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Chapter 18

Pests in rubber plantations

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1. INTRODUCTION

Unlike most crops, rubber is subject to pest attack only on a limited scale, and compared to the effect of diseases, the intensity of damage caused is less and mostly below the economic threshold. One of the main reasons attributed to the apparent aversion of insect and other pests to rubber is the presence of latex in all parts of the plant, which coagulates spontaneously on fresh wounds and blocks the mouth parts of pests. However, a few pests do become serious at times and inflict fairly significant damage when the conditions are ideal for their survival and proliferation. The occurrence of most other pests seems to be sporadic and localized often in restricted areas and their outbreaks transient.

Rubber wood as well as the cover crops grown in rubber plantation are susceptible to attack by many pests. There are also pests which cause considerable health hazards and menace to residents near rubber plantations. Pests in rubber plantations have been discussed by Petch (1921), Steinmann (1925), Sharples (1936), Edgar (1958), Rao (1965), Pillay (1968), Abdul Aziz (1980), Jayarathnam (1980; 1992) and Johnston (1989).

2. INSECT PESTS

The predominant insect pests of rubber in India include white grubs, bark-feeding caterpillars, termites, scale insects and mealy bugs. The rubber wood-boring beetles, pests of cover crops and those affecting plantation workers occur sporadically and are of less significance.

2.1 Insect pests of rubber

2.1.1 White grubs

White (root) grubs (Plate 53. a) are by far the most serious pests of rubber at the nursery stage in India and cause much more damage than any other pests. They are the larvae of cockchafer beetles (Coleoptera: Melolonthidae). The grubs are fleshy with wrinkled C-shaped bodies and feed on roots of rubber seedlings and cover crops. This polyphagous pest is universal in occurrence and attacks rubber especially in areas adjacent to virgin forests. Detailed investigations on this pest have been carried out in Malaysia (Rao, 1965; RRIM, 1968), Papua New Guinea (Smee, 1964) and India (Ramakrishnan and Pillay, 1963; Jayarathnam and Nehru, 1984; Nehru and Jayarathnam, 1988; Nehru, 1991). White grubs of the species *Holotrichia serrata F., H. rufoflava F., H. fissa* Brenske and *Anomala varians* Ol. are predominant, causing severe damage to rubber seedlings in nurseries and rendering them unfit for transplanting (Jayarathnam and Nehru, 1980). The most common among the four species is *H. serrata* . The damage in general is severe when the voracious third instar grubs are abundant in the nursery (Nehru and Jayarathnam, 1988).

The life cycle of white grubs lasts for one year. Adults emerge from the soil with the first summer rains in April (Nehru, 1991). They are sturdy and the females are larger than males. They mate and lay eggs singly in nursery fields at depths of about 8 to 10 cm, enclosed in earthen cells. Adult beetles live for about two months. The grubs emerge in 10 to 12 days and the first instars feed on humus and very tender roots. The second instars tend to feed partly on lateral and tap roots while the third instar grubs feed voraciously on tap roots, leading to the total destruction of nursery plants which seem to sway in the fields due to active feeding of roots at the collar region. At this stage, the foliage of seedlings turns yellow, sheds off and the whole plant wilts and dries up. The three larval instars last for 30, 35 and 102 days respectively. The population of grubs may exceed 500000 per ha in areas of high infestation. Pupation takes place from November to December in earthen cells and lasts for 12 days. The adult beetles (Plate 53. b) lie quiescent in the soil and emerge with the advent of summer rains.

An integrated pest management strategy has been worked out for cockchafers in Malaysia (Rao, 1969) and in India (Nehru, 1991), which combines mechanical, cultural, chemical and biological methods of control. Field trials have proved the effectiveness of appropriately designed light traps incorporating mercury vapour lamp as an effective mechanical means of trapping adults (Rao, 1964). The beetles are highly attracted to light and can be caught in large numbers in traps incorporating black light fluorescent (3600°A) tubes (Rao, 1964; Van Iddekinge and Gill, 1969). Biological control of white grubs by the entomopathogenic fungus, *Beauveria brongniartii* and the entomopathogenic bacterium, *Bacillus poppillae* has been evaluated (Veeresh 1977; Jayaramaiah and Veeresh, 1983; Nehru,

1991). Application of *B. brongniartii* was effective for the control of chafer beetle of the white grub, *Holotrichia serrata* (Nehru *et al.*, 1991b). Applying carbaryl 0.1 per cent is effective in controlling the adult population (Nehru, 1991). Application of phorate 10 G at the rate of 25 kg per ha in the soil at the time of preparation of rubber nursery beds could effectively control white grubs (Nehru, 1983; Jayarathnam and Nehru, 1984; Nehru and Jayarathnam 1988). Natural control of white grubs by parasitoids and predators such as wasps, tachinid flies and birds is also observed in nurseries.

