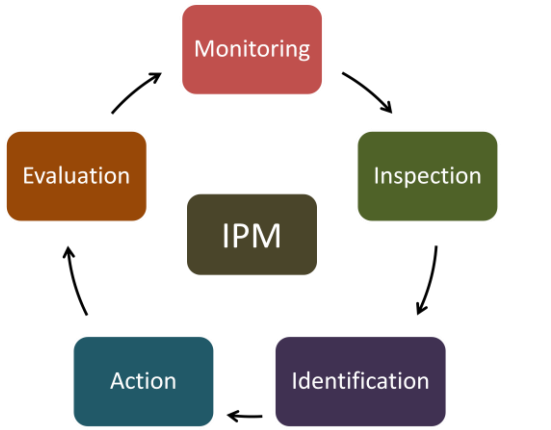
- Ploughing of orchard in November.
- Avoid plant stresses - healthy plants are much less susceptible to attack
- Release *Cryptolaemous montrouzieri* beetles @ 10/tree or @ 30 larvae/plant twice at 15 days interval.
- The Coccinellid *Menochilus (Chilomenes)* sex maculatus (F) is a predator of the nymphs and adults, and the Hymenopterous parasite *Anaysis alcocki* (Ashm.) *Anagyrus dactylopii* and *Aenasius advena* are three parasitoids on mealy bugs.
- Release of coccinellid *Scymnus coccivora* @ 10 beetles /tree or @ 30 larvae/plant is a good predator of both nymphs and adults.
- Collect fallen infested fruits and destroy them.
- Provide summer ploughing to expose the pupae.
- Immersion of fruits in hot water (45 to 47°C) for 60 minutes to kill eggs and maggots
- Use 10 traps per acre of methyl eugenol.
- Field release of natural enemies *Opius compensates* and *Spalangia philippines.*
- Apply well rotten sheep manure @ 4 t/ acre in two splits or poultry manure in 2 splits
- Control ants and dust which can give the scale a competitive advantage.
- Field release of ladybird beetle.
- Spray dormant oil in late winter before spring.
- Spray horticultural oil, if needed, year round.
- Adopt bagging of fruits.
- Use of braconid parasitoids (*Apanteles* spp.) to parasitize larvae

Biodiversity in natural enemies: **Parasitoids**

Biodiversity in natural enemies: **Predators**

Important activities for pest free drumstick production for export



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Integrated Pest Management (IPM) in Drumstick (*Moringa oleifera*) for export purpose

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Drumstick scientifically known as *Moringa oleifera* is well known for its multipurpose attributes as a food (leaves and pods) and non-food (moringa oil) commodity. The crop is attacked by many insect pests and among these bud worm (*Noorda moringae)*, Hairy caterpillar (*Eupterote mollifera)*, pod fly (*Gitona distigma*), bark caterpillar (*Indarbela tetraonis)* and leaf caterpillar (*Noorda blitealis*) are pests of economic significance because they cause significant agricultural losses.

I. Identification pest of Drumstick

1. **Bud worm (*Noorda moringae*):**

Adult is small in size with dark brown fore wings and white hind wings with dark brown border. It lays oval, creamy white eggs in clusters or singly on flower buds. Caterpillars are dirty brown with a prominent mid-dorsal stripe and black head and pro-thoracic shield. Full-fed caterpillars come out and pupate in minute brownish cocoons, either in soil or on ground itself, below dried leaves and debris. Egg, larval and pupal periods occur respectively 3-4, 8-16 and 6-10 days.Larvae bore into flower buds and cause shedding of buds up to 75%. Generally, infested buds contain only one caterpillar. Damaged buds seldom blossom; fall down prematurely. Insect activity is more during summer months in South India.


2. Leaf caterpillar (Noorda blitealis):

Adults are medium sized moths. Fore wings are uniformly dark in colour with a small white streak near the base. Hind wings are hyaline with broad black marginal band towards anal side. Eggs are creamy white and are laid in batches usually on ventral surface of leaves. Pupation occurs in soil. Caterpillars feed on leaf lamina, turning them into transparent parchment like structures. Peak period of infestation is during March to April and December to January


3. Hairy caterpillar (*Eupterote mollifera*):

Adult is yellow or drab in both sexes, with reddish brown markings spread over wings. Eggs are laid in clusters on leaves and tender stem. The larvae are whitish, speckled with black and with dorsal tufts of black hairs arising from a whitish hump. There is a dorsal blue-black band and a subdorsal pinkish band traversed by a grey line, as well as a series of small lateral black spots. Larva seen in groups in tree trunks feeding gregariously, scraping the bark and gnawing foliage. Severe infestation leads to defoliation of the tree.


4. Pod fly (*Gitona distigma*):

Adult is a small yellowish fly with red eyes. Wings extend beyond body and have a dark spot near the coastal margin. Eggs are cigar shaped sculptured and white coloured and are laid on the grooves of tender pod either singly or in groups of 3-4. Maggots enter into tender fruits by making small-bore holes at the terminal end. This causes oozing out of gummy fluid from fruits, which ultimately results in the drying of fruits from tip upwards. A maximum of 20-28 maggots are found in a fruit. Internal contents of the fruits rot. Full-grown cream coloured maggots pupate in soil


II. Pest Surveillance

Weekly monitoring should be done through pest scouting with the help of monitoring devices like pheromone and colored sticky traps. For field scouting 300 fruits from 100 plants per acre should be observed. Minimum 15 spots at reasonable distance with each other following a cross diagonal pattern moving zig zag manner for counting all type of insects. Pest monitoring for fruit flies using traps should be done regularly from fruiting stage onwards. If 95% plants are found free from insect pests then the field will be considered fit for export.

III. Integrated Pest Management strategies

The following Good Agricultural Practices should be adopted for the management of various pests of drumstick:

- Collect and destroy the mealy bug infested leaves, twigs and fruits.
- Flooding of orchard with water in the month of October kill the eggs.