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AN ANNOTATED CONSPECTUS OF THE INSECTS AFFECTING FRUIT CROPS IN S. INDIA*

BY T. V. RAMAKRISHNA AYYAR, B. A., Ph. D.,
Government Entomologist, Madras (Retd.).

Introduction. With the spread of knowledge regarding the value of fruits in our dietics, there is nowadays a greater demand for fruits and consequently a tendency on the part of land-owners for an extension of fruit culture all over India. Among the various problems which the fruit grower has to pay particular attention to, the role played by insects of different kinds on fruit trees is of very great importance. The writer, has attempted in this paper to give some information on the entomological aspect of fruit growing in S. India. It does not, pretend to be in any way a complete or final account of the fruit insects of the province. It is only an annotated conspectus of all the important fruit insects so far noted in S. India with very brief notes on their bionomics and economic importance with some very general suggestions towards their control.

South Indian Fruit Crops and their pests in general. Though numerous varieties of tropical fruit trees are found grown in the different parts of the Madras Presidency very few of them are cultivated on any extensive scale. The only fruit crops which are cultivated on a fairly large scale in different tracts of this province are the *Mango*, the various varieties of *Citrus* and the *Banana*. The others which rank next to these include Guava, Sapodilla, Melon, Grape, Pomegranate, Fig, Jujub, Jak, Pine apple, etc. Crops like Apples, Peaches, Plums, etc. are mostly confined to the hill areas like the Nilgiris, Shevaroys, Pulneys, and parts of the Mysore plateau. Fruit crops in S. India are as much subject to insect pests as are the various field or garden crops. They, however, differ from the latter in that, their hosts being perennial plants they afford permanent footings to insect pests. The more important categories of pests which affect fruit crops in South India are the *stem borers*, *leaf*, *shoot* and *bark caterpillars*, which come under biting insects and the *mealy bugs*, *plant lice*, *leaf hoppers*, *fruit flies* and the *fruit sucking moths* which are sucking forms. Some of the worst foreign pests of fruit crops like the Sanjose scale (*Aspidiotus perniciosus*, G.) and the Codling moth (*Laspeyresia pomonella*, L.) which are very serious in other countries have not as yet appeared in S. India though they are reported to have come to Kashmir and Baluchistan. The cottony cushion scale (*Icerya purchasi*, M.) has appeared on the Nilgiris. In the following paragraphs is given an account of the different fruit pests arranged according to crops.

Mango. (*Mangifera indica*). Among insect pests of mango in S. India the most important are the mango hopper bug, the stem borer beetle, fruit flies and some scales and mealy bugs. Of lesser importance are the

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various leaf eating caterpillars, beetles, etc., and the mango nut weevil; some of them however appear occasionally as sporadic local pests causing some appreciable damage.

The Mango Hopper—(*Idiocerus niveosparsus*, L.) Jassidae. This insect has a wide distribution all over the presidency especially in the chief mango areas like Salem, Chittoor, Mysore and Vizagapatam. It is a small greenish brown creature about $\frac{1}{8}$ inch in length with a wedge shaped body, is very active and can both fly and hop. It feeds by sucking up the sap from the tender flower spikes and shoots in all its stages and secretes a sweet liquid known as 'Honey dew' (Telugu: *Theni manzu*) which is found very often wetting the whole soil around infested trees. In bad attacks the blossoms drop and no fruits develop. Very serious loss is sustained by mango gardeners in certain years. The life history and habits of the insect are detailed by Ayyar (2) and Ramachandra Rao (10). Two methods can be adopted against this pest—trapping the hoppers by nets or sticky screens and spraying the trees with a contact insecticide like fish oil rosin soap or crude oil emulsion.

Mango stem borer beetle, (*Batocera rubus*, *L*) Cerambycidae. The stout fleshy grub of this beetle often reaching 3" in length bores through the stem or main branches of mango trees and often kills them outright. The adult beetle is a dull brown stout insect with long feelers and strong mouth parts, and measures about 2 inches in length. The grub grows to a length of about 3 or 4 inches and remains as a grub for several months. This creature attacks other plants also such as rubber, jak, fig, etc. The presence of the pest on the tree is known by the gradual drying up of the attacked branch and also by the holes on the stem plugged with dust and excretions of the grub. The control measures consist in killing the adult beetle when found in the gardens, extracting the grub through holes found plugged with fibrous material by means of a hook or wire or injecting the holes with dilute kerosene emulsion, tar water or petrol, to kill the grub *in situ*.

