Proc. Indian natn. Sci. Acad. **B52** No. 3 pp 358–363 (1986)

Thrips-crop-weed Interactions of Thrips *Palmi karny* and *Toxothrips ricinus* Bhatti infesting *Sesamum indicum* and *Ricinus communis*

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(Received 4 November 1985; after revision 4 April 1986)

The impact of biological parameters pertaining to the life cycles and population trends of the thrips species, *Thrips palmi* and *Toxothrips ricinus* both on the oil seed crops *Sesamum indicum* and *Ricinus communis* as well as on their respective weed hosts *Croton sparsiflorus* and *Cassia occidentalis* are discussed. The role of abiotic factors such as temperature, rainfall, and humidity as well as weed density and natural enemies on the thrips population are also included.

Key Words: **Bioecology**, *Thrips palmi*, *Toxothrips ricinus*, *Sesamum indicum*, *Ricinus communis*

Introduction

Information pertaining to the crop-weed interaction with respect to thrips pests are available from Taylor (1974), Ananthakrishnan and Thangavelu (1976), Ananthakrishnan (1978), and Daniel et al. (1983, 1984). They have established that the pest population on the crop is inversely proportional to those in the weed during their growing seasons. In the present investigation an attempt has been made to assess the impact of the two thrips species, *Thrips palmi* on *Sesamum indicum* and *Toxothrips ricinus* on *Ricinus communis* in terms of bioecological parameters, pertaining to the biology and population trends both on the oil seed crops as well as on their respective weed hosts (*Croton sparsiflorus* and *Cassia occidentalis*) along with the impact of abiotic factors and their natural enemies.

Material and Methods

To assess the reproductive efficiency of the thrips on crops as well as on the weed hosts, different culture methods (Daniel et al. 1984) were adopted. Fecundity was calculated by using the technique of Gaddoura and Venkataraman (1967). Regular field surveys were made in the South and North Arcot districts and in and around Madras to assess the population trends of the thrips and density of the weeds. For sampling *Toxothrips ricinus* both in the crop as well as in the weed, Dry Count Technique (Irwin & Yeargan 1980) was applied, whereas in the case of *Thrips palmi*, samples were made by using

the beating technique. Plants to be sampled were beaten gently on a white pad and the numbers of thrips falling on the pad were collected, with the help of fine Camlin brush ('O') in vials containing 70% alcohol and counted under a stereoscopic microscope. Parasites and predators collected from the field were released in glass cages provided with host plants infested by various stages of the thrips.

Results

Life Cycle

Sexual reproduction was more pronounced in *Thrips palmi* and *Toxothrips ricinus* but a few non-viable parthenogenetic eggs were also laid in the laboratory. In both the cases a single sexually reproducing female laid an average of 2-3 eggs per day, both in the crops as well as in the weeds. The fecundity of *T. palmi* was more in the crop *Sesamum indicum* (58±2.58) than the weed *Croton sparsiflorus* (42±3.0) and of *Toxothrips ricinus* was more in the weed *Cassia occidentalis* (49±3.8) than in the crop *Ricinus communis* (32±2.32). *Thrips palmi* took longer period to complete its life cycle in the weed than the crop, and vice versa in *Toxothrips ricinus* (table 1).

Infestation

Toxothrips ricinus infested only the buds of the crop *Ricinus communis* (Ananthakrishnan et al. 1982) and the weed *Cassia occidentalis*. Initial infestation of *Thrips palmi* on *Sesamum indicum* was noticed on the young foliage of the seedlings and following the flowering of the crop, this species switched over to the flowers. Floral infestation resulted in the malformation of the stamens, injury to the ovarian wall and ultimately the development of a dark pigment on the fruit wall, instead of the usual green colour (Ananthakrishnan 1955). No specific site for infestation was evident on the weed *Croton sparsiflorus*.

