

**RHACONOTUS SCIRPOPHAGAE, Wlk.,
A PARASITE OF THE SUGARCANE WHITE MOTH
BORER (*Scirpophaga*).**

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Introduction. As a result of the intensive study of the natural enemies of the sugarcane white moth borer (*Scirpophaga*) in Coimbatore, seven larval parasites have been collected. A paper on one of these—*Elasmus zehntneri*, err., was published in the Madras Agricultural Journal, Vol. XXV, pp. 73—279. *Rhaconotus scirpophagae*, Wlk., another parasite, is the subject matter of the present paper. Interesting information on the habits and life history of the parasite, egg-laying capacity, longevity, etc., is given and the status of the parasite discussed.

Life History of the Moth. A short account of the life history and habits of the moth borer is necessary to understand the activities of the parasite better. Eggs are laid by the female moth on the under surface of the leaves and covered with reddish brown hairs. The larvae, on hatching, find their way into the leaf roll and destroy the growing point. Only one larva will be found in each plant. When full fed the caterpillar constructs a tunnel at right angles to the larval gallery to the outside of the stem and closes it with a lid constructed out of the outermost leaf sheath. It then retreats into the tunnel spinning partitions of silk, one behind the other and finally pupates and the moth emerges in due course through the exit hole. The total life cycle of the pest is about 2 to 2½ months.

History of the Parasite. The parasite was first collected by the Imperial Entomologist, Pusa, Bihar, in 1914—16 on caterpillars of the sugarcane white moth borer *Scirpophaga auriflua*, Zeller, and described as a new species by Wilkinson in the Bulletin of Entomological Research, Vol. XVIII, p. 33. Wilkinson also adds that it was later recorded from Africa on rice stem (Ritchie—labelled 12—8—1925, rice stem). Later on it was reported from the Punjab by M. A. Husain as a parasite of *Scirpophaga nivella* on sugarcane (Review of Applied Entomology, Vol. XXV, p. 45). There is also a mention of the parasite in the Pusa Agricultural Research Institute Annual Report, dated June 30, 1936.

Description of the Parasite. *Rhaconotus scirpophagae*, Wlk., belongs to the sub-family Doryctinae, family Braconidae. The description of the parasite by Wilkinson is given below:—

Male: "Dark red, tinged with black and blackish-red, head capsule tending to be rather paler; all legs rather pale red-testaceous; ovipositor bright red, black red at extreme apex; sheaths black; the apical joint and

often the proapical joint or joints of all tarsi darkened to nigrescent; wings with tegulae and costal vein pale red testaceous, remaining wing veins red brown; stigma very pale yellow to almost colourless; wings hyaline except for a very slight general infuscation.

