

employment for the people and to colonize and populate the North part of Queensland which is considered to be rather a vulnerable point in that country. It is only the sugar industry there that is keeping the people on that land. The higher cost of production is largely due to the higher wages for labour in that country which again is due to the higher standard of living that is maintained therein. Cheap black Kanaka labour was once employed in the sugar plantations but this has all been steadily substituted by white labour.

The sugar industry in Australia is artificially nurtured, controlled and protected in all stages—the area of supply being assigned to each factory, wages of labour and hours of working fixed, compulsory holiday enforced in the factory on Sundays, and the price to be paid to the grower fixed as also the price at which sugar is to be sold in the Australian market. The peculiar basis on which the Australian Industry is run will be evident from the fact that at the time of the Congress the price of sugar in the home market was 4 pence a lb though its selling price in London market was only about 1½ pence (both in Australian currency). In spite of this obvious loss on every ton of sugar exported—this was roughly computed at about 6 to 18 pounds (Australian)—that country finds it necessary and worthwhile to keep the Industry going for the reasons already indicated.

The obvious lesson to India is that it is necessary to keep the ancient industry of cane growing in India going and develop it in all ways in the interests of the agricultural prosperity and well being of the country as a whole. The Government of our country was therefore fully justified in affording the sugar industry of India the tariff protection it is receiving at present.

“A Delegate”.

THE IMPORTANT INSECT PESTS OF THE CASTOR OIL PLANT IN S. INDIA WITH SUGGESTIONS FOR THEIR CONTROL.

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Among the different oil seed crops cultivated in India, the castor plant (*Ricinus communis*) appears to be one of the most important and extensively grown ones. Recent statistics* indicate that among the well-known castor growing areas of the world, such as Brazil, Russia, India and Egypt, India stands not only as the foremost grower but is also responsible for over 90 per cent of the world's export trade in castor. Inside India though the crop is cultivated, in small areas in parts of Berar, Baroda, Behar and the United Provinces, we find that

* The writer is indebted to Dr. Patel, the Oil Seed Specialist for information on this point.

the largest area under castor is to be found in Peninsular India including the Nizam's dominions, Mysore and the Madras Presidency; in fact, the area under this crop is greatest in the Nizam's dominions, the ceded districts and Mysore coming next in order. It is also well known that apart from its use as an oil seed producing plant, the castor plant is also utilised in many parts of India to feed the eri silk-worm—the rearing of which is becoming a popular and important cottage industry; in fact, the eri silk-worm is so named after its food plant (*Erandi* or *Eri*—castor). In view of such importance, it is up to South India to do everything in its power to hold its own superior position as the premier castor growing area in the world. One of the duties of the South Indian Castor grower, therefore, is to have sufficient knowledge of the insect pests, which cause serious damage to the growing crop, which often results in substantial loss to him.

It is the writer's idea in this paper to give the South Indian castor grower some general ideas of the more important insect enemies of that plant in this province with some suggestions in controlling them, so that they might be able to grow as far as possible a pest free crop.

Insects found on Castor. Of the several insects which levy their seasonal toll on the castor crop in the different areas of this province the more important and the more numerous are those which feed on the foliage and the great majority of these are what are known as leaf eating caterpillars. Among the others which possess other habits such as boring into the plant tissue or sucking the plant juice, we have a shoot and capsule boring caterpillar, a stem boring beetle and some bugs including what are known as leaf hoppers, scale insects, stink bugs and mealy bugs. The important insects so far noted as more or less injurious to the castor plant can be grouped conveniently as below showing the general habits and the insect group to which each belongs.

Table of Castor Insects.

