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CABBAGE PESTS AND THEIR NATURAL ENEMIES IN BARBADOS, W.I.

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SUMMARY

In Barbados, some 20 insects attack cabbage. Of these, only 5, i.e. diamond-back moth, Plutella xylostella, cabbage semi-looper, Trichoplusia ni and Pseudoplusia includens, cabbage bud-worm, Hellula phidilealis and cabbage white-butterfly, Ascia monuste monuste, were of economic importance.

A large complex of indigenous natural enemies present in Barbados does not keep the pests below economic levels. As a result exotic natural enemies were introduced from India, Pakistan and the Caribbean Islands.

Amongst the parasites introduced against P. xylostella, Cotesia (=Apanteles) plutellae and Tetrastichus sokolowskii became established. The former parasite is widespread. The annual range of parasitism, from 1971-80 was 17.9 to 52.2%. This parasite introduced into the Leeward and Windward Islands by the Commonwealth Institute of Biological Control (CIBC), Trinidad, and later by the Caribbean Agricultural Research and Development Institute (CARDI) is well established.

T. sokolowskii, an indigenous parasite in the East Caribbean Islands, was introduced into Barbados from India, Montserrat and St. Vincent. It is established in the island, but possibly because of the heavy applications of pesticides, has failed to achieve high populations. It has also been recorded as an incidental secondary parasite of C. plutellae.

An egg-larval parasite, Litomastix sp. (truncatellum group), introduced against Trichoplusia/Pseudoplusia, from India, is very well established, attacking an average of 25.8% larvae on cabbage, 79.4% on tomato, 78.8% on sweet potato, 33.3% on okra, 58% on beans and 25% on cucumbers.

Hellula phidilealis, also attacks the buds and pods of Cleome spp. and Gynandropsis gynandra in Barbados, the East Caribbean Islands and Guyana (South America). The pest population and the parasite complex on these plants was greater and more consistent than that on crucifers, suggesting that Cleome and Gynandropsis are the primary host plants. The natural enemies recorded were: Apanteles spp., Chelonus sp. nr. mexicanus, Eiphosoma annulatum, Bracon sp., hebetor and an unidentified Tachinid, which are all first records from this host.

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Cabbage white-butterfly, Ascia monuste monuste, a migratory pest, breeds freely on Cleome spp. and G. gynandra in Barbados and the East Caribbean Islands, and also feeds on Lepidium virginicum in Barbados.

A Tachinid, Phorocera sp. ?parviteres attacked 8% and 14% larvae during May and November 1973 respectively, whereas a pupal parasite, Brachymeria ovata, attacked an average of 36.4% pupae on B. oleracea in 1979, 50.3% on C. spinosa and 35.2% on C. viscosa in 1980. During outbreaks, some 93.7% larvae on B. oleracea and 94% on C. viscosa were destroyed by various predators. In the wet season, about 20% larvae and 95% pupae were killed by a polyhedrosis virus.

The egg-masses of Spodoptera spp. were parasitised by Telenomus remus. The average parasitism recorded was 58.3% during 1978, 52.2% in 1979 and 41.1% in 1980.

INTRODUCTION

Amongst vegetables, cabbage, cauliflower and other crucifers have an important place in the daily diet of the public. In the Tropics, where the climate favours the growth of these and other vegetables throughout the year, cabbage occupies a considerable acreage.

In Barbados, with the ever expanding tourist industry, demand has increased. The acreage under this crop in 1968-69 was only 24.3ha, whereas during 1979-80 it expanded to 144 ha.

In Barbados, cabbage and cauliflower suffer from four main groups of pests, i.e. diamond-back moth (Plutella xylostella (L.), the cabbage white-butterfly (Ascia monuste monuste (L.)), cabbage bud-moth (Hellula phidilealis Wlk.) and cabbage semi-loopers (Trichoplusia ni Hubner and Pseudoplusia includens (Wlk.)). There are also several other insects pests which appear sporadically, and need control measures when these attain high populations.

The insect pests and their natural enemies recorded in Barbados and in certain other East Caribbean Islands, and the natural enemies introduced from other parts of the World are discussed herein.

