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VEGETABLE PESTS AND THEIR NATURAL ENEMIES IN BARBADOS

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ABSTRACT

Vegetable crops in Barbados are attacked by a complex of insect pests, which in turn, are attacked by a number of natural enemies. The more important pests recorded are diamond-back moth on cabbage, melon-worm and leaf-miner on cucurbits, cotton semilooper, flea beetle and pinworm on tomato, cotton semilooper, armyworms and a leaf stitcher on beans, a leaf defoliator and a red spider mite on okra, and a leaf webber and armyworms on beetroot.

A complex of both indigenous and introduced parasites help to contain these pests within reasonable economic control, although at certain times outbreak conditions occur and insecticides have to be used to reduce the pest population.

Parasites such as *Cotesia plutellae* (Kurdj.), *Copidosoma* sp. nr. *truncatellum* (Dalman), *Telenomus remus* Nixon and *Trichogramma* spp. have contributed most of the biological control of these pests and continue to play a major role in the field.

INTRODUCTION

Since 1968, the Government of Barbados (through the Ministry of Agriculture, Food and Consumer Affairs), has, in a continuous drive to reduce food import bills, successfully diversified the agricultural sector. At present, besides sugarcane (which is the major crop in the island and still occupies the largest acreage) a number of vegetables, especially cabbage, cucumber, beans, beets, okras, and tomato, are being successfully grown. All these crops are affected, to some degree, by various insect pests. The most important of these, and their biological control, are herein discussed.

MATERIALS AND METHODS

For the assessment of the pest and parasite populations, random samples of five whole plants of crucifers and beans, and 50 leaves from cucurbits, beets, okras and tomato were taken from the field at one week intervals, and were examined leaf by leaf in the laboratory. All the insect pests on those leaves and plants were collected and recorded in data sheets. The data were analyzed for the levels of pest populations and their relative abundance.

The immature stages (viz. eggs, larvae and pupae) were isolated in glass tubes, provided with small bits of plant material for food or moisture for humidity. These were observed every day for the emergence of natural enemies, if any, or raised to adult stage for identification. After the completion of these observations, the data were used to determine levels of parasitism.

CABBAGE AND CAULIFLOWER (*Brassica oleracea* var. *capitata* and *B. oleracea* var. *botritis*)

Amongst the many insect pests attacking these crops, the diamond-back moth (*Plutella xylostella* (L.)) stands first, (Alam, 1982). This pest is widely distributed throughout the world. In the Caribbean, and particularly in Barbados, where cabbage and cauliflower are grown throughout the year, conditions are ideal for continuous breeding of the pest. Alam (1982) and Yaseen (1974) studied the biology of the pest and its natural enemies in Barbados and Trinidad, respectively. Insecticides at short intervals have been used freely and as a result the pest has developed considerable resistance to some chemicals. In a number of cases it has been found that, despite regular spray programmes, the crop suffers extensive damage and is sometimes a complete failure. Data on the populations of this pest in Barbados, for the period 1982-1985 are given in Table 1.

Table 1. Number of *Plutella xylostella* larvae per cabbage plant in Barbados, 1982-1985

Item	1982	1983	1984	1985
Range/plant	0 - 107	0 - 270	0 - 100	0 - 190
Avg./plant	17	26	36	27

It is encouraging to note that in spite of heavy use of pesticides, *Cotesia* (= *Apanteles*) *plutellae* (Kurdj.) survived and maintained a high level of parasitism throughout the island. Where the use of chemicals was moderate, natural enemies provided good control.

Alam (1974) reported the introduction of five parasite species into Barbados for the control of diamond-back moth. Of these, *C. plutellae* from India, and *Tetrastichus sokolowski* Kurdj. from India, Montserrat and St. Vincent became established (Alam, 1982). Data on observed parasitism by *C. plutellae* for the years 1982-85 are given in Table 2.

Table 2. Percentage parasitism of *Plutella xylostella* by *Cotesia plutellae* in Barbados, 1982-1985

Item	1982	1983	1984	1985
Range	0 - 74	11.5 - 84.5	1.4 - 87.6	11.9 - 92.2
Average	39	51	49	38

The parasite was also introduced into the Leeward and Windward Islands, where it is now well established and maintains high levels of parasitism.

Tetrastichus sokolowski Kurdj., a gregarious larval-pupal parasite, is indigenous to the Leeward and Windward Islands. Following releases, it was recovered from many cabbage fields. The average annual parasitism ranged from 19-86 per cent, but possibly because of the persistent use of

pesticides against various cabbage pests, the parasite failed to maintain its population in the field.

