Insect Pests of South India and their Control.

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About four years ago an insect pest had the honour of cutting a prominent figure in the Budget discussions of the Madras Legislative Council. In addition to the chronic failure of timely rains that the dry farming ryots of the Bellary Districts are usually afflicted with, the "Aggipurugu" or "Benkihula" of Cholam (*Calocoris*) had appeared that year and caused an almost total loss of grain. "What have the Agricultural Department done to save the ryot from this pest?" demanded the Member for Bellary and naturally much of his wrath decended on the devoted head of the Entomologist. Two or three other pests had bid fair to attain to such distinction, though they did not actually get into similar limelight. One of these is the "Rice Army Worm"—*Spodoptera mauritia*,—known variously as "Karakkotti", "Laddepurugu" and "Arakkan." It is one of those swift scourges of Nature, that seem to descend like the lightning on broad stretches of young paddy and disappear altogether after dealing widespread destruction. In the year 1924, numerous villages in Malabar had been affected and there was a loud wail calling for help from everywhere at one time. Later in the season the same year, there were numerous calls for help against "Bambuchu" or "Chazhi" (the name by which the Rice Bug is known in South Kanara and Malabar respectively) sucking dry the green ears of paddy.

There are numerous other pests of importance in South India, which the Entomologist is expected to tackle. There is the "Kumblipuchi" or "Gongalipurugu" dealing destruction in its millions to all young cereals and pulses in most red-soil areas of the Presidency. There is next the Rice Grasshopper defoliating the leaves of young paddy and later on cutting the bases of the earheads in the mature crop. There was last year a tale of woe from one of the western taluks of Bellary regarding the depredations of the "Jitti" or the Deccan Grasshopper, which had thus reappeared after an interval of several years' duration. There are a thousand ills to which fruit trees are subject. The Mango-hopper may in certain years cause an entire failure of the crop. The fruit fly, the mango stone weevil, and the stemborer are only a few of the varied hordes of insect enemies of Fruits. Besides these there are numerous other insects destructive to various other crops. Remedies are demanded for all of these : some "medicine" is wanted that would make the pests vanish in a moment and save the crops. You may give the ryot full information

as to what the insect is, how it lives and what it does; you may give him sage advice as to what he should or should not do in future ; but this is not what the Indian ryot wants : what he expects of you is something very different. He demands something very spectacular—a prescription that could transform, as with a magic wand, his yearning wishes into solid reality and a stricken crop into a plentiful harvest, all without the least exertion on his part. Spells and incantations—"mantrams"—are what he places more reliance on, and the village magician oftentimes reaps a decent harvest of silver and copper coins whenever pests come into existence.

We are not, however, living in the days of Aladdin and his wonderful lamp : and though indeed greater wonders have been accomplished during the recent developments of science, it has seen, only through patient plodding research and not by the reputed touch of the magic wand. It may be confessed at once that there is, as in medicine, no universal panacea for all kinds of disease. In each case the disease has to be carefully diagnosed ; the actual cause traced and the circumstances under which it comes into existence investigated before proper remedies can be suggested. Each different insect has its own peculiar ways of damage. The remedies have necessarily to be adapted to suit the nature of the particular insect. In reporting the occurrence of diseases, a mere statement of symptoms will not, generally speaking, be sufficient. Several entirely different causes give rise to diseases the symptoms of which are identical to the eyes of the layman. For instance, when the leaves of a plant turn pale and wither, it may be due, firstly, to one of the several sucking insects, such as, scale insects, thrips, or plant-lice or even to redspider, or secondly, to any leaf mining caterpillar, grub or maggot or thirdly to a fungus disease, like Mildew; but the treatment depends on a knowledge of the exact cause of the disease. It is therefore absolutely necessary that specimens of the attacked plants together with those of the suspected insects should accompany reports of pests or disease. In many cases the best procedure on the part of a competent entomologist would be to examine the pest on the spot, institute enquiries and study the life history of the insect, so that he could be in a position to suggest remedial measures suited to the particular conditions.

