BIOLOGY OF A NEW ICHNEUMONID PARASITE OF
THE AMARANTHUS STEM WEEVIL OF
SOUTH INDIA

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Introduction

A STUDY of the natural enemies of the Amaranthus stem-boring weevil
Hypolixus truncatulus B. in the environs of Coimbatore has been in progress
since 1935. During this period considerable quantities of material consisting
of the weevil stages and their parasites have been handled. Some attention has been therefore devoted to the study of the biology of the weevil and also that of the rather formidable array of its parasites. An account of some of these was presented before the Indian Science Congress, Calcutta (1938). The investigation was however far from exhaustive since it has not been possible to bestow undivided attention to same. Recent studies on the same subject have revealed some new and interesting species of parasites which have not been recorded hitherto from India. One such species of parasite forms the subject of this short paper.

The Parasite

The species in question is an ichneumonid parasite belonging to the genus
Xoridescopus. The genus Xoridescopus was erected in 1907 by Cameron to
include the new species X. annulicornis from Borneo. An extensive search of all
the available literature has failed to reveal any other record of this genus. Further, this appears to be the only species so far known or recorded. The parasite in question is apparently very divergent from the only known species. It is quite possible therefore that this species occurring in South India is new to science. A detailed description of the same will be attempted as soon as the concerned literature becomes available. Meanwhile, the following description will suffice to distinguish the parasite. The species is a primary ectophagous parasite of the grubs of the common stem-boring weevil Hypolixus
truncatulus B. of South India. It was for the first time reared from the host in November 1940. Numerous recoveries of the same from the same host in Coimbatore and surroundings have been made since. Since the parasite

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has not been previously recorded from India and since it is of some importance as attacking this host, a description of the morphology and biology, particularly of its immature stages, is presented in the following paragraphs. A detailed study of the species in regard to the development of cephalic skeleton and skin armature has been attempted since these form the main distinguishing characters of the larva.

Host Records and Distribution

Little information is available concerning other hosts of the parasite. From observations so far made, the primary host appears to be the grubs of *Hypolixus truncatulus*, the Amaranthus stem weevil. There is a single specimen in Coimbatore collections reared from the grubs of the weevil *Alcides aff.iber* from *Hibiscus cannabinus* stems. Numerous laboratory trials have been made in order to obtain an idea regarding possible alternate hosts of the species. The parasite oviposited on a few and developed into adults successfully. Among these, the grubs of *Alcides* spp. boring in stems of Daincha, Agathi, Bhindi, *Hibiscus fuculneus* were occasionally oviposited upon. Successful development has however taken place only in trials with Daincha, *H. fuculneus* and *H. cannabinus*. The egg-laying capacity was in all these cases observed to be considerably diminished. Never more than a maximum of 5 eggs was found laid per female. Besides, the pupal period was in majority of cases appreciably prolonged. In one instance it exceeded even one month.

The Adult

The adult (Fig. 1) is a handsome shining bluish black wasp-like insect with conspicuous greyish white markings on head and body. The female varies very much in size averaging about 14 mm. in length (excluding ovipositor). The male is considerably smaller and averages about 8 mm. in length. The head is black, closely punctate above and somewhat rectangular in shape, with the face, clypeus and orbits greyish white. The eyes are fairly large and dark brown. The antennæ are long but shorter than body and hardly attenuate anteriorly having about 21 flagellar joints in the female and about 25 in male. These latter are in colour black except for a pale band covering the third quarter of their length. The thorax is black with pale markings on neck and shoulders and a pale pronotal band. Meso-notum has a white central dark mark and the scutellum is pale white with a central dark mark. Metathorax has a white band over the basal area, a white patch on either side of middle area and a large white patch on post area. The wings are hyaline and large with an expanse of about 17 mm. across. The legs are reddish except at the tarsus. The abdomen is black with the segments edged with pale grey bands posteriorly. The ovipositor is
conspicuous and is about three quarters of the length of the abdomen (Fig. 2).

The male is easily distinguished from the female by the absence of ovipositor, by the larger number of flagellar joints and by their distinctly smaller size.

Habits of the Adult

The adults are fairly active and display a restless temperament particularly the females. They are positively phototropic as seen from their behaviour in rearing cages. These make incessant attempts to move and escape towards lighted portions of cages or laboratory. The matings were occasional and generally commenced soon after emergence. The mating preliminaries are brief and simple and the performance itself was of slight duration. Except for the excitement of the male and the vibration of antennæ, the process of coition may be described as quick and normal and did not exceed a minute in duration.