CUCUMBER, PUMPKINS AND SQUASHES (*Cucumis sativus* and *Cucurbita* spp.)

Although these crops are attacked by a large number of pests, the most important is the melon-worm (*Diaphania* (= *Margaronia*) *hyalinata* (L.)). In Barbados, the population of this pest on cucumbers remains relatively small, averaging 0.4 larvae per leaf between 1982 and 1985, whereas on squashes the larval population is usually very high, causing serious leaf defoliation. Fifteen to 25 larvae per leaf were recorded.

The larvae feed under sparsely woven silken webs on the underside of the leaves. During heavy infestations a number of adjoining leaves are pulled together and tangled 'n webs, on which the larvae feed. Heavy infestations can cause the death of the plant.

In Barbados, melon-worm eggs are parasitized by *Trichogramma pretiosum* Riley. The larvae are attacked by *Eiphosoma dentator* (F.) (= *Eiphosoma annulatum* Cresson) and by *Cotesia* (= *Apanteles*) sp. (*glomeratus* group), and the pupae by *Brachymeria* sp. Parasitism levels recorded between 1982 and 1985 are given in Table 3.

Table 3. Percentage parasitism of *Diaphania hyalinata* by *Eiphosoma dentator*, *Cotesia* sp. (*glomeratus* group) and *Trichogramma pretiosum*, in Barbados, 1982-1985

Year	<i>E. dentator</i>	<i>Cotesia</i> sp. (<i>glomeratus</i> group)	<i>T. pretiosum</i>
1982	0-6.5 (avg. 1.6)	0-41.6 (avg. 4.8)	0-100 (avg. 24)
1983	0-17.6 (avg. 1.6)	0-41.4 (avg. 6.0)	0-66.6 (avg. 48.3)
1984	0-16.6 (avg. 5.6)	0-39.4 (avg. 12.7)	Data not available
1985	0-7.4 (avg. 7.1)	0-40.0 (avg. 7.6)	0-80 (avg. 44.4)

A pupal parasite, *Trichospilus diatraeae* Cherian and Margabandhu is also now established in Barbados.

In St. Vincent, a larval parasite, *Hypomicrogaster diaphaniae* (Mues.) attacks up to 75% of melon-worm larvae in the field. A small number of adults raised in the laboratory were liberated in the field in Barbados, but no recoveries were made. Because of its abundance in St. Vincent, it should be worthwhile to carry out a comprehensive breeding and release programme in Barbados and in other Eastern Caribbean islands where *Diaphania* is a serious pest.

The other important pest of cucurbita is a dipterous leaf miner, *Liriomyza sativae* Blanchard (= *Liriomyza munda* (Frick)). Usually a large percentage of leaves is attacked by the pest. The number of mines per leaf varies with the time of the year and the age of the plants. During heavy attacks, the entire leaf surface is covered by mines, resulting in the death of the leaf. Data on the percentage of leaves of cucumbers infested and on the average number of mines per leaf are given in Table 4.

Table 4. *Liriomyza sativae* population data on cucumber in Barbados, 1982-1985

Year	1982	1983	1984	1985
Percent of leaves infested	20 - 100 (avg. 80)	0 - 100 (avg. 73)	42 - 100 (avg. 78)	0 - 96 (avg. 46)
Average number of mines per leaf	14	17	18	6

The leaf miner is usually attacked by *Chrysocharis* spp., *Diglyphus* sp. and *Opius* sp., and the levels of parasitism by these parasites recorded between 1982 and 1985 are summarized in Table 5.

Table 5. Percentage parasitism of *Liriomyza sativae* by *Chrysocharis* spp., *Diglyphus* sp. and *Opius* sp. in Barbados, 1982-85

Year	Range	Average
1982	0-33	2
1983	0-68	9
1984	0-52	18
1985	0-67	30

These parasite species were also introduced from Pakistan against leaf-miners, but because of non-specific determinations, it is difficult to say if these parasites became established in the island.

TOMATO (*Lycopersicon esculentum*)

The pests of economic importance recorded on this crop are the cotton semi-looper (*Pseudoplusia includens* (Walk.), flea beetle *Epitrix fasciata* Blat.), pinworm (*Keiferia lycopersicella* (Wals.)), and the red spider mite (*Tetranychus gloveri* Banks).

In Barbados, the cotton semi-looper is an important pest of the tomato crop. The yellowish-white eggs are laid singly on the underside of the leaves. The larvae are usually green although black forms occur during outbreaks, and have prominent longitudinal white stripes. These caterpillars feed on the underside of the leaves. The full-grown larva spins a thin silken cocoon in a fold on the underside of the leaf and pupates under it.