Succession of Weeds

Both the weeds, *Cassia occidentalis* and *Croton sparsiflorus* appeared in the fields of *Ricinus communis* and *Sesamum indicum* in

Table 1

Thrips species	Host plants	Life cycle duration in days						
		Fecundity	Incubation	I instar	II instar	Pre-pupae	Pupae	Total duration
Thrips palmi	*Sesamum indicum*	58±2.58	3.5±0.5	3.0±1.0	4.0±0.3	1.0±0.2	2.5±0.8	14.0±2.35
	Croton sparsiflorus	42±3.0	4.0±0.6	4.0±0.6	4.5±1.0	1.0±0.5	4.0±0.5	17.5±1.43
Toxothrips ricinus	*Ricinus communis*	32±2.32	7.2±0.3	3.5±0.5	6.3±0.3	1.0±0.3	2.8±0.0	20.8±2.84
	Cassia occidentalis	49±3.8	4.1±0.8	3.0±0.2	5.5±0.4	1.0±0.1	1.6±0.7	15.2±2.84

Values represent mean ± standard deviation

large numbers after the rains during July, and the maximum density of *C. occidentalis* was noticed in October (5–15 plants/30 sq. m.) while that of *Corton sparsiflorus* in September (11–40 plants/30 sq. m.) and declined thereafter.

Population Trends

Population trends assessment over a period of two years revealed that *Croton sparsiflorus* appeared to be the primary reservoir host for *Thrips palmi* (pest on *Sesamum*) where its population was evident almost throughout the year. On *Sesamum indicum* in 1981-82, the pest population exhibited two peakes; the first peak was noticed in the seedling stage (January) and the second peak appeared in April, following the flowering of the crop. A sudden decline in the pest population on the weed occurred during January and at this period a heavy infestation was observed on the crop. Following this, there was a sudden decline in the population on the crop in February. No further migration was evident, but the population gradually increased both in the crop as well as in the weed and reached the second peak by April. By the end of April when the crop was harvested, a continuous increase in the population was noticed on the weed where it reached its maximum during July. Early rainfall during July brought about a decline of the population on *Croton sparsiflorus* and only a low population was maintained from August to October.

Toxothrips ricinus on *Ricinus communis* occurred almost throughout the year excepting the month of July, its incidence on the crop commencing during late August. Maximum population was attained in March during both the years under observation (1981 & 82). Increasing temperature along with decreasing humidity resulted in the gradual decline of the population after March, but the early monsoon rains during July enhanced the appearance of the alternate weed hosts *Cassia occidentalis*, resulting in the switch over of the pest from the crop to the weed. On the weed host the thrips exhibited peak population in August and gradually declined thereafter. Subsequently, population buildup was noticed on *Ricinus communis*.

Natural Enemies

Many predatory beetles, predatory thrips, anthocorids such as *Micraspis discolor* Weise. (Coleoptera: Coccinellidae) and *Orius maxidentex* Ghauri (Heteroptera: Anthocoridae) appeared during the infestation period of *T. palmi*. The earlier nymphal stages of *Haldwania liliputana* Beier (Dictyoptera: Mantidae) was found to be feeding on *Toxothrips ricinus*, but no effective predation resulting in a noticeable decrease of the prey population was evident. It is also of interest to note that the anthocorid *Orius maxidentex* showed a typical numerical response where they responded and established their population with the increasing evident. It is also of interest to note that the anthocorid *Orius maxidentex* showed a typical numerical response where they responded and established their population with the increasing trends of *Thrips palmi* population and effected the decline of the thrips population due to heavy predation (figure 1).

The eulophid parasite, *Ceranisus menes* Walker was found to parasite the second instar larvae of *T. ricinus* where it laid a single egg per larva. *C. menes* mostly selected the early second instar or the late first instar larvae of *T. ricinus* for parasitisation, but the late second instar, prepupae, or pupae were rarely attacked by the parasite. Host mortality occurred in the pupal stage, depending upon the stage of development of the host at the time of attack. The parasite larvae consumed the entire body contents of the larval host and pupated inside

the empty shell. Adult parasites emerged from the host by breaking open the posterior abdominal segments of late larvae and pupae. The sex ratio was observed to be 3 : 2 (Female: Male).

