

Studies on the Biology of *Ragnus importunitas* D. (Miridae-Hemiptera) on Sunnhemp*

by

M. GOPALAN¹ and M. BASHEER²

Synopsis: The complete biology of the plant bug *Ragnus importunitas* D which causes extensive damage to the green manure crop of Sunnhemp is described in this paper.

Introduction: In recent years the plant bug *Ragnus importunitas* D. (Miridae-Hemiptera) is causing extensive damage to the green-manure crop, Sunnhemp (*Crotalaria juncea* L.). The damage is especially severe when the crop is grown for seed purposes. The distribution of the insect has been reported to be India, Ceylon (Hutson 1931, 1933), Java (Goot 1927, Tollenaar 1934), and Celebes (Goot 1927). In India the insect has been noted in Delhi, Nagpur, Samalkot and Madras. Considering the importance of the insect on the green-manure crop as a potent pest and as information on the biology of the insect is lacking, investigations were undertaken during 1960—'61 in the Agricultural College and Research Institute, Coimbatore. Results obtained in the investigations are reported in this paper.

Life-history Studies: The observations on the life-history of *Ragnus importunitas* D. were made in three different periods viz., March, June and September during 1961 in caged plants in the laboratory. The different developmental periods, the various stages and their descriptions are given below.

Mating: Mating occurred end to end early in the morning or late in the evening, two to three days after the emergence of the adults. Mating occurred after courtship. The male approached the female from behind and stroked the hind legs, wings and head of the female with its antennae. This process was repeated several times by the male, extending more than ten minutes and after each unsuccessful attempt for mating, it returned to a portion of the leaf for feeding. Finally it succeeded in inducing the female

* Forms part of Dissertation submitted to the University of Madras for the part fulfilment of M. Sc. (Ag.) course by the first author under the guidance of the second author.

¹ Assistant Lecturer in Entomology, Agricultural College and Research Institute, Coimbatore-3.

² Retired Entomologist and Associate Professor of Entomology, Agricultural College and Research Institute, Coimbatore-3.

Received on 30-1-1965.

for mating and mounted directly upon the female, bent its abdomen towards the ventral side of the female and the female also responded by raising its abdomen. Immediately after the union, the male turned to be in the opposite direction.

Preoviposition and oviposition: Mating pairs were collected and left on young sunnhemp plant covered by the glass chimney cage. Since the eggs are laid inside the plant tissue, the preoviposition, oviposition and incubation periods were observed by changing the mated pairs every day from one caged plant to another and noting the date of emergence of the nymphs. The female selected the site for oviposition with its rostrum feeling the surface all the time. After selecting the site, it made a hole by plunging the stylets several times. Then without removing the legs it arched its abdomen up, keeping the ovipositor in a vertical position. In that position it brought down its ovipositor to the hole made by the stylets. If it did not succeed in its attempt, it turned and examined the hole, made it bigger by plunging the stylets several times and again tried to oviposit in the same way. After insertion of the ovipositor in the plant tissue, the abdomen was found to move up and down. Only one egg was laid at each puncture made by the stylets. The preferred places for oviposition seemed to be the axils of the leaves since a number of eggs were found in groups in the axils. The eggs were laid in the stems, axils, petioles and midribs of the leaves. The oviposition site was completely covered by the hairs present on the plant and a dark brown spot, the anterior pole of the egg, indicated the presence of the egg, when viewed under a binocular microscope.

The total number of eggs laid by a female varied from 38 to 82. The oviposition period ranged from five days in March and up to seven days during June and September. The number of eggs laid in the first day was 14 since in many cases the emergence of the nymphs in one day was 14.

Observations on the life history of R. importunitas D. on Sunnhemp.

No.	Month	Preoviposition (in days)	oviposition (in days)	No. of eggs laid by a female
1.	March	2	5	38
2.	March	2	5	42
3.	June	1	7	76
4.	June	1	7	82
5.	September	1	7	74

Incubation period and Hatching: The incubation period ranged from seven to eight days. The hatching of the nymph was observed under a binocular microscope when the eggs were removed along with the epidermal layer. The presence of two red spots in the egg indicated the red eyes of the nymphs. During hatching, first the operculum broke open allowing the head to come out. Then the appendages were released from their closely oppressed condition by the forward and backward movement of the nymph within the egg. The front pair of legs were extricated first and by fixing them to the plant surface, the nymph completely hatched out by further movements of the body.