Fruit flies. In almost all mango areas a very good percentage of ripening fruits get infested with fruit fly maggots of different kinds. Though similar in fundamental characters to the common housefly, fruit flies have spotted wings with often yellow and dark brown body spots. These thrust their eggs into ripening fruits of different kinds and the hatching maggots damage the fruit pulp from inside and drop to the soil when fully fed to pupate. Fruit flies attack many kinds of fruits such as guava, melons, peaches, citrus, etc. The species noted so far belong chiefly to the genus *Chaetodacus*, *C. ferugineus*, being the commonest on mango in S. India. Further particulars on fruit flies are given in the author's paper on these insects (4). Prophylactic methods such as destruction of infested and fallen fruits, trapping adult flies with poison sprays and traps may be adopted.

Leaf caterpillars. Several species of caterpillars are now and then noted feeding on mango foliage in different tracts though very few of them

cause any very appreciable damage. The more important and well known of these are the castor slug *Parasa lepida* G Limacodidae the Tussock caterpillar (*Euproctis scintillans* W) Lymantriade—the striped and spotted leaf caterpillar *Bombotelia jocosatrix* G, the shoot webber *Orthaga exvinacea*, M. Noctuidae—the small shoot boring worm *Chlumetia transversa* W. Noctuidae, and a slender leaf mining caterpillar causing blister marks on the tender foliage (*Acrocercops syngramma* M). When any of these appear in pest form both mechanical and insecticidal measures may have to be adopted, the insecticide used being a stomach poison like Lead arsenate or Paris green.

Leaf beetles. Among these there are four with different habits of their own:- 1. the leaf twister weevil (*Apoderus tranquebaricus* F) Curculionidae; the grubs of this remain and feed inside characteristic knots of tender mango leaves, 2. a slender pale green weevil which cuts the tender leaf tips (*Eugnamptus marginatus*, P) Curculionidae: 3. a minute leaf mining weevil (*Rhynchaenus mangiferae* M) Curculionidae; 4. ordinary leaf eating cock chafers and weevils—the latter chiefly belonging to the genus *Myllocerus* common on many cultivated plants, and the former belonging to species *Holotrichia etc.* which are night feeders. The beetle pests especially cockchafers can be easily checked by mechanical measures such as light traps, and by the process of jarring infested branches over a sheet or basket. The short stout built dark brown mango nut weevil *Cryptorhynchus mangiferae* M) Curculionidae - though found in S. India has not as yet become very important as a pest; it is usually noted attacking only certain varieties of mangoes, especially the long fruited *Kilimooku* or *Bangaloora* variety in S. India *(see ref. No. 12).*

Scales and mealy bugs. Scales and mealy bugs occasionally affect our fruit crops seriously. About eighteen species of these insects (Coccidae) have been so far recorded on mango alone in S. India, see (Ayyar, 3). Of these the commoner and more important are the scales 1. *Chionaspis vitis Gr.* 2. *Aspidiotus rossi M.* 3. *Aspidiotus ficus*, A. 4. *Pulvinaria psidii M*, 5. *Lecanium adersi N.* and the mealy bugs—6. *Phenacoccus iceryoides G.* and 7. *P. mangiferae G.* Of these numbers 1, 2, 4 and 6 are often troublesome. Scales and mealy bugs are perennial and often persistent, and as such might require some special attention. Since ants of different kinds also help in the increase of these Coccid pests attention should also be paid to the control of those species of ants which transmit the scale pests from tree to tree and from garden to garden. The red tree ant *oecopylla smaragdina F.* is notorious in this respect and can be noted on almost all tropical fruit trees.

Citrus. *(Citrus spp.)* Just as in the case of mango all the varieties of citrus found in different parts of the province such as oranges lemons, pomelos, sour limes, etc. are all subject chiefly to the same categories of insect pests such as leaf caterpillars, borers and coccidae, though there are a few forms specific to citrus plants in the different tracts of the province.

