workshop also is being worked out as the system in polyhouse may have issues related to control of pressure.

vii. All divisional staff attended the awareness lecture on parthenium weed, its mitigation strategies. Further staff actively involved in mass removal of parthenium weed in Institute premises.

viii. All divisional staff attended the Hindi Diwas and staff also participated in some of the competitions.

ix. On 54th Engineers Day, the birth anniversary of Sir Mokshagundam Visvesvaraya, Division had a get-together to remember the services of great Engineer. All the divisional members participated and reaffirmed to work with vigour and commitment for better output.

x. All the staff Participated in awareness seminar on Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Rules, 2013 (“POSH Rules”), conducted by Internal Complaints Committee of the Institute.

NIPHM Instructional farm:

- During this quarter (July to September 2021) , the following farm activities are performed; In Okra crop - weeding, drip irrigation operations done, Red gram-weeding, drip irrigation was done, in Brinjal field crop was harvested, Maize-Irrigation and weeding. Groundnut- Application of enriched manures, spraying of neem oil and weeding was done, under Ecological engineering concept Sunflower seeds sown in fields,

Tomato transplantation was carried out. Natural enemies and pest are recorded and data prepared. Tomato- Irrigation, weeding and spraying of pongamia oil. Bittergourd- Irrigation and weeding. Paddy- Ploughing and nursery preparation, transplanting was done. Ridge gourd- Irrigation, weeding, harvesting and installed fruit fly traps.

- Under concept of NIPHM beautification, the ornamental plants propagation was carried out and established herbal garden in the campus. Established rose garden, other flower garden and apiary unit in the campus. Planted banana and spices at front side of LBS building.








Polyhouse (Protected cultivation)

During this quarter (July to September 2021) , the following farm activities are performed under protected cultivation.

- Prepared bunds and covered with mulch sheets. Sown cucumber, okra, spinach, coriander, carrot and beetroot. Transplanted tomato, broccoli and cabbage. Staking in cucumber and tomato.Cucumber-Irrigation, thinning, staking, Spraying of pongamia oil and harvesting
- Tomato- Irrigation, thinning, staking and Spraying of pongamia oil
- Broccoli- Irrigation, thinning, weeding, Spraying of pongamia oil and releasing of reduviid bugs
- Cabbage & Cauliflower - Irrigation, weeding and Spraying of pongamia oil, spraying of EPN and harvesting
- Okra- Irrigation, weeding and Spraying of pongamia oil and Spraying of EPF and harvesting
- Coriander- Irrigation, watering and harvesting
- Maintenance of hydroponics. Broccoli- Irrigation, thinning, Spraying of EPN and harvesting
- Coriander- Irrigation, watering and harvesting






Success Stories

Title: Spraying Technology in Gadchiroli District
Contributed by: Mr Pushpak Bothikar, SMS, Plant Protection, KVK, Gadchiroli

I had attended a training programme on 'Pesticide application techniques and safety measures', organized by PHE division at NIPHM for officials. We organized another off-campus training for officers and farmers at Gadchiroli, coordinated by Er. M. Udaya Bhanu & Er. Govind Kr. Maurya. With great efforts of officials and Head of KVK, Gadchiroli the programme was successfully conducted. Based on the programme, KVK assessed the sparying techniques implemented in the nearby areas.

Situation analysis/Problem statement:
No proper use of application of Sprayer in field.
No proper use of spraying concentration and nozzle.
No proper care during spraying, preparation of concentration and waste insecticide container.

Plan, Implementation and Support: Various activities were implemented by KVKs to demonstrate and train the people like awareness campaign through RAWE students, Agriculture department staff, BTM, ATMA etc. as they are under this programme on Care and management during spraying.

Output: Promising results received among participating farmers in executing correct techniques in sparying and care and management during spraying, during Kharif & Rabbi Season.

Outcome: Farmers are aware regarding Care and management during spraying. Also aware use of spraying concentration and nozzle, proper care during spraying, preparation of concentration and disposal of insecticide container. The behavioral change were observed with reguar visits and promotion through mass media by KVK staff.