Female: All integuments coriaceous and with strong pubescence. *Head*: Antennae longer than head, thorax and abdomen together; flagellar joints about 40, but the number is variable. *Thorax*: notauli anteriorly strongly marked, posteriorly more or less obsolete; scutellar depression broad but not deep, with at least a median longitudinal carina; mesothorax at least crenulate medianly; propodeon with at least three longitudinal carinae at base, one in the middle, the others at the sides, these carinae extending almost half way down the propodeon and becoming lost amongst the wrinkles with which the apical two thirds of the propodeon abounds; basal third of propodeon more or less devoid of wrinkles. *Wings* with the recurrent interstitial or received distinctly into the 2nd cubital; nervulus interstitial or very slightly postfurcal; radial cell reaching apex of wing; stigma sub-lanceolate; 2nd abscissa of radial vein three times, and 3rd abscissa five times, as long as 1st abscissa; 2nd abscissa in the neighbourhood of 0.495 mm. long; radial emitted from about the middle of the stigma 2nd cubital cross-vein very faint. *Legs*: front femur usually 0.6 mm. long with a noticeable tumescence on the antero-dorsal surface at apex of basal third; front tibia usually 0.6 mm. long, and on its anterior surface, a row of generally eight small stout spines commencing at about the apex of the basal third and extending to about the base of the apical fourth; front tarsus usually about 0.96 mm. long; middle femur usually 0.6 mm. with a noticeable tumescence on the antero-dorsal surface at apex of basal third; middle tibia 0.65 mm. long, and on its antero-dorsal surface a row of general five small stout spines, usually four of them evenly spaced and placed towards the apex of basal half of tibia, the fifth somewhat isolated at about the base of the apical third, but the number of spines may vary from four to six and their position is somewhat inconstant; middle tarsus 0.66 mm. long; hind coxa about 0.38 mm. long, with a small, fairly sharp prominence (blunted tooth) towards base of ventral surface; hind femur 0.68—0.75 mm. long, with a tumescence on the antero-dorsal surface at apex of basal third; hind tibia 1.05—1.2 mm. long, devoid of spines; hind tarsus 1.2 mm. long; the third and fourth joints of all tarsi the smallest, the 5th joint being definitely longer than the 3rd; basal joint of hind tarsi as long as, or shorter than, 2nd and 3rd joints together. *Abdomen* with the four basal tergites nearly completely longitudinally carinate; 5th tergite only carinate basally and with basal half noticeably more strongly coriaceous than apical half; 1st suture plain, 2nd, 3rd and 4th sutures strongly crenulate; 1st tergite longer than broad; 2nd tergite transverse; 2nd suture, which is more or less obsolete laterally, strongly curved; 3rd and 4th tergites transverse and noticeably shorter than the 5th tergite, which is also transverse; 3rd and 4th sutures straight; ovipositor long, extending at least 1.5 mm. beyond

apex of abdomen, which length is less than the combined lengths of the 2nd, 3rd, 4th and 5th tergites.

The description of the female applies equally for the male, except for the following:— *Head* - antennae with a smaller number of joints. *Wings* with the recurrent received only into the 2nd cubital cell. *Legs* - front femur and tibia 0.54–0.6 mm. long; front tarsus 0.83–0.87 mm. long; middle femur 0.51–0.57 mm; middle tibia 0.6–0.68 mm; hind of femur 0.6–0.72 mm; hind tibia 0.9–1.13 mm; hind tarsus 1.05–1.11 mm; hind femora without tumescence. *Abdomen* with 5th tergite generally (more seldom only basal half) as completely carinate as the basal segments, and the more strongly coriaceous condition invariably extending almost to apex; 2nd suture not strongly curved, almost straight; 3rd and 4th tergites not noticeably shorter than the 5th.

Length: F. about 4.5–5.0 mm; M. about 4.25–4.5 mm."

Emergence and Behaviour of the Parasite. The adult parasite when ready to emerge cuts a small hole in the cocoon and crawls out of it. When further passage to the outside is found closed by the lid constructed by the host on the outermost leaf sheath, the parasite cuts a hole in this lid and escapes through it. It is seen that the heads of all the parasites in the cocoons lie in the direction of the lid. Table I gives the number of parasites from host larvae collected from the field. It is seen from the table that out of 201 adults which emerged from 17 cocoon spindles the number of females was 169 the percentage being 84. In the rearings at the laboratory also the proportion of females to males was about the same. On an average about 12 adults emerged from each host larva, the maximum and minimum being 21 and 5 respectively.

TABLE I.

Statement showing the number of parasites emerged from each host Larva Collected from the field.

Ser. No.	Total No. of adults.	No. of females.	No. of males.	Date of Emergence.
1	15	13	2	21 4 36
2	13	12	1	10 10 36
3	11	8	3	4 11 36
4	8	6	2	12 12 36
5	11	9	2	3 1 37
6	11	10	1	3 1 37
7	13	11	2	10 9 37
8	7	6	1	13 9 37
9	18	17	1	13 9 37
10	11	10	1	17 9 37
11	5	3	2	18 9 37
12	14	12	2	24 9 37
13	14	13	1	2 10 37
14	5	3	2	11 11 37
15	21	16	5	14 11 37
16	17	14	3	22 11 37
17	7	6	1	25 11 37
Average number of adults } emerged from each host }	12			

Longevity of Adults. Under laboratory conditions, when fed with honey solution, the maximum longevity of a female was 107 days and of a male 59 days. Without food no parasite lived for more than 12 days. Table No. II gives the longevity records of 33 parasites.

