MODE OF SPREAD

White grub infestation in arecanut garden is influenced by various factors like soil type, drainage, nearness of infested gardens and lack of proper management practices. The spread of white grub infestation occurs over a period of time from a single infested palm. Observations recorded from different white grub infested gardens revealed that average spread of infestation takes 5-6 years. Water stagnation in the garden facilitates faster root grub damage.

POPULATION DYNAMICS

White grubs incidence can be seen from last week of August to March. Different stages of root grubs namely, first instar grubs upto September, second instar grubs upto December and third instar grubs upto March can be noticed in the garden.

INTEGRATED PEST MANAGEMENT

- Periodical digging, hoeing and ploughing reduce the root grub population by exposing them to predatory birds.
- Collection and destruction of adult beetles during peak period of emergence, May to July at 6.30 to 7.30 PM help to reduce population. Adult beetles can be identified by their buzzing sound during their emergence.
- Soil raking helps in manual collection and destruction of eggs, grubs and adults.
- Forking or ploughing of the soil during August - September helps in collection of grubs which are concentrated around the intercrops like cocoa and banana.
- Proper drainage reduces the population of root grubs.
- Removal of weeds and fallen leaves prevents the movement of grubs.
- Application of powdered neem cake @ 1kg/palm during May – June and September – October i.e. pre and post monsoon periods in the root zone, acts as good repellent/antifeedant against root grubs and also induces the emergence of new roots.
- Application of plant products like *Vitex negundo (Lakkigida/ Nekki gida)* leaf extract 2% (or) Nimbecidine 2% in the root zone of arecanut, effectively control the early instar grubs.
- Application of insecticides are advised during May – June and September – October i.e. pre and post monsoon periods. Treat the root zone of the palm by pouring 3 litre of Chlorpyriphos solution (@7 ml Chlorpyriphos 20 EC/litre of water).
- Spray Imidacloprid 17.8 SL @ 2.5 ml/ litre of water in the inter spaces of arecanut palm to control the early instars of root grubs.

All management practices should be undertaken continuously for a minimum period of three years for effective control of this pest. Root grub infestation may spread to neighbouring arecanut gardens. Hence, integrated pest management practices should be implemented by all the farmers of the root grub affected area.

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INTEGRATED MANAGEMENT OF ROOT GRUBS IN ARECANUT

Root grubs/white grubs (*Leucopholis* spp.) are the immature stages of scarabaeid beetles popularly known as chafer beetles, cock chafers or June beetles. They are perennial insect pests in many agricultural eco-systems. Root grubs occur mostly in clayey, sandy loam, lateritic and coastal alluvial soil where the water table is high. The grubs are seen in the moist layers of soil, usually at 7.5-10 cm depth. During the dry weather they move down even upto 30-45 cm depth. There are three species of *Leucopholis* which affect arecanut. They are *L. coneophora*, *L. burmeisteri* and *L. lepidophora*. Adults can be recognized by the chestnut colour of the beetles which emerge from the soil during May to June. Arecanut root grubs have wide range of hosts *viz.*, coconut, banana, cocoa, tuber crops *etc.*

DISTRIBUTION, HOST PLANTS AND MONTH OF ADULT EMERGENCE OF *LEUCOPHOLIS* SPECIES

S. No.	Hosts and distribution	*L. coneophora*	*L. burmeisteri*	*L. lepidophora*
1.	Distribution	Karnataka: Dakshina Kannada, Udupi, Shimoga and Kolar Kerala: Thrissur, Azhapuzha and Kasaragod	Karnataka: Shimoga, Chikmagalur, Coorg, Dakshina Kannada and Uttara Kannada Kerala: Thrissur, Azhapuzha and Kasaragod	Karnataka: Shimoga, Chikmagalur, Coorg, Dakshina Kannada and Uttara Kannada Maharashtra: Kolhapur and Sangli
2.	Larval hosts	Coconut, Arecanut and Coffee	Arecanut and Coconut	Arecanut, Coconut,Coffee, Sugarcane, Paddy, Bamboo, Phoenix, Cocoa and Butter fruit
3.	Host plants where adults congregate	Banyan tree, Coconut, Mango, Guava, Jack, Fig, Cashew and Bread fruit	Banyan tree, Mango, Guava, Jack, Fig and Rose apple	Banyan tree, Fig, Jack, Mango and Cashew
4.	Month of adult emergence	May to June	Late June	Late July to early August
5.	Life cycle	One year	Two years	Two years