THE MAIN INSECT PESTS AND THEIR NATURAL ENEMIES

(1) The Diamond-back moth - Plutella xylostella (L.) (Lepidoptera: Plutellidae).

In the Caribbean, where cabbage, cauliflower and other crucifers are grown throughout the year, and conditions exist for the continuous breeding of the pest. Prior to 1970, Plutella reached serious pest status, causing

heavy losses to the growers each year. The application of insecticides at short intervals, has resulted in the development of resistance to some chemicals (Alam, 1974).

Plutella larval feeding creates numerous small holes in the leaves, retarding plant growth and often rendering the plants unfit for marketing.

The eggs usually laid singly or in small batches on the underside of the leaves, but occasionally also on the upper surface, hatching in 3 days. During the early instars, the larvae are pale yellow, becoming dull-green when full-grown. Pupation occurs on the underside of the leaves, in thin silken cocoons. The pupa is light yellowish-brown in colour. The young larvae feeding leave small transparent windows in the upper leaf-surface, whereas the mature larvae perforate the leaves completely. Generally the larvae pass through four, but in some cases five instars. The larval period occupies 7-16, average 9.2 days, and the pupal period 4-5, average 4.2 days. The complete life cycle takes 14-24, average 16.4 days. Yaseen (1974) studied the biology of the pest in Trinidad. From these studies it is evident that the pest could complete over 20 generations a year.

The adults when fed on honey solution lived for 8-22, average 17.4 days.

Distribution and Host Plants

The pest is of world-wide distribution (CIE distribution map). In the Caribbean, it has been reported from the Greater and Lesser Antilles, Jamaica, Cuba, Puerto Rico, Guyana (South America) and in the U.S.A.

The pest has been recorded on cabbage (Brassica oleracea var. capitata), cauliflower (Brassica oleracea var. botritis), chinese cabbage (Brassica chinensis), mustard (Brassica juncea), turnip (Brassica rapa), radish (Raphanus sativus) and other Brassica spp., and Swiss Chard (Beta vulgaris var. cicla).

Indigenous natural enemies

Parasites: Alam (1974) reported Trichogramma sp. attacking the eggs, and Apanteles sp. (ater group) parasitising the larvae of Plutella in Barbados. Since then an additional pupal parasite, Spilochalcis hirtifemora (Ashmead (Chalcididae) has been added to the list. The parasite attacks a small population of the pest, particularly during the wet season. Spilochalcis was also recorded as a secondary parasite of Cotesia (=Apanteles) plutellae (Kurdj.). Bennett and Yaseen (1972) reported similar observations in Trinidad.

Predators: In Barbados, several predatory insects attack the eggs, larvae and pupae. They include: Cycloneda sanguinea (L.), Nephus sp.

and Pullus sp. (Coccinellidae); Apenes marginalis (Dejean), Athrostictus sp., Calosoma alternans (F.), Selenophorus affinis Dejean, Selenophorus macleayi (Kirby), Selenophorus parvus Darl., Selenophorus straitopunctatus Putz. (Carabidae); Polistes bellicous Cresson, Polistes (=Aphanilopetrus) cinctus barbadensis Richards, Polistes (=Fuscopolistes) fuscatus fuscatus (Vespidae) (Fabricius); Brachymyrmex heeri var. obscurior Forel, Monomorium destructor Jerson and Pheidole fallax Mayr. (Formicidae); Chrysopa lanata Bks. and Chrysopa limitata Nav. (Chrysopidae); Euborellia sp. (Carcinophoridae) and Scolopendra sp. (Scolopendridae).

Most of these were observed feeding on Plutella eggs, larvae and pupae, whereas a few particularly Carabids (except C. alternans) were found under cabbage/cauliflower leaves, suggesting that these might also be predatory on the pest(s).

Although the exact contribution of these predators has not been evaluated, it is likely in the absence of pesticides that these have a substantial effect in regulating the populations of Plutella and other cabbage pests.

Parasite Introductions

Alam (1974) reported the introduction of five parasites into Barbados for the control of P. xylostella. Of these, C. plutellae from India and Tetrastichus sokolowskii Kurdj. (Eulophidae) from India, Montserrat and St. Vincent, became established.