TABLE II.
Length of Life of *Rhaconotus scirpophagæ* Wlk.

Ser. No.	With food				Ser. No.	With food and allowed to lay eggs.			
	Emerged on.	Died on.	No. of days lived.	Sex of the Adult.		Emerged on.	Died on.	No. of days lived.	Sex of the Adult.
1	21 4 36	7 5 36	16	Male	1	11 3 37	9 4 37	29	Female
2	21 4 36	9 5 36	18	Female	2	24 4 37	5 5 37	11	do.
3	21 4 36	4 5 36	13	do.	3	10 9 37	20 10 37	41	do.
4	21 4 36	8 5 36	17	do.	4	10 9 37	1 10 37	21	do.
5	21 4 36	16 5 36	25	do.	5	10 9 37	3 10 37	23	do.
6	21 4 36	15 5 36	24	do.	6	10 9 37	6 10 37	26	do.
7	21 4 36	11 5 36	20	do.	7	10 9 37	21 9 37	11	do.
8	15 5 36	4 7 36	50	Male	8	12 9 37	1 11 37	50	do.
9	15 5 36	5 7 36	51	Female	9	13 9 37	18 10 37	36	do.
10	20 5 36	12 6 36	23	do.	10	13 9 37	10 10 37	28	do.
11	20 5 36	6 6 36	17	do.	11	13 9 37	24 9 37	11	do.
12	16 7 36	23 7 36	6	do.	12	13 9 37	12 10 37	30	do.
13	10 10 36	10 12 36	61	do.	13	13 9 37	1 10 37	19	do.
14	10 10 36	29 10 36	19	do.	14	13 9 37	3 10 37	21	do.
15	10 10 36	29 10 36	19	do.	15	14 9 37	24 10 37	41	do.
16	10 10 36	7 12 36	58	do.	16	17 9 37	6 10 37	20	do.
17	10 10 36	1 1 37	83	do.	17	24 9 37	28 10 37	35	do.
18	3 11 36	3 1 37	61	do.	18	8 10 37	15 11 37	37	do.
19	3 11 36	1 1 37	59	do.	19	8 10 37	10 11 37	33	do.
20	4 11 36	19 2 37	107	do.	20	8 10 37	15 11 37	37	do.
21	28 11 36	26 1 37	59	Male	21	8 10 37	8 11 37	30	do.
22	3 1 37	15 1 37	12	do.	22	11 11 37	17 12 37	6	do.
23	3 1 37	17 2 37	44	Female					
24	3 1 37	19 3 37	74	do.					
25	11 3 37	9 4 37	29	do.					
26	12 9 37	3 10 37	21	do.					
27	12 9 37	18 10 37	36	Male					
28	12 10 37	20 10 37	8	do.					
29	12 10 37	28 10 37	16	do.					
30	12 10 37	3 11 37	22	do.					
31	16 10 37	26 10 37	10	do.					
32	16 10 37	14 12 37	59	do.					
33	17 10 37	8 12 37	52	do.					

Average Longevity } 38 days (Fed); 27 days (Fed and allowed to lay eggs);
for females } 7 days (unfed).
Average Longevity } 30 days (Fed);
for males } 7 days (unfed).