Photograph of Demonstration during 2020-21


Visit to demonstration plot with farmers at Dhannur

Article 1

Organic Farming its Advantages and confines

VINAY TEJA PATHAKAMURI (PGDPHM 2021-22, NIPHM)

INTRODUCTION:

- Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, genetically modified organisms and livestock food additives.
- Organic farming is not a new concept, It has been practicing since ages by farmers but governments felt need of High yielding varieties and use of Chemical fertilizers which boost yields of farmers to feed the increasing population at the same time farmers are also attracted to the yields produced by fertilizer applied crops which lead to Green Revolution.
- It is an alternative to the Green Revolution's methods driven by chemical fertilizers and **pesticides** and intensive irrigation.
- Organic methods can increase farm productivity, repair decades of environmental damage and knit small farm families into more sustainable distribution networks leading to improved food security
- Use of massive inputs of chemical fertilizers and toxic pesticides poisons the land and water heavily.

AIMS:

- Reduce the impact of chemical fertilizers on soil and groundwater.
- To protect the soil from degradation.
- To improve water holding capacity of soil.
- To reduce the input cost of Farmers.
- Enhancing farm biodiversity and ecosystem services.
- Conserving environment and natural resources, re-establishing ecological balance.
- Encouraging sustainable agriculture.
- Reduce the massive inputs of chemical fertilizers and toxic pesticides that poison the land and water heavily.

ADVANTAGES:

- It reduces the cost of agricultural production and also improves the soil health.
- It not only saves energy for both animal and machine, but also reduces risk of crop failure.
- It improves the soil physical properties such as granulation, good tilth, good aeration etc.

LIMITATIONS:

- Organic manure is not abundantly available.
- Organic manure may be more expensive than chemical fertilizers if organic inputs are purchased.
- The guidelines for organic production, processing, transportation and certification etc are beyond the understanding of ordinary Indian farmer.
- Marketing of organic produce is also not properly streamlined.

GOVERNMENT INITIATIVES:

- Government of India has been promoting organic farming in the country through the dedicated schemes of *Paramparagat Krishi Vikas Yojana (PKVY)* since *2015-16* and also through *Rashtriya Krishi Vikas Yojana (RKVY).*
- In the revised guidelines of *PKVY* scheme during the year 2018, various organic farming models like Natural Farming, Rishi Farming,ZBNF ,etc. have been included wherein flexibility is given to states to adopt any model of Organic Farming .
- Under the *RKVY* scheme, organic farming/ natural farming project components are considered by the respective State Level Sanctioning Committee (SLSC) according to their priority.

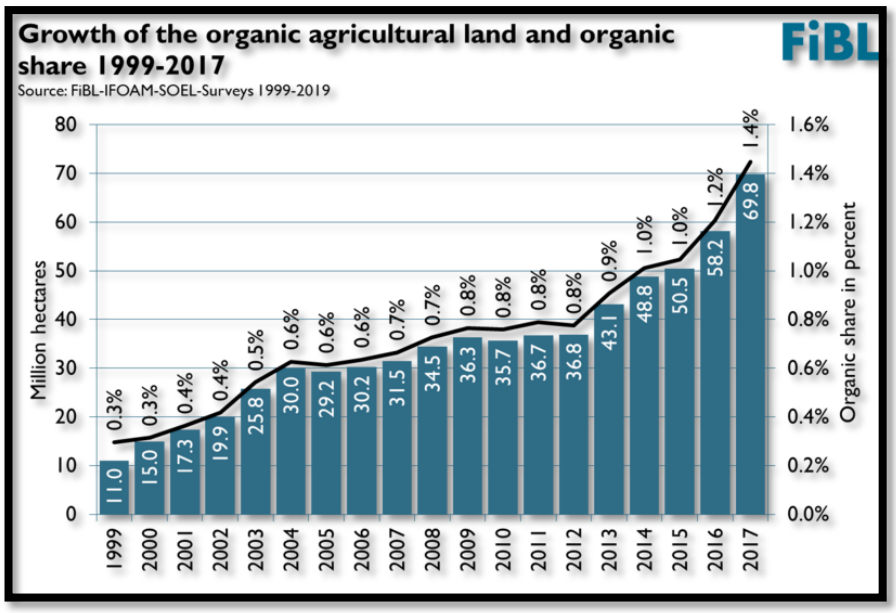
National Programme for Organic Production(NPOP)

EXAMPLE:

- Sikkim becomes India's first fully organic state.
- Area under cultivation of certified organic farming has grown 17 fold in the past one decade from 42,000 ha in 2003-2004 to 7.23 lakh ha in 2013-2014.
- In June 2018, Andhra Pradesh rolled out an ambitious plan to become India's first State to practice 100% natural farming by 2024. It aims to phase out chemical farming over 80 lakh hectares of land, converting the State's 60 lakh farmers to ZBNF methods.
- At present a total of 5,23,000 farmers of 3,015 villages in an area of 5,04,000 acres are practicing ZBNF in Andhra Pradesh.