SYMPTOMS OF DAMAGE

It is difficult to identify the symptoms in the early stages of root grub infestation except in young palms of less than three years of age which may wither if attacked by more number of grubs. Continuous feeding on roots results in poor supply of water and nutrients to the palm which lead to uniform pale yellowing of leaves, drooping of fronds, button shedding and decrease in yield. Reduction in stem girth, size of the crown, yellowing of leaves, tapering of palms and heavy reduction in yield or no yield are characteristic symptoms in the advanced stage of damage. In severely infested plots 30-40 grubs can be seen in the base of a single palm. After the pre-monsoon showers, the beetles make a buzzing noise while emerging from the soil during dusk hours which is another sign of the presence of white grubs in the garden. Severely infested palms can be easily pulled out as most of the roots are eaten away by the grubs. After feeding on the roots the grubs may go to the bole region and cause damage. At this stage, the infested palm may fall down by a slight push or due to wind. The suspected garden may be examined at random by digging the base of the palm to a depth of 30 cm for the presence of grubs at the root zone.

Damage on seedling roots

Crown symptoms - reduction in size of crown, yellowing of leaves and tapering of stem

Advanced stage of infestation - wilting and drying

Grubs

Toppled palms with damaged roots

BIOLOGY

The emergence of adults of all the three species of *Leucopholis* differs from each other. *L. coneophora* emerges after two rains in May to June. *L. burmeisteri* requires more wetting of soil before its emergence in June. *L. lepidophora* emerges in late July or early August. Adults of root grubs emerge during late evening hours, between 6.30-7.30 PM.

Immediately after emergence, male and female adults attract each other and mating takes place on the ground. They continue to be active till midnight. After mating, the adults may fly out to the host plants, often several meters away and return back to the place of egg laying. But the adults will not cause any damage to the host plants. Eggs are laid singly in soft earthen cells in soil at 5-10 cm depth during May/June. On an average, 20 eggs are laid by a female. Eggs are pearly white when laid and 4-5 mm in size. They turn creamy white after two days. Incubation period varies from 12-15 days and hatch into tiny grubs with a brown head and white body. First instar grubs feed on the small roots of grasses, weeds and organic matter of soil. The second and third instar grubs feed on roots of arecanut and other alternate hosts. Grubs initially feed on the tender feeder roots and later they shift to the bigger anchoring roots and in severely infested gardens they feed into the bole portion of the palm, making them vulnerable to uprooting during wind storms. White grubs are not specific to any particular roots as long as they get enough food, but prefer bigger roots or underground tubers or grass roots.

Pupal stage takes about 25-30 days. Pupation occurs in earthen cocoons in the soil at a depth of 60-70 cm. Substantial rainfall is found to be necessary to trigger emergence. Adults emerge from the cocoon *en mass* during the pre monsoon period in May to June. Larvae of *L. lepidophora* pupate upto the last week of June and adults emerge during early July to August. Rainfall stimulates the beetle emergence from soil. *L. coneophora* has an one year life cycle but *L. burmeisteri* and *L. lepidophora* have two years life cycle. Hence, they may often be found in overlapping generations which may be due to prolonged duration of grubs, dormancy of adults, differences in duration of the life stages and influence of soil temperature and moisture.

L. coneophora

L. burmeisteri

L. lepidophora

Adults of different species of root grubs