Oviposition. The females usually take 5 to 10 days to deposit eggs. The first indication of ovipositing stimulus is the slight unsheathing of the ovipositor. When supplied with a sugarcane stem with a host larva, the parasite commences to prod rapidly with extended antennae and finally locates the hole perforated by the host which is covered by a thin lid and thrusts the ovipositor through the lid to reach the larva inside. If the ovipositor comes into contact with the larva it is thrust into the latter to paralyse it. If the larva is not encountered, it does not abandon the spot but pauses for a moment to resume her exploratory thrusts. It is not easy for the parasite to encounter the larva, for, it possesses only a short ovipositor

measuring $1\frac{1}{2}$ mm. It is able to paralyse the larva only between the time when the latter comes to cut the outermost lid and withdraws to construct the series of silken partitions in the tunnel. The parasite generally takes 30 - 45 minutes to paralyse the host. As soon as the borer is paralysed the parasite pushes inside the entire length of the ovipositor and holds it there for 10 - 15 minutes during which time it deposits its eggs on or near the body of the larva. Eggs are laid in clusters of 10 - 15 but occasionally stray clusters of 20 - 25 are also on record. Table III gives the egg-laying records of 20 females. Under laboratory conditions, a female laid as many as 86 eggs, the average for a female being 37 eggs. A close study of table III also reveals that the parasite has not got the habit like *Stenobracon nicevelli*, Bingh., to distribute its eggs. When once it encounters a host larva it deposits on it, all the available matured eggs and never seeks to distribute its eggs on another host, even if it was nearby. In most cases under rearing it is noticed that some indefinite time (from 2 to 10 days) elapses before the second batch of eggs is laid.

As a result of a series of trials, it was found (1) that a host parasitised once is not again parasitised by the same parasite or by other individuals of the same species, (2) that eggs are laid by a parasite only on one host even if more are supplied, (3) that the parasites do not accept caterpillars which are given exposed, (4) that if one host alone is supplied to a number of parasites some of them may simultaneously attack the host and lay eggs on it, and (5) that parthenogenesis occurs in the species, the progeny in such cases being males.

Life History. *Egg*: Eggs are generally translucent or almost transparent, about 1 mm. long, elongate, cylindrical, curved at the centre with one end more pointed than the other. They are laid attached to the inner circumference of the tunnel or in some cases on the head of the host caterpillar in a bunch. The egg period is 1-3 days. In five cases, the egg periods have been noted as 49, 43, 32, 30 and 30 hours, the first two in November and October respectively and the remaining ones in May.

Larva: The newly hatched grub measures 1 mm. and is white and transparent. If the eggs are laid away from the host, the grubs when hatched glide on the smooth silken lining of the tunnel until they reach the host. The grubs attach themselves firmly to the host with their head-end and puncture the skin of the host at some tender part of the cuticle and suck the juice of the host on account of which they attain the color of the host on the second day. The grub reaches its maximum size of $6\frac{1}{2} \times 1\frac{1}{2}$ mm. in 3-4 days by which time the host larva is completely eviscerated. At this stage, the grubs spin individual white cocoons of silk which measure from 7-10 mm. within which they pupate. These small cocoons are attached to one another and this cocoon spindle running through the tunnel measures 3.8 to 4.8 cm. The larval period is 6-10 days.

Pupa: The freshly formed pupa is uniformly white and measures 7 mm. $\times 1\frac{1}{2}$ mm. One to five days after the formation of the cocoon the grub

TABLE III.
Oviposition record of Twenty mated females of *Rhaconotus scirpophagae* Wlk.