An account of the chief insects affecting oranges in the northern circars is given by Margabandhu (9).

Among leaf caterpillars the important ones are the different familiar smooth greenish larve of species of swallow tail (*Papilionid*) butterflies of the genus *Papilio* (*P. demoleus*, P. *polytes* and *P. polymnestor*); these cause more damage to younger plants than to well grown ones. The citrus leaf miner caterpillar (*Phyllocnistis citrella S.*)—Phyllocnistidae, is a small pale brown worm which almost exclusively confines its attacks to tender foliage and in young plants often causing appreciable injury; due to the mining habit of the larvae the attacked leaves develop glistening blistered patches and curl up. Of minor importance are two other caterpillars the leaf roller (*Tonica zizyphi S.*)—Oecophoridae—and the blue butterfly larva (*Chilades laius, G*) Lycaenidae. For these leaf caterpillars hand picking alone will be found effective except in bad infestations in extensive areas which might call for insecticidal methods.

The borers attacking citrus include both beetle grubs and caterpillars. As in mango, the former are larvae of longicorn beetles boring into the stem and branches of citrus trees; these beetles are especially found in parts along the Western Ghats, and two species have been noted in South India viz. *Chloridolum alcemene*, T. and *Chelidonium cinctum*, G. shining dark bluish beetles. These have the same habits as the mango stem borer.

The caterpillar borer (*Arbela tetraonis*, M.) (Arbelidae) bores also into the shoots and the bark of grown up trees showing winding irregular galleries of frass on the attacked tree. This insect is found everywhere and is occasionally serious in parts of the Ceded Districts. It is also seen now and then to affect different species of shade and avenue trees very badly.

Of the typical sucking insects affecting citrus plants we have the different scale insects, mealy bugs, aphids and mealy wings. In South India we occasionally find the scales *Aspidiotus ficus*, *A. aurantii*, *Parlatoria zizyphus*, *Lecanium viridae*, *Saissetia hemisphaericus*, *L. hesperidum* and the mealy bugs *Pseudococcus corymbatus*, G. and *Phenacoccus iceryoides*, G.

The recently introduced cottony cushion scale (*Icerya purchasi*, M.) though more evident on wattle trees on the Nilgiris has also been occasionally found on Citrus plants in the same district. This insect being an *insect K. D.* its behaviour and further progress have to be carefully watched by citrus growers in S. India. The mealy wings found on citrus include *Aleuracanthus spiniferus*, Q. and *Dialeurodes citri*, A. These are often found in company with the citrus plant louse *Aphis taverasi Dg.* which is often a bad pest of young plants. In addition to the above well known sucking insects, citrus is now and then found subject to the attentions of two or three heteropterous bugs puncturing the ripening fruits but rarely causing any appreciable damage; these are the two Pentatomids—the green *Vitellus orientalis*, D., the spotted *Cappaea taprobanes*, D. and the greenish brown Coreid *Dasynnus antennatus*, K. Attention to plant sanitation and

regular periodical spray programme will keep away these pests from citrus orchards. In dealing with scales and mealy bugs, of course, attention has to be paid to ants of different species (especially *Oecophylla* and *Camponotus*) and their role in spreading the bugs.

The fruit sucking moth *Ophideras fullonica*, L. Noctuidae—is one of the very few examples of adult lepidopterous insects (moths) directly injuring a cultivated plant in the adult stage. This and allied species (such as *O. materna*, L., *O. ancilla*, Cr.) which are stout built moths with long and sharp tipped sucking tubes puncture the ripening fruits and suck the juice during night. Fruits so affected usually rot and drop down. Very serious damage in this way is often reported from the Ceded Districts and N. Circars (11). Hand netting or baiting the moths over traps of ripe mangoes or syrup set here and there in orchards, and spraying as a preventive against the moths approaching the trees will check the pest considerably. Destruction of some wild plants chiefly the wild *Tinospora* on which the caterpillars of these moths breed in the vicinity of the gardens will also help to check pest multiplication. In the case of valuable varieties, covering the ripening fruits with wicker baskets or paper envelopes is also found effective and economic to some extent as is done in parts of the N. Circars.