A. Caterpillars. (Biting insects).

I. Feeding exposed on the foliage.

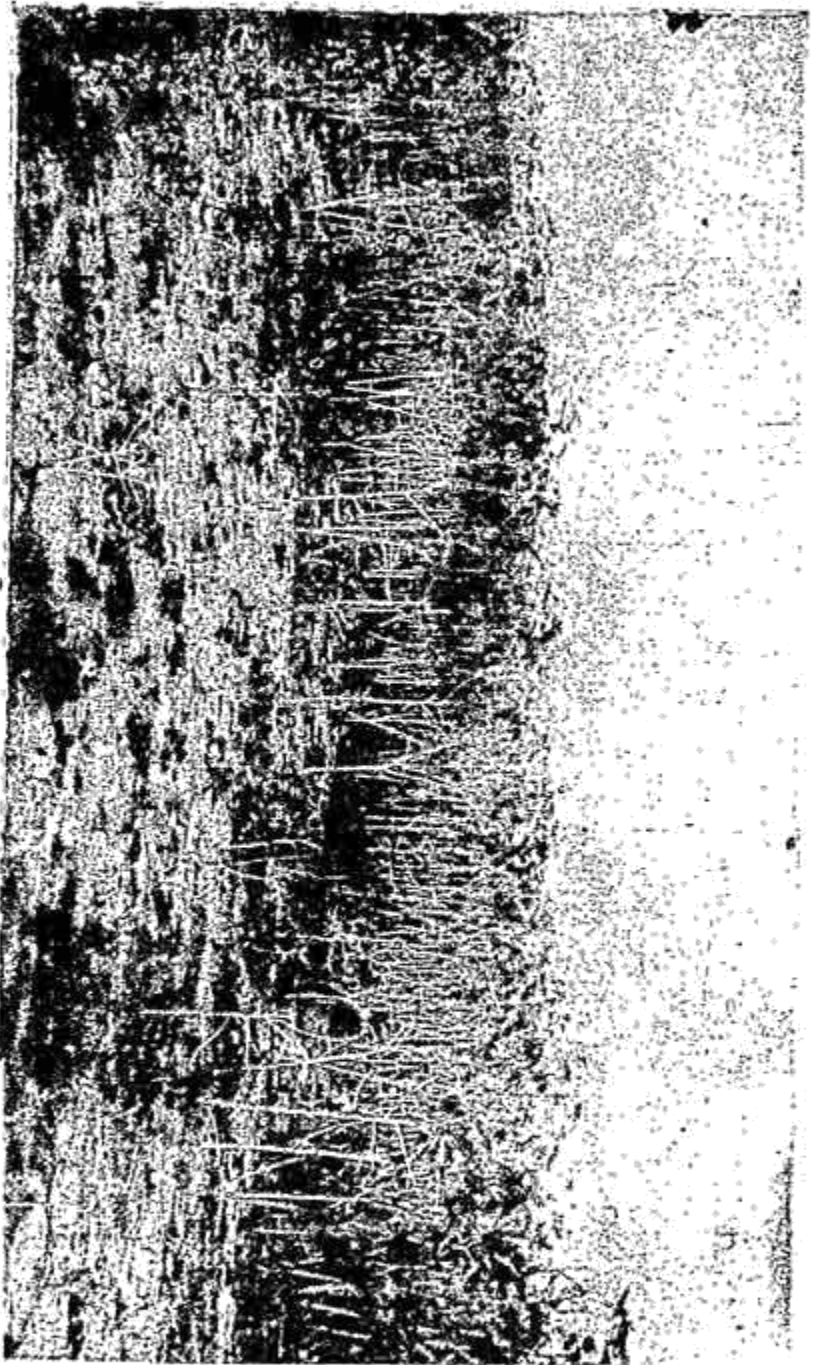
- (a) Smooth caterpillars (both moths).
 - i. Semilooper—*Achosa janata*, L.
 - ii. Ordinary—*Prodenia litura*, F (known as the Tobacco caterpillar).
- (b) Hairy caterpillars (all moths).
 - i. Uniformly hairy
 - Black—*Pericallia ricini*, F
 - Yellowish—*Diacrisia obliqua*, W
 - ii. Hairs with tussocks also
 - Reddish—*Euproctis fraterna*, M
 - Greyish—*Olene mendosa*, H
 - Yellowish brown—*Orgyia postica*, W.
- (c) Case bearing caterpillar (moth)
 - Bagworm—*Clania crameri*, W.
- (d) Spiny or slug caterpillars
 - Spiny—*Ergolis merione*, Cr. (Butterfly)
 - Sluglike—*Parasa lepida*, Cr. (Moth).