Nymphal instars and Moulting: The developmental periods of the five nymphal instars ranged from 1 to 2, 1 to 2, 2, 2 to 3 and 3 to 4 days respectively. The total nymphal duration ranged from 10 to 11½ days both in males and females.

Duration of developmental stages of R. importunitas D.

S. No.	Stage	Duration in days		
		Maximum	Minimum	Average
1.	Eggs	8	7	7.5
2.	1st instar	2	1	1.2
3.	2nd instar	2	1	1.8
4.	3rd instar	2	2	2.0
5.	4th instar	3	2	2.2
6.	5th instar	4	3	3.3
7.	Total	19½	18	18.0

Moulting occurred near the margin of the leaf or along the depression formed by the elevated veins. The depressions formed by the crinkling of the leaves as a result of the feeding of the bug were the convenient places for moulting. During moulting the nymph fixed itself at an angle to the leaf surface and a longitudinal slit appeared in the head extending along the mid-dorsal line upto the meta-thorax. Through this slit the head appeared first and then the rest of the body.

Descriptions of the life-history stages: (Plate. I. Figs. 1 to 7)

Egg: Average of 20 eggs-length 0.833 mm, breadth 0.206 mm. Elongate, slightly curved anteriorly, opalescent and shining. Lower end rounded and tapering towards the operculum. Surface minutely honeycombed. The anterior pole of the operculum is dark brown. There are no filaments such as frequently occur in the eggs of some other Miridae. Red eyes visible in the later stages.

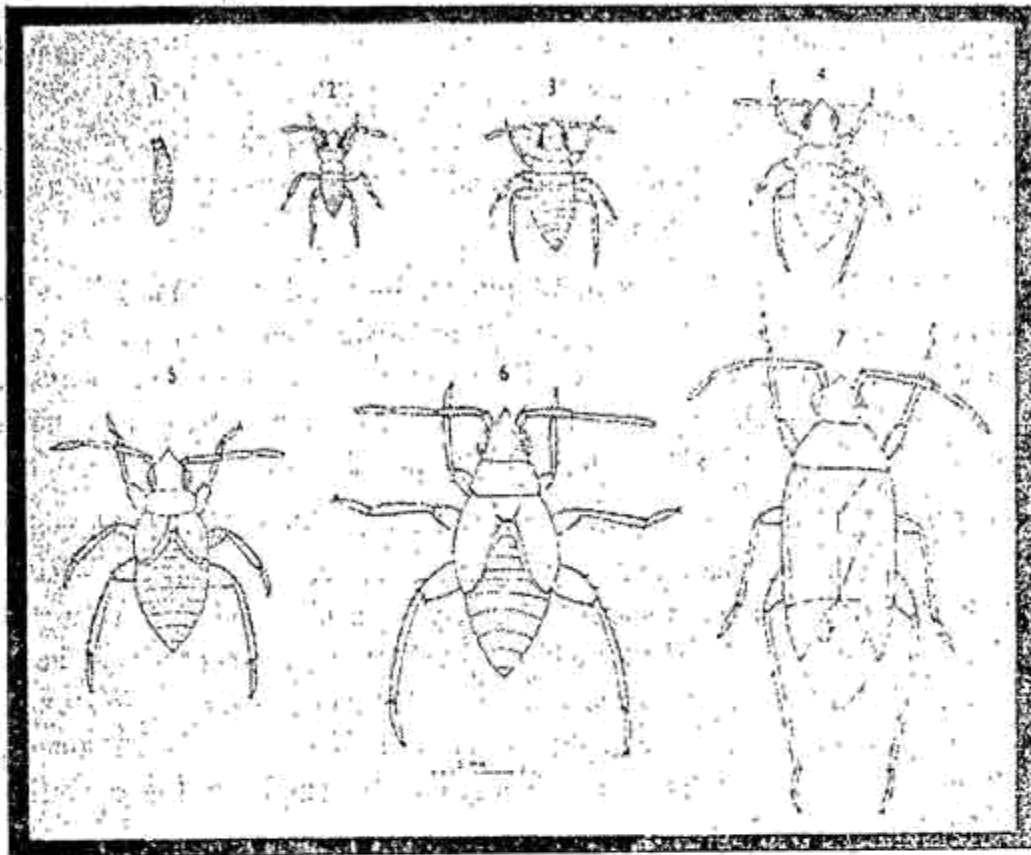


PLATE I: Life history stages of *R. importunitas* D.