The eggs are parasitized by a *Trichogramma* sp. A polyembryonic egg-larval parasite, *Copidosoma* (= *Litomastix*) sp. nr *truncatellum* (Dalman), introduced from India, along with an indigenous species of *Copidosoma* sp. (prob. *truncatellum*), parasitises 8-100% of the pest population in the field, averaging about 80%.

The other parasites recorded were *Enicospilus* sp., attacking 17%, *Nemorilla pyste* (Walker) attacking 50% of the larvae at any one time, and *Brachymeria* sp. attacking 1% of the pupae. *T. diatraese*, a pupal parasite introduced from India, was also recorded in the field.

The flea beetle (*Epitrix fasciata* Blatchley (= *Epitrix parvula* (F.)) is generally a minor pest, but occasionally outbreaks occur in Barbados. The adults eat numerous small holes in the leaves, producing a "shothole" appearance. The eggs are laid in the soil near the roots of the host. The grubs feed on the root tissues but on account of their extremely small size probably do not seriously interfere with nutrient uptake by the plant. The larval stage lasts about a month, after which they pupate in the soil and emerge as adults in about six days.

Recent outbreaks of the pest were recorded in the parishes of St. Lucy, St. George, St. John and St. James, where tomato plants were heavily attacked. Because of extensive feeding by enormous numbers of beetles on both surfaces of the leaves, the chlorophyll was almost completely destroyed, giving the plants a scorched appearance and they eventually died. Older plants are usually more heavily attacked and after destroying one field the pest moves to another.

The pest also attacks eggplant (*Solanum melongena*), okra (*Abelmoschus* (= *Hibiscus*) *esculentus*), and sweet potato (*Ipomoea batatas*). Several weeds, such as cow pops (*Physalis angulata*), black nightshade (*Solanum nigrum*), white and prickly caterpillars (*Amaranthus viridis* and *Amaranthus spinosus*) and vervin (*Stachytarpheta jamaicensis*), which grow in and around vegetable fields, serve as major sources of infestation. During outbreaks, the crops may be sprayed with Malthion^(R) 57% E.C. at 1 to 2 pt/100 gal. water, or with Rogor^(R) 40% E.C. at 1 pt/100 gal. water. Also keep the weeds under control.

Pinworm (*Keiferia lycopersicella* (Wals.)), although not widespread in Barbados, have been recorded in the St. Philip area causing substantial damage to the tomatoes, and more recently in St. George, where the population was low. Eggs are laid on the leaves and the newly hatched larvae feed on the leaf epidermis for some time before mining into the leaf. During heavy attacks the leaves are deformed and fall prematurely.

In Barbados, two parasite species, *Chelonus* (= *Microchelonus*) sp. and *Pseudapanteles* (= *Apanteles*) *dignus* (Muesebeck) attack over 55% larvae in the field.

BEANS (*Phaseolus vulgaris*, *Phaseolus lunatus*, *Lablab niger* and *Vigna unguiculata*)

The major insect pests recorded on these crops are the cotton semi-looper (*P. includens*), armyworm (*Spodoptera eridania* (Cramer) and *S. frugiperda* (J. E. Smith) and the bean leaf-webber (*Omiodea* (= *Hedylepta* = *Lamprosema*) *indicata* (Fab.)).

Cotton semi-looper populations vary considerably at different times of the year. During the rainy season the pest appears in greater numbers, causing serious defoliation. Average numbers of larvae per plant ranged from 0.6 to 1 between 1982-85.

The most important natural enemy recorded was *Trichogramma* sp., which attacks an average of 33% eggs in the field. Other parasites recorded were *Copidosoma* sp. nr. *truncatellum*, *Cotesia* sp. and *Brachymeria ovata* (Say). Parasitism levels between 1982 and 1985 are given in Table 6.