Since its establishment, the data for the past ten years have shown that in spite of heavy applications or pesticides, C. plutellae has not only survived but also maintained a high level of parasitism throughout the island (Table 1).

Table 1.--Parasitism levels of C. plutellae from 1971-1980, in Barbados, W.I.

Year	Range/Percent Parasitism	Average/ Percent Parasitism
1971	12.0 - 61.6	32.0
1972	13.7 - 50.0	27.3
1973	22.0 - 75.0	17.9
1974	18.2 - 52.3	37.6
1975	30.7 - 57.9	45.3
1976	3.1 - 52.7	32.3
1977	17.4 - 53.8	51.1
1978	32.1 - 79.3	50.3
1979	33.3 - 77.8	52.5
1980	13.6 - 81.4	49.6

In an independent evaluation, Cadogan (1979) reported 33.3 - 41.2% parasitism by C. plutellae, in experimental plots in Barbados.

This parasite was also introduced into the Windward and Leeward Islands, by the Commonwealth Institute of Biological Control, West Indian Station, Trinidad, and later by the Caribbean Agricultural Research and Development Institute, Barbados. Surveys by the latter Institute have shown that the parasite is well established.

In Barbados, the cocoons of C. plutellae were attacked by a secondary parasite, Aphanogmus (=Ceraphron) fijiensis (Ferriere) (Ceraphronidae). It was more abundant during the wet season, when up to 13% cocoons were attacked. It was also recorded in St. Vincent attacking the cocoons of C. plutellae and other Microgastrinae (Apanteles spp.).

T. sokolowskii: This gregarious larval-pupal parasite is indigenous to the Leeward and Windward Islands, in the Caribbean. It was introduced into Barbados from India and Montserrat during 1970-71, and from St. Vincent and Montserrat during 1977-1980.

Following releases, it was recovered from many cabbage fields. The levels of parasitism recorded were: 67.7-100%, average 86% in 1976, and 26.1% in March and 12.5% in April 1980. Possibly because of the persistent use of pesticides against various cabbage pests, the parasite failed to maintain its population in the fields.

It attacks the last instar larvae of P. xylostella and completes its development in the pupae. The total development period, i.e. from egg to adult emergence, occupies 12-13 days.

As recorded earlier from India and Trinidad (F.D. Bennett, pers. comm. 1982), it is also an incidental secondary parasite of C. plutellae. T. sokolowskii apparently does not discriminate between parasitized and unparasitized larvae; when the body cavity of the parasitized caterpillar is filled by the full-grown Cotesia larva, Tetrastichus oviposits into the Cotesia larva (through the integument of the Plutella larva), development is completed after Cotesia spins its cocoon. Some 7.3% of C. plutellae cocoons collected in April and 6.6% in June, produced Tetrastichus.

The cocoons of C. plutellae, exposed to the parasite in the laboratory were not attacked.

(2) The cabbage semi-loopers - Trichoplusia ni (Hubner) and Pseudoplusia includens (Walker) (Lepidoptera;Noctuidae).

Normally cabbage semi-loopers are minor pests, but these often attain large populations during March, November and December, and chemical control becomes necessary.

The eggs are laid singly on the underside of the leaves, on which the hatching larvae feed. Pupation occurs in sparsely woven cocoons on the

underside of the leaves. The egg, larval and pupal periods occupy 5-6 days, 18-21 days and 7-10 days, respectively.

Distribution and Host Plants

The pests have been reported from Greater and Lesser Antilles, South America and U.S.A. These attack, cotton (Gossypium barbadense), sweet potato (Ipomoea batatas), tomato (Lycopersicon esculentum), woolly pyrol (Vigna radiata (=V. mungo), beans (Phaseolus spp.), cucurbits (Cucumis sativus and Cucurbita spp.), okra (Hibiscus esculentus) and a number of other cultivated and wild host plants.

Indigenous natural enemies

Parasites

Trichogramma sp. (Trichogrammatidae) - and egg parasite.

