Integrated management of whitegrubs in coconut garden

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Coconut provides livelihood security to millions of people in India. Crop loss due to incidence of pests adversely affects coconut production. Being a perennial crop it is attacked by an array of insect pests, among which root eating grubs / white grubs are polyphagous key pest of national importance. Palm white grub complex include closely related three species of genus Leucopholis viz., Leucopholis coneophora Burmeister, Leucopholis burmeisteri Brenske and Leucopholis lepidophora Blanchard (*O: Coleoptera, F. Scarabaeidae, SF: Melolonthinae*). Among these, *L. coneophora* is known as "coconut white grubs" as it is found associated with coconut based cropping systems along coastal belts and in plains which was first reported by Nirula et al. in 1952. The population is restricted up to an altitude up to 200 m from MSL and has annual life cycle. Though it is known as coconut white grubs, it feeds on root of areca palms as well and a menace to tuber crops and rhizomatous intercrops raised in coconut garden. The other two species viz., *L. burmeisteri* and *L. lepidophora* are found associated with arecanut based cropping system in high ranges or Ghat region at an altitude of >200 m above MSL and are known as "arecanut white grubs". It also feeds on roots of coconut / intercrops in coconut gardens in high ranges. Unlike coconut white grub, these species have biennial life cycle. Above mentioned three white grubs species require rain water to trigger adult emergence, hence it occurs during monsoon season.

Bio- ecology and behaviour of coconut white grub chafer

Studies conducted in ICAR- CPCRI indicated that, the adult emergence of *L. coneophora* commenced with the summer shower in April. Delay in summer shower delayed the emergence. After a pause in May, the emergence resumed with setting of South West monsoon. This pause was due to rise in soil temperature followed by summer shower. Soil temperature played a direct role on the emergence of beetles. There was no beetle emergence during the dry spells between the rainy days due to rise in soil temperature. Daily the emergence starts when the light intensity reaches 124.37 ± 75.5 l in the evening hours and remained active till illuminance fall to1.2 ± 0.4 l (ie.,between 6.45 to 7.15 IST). The males emerged prior to the females and then locate the females by fluttering in soil in inverted position directing antennae down. They also congregate in the spots where females are about to emerge. There was a strong competition among males for mating during female emergence, which was indicated by a wider operational sex ratio in the initial period (1:10.11) that narrowed down to 1:4.33 in later days. When female protrudes its head, the males pull it out and attempt to mate. Male mounted on female, after establishing the union, fell upside down on the ground without breaking the union. It remained in mating position for a long time. Towards the end,


Fig 1.


Fig 2.


Fig 3.


Fig 4.

the female went back to soil by digging and dragging the male behind. Adult activity prolonged for a maximum period of three weeks during each season. During emergence period birds were found to be predating on cock chafers and their activity noticed up to 100 l illuminance. But, maximum swarming of beetles occurred at 32.6 ± 15.1 l illuminance i.e., just before female emergence. It is an ecological or ethological adaptation by the beetle to ward - off predators. The beetles did not orient to the light trap. They could be collected by handpicking which could be an effective management strategy. The beetles exhibited sexual dimorphism with respect antennal and hind tibial characters. Size of terminal club forming segments of antenna is comparatively smaller in females than that of males. A pair of spines present at the posterior end of hind tibia are broad and flattened in females but in males it is circular in cross section (Fig. 1).

Adults are non- pestiferous which feed on leaves of cashew, mango and a few weed plants. It lay the eggs in soil that hatch in 23 days (Fig 2). Emerging grubs are whitish in colour with well sclerotized head and mouth parts (Fig 3). It has three larval instars with first instar stage feeding on organic matter and grass roots. By August – September, second larvae will be in second instar stage, move towards the root zone and start feeding on fibrous roots of palms. Which in turn results in impairing conduction of water and nutrient that leads to general yellowing of fronds, poor production of inflorescence and yield loss It tunnels bole and collar region of seedlings and severe incidence leads to seedling mortality (Fig 4 and 5). Being a polyphagous pest, larval stages feed on a wide array of crops viz., sweet potato, tapioca, yams, colocasia, elephant foot yam, banana, fodder grass, cocoa, rubber etc. As the soil moisture depletes after rainy season the larvae move down to deeper layers of soil. By October the larvae will be in third instar stage which are voracious feeder of subterranean parts (Fig. 6). The larval period is the longest period in the life cycle which extends for 260 -270 days. During summer months it pupate in deeper layer of soil and pupal period prolongs for 25.3 to 25.7 days.During next monsoon season adults emerge and continue the life cycle.

