Pheromone technology for the management of economically important insect pests





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Cover page:

Front Top: Rhinoceros beetle Red palm weevil Coconut pheromone trap Cue lure trap Cotton wick

Center: Coconut plantation

Back top: Distribution of Pheromone traps Circle: Fruit flies Methyl eugenol trap Cotton wick in Methyl eugenol

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(E.B. Chakurkar) Director (A) Coastal region of India have a warm, tropical and humid climate that is suitable to grow wide range of crops. Farmers of this region grow plantation crops viz., coconut, areca nut and cashew nut, fruit and vegetable crops. The productivity of these crops are reducing day by day and one of the main reasons is the loss caused by the insect pests. Red palm weevil and Rhinoceros beetle are the most devastating insect pest of coconut. Fruit flies in cucurbits and mango are the major hindrance for its production. Management strategies for these insect pests mainly involve extensive use of chemical insecticides, which may have a harmful effect on human health and the environment. Presently, the use pheromone traps has been encouraged much as a viable alternative to chemical insecticide.

This technical bulletin is based on the scientific studies of a NABARD sponsored research project "Management of economically important insect pests with the use of pheromone technology through trainings and demonstrations." Under the project, large scale on-field demonstrations and trainings have been organised in different taluk of Goa on use of pheromone traps for the management of Red palm weevil and Rhinoceros beetle in coconut; fruit flies in cucurbits and mango. This technical bulletin contains detailed information of damage symptoms, pest biology, use of pheromone traps and preparation of fruit flies lure and trap. I hope this will be useful to agricultural officers, field extension personnel and progressive farmers.







NABARD Goa Regional Office has sanctioned a project under Farm Sector Promotion Fund (FSPF) to ICAR-CCARI for training and demonstration of use of pheromone traps on farmers' fields to create awareness and popularise their use among Goan farmers.

With increasing public concern about the use of toxic pesticides to control insects/pests, we need to explore alternate techniques of Integrated Pest Management (IPM). Use of Pheromone Traps is one such method for monitoring, trapping and suppression of pests which cause economic loss to the crops Pests viz *Rhinoceros Beetle* and *Red Palm Weevil* in *Coconut Palms* and *Fruit fly* in Mango and Cucurbits were selectively targeted for control under the project.

ICAR-CCARI has widely demonstrated and trained farmers in use of Pheromone Traps. More than 1600 Pheromone Traps have already been distributed to 435 farmers. The project is successful in demonstrating the impact in terms of reduction in pests and increase in income of the farmers. We hope that with this initiative, dependence on chemical pesticides for control of pests will reduce and Goan food produce continues to be organic.

NABARD continues to strive to work with the research institutions on solutions for farm related problems and transfer of technologies from lab to land.



Ms. Kamakshi S. Pai General Manager / Officer-in-Charge NABARD, Goa RO, Panaji 27 September 2019



Dest infestation is one of the major constraints for agricultural production and productivity. Generally, pesticides are used for managing the insect pests that sometimes leave toxic residues in food commodities posing health hazards. Use of pheromone traps and lures ensure minimum and need based application of pesticides instead of prophylactic and calendar based pesticide spray schedule. Insect pheromones are commercially exploited for monitoring the insect populations, mass trapping, and mating disruption and is one of the key components in Integrated Pest Management programme. Keeping this in view, ICAR-Central Coastal Agricultural Research Institute, Goa, has undertaken a NABARD sponsored research project on "Management of economically important insect pests with the use of pheromone technology through trainings and demonstrations" in the state of Goa.

This technical bulletin is a result of research and extension work carried under the project. We have popularised pheromone technology for the management of red palm weevil and rhinocerous beetle in coconut, fruit flies in cucurbits and mango. The project has enhanced the technical capability of farmers and other stakeholders on use of pheromone technology. The research efforts and the awareness campaigns have resulted in reduction of insect pest damage and pesticide usage in coconut, cucurbits and mango.

We gratefully acknowledge the NABARD, Regional office, Panaji for the financial support and help at various stages of project implementation. We appreciate the progressive farmers of Goa for their cooperation and help to successfully conduct trainings and demonstrations. We also thank all the project staff for their technical assistance during the project implementation.

> Maruthadurai. R R. Ramesh

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1. Pheromone technology for the management of economically important insect pests

Introduction

Pest infestation is one of the major constraints for agricultural production and productivity. The climatic condition in Goa is hot and humid which is favourable for the incidence of insect pests in major crop plants causing severe loss in the production and productivity, sometimes complete crop failure. Management strategies for the insect pests mainly involve extensive use of chemical insecticides, which may have a harmful effect on human health and the environment. Extensive use of insecticides can also lead to the development of resistance, effects on non-targets, residue, environmental pollution, ecological disturbances, emergence of new pests, destruction of natural enemies, pollinators, and increased cost of production. These problems have necessitated the search for safer and effective methods of pest control, including behavioural, biocontrol and botanical bio-pesticides.

Integrated Pest Management (IPM) approach includes integrating all available control methods in a cost-effective, environmentally friendly and sustainable manner to reduce the pest population below economic injury level. Use of pheromone traps is one of the key components in IPM programme. Employment of pheromone traps and lures ensured minimum and need based application of pesticides instead of prophylactic and calendar based pesticide spray schedule. Pheromones are chemical that are secreted by one species of individual to attract the other individual of the same species. Sex pheromones is released by one sex triggers of a series of behavior pattern in the other sex of the species and thus facilitates mating. It is generally originate from females and attract males for mating. In certain species of insects the males are known to produce the sex pheromone which attracts the females. Insect sex pheromones are being commercially exploited for monitoring the insect populations, mass trapping, and mating disruption. Aggregation pheromones attract both sexes to the source of the pheromone for feeding or reproduction. Since pheromone techniques are knowledge intensive and skill oriented programme, training of farmers and extension functionaries are essential for effective implementation of pheromone technology in the field.