2.1.2 Bark-feeding caterpillars

Among the insect pests of rubber, the bark-feeding caterpillar (Plate 53. c) is the most serious endemic pest of mature trees in India (Nehru, 1983; Nehru *et al;* 1983. Nehru and Jayarathnam, 1984). Between the two common species of bark-feeding caterpillars infesting rubber *viz. Aetherastis circulata* Meyr. (Yponomeutidae) and *Ptochoryctis rosaria* Meyr. (Xyloryctidae), the former is more severe and abundant. The caterpillars build galleries on the trunk with chewed bark, faeces and silk and live inside the gallery. They feed on the bark on all parts of the trunk (Plate 53. d) and branches. At certain points where they feed deeper, latex vessels break and latex oozes out continuously from the wounds. These points facilitate easy entry of pathogenic fungi such as *Phytophthora, Botryodiplodia* and *Pythium* , thus intensifying the damage. The rotting of tissues up to the wood region may lead to breakage of branch, or rarely the trunk.

The bark-feeding caterpillar, *A. circulata* is brick red in colour, flat with a broad head and thorax and tapering abdomen. It measures about 1.5 cm in length during its pre-pupal stage. The adult moths are white in colour with black dots on the fore wing (Plate 53. e). Each female moth lays on an average 400 eggs on the bark. The caterpillars emerge in about four days. Larval period ranges from 25 to 30 days and the pupal period lasts for six to seven days. Pupa is enclosed in a cocoon made of thick silken gallery. The caterpillars thrive well during dry season and they seem to disappear during rainy months, as the galleries get wet and damaged. The pest can effectively be controlled by dusting insecticides such as fenval 0.4 per cent D, carbaryl 5 per cent D, methyl parathion 2 per cent D or quinalphos 1.5 per cent D with a power duster at the rate of 10 to 15 kg per ha (Jayarathnam *et al.*, 1991). Dusting should preferably be carried out early in the morning. *Himertosoma* sp. (Ichneumonidae) has been identified as a pre-pupal parasitoid of *A. circulata* (Nehru *et al.*, 1983).

2.1.3 Termites

Termites are social insect pests leading a subterranean life in the soil. They occasionally build huge termitaries (Plate 54. a) They live in colonies comprising of a queen, males, standby reproductives, sterile workers and soldiers. The workers attack the rubber plants by feeding on the outer dead bark (Plate 54. b) or any part which is partially or wholly dead. The most common species that infests rubber in India is *Odontotermes obesus* Rambur (Jayarathnam, 1968). This pest destroys only dead or partially dead trees, dry mulch, shade baskets, *etc.* Termite colonies generally originate from a dead tree or old logs buried in the soil. Termites have been particularly damaging to rubber in Malaysia (Rao, 1965) Indonesia, Cambodia, Sri Lanka, Vietnam, Africa and Brazil (Kashyap *et al.*, 1984).

Termites can be controlled by the application of insecticides such as chlorpyriphos 0.1 per cent in and around the base of the affected tree.

2.1.4 Scale insects and mealy bugs

Scale insects are small insects with an outer black, dome-shaped covering (Plate 54. c). The adult female and the immature stages of both sexes are destructive pests of rubber. They suck the sap from terminal green parts of young and mature rubber plants. The common species of scale insects that attacks rubber in India is *Saissetia nigra* Nietn. More than 12 species of scale insects have been recorded on rubber. Scale insects weaken plants in proportion to their number. In heavy infestations, plants exhibit yellowing and shedding of leaves and the growing points may die back. Mealy bugs (Plate 54, d) are soft-bodied small insects with white mealy outer covering. The common species on rubber in India is *Ferrisiana virgata* Ckll. (Ramakrishnan and Pillay, 1961; Jayarathnam, 1980). *F. virgata* attacks inflorescence of rubber trees, young shoots and the underside of leaves of nursery plants. Another characteristic of scale insects and mealy bugs is their ability to excrete honey dew, which spreads on the stem and leaves. A black fungus, sooty mould (*Capnodium* sp.) grows on it, rendering a black appearance to the stem and leaves. Scale insects have numerous natural enemies, predatory and parasitic insects and parasitic fungi, which often keep the pest populations under control. Entamopathogenic fungi such as a few species of *Fusarium* and *Hypocrella reineckiana* are biocontrol agents, particularly during the wet season. When natural enemies decline, pest outbreak occurs. Application of malathion at 0.05 per cent concentration along with a wetting agent is effective for the control of these pests.