Serial No.	Emer- ged on	1st batch		2nd batch		3rd batch		4th batch		5th batch		6th batch		7th batch		8th batch		9th batch		Died on	Total No. of eggs.						
		Laid on	No.	Laid on	No.	Laid on	No.	Laid on	No.	Laid on	No.	Laid on	No.	Laid on	No.	Laid on	No.	Laid on	No.								
1	21	4	36	28	4	36	11	1	5	36	14									4	5	36	25				
2	21	4	36	24	4	36	4	27	4	36	14	1	5	36	10	4	5	36	12		8	5	36	40			
3	21	4	36	25	4	36	5	1	5	36	17	10	5	36	5						16	5	36	27			
4	21	4	36	28	4	36	14														16	5	36	14			
5	21	4	36	4	5	36	11	13	5	36	10										15	5	36	21			
6	21	4	36	6	5	36	15														11	5	36	15			
7	20	5	36	22	5	36	12	27	5	36	13	6	6	36	15	7	6	36	8		12	6	36	48			
8	20	5	36	24	5	36	14	6	6	36	18										6	6	36	32			
9	16	7	36	19	7	36	6														23	7	36	6			
10	10	10	36	21	10	36	19	29	10	36	25	10	11	36	12	29	11	36	12		10	12	36	68			
11	10	10	36	21	10	36	15	28	10	36	17										29	10	36	32			
12	10	10	36	22	10	36	17	27	10	36	19	28	10	36	2						29	10	36	38			
13	10	10	36	1	11	36	3	2	11	36	15	4	11	36	6						7	12	36	24			
14	10	10	36	7	11	36	18	9	11	36	15										3	1	37	33			
15	3	11	36	10	11	36	8	17	11	36	12	19	11	36	18	23	11	36	12	25	11	36	7	3	1	37	86
16	3	11	36	23	11	36	24	27	12	36	18	29	11	36	13	14	12	36	15		1	1	37	85			
17	11	3	37	23	3	37	20	24	3	37	5										9	4	37	25			
18	24	9	37	7	10	37	15	13	10	37	12	18	10	37	14						28	10	37	41			
19	24	9	37	29	10	37	18														10	11	37	18			
20	8	10	37	20	10	37	11	28	10	37	14	7	11	37	13						15	11	37	38			

side generally pupates. The rudiments of legs and antennae on the ventral side of the pupa and the wings on the dorsal side are clearly visible. The whole pupa turns brownish on the fourth day and a day later the eyes assume the black color. The pupal period ranges from 11-16 days. Table IV gives the total life cycle of the parasite which is about 7-28 days.

TABLE IV.
Detailed Life-history record of *Rhaconotus scirpophagae* Wlk.

Ser. No.	Egg Laid on.	Larva hatched on.	Egg period in days.	Cocoon formed on.	Active larval life.	Pupated on.	Total larval period.	Adult emerged on.	Pupal period.	Total life Cycle.
1	27 4 36	28 4 36	1	2 5 36	4	4 5 36	6	15 5 36	11	18
2	27 4 36	28 4 36	1	2 5 36	4	4 5 36	6	14 5 36	10	17
3	28 4 36	29 4 36	1	3 5 36	4	5 5 36	6	15 5 36	10	17
4	1 5 36	2 5 36	1	7 5 36	5	8 5 36	6	19 5 36	11	18
5	1 5 36	2 5 36	1	6 5 36	4	8 5 36	6	18 5 36	10	17
6	2 5 36	3 5 36	1	8 5 36	5	9 5 36	6	21 5 36	12	19
7	4 5 36	5 5 36	1	9 5 36	4	11 5 36	6	21 5 36	10	17
8	6 5 36	8 5 36	2	12 5 36	4	13 5 36	6	25 5 36	11	19
9	13 5 36	14 5 36	1	19 5 36	5	20 5 36	6	3 6 36	14	21
10	27 5 36	28 5 36	1	1 6 36	4	3 6 36	6	16 6 36	13	20
11	6 6 36	7 6 36	1	12 6 36	5	13 6 36	6	26 6 36	13	20
12	28 6 36	30 6 36	2	7 7 36	7	8 7 36	8	23 7 36	15	25
13	20 7 36	21 7 36	1	27 7 36	6	28 7 36	7	2 8 36	11	19
14	21 10 36	23 10 36	2	27 10 36	4	1 11 36	9	12 11 36	11	22
15	22 10 36	24 10 36	2	28 10 36	4	2 11 36	9	13 11 36	11	22
16	27 10 36	29 10 36	2	3 11 36	5	8 11 36	9	19 11 36	11	22
17	28 10 36	30 10 36	2	4 11 36	5	10 11 36	9	21 11 36	11	22
18	2 11 36	4 11 36	2	8 11 36	4	13 11 36	9	28 11 36	15	26
19	4 11 36	6 11 36	2	10 11 36	4	15 11 36	9	26 11 36	11	22
20	7 11 36	9 11 36	2	13 11 36	4	18 11 36	9	29 11 36	11	22
21	10 11 36	12 11 36	2	16 11 36	4	21 11 36	9	2 12 36	11	22
22	10 11 36	12 11 36	2	16 11 36	4	21 11 36	9	2 12 36	11	22
23	19 11 36	21 11 36	2	25 11 36	4	30 11 36	9	12 12 36	11	22
24	19 11 36	21 11 36	2	25 11 36	4	30 11 36	9	11 12 36	10	21
25	27 11 36	29 11 36	2	3 12 36	4	9 12 36	10	23 12 36	14	26
26	29 11 36	1 12 36	2	5 12 36	4	10 12 36	9	21 12 36	11	22
27	29 11 36	1 12 36	2	6 12 36	5	10 12 36	9	26 12 36	16	27
28	30 11 36	2 12 36	2	6 12 36	4	11 12 36	9	27 12 36	15	27
29	14 12 36	17 12 36	3	22 12 36	5	27 12 36	10	11 1 37	15	28
30	20 12 36	22 12 36	2	27 12 36	5	31 12 36	9	16 1 37	16	27
31	23 3 37	25 3 37	2	29 3 37	4	3 4 37	9	14 4 37	11	22
32	24 3 37	26 3 37	2	30 3 37	4	4 4 37	9	15 4 37	11	22
									Average total	21.8