Objectives

- 1. To capacity building of farmers through organization of trainings and demonstrations on pheromone trap design, installation, lure replacement, monitoring and food attractants
- 2. To conduct wide area demonstrations on the use of pheromone traps



2. Pheromone technology for the management of red palm weevil and rhinoceros beetle in coconut

Introduction

Coconut is a major plantation crop in Goa and cultivated an area about 25,818 hectares. Red palm weevil (RPW) Rhynchophorus ferrugineus and Rhinoceros beetle (RB), *Oryctes rhinoceros* are the most devastating insect pest of coconut. Infestation due to RPW and RB are as high as 20 % leading to substantial losses. The estimated loss of one palm is around Rs 2000. If farmers are not managing these insect pest properly, the estimated loss may go from 3-4 lakhs/ha. Application of insecticides on palms is a major constraint because of greater height to which palms grow. The structure of palms make difficult the implementation of mechanical/physical tools of pest management. Besides, insecticides that are used for managing these insect pests leave toxic residues in food commodities posing health hazards. Presently, the use pheromones has been encouraged much as the viable alternative to chemical insecticides. The beetles and weevils will be attracted to the pheromone traps and get killed thereby the loss caused by insect pest is reduced and productivity of crops will be increased. Field studies found that pheromone lures (750 and 1000 mg) of RPW and RB attracted on an average of 80-85% population of RPW and 72-78% population of RB. With the adoption of pheromone traps reproductive adult population got trapped. So, the breeding cycle, damage and the loss caused by RPW and RB will be reduced and productivity of coconut will be increased.

Red palm weevil Rhynchophorus ferrugineus (Curculionidae: Coleoptera)

Red palm weevil is a major and most destructive insect pest of coconut palm. The palms less than 20 years are highly susceptible to attack. The pest is well distributed throughout coconut growing states of India. It is an internal tissue borer and very difficult to detect at the early stage of infestation.

Symptoms

- Presence of small bore holes with protruding chewed fibrous material
- Oozing of a brown liquid from such holes indicate the early infestation by the pest.
- Central shoot shows sign of yellowing and wilting.
- Presence of chewed fibrous material/empty pupal cases on the ground of the infested palm
- Large number of grubs, pupae and adults of the insect could be seen inside the trunk at the affected portion.









Bore holes on the stem

Extrusion of frass material

Wilting of central shoot

Life cycle

- The female weevil lays oval and white eggs on fresh wounds on the stem
- The full grown grub is stout, fleshy, apodous and pupates in a fibrous cocoon inside the trunk itself. The reddish brown weevil has six dark spots on the thorax.



Rhinoceros beetle: Oryctes rhinoceros (Scarabaeidae: Coleoptera)

It is one of the most damaging insect pest of coconut palm and distributed throughout the coconut growing tracts of India. Adult beetle is the destructive one and causes 10 to 15 % yield loss. The peak incidence of the pest is noticed during the monsoon period of June to September.

Symptoms

- The damaged leaves show characteristic 'V' or diamond shaped cuttings.
- A series of holes present on the fronds when leaf opens out.
- Death of the growing point in young plantations.
- The infestation can be easily made out by the chewed fibrous material present near bore holes.





V- shaped cut on leaves

Damage on leaves

Life cycle

- The insect breeds in decaying organic matter such as farm yard manure pits, dead palm trunks, compost heaps and other decaying materials
- The adult beetle is stout, black or reddish black, about 5 cm in length. It has a long horn projecting dorsally from the head.
- Grub is stout, fleshy, dirty white, curved (C- shaped).



Grub



Adult beetles



Pheromone trapping technology for the management of red palm weevil and Rhinoceros beetle

The use of aggregation pheromone traps is one of the main component in integrated pest management programme of RPW and RB. Mass trapping of adult beetles and weevils using food baited pheromone traps in an infested coconut plantation significantly reduces the infestation levels. The red palm weevil lure (Ferrolure), rhinoceros beetle lure (Rhino lure) and traps are available commercially in private agro firms.

Trap preparation

The traps can be easily prepared by using a five litre plastic bucket. Cut with four windows $(1.5 \times 5 \text{ cm})$ below the upper rim of the bucket.

Wrap jute sack around the outer surface of the bucket to facilitate the entry of the beetle and weevil in to the trap.

Hang the pheromone lure is to be hung inside of the bucket

Add food bait (200 - 300 g of fresh coconut petiole/ sugarcane pieces) mixed in one litre of insecticidal solution (0.05% carbofuran 3G) in to the bucket.

Mass trapping

The pheromone traps should be placed under the shade of the palm/tree canopy at a height of one meter above the ground.

For mass trapping programme 1 trap/ ha is recommended

The traps should be serviced (discarding the attracted weevils and beetles, replacing the food baits and insecticide solution) every 10 days.

Pheromone lure to be replaced only when most of the lure is exhausted

Community based approach is desired for mass trapping of RPW and RB in coconut plantations

Popularisation of pheromone technology

ICAR-CCARI with assistance from NABARD conducted awareness training programme and field demonstration on use of pheromone traps for management of red palm weevil and Rhinoceros beetle in coconut in various parts of Goa.

Area of implementation

- 1. Tiswadi- ICAR-CCARI, Old Goa, Goa-Velha, Pillar, Neura, Mandur
- 2. Ponda Mardol, Cuncolim, Savai verem
- 3. Salcete Arossim,
- 4. Quepem Cotomb,Gomvol
- 5. Sattari- Valpoi

Awarness programme, training, demonstration of pheromone traps and distribution of traps to the farmers

Programme -1

A distribution cum field demonstration on use of pheromone traps of RPW and RB in coconut was organised at Goa - Velha on 8/11/17. The damage symptoms, insect



life stages and other management aspects has been explained to the farmers. Trap placement, lure replacement, food attractants, trap servicing and insect observation has been demonstrated to the farmers by Dr. Maruthadurai. R. District development manager of NABARD, Shri P.V Sreenivasa, Dr. R. Ramesh, Principal Scientist (Plant Pathology), ICAR-CCARI, Shri H R C Prabu, PC, KVK, North Goa, and Sarpanch of Goa-Velha were participated in the programme and interacted with the farmers. More than 30 farmers actively participated in the programme and 60 traps of RPW and RB has been distributed to the coconut farmers.



