HYMENIA RECURVALIS F. AND ITS PARASITE COMPLEX

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Introduction

Hymenia recurvalis F. is one of the sporadic pests of irrigated vegetable crops, especially the leafy vegetables. It is known to have an almost world-wide distribution and is of common occurrence in our country during the warmer months both in the hills and plains all over India. It webs the leaf, feeds on the green matter and pupates within the rolled leaf. It is found to attack most of the leafy vegetables, the main host plant being *Amaranthus* sp. and is also known to attack maize, beet root and sweet potato. In this paper observations made in the field as well as in the laboratory with regard to the host parasite relationship of *Hymenia recurvalis* and its parasites have been explained and discussed. No sampling methods have been undertaken to calculate the percentage of damage caused by the pest or the population of the pest per unit area, but as trained observers in the field the authors could estimate the abundance of the host in the field and the damage caused by the pest.

Observations

During the months of July and August 1956, the *Amaranthus* crop in the vegetable gardens of the Indian Agricultural Research Institute was found to have been severely attacked by *Hymenia recurvalis*. Almost every plant was infested with a number of larvæ and it could be well said that the insect was present in an epidemic form. At the same time a number of cocoons of the parasite *Apanteles* new species were also seen on the lower surface of the leaves. Laboratory rearing of the host larvæ collected from the field revealed that the pest was attacked by three primary parasites of potential importance; the most abundant being the *Apanteles* new species, the lesser being an unidentified Ichneumonid and a Braconid. Very few pupæ of the latter two species could be collected from the field nor could be reared from the host larvæ collected from the field. But in the new *Apanteles* sp. the case was different. Collections of pupæ of *Apanteles* and also laboratory rearing of the host larvæ collected from the field revealed that the parasitisation by *Apanteles* was observed to be as high as 60% and in every case only

one parasite emerged from each host larva. This high population of the species remained throughout the months of July, August and also a part of September as evidenced by the laboratory rearing of the host as well as from the pupæ of the parasite collected from the field. Surprisingly the host population in the field also remained more or less stable throughout the period under observation in spite of the fact that it was being attacked by three primary parasites and also being subjected to a high degree of parasitisation by *Apanteles* sp. In order to investigate the causes for the abundance of the host population in spite of the presence of its parasites, careful field and laboratory investigations were undertaken. *Apanteles* pupæ were collected from the field at frequent intervals to find out in the laboratory the percentage of actual emergence of the adult parasites from the pupæ. The *Apanteles* pupæ collected during the months of July and August were mainly found to be hyperparasitised by an Elasmid (*Elasmus* sp.), an Eurytomid (*Eurytoma* sp.), a Ceraphronid (*Ceraphron* sp.), and those pupæ collected in the month of September were mainly hyperparasitised by the Elasmid and two species of Eulophid (*Entedon* sp. and *Mestocharis* sp.) and a species of Pteromalid to a lesser extent.

Two interesting points revealed by this phenomenon of hyperparasitism as evidenced by the following tables are that (1) the degree of hyperparasitism varied greatly between the different secondary parasites attacking the *Apanteles* pupæ at the same time, (2) that there was more or less a sort of seasonal distribution and abundance of these hyperparasites that made their appearance to constitute this parasite complex. For example, among the five different hyperparasites that attacked the *Apanteles* pupæ in the month of July, the degree of hyperparasitism was very high in the case of the Elasmid and Ceraphronid in comparison with the rest of the three species. Similarly with regard to the tendency towards the seasonal prevalence of the hyperparasites, laboratory studies and observations revealed that only the Elasmid and Ceraphronid were dominantly present in the month of July, whereas the Eupelmid appeared only at a later stage, namely in the month of August. The pupæ collected in the month of September were attacked by two different species of Eulophids which had not hitherto made their appearance, as will be seen in the following table and graphically represented in Fig. 1.