Discussion

The present study pertaining to the interaction of the weeds such as *Croton sparsiflorus* and *Cassia occidentalis* with the thrips population in the fields of *Sesamum indicum* and *Ricinus communis*, revealed their role either as primary or alternate hosts for *Thrips palmi* and *T. ricinus* respectively, thereby enabling them to sustain their population in the field throughout the year. Such association between thrips, crops and weeds appears well established in some of the thrips species infesting cereals in which it was found that the grass weeds, *Chloris barbata* acted as an alternate host for *Chirothrips mexicanus* Crawford in *Pennisetum typhoides* fields (Ananthakrishnan & Thirumalai 1977), *Echinochloa colona* and *Cyperus iria* for *Baliothrips biformis* (Bagnall) in *Oryza sativa* fields (Ananthakrishnan & Kandasamy 1977), *Echinochloa colona* for *Florithrips traegardhi* Trybom, in *Sorghum vulgare* fields (Ananthakrishnan 1978), with respect to dicots, *Centrosoma pubescens* for *Taeniothrips sjostedti* (Trybom) in cowpea fields (Taylor 1974) and *Achyranthes aspera* for *Caliothrips indicus* (Bagnall) in *Arachis hypogaea* fields (Daniel et al. 1984). *Sesamum indicum* appeared to be the primary host for *Thrips palmi* due to the high fecundity and quick development of the thrips on this host and as a result of which a comparatively higher population build-up was evident on the crop than in the weed. Though *S. indicum* appeared to be the primary host, with respect to the reproductive efficiency of *T. palmi*, the occurrence of this crop in the field was seasonal, hence the weed *C. sparsiflorus* acted as the reservoir host for *T. palmi* throughout the year. A similar observation was also made where *A. aspera* provided shelter for *Caliothrips indicus* in *A. hypogaea* fields (Daniel et al. 1984). In contrast, *T. ricinus* reproduced at a quicker rate on the weed *C. occidentalis* as evidenced by the higher population, when compared to that of the crop. Since both the weed as well as the crop are annual, the incidence of *T. ricinus* on both the host plants was observed almost throughout the year. As revealed in the case of *C. indicus* (Daniel et al. 1984) the weed density in the fields had a definite impact on these thrips populations. Decrease in the density of the weed *C. sparsiflorus* (after October) resulted in the increase of thrips population on each plant, because no crop was available in the field for the migration of *T. palmi*. On the contrary, in *T. ricinus* when the density of *C. occidentalis* decreased in the fields, decrease in the population of thrips on the weed was evident; and with the subsequent migration of them to the crop *Ricinus communis* resulted in the population increase in the crop. In the case of both in *T. ricinus* and *Thrips palmi*, migration towards the weed was evident following the removal of crops from the fields. Bournier (1970) made a similar observation, in the case of *Taeniothrips vulgattisimus* (haliday) which infested the flowers of almond and migrated to wild plants following the fall of flowers.

Rainfall along with temperature and increasing humidity influenced the decline in the population of *Thrips palmi* as observed by Andrewartha and Birch in *Thrips imaginis* Bagnall (1954), Ananthakrishnan and Jagadesh in *Anaphothrips sudanensis* Trybom (1968), Ananthakrishnan (1956) in *Retithrips syria cus* Mayet. In the case of *Toxothrips ricinus* no such impact was evident, reason to which could be attributed to the occurrence of *T. palmi* on the leaves and flowers, where it was subjected to the washing away by rain, whereas *T. ricinus* remaining inside the