Distribution programme of pheromone traps of coconut insect pests

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Visit of NABARD officers and interaction with beneficiaries

NABARD officers interacted with the farmers and seen the project implementing areas on 11th January 2018. The officials appreciated on the progress of the project and seen the attracted weevils and beetles inside the pheromone traps. Farmers were expressed their difficulties in the farming activities and requested to support and provide the pheromone traps and other agricultural inputs.



NABARD officials interaction with the beneficiaries

Programme - 2

A distribution cum field demonstration on use of pheromone traps of RPW and RB in coconut was organised at Arossim, Cansaulim on 6/3/18. Dr. E.B. Chakurkar, Director, ICAR-CCARI has addressed the farmers and briefed about the benefits of pheromone technology. The damage symptoms, insect life stages and other management aspects has been explained to the farmers by Dr. Maruthadurai.R Scientist (Agril. Entomology). Trap placement, lure replacement, food attractants, trap servicing and insect observation has been demonstrated to the farmers. District development manager of NABARD, South Goa, Shri Sushil Naik, and ZAO of Madgaon participated in the programme and interacted with the farmers. More than 20 farmers actively participated in the programme and 30 traps of each RPW and RB has been distributed to the coconut farmers.





Demonstration and distribution of pheromone traps of red palm weevil and rhinocerous beetle in coconut

Programme - 3

A field demonstration on use of pheromone traps of Red palm weevil and Rhinocerous beetle in coconut was organised at at Mardol on 18/5/18. Dr. E.B. Chakurkar, Director, ICAR-CCARI has addressed the farmers and briefed about the benefits of pheromone technology. The damage symptoms, insect life stages and other management aspects has been explained to the farmers. Trap placement, lure replacement, food attractants, trap servicing and insect observation has been demonstrated to the farmers. District development manager of NABARD, South Goa, Shri Sushil Naik, and ZAO of Madgaon participated in the programme and interacted with the farmers. More than 25 farmers actively participated in the programme and 92 traps of each RPW and RB has been distributed to the coconut farmers.





Distribution and field demonstration on use of pheromone traps in coconut at Mardol

Programme - 4

A field demonstration on use of pheromone traps of RPW and RB in coconut was organised at Quepem on 5/2/19. The damage symptoms, insect life stages and other management aspects has been explained to the farmers. Trap placement, lure replacement, food attractants, trap servicing and insect observation has been demonstrated to the farmers. District development manager of NABARD, South Goa, Shri Sushil Naik, and ZAO of Madgaon participated in the programme and interacted



with the farmers. More than 33 farmers actively participated in the programme and 120 traps of each RPW and RB has been distributed to the coconut farmers.



Demonstration and distribution of pheromone traps

Programme - 5

A training cum distribution on use of pheromone traps for the management of RPW and RB in coconut and fruit fly in mango was organised at ICAR- CCARI, Old Goa on 31/1/19. More than 40 farmers from different taluks of Goa actively participated in the training programme. Detailed presentation on various insect pests of coconut, and their management has been delivered by Dr. Maruthadurai.R Scientist (Agril. Entomology). Trap placement, lure replacement, food attractants, trap servicing and insect observation has been demonstrated to the farmers. A total of 160 traps and lures of RPW and RB has been distributed to the farmers.





Glimpses of training programme and distribution

Programme - 6

A capacity building programme on use of pheromone traps for the management of RPW and RB was organised for coconut growers in association with Department of Agriculture, Ela, Old Goa on 13/2/19. A detailed presentation on various insect pests of coconut has been delivered by the project investigator Dr. Maruthadurai. R. Hands on training on use of pheromone traps for the management of RPW and RB in coconut has been provided to the coconut growers. More than 23 farmers from Tiswadi taluk participated in the programme and 50 traps of each RPW and RB has been distributed to the coconut farmers.





Capacity building programme and distribution of pheromone traps

Programme - 7

A training cum distribution on use of pheromone traps for the management of RPW and RB in coconut and fruit flies in cucurbits was organised at ICAR- CCARI, Old Goa on 25/6/19. Dr. E.B. Chakurkar, Director, ICAR-CCARI addressed the farmers and briefed about the benefits of pheromone technology. He also stressed the ill effect of pesticides usage on cucurbitaceous vegetables. He distributed pheromone traps and lures of red palm weevil and rhinocerous beetle and cue lure traps and lures to the farmers. Dr. R. Ramesh, Principal Scientist (Plant pathology) associated in organising the programme. The damage symptoms, insect life stages and other management aspects has been explained to the farmers by Dr. Maruthadurai.R Scientist (Agril. Entomology). Trap placement, lure replacement, food attractants, trap servicing and insect observation has been demonstrated to the farmers. More than 30 farmers participated in the programme and 200 cue lure traps and 70 traps and lures of RPW and RB were distributed to the farmers.





Distribution of pheromone traps



A training cum distribution on use of pheromone traps for the management of RPW and RB in coconut and fruit flies in cucurbits was organised at ICAR- CCARI, Old Goa on 31/8/19.