Banana (*Musa spp.*) In South India though different species of Banana or plantain (*Musa spp*) are grown extensively, even more than mangoes or citrus, this plant, unlike the latter is not grown exclusively for fruit purposes but for vegetable as well. Compared to mangoes and citrus the banana is subject to fewer insect pests. The pests include leaf caterpillars which occasionally defoliate the plants; the chief ones are the castor slug (*Parasa lepida*, C.), the omniverous tobacco caterpillar (*Prodenia litoralis*, F) the black hairy caterpillar (*Pericallia ricini*, F) and a bag worm (*Kophene cuprea*, M.) A species of thrips (*Heliothrips kadaliphilo*, R.) was noted to do some serious harm to young foliage in S. Malabar in 1931. Hundreds of these minute insects swarm on the tender foliage and suck up the leaf sap causing the leaf to turn brown and dry. The notorious and widely distributed banana root and stem weevil (*Cosmopolities sordidus* G.)—Curculionid—though noted in the province in two or three areas such as Ganjam, Godavari and Malabar, has not yet become so serious as in other tropical areas like Fiji, Queensland or Philippines where it is found to cause appreciable harm. When a number of grubs of the weevil attack the banana stem the central shoot fades and the plant is gradually killed. Minor pests of banana include sucking spittle insects the commonest being the red and blue *Phymatostetha deschampis* L, the lace wing bug (*Stephanitis typicus* D) and a few scale insects *Lecanium descrepans*, *Asp. destructor*, S. and *A. cyanophylli*. Some of these scales occasionally cover fruits also. Excepting the borer weevil which may be found difficult to control in widespread cases except by prompt prohylactic methods, all the other insects of banana can be easily checked by prompt pruning of early infested leaves and if necessary by insecticidal washes in very serious cases.

Guava (*Psidium guava*). The important pests of the guava plant are scales, fruit flies and the fruit moth. The scale pests include the guava mealy scale (*Pulvinaria psidii*, G.) which is a specific pest of this plant and a few others includig the red and green bugs of coffee (*Saissetia hemisphærica*, T.) and (*Lecanium viride*, G.); all these have been referred to under mango. Prompt pruning of badly infested parts and spraying the rest with a contact poison will check these insects effectively. The fruit flies attacking this fruit chiefly belong to a darkish brown species (*Chaetodacus incisus*, W.). The fruit moth *Ophideres fullonica* and sometimes the caterpillar of the castor capsule borer (*Dichocrocis*) also attack this fruit. A reddish brown capsid bug (*Helopeltis antonii*, S.) which is a specific pest of tea in the hill plantations, is occasionally found damaging guava shoots in Coimbatore but has not been noted as serious.

Pomegrante (*Punica granatum*). The most important and specific pest of this plant is the fruit boring blue butterfly (*Virachola isocrates*, F.)—Lycaenidae); others include a few leaf eating caterpillars. The dirty brown caterpillar of this bluish brown butterfly emerging from shining eggs laid on the tender parts of the plant bores into the ripening fruit, feeds on the seeds and allows the fruit to rot and fall down. Infested fruits generally show holes on the fruit surface often plugged by the anal segment of the caterpillar or its excreta. The insect is found everywhere and serious loss of fruits is caused in some places like Coimbatore, N. Circars, Mysore, etc. The control measures generally adopted are: covering the developing fruits with paper or muslin bags to prevent egg laying by the butterfly, destruction of all badly damaged fruits and collection of the butterfly when possible. The castor capsule borer (*Dichocrocis*) is also occasionally found boring this fruit. The chief leaf eating pests are some of the caterpillars affecting castor, viz. the castor slug (*Parasa lepida*, C.) the red tussock caterpillar (*Euproctis fraterna*, M.) and the semilooper (*Achoea janata*, L.); the last is not so common as the first two. Minor pests include one or two mealy bugs which affect the fruit stalks and cover the fruit also *Pseudococcus lilacinus*, C.) and a mealy wing (*Siphonimus finitimus*, S.) the bluish black nymphs of which are often found in numbers on the foliage. The mealy bugs and mealy wings can be easily controlled if serious by contact spraying. In Kurnool, a fruit sucking plant bug (*Jartina indica*, D.) has been noted doing some harm on one or two occasions. The red borer caterpillar of coffee (*Zeuzera coffeae*, N.) has been noted on one or two occasions attacking pomegranate stem in the Malabar district.

