PESTS OF COCOA AND THEIR MANAGEMENT

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INTRODUCTION

The cocoa tree. *Theobroma cacao* Linn. is cultivated in the southern parts of India for the last 30 years. Most of the cocoa plantations in Kerala, Karnataka and Tamil Nadu are mixed gardens along with arecanut or coconut palms. In few cases, it is grown in forest clearings with few forest trees retained as shade trees. In all these plantations, the cocoa trees are damaged by many of the polyphagous insect pests of these regions, but most of these insects have not evolved to a major pest status which required regular insecticidal control. Probably, the insect acclimatisation to this plant is still going on and with prospects of area under cocoa to increase, we may encounter more serious problems.

Out of the present load of insects on cocoa, few could cause severe damage during the initial years of the plantations and a number of sucking insects could cause direct loss of the crop by feeding on young and maturing cocoa pods, especially as one of the causes of cerelle wilt. Also, within a short period of the plant's introduction to this country, one group of pests have become a major threat economically, *viz.*, the rodents.

The damage these pests cause to cocoa and the pest management measures to be adopted to obtain maximum yield are given below:

INSECT PESTS

(a) Sucking insects

1. **Mealy bugs:** Two species of mealy bugs are important *viz.*, the cocoa mealy bug, *planococcus lilacinus* (Ckll.) and the citrus mealy bug, *P. citri* (Risso) (Pseudococcidae). These occur on the trees throughout the year and are present in all cocoa growing tracts of the country. They infest the tender parts of the plant such as growing tips of the shoots, the terminal buds, the flower cushions, the cherelles and pods of all maturity. Colonies could be found on the bark of the branches also. Feeding on tender apical shoots results in reduced growth and they develop as hair-like processes giving the appearance of a brush. In seedlings, the mealy bug feeding can retard the growth of terminal shoot. Flower cushions with mealy bug colonies ultimately wither and dry up. Upto 85 per cent cherelle wilt is reported due to mealy bug feeding. In the case of pod colonisation there is no injury to the beans inside.

Population of the mealy bug is lowest in June-August months, then a build up of the population starts with a peak in April and May. Population build up is positively correlated with higher temperature.

The ants. *Oecophylla smaragdina* (Fab) and *Technomyrmex* sp. are the main attending ants to these mealy bugs in cocoa gardens. These ants aid in the dispersal of the mealy bugs and may protect them from predators.

Control

Natural enemies: Native natural enemies of these mealy bugs include a coccinellid beetle *Pullus* sp. and the caterpillars of the lycaenid moth *Spalgis epius*. These predators are more in the field during summer months.

Insecticidal: Foliar spraying of fenthion, dimethoate, quinalphos or monocrotophos at 0.05 per cent was found effective in checking the mealy bug population. This could be given as spot sprays in the foci of infestation in an orchard after removing the intermingling branches of adjacent trees.

2. **Citrus black aphid,** *Toxoptera aurantii* B. de. F. (Aphididae): This dark brown to black aphid colonises the tender leaves, shoots, flower cushions and tender cherelles. Severe feeding by aphids results in crinkling of leaves and shedding of flower buds. Aphid colonies are found on the plant throughout the year, but the highest infestation is noticed from July to January months. The ants, *Camponotus* sp., *Crematogaster* sp. and *Anoplolepis* sp. are found attending this aphid.

Natural enemies of this aphid are well represented in the field and predation by these exert a good control of this insect. These predators comprise coccinellids, syrphids, chrysopids and hemerobiids. Insecticidal control is not usually required for this insect's management.

3. **Cowbugs:** *Gargara mixta* Bucket and *Gorgara* sp. (Membracidae). The nymphs and adults of these

tree hoppers colonise tender shoots, cherelles and pods. Due to their feeding, cherelles wilt and dry. Ants like *O. smaragdina* and *Anoplolepis* sp. are attending to these membracids. These insects are serious on few trees at few pockets of the orchard.

4. The tea mosquito bug, *Helopeltis antoii* Sign. (Miridae): These bugs are becoming serious pests of cocoa in many parts of Kerala and Karnataka in the recent years. The nymphs and adults colonise cherelles, pods and tender shoots. Characteristics circular water soaked lesions develop on cherelle and pod surfaces which blacken afterwards. According to the severity of feeding, the cherelles dry up. Severe feeding on pods may lead to deformation of pods. Tender shoots with linear feeding lesions dry up in course of time.

This insect, in future, may warrant an insecticidal management schedule since two favourite host plants of this bug *viz.*, cashew and cocoa are increasing in area.

5. **Red-banded thrips,** *Selenothrips rubrocinctus* (Giard) (Thripidae): These thrips colonise mature leaves and surface of pods. Infested leaves turn brown and dry up and on pods scabby patches develop. Cashew is an alternate host of this species. Incidence of thrips is more in areas where drought conditons prevail. Attacked plants show improvement when irrigation is provided to the plants.