Distribution of pheromone traps

Details of project implemented area and total beneficiaries and traps distributed

S.No	Project implemented area	No of beneficiaries	Total traps distributed (red palm weevil and rhinocerous beetle)	Approximate area coverage (Ha)
1	North Goa- Tiswadi (ICAR-CCARI, Old Goa, Goa-Velha, Pillar, Neura, Mandur) Sattari- Valpoi, Pernem	151	688	30
2	South Goa Ponda – Mardol, Cuncolim, Savai verem Salcete – Arossim, Quepem- Cotomb Gomvol, Sulcorna	85	412	15
	Total	236	1100	45



Salient findings of pheromone technology in coconut

From the field demonstration, periodic sampling was taken to know the effect of pheromone traps on the reduction of pest population. The performance of aggregation pheromone traps for mass trapping of red palm weevil and rhinocerous beetle in coconut were evaluated. Experiment results showed that an average of 2-4 adults of red palm weevils were attracted/trap/week. An average of 1-2 adults of rhinocerous beetles were attracted/trap/week. Maximum of 17 adults of red palm weevil was recorded in the month of November. In case of rhinocerous beetles, maximum of 5.46 adults was recorded in the month of September during the year 2017-18. More number of females were attracted to the traps compared to the males on both the species. A similar trend of observations were recorded during the year 2018-19. Significant percent reduction of red palm weevil and rhinocerous beetle infestation was recorded in the pheromone traps implemented coconut plantations.



Pheromone traps at farmers field



Attraction of RPW and RB in the pheromone traps during August 2017 to August 2018







Attraction of RPW and RB in the pheromone traps during September 2018 to August 2019



Attracted of RPW and RB in the pheromone traps



3. Pheromone technology for the management of cucurbit fruit fly Zeugodacus cucurbitae

Introduction

Cucurbits are important vegetable crops in coastal regions of India. In Goa, cucurbits are cultivated by a specialised group of farmers called mollekars. Cucurbits viz., cucumber, ridge gourd, bitter gourd, bottle gourd, snake gourd, sponge gourd, snap melon and pumpkin are cultivated during Kharif season. Cucumber occupies the major area followed by ridge gourd, bitter gourd and snake gourd. The melon fly, *Zeugodacus cucurbitae* (Coquillett) (Diptera: Tephritidae) is a very serious and economically important insect pest of cucurbitaceous crops. The polyphagous fruit fly attacks more than 125 cucurbitaceous and solanaceous crop plant species in tropical and subtropical regions of the world. It causes significant damage to these crops. The extent of yield loss due to infestation by melon fly in cucurbitaceous crops may vary between 30 to 100% depending upon the season.



Various cucurbits cultivated in Goa



Symptoms of damage

- Adult female lay eggs in soft tender fruit tissues leads to appearance of small brown resinous deposit on the fruits. This reduces the market value of the produce.
- After egg hatching, the maggots bore into the fruits and make the feeding galleries.
- Infested fruits appears malformed.
- Damaged fruits rapidly rot due to secondary infection (bacterial and fungal) and become unfit for human consumption
- The damage due to fruit flies in Goa ranges from 5 to 20 percent with cucumber being the most susceptible.



Cucumbers infested by fruit fly



Ridge gourd infested by fruit fly

Life cycle

- Adult female lay eggs in soft tender fruit tissues. Egg period ranges from 2-5 days
- The larval stage lasts for 5-12 days
- Matured larvae pupate in the soil. Pupal period ranges from 9-12 days



Adult flies inflicting damage on Ridge gourd and Cucumber

Pheromone traps for management of cucurbit fruit fly

The sex pheromone released by one sex will trigger the behavioural patterns of other sex that facilitate in mating. Here the sex pheromone produced by female cucurbit fruit fly will attract the male one. The commercial lure having parapheromone (mimic the effect of pheromone) is chemically synthesised which will attract the male flies attracted flies and get killed in the insecticide ketp in the trap. The sex pheromone is used for monitoring and mass trapping of insect pests.



The cue lure pheromone trap can be prepared by farmers themselves or can be purchased from ICAR- CCARI, Old Goa or Zonal agricultural office or private agro firms. Procedure for preparation of cue lure pheromone traps is given below.

Preparation of cue lure

- Mix Ethyl Alcohol 60 ml + Cue lure (p-Acetoxyphenyl butanone- 2) 40ml + Dichlorvos (DDVP) Pesticide 20ml (i.e. in the ratio of 6:4:2).
- Take Plywood or soft board or straw board squares of approximately 5 x 5 x l.2 cm in size
- Otherwise take ½ inch thick cotton rope & cut the rope into 2 inches size, tie the cut ends with thin wire.
- Soak any one of these in cue lure solution for 24 hrs. Now the cue lure is ready.
- Around 30 lures can be prepared from the above proportions.



Cotton wick

Chemicals for cue lure preparation



Plywood in cue lure

Cotton wick in cue lure

Cue lure trap

Preparation of low cost trap

- Take used plastic water bottle (1L), make 3 or 4 windows of 1 inch size with a knife at 3 inches from top of the bottle
- Hang the lure inside the trap and place it in the field at least 3-4 feet above the ground level



Usage or recommendation of cue lure

- Around 10-12 lures / acre is recommended
- The pheromone trap should be placed from onset of flowering to harvest of the crop
- The lure need to be replaced once in 30-40 days
- The trap should be serviced at 15 days interval

Popularisation of pheromone technology

ICAR-CCARI with financial assistance from NABARD conducted awareness training programme and field demonstration on use of pheromone traps for cucurbit fruit fly management in various parts of Goa.

Area of implementation

Ponda- Veling, Keri, Cuncolim, Farmagudi, Mardol, Priol, Curti, Savai-verem, Bhoma, Mangeshi

Tiswadi- Karmali, Carambolim, Old Goa, Divar, Bombolim, Goa-velha, Porvorim

Awarness programme, training, demonstration of Cue lure pheromone traps and distribution of traps to the farmers

Programme -1

A demonstration cum distribution on use of cue lure pheromone traps for management of cucurbit fruit flies has been organised at Veling on 7/7/17. Cue lure trap preparation, placement, servicing and lure replacement have been explained to the farmers. The damage symptoms, insect life stages and other management aspects have been briefed to the farmers by Dr. Maruthadurai. R Scientist (Agril. Entomology). More than 30 farmers participated in the programme and 84 cue lure traps were distributed to the farmers.