- II. Boring caterpillar—The shoot and capsule borer—*Dichocrocis punicifera* ferals, G. (moth).
- B. Beetles. (Biting insects).
- I. Leaf eating—Flea beetle—*Heimacophaga ruficollis*, L.
- II. Boring beetle—shot hole borer—*Xyleborus fornicatus*, E.
- C. Bugs. (Sap sucking insects).
1. Stink bugs—The green plant bug—*Nezara viridula*, L.
2. Leaf hoppers—the green jassid—*Empoasca flavescens*, F.
3. Scales and mealy bugs—Black scale—*Saissetia nigra*, N.
4. Mealy wings—castor mealy wing—*Trialeurodes ricini*, M.

Major and Minor Pests. From the above it is evident that about twenty forms pay their attentions to the castor crop to a smaller or greater extent now and then. However, the castor grower need not be frightened at this fairly long list of insect guests, since it is generally found that neither do all these insects appear as regular pests season after season, nor does any one of them cause equally serious damage. Some of them are of minor importance and some others only appear rarely as sporadic pests while only a few are of real importance. The above list is given however to give the cultivator a general idea of castor insects to help him to make them out when they appear on the crop. The really serious or major pests of castor which appear more or less regularly and cause appreciable injury to the crop are caterpillars including some of the leaf eating forms and the seed and shoot boring caterpillar.

Leaf-eating Caterpillars. It is hardly necessary to state at the outset that these caterpillars are the young ones or larval stages either of moths or butterflies and these latter which are the adults do not cause any direct harm to the growing crop. Among the ten leaf-eating forms noted above under this category the semi looper *Achoea janata*, L. is the most important and is a specific pest of castor found very rarely on other cultivated plants. It enjoys a very wide distribution being found all over India. The adult insect is a stout built dark greyish brown moth with the fore-wing showing wavy brownish transverse lines and the hind wing having black and white patches. (Fig. 4 plate). The full grown caterpillar which injures the foliage is about 2 to 2½ inches in length, smooth and having a greyish to dark brown colour (occasionally different shades of brown colouring are noted often with dark and brown markings also). Unlike the great majority of caterpillars which crawl about like worms, this insect is a semi looper the first pair of pro-legs becoming functionless. The insect starts its active life from young caterpillars hatching out of bluish green round beautifully sculptured eggs laid singly on the tender portions of the castor plant. Young caterpillars pass through the usual moults and in about two weeks assume the full grown condition described above. It is during this period that the damage is done to the foliage and this is often so serious that a whole plot is completely

stripped of the foliage in the plants which are practically skeletonised. (Fig.) When fully fed the caterpillar changes into the pupa condition either under the soil or inside folds of leaf on the plant itself and emerges as the adult moth in about another two weeks. The whole life cycle from egg laying to adult condition generally occupies about four weeks; this period varies according to weather conditions in different localities. As stated above this insect is found very rarely and only in small numbers on other plants and these include the Rose, the Pomegranate and one or two species of *Euphorbia*. For details on the bionomics of this insect reference may be made to Lefroy (1). All the leaf eating caterpillars of castor have more or less the same life histories with, of course, some differences, in the manner of egg laying, pupation and other minor characteristics. Next in importance to the castor semilooper comes the smooth cylindrical stout caterpillar (*Prodenia litura* F. fig 3 Pl.). This insect, the adult of which is also a stout built brown moth, is a very common insect found in a number of other plants besides castor and is a specific pest of tobacco; hence popularly known as the tobacco caterpillar (4). The eggs of this moth are laid in batches of many, each batch being hidden under a covering of felted hairs. The young caterpillars feed together gregariously during the earlier stages and separate gradually as they reach the full grown period; at this latter stage the caterpillar is about an inch and a half in length, cylindrical and of a dark to blackish brown colour with yellowish and dark patches on the segments. The pupation takes place underground in an earthen case; in a week or ten days the adult emerges from the pupa. The other caterpillars feeding on castor foliage are not of general occurrence, but occasionally appear as sporadic, and sometimes cause serious damage. The commonest of these are the different hairy larva of which the tussock caterpillars are the ones more frequently noted. These are all larvae of moths and among these the yellowish brown form (*Orgyia postica* W. Fig 8. Pl.) now and then assumes destructive proportions as may be found from the author's paper ³ on this insect and his colour plate in another paper ⁵. The other two tussock caterpillars and the hairy caterpillars are *Euproctis fraterna*, *Olene mendosa*, *Pericallia ricini* and *Diacrisia obliqua* having the same habits as *Orgyia*; these are occasionally found in company at the same time. The last two are however very rarely seen in serious form. *Pericallia* (Fig. 7 pl.) is a more common pest of banana and lablab and *Diacrisia* is generally found on the hills and in North India as a general-feeder. The bag worms which move about often enclosed in bags or cases made of thorns and sticks are not serious on castor in S. India. The slug caterpillar (*Parasa lepida*, C. fig. 1 Pl.) which is apple green and covered with irritating spines and hairs is occasionally found as a pest on castor. The pupal cases of the creature are found as hard shell like objects attached to the plant stem (see fig. pl.) The spiny caterpillar (*Ergolis*) is the only one among these numerous