Oviposition

The process of oviposition has been watched several times in cages in the laboratory. The cages provided were simple and consisted of large sized tubes 6" × 2". Active non-parasitised grubs were dissected out from the host plant and suitable stages were lodged in artificial cells scooped out in small bits of fresh amaranthus stems and introduced in these cages with a mated female. The preoviposition period ranged from 3 to 5 days averaging 4 days for 12 individuals. This period was the same for both mated and unmated females. During this period the parasite rarely paid any attention to the loaded stems provided in the cages. A free crawling naked grub never excited her curiosity and was never oviposited upon. At the end of the pre-oviposition period, the female took an active interest on the stems supplied and moved about the stem in her search for host grubs. She is guided in the location of the grub apparently by the vibrations caused by the movements of the grubs within the stem. A dead, diseased or inactive grub was never seen oviposited upon. After locating a healthy active grub, the abdomen is lowered and bent downwards almost at right angles to the rest of the body and a quick deep thrust into the stem is effected by the long ovipositor. After thus stabbing and paralysing the host, an egg is laid on it, the entire process occupying about two minutes at the maximum but averaging about a minute. The stages preferred for oviposition were the late third instar grubs and the fourth instar. Occasionally late second instar and mature grubs were accepted. Ordinarily a single egg is laid on any part of the paralysed host. Rarely two eggs were deposited on a single host. The maximum number laid by a single female per day never exceeded three eggs. The greatest number seen laid on
a single host was six in the course of two days. The total egg-laying capacity of a female varied from 5 to 34 eggs averaging 16 in twelve cases. The maximum egg-laying period noted was 61 days. The post-oviposition period averaged two days for a dozen cases under observation.

**Description of Immature Stages**

*The egg*: The egg (Fig. 3) is translucent, creamy white with a perfectly smooth, shining, unsculptured surface. In shape it is elongate-ovate, slightly arched with a broad obtuse cephalic end and narrow caudal end. The eggs varied very widely in size from 1.9 mm. to 3.3 mm. in length, averaging 2.2 mm. for 10 eggs; the width ranged from 0.5 mm. to 0.71 mm. averaging 0.54 mm. The egg period also varied appreciably during the period November to March when the species was under rearing in the laboratory. It ranged from
24 to 40 hours, averaging 30 hours for a dozen cases. In the process of hatching, the fully formed young larva emerges by breaking through the elastic chorion from the anterior ventral region leaving behind the irregularly split and collapsed empty egg shell.

**First stage larva**: The primary larva (Fig. 4) is of the usual ichneumoniform type. It is nearly pure white with a distinct broad head and cylindrical body of 13 segments tapering towards the caudal end. The head is comparatively well chitinised with a dorso-ventrally flattened capsule bulging laterally and is generally broader than the body. It is slightly brownish in colour with a pair of small papillae like antennae placed antero-dorsally. The body is apparently smooth and appears devoid of tubercles or spines or hairs. The digestive canal with its fore, mid and hind parts is visible through translucent cuticle. The pulsations of the heart are discernible. The fat body is not distinguishable at this stage but the tracheal system may be traced to some extent. The suctorial mouth is prominent and protruding on the ventral aspect of head. The cephalic skeleton and mouth parts may be visible under a binocular. The most prominent parts are the strong curved mandibles. The cephalic skeleton at this stage (Fig. 5) consists of the supporting mandibular struts (superior and inferior connected together by the arched pleurostoma. These latter are continued anteriorly to form the semicircular epistoma. The clypeal arch is not quite distinct. The pleurostomal rami are drawn backwards to form the hypostoma. The tentorium which connects these latter is not distinct at this stage. The transparent fleshy lobes of maxillae below the mandibles are not very clear and the beginnings of the bilobed labium may be indistinctly traced. The salivary duct is present but not pronounced. A few setae on the cuticle around the mouth region may be visible. These parts of the head skeleton attain their full development and complexity in the course of the succeeding three instars. The larva is active and effects quick movements. Often more eggs than one are laid and therefore two or more larvae are hatched on same host but never more than one larva survived till the next instar. Usually the older or the earliest hatched or the strongest larva survives, the rest being destroyed by competition and actual fight. Several trials with two or more larva have been made in cages and watched under a binocular. The larva fight with each other and either or both are dead. In two cases under observation the fight was so severe that both succumbed due to injuries caused by mouth parts. In no case was found more than one larva surviving beyond the first stage on the same host. The larva measures from 1.95 mm. to 3.4 mm. averaging 2.5 mm. in length; and 0.45 to 0.54 mm. averaging 0.5 mm. in width; and the head capsule varies from 0.55 to 0.62 mm. averaging 0.57 mm. The larva undergoes the first moult within about 12-16 hours of hatching.
Second stage larva: The larva at this stage (Fig. 6) differs from the previous stage not only in size, shape, appearance and colour but also in head and cephalic skeleton. The larva is more elongate and cylindrical with the head slightly smaller and narrower than body. The general colour is yellowish white with the coloured gut and creamy granular fat bodies visible through the cuticle. The cuticular surface appears to be rough being covered with minute setae. The head and mouth parts (Fig. 7) are weaker and less sclerotised at this stage. The epistoma is thinner and less conspicuous. The larva measures from 2.7 mm. to 4.7 mm. averaging 3.5 mm. in length and 0.62 mm. and 0.85 mm. averaging 0.70 mm. in width; the head varies from 0.56 mm. to 0.61 mm. averaging 0.58 mm. This stage occupies one to two days.