It is perhaps not generally known that insects—low as they are in the scale of creation—have a more complicated life history than the higher animals. Butterflies are not born as butterflies nor are grasshoppers born as such. The parent insects lay eggs, from which in one class of insects—typified by the grasshopper—young insects hatch out which resemble the parents in general appearance but

differ in being smaller and wingless. As they feed, they grow gradually bigger and bigger until they assume wings and become mature. In the other class, typified by the butterfly, the egg hatches into a worm-like form very different from that of the parents. It is unable to fly but crawls about on the food plant and feeds actively on the leaves and grows bigger and bigger until it becomes fullgrown. It then assumes a form known as the chrysalis or the pupa. It is seed-like in shape and is unable either to feed or to move. After a period of about a week or two in this resting condition, the skin of the chrysalis splits and the butterfly crawls out. The wings are not noticeable in the beginning, but soon grow out and expand, so that in a short time the butterfly is able to fly away. Whereas the caterpillar feeds on the leaves the butterfly is not possessed of biting jaws but only of a sucking tube with the aid of which it sucks nectar from flowers. The life-story of the silk worm is perhaps a more familiar illustration. The silk worms hatch from small circular eggs and are at first very small. As they feed on the mulberry leaves, they gradually increase in size, until they become full grown, when they spin oval cocoons of silk and turn into pupae inside. After a week or two the moth emerges from the cocoon piercing a hole at one end.

Again insects differ a great deal in their feeding habits. Some are armed with teeth and are able to bite, cut and chew. They may feed on the leaves or the bark or may tunnel into hardwood. There are other groups of insects which possess a sharp tubular beak instead of jaws and use it for sucking up plant juices.

A study of the habits of insects is very important in relation to a consideration of remedial measures against them. In the case of insects which have jaws and are capable of feeding on plant tissues, such as leaves, the recognised method of treatment is the application of a stomach poison—like the compounds of arsenic—on the plants to be protected, whereby the insect takes in the poison along with the leaf and gets killed. It must, however, be kept in mind that, in the arsenates, we are dealing with chemicals that are deadly to man and the higher animals as well, and also that if a certain proportion is exceeded, the leaves themselves become affected and get burnt. It is therefore essential that the poison should be mixed with water in certain particular proportions—whereby the insects are killed but the leaves are unaffected. It is also important that the mixture thus prepared should not merely be splashed on the leaves but spread over them sparingly but evenly. This is effected with the help of a mechanism known as a spraying machine. It exists in various sizes

and in various patterns. The most convenient size is that known as the Knapsack sprayer—capable of being carried on the back and being operated by one man. It consists of a metallic reservoir to receive the spraying mixture, a force pump, a hose and a nozzle-which produces a fine mist-like spray. A spraying machine is onvaluable in any up-to-date orchard.

The other class of insects—which have a sucking tube in the place if jaws–are not affected by the above treatment. As they do not feed on solid tissues, the use of stomach poisons does not affect them. In fact they need a different sort of treatment—viz., the use of a contact insecticide. Insects possess a respiratory or breathing system composed of branching air tubes which communicate with the outside air by means of spiracles or breathing holes situated along the sides of the body. Preparations, like an emulsion of kerosene and soap, or a decoction of Tobacco and soap, have, when sprayed on the body of such insects, the effect of penetrating the air-tubes through their breathing holes and causing their death. These contact poisons are of great use against soft-bodied insects like the Mango Hopper, the Cabbage Aphis and Scale insects.

There is yet a third class of insects which, though possessing jaws, live a concealed life. They may be borers in stems of plants, or may tunnel into the pulp of fruits or may mine into the tissues of leaves, but in all cases they are beyond the reach of insecticides that may be sprayed on the plants. It is a difficult matter to get at them unless the stem or the fruit they inhabit is cut open. In certain cases, however, as for instance, of the codling moth caterpillar boring into apples, peaches etc., a careful study has shown that the borers are vulnerable at a particular stage. The eggs are laid on young fruits or flowers and the young caterpillars have to bite their way inside from the surface. Experience has shown that if a stomach poison be sprayed on the flowers or fruits at this stage, most of the young caterpillars are killed and the fruits thus protected from borers.