A field demonstration on use of cue lure traps for cucurbit fruit fly management has been organised at Keri, Ponda on 26/7/17. Cue lure trap preparation, placement, servicing and lure replacement have been explained to the farmers. The damage symptoms, insect life stages and other management aspects have been briefed to the farmers.





A field training and demonstration on use of cue lure traps for cucurbit fruit fly management was organised at Carambolim on 2/8/17. Demonstrated the use of cue lure traps for cucurbit fruit fly management.



Attraction of melon flies in the pheromone traps

Cue lure traps at farmers field and collection of pheromone trapped flies



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A demonstration cum distribution on use of cue lure pheromone traps for management of cucurbit fruit flies has been organised at Cuncolim on 19/7/18. Cue lure trap preparation, placement, servicing and lure replacement have been explained to the farmers. The damage symptoms, insect life stages and other management aspects have been briefed to the farmers by Dr. Maruthadurai. R Scientist (Agril. Entomology). Dr. R. Ramesh, Principal Scientist (Plant pathology) briefed about the benefits of pheromone technology and interacted with the farmers. More than 30 farmers actively participated in the programme and 200 cue lure traps were distributed to the farmers.



Programme -5 & 6

A field training and demonstration on use of cue lure traps for cucurbit fruit fly management was organised at Karmali and Veling on 3/8/18. Demonstrated the use of cue lure traps for cucurbit fruit fly management. A total of 50 cue lure traps had been distributed to 22 farmers.





Programme -7

A field training and demonstration on use of cue lure traps for cucurbit fruit fly management was organised at Veling on 19/7/19. Demonstrated the use of cue lure traps for cucurbit fruit fly management. A total of 30 cue lure traps had been distributed to 13 farmers.



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A training cum distribution on use of pheromone traps for the management of fruit flies in cucurbits has been organised at ICAR- CCARI, Old Goa on 25/6/19. Dr. E.B. Chakurkar, Director, ICAR-CCARI addressed the farmers and briefed about the benefits of pheromone technology. He also stressed the ill effect of pesticides usage on cucurbitaceous vegetables. The damage symptoms, insect life stages and other management aspects has been explained to the farmers Trap placement, lure replacement, food attractants, trap servicing and insect observation has been demonstrated to the farmers. More than 30 farmers were actively participated in the programme and distributed 200 cue lure traps to the farmers.



Details of project implemented area and total beneficiaries and traps distributed

S.No	Project implemented area	No of beneficiaries	Total traps distributed	Approximate area coverage (Ha)
1	North Goa - Tiswadi- Karmali, Carambolim, Old Goa, Divar, Bombolim, Goa-velha, Porvorim	26	47	2
2	South Goa- Ponda- Veling, Keri, Cuncolim, Farmagudi, Mardol, Priol, Curti, Savai- verem, Bhoma, Mangeshi	120	568	8
	Total	146	615	10

Salient finding of pheromone technology in cucurbits

Efficacy of cuelure pheromone traps in cucurbitaceous vegetables showed that maximum attraction of 120 fruit flies/trap was recorded in the last week of July, 2017. More number of fruit flies were attracted during the month of July and August and thereafter the catches got reduced. A similar trend of observation was also recorded in the year 2018.





Weekly attraction melon flies during the year 2017



Weekly attraction melon flies during the year 2018

Economic benefit of using pheromone traps in cucurbitaceous vegetables

Management strategies for melon fly mainly involve extensive use of chemical insecticides, which may have a harmful effect on human health, residue and ecological disturbances. We have popularized the pheromone technology and created awareness among the farmers. In control plot (without the use of pheromone traps) around 30% fruit fly infestation was recorded. In the treatment plot (use of pheromone traps) around 10 to 15% fruit fly infestation was recorded. An Increase in yield of 15 to 20 % was recorded in the treatment plot. The vegetables from the pheromone implemented fields were free from insecticides residue and safe to consumers. Use of pheromone traps is one of the main components in integrated pest management programme.



4. Pheromone technology for the management of mango fruit fly Bactrocera dorsalis

Introduction

The fruit fly *Bactrocera dorsalis* is the most destructive insect pest of mango in India. The polyphagous fruit fly damages mango, guava, citrus, plum, peach and sapota. It causes yield loss ranges from 5 to 30% on different fruit crops and pest of quarantine importance. Chemical control of the mango fruit fly leave toxic residue on fruits. One of the eco-friendly approach is the use of sex pheromone traps to attract male flies also called as male annihilation technique (MAT) using methyl eugenol lure.

Symptoms of damage

- Adult female flies lay eggs on the fruit epidermis
- Maggots bore into the fruits and feed on the inner content of pulp.
- Occurrence of brown patches around the place of oviposition
- Rotting of infested fruits
- Oozing of fluid and drooping of fruits



Adult fruit flies

Maggot

Biology of mango fruit fly

Adult female lay eggs in the peanut sized fruits. Maggots after hatching bore and feed on fruit pulp and inner content.

The matured larvae come out of the fruit, drop on the ground and pupate deep under the soil.

Usage of Methyl eugenol pheromone traps

Crops:

Mango, Guava, Sapota, Citrus, Papaya, Banana, Apple, Peach, Plum and other fruit crops **Attracted fruit flies**

Bactrocera dorsalis, Bactrocera correcta, Bactrocera zonata, Bactrocera caryeae Preparation of Methyl eugenol lure

• Mix Ethyl Alcohol - 60 ml + Methyl eugenol- 40ml + DDVP (Pesticide) - 20ml (i.e. in the ratio of 6:4:2).



- Take Plywood or soft board or straw board squares of approximately 5 x 5 x l.2 cm in size
- Otherwise take ¹/₂ inch thick cotton rope and cut the rope into 2 inches size, tie the cut ends with thin wire.
- Soak any one of these in methyl eugenol solution for 24 hrs. Now the methyl • eugenol lure is ready.
- Around 30 lures can be prepared from the above proportions and quantity.