Fig. 1. Egg, 2. First instar, 3. Second instar, 4. Third instar, 5. Fourth instar, 6. Fifth instar, 7. Adult.

First Instar: Average of 10 nymphs-length 0.773 mm, breadth 0.235 mm. On hatching slender, pale white, semi-transparent, turning yellowish green after feeding. Body bearing hairs all over, those on abdomen being more prominent. Head conical, relatively large; Eyes deep red, laterally situated and spherical; Antennae four segmented, basal segment smallest with a prominent spine anteriorly, distal segments with sensory hairs, those on distal segment being more dense; rostrum reaching hind coxae; prothorax prominent, longer than meso and meta-thorax. Legs long and pale yellow with numerous spines all over. Tarsi two segmented, terminal segment longest; abdomen longer than broad with hairs all over, those on the three terminal segments being more dense.

Second Instar: Average of 10 nymphs-length 1.260 mm, breadth 0.478 mm. Yellowish green, abdomen darker than head and thorax; all other characters similar to the first instar except the following; eyes dark in colour; rostrum reaching meso-coxae; meso and metanotum broader than pronotum; legs progressively longer from the first pair to the third; tarsi two segmented; anal protrusion prominent.

Third Instar: Average of 10 nymphs—length 1.493 mm, breadth 0.626 mm. Head distinctly broader than long. Second and third segment of the antennae longer than the first and last. Wing pads slightly visible. Hind legs distinctly longer than the other legs. Dark spots around the base of the spines appear in all femora and tibiae. Tarsi two segmented. Segmentation of abdomen more marked.

Fourth Instar: Average of 10 nymphs—length 2.139 mm, breadth 0.858 mm. Wing pads extend upto second abdominal segment. Second segment of the antenna longest. Rostrum reaching upto meso-coxae. Femora and tibiae with distinct darker spots. Scutellum present as a small triangular patch. Tarsi two segmented with prominent dark brown claws.

Fifth Instar: Average of 10 nymphs—length 2.627 mm, breadth 1.216 mm. Head broader than long tapering anteriorly. Antenna—basal joint short with a prominent spine anteriorly, second segment the longest and distal segment smaller than second and third; all segments with hairs those on distal segment more dense. Rostrum reaches pro-coxae. Scutellum well developed. Wing pads reach upto fifth abdominal segment. Tarsi two segmented. Ovipositor visible in female nymph on the posterior ventral side of the abdomen.

THE ADULT: The average length and breadth of males varied from 3.732 to 5.002 mm and 3.418 to 4.176 mm respectively whereas that of females varied from 4.152 to 4.230 mm and 3.332 to 3.961 mm. A description of the adult is given by Distant (1910).

LONGEVITY OF ADULTS: The adults were comparatively long lived and the females lived longer than the males. The longevity of males varied from 13 to 33 days with an average of 20.8 days whereas that of females varied from 19 to 43 days, the average being 31.6 days. The longevity of adults was more during September–October. The total life cycle of the insect varied from 35.5 days to 62 days.

Observations on the longevity of R. importunitas D. adults on sunnhemp.

S. No.	Period	Longevity in days	
		Males	Females
1.	March — April	18	24
2.	March — April	13	12
3.	June — July	33	38
4.	June — July	21	34
5.	September — October	19	43
	Average	20.8	31.6

SEX RATIO: The prevalence of the sexes during the crop period, throughout the year 1961, was observed in the fields. Sex can be easily differentiated by the presence of the dark ovipositor on the ventral side of the female. The occurrence of the female bugs ranged from 44 per cent to 61 per cent in the year 1961 whereas that of the males from 39 per cent to 56 per cent.