Third stage larva: This stage (Fig. 8) differs little from the second one except in size. The mandibles and other cephalic structures (Fig. 9) have increased in size. The colour is more dull and the fat bodies are larger and more conspicuous. Length varies from 4.3 mm. to 6.2 mm. averaging 5.1 mm.; width from 0.75 mm. to 1.4 mm. averaging 1.0 mm.; head 0.65 mm. to 0.8 mm. averaging 0.7 mm.

Final stage or mature larva: The mature larva (Fig. 10) is much larger in size and has assumed a typical ichneumonid form. It has an arched dorsal surface and somewhat flattened ventral surface. It is of a dull cream or yellowish colour with the dark gut and large elongate fat bodies prominent. The cuticle is very rough and prickly with setae and spines of varying sizes (Fig. 12). The head is much smaller in comparison with the body. The spiracles (Fig. 13) in meso and meta thorax and the seven abdominal pairs with the longitudinal trunks are well developed and conspicuous. The head is slightly convex dorsally with the strongly chitinised and pigmented mouth parts and skeleton conspicuous ventrally.

Mouth parts: (Fig. 11) The cephalic skeleton at this stage is very characteristic in being heavily chitinised and pigmented. Though the general arrangement is somewhat similar to that of first stage larva, the parts as a whole are well developed with the addition of certain new structures followed by the disappearance of a few others. The mandibles are strong, sharp and pointed and are supported by the superior and inferior mandibular struts. The epistomal arch connecting the two superior struts has disappeared. The inferior strut is only a projection of the curved hypostoma. The pleurostomal rami connect the struts, superior with the inferior. The maxillary lobes are supported by maxillary struts which are mere curved prolongations of the hypostoma. On the lower border of the mouth is found the labial ring which is somewhat horse-shoe-shaped. The labial ring is supported on
either side by the labial struts. The labium connects the open ends of the labial ring wherein the salivary duct opens. The lateral and the anterior borders of the mouth are bounded by the maxillary lobes and the labrum.

The edges of the labrum bear pairs of setæ and sensory pits. Setæ are also borne by the maxillary lobes. Besides these setæ, the maxillæ as well as the labium bear traces of a pair of maxillary palps and labial palps which are represented by sensory pits surrounded by chitinous rings shaped like Fig. 8. The size of the mouth parts, the disposition of setæ and sensillæ are distinguishing characters of the species. Among these structures the labial ring

Text-Figs. 8-13.—Fig. 8. Third stage larva (side view showing spiracles and tracheal system). Fig. 9. Third stage larva (cephalic skeleton). Fig. 10. Mature larva (side view). Fig. 11. Mature larva (cephalic skeleton). Ep., Epistoma; Hyp., Hypostoma; I.M.S., Inferior mandibular strut; L.M., Labrum; Lbr., Labial ring; L.S., Labial strut; M.X.L., Maxillary lobes; M.X.S., Maxillary struts; P.S., Pleurostoma; S.M.S., Superior mandibular strut; S.O., Salivary opening. Fig. 12. Thoracic segment (dorsal view). Fig. 13. Thoracic spiracle (enlarged).
and struts, the maxillary struts, the labial and maxillary sensory papillae form new structures developed in the mature larva.

The duration of this stage may extend up to a period of seven days but averaged about two days before starting cocooning. By this time the host larva is reduced to an empty cuticle and head capsule. The larva ranged from 7.5 mm. to 8.5 mm. in length averaging 8.0 mm.; from 1.9 mm. to 2.1 mm. averaging 1.95 mm. in width. The head measurements varied from 0.85 mm. to 0.9 mm. averaging 0.87 mm.

*The cocoon*: The full grown larva normally within two days sometimes extending up to eight days begins to spin a cocoon. The cocoon is thin, papery, cylindrical and is almost semi-transparent. The cocoon is formed within the tunnel made by the host in the stem. With this, the mature larva has passed on to the prepupal stage.