The fruit maggot is another knotty problem. The eggs are laid singly under the skin of the rind, and the maggot tunnels in and feeds on the pulp. Until the maggots bore their way out of the fruit to pupate in the soil, the fruit presents a healthy appearance, so that it is usually not possible to distinguish infested fruits till the last stages. In Italy, spraying of poisoned solutions of sugar or molasses has been tried with some success against the Olive Fruit Fly—an allied insect pest, the flies, especially the females, feeding on the solutions and getting killed. A similar method is under trial against the Mango Fruit-Fly at Kallar. A measure readily suggested

by common-sense, is of course, the destruction of all infested fruit, since each fruit neglected would mean a deliberate encouragement given to the increase of the pest and would lead to the loss of numerous fruits in the succeeding generations of the Fly.

In the case of certain other insects, the perfect or the winged stage comes to light in abundance and contrivances have been devised whereby such insects are trapped at light and destroyed. The light trap is, however, generally an unreliable method, since in moonlit nights it has not much attraction for insects and to a certain extent useful insects are also lured and destroyed. In other instances, moths have been found to be powerfully attracted to mixtures of sugar solution and arrack, and certain pests have been tackled by exploiting such habits. Experience has yet to show if this method will prove useful in South India.

Of recent times, the utilisation of natural checks against the spread of insect pests has caught the popular imagination, especially in America. In Nature, the powers of reproduction among insects are enormous. In certain species each mother insect is known to be capable of laying as many as 3,000 to 5,000 eggs. Each egg may, under favourable conditions reach the adult or egglaying stage in a month or less. If insects were to continue to breed at this rate throughout the year, the numbers which may be produced from one parent insect would reach a frightfully large figure and there would soon be no space on earth for man or for beast. Under natural conditions, however, there are certain automatic checks on the increase of insects—of which the most important are the limitations of climate and the existence of natural enemies. Of these, the former is clearly beyond human control, but the latter may be made use of to a certain extent.

The instances of successful checking of several serious insect pests by the introduction of parasities in America have already become classics in Entomological achievement. The romantic circumstances under which successful results were achieved have served to clothe the method of utilising the natural enemies of insects with a peculiar halo in the popular imagination; with the result that the layman always imagines that success is indisputable wherever parasites have been discovered. It is however important to recognise that the undeniable success of parasite introduction in America was due to certain peculiar circumstances. In attempts at importing various famous varieties of fruit trees from Europe and the East, the Americans had in the earlier days unwittingly introduced certain serious pests belonging to the Eastern Hemisphere. Though these

insects were not known to be very serious in their native homes they were found, much to the chagrin of the importers to multiply so rapidly and to such an alarming extent in America as to threaten the complete ruin of the fruit-growing industry. On investigation this abnormal increase was found to be due to the absence in their new homes of their natural checks in the shape of insect-enemies. Consequently American investigators scoured through the world in quest of parasites; and the story of the discovery of these parasites and later on of their successful introduction into America is now a matter of history. The position is however quite different in the case of pests indigenous to the country. These have their own parasites which usually keep them within bounds, but at times, owing to a peculiar combination of climatic conditions, the parasites happen to decrease and as a natural sequence the pests increase in numbers till such time as the parasites are able to regain their ascendency. Under such conditions, it is rather difficult to make use of the parasites. The only way would be to give them protection during adverse conditions in winter or midsummer, to give them other hosts in the absence of the particular pest, and to give them an early start, if possible in spring, so as to enable them to obtain an efficient control of the pest before it assumes real magnitude.