2.1.5 Leaf-feeding caterpillars

Some lepidopterous pests are reported to feed on rubber leaves in other rubber growing countries. These include *Erinnys ello* L. reported from Brazil and Guyana (Winder, 1976) and *Tiracola plagiata* Walk. reported from Indonesia, Sri Lanka, Malaysia and Papua New Guinea (Rao, 1965). Application of insecticides like carbaryl or lindane has been found effective in their control (de Abreu, 1982).

2.1.6 Other insect pests

The weevil, *Hypomeces squamosus* F. (Coleoptera: Curculionidae) feeds on tender leaves of nursery plants and young plants in North East India (Mondal *et al.*, 1995). Legume covers are also attacked. A species of cricket (Plate 55. a) most destructive to polythene rainguards in rubber plantations is *Gryllacris* sp. (Gryllacrididae). This pest can effectively be controlled by the application of neem oil 10 ml per L, malathion 0.1 per cent and carbaryl 50 WP at 0.2 per cent concentration on the tapping panel region at weekly intervals from May to October (RRII, 1995). These pesticides are also effective for the control of weevils, bugs and thrips.

2.1.7 Rubber wood-boring beetles

Several beetle pests damage rubber wood and the most predominant among them are *Heterobostrychus aequalis* Waterhouse, *Sinoxylon conigerum* Gerstaecker, *Minthea rugicollis* Walker, *Dinoderus bifoveolatus* Wollaston and *Platypus solidus* Walker. The tunnels of

boring beetles are easily noticeable by the strings of wood dust ejected from the tunnels (Plate 55. b). The borers attack trees that have suffered injury following fire, lightning, sunscorch, drought or trees that are partially or wholly dried as a result of tapping panel dryness or other diseases. The attack is severe in Malaysia (RRIM, 1959; Tan *et al.*, 1979). The market value of infested timber gets reduced drastically. Among the wood preservation methods, the simplest method is the immersion of freshly-sawn rubber wood planks in a preservative solution consisting of 0.5 per cent sodium pentachlorophenoxide (against sap stain fungi), 7.5 per cent borax and 5 per cent boric acid (both against insects) for a period of 40 and 160 min for planks of 2.5 and 5 cm thickness respectively (Jose, *et al.*, 1995).

2.2 Insect pests of cover crops

The cover crop, *Pueraria phaseoloides* is more susceptible to pest attack compared to other cover crops such as *Calopogonium mucunoides, Centrosema pubescens, Mimosa invisa* and *Mucuna bracteata*. The most serious pests infesting the stem, leaves and inflorescence of *P. phaseoloides* are the stem borer *Eucomatocera vittata*, the leaf-lacerating flea beetle, *Pagria signata*, and the flower and pod borer, *Maruca testulalis*. *Nacoleia vulgaris* is another common pest of *Pueraria* in India. *M. bracteata* is attacked by leaf feeding caterpillars (Plate 55. c,d). The ladybird beetle, *Epilachna indica* is the most harmful pest of *Centrosema pubescens* in Malaysia. In situations where there is no alternative to chemical control, the pest infesting cover crops can effectively be managed by dusting carbaryl 5 D.

2.3 Pests affecting plantation workers

Mosquitoes are serious pests in most estates, causing serious health hazard by transmitting many diseases (Edgar, 1958; Jayarathnam, 1980). Stagnant water in pools and tanks in plantations should be treated with a thin film of insecticide (0.2% carbaryl or 0.5% fenthion mixed in diesel oil). The mooply beetle, *Lyprops corticollis* Frm. (Plate 56. a) causes considerable nuisance because of its presence in large numbers and secretion of stain after invading dwellings in plantations. The beetles can be collected using light traps or killed by spraying insecticides like chlorpyriphos 0.2 per cent and malathion 0.1 per cent. Leeches (*Hirudinaria cochiniana*), which inhabit swampy areas in rubber plantations, bite workers and suck blood.

3. NON-INSECT PESTS

3.1 Invertebrate pests

Among the non-insect pests, slugs, snails and mites cause more damage to rubber. Nematodes are associated mainly with cover crops.