Castor Crop defoliated by Leaf eating Caterpillars

INSECT PESTS OF CASTOR

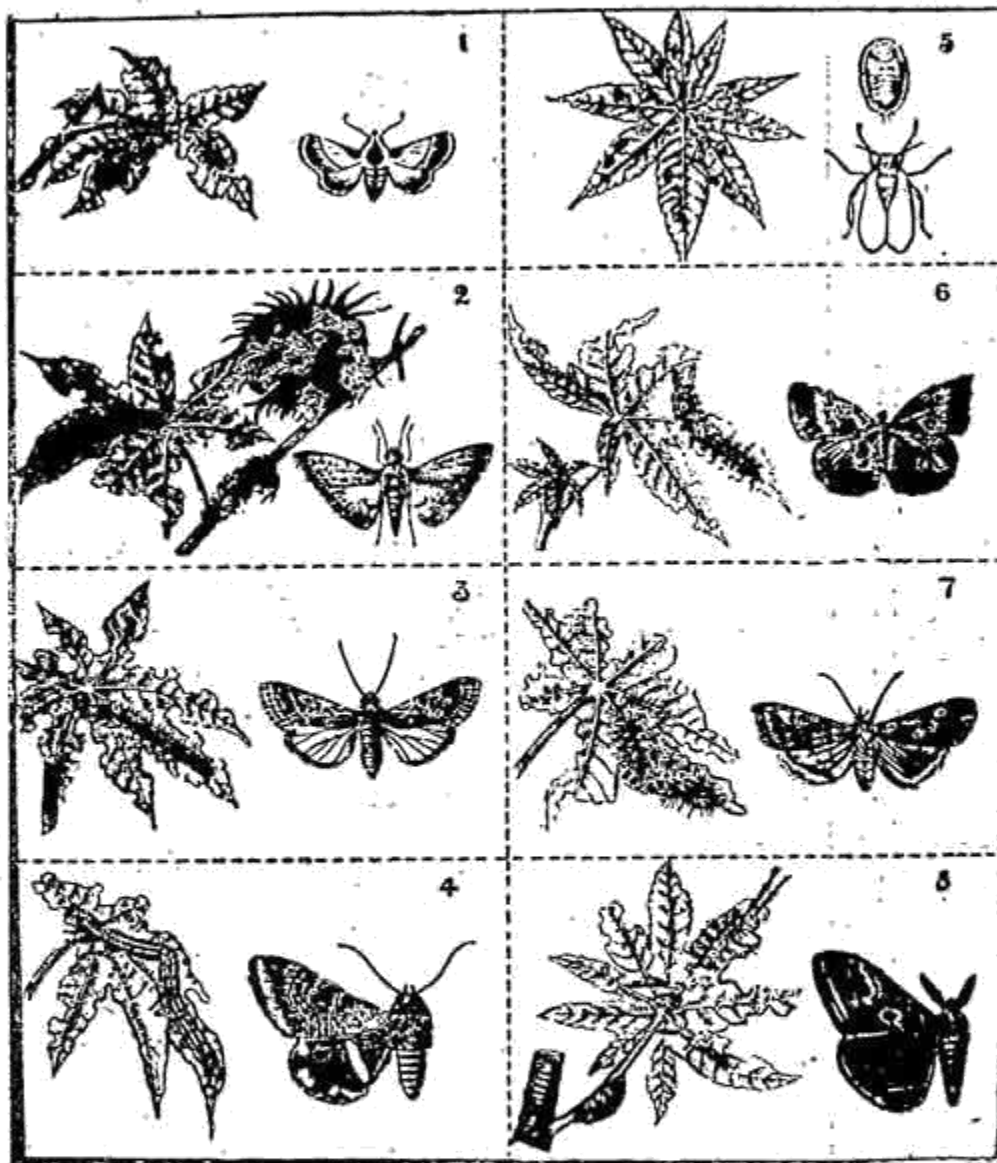


Fig. 1. Castor Slug.
 Fig. 2. Boring caterpillar.
 Fig. 3. Leaf eating caterpillar.
 Fig. 4. Castor Semilooper.
 Fig. 5. Castor mealy wing.
 Fig. 6. Spiny caterpillar.
 Fig. 7. Black hairy caterpillar.
 Fig. 8. Brown hairy caterpillar.

Parasa lepida.
Dichocrocis punctiferalis.
Prodenia litura.
Achoca Janata.
Trialeurodes ricini.
Ergolis merione.
Pericalia ricini.
Orgyia postica.

caterpillars which is the larva of a butterfly instead of a moth; the insect is a uniform snuff brown creature found flying about during day time unlike the moths (fig. 6 Pl.)

Borers. We now come to the borers which include (a) a caterpillar (*Dichocrocis punctiferalis*, G.) which is in fact a somewhat important pest more or less with a status equal to the semilooper or the commoner leaf caterpillars and another (b) a small dark brown stem boring beetle (*Xyleborus*). The former is a short stout pinkish brown caterpillar with dark spots. It bores into the shoots especially at the junction of the main stem and the side shoots or leaves and in addition it also attacks the ripening fruits or seed capsules. The incidence of this insect on the plant is indicated by the presence of black excrementitious matter and webbing covering infested shoots and seed capsules. This broing caterpillar is often noted as a pest of Turmeric, Ginger and Cardamom also in different parts of S. India. The adult insect is a medium sized moth with yellow wings, spotted in dark (Fig. 2 pl.).