6. **Leaf feeding caterpillars:** Caterpillars of many polyphagous species of moths feed on cocoa leaves both in nursery and in orchards. They attack the trees mainly in the flushing seasons especially after the monsoon rains and when the trees are putting forth new flushes after pruning. In some years, in some localities, few of these species may cause severe defoliation like caterpillars of lymantriids, and bagworms. When they are in more numbers natural enemies like parasites, predators, entomogenous fungi etc. also become numerous and exert a good control. Out of the many species of moths recorded on cocoa, the most important ones are mentioned below:

1. **The lymantriids,** *Lymantria ampla* Walk *Euproctis subnotata* Walk, *E. guttata* Walk. and *Dasychira mendosa* Hb Caterpillars of these moths are the most commonly encountered leaf feeding insects. These caterpillars feed on tender leaves and on the surface of cherelles and pods. These caterpillars are seen in large numbers after monsoon rains. On young plants, the caterpillars may cause severe leaf damage.

2. **Bagworms** (Psychidae): Many species of bagworms defoliate cocao plants and in some years, complete defoliation of cocoa trees are observed with only the twigs and branches remaining. These insects are polyphagous and attack palms like arecanut and coconut also. Handpicking and destruction are the best control methods since insecticidal sprayings would not kill the caterpillars easily which shelter inside the cases.

3. **Loopers:** *Hyposidra talaca* Walk. and *Pingasa ruginaria* Guen (Geometridae). These looper caterpillars feed and defoliate cocoa especially in nurseries and young plantations.

4. **Leaf webber,** *Adoxophyes privatana* Walk, (Tortricidae): The caterpillars of this moth web together young leaves and feed from within making irregular holes on them. Maximum infestation is recorded during January-March.

Hairy caterpillars of *Spodoptera litura* (F.) *Pericallia ricini* F., *Diacrisia obliqua* (Walk.) and polyphagous grasshoppers can cause severe defoliation of nursery seedlings if nursery area is covered with weed growth and surrounded by wild vegetation. The area should be cleared of weed growth and prophylactic sprayings with dimethoate or endosulfan at 0.05 per cent must be given on the seedlings and surrounding areas.

(b) Leaf feeding beetles and weevils

Adult beetles of the scarabaeid *Popillia complanata* Newm., theflea beetle. *Monolepta longitarsus* J.G. and the ash weevils Myllocerus spp. feed on tender leaves. These insects become active during the post monsoon months and feed on the flushing leaves. Infestation by weevils is relatively severe on young plants and quite often. The entire foliage of such plants are skeletonised leading to growth retardation. Prophylactic application of fenitrothion or quinalphose at 0.05 per cent on the under surface of leavea is essential to afford some protection in severe cases of infestation.

(c) Stem boring caterpillars and beetles

1. **Red borer of coffee,** *Zeuzera coffeae* Nietn (Cossidae): Caterpillars of this leopard moth make unramified hollow tunnels inside the branches. The external symptoms of attack are a round hole on the branch/stem, drying of the upper portions above the hole, and excretal pellets and chewed up fibres strewn out on the ground. When only branches are attacked, they dry up and pruning and destruction of these branches can save the tree. When the main stem is attacked, in young plants, the plant dies. Attack is more during post monsoon months.

2. **Bostrichid beetle,** *Sinoxylon* sp: Adult beetles bore into green shoots and twigs. They attack seedlings transplated in the field, especially in forest—clear-plantations and plantations surrounded by forests. Beetles make horizontal tunnels. Grubs also bore into the twigs of plants. Dried leaves on the tree is a symptom of attack by this insect. Careful monitoring of plantations in forest areas is a must to check the incidence of this beetle.

3, **Trunk borer,** *Glenea* sp. (Cerambycidae): Attack is seen in neglected gardens. Usually more than one grub is present in a stem. Attack is mostly on lower

trunks. Wood and bark tissues of the trees are eaten. Tree may succumb to attack if attack is unnoticed and continues for a long period. Stem girdler, *Sthenias grisator* Fab. (Cerambycidae). Attack is relatively severe in gardens bordered by wild vegetation. The beetles girdle the main stem as well as thick fan branches and cause breakage at the ringed region. Control of this borer is very difficult.

MAMMALIAN PESTS

Mammalian pests like rats, squirrels and palm civets inflict direct loss of the crop by feeding on pods. These are the major non insect pests of cocoa in India.

Rodents: Rats and Squirrels

Rodents damage the pods and the nature of attack follows a fairly constant pattern. Ripe pods are usually chosen and a large hole is bitten through the pod husk. The beans are extracted out and after the sweet mucilage covering is eaten these are discarded.

Three species of rodents *viz*., the Western Ghats Squirrel, Fumambulus tristriatus Waterhouse., the South Indian Palm Squirrel. *F. palmarum* Linn., and the black rat, *Rattus rattus* Linn. are the most important vertebrate pests of cocoa. Of these, the Western Ghats squirrel and the black rat are the major pests occurring in arecanut-cocoa, coconut-cocoa mixed gardens and in pure gardens of cooca. Of these two, the squirrel is the most serious pest of cocoa in India. Two sub-species of rats, *R.r. wroughtoni* and *R.r. rufescens* are known to cause damage to cocoa.

