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INSECT PARASITES OF THE DIAMONDBACK MOTH
Plutella xylostella (L.)
AND SEASONAL FLUCTUATIONS IN PARASITISM
AT THREE LOCATIONS IN JAMAICA

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ABSTRACT

Two species of parasites of Plutella xylostella (L.) were recorded in Jamaica, and indeed in the Caribbean, for the first time. These are: a new species of the larval parasites Diadegma (Ichneumonidae) and the larval and pupal parasite, Tetrastichus sokolowskii Kurdjumov. A new species of a hyper-parasite of Diadegma, Spilochalcis sp. was also recorded.

The incidence of parasitism by these hymenopterans has been fairly high throughout the study period of 1986-1988 in three cabbage growing areas of Jamaica, in spite of heavy uses of insecticides on weekly or twice-weekly basis. The monthly mean levels of parasitism (with \pm 95 percent C.L.) in Douglas Castle between March 1986 and July 1987, was 32.8 ± 8 percent, and in Guy's Hill, it was 16 ± 10 percent between August 1987 and August 1988.

INTRODUCTION

The diamondback moth, Plutella xylostella (L.) (Yponomeutidae: Lepidoptera) is one of the most important international pests of cole crops. Continual use of insecticides since the 1940s has evolved resistant populations of the pest all over the world. Relevant research data on the subject has recently been bibliographed by Talekar et al., (1985).

The general pest management and environmental, occupational and consumer health problems created by insecticides have diverted the attention of entomologist towards greater reliance on biological control. In the eastern Caribbean (EC), the Commonwealth Institute of Biological Control initiated research on insect parasites of P. xylostella in the 1970s (Bennett and Yaseen, 1972; Alam, 1974; 1982). Surprisingly, only three species of parasites belonging to the families Trichogrammatidae and Braconidae, have thus far been recorded from the EC; these are the egg parasite Trichogramma sp. and the larval parasites Cotesia (= Apanteles) plutellae Kurdjumov and Apanteles sp. (Alam, 1974; Bennett and Yaseen, 1972). Recently Alam (per comm. 1987) has recorded a Trichogramma sp. parasitizing the eggs of Plutella in Jamaica.

For achieving biological control of the diamondback moth in Barbados, Alam introduced four species of ichneumonid larval parasites in the early 1970s; these are Diadegma eucerothaga Horstman from Pakistan, and Diadromus (= Thyraella) Collaris (Gravenhorst), Macromalon orientale Kerrich and Macromalon sp. from India. A colony of the braconid C. plutellae was also introduced from India.

In spite of the economic importance of the crop to Jamaica, and the enormous problems faced by the farmers in controlling P. xylostella, hardly any study of significance had ever been conducted on the pest in the island. The results reported herein are a part of a wider study initiated in 1986 on the population fluctuations, economic importance, incidence of parasitism and chemical control of the pest in Jamaica.

MATERIALS AND METHODS

Last instar larvae and pupae of P. xylostella were collected from cabbage fields in Douglas Castle, Sandy River and Guys Hill areas which are about 5 to 10 miles apart and separated by mountain ranges and valleys. Collections were made on a monthly basis for at least a year each locality, starting in 1986.

The insects were kept individually in sterilized plastic vials (4 x 2.4 cm), provided with fresh green leaves every other day (larvae only) and held at room temperature (27-30°C, 50-60% RH). Emergence of adult moths or parasites was recorded in very vial at regular intervals. Each specimen was separated after morphological examination.

RESULTS AND DISCUSSION

Two species of parasites of P. xylostella and one hyper-parasite were recorded for the first time in Jamaica, and indeed, in the Caribbean. These include a new species of the larval parasite Diadegma (Ichneumonidae) and the larval and pupal parasite Tetrastichus sokolowskii Kurdjumov. A hyper-parasite of Diadegma, the Spilochalcis sp. is also widely present in Jamaica.

Data presented in Table 1 show that Diadegma is the major parasite in Jamaica, attacking both the early and advanced stages of the last larval instar. The parasite was present all the year round at Douglas Castle, and incidence of parasitism of the early larval instar ranged from about 21.5 to 62 percent, except in August and October, 1987. The emergence of the parasites from the pupal cocoons of the host (reflecting late larval parasitism) ranged from about 0 to 62 percent. Parasitism by Tetrastichus was sporadic and more on pupae than larvae, particularly in October, 1986 and June, 1987. The hyper-parasite of Diadegma was present throughout the study period, and most Spilochalcis adults emerged from the field-collected pupae than larvae.

The mortality of the field-collected population of the diamondback moth due to parasitism was usually over 30 percent (monthly mean = 32.8 ± 8 percent). The incidence of disease also was high and uniform, ranging from 7.1 percent in April, 1987, to 34.1 percent in May, 1987, with a monthly mean of 14.0 ± 3 percent.