3.1.1 Slugs and snails

The most important species of slugs and snails (Plate 56. b) attacking rubber in India are *Mariaella dussumieri* Gray and *Cryptozona* (*Xestina*) *bistrialis* Beck (Pillay, 1968) respectively. The other common species of slugs are *Vaginula* sp. and *Semperula maculata* Templeton (Ramakrishnan and Pillay, 1962). The snails present in Malaysia are *Paramarion martensi* Simorth, *Xestina striata* Gray and *Achatina fulica*. Fer. Slugs and snails, in general,

are capable of seriously damaging young rubber (Plate 56. c), particularly where there is abundant ground cover in which they can shelter. These terrestrial molluscs also climb on stems and feed on terminal and axillary buds repeatedly, arresting the growth of young plants. Uncontrolled slug and snail damage will result in a compact cluster of shoots having a very characteristic clubbed appearance. Symptoms of die-back and fasciation appear in severely affected plants. Slugs and snails occasionally ascend mature trees and drink latex (Plate 56. d) from tapped trees and cross over the tapping cut or stray into the collection cup. In addition to consumption of latex, spillage and contamination of latex occur. They are not affected by feeding on latex and excrete coagulated latex. By nature, they are nocturnal and in the daytime lie concealed under mulch, decayed logs and crevices of rocks and soil. However, their presence can easily be identified by the spring-like excreta and glistening lines of dried slimy secretion all over the shoot. The increasing incidence of this pest is currently noticed in many rubber plantations in Kerala.

Slugs and snails are soft-bodied animals with a sole-like foot on which they glide. They have a distinct head bearing two pairs of club-shaped tentacles, the posterior longer pair bearing the eyes at the apex. Snails bear a spiral shell while slugs bear none or have only a rudimentary shell. They are hermaphrodites but mating is required to lay eggs. They lay up to 400 pearly white eggs in masses on the soil in sheltered places. Life cycle is completed in a year.

Limited biological control of slugs and snails takes place through predation by carnivorous snails, beetles, birds and pigs. Application of metaldehyde, either made up as a bait or applied as a slurry or paint to the base of the stem of young plants, is an effective control measure (Ramakrishnan and Pillay, 1962; RRIM, 1964b). Use of metaldehyde as dusts and sprays is effective for the control of the African snail, *Achatina fulica* (Nair *et al.*, 1968). Metaldehyde used in the form of baits is available as Metabait. The bait is available in 2.5 per cent briquettes or pellets. Five grams of the bait pellets are recommended to be broadcast around the bases of the affected rubber plants (Jayarathnam and Rajendran, 1979). Snailkill, another metaldehyde bait, when broadcast at the rate of 20 g per plant around the base of the affected rubber plant, gives effective control (Jose *et al.*, 1996).

Aldicarb 10 G was observed to be effective for broadcast application around the plant base (Jayarathnam and Rajendran, 1979) or painting as a 0.01 per cent slurry with wheat flour at the base of the stem. Alternatively, 10 per cent Bordeaux paste can be used for band application at the base of the stem which is reported to repel slugs and snails for a period of 30 to 40 days (Jose *et al.*, 1989; 1996).

3.1.2 Mites

The yellow mite *Hemitarsonemus latus* Banks (Acarina : Tarsonemidae) is a common pest of nursery rubber in India and often causes severe leaf distortion and defoliation whenever new flushes are put forth. This pest sucks sap from the underside of tender leaves and on the upper surface numerous small white spots appear. These pests cause only minor damage as they feed only on the surface of mature leaves.

Mites are normally kept in check by a large number of predators including ladybird beetles and another mite, *Typhlodromus newsami* Evans. Spraying of wettable sulphur

(0.2%) or dicofol (0.05%) particularly to the undersurface of the leaves, is effective for control of mites.

3.1.3 Nematodes

The common legume covers are highly susceptible to the root-knot nematode *Meloidogyne incognita* (Thankamony *et al.*, 1989). Incidence of this species has been reported in rubber (Raveendran and Nadackal, 1975; Rajendran and Jayarathnam, 1977) but the infestation has not been severe in any plantation. However, the attack has been recently noticed in rubber nurseries in two regions indicating its slow establishment and potential threat to rubber seedlings (Nehru *et al.*, 1991a; Thankamony *et al.*, 1996). Root-knot nematode-infested rubber seedlings have conspicuous swellings on the lateral roots or rootlets (Plate 57. a). Seedlings also exhibit symptoms like discolouration and shedding of leaves and wilting of plants. Systemic insecticides like carbofuran 3 G (at 15 kg per ha) are effective against nematodes.