*Prepupa*: This stage in this species is remarkable. It passes through two distinct phases or types of form before it actually turns to a pupa, as in *Exenterus abruptorius* (Morris, 1937). The first of these prepupal stages corresponds to the eonymphal stage. The shape is similar in general appearance to that of mature larva but is to some extent contracted in length and averages about 7.5 mm. in length. It is only capable of slight side to side movement. The large mouth parts are still clear but not useful for feeding. The colour becomes dull and dirty white. The segmentation of the body is not so marked as in the mature larva. It shows no activity of any kind. This condition lasts for about two days when it passes on to the next phase—the pronymphal stage. The beginning of this stage is marked by the appreciable swelling of the abdomen and the separation of the body into thorax and abdominal regions by a constriction. The head and thorax are not well separated. The body has become somewhat lengthened and much curved on the ventral aspect. The imaginal eyes have begun to appear. It passes one or two days in this stage and voids the larval meconium. At the same time it casts away the last larval skin and turns to a white Ichneumoniform pupa.

*Pupa*: It is pure white when freshly formed with pinkish eyes. It soon attains a yellowish tint followed by light brown. The mandibles also turn brown. Two days prior to emergence the pupa becomes dark and assumes the general markings and form of the adult. On exposure of the cocoon by opening the stem the pupa becomes extremely active and revolves rapidly on its axis for several minutes. When fully formed the adult breaks open the pupal skin, bites a hole at the cephalic ventral aspect of the cocoon first and then through the stem so as to emerge out. The prepupal and pupal periods occupy from 14 to 21 days averaging 18.1 days for 12 individuals.
Development and Life-Cycle

There is considerable lack of uniformity in the development and many instances were observed when the development was retarded mainly in the larval or pupal periods. The egg period was fairly uniform within the range of one day to a little less than two days, averaging about 30 hours. The larval period varied from 5 to 13 days extending even upto 18 days but averaging 8·4 days. The prepupal stage including its two phases ranged from 3 to 5 days, averaging 4 days made up of 3 days for eonymphal and one day for pronymphal stages. The pupal period proper ranged from 10 to 16 days averaging 13·7 days. The total life-cycle ranged from a minimum of 23 to 30 days averaging 27 days. The life-cycle period of the male was always two to three days shorter than that of the female.

Parthenogenesis

Experimental trials have shown that the species can reproduce parthenogenetically. In a set of three trials virgin unfertilised females were isolated on emergence from cocoons in cages with a supply of amaranthus stalks loaded with unparasitised host grubs. Oviposition resulted in both the cases and the progeny developed into males.

Sex Ratio

Out of 15 adults whose sexes were recorded, six happened to be females. The number is too few to arrive at a correct appreciation of the proportion of sexes in nature. But yet an indication may be traced from this that the ratio may be somewhere near 40% females and 60% males.

Longevity of Adults

The life of the adult female was tested in a series of cases with a supply of food in the shape of sugar solution. It varied from 10 to a maximum of 67 days, averaging 29·3 days for 12 individuals. The longevity of males was seen generally to be much reduced, varying from 7 to 39 days, averaging 22·3 days.

Seasonal Occurrence

The studies so far made have shown that the parasite does not occur throughout the year. The species appears to occur during the season—November to March. Even during this period it is not of great abundance. The peak of its comparative abundance is during the month of December. The percentage of parasitism from rough computations may not be appreciable but it may be safe to conclude that the species is an important ecological factor in the balance which is maintained in the complex of host-parasite association.
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Summary

In exploring the possibilities of biological control of the cotton stem weevil of South India, some attention was directed towards the study of the biology and natural enemies of allied curculionids of similar habits. Among such forms, the common Amaranthus weevil of South India, Hypolixus truncatus B. proved to be the most useful laboratory host for many species of parasites. An account of this weevil and its parasites was presented before the Science Congress session (Calcutta, 1938).

Since then, the studies have been continued, though intermittently, and a few new and interesting species of parasites have been encountered. One such species forms the subject of this short paper.

The parasite in question is a new species of Ichneumonid belonging to the genus Xoridescopus. An account of this parasite together with its life-history and habits is furnished.

It is a primary ectophagous larval parasite of Hypolixus truncatus B. preferring the late third and fourth instars of the host grubs for parasitisation. It has a few other hosts which are all stem-boring weevils. The parasite stings and completely paralyses the host before oviposition with a maximum capacity of 34 eggs per fertilised female in captivity. On account of intense larval fight, never more than one larva was seen to survive beyond the first stage on a single host. The total life-cycle covered an average of 27 days made up of an egg period of about 30 hours, larval period of 8.4 days, a prepupal period of 4 days and a pupal period of 13.7 days. The length of life of adults never exceeded 67 days. Detailed descriptions of the immature stages, the nature and development of cephalic skeleton and mouth parts and the prepupal phases have been presented since these form the most characteristic and distinguishing features of the species.

REFERENCES

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