Table 6. Percentage parasitism of *Pseudoplusia includens* by *Copidosoma* sp. nr. *truncatellum*, *Cotesia* sp. and *Brachymeria ovata* in Barbados, 1982-85

Year	<i>Copidosoma</i> sp. nr. <i>truncatellum</i>	<i>Cotesia</i> sp.	<i>Brachymeria ovata</i>
1982	0 - 17 (avg. 5)	0 - 50 (avg. 2)	0 - 6 (avg. 1)
1983	0 - 33 (avg. 8)	0 - 50 (avg. 1)	0 - 33 (avg. 22)
1984	0 - 100 (avg. 36)	67 (Aug. only)	35 (Dec. only)
1985	0 - 33 (avg. 8)	0 - 14 (avg. 4)	7 (May only)

Populations of armyworm (*S. eridania* and *S. frugiperda*) usually remain low, mainly due to heavy parasitism by an egg-parasite, *Telenomus remus* Nixon. Average levels of parasitism recorded between 1982 and 1985 were 44% in June 1982, 38% during 1983, 73% in 1984, and 50% in 1985. Two other parasites, *Apanteles* sp. and *Chelonus antillarum* Marshall, kill about 7% and 33% larvae, respectively.

The bean leaf-webber (*Oniodes* (=Hedylepta=Lamprosema) *indicata* (Fab.) is one of the important pests of beans in the Caribbean. The larvae feed on the leaves, which they web into a rough shelter. When the population is high, they drag the pods into the webs and feed on them.

On average some 21% larvae are attacked by a *Cotesia* sp. and up to 50% by a tachinid - *Nemorilla pyste* (Walker).

OKRA (*Abelmoschus* (=Hibiscus *esculentus*)

The main pests recorded on okra are the leaf defoliator (*Anomis illita* (Guenée) and the red spider mite (*Tetranychus gloveri* Banks).

The leaf defoliator is the most important pest of okra in Barbados. Frequently the pest appears in outbreak proportions causing serious defoliation. The eggs are laid singly on the underside of the leaves. The green coloured larvae, which move with a looping action, remain on the lower side of the leaves, chewing big holes in these. When disturbed, they react violently and drop to the ground. Pupation occurs in the soil.

The eggs are parasitized by an indigenous *Trichogramma* sp. and also by an introduced species, *Trichogramma chilonis* (Ishii) (=Trichogramma *australicum*). The levels of parasitism range from 6 to 96%. Some 25% larvae are parasitized by two tachinids, *Phorocera* sp. and *Winthemia singularis* Reinhard.

The red spider mite often appears in large numbers infesting the entire crop. Undersides of leaves are usually covered with the pest. Adults and nymphs puncture the leaf cells and imbibe the sap. Their feeding causes a pale speckling, which extends to an area that later turns brown and falls out, giving a characteristically perforated appearance near the base of the leaf-veins. The eggs are laid on the underside of the leaves, usually alongside the leaf veins. Pale coloured nymphs and reddish adults feed in colonies.

A staphylinid, *Oligota barbadorum* Frank and coccinellid beetles, *Diomus* spp. and *Pullus* sp., feed on the pest.

BEETROOT (*Beta vulgaris*)

This crop is usually attacked by two insect pests, a leaf webber (*Spoladea recurvalis* Fab. (= *Zinckenia fascialis* (Stall)) and an armyworm (*Spodoptera eridania* (Cramer)).

The leaf webber is a serious pest of beets. Adults are dark brown with two incomplete white bands, the inner of which adjoins a single broad diagonal white band that traverses the hind wing.

The eggs are laid singly, in pair or in short rows on the underside of the leaves. Newly hatched feed on leaf surface, leaving the epidermis of the other side intact. Later they spin a silken web around the leaves, forming a shelter, under which they feed. Pupation occurs in the soil, in an oval silken cocoon.

Over 78% of eggs are parasitized by a *Trichogramma* sp. The larvae are parasitized by *Cotesia* (= *Apanteles*) *glomeratus* (L.). The range of parasitism was from nil to 33%, with an average of about 4%. A tachinid, *Winthemia* sp. attacked about 4% of larvae.

An armyworm (*Spodoptera eridania* (Cramer)) eggs are laid on the undersides of the leaves. Newly hatched larvae feed gregariously on the leaf epidermis and disperse as they grow in size, consuming the whole tissue. Pupation occurs in the soil.

Annually an average of 24% of the eggs are parasitized by *Trichogramma exiguum* Pinto and Platner (= *T. fasciatum* auct. = *minutum* auct.) and an average of 62% by *Telenomus remus* Nixon. Some 2% larvae are parasitized by *Cotesia* sp. (*glomeratus* group), 8% by *Euplectrus platyhyphenae* Howard and another 8% by *Chelonus antillarum* Marshall.

From the data discussed under various crops, it is evident that in Barbados, a number of exotic natural enemies were successfully established against various pests, some of which provide excellent control, while the others, along with the indigenous natural enemies caused further mortality of the pests, and lessened the overall crop damage. Under such conditions, efforts for the introduction of additional parasites are being made, so as to achieve satisfactory control.

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