Grape (*Vitis vinifera*). The insect pests of this crop in the important grape growing areas like Krishnagiri, Penukonda and Dindigul include some beetles, leaf eating caterpillars, thrips, white ants and scales. The most important of all grape pests in S. India is the small copper brown flea beetle (*Scelodonta strigicollis*, M.) a specific pest of this crop in many parts of India. In bad infestations numbers of the beetle are found feeding on the tender shoots and leaves and causing substantial damage to the foliage.

They may be collected with nets and others traps and; in bad cases, a stomach insecticide may be sprayed. In some cases, the vines are badly defoliated by night feeding cockchafer beetles also, the chief species noted so far in S. India are medium sized brown ones (*Adoretus lasiopygus*, B. and *A. versutus*, H.). Such beetles can be trapped by lights at night and also by stomach sprays. Another beetle pest found on grape vine is the vine girdler (*Sthenias grisator*, F.) a medium sized strong built longicorn beetle. It has the peculiar habit of ringing the vines and often killing the same; in some gardens very serious damage is often caused by the beetle cutting off some of the main vines. The early stages of the insect are passed on the girdled branches in which the eggs are laid by the beetle after ringing the bark. Control measures include destruction of the ringed branches and the collection of the beetles when found. In parts of Mysore and Coimbatore, the common dark brown ground beetle (*Gonocephalum depressum*, F.) is sometimes found doing damage to tender vines. Grape caterpillars include one or two species of horn worms—*Hippotion celerio*, L. and *H. oldenlandiae*, F. being the commonest. A leaf rolling pale green caterpillar (*Sylepta lunalis*, G.) and a very small leaf mining caterpillar (*Phyllocnistis toparcha*, L.) are also occasionally found as minor pests. None of these insects generally assumes serious proportions. They can be easily handpicked or controlled by stomach sprays when necessary. The tender foliage of grape is in many places affected by thrips which lacerate the tissues suck up the juice and make the leaves fade and dry. The grape thrips (*Physiphorothrips cruentatus*, H.) is specific to grape though found on other plants like roses, country almond etc. The pest can be easily checked by tobacco dusting. White ants—*Odontotermes sp.*—cause damage to newly planted setts of grape vine in notoriously white ant infested areas. Dipping of setts in crude oil emulsion or tar water and mixing crude oil emulsion in the irrigation water will give relief. Attention to termite nests in the vicinity will also be found preventive. Occasionally the vines are covered by small pale grey hard scales (like *Aspidiotus lataniae*, S) and (*A. cydoniae*, C.) and soft scales (like *Eccanium longulum*, D. and *Pulvinaria maxima*, G.). These can be easily checked by contact washes and careful pruning.

Melons. The chief insects on melons of different kinds are the same as those found on Cucurbitaceae, especially pumpkins, cucumbers and gourds; the commonest are the pumpkin beetles (*Aulacophora spp.*), the pumpkin leaf caterpillar (*Margaronia indica*) and fruit flies—*Chaetodacus spp.*

Fig (*Ficus spp.*). The important pests of cultivated fig which is not found on any large scale anywhere in S. India are: (1) the stem boring grub of a longicorn beetle (*Olenecamptus bilobus*, F.) a slender pale whitish brown insect with long antennae with same habits as the borer on mango; (2) leaf eating caterpillars of different kinds including (a) a small whitish wild silkworm (*Ocinara varians*, W.) the larva of a pale whitish moth, (b) the hairy caterpillars (*Perina nuda*, F. and *Hypsa ficus*, F.) and (c) other leaf eating