Sex ratio of Ragmus importunitas D. during the year 1961.

S. No.	Date	Total insects counted	Females		Males	
			Number	Per cent	Number	Per cent
1.	17-3-1961 ...	150	79	53	71	47
2.	17-4-1961 ...	100	47	47	53	53
3.	21-5-1961 ...	70	43	61	27	39
4.	18-6-1961 ...	100	61	61	39	39
5.	18-7-1961 ...	158	74	47	84	53
6.	18-8-1961 ...	75	35	47	40	53
7.	19-10-1961 ...	50	22	44	28	56
8.	19-11-1961 ...	100	51	51	49	49

Feeding and Symptoms of damage: The feeding behaviour of the insect was observed both in the field and also in the cages. The insect selected the actual point of penetration in the plant with great ease, feeling the surface with the tip of the labium all the time. All parts of the plant and both surfaces of the leaves were utilised for feeding. The tender inflorescence axis and the young unopened buds were preferred for feeding.

The plants showed the symptoms characteristic of Mirid feeding. In the initial stage yellow spots appeared in the place of feeding on the leaf. Later the nearby spots coalesced forming a bigger lesion. In the highly attacked leaf, the whole leaf area became chlorotic except near the bigger veins and crinkled. The leaves were frequently undersized, distorted and badly shaped. The attacked leaves started drying up from the margin and finally dried up completely and shed from the plant. In the younger plants the bugs showed a preference to the terminal bud and as a result the plants wilted and died subsequently. If the incidence occurred in the later stages of the crop, severe stunting of the growth resulted with very little seed set. In addition to the damage by

feeding, the oviposition damage to the plant is also more, since there is considerable amount of mechanical damage to the plant tissue due to the continuous piercing by the stylets and the ovipositor to make a hole for oviposition.

Population studies: Observation on the population level of *R. importunitas* D. was undertaken for a period of one year commencing from 13-11-1960 to 3-12-1961 except for the month of September when there was no crop of Sunnhemp in the fields of Central Farm attached to the Agricultural College and Research Institute, Coimbatore. Twenty five plants were selected at random by a straight walk across the field along the two diagonals. In each plant nine leaves and six internodes were selected in three different regions of the plant viz., three leaves with the intervening two internodes in the terminal and leaving the tender buds; Three leaves with two internodes in the middle region and three leaves with two internodes at the bottom. In each region both the adults and nymphs were counted. Weekly counts were made. The data on the population level and the weather factors viz., temperature, humidity and rainfall were plotted on graph and correlation co-officients were worked up. The results are presented below :

Correlation between population of R. importunitas D. and weather factors.

S. No.	Weather factor	D. F. (n-2)	Correlation Coefficient
1.	Maximum temperature ...	49	r = - 0.55144**
2.	Minimum temperature ...	49	r = - 0.02605
3.	Relative Humidity ...	49	r = + 0.1631
4.	Rainfall ...	49	r = - 0.1473

**Significant at one per cent level.

Population level and the influence of weather factors:— (Plate II) (Table I). With regard to the population level, maximum temperature, minimum temperature, and rainfall have been found to show negative correlation whereas relative humidity showed positive correlation. The population level has been found to be high during the months November — December and July — August and low during the summer months April — May.