Plywood in methyl eugenol

methyl eugenol



Methyl eugenol trap



Chemicals for preparation of methyl eugenol trap

Preparation of low cost trap

- Take used plastic water bottle (1L), make 3 or 4 windows of 1 inch size with a • knife at 3 inches from top of the bottle
- Hang the lure inside the trap and place it in the field at least 3-4 feet above the • ground level

Recommendation or dosage of methyl eugenol trap for mass trapping

- Around 10-12 lures / acre is recommended
- The pheromone trap should be placed from onset of flowering to harvest of the • crop
- The lure need to be replaced once in 30-40 days
- The trap should be serviced at 15 days interval

Precautions

- The Lures and mixtures are to be prepared in well ventilated room.
- Wear disposable gloves and use separate containers and measuring jars.

Benefits

- It reduce the infestation 10-15% against control 30%. •
- Eco-friendly approach, safe to environment and human beings •
- Reduce the insecticide usage and residue free fruits and vegetables
- Easy to adopt the pheromone technology •



Availability

• It is available from ICAR- CCARI, Old Goa or Zonal agricultural office or private agro farms.

Popularisation of pheromone traps for management of mango fruit fly

ICAR-CCARI with financial assistance from NABARD conducted awareness training programme and field demonstration on use of pheromone traps for management of mango fruit fly in various parts of Goa.

Area of implementation

Tiswadi- Old Goa, Chodan, Kumbharjua, Ponda- Curti Canacona – Gaondongrim

Awarness programme, training, demonstration of Methyl eugenyl pheromone traps and distribution of traps to the farmers

Programme -1

A training programme on design and distribution cum demonstration on use of pheromone traps of mango fruit fly was organised at Chodan on 24/2/18. The principle investigator of the project Dr. Maruthadurai, Scientist (Agricultural Entomology) from ICAR-CCARI, Old Goa has explained the preparation of methyl eugenol lure and low cost trap to the mango growers. The damage symptoms, insect life stages and other management aspects has been explained to the farmers. Trap placement, lure replacement, trap servicing and insect observation has been demonstrated to the farmers. Shri P.V Sreenivasa, DDO, Nabard was briefed about the schemes of NABARD and their role on upliftment of farming community. More than 25 farmers participated in the training programme and 40 pheromone traps were distributed to the farmers.



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Glimpses of training on use of pheromone traps for mango fruit fly

Programme -2

A training cum distribution on use of pheromone traps for the management fruit fly in mango was organised at ICAR- CCARI, Old Goa on 31/1/19. More than 40 farmers from different taluks of Goa were actively participated in the training programme. Detailed presentation on various insect pests of mango and their management has been delivered by Dr. Maruthadurai.R Scientist (Agril. Entomology). Trap placement, lure replacement, trap servicing and insect observation has been demonstrated to the farmers. Mango fruit fly traps 60 had been distributed to the farmers.



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S.No	Project implemented area	No of beneficiaries	Total traps distributed	Approximate area coverage (Ha)
1	North Goa - Tiswadi- Old Goa, Chodan, Kumbharjua,	33	85	5
2	South Goa- Ponda- Curti Canacona – Gaondongrim	20	60	2
	Total	53	145	7

Details of project implemented area and total beneficiaries and traps distributed

Salient finding of pheromone technology in mango

A field trail was undertaken to evaluate the attraction potential of methyl eugenol traps for management of mango fruit fly Bactrocera dorsalis. Weekly observation were made. Empty water bottle + $4 \times 1 \times 1$ cm lure, attracted an average of 57.20 fruit flies/ week/trap during the year 2018. In the year 2019, maximum attraction flies was recorded in the month of April.



Weekly attraction of mango fruit flies in the methyl eugenol traps during 2018



Weekly attraction of mango fruit flies in the methyl eugenol traps during 2019

Awareness creation on use of pheromone traps for managing insect pests Awareness created among the farmers, self help groups, NGO'S, students and other stakeholders on use of pheromone traps for managing insect pests.



Awareness creation on use of pheromone technology to the students from Government Higher Secondary, Khandola, Marcela



5. Success stories

1

Management of red palm weevil and rhinocerous beetle in coconut plantations through pheromone traps

Sanjiv Balaji Kunkalienkar, Kunkaliem, Mardol, Goa Mobile: 9011366430



I am having a coconut based integrated farming system with dairy component. Since I am having dairy unit I was suffering heavy losses in coconut due to the infestation of rhinocerous beetle and red palm weevil. With the assistance from ICAR-CCARI, I started using the pheromone traps in coconut plantations for last two years. Since I started using the pheromone traps, I could see the less damage incidence due to these pest and I have not lost a single tree. Initially, when I started using the pheromone traps I could trap more than 100 weevil in a month. Now they are reduced to a single digit. Thanks to ICAR-CCARI Scientists for providing me the traps, technology, training and knowledge on the life cycles of these insect pests. With the success in my farm I have encouraged the farmers in my neighbourhood to use this pheromone based technology. They are also happy with the results and could save their palms. Similarly we are using the pheromone trap technology for managing fruit flies in cucurbits and mango and the results are encouraging to adopt the technology.



Success stories



Management of red palm weevil and rhinocerous beetle in coconut plantations through pheromone traps

Pandurang Dhond, Goa Velha Mobile: 9764801757

I am having a coconut plantations with 200 trees and had been facing severe problems due to the damage caused by red palm weevil and rhinocerous beetle. Young palms were severely affected by rhinocerous beetle leads to loss of palms. Grown up palms were damaged by red palm weevil. There was a great difficulties to manage these insect pests. Thanks to ICAR-CCARI Scientists for providing me the traps, technology and training. The pheromone traps solved our problems to a great extent and easily trapped in the traps. There was a significant reduction in the



damage caused by these insect pests due to implementation of pheromone technology.