forms (*Phycodes radiata*, O., *Margaronia stolalis*, G. and *Plothea cetis*, M.). These can be checked by mechanical methods or stomach sprays. Some scale insects and mealy bugs (*Saissetia oleae*, B.) (*Aspidiotus cydoniae*, C.) (*Pseudococcus lilacinus*, C.) and (*Lecanium ramakrishnae*, G.) are occasionally found on the shoots and stems, but very rarely in serious form. A dark giant thrips (*Gigantothrips elegans*, Z.) is usually found on the tender foliage causing the leaves to curl and fade. In some species of figs especially *Ficus glomerata* the leaves are often badly galled by two or three species of jumping bugs Psyllidae (*Pauropsylla depress*, *Dynopsylla grandis*, etc.) some of these galls taking peculiar shapes.

Jak (*Artocarpus integrifolia*) and bread fruit (*A. incisa*). Of these two species of Jak in S. India, it is the common Jak (*A. integrifolia*) which is more subject to important pests. These include (1) the shoot and fruit boring caterpillar (*Margaronia caesalis*, W.) the larva of a whitish brown moth with greyish pattern on the wings. The reddish brown caterpillar bores into the tender shoots and developing fruits and causes substantial damage in many localities such as Malabar, Godavari, etc. (2) A small grey brown weevil, the Jak bud weevil (*Ochyromera artocarpi*, M.) the small whitish grubs of which bore into the tender buds and fruits. This insect is also common all along the western coastal areas and in parts of Mysore. In these cases only preventive measures such as the destruction of all infested and fallen buds and fruits and collection of weevils when found appear practicable. (3) Scales and mealy bugs—the tender shoots and buds of both Jak and bread fruit tree are often found covered with thick white masses of mealy bugs, chiefly (*Icerya aegyptiaca*, D. and *Pseudococcus corymbatus*, G). In parts of Mysore and Coorg, a small dark scale (*Aspidiotus triglandulosus*, G.) covers the foliage but does not cause appreciable harm. In all bad cases, prompt pruning and spraying of contact insecticides may be adopted. One or two species of spittle insects occasionally appear on the tender shoots and foliage and cause the leaves to curl up. The common forms noted are small creatures (species of *Ptyelus* and *Clovia*) but in Coorg and parts of S. Mysore a fairly large sized spittle bug reddish in colour (*Cosmoscrata relata*, D.) has been noted on jak in swarms covering whole branches with its frothy secretion. (5) A beautiful aphid (*Greenidea artocarpi*, W.) with long hairy cornicles is specific on jak and causes some harm to the tender leaves and buds.

Sapodilla (*Achras sapota*). Very rarely have insects caused any serious damage to this crop so far though mealy bugs (*Phenacoccus iceryoides*, GR. and (*Pseudococcus lilacinus*) are occasionally noted in small numbers.

Wood apple (*Feronia elephantum*). The castor slug (*Parasa lepida*, C.) occasionally attacks the foliage of this tree and a slender brown caterpillar (*Enzophera plumbeifasciella*, H.) attacks the fruits as a borer.

Jujub (*Zizyphus jujuba*). Both the wild and cultivated varieties of this fruit tree are subject to a few important pests. A grey hairy caterpillar

(*Thiacidas postica*, W.) is often found in swarms on the foliage. Leaf beetles like *Myllocerus* and *Platypria*, scales like *Ceroplastodes cajani* and *Pulvinaria maxima*, C. and a tube building spittle bug *Machcrota* are also found on the trees as minor pests. The really important ones are the reddish fruit boring caterpillar (*Meridarches sycrodes*, M.) the larva of a small brownish moth and the jujub fruit fly (*Carpomyia vesuviana*, B.); these bore into the ripening fruits and often cause severe damage.

Custard apple (*Anona squamosa*). Only the fruits of this plant have been found attacked by any insects and the chief ones are the mealy bug (*Pseudococcus virgatus*) which often covers the fruits, the fruit boring caterpillar (*Heterographis bengalella*, H.) and fruit flies (*Chaetodacus spp.*).