Seasonal Incidence. Field observations on the incidence of the parasite in Coimbatore show that the attack of the parasite is noticed in larger numbers from January to April. From October to December and in May, there is only slight attack.

Status of the Parasite. As far as our studies show, there are some points in favour of, as well as against the parasite. Except for the fact that only one stage of the caterpillar is attacked and that eggs are not distributed singly but in clusters all other factors are in its favour. This parasite has

not been known to attack any other host under field conditions. The longevity records show that the parasites are fairly long lived and the egg laying capacity is not low as in other cases. The cocoons collected from the field as well as those reared at the laboratory give rise to a higher percentage of females than males. Moreover, the life cycle of the parasite is much shorter than that of the pest. All these considerations make the parasite a fairly efficient one in the control of the pest under South Indian conditions.

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STUDIES IN THE QUALITY OF CROPS II

Nutritive values of proteins of different varieties of Red gram (*Cajanus Indicus*).

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It has been shown in a previous communication by the present authors (1) in their work on *ragi* grains that different varieties of the same cereal possess different nutritive values. In this communication the nutritive values of different varieties of red gram obtained locally and from the hills are presented as determined by Mitchell's N-balance method. The technique of the experiments was the same as that used in a previous communication (1), and the diets were compared at 5% and 10% protein levels. Whole grains with the husk on, and *dhalls* prepared out of them by the local method of mixing the grains with red earth and pounding were analysed for their food values, and the results of those analysis, presented in Table IV. Marmite at the rate of 50 mg. per rat per day, and codliver oil at 4-5 drops per animal daily were fed to provide the necessary vitamins. The N content present in marmite was not taken into consideration while calculating the results. As usual it has been assumed that the variation in the values of endogenous N of urine and metabolic N of feces from the first to the final period is linear.

Discussion. The analytical data of the food values (Table 2) shows that the protein content of the local variety is decidedly higher than that of the rest. There are, otherwise, no marked differences in any of the other nutrients analysed for food value.

Considering the digestibility coefficient and biological values, it is found (Table 1) that the local variety has the highest digestibility coefficient and next to it comes the white variety, small, hill type. The black variety (hill type), is easily the worst of the lot both as regards digestive coefficient