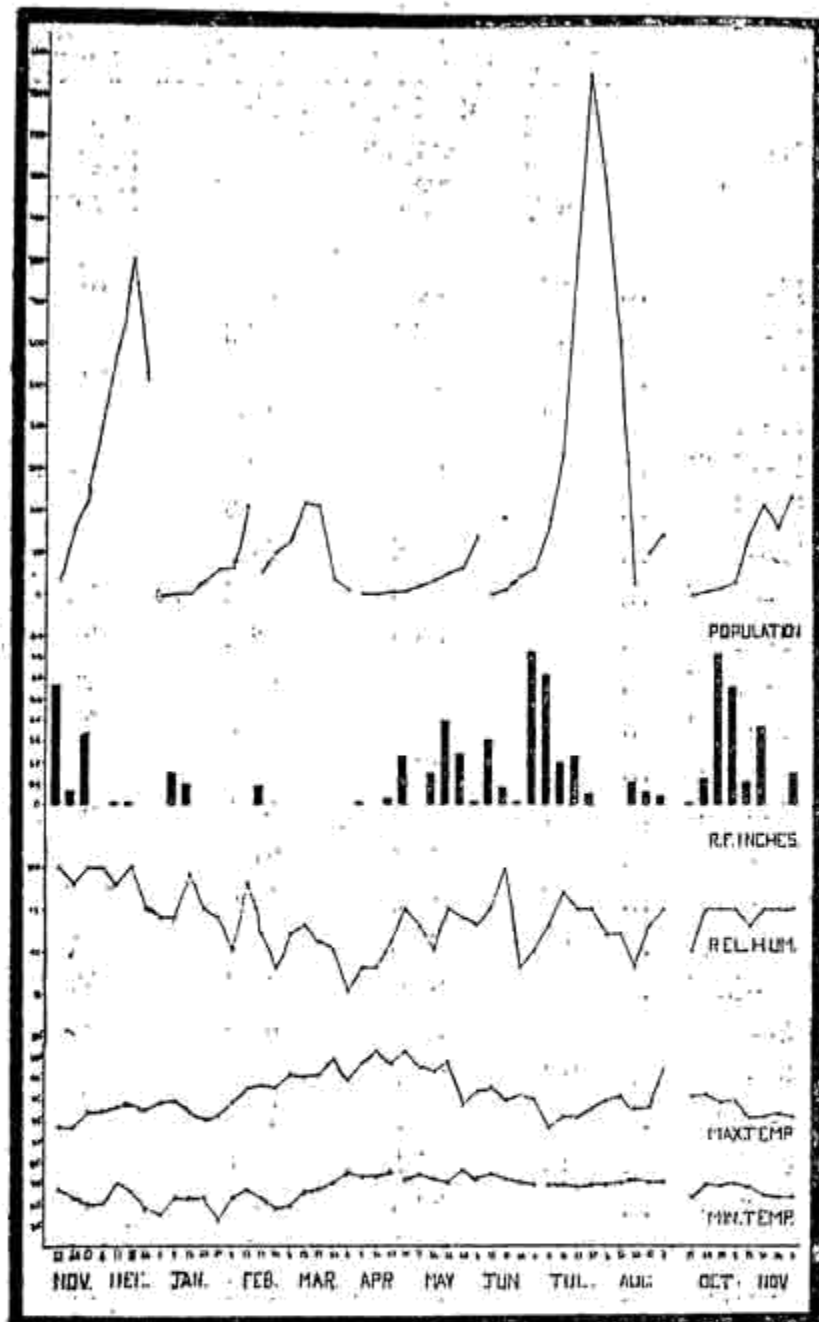


PLATE II: Graph showing population of *Ragnus importunitas* D. on sunnhemp during 1960-61 in relation to weather factors.

Maximum temperature: The maximum temperature during the study period varied from 83.0°F to 101.1°F, maximum temperature alone has been found to show a high negative correlation coefficient of -0.5514 for total population at 1% level of significance. (Plate III) This has been clearly shown by the low population during April-May when the maximum temperature was above 95.0°F. A high population level has been noted during the months of July - August when the maximum temperature did not exceed 90.0°F.

TABLE I.

Population of Ragmus importunitas D. in relation to weather factors.