Beetles. Coming to beetles and bug pests of castor, most of them are of minor importance and are very rarely found as serious. The boring beetle (*Xyleborus fornicatus*, E) is a small reddish brown creature found usually boring into the stem and producing numerous holes just as is found on bamboo and other posts in buildings throwing out powdery matter from the stem. This was found serious on a species of the red variety of castor in Bangalore and has been recorded by the author in a previous paper⁵ with a plate. It is an insect found on Tea and other hill plants in Ceylon and South India. Tender leaves of castor are occasionally found attacked by a very small greenish flea beetle (*Hermacophaga ruficollis*, L); numbers of this creature often bite small round holes on the leaves and thus injure the foliage. These are very active creatures and leap like fleas.

Bugs. Among sucking insects found on castor the commonest is the mealy wing (*Trialeurodes ricini*, M. fig 5 pl.) which has a wide distribution all over India. It is a very small snow white winged moth like creature, often found in thousands on the under surface of castor leaves, especially on the foliage of fairly well grown plants. Hundreds of small yellowish seed like eggs are laid by this bug and from these emerge practically stationary larvae which are the real pests sucking the nutrition from the foliage. These larvae are more or less fixed to the leaves like scales, and in bad infestations the whole field appears pale ashy white and sickly and sticky to the touch due to the sweet secretion thrown out by thousands of these larvae. Scales and mealy bugs are rarely found and the species usually found among scales are the common black scale (*Saissetia nigra*, N.) the one generally found on various plants like cotton, coffee, Guava, *Thespesia* etc. and among the mealy bugs the common tomato and croton mealy bug

(*Pseudococcus virgatus*, C.) is sometimes found. Both these are very rare and hardly cause any injury to the plants.