DISCUSSION

Observations in the field disclosed that the population of the pest was constantly abundant throughout the period under study, that is, till the middle of the month of September in spite of the fact that the host was being attacked by three primary parasites and that there was altogether an overall high degree

of parasitisation. By the middle of September the host was observed to have completed two broods and was running the third generation whereas by the same time *Apanteles* new species should have reached its fifth generation since its life-cycle ranged only from 15–20 days as compared to the long

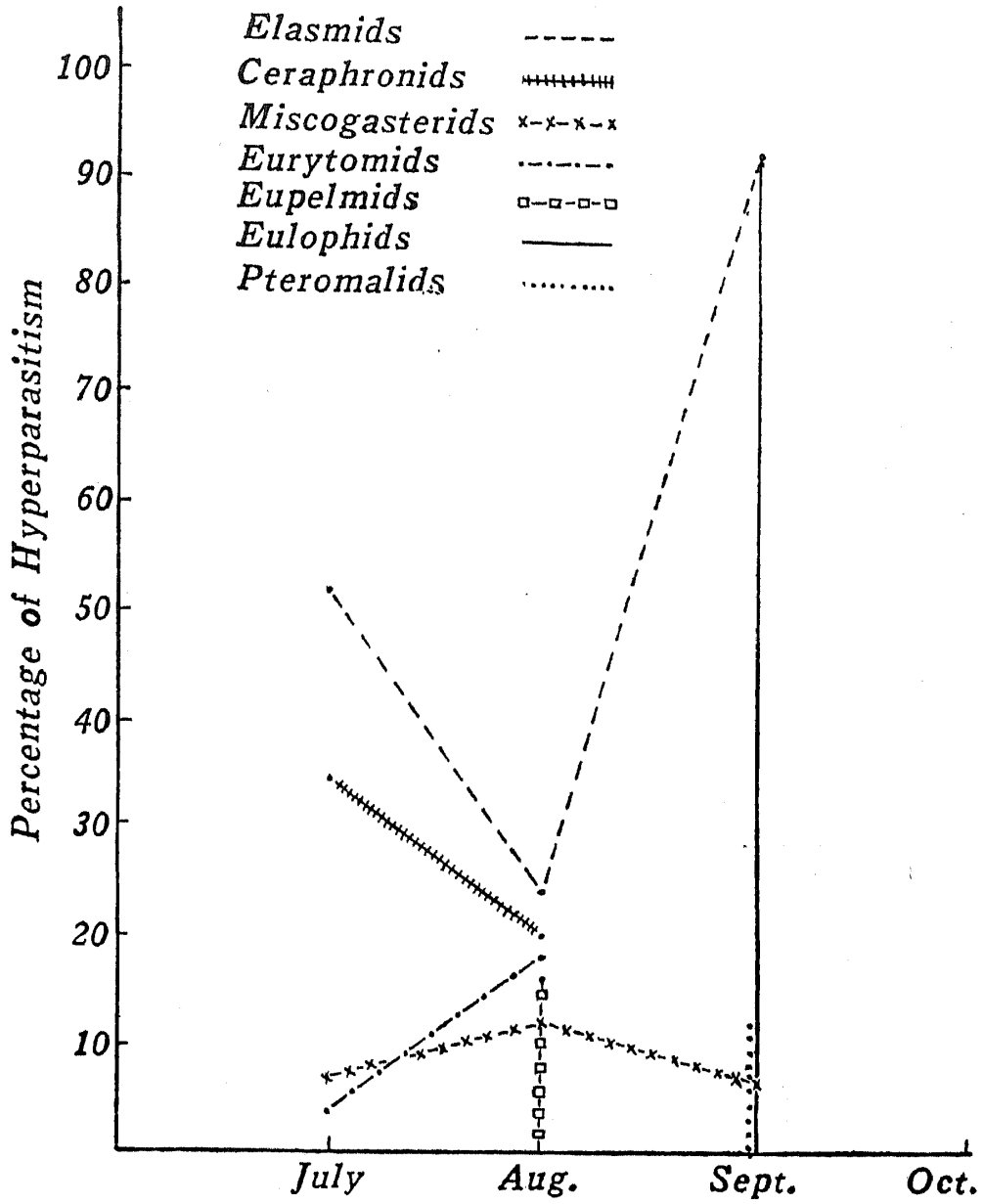

FIG. 1. The Percentage and Sequence of Hyperparasites on *Hymenia recurvalis* F.

life-cycle of the host. Notwithstanding the fact that it was a solitary parasite it should have brought down the host population at least to a considerable extent mainly on the strength of its being ahead of the host by two generations ccording to Thompson (1922) as quoted by Sweetman (1936). According