S. No.	Date of observation	Total population	Maximum temperature °F	Minimum Temperature °F	Relative Humidity (Per cent)	Rainfall (inches)
1.	13—11—1960	37	83.6	67.0	100	2.84
2.	20—11—1960	159	83.1	63.2	98	0.33
3.	27—11—1960	235	86.9	60.8	100	1.71
4.	4—12—1960	424	87.0	60.2	100	—
5.	11—12—1960	596	88.3	70.2	98	0.02
6.	18—12—1960	805	88.5	65.6	100	0.02
7.	25—12—1960	516	87.6	57.9	95	—
8.	1—1—1961	—	89.0	55.2	94	—
9.	8—1—1961	2	89.5	62.2	94	0.79
10.	15—1—1961	5	86.9	62.5	99	0.50
11.	22—1—1961	34	85.0	63.3	95	—
12.	29—1—1961	61	85.8	52.0	94	—
13.	5—2—1961	67	89.0	63.1	90	—
14.	12—2—1961	215	92.2	67.4	98	—
15.	19—2—1961	57	93.2	62.6	92	0.47
16.	26—2—1961	104	92.5	58.0	88	—
17.	5—3—1961	131	95.6	59.5	92	—
18.	12—3—1961	221	95.0	66.0	93	—
19.	19—3—1961	219	95.7	66.6	91	—
20.	26—3—1961	39	99.1	70.2	90	—
21.	2—4—1961	12	94.1	74.7	85	—
22.	9—4—1961	2	98.5	72.5	88	0.01
23.	16—4—1961	2	101.1	72.8	88	—
24.	23—4—1964	4	98.8	74.6	91	0.11
25.	30—4—1961	10	101.1	71.5	95	1.12
26.	7—5—1961	23	97.0	74.3	93	—
27.	14—5—1961	35	96.6	71.9	90	0.72
28.	21—5—1961	51	98.9	70.3	95	2.00
29.	28—5—1961	63	88.7	75.9	94	1.26
30.	4—6—1961	141	91.8	71.6	93	0.04
31.	11—6—1961	2	92.7	73.5	95	1.54
32.	18—6—1961	12	89.2	71.5	100	0.40
33.	25—6—1961	43	90.9	70.4	88	0.03
34.	2—7—1961	62	89.9	69.6	90	3.65
35.	9—7—1961	163	83.0	69.3	93	3.11

TABLE I (Contd.)

No.	Date of observation	Total population	Maximum temperature °F	Minimum Temperature °F	Relative Humidity (Per cent)	Rainfall (inches)
36.	16—7—1961 ...	336	85.9	69.3	97	1.00
37.	23—7—1961 ...	816	85.8	68.6	95	1.15
38.	30—7—1961 ...	1264	87.9	69.5	95	0.24
39.	6—8—1961 ...	950	89.5	69.4	92	—
40.	13—8—1961 ...	615	90.4	70.4	92	—
41.	20—8—1961 ...	28	87.9	71.2	88	0.57
42.	27—8—1961 ...	109	87.9	70.2	93	0.30
43.	3—9—1961 ...	145	96.8	70.8	94	0.20
44.	15—10—1961 ...	—	90.3	63.4	90	0.04
45.	22—10—1961 ...	12	91.0	69.0	95	0.66
46.	29—10—1961 ...	18	89.0	68.9	95	3.56
47.	5—11—1961 ...	30	89.4	69.2	95	2.83
48.	12—11—1961 ...	146	85.2	68.2	93	0.56
49.	19—11—1961 ...	215	85.6	64.5	95	1.88
50.	26—11—1961 ...	160	86.1	63.3	95	—
51.	3—12—1961 ...	289	85.9	63.0	95	0.73

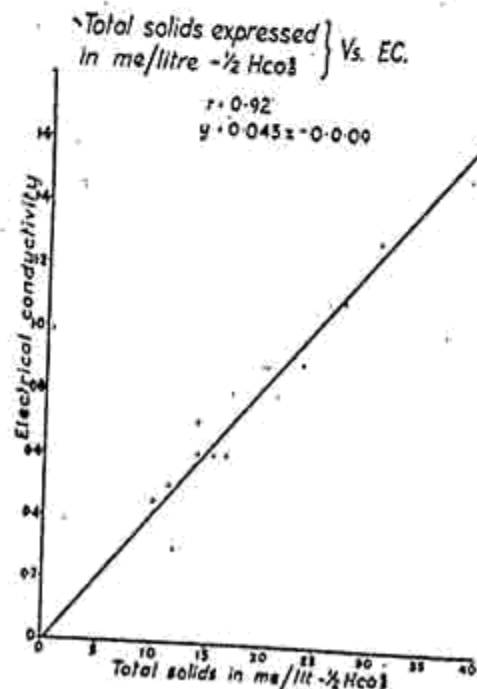
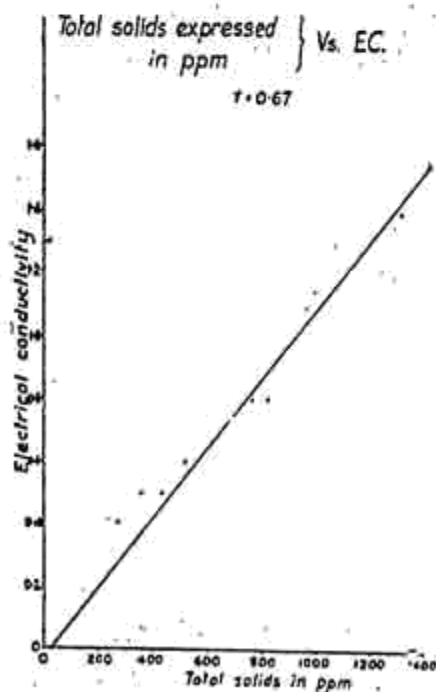