Success stories

3

Management of red palm weevil and rhinocerous beetle in coconut plantations through pheromone traps

Shankar C Betkekar, Valpoi, Sattari Mobile: 9923020821

I use to face lot of insect pest problems especially rhinocerous beetle and red palm weevil in my coconut plantations. I lost 2-3 palms every year due to these pest. I started using the pheromone traps with the assistance and training from ICAR-CCARI for last two years. I used to collect an average of 10-12 red palm weevil and 4-5 rhinocerous beetle /trap/month. The infestation was greatly reduced due to implementation pheromone technology in coconut plantations. I got absolutely satisfying results and express mv sincere thanks to ICAR-CCARI for providing

me the pheromone traps. With the success in my farm I have encouraged the farmers in my neighbourhood to use this pheromone based technology.













Management of red palm weevil and rhinocerous beetle in coconut plantations through pheromone traps

Abhay Totekar & Deepak Totekar Mardol, Goa Mobile: 9421157937 / 9049921135



फेब्रुवारी 2018 पासून भा.कृ.अ.संस्थान जुने गोवा यांच्याकडून मिळालेली माहिती, मार्गर्दन व फेरोमोन सांपळे यांचा उपयोग करून मी माडांना लागणारे Rhinoceros Beetle & Red Palm Weevil ह्या भुंग्यांना सांपाळयात पकडत आहे?

सापळे लावून या उपद्रवी भुंग्यांना पकडल्यानंतर विशेषतः तरुण माडांचे नष्ट होणे थांबवण्यात मी व माझे बंधू श्री दीपक तोटेकर यांना यश मिळाले आहे. भूंगे नियंत्रण व माडांना लागणारे अन्य रोग व त्यांचे केलेली तपासणी व मार्गदर्शन याचा आम्हाला नियंत्रण याची माहिती, प्रशिक्षण, प्रात्याक्षिक व सापळे खूप फायदा झाला? आम्ही त्यासाइी भा.कृ.अ. उपलब्ध करुन भा.क.अ.संस्थानच्या वैज्ञिकांनी, बरीच संस्थान केंद्र व त्यांचे वैज्ञानिक यांचे फार फार मदत केली आहे. तसेच त्यांनी वेळोवेळी येऊव आभारी आहोत.







Success stories

Pheromone traps for the management of mango fruit flies

Gouresh Kouthankar Chodan, Goa Mobile: 9226221133

I am having a mango plantations with 60 trees of different varieties. Every year I use to encounter the fruit fly infestation in my mango orchard. ICAR-CCARI has provided us hands on training on preparation of fruit fly trap, installation and trap servicing. Pheromone traps provided by the ICAR-were placed before flowering. The pheromone traps were effective and attracted an average of 50-70 fruit flies/trap/week. There was a significant reduction in the fruit damage due to fruit fly. I would like to thanks ICAR and the concern scientist for providing me the fruit fly traps.



Success stories

Pheromone traps for the management of mango fruit flies

Dhillan Mhalgo Velip Kindalkatta Gaondongri, Canacona Mobile: 8275919296

I am having a mango orchards with varieties like Mankurad, Nilam, Mushrad, Totapuri and Kease etc. Every year we are facing severe infestation of fruits due to fruit flies. Pheromone traps provided by the ICAR-CCARI, were placed before flowering. An average of 80-110 fruit flies/week was recorded in the trap. There was a significant reduction in the fruit damage due to fruit fly. The technology was effective and I encouraged the other farmers to use this pheromone based technology.





Success stories

Pheromone traps for the management of cucurbit fruit flies



Anthony F.C. Gonsalves, Divar, Mobile: 9822140797

I would like to thank ICAR-CCARI for promoting pheromone traps for the management of cucurbit fruit flies. I was very much depressed as being a small time vegetable grower like cucumber and ridge gourd were infested by fruit fly. The maggots spoiled the fruits. However after the use of pheromone traps given by ICAR Scientist the infestation was greatly reduced. I used to trap on an average about 70-80 flies/trap/ week. It is my request that the traps should be promoted in community basis.



6. Summary of achievements

- Popularised pheromone technology for the management of red palm weevil and rhinocerous beetle in coconut
- Red palm weevil activity was recorded throughout the year with maximum recorded in the month of November
- Maximum activity of rhinocerous beetle was recorded in the month of September
- Beetle and weevil captured throughout the experiment period revealed that catches were female dominated.
- Demonstrated 45 ha area of coconut plantations for the management of RPW and RB in coconut plantations through pheromone technology. Distributed 550 each of RPW and RB pheromone traps to 236 coconut farmers
- Enhanced the technical knowldge of coconut farmers on use of pheromone technology through trainings and demonstrations. A total of 10 trainings and demonstrations have been organised on use of pheromone technology for the management of RPW and RB in coconut plantations.
- Mass trapping of red palm weevil and rhinocerous beetle infested coconut plantations has successfully managed these insect pest
- Popularised sex pheromone traps viz., Cue lure for cucurbit fruit fly and Methyl eugenol lure for mango fruit fly
- Imparted hands on training on preparation of Cue lure and Methyl eugenol traps to the farmers
- Distributed a total of 615 cue lure traps to 146 farmers.
- A total of 145 methyl eugenol traps were distributed to 53 mango farmers.
- Fruit fly infestation 10 to 15% was reduced in pheromone implemented cucurbits field and mango orchards.
- A total of 12 trainings and demonstrations have been organised on use of Cue lure and Methyl eugenol lure for the management of fruit flies in cucurbits and mango



7. Recommendations

Management of red palm weevil and rhinocerous beetle in coconut

- Pheromone traps viz., Ferrolure and Rhinolure @ 1 trap/ha is recommended. The traps should be serviced at fifteen days interval
- Food baits like coconut petiole, sugarcane and pine apple pieces need to be added inside the bucket to enhance the attraction of beetle and weevil