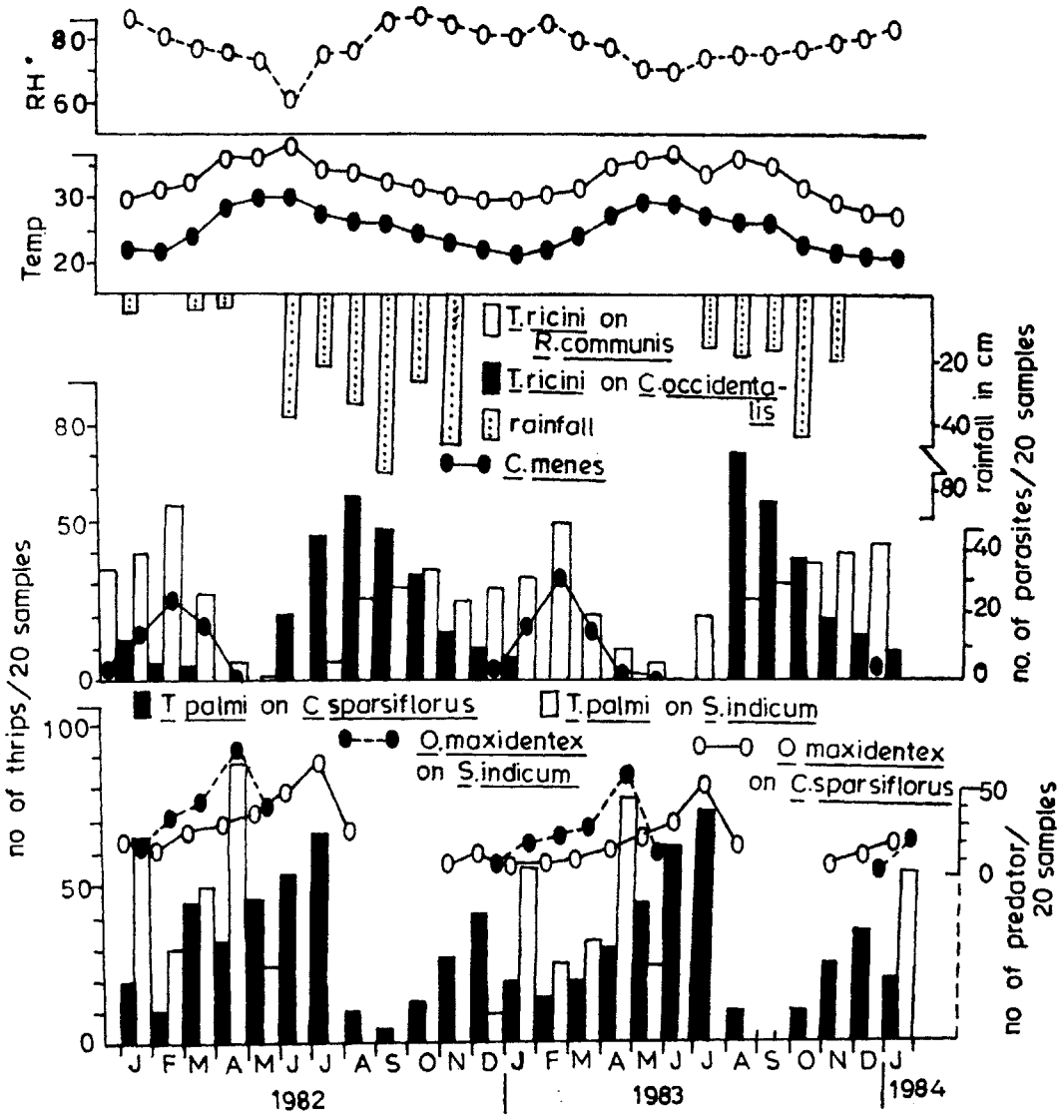

Figure 1 Influences of meteorological factors on the rate of disease progress during 1983

partially opened buds of *R. communis* could avoid the rains.

The peak population of the predator synchronised with the decline in the prey population. Such correlation involving the numerical abundance of the anthocorids in accordance with the fluctuating thrips populations was evident from the earlier works of Viswanathan and Ananthakrishnan (1974), Stoltz and Stern (1978), Irwin and Kuhlman (1979), Isenhour and Marston (1981), Sureshkumar and Ananthakrishnan (1984), and Anantha-

krishnan and Sureshkumar (1985). The present investigation on the interaction of the eulophid parasite *Ceranisus menes* with *Toxothrips ricinus* is well in agreement with the earlier observation on *zaniothrips ricini* (Daniel et al. 1983), another species infesting *Ricinus communis*.

Acknowledgements

The authors are grateful to Professor T N Ananthakrishnan, under whose guidance this work was carried out. This work was done during the tenure of the ICAR Project, for which thanks are due.

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