At Sandy River also, Diadegma was the major parasite of Plutella. It is interesting to note that in 1986, most parasite adults emerged from field-collected larvae than pupae, but in 1987, the emergence from pupae was fairly high. Parasitism by Tetrastichus also was confined only to larvae in 1986 but

Table 1. Incidence of parasitism, hyper-parasitism and disease in the larvae and pupae of Plutella xylostella (L) collected from field at Douglas Castle, Jamaica.

Year & month	Number collected		Percentage parasitism by ^a						Total (%) incidence of ^b	
			Diadegma		Tetrastichus		Spilochalcis			
	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae	Larvae	Pupae	hyper-parasitism	Disease
1986										
March	468	-	39.3	-	0.2	-	0.2	-	39.7	15.0
April	117	-	35.0	-	0.0	-	0.0	-	35.0	18.8
May	266	-	26.3	-	0.0	-	0.0	-	26.3	13.9
July	315	-	32.1	-	1.0	-	1.3	-	34.4	13.3
August	309	193	43.4	45.1	0.0	0.3	0.3	0.0	46.0	10.4
September	117	252	30.8	17.5	3.4	0.4	0.0	4.0	25.8	13.8
October	191	199	21.5	6.5	2.1	7.1	0.0	0.5	19.2	12.1
December	144	80	34.0	35.0	1.4	0.0	0.0	1.3	36.2	8.4
1987										
February	221	99	57.9	61.6	0.0	0.0	0.0	1.6	60.6	11.6
March	251	149	49.4	61.7	0.0	0.0	0.0	4.5	58.5	14.0
April	52	201	21.2	36.8	0.0	0.5	0.0	0.0	34.0	7.1
May	348	130	14.9	24.6	0.0	0.8	0.3	3.8	19.1	34.1
June	46	106	37.0	41.5	2.2	10.4	0.0	12.3	50.1	9.8
July	163	100	62.0	51.0	0.6	1.0	0.0	30.0	30.8	11.4
August	61	10	1.9	0.0	0.0	0.0	0.0	0.0	1.4	9.9
September	96	75	28.1	29.3	0.0	5.3	0.0	2.7	32.2	14.0
October	224	41	4.9	26.8	0.0	0.0	0.0	0.0	8.3	23.4

a. As determined by emergence of adults from field-collected larvae and pupae.

b. The incidence of mortality due to miscellaneous, disease and adult emergence is the difference between 100 and the incidence of parasitism/hyper-parasitism.

Table 2. Incidence of parasitism, hyper-parasitism and disease in the larvae and pupae of Plutella xylostella (L) collected from fields at Sandy River, Jamaica

Year & month	Number collected	Percentage parasitism by ^a						Total (%) incidence of ^b	
		Diadegma		Tetrastichus		Spilochalcids		parasitism/	Disease
		Larvae	Pupae	Larvae	Pupae	Larvae	Pupae	hyper-parasitism	
<u>1986</u>									
February	342	-	-	0.0	-	0.3	-	15.8	14.0
March	154	-	-	3.2	-	0.0	-	15.5	14.3
April	194	-	-	0.5	-	4.6	-	38.0	19.1
May	12	-	-	0.0	-	0.0	-	8.3	25.0
July	107	-	-	21.5	-	5.6	-	51.4	24.3
September	43	-	-	32.6	-	4.7	-	55.9	34.8
October	128	-	-	7.8	-	7.8	-	39.0	13.3
November	28	48	8.3	0.0	0.0	0.0	8.3	18.4	17.1
December	156	165	17.1	3.8	4.2	0.0	0.6	25.2	7.8
<u>1987</u>									
February	51	156	44.2	2.0	1.3	0.1	1.9	46.3	17.9
March	391	166	33.1	0.8	6.6	0.3	3.6	39.8	5.6
May	22	10	27.3	4.5	0.0	9.1	10.0	46.9	3.1
June	31	53	0.1	0.0	1.9	0.0	18.9	45.3	19.0
July	90	17	20.0	2.2	0.0	0.0	17.6	22.9	9.5

a, b legends as in Table 1.

Table 3. Incidence of parasitism, hyper-parasitism and disease in the larvae and pupae of Plutella xylostella (L), collected from fields at Guys Hill, Jamaica.