TABLE I

The percentage and sequence of primary parasites on Hymenia recurvalis *F.*

Month	No. of Hymenia larvæ collected from field and reared	No. of *Apanteles* adults			No. of Ichneumonids			No. of Braconids		
		Reared in the laboratory from the larvæ collected from the field	Pupæ collected from the field	Percentage of parasitism	Reared from the host larvæ collected from the field	Pupæ collected from the field	Percentage of parasitism	Reared in the laboratory from the field collected larvæ	Pupæ collected from the field	percentage of parasitism
July ..	22	13	67	..	1	1	..	1	1	..
August ..	42	26	34	..	2	1	..	2	2	..
September ..	23	14	208	..	1	..	..	..	..	..
Total ..	87	53	309	61%	4	2	4·6%	3	3	3·4%

TABLE II

The percentage of hyperparasitism on Apanteles *new species and the degree of hyperparasitism among various hyperparasites and their seasonal occurrence*

Month	No. of *Apanteles* pupæ collected from the field	No. of pupæ hyperparasitised	Total percentage hyperparasitised	No. of pupæ of *Apanteles* hyperparasitised by						
				Elasmids	Cera-phronids	Miscogas-terids	Eurytomids	Eupelmids	Eulophids	Pteromalids
July ..	67	42	..	22	15	3	2	Nil	Nil	Nil
August ..	34	25	..	6	5	3	7	4	Nil	Nil
September ..	208	130	..	62	Nil	4	Nil	Nil	57	7
Total ..	309	197	63·7	90	20	10	9	4	57	7

to him if the reproductive potential of a parasite exceeds the reproductive potential of the host, then the time which will elapse before the parasite theoretically will equal the host in numbers and so exterminate it, can be determined from the formula

$$t = \frac{\log\left(\frac{na - n - pa}{pa}\right)}{\log a}$$

where

n = the initial number of hosts,

p = the initial number of parasites,

t = the required time, expressed in number of parasite generations, and

$$a = \frac{\text{the reproductive potential of the parasite}}{\text{the reproductive potential of the host}}.$$

However, the high percentage of parasitisation by the *Apanteles* sp. in association with the two other primary parasites could not bring down the population of the host. The failure of natural control by the parasites here is mainly due to the presence of hyperparasites that attacked *Apanteles* pupæ and may not be due to the high reproductive potential of the host or the unequal sex ratio among the host and the parasites even though it is possible they may have played a role but certainly only a very lesser role. Hyperparasitism as evidenced here was a significant factor in the maintenance of the balance between the insect species involved. Here is a classic example of the biological association of the host, primary parasites and secondary parasites forming an amazingly well-adjusted complex. The hyperparasites certainly delayed considerably the time when the primary parasite (*Apanteles* sp.) would become sufficiently abundant to check the host population appreciably. As for the phenomenon that a large number of hyperparasites of different families attacked the *Apanteles* pupæ can be explained by the continued abundance of these parasites in the locality, the non-availability in sufficient numbers of their preferred host species and the subsequent adaptability to the host available in plenty rather than to the laws of specificity and host selection. The variation in the degree of hyperparasitism among the various secondary parasites involved may be ascribed to the high reproductive potential of the available secondary parasites. It was also remarkable that from each pupa only one particular species of hyperparasite emerged. In other words, there was no multiparasitism in this remarkable phase of

hyperparasitism. Could it be that this occurrence is only a way to keep the balance of population in nature?

SUMMARY

1. *Hymenia recurvalis* F. was found to be attacked by three primary parasites namely (1) *Apanteles* new species, (2) an unidentified Ichneumonid and (3) an unidentified Braconid.

2. The degree of parasitism was observed to be about 62% in case of *Apanteles* sp. and not significant in the two other species.

3. In spite of the two observations cited above, the pest was found to be abundant in the field throughout the period under observation and the population of *Apantales* sp. also remained more or less constant.

4. Investigations into the failure of the natural control by parasites to check the host population revealed the presence of eight different species of hyperparasites attacking the pupæ of *Apanteles* sp. and constituted a major factor in the maintenance of balance between the host and the parasites.

5. There is a wide field for research in this direction which will attract some of the younger and energetic entomologists of our country.

ACKNOWLEDGEMENT

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REFERENCE

Sweetman, H. L. .. *The Biological Control of Insects*, Comstock Publishing Co., New York, 1936.