During the last three years, some amount of work has been done in South India by way of the control of a pest by means of its parasite enemies. About 5 years ago a serious coconut pest the black-headed caterpillar—*Nephantis serinopa*—had been inadvertently introduced by rail traffic from Travancore and the pest increased in such numbers within a year that coconut palms became badly affected and began to dry up. Owing to the impossibility of spraying trees of such size and height, the cutting and burning of infested fronds was the only measure that could be adopted. Due to a lack of co-operation among the garden-owners, the help of the Pest Act had to be called in by Government for enforcing the remedial measures uniformly. However, in spite of even a thorough clearing, a re-infestation was always noticed since there were always a large number of moths at large to lay fresh eggs. An examination of the pest in the East Coast Districts of South India revealed the fact that the pest was automatically controlled in these places by the combined action of three or four different parasites. Since all but one of these were absent at Mangalore, live cocoons of these parasites were imported from East Coast Districts and set free there. It was pleasing to find that within the period of a year of introduction two of these got established at Mangalore and there was a perceptible betterment of trees in the infested area. Although the pest has of late spread from Mangalore into various parts of South Kanara and

Malabar it is hoped by a systematic introduction of the parasites into these areas that the pest will be kept fairly within safe bounds. The problem of control by parasites is, however, very much complicated by the interference of other factors such as the effect of weather conditions and the presence of hyperparasites so that it is not such an easy matter as it appears to be.

No hard and fast rules can be given as to the application of remedial measures. The right method of treatment even for the same pest will depend on the particular conditions of the particular spot. Given different conditions the treatment may have to be modified very greatly to suit them It is on the whole a question of mere common sense. For instance, the swarming caterpillar *Spodoptera mauritia*—may occur in wet nurseries or in dry ones. It may be found in young broadcast crops or may occur in "Kole" cultivation. It may even attack hillgrasses on the tops of hills. The measures that may be successful under one set of conditions may not hold good under others. Flooding the fields has been found to be of value where there are facilities for irrigation, but this method is obviously of no use in dry sown crops, or in the case of hill grasses. Hence the only operation that is possible in dry areas is to prevent the caterpillar from marching from attacked to unattacked fields by digging trenches across their path. It may be possible to destroy them either by poison baiting or by dusting, but these methods are still in an experimental stage and no statement can therefore yet be made on their merits. In the "Kole" cultivation in backwater areas it was found this year that, although water was available in the early stages, flooding was impossible on account of the difficulty of baling it back—an operation which is by no means an economic proposition. Remedies can therefore be based only on common sense—quickness of judgment and rapidity of action being more important than elaborately thought-out plans.

In the case of certain major pests, elaborate spraying is an impossibility, especially when the crops concerned are " Poor man's crops" like cholam and the small cereals. What the Entomologist has therefore to do is to study the life habits of the pest in question in great detail and find out weak points in its life history that could be taken advantage of for devising control methods. In the case of the Red Hairy caterpillar, the pest rests in the ground as a pupa for nearly 9 or 10 months. When the monsoon rains are received, the pupa transforms into a moth, which pushes its way up to the surface of the ground and flies about. The female moths are able to lay about 1000 eggs each and these hatch in 3 or 4 days into small hairy caterpillars which feed on the crops and grow. When they are full grown they are very voracious and do immense damage

to dry crops. Ultimately they dig their way into the soil and wait till next year's rains In the instance of this pest, hand-picking the moths—absurd as the proposition may sound—has been found extremely efficacious, for, each moth picked out is really equivalent to the destruction of 1000 prospective caterpillars.

In fine, under any circumstances, the ultimate aim of the Economic Entomologist is the furtherance of the prosperity of the farmer. Considering the large amount of loss sustained by the agriculturist owing to the incidence of insect pests, the Entomologist will not only have justified his existence but have earned the confidence and the gratitude of the ryot, in case he could show him how to remedy even a portion of such loss Before advising remedial measures the Entomologist must first satisfy himself that they are really efficient. His next step should be to see if they are practicable and safe in the hands of the practical farmer; and lastly he must see if they are cheap. It is only when his advisory measures emerge triumphant from all these tests, that he can congratulate himself on being a successful Entomologist.