Management of fruit flies in cucurbits and mango

- Sex pheromone traps viz., cue lure and methyl eugenol lure @ 10-12 / acre is recommended. The pheromone trap should be placed from onset of flowering to harvest of the crop
- The lure need to be replaced once in 30-40 days .The trap should be serviced at 15 days interval



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8. Awarness creation on use of pheromone traps through print media

The Times of India Dated:-13-09-2018 Scientists use insects' sex hormone to help ryots beat pests, boost crops

TIMES NEWS NETWORK

Panaji: Pest attacks and fruit flies can destroy pulp, making it foul-smelling and discoloured besides leaving toxic residue on fruits. The infestation of pests can severely cut farmers' profits but the extensive usage of

Cue lure attracts male fly into trap where it dies'



agro companies are marke ting the plastic traps contai ning parapheromone. Far-mers can also purchase the chemical and make their series

chemical and make traps, which cost ab

traps, which cost about P per piece in the market. "The cue lure attract make fruit fly into the where it dies. Thus female will not be to repa ce, and this will help co and manage the pest." M hadural said. "Enterties and that the Thus th

From P1

ach fly sitting on a cu-cumber can lay about 200 eggs. Once hat-d. the maggots enter the it. The pierced part auto-tically fills up, but the cu-ber rots from within," di-tor. ICAR, Old Gaa, Eknath hakurkar said.

kurkar said. a bid to popularize endly pest control res. ICAR distributed lure pheromone trans ure pheromone traps abard-funded project mers at Veling, Ponda

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Panaji: The sex hormone

ranau: The sex hormone, cue lure pheromone, emitted by the female melon fly Bac-trocera cucurbitae to find a mate is proving useful in Go-a's cucumber crop protec-tion, with a chemical able to mimic it seffect being used to

mimic its effect being used to trap melon flies

The melon fly is a serious

and economically damaging insect pest, causing yield los-ses to the tune of 20% to 30%.

"Farmers resort to chemical spraying to protect their crops but even if the taste of cucum-

bers is good, the chemical resi-due may remain on the vege-table " a JCAR scientist said.

Chemical pest control

Agricultural Research Institute (CCARI) scientists have developed low-cost eco-friendly pheromone traps that can be used to hang on fruit trees and repel insects.

The pheromone trap is a sex hormone trap that at-tracts insects. This way, the insect population is controlled, and farmers need not spray any chemicals on fruits or vegetables to keep pests away," ICAR-CCARI direcor, E B Chakurkar said. He explained that a female insect attracts a male insect of its own species by secreting a chemical called pheromone. The male can sense the odour and reach the female even from a distance.

BACK TO BASICS

> Pheromones are natural compounds that are created in the body of an insect

Insects use pheromones to communicate with each other

> Pheromone traps are used for integrated pest management

> Sanitation, inspection, and disposal of infested material are important aspects of the integrated approach

The trap is made with an artificial methyl eugenol lure which mimics the smell of the pheromone of female files. When placed in the field. male insects are attracted to

the lure and trapped.

In a bid to popularize this technology among farmers, the institute along with NA-BARD recently conducted a training session for farmers in Farmagudi and Priol among other areas and distributed the traps free of cost.

"Training is essential to build such skills among farmers. While we are making efforts in integrated pest management, in the coming months, we will also train them in harvesting skills to reduce crop loss," Chakur-kar said, adding that very often 30% harvest is lost due to the lack of appropriate harvest machinery, proper harvest methods and storage.

Mango farmers urged to tackle insect pest using traps

Panaji: The first ripe mango fetches a handsome price of Rs 300 per piece, but the pesky fruit fly Bactrocera dorsalis cuts the farmers profits all the way - from its peanut size on trees to its ripened stage to

council of agricultural rese arch (ICAR), Old Goa.

control mango fruit fly is harmful to consumers, as it leaves toxic residue on fruits. Using methyl eugenol lure, which is artificially made and mimics the smell of the sex pheromone of the female files, is the best option to attract male flies in traps.

TACKLING THE MENACE

> Scientists are encouraging mango farmers to use methyl eugenol to attract male flies in traps > The low-cost pheromone

trap is a plastic bottle, that has cardboard pieces soaked in the chemical and poison

> The trap is hung then on mango trees to lure the insect pests

to 24 farmers. They can easily make an eco-friendly trap with a plastic bottle and insert cardboard pieces soaked in the lure and poison for 24 hours and hang them on mango trees



crop is vulnerable to the p throughout the fruiting a ripening stage and beyon After the female lays the es in the small raw fruit, t maggots emerge from t eggs and feed on fruit pu and inner content.

"These maggots destr the pulp, making it foul sm ling and discoloured. Inf ted fruits develop brow rotten patches on them a fall to the ground ultimatel he said.



> Its life cycle is hardly 15 days, but it causes huge economic losses 6 > Farmers can

vegetables

Female fly's sex hormone

to kill male cucurbit pests

for consumption due to toxic residue, but the use of phero mone traps with the melon fly sex hormone is comparatively a better and eco-friendly approach, said scientist (ag-ricultural entomology), ICAR, Old Goa, Maruthadu rai R. "Also, chemical pest control is relatively ineffecti-

ground ► Five traps can cover an acre The insect pest causes severe damage to major crops like cucumber, gourds, and cucurbitaceous vegetables and Goa's specialized group of farmers called "mol" kars", who cultivate cucur taceous vegetables on hill s pes, suffer heavy losses due the severe melon fly attack

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the market. "The fruit fly Bactrocera dorsalis is the most destructi-ve insect pest in mango in India. The yield loss ranges from 5 to 30%," says Maruthadurai R, scientist, (agricultural entomology) from Indian

The use of chemicals to

ICAR scientists recently trained mango growers at Chorao on design and deve-lopment of low-cost pheromone traps through a project funded by NABARD. A total of 40 traps were distributed

The profitable mango



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9. Publicaitons brought out under this project