During the younger stages of the crop a small green leaf hopper (*Empoasca flavescens* F.), almost similar to the one that attacks cotton, sometimes appears in swarms on the foliage, suck up the juice from the leaves and make them fade and curl up; but very rarely is serious harm caused. From the above brief account we find that the only important insects the activities of which the castor grower in South India will do well to watch are a few of the leaf eating caterpillars and the borer caterpillar.

Control Measures. As in the case of most pests, both preventive and curative methods can be adopted in the case of castor pests also. For the leaf infesting caterpillars both preventive and curative measures can be adopted; the former consists chiefly of cultural operations which will make the plants vigorous and keep away or withstand pest attacks, and the latter of mechanical and insecticidal operations. Among mechanical operations, the picking of egg masses and clipping off of and destruction of leaves containing numerous young caterpillars feeding together will be found very useful in the case of the tobacco caterpillar and the hairy larvae, all of which lay eggs in masses and the young caterpillars of which are gregarious in habits. In the case of the castor semi-looper and frequently with the tobacco caterpillar prompt hand picking of the smooth caterpillar will be found effective and economical. When, however, the caterpillars are noted late at a time when they have already multiplied and increased in numbers and may not be amenable to any of the above measures, insecticidal methods can be used with advantage. The insecticides in this case where the creatures are all biting insects stomach insecticides (viz. those which cover the plant surface which when eaten will poison the insects) are to be used. These usually include arsenical preparations. Lead arsenate and Calcium arsenate are the ones which can be used either in the powder form or as a spray liquid mixed with water. In those localities, however, where water cannot be easily got, dusting the insecticide as a powder is certainly more effective and economic; dusting should however be done where there are no strong winds in the field or if the winds persist, then it is better to use the material as a spray. Dusting will be very effective if done early in the morning when there will be dew drops on the foliage which will make the poison dust stick to the leaf surface. These insecticides and the necessary appliances such as dusters and sprayers can be easily got from wholesale chemists or through the officers of the Agricultural Department.

For the shoot and capsule boring larva only preventive measures can be adopted since the creature feeds from inside and no external applications of insecticides will have any effect on it. The measures suggested are the prompt cutting off and burning of infested shoots and capsules and preventing their multiplication. The same is the

case with the stem boring small beetle (*Xyleborus*). Very rarely do any of the sucking insects (bugs) found on castor call for any serious attention. If and when they do appear serious a spray with crude oil emulsion or tobacco decoction will check them easily. The mealy wing and any mealy bugs will also be easily controlled by such a spray. For the leaf hopper, when it becomes serious the waving of boards or winnows smeared with gum or some sticky material will trap hundreds of the hoppers and appreciably reduce their number on the crop.

In speaking of control measures it is possible that with some gradual observation and experience the cultivator can adopt in certain cases the method known as the Biological control of pests; this chiefly consists in the discovery of the enemies, especially insect enemies of the plant pest and artificially make use of them to destroy the pests. Different insect pests have different kinds of enemies and these have to be discovered and their habits and pest controlling capacity tried. In the case of castor caterpillars—the castor semilooper has been found subject to three or four parasitic insects which destroy it, very appreciably during certain seasons. The commonest of these parasites is a small dark braconid wasp (*Microplitis ophiusae*, R) described by the writer in his paper in 1921³. The presence of this parasite is easily found out by the peculiar position occupied by the parasite cocoon under the tail end of the dying semilooper caterpillar. Other wasps have also been noted recently on this and some on the castor boring caterpillar among the Ichneumonid and chalcid wasps. When the presence of such parasites is noted in the field it is better to collect these and keep them in a wire gauze cage near the field so that the wasps which emerge can pass out through the meshes of the gauze cage while the moths if any from the cage cannot emerge through the small meshes of the gauze. The beneficial wasps will go into the fields and do their good work on other caterpillars.

In conclusion it may be stated, that though the castor crop suffers less from insect pests compared to other crops like cotton, cholam or paddy, the damage it occasionally suffers from caterpillar plagues is often wholesale and very serious. The castor cultivator cannot therefore afford to ignore the insect pests of his crop and allow them to levy their heavy toll during certain seasons. A general knowledge of these pests will certainly be of advantage to him to save his crops from the clutches of insect pests and it is hoped this paper might help him to some extent in that direction.

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