3.2 Vertebrate pests

New clearings, nurseries and plantations adjacent to primary or secondary forests are subject to frequent invasions of wild animals. Those that shelter in plantations as well as under the carpet of covers are also destructive to all stages of young rubber. A large number of vertebrate pests ranging from rats to elephants inflicts severe damage to rubber plants from the nursery to mature plantations (RRIM, 1964a; Rao, 1965; Nehru and Jayarathnam, 1985). As an intelligent and highly adaptable group, management of these pests by poison baits, scaring devices, traps and other techniques has often proved ineffective.

3.2.1 Rats

Dominant rat pests of rubber in India are the Indian mole rat, *Bandicota bengalensis* Gray, the large bandicoot rat, *B. indica* Bechstein and the soft-furred field rat, *Rattus meltada* Gray, which destroy nursery plants and young plants in the field by eating the tap root just below the collar region and often pulling whole plants of up to two years growth down to the burrow (Nehru and Jayarathnnam, 1985). *B. bengalensis* causes extensive damage in nurseries by attacking the roots (Plate 57. b) of plants.

Of all the rat control strategies, poison baiting is the most widely used and probably the most economical and effective control measure (Nehru and Jayarathnam, 1985). Poison baiting with two per cent zinc phosphide after two rounds of pre-baiting is effective against rats. An acceptable degree of control of mole rats can easily be achieved by baiting stable and weather resistant granular insecticides such as aldicarb (Temik) 10 G with tapioca (Nehru and Jayarathnam, 1985). Mass baiting at a time should be practised in areas of severe infestation and baits should be applied at points of fresh damage. Baits of single dose blood anticoagulant rodenticides like broadifacoum, bromadiolone (Roban) and flocoumafen (Storm) at 0.005 per cent concentrations are effective for the control of rats infesting rubber (RRII, 1995). These baits are more resistant to attack by insects and mould and retain their freshness and appeal longer than traditional loose-grain baits. The single dose blood anticoagulants, in general, neither cause bait shyness nor resistance.

3.2.2 Porcupine

Porcupine gnaws away pieces of bark from the ground level up to about 0.5 m, the stem sometimes being ring-barked leading to total drying of trees (Plate 57. c). They pull young plants out and feed on the tap root. Young plants may be attacked at one or more points above and below the ground. The common species found in India is *Hystrix indica* Kerr. Baiting with zinc phosphide either made up as a bait in salt meats or applied as a slurry or paint with wheat flour is effective. Application of 10 to 15 g of phorate 10 per cent granules in and around the plants is also effective in repelling porcupine for a period of 45 days.

3.2.3 Others

Many of the other vertebrate pests are mammals and include rabbit, hare, wild boar, elephant, monkey, bat, deer, sambar, squirrel and flying fox. Rabbits and hares are frequently encountered as pests of nursery plants. The former is gregarious and the latter is solitary in habit. The damage may extend from the ground to a height of about 15 cm, the stem being sharply cut and the stripped part of the stem found as splinters lying at the base of the plants. These pests are usually invaders from adjacent forests and so the damage is severe in areas bordering forests. Rabbits and hares can easily be repelled by means of suspending porous polythene bags filled with phorate 10 G granules from a stick or pole at a height of 45 cm from the ground in the affected nursery. The intense smell of this insecticide effectively repels hares and rabbits. Phorate is highly poisonous and should be handled with care. Wild boars destroy seedlings and stumps to feed on roots, pull out germinating seeds and feed on the bark of rubber trees. They also dig up the bases of rubber trees, damaging their roots (Plate 57. d). Elephants uproot young trees to feed on roots, but cause greater damage through trampling and breaking of trees and by destroying fences, thus allowing the entry of other animals. Monkeys are known to eat young shoots and leaves of rubber and break branches by swinging on them. Bats occasionally break the twigs and tear off the leaves of rubber. Deer and sambar eat the shoots of small plants and strip the bark, often ring-barking the young trees. Squirrels damage nursery seedlings by sharply cutting the stem to expose the pith, which is consumed. They are also known to consume the renewing bark of the tapping panel. In mature rubber, they damage young fruits to consume the seeds. The common flying fox, *Pteropus vampyrus* Linn. eats the leaves and sometimes defoliates the trees. The damage can be severe enough to lay bare the twigs of topmost branches. Flying foxes can be trapped in large-meshed nets hung among the trees.

In general, wild animals from the forest cause serious problems only when the plantation is not securely fenced. Installation of a well-maintained ordinary or electric fencing system is the best insurance against most of these pests (Baby, 1993). Details on pest control measures including trenches, barricades and electric fences have been reported by Blair and Noor (1981). Trapping, game-scaring devices and baiting with poisoned foods are other useful methods to control wild animals.

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