PLATE III: Regression of population on maximum temperature

Minimum temperature: The minimum temperature during the period of study ranged from 52.0°F to 75.9°F. There existed no significant correlation between population level and minimum temperature, the 'r' value for minimum temperature being -0.02605. However, the influence has been towards the negative trend.

Relative humidity: The relative humidity during the period of study varied from 85 to 100 per cent. Although no significant correlation has been obtained with regard to relative humidity on the population level, the effect has been found to be on the positive side.

Rainfall: Rainfall also has not shown any significant correlation on the population level, the 'r' value being -0.1473.

The problem is further complicated by the influence of the stage of the crop on the population level of the insect. It will be seen that the population is minimum in the early stage of the crop reaching its peak at a stage when the plants are fully grown. The increase may be due to the availability of a larger space for feeding, for oviposition and for shelter. After the plants have matured considerably there is a drop in the population level.

Summary: 1. The biology of *Ragnus importunitas* D. on sunnhemp has been carried out in detail. Mating occurred two to three days after the emergence of the adults. The oviposition is peculiarly done by making a hole in the plant tissue by the stylets and inserting the egg singly in each hole. The preoviposition and oviposition periods range from one to two days and five to seven days respectively. The incubation period lasts seven to eight days. The developmental periods in the five instars have been noted to be 1.2, 1.8, 2, 2.2 and 3.3 days respectively, the total being from 10 to 11.5 days. Longevity of males varied from 13 to 33 days with an average of 20.8 days and that of females from 19 to 43 days, the average being 31.6 days. The total life cycle of the insect from egg to adult varies from 35.5 to 62 days.

2. Descriptions of the various instars are given. The sex ratio studies carried out revealed that the prevalence of the sexes to be about equal throughout the year 1961, the ratio being 44 per cent to 61 per cent for females and 39 per cent to 56 per cent for males.

3. Yellow spots first appeared on the leaves due to the feeding of *R. importunitas* D. on sunnhemp. These spots later coalesced to form a bigger lesion. Attacked leaves were frequently undersized, distorted and badly shaped. Complete death of young plants resulted due to the attack and in older plants severe stunting of growth with reduction in seed set occurred.

4. Population studies on *R. importunitas D.* were undertaken during the year 1960—'61 and the population level was found to be high during the period of November—December and July—August and low during the summer months April—May. The population was statistically correlated with the weather factors and only maximum temperature gave a high significant negative correlation coefficient at one per cent level.

REFERENCES

- Distant, W. L. 1910 "Fauna of British India". Rhyncoeta Vol. V Heteroptera Appendix pp. 228-294.
- Goot, van der 1927* Het. crotalaria—Wantsje (The *Crotalaria* bug) *Korte. Meded. Inst. Plziek* No. 6; 18 pp. Bintenzorg.
- Hutson, J. C. 1931* Report of Insect pests in Ceylon during 1930. 17 pp. Typescript Peradeniya 1931.
- _____ 1933* Report on the work of the Entomological Division (Ceylon Dept. Agric. 1932) 23 pp. Typescript. Peradeniya 1933.
- Tollenaar, D. 1934* Jaarversleg (Annual Report of the Vorstenland Tobacco Experimental Station, Java). I Mei April, 1933. *Meded Proefst vorstenl. Tabak* No. 77, 115 pp. 1933.

* Original not seen.