Natural enemy complex associated with coconut white grub

An array of natural enemies are recorded on coconut white grubs. On emergence, the beetles


Fig 5.

are predated by birds viz., domestic crow (Corvus splendens), jungle crow (C. macrorhynchosL.), common egret (Ardea alba L.), and raptors like king fisher (Alcedo atthis L.) and brahmini kite (Haliastur indusL.). Larval stage are parasitized by solitary internal parasitoid, Campsomeriella collaris collaris (Hymenoptera: Scoliidae) (Fig. 7), Prosena sp. nr. Siberita (Diptera : Tachinidae) in organic coconut garden (Fig. 8). Natural infection (4.2 %) of amber disease due to bacterial entomopathogen, Serratia spp. was recorded on third instar coconut white grub (Fig. 9 and 10). Mycosis observed were due to Cordyceps spp. (3.8 %) and due to green muscardine fungus, Metarhizium spp. (0.18 %) (Fig. 11 and 12). Two potential entomopathogenic nematodes found associated with coconut white grubs are Steinernema carpocapsae and Heterorhabditis indica. Bioassays indicated that, Steinernema sp. was more potential pathogen to L. coneophorahaving LT50of 5.104 days at with 8000 infective juveniles (ijs). Whereas, Heterorhaditis indica recorded an LT50 of 14.576 days at 8073 ijs.

Integrated management of coconut white grub

A set of refined strategies are suggested for the


Fig 6.

effective management

Hand picking and destruction of adults during peak emergence period. Generally, in plains (ie., along west coast) emergence begins with the commencement of South West monsoon (ie., last week of May / first week of June) which prolongs till middle of June. Adult beetles can be located by buzzing sound during swarming. Mechanical collection and destruction of beetles from ground is possible as they congregate in soil. It is to be done regularly for first 15- 20 days with the setting of south west monsoon daily during evening hours between 6.30 to 7.15pm IST continuously (Fig 13)

Patch application of any one of the following insecticides in the interspaces where grasses are dried due to damage caused by early instar root grubs during July – Aug second week when the grubs are in early instar stage

• Imidacloprid 17.8 SL @ 0.7 ml/ Litre of water, 3- 4 L of spray solution / m2 area

or

• Bifenthrin 10 EC @ 3 ml/ litre, 3- 4 L of spray solution / m2 area

or

• Chlorpyriphos 20 EC @ 3 ml/ litre @ 3-4 L spray solution / m2 area

• Drenching of Entomo Pathogenic Nematode suspension (EPN), Steinernema carpocapsae @ 1.5 billion infective juveniles / ha. For this, loosen the soil around the base of the palm to a depth of 5-10 cm and drench with EPN, suspension during August in plains. Approximately 40 to 50 lakh infective juveniles to be applied / palm basin. Based on the availability of EPN number of treatments can be increased. It can be applied along with imidacloprid @ 0.25 ml/ litre. EPN can be introduced by direct application of EPN multiplied cadaver of Giant wax moth larvae. EPN require thin film of water to be biologically active. Hence, care to be taken to conserve soil moisture once the EPN is introduced in the garden. EPN culture is available at crop protection division in ICAR - CPCRI Kasaragod.

• Need based second round root zone application of insecticide during second week of OctoberFor this, either of the following insecticide can be used


Fig 7.


Fig 8.

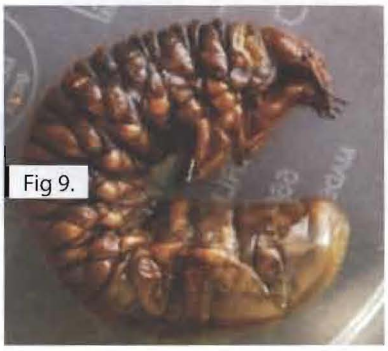
Fig 9.

• Imidacloprid 17.8 SL @ 4 ml/ palm in 10 L of water

• Bifenthrin 10 EC @ 30 ml/ Palm

• Chlorpyriphos 20 EC @ 30 ml/ palm

• Repeated ploughing / soil raking from October - December (ie., when the grubs are in second- third instar stage) to expose the root grubs for predation by raptors and other birds like, common crow, egrets, kingfisher, kite etc. Moreover, it also helps to improve the soil structure for better root development. It is difficult to locate eggs and first instar grubs in the field as they are small in size and are randomly distributed in field. Late second and third instar grubs move towards the rhizosphere and start feeding on roots of the palms. Hence, digging (forking) around the palm basins and interspaces up to 20- 30 cm depth during October - December enables handpicking and destruction of grubs. Intercrops raised in palm garden (viz., banana, colocasia, sweet potato, elephant foot yam, fodder grass etc.,) serve as alternate hosts for this pest.

• Application of powdered neem cake @ 1 kg / palm in the palm basin helps in rejuvenation of roots and to ward offinsect pests to some extend

These IPM strategies are to be continued for three years for the effective management of white grubs in coconut gardens ■