Jambu (*Eugenia jambolana*). No insects of a serious nature affect this plant though leaf weevils, caterpillars, mealy wings, jumping bugs, etc. are occasionally found breeding. Fruit flies (*Chaetodacus* sp.) attack the fruits. The greenish caterpillar of a purple winged moth (*Carea subtilis*, W.) attacking the leaves is a specific insect of this tree; this caterpillar is peculiar in that it has the anterior part of the body conspicuously swollen. The mealy wings *D. aleurodes eugeniae*, M.) and the Psyllid jumping bug (*Trioza jambolanae*, G.), though they cause malformation of the shoots and foliage, hardly bring about any serious harm. The rose apple *Eugenia jambos* a tree grown here and there in the province is also subject to these same insects.

Tamarind (*Tamarindus indicus*). Scale insects and mealy bugs of different kinds often cause some damage to this tree—especially to the tender shoots and fruits which are literally covered with these insects during certain years. These include both hard scales (*Aspidiotus orientalis*, N) (*A. tamarindi*, G.) and (*Saissetia oleae*, B.) and mealy bugs (*Pseudococcus lilacinus*, C.) and (*P. corymbatus*, G.). The curious crab caterpillar found on redgram (*Stauropus alternus*, W.)—Notodontidae—is sometimes noted on tamarind foliage but only as a minor pest. Bag worms (chiefly *Chaliodes vitrea*, H. and *P. teroma plagiophleps*, H.) are occasionally found damaging the foliage also. Sometimes the pomegrante butterfly (*Virachola isocrates*, F.) is also found on the fruit. The beetle *Caryoborus gonagra*, F. is generally found breeding on stored tamarind in provision stores feeding on the seeds.

Cashew (*Anacardium occidentale*). Insects visiting this plant have been so far found to do harm only to the different parts other than fruits and these are mostly sap sucking forms. These include (1) the small dark brown thrips (*Selenothrips rubrocinctus*, G.) which is the notorious Cacao thrips of Ceylon and other tropical regions; in parts of N. Malabar it is occasionally found doing damage to tender leaves and flowers by sucking the sap and allowing them to fade and dry up; (2) the active reddish brown mosquito bug (*Helopeltis antonii*, S.) the well known pest of tea and which attacks the tender shoots, and (3) scale insects (chiefly the wax scale *Ceroplastes floridensis*, C.) which are rarely serious. Of other pests, the leaf eating caterpillar of the wild silk moth (*Cricula trifenestrata*, H.) a stout reddish brown hairy caterpillar, is occasionally found in swarms on these trees in different

areas along the west coast; the golden yellow hairy and spiny silken coccoons of these caterpillars are sometimes found in masses on the tree branches. Occasionally a pretty little long snouted dark weevil (*Apion amplum*, F.) is also found nibbling the shoots.

Country almond (*Terminalia catappa*). This tree is not subject to any serious pests. Among insects noted on it are 1. the leaf twisting reddish brown weevil (*Apoderus tranquebaricus*, F.); noted under mango, 2. The grape thrips (*Rhipiphorothrips cruentatus*, H.) is found on the tender foliage, 3. Scale insects (chiefly *Saissetia nigra*, B. and *S. hemispherica*, T.).

Nelli (*Phyllanthus emblica*). The insects found in this tree include 1. mealy bugs of different kinds (*Pseudococcus spp.*) covering the tender parts 2. a bluish metallic green pentatomid bug (*Scutellera nobilis*, F.) which sucks the fruit—noted only in parts of N. Circars; 3. a small leaf rolling caterpillar of very minor importance 4. a species of aphid *Setaphis bougainvilliae*, H.) noted on this tree in Coimbatore. The garden Phyllanthus (*P. distichus*) often suffers badly from the attacks of a mealy wing (*Aleurodes*) which covers the undersurface of leaves in masses.

Pine apple. (*Ananas sativus*). No insect pests of any importance have been noted on this crop in S. India, though the pine apple mealy bug (*Pseudococcus bromeliae*, B) was noted on one or two occasions in Malabar on the Kew variety.

Mulberry (*Morus sp.*). The only important pest of this crop, which is generally grown only for its foliage to feed silk-worms in parts of Mysore and Kollegal, is the stem girdling beetle (*Sthenias grisator*, F.) already noted under grape vine. The mealy bug pest causing *Tukra* disease of N. India has not yet been noted as a pest on mulberry in S. India.