CONCLUSION:

- According to FiBL Survey 2017 growth of the organic agricultural land and share are as follows.



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- The world of organic agriculture by Research Institute of Organic Agriculture(FiBL).
- Organic farming in the Country (http://pib.gov.in Government of India)

Article 2

HONEYBEE'S THE SAVIOUR OF WORLD

S. Abhilash, PGDPHM (Session 2021-22)

In Marati, Honeybee is called as *krushi Laxmi* because of their economic importance in Pollination, It helps in production of bee wax, propolis, royal jelly and is an integral part in curing many medical illness. Einstein quoted, "if the Bees disappeared from the surface of the earth, man would have no more than four years to live", what he stated is true. Globally more than 80% of pollination is done by honeybees that includes food crops too**.**

What's killing the bees

- Heavy use of chemicals pesticides' leads to the colony collapse disorder (CCD). Here, the honeybee forgets its pathway to the hive and never returns back that leads to destruction of the colony.
- Climate changes, habitat destruction, global warming, indiscriminate use of the insecticides and combination of these factors will pose high threat to existences of honeybees
- Afforestation and then converting into Agriculture farms which further contaminates with Pesticides
- Increase in urbanization

Measures to be taken

- Multiple cropping system should be promoted by avoiding the mono cropping that helps in the availability of food for honey bee throughout year
- More emphasis should be given to Indian bee compared to European bee because they can adopt to local conditions
- Promoting sweet revolution & Honey mission by Govt of India for land less famers
- Conservation of Biodiversity
- Banning of harmful pesticides which causes severe affects to bee surviving
- Promotion of sustainable honey extraction which does not harm the bees, like practices following in North eastern region of Maharashtra by using honey extraction kit
- Govt of India has taken up the National beekeeping and Honey mission in Atmanirbhar bharat 2020, which help farmers in rearing honeybee and also they can gain profits
- Organic farming practices will increase the ecological health and helps in population increase of Bee.

Staff Corner

संस्थान यह कृषि उन्नति का

संस्थान यह कृषि उन्नति का, पाठ हमे पढाता है।

खेती के नये नये तरीके, रोज हमे सिखाता है।

प्रशिक्षण और तकनीकी से यह, किसान समृध्द बनाता है।

किसानो की आय को दुगना करने मे, यह साथ निभाता है।

कीट तथा रोग पहचान कर, किसानो को समझाता है ।

पादप स्वास्थ्य की बात बताकर, जैविक को अपनाता है।

पाद्प स्वास्थ्य अभियंत्रिकि विभाग भी अब ड्रोन उडाकर

कीट्नाशी छीड्काव करना दिखलाता और सीखलाता है।

पादप जैव सुरक्षा अब हे अब, संस्थान के हाथो मे।

अव्वल है ये प्रशिक्षण मे, आयात निर्यात सिखाता है।

कीट्नाशी प्रबंधन विभाग की तो बात ही निराली है।

एन ए बी एल, आइ एस ओ सत्यापित, ये लेब देश मे निराली है।

फल मक्खी प्रबंधन, निमेटोड उन्मुलन, जैविक नियंत्रण,

क्रिषी पारिस्थिकि तंत्र विश्लेशण, पारिस्थिकि अभियांत्रिकि,

इसकी रग रग मे बसते,

जिन्हे किसान उपयोग कर करके कभी नही है थकते।

राष्ट्रिय वनस्पति संस्थान की गाथा यही सब गाते है

किसानो के हित मे, ये हे बेहतर

तकिनिकी प्रबंधन सिखलाता है।

रचना एवं प्रस्तुति
डॉ चन्द्र शेखर गुप्ता
सहायक वैज्ञानिक अधिकारी (पीपी)

Published by:
Director General

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Ministry of Agriculture & Farmers Welfare, Government of India
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