Year & Month	Number collected		Percentage parasitism by ^a						Total () incidence of b	
			Ooidegma		Tetrastichus		Spilochalcis			
			Larvae	Pupae	Larvae	Pupae	Larvae	Pupae		
<u>1987</u>										
August	488	123	0.4	5.6	0.0	0.0	0.0	0.0	1.5	25.7
September	289	160	0.3	1.9	0.3	4.4	0.0	0.0	2.7	8.7
October	127	53	10.2	9.4	8.7	30.2	0.0	7.5	27.2	9.4
November	361	84	10.0	59.5	2.5	1.2	0.0	0.0	21.6	0.0
<u>1988</u>										
May	109	79	14.8	39.2	0.0	1.3	1.8	5.1	28.7	3.7
June	128	7	31.3	0.0	4.7	14.3	1.6	0.0	36.3	0.0
July	87	23	8.0	0.0	0.0	0.0	0.0	0.0	6.4	16.4
August	352	-	0.9	-	0.0	-	0.0	-	0.9	3.9

a, b legends as in Table 1.

was found on pupae too in 1977. The incidence of hyper-parasitism was quite uniform throughout the study period, the highest being during May, to July 1987. The total parasitism of the pest population in Sandy River was very high, ranging from 8.3 percent in May, 1986 to 55.9 percent in September 1986, with a monthly mean of 33.5 ± 8 percent. The incidence of disease averaged 16.1 ± 4 percent per month.

At Guys Hill too, Diadegma was the major parasite of Plutella, while incidence of parasitism by Tetrastichus was relatively low. The presence of the hyper-parasite, Spilochalcis was very irregular. The overall incidence of parasitism was not uniform, being very low in August and September of 1987 and July to August of 1988 and fairly high in October and November of 1987 and May and June of 1988. The incidence of disease continued to be fairly high throughout, with a monthly mean of 8.5 ± 6 percent.

The present results demonstrate the presence of Diadegma and Tetrastichus in the cabbage growing areas of Jamaica in significant numbers throughout the year. The most interesting and encouraging aspect is the fact that these parasites thrive in fields where a range of organochlorine, organophosphorus and synthetic pyrethroid insecticides have been used once or twice (in summer) a week for the past 30 years or more. Obviously the parasites have developed resistance to these chemicals and thus offer great promise for being a significant agent in the integrated management of the pest in Jamaica.

Biological control of this cabbage moth has been reasonably successful in the Eastern Caribbean. Since its introduction into the islands in the 1970s Cotesia has maintained high level of parasitism, ranging from 17.9 percent in 1973 to 52.5 percent in 1979, despite heavy usage of insecticides (Alam, 1982). Similar high level (33.3 to 41.2 percent) of parasitism has been reported in Barbados by Cadogan (1979). Tetrastichus has also been very active in Barbados, parasitizing 67 to 100 percent of Plutella larvae and pupae (Alam, 1982).

The Diadegma and the Spilochalcis sp. found in Jamaica are regarded by the British Museum as new species, awaiting further identification (A. Walker, per comm., Nov. 1988). An allied species, X. hirtifemora (Ashmead) is present in the EC and was found to hyper-parasitize up to 50 percent of the larvae of Diadegma insularis (Cress) in Cuba (Castineireis et al, 1980). It is pertinent to note that in all cases of hyper-parasitism, the pest larvae or pupae had also died.

Diadegma is known to parasitize last instar larvae of Plutella and the adults of the parasite may emerge before the host larva pupates or after the cocoon has been formed and larval-pupal moult completed. However, the emergence of the hyper-parasite during the pharate-adult development of the host suggest that the parasite may be attacking the host pupae as well. The observations merit further investigation.

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REFERENCES

- ALAM, M.M. 1974. Biological control of insect pest of horticultural crops in Barbados. Crop Prot. in the Caribbean. Edit. by C.W.D. Brathwaite, R.H. Phelps and F.D. Bennett, pp. 253-261.
- ALAM M.M. 1982. Cabbage pest, and their natural enemies in Barbados, W.I. 18th C.F.C.S. Annual meet. in Barbados, 22-28 August, 1982, pp. 307-320.
- BENNETT, F.D. and M. Yaseen. 1972. Parasite introductions for the biological control of three insect pests in the lesser antilles and British Honduras. PANS 18: 468-474.
- CASTINEIRAS, A. and L.R. Hernandez. 1980. New hosts of Spilochalcis hirtifemora (Ashmead) (Hymenoptera:Chalcididae) from Cuba. Poeyana. No. 209, 9 pp.
- CODOGAN, B.L. 1979. Cabbage - Tomato intercropping in Barbados. The incidence of Plutella xylostella and Apanteles plutellae. Proc 15th C.F.C.S., Santo Domingo, Dominican Republic, 5-11 August, 1979.
- TALEKAR N.S., H.C. Yang, S.T. Lee, B.S. Chen, and L.Y Sun. 1985. Annotated Bibliography of Diamondback moth Trop. Veg. Inf. Ser. Asian Veg. Res. and Develop. Cent., Taiwan.