All rodent species while feeding on cocoa pods leave tooth marks on pods. These tooth mark of rodents are distinguishable from those of monkeys or civet cats.

Squirrels usually make oval holes either in the central or in the terminal portion of pods, while rats make round or oval holes near the stalk region of the pods. Squirrels damage ripe pods during day time and rats damage both ripe and unripe pods during night time. Rats feed on both immature and mature pods and while feeding on the mature pods the rats feed only on the mucilage, but on immature pods the beans are also eaten.

The population of squirrels is about 4—5 numbers per hectare and the home range is 2 ha. Squirrels are very active during early morning and late evening hours. The population of black rats is 25-30 number per hectare and the home range is 0.5 ha. only. Rats are nocturnal and they are good climbers. Though the population of rate is more in an area, the intensity of squirrel damage to cocoa was nearly three times more than that caused by rats.

The extent of rodent damage to cocoa various from 18 to 47.6 per cent in Dakshina Kannada district of Karnataka, 8 to 51.3 per cent in different districts of Kerala and 18.5 to 50 percent in Kanyakumari district of Tamil Nadu.

Control

Baiting and trapping : The detailed studies conducted at CPCRI on the different trapping and baiting methods concluded that judicious trapping using wooden or wire mesh live box traps is the best control measure against squirrels. These traps have to be set up in the early hours of the day since the squirrel feeling activity is highest at that time.

Poison baiting : Multiple dose anticoagulants like warfarin and fumarin are very effective in controlling rats in cocoa gardens. The poison baits are prepared by mixing broken rice, jaggery, paraffin wax and poison (warafarin or fumarin at 5% a.i.) in the ratio of 12:1:6:1. Rice, jaggery and poison are mixed first in a tray of convenient size. In another vessel the wax is melted. The molten wax is then poured over the bait mixure in the tray, mixed properly and spread evenly. Once the smooth surface is formed the slightly harendend mixture is cut to blocks of 4×4×2 cm. Each block weights around 35g. In a highly rat infested garden, one out of every five trees is to be selected for poison baiting. Three bait blocks are then kept on the branches of cocoa tree. Two more rounds of poison baitings are recommended at an interval of 2-3 days. The second round of application is done using two cakes and the third round with one cake. This schedule of baiting is found to give cent per cent control of the black rat.

Single dose anticoagulants are available now. Bromadiolone (0.005%) in wax cake formulation was evaluated in a recent study against black rat. Two application of 10g bromadiolone (0.005%) wax blocks at an interval of 12 days on the branches of one tree out of every five tree is recommended for effective control of black rat.

Other mammalian pests

The palm civet,*paradoxurus hermaproditus* pallas (Carnivora): known other wise as toddy cat, damage by this to cocoa pods is recorded from Kerala, Karnataka and Tamil Nadu. This is reported as causing about 12.8 per cent damage in Kerala. The palm civet, as big as a small dog, has a slightly pointed snout and a hairy tail, measuring about 45-60 cm with a tail of equal length. The palm civet is nocturnal and arboreal in habit.

The palm civet bites and breaks the husk of cocoa pods. The piece of broken chunks are 2.0—3.0 cm in diameter. There is no distinct pattern of attack. While feeding, the civets are known to swallow the beans also and as such no trace of beans is visible directly under the tree.

Control: Palm civets could be easily controlled by poison baiting with carbofuran granules using ripe

bananas as baits. Through a longitudinal slit in the banana, 0.5 g of carbofuran is added to it and closed properly. Two such bananas are tied on the trunk/ jorquette of five to six cocoa trees per hactare.

The bonnet monkey, *Macaca radiata* Geoffroy is observed feeding on cocoa pods in Karnataka. The monkey damage on cocoa pods could be easily distinguished by their 5 mm wide incisor teeth marks around the periphery of the gnawed hole. Monkeys remove the bark portion of the tree along with the pods and its damage was only 0.3 per cent of the total 30 per cent damage by mammals in Dakshina Kannada gardens.

BIRDS

Woodpecker: The golden backed woodpecker (*Dinopium* sp.) is seen damaging ripe cocoa pods. They make small holes of 1-2 cm diameter on the husk of ripe pods and lick the mucilage inside with their sharp, flexible tongue. The damage is generally noticed in summer months and the intensity at times reaches upto 16.0 per cent.

CONCLUSIONS

Rodents like black rats and squirrels; sucking insects like mealy bugs, tea, mosquito bugs and tree hoppers; leaf feeding beetles, weevils, and bagworms; and stem girdling and boring beetles are the key pests of cocoa in India which will affect the production. Tea mosquito bugs, thrips. bagworms, root grubs are to be closely monitored in the cocoa/cashew/cocount/ arecanut palms habitat since these environments may be more favourable for their existence as major pests of these crops singly and in crop combinations. Other insect and non insect fauna recorded on cocoa are of minor importance at present but these may turn as major pests, if any of the biological or climatological parameters which balance the population of these insects in nature are destroyed/changed. When area under cocoa is extended to other parts of the country, hither to unknown pest problems may arise; so systematic observations on the acclimatisation of local insect/non insect fauna to this introduced plant are necessary.

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