Bael or Bilwa (*Aegle marmelos*). In S. India this plant is utilised more for its foliage for use in religious functions than for its fruits. The leaves and shoots are very often badly infested by the green coffee scale (*Lecanium viride*, G.). In some places a small black shining flea beetle (*Clitea indica*, J.) and its yellowish white grubs seriously defoliate this tree. The citrus butterfly (*Papilio demoleus*, F.) is also found breeding on this plant but does not affect it seriously.

Papaya (*Carica papaya*). No pests have been noted on this plant till now in S. India.

Apples, Pears, Peaches, Plums, Etc. These fruits are found subject chiefly to the attacks of plant lice, scales and fruit flies. The plant lice include two forms: 1. the notorious 'wooly blight' (*Eriosoma lanigerum*, H.) which is apparently an introduced pest and which is often serious on apples on the hills, and 2. (*Dilahunus krishni*, G.). Hard scales (especially *Aspidiotus cydoniae*, C.) are sometimes found on introduced stalks of apples peaches, etc. Leaf weevils generally (*Myllocerus subfasciata*, G.) are found occasionally, but are of minor importance. Of some importance are the fruit flies (*Chaetodacus spp.*) which attack peaches, plums, perismmon, etc. The wooly blight and fruit flies should receive prompt attention in the case of these exotic fruit plants and in importing stocks from outside the country,

very great care should be taken to see that only pest free material is brought into the country. In fact the import of foreign fruits and fruit plants, unless done under very careful quarantine supervision, is one important channel for undesirable foreign insects to enter our country as already noted in the author's two papers (Nos. 6 & 7).

Control measures. Before concluding this brief account of S. Indian fruit insects a word or two may be added regarding control measures against them in general. Unlike as in the case of ordinary field crops like paddy, sorghum, etc. where, methods like spraying, dusting etc. for pests are out of question, in the case of paying crops like fruits all modern methods whether mechanical or insecticidal are well worth introduction in orchards; in fact such methods should be included in the routine of fruit cultivation just in the same way as cultural methods like manuring, irrigation hoeing, pruning, etc., etc. It will also be quite economic and practicable for orchardists in extensive areas to equip themselves with the necessary pest controlling apparatus and insecticides for their periodical use; else they can even arrange for stocking all such materials on a co-operative basis for the use of all fruit growers in any area. If modern methods of spraying, etc., have any definite chances of success in India, paying crops like fruits and industrial crops like cotton, tobacco, etc. are the ideal ones for such trials. Biological control may be very effective in some cases but the same will have to be always supplemented by the ordinary prophylactic and curative measures like spraying, dusting, etc.

References Cited.

1. Ayyar T. V. Ramakrishna—"Some insects noted as pests of fruit trees in S. India". *Agr. Journal of India*, 18. 50–58. 1923.
2. " " "The mango hopper pest and its control in S. India." *Tropical Agriculturist*, 51. 1918.
3. " " "Coccidae affecting fruit trees in S. India," Report of 3rd Entomological meeting Pusa 1919, pp. 601–10.
4. " " "Fruit flies and their economic importance in S. India." M. A. J. XXIII, 1935, pp. 127–138.
5. " " "Insects affecting important cultivated plants in S. India." Madras. Bulletin No. 27, 1932.
6. " " "Some foreign insects which we do not want in India." *Agr. J. India*. XIV, 1919.
7. " " "The economic danger in the introduction of some foreign animals and plants." M. A. J. XXI, 1933, pp. 247–255.
8. Kannan K. "The large citrus borer of South India." *Mysore bulletin* No. VIII, 1928.
9. Margabandhu V. "Insect pests of Orange in N. Circars." M. A. J. XXI, 1938.
10. Rao Ramachandra Y. "The mango hopper problem in S. India." *Agr. Jour. of India*, XXV, 1930, pp. 17–25.
11. Susainathan P. "Fruit sucking moths of S. India." Rept. of 5th Entomological meeting Pusa 1923, pp. 23–27.
12. Subramaniam C. K. "Notes on mango nut weevil" Department Y. B. 1925, pp. 29–36.