Cotesia (=Apanteles) sp. prob. plutellae (Kurdj.), attacks 1st. to 3rd. instar larvae. The levels of parasitism recorded were 3-50%, average 17%.

Glyptapanteles (=Apanteles) sp. (vitripennis group) (gregarious) - Attacks half to full-grown larvae. Parasitism on cabbage was low; during December 1979, 0.5-2% larvae were parasitized.

Euplectrus platyhypenae How. (Eulophidae), a gregarious ecto-larval parasite of various Noctuids, attacks very young to full-grown larvae (Alam, 1974). Parasitism ranged from 4.3 to 50%, average 18.5%.

Litomastix (=Copidosoma) sp. nr. truncatellum (Dalman) (Encyrtidae) - A polyembryonic egg-larval parasite which deposits its eggs in that of cabbage semi-loopers, and the embryonic development is synchronized with that of its host. The number of adults reared from a single larva ranged from 224 to 1,055, average 522.7. This indigenous parasite species was very rare in the field, attacking 0.5 to 5% larvae on various host plants.

Brachymeria sp. (Chalcididae) - This pupal parasite was reared from only 0.5% field collected pupae.

Wintthemia sp. nr. pinguis Fab. and Winthemia sp. ?pyrrhopyga (Wiedemann) (Tachinidae) - These parasites deposit 1 to 4 eggs on the head capsule or on the thoracic segments of the caterpillar, which quickly hatch, the larvae then penetrating into the body of the host. When mature, the parasite larvae leave their host, drop to the ground and pupate in the soil. If nearly full-grown host larvae are attacked, the parasite larvae complete their development in the host pupae. The parasites are common in the field during July and August, attacking 20-35.8% larvae.

Predators: Same as under P. xylostella

Parasite Introductions

Litomastix (=Copidosoma) sp. (truncatellum group) (Encyrtidae) - As the indigenous species of Litomastix was rare in the field, the parasite was obtained from the Indian Station of the CIBC during 1975, and some 25,000 adults were released in a cotton field. Observations have shown that the parasite became established in the island and attacks a high proportion of Trichoplusia and Pseudoplusia, not only on cabbage and cauliflower, but also on tomato, sweet potato, okra, beans and a number of other host plants. The average percentage parasitism recorded on some of the host plants of Trichoplusia and Pseudoplusia, was 25.8% on cabbage, 79.4% on tomato, 78.8% on sweet potato, 33.3% on okra, 58% on beans and 25% on cucumbers. Levels of parasitism have risen from about 5% before the introduction, to a maximum of 79% on tomato and sweet potato, and is possible that a cross between the indigenous and the Indian species has produced a more efficient race, which attacks the pests on a wide range of host plants.

(3) The cabbage bud-worm - Hellula phidilealis Wlk. (Lepidoptera: Pyralidae).

The larvae bore into the growing point or into the leaf-axils. Heavy infestation leads to the death of the bud, resulting in the production of multiple heads, which are unsuitable for marketing. The infested leaves at the point of entry of the larvae are subject to secondary infestation by bacteria, which cause rotting.

It is a minor pest (except in neglected fields) in the Leeward and Windward Islands, but in Trinidad, it causes substantial damage to cabbage, cauliflower and Chinese cabbage.

The eggs are laid singly near the mid-rib and hatch in 4-6 days. Newly hatched larvae feed on the leaf surface for a short time and then burrow into the mid-rib, leaf axil or into the growing point. The last situation is particularly serious, as the destruction of the growing point by actual feeding or secondary infection results in multiple heads of reduced size that are usually unmarketable. Early in the crop, when heads have not yet formed, or are just beginning to form, is the most critical period. At this stage the growing point is exposed and very vulnerable, even low densities of the pest can cause substantial losses. After head formation has progressed for several weeks, the growing point is protected by layers of expanding leaves and the larval damage is more likely to occur on these. The larval period lasts 14-17 days. The full-grown larva spins a silken cocoon in the feeding tunnel, near the emergence hole, and pupates. Sometimes larvae may pupate in the soil. The pupal period lasts 8-9 days.

Table 3.--Parasite complex on Brassica oleracea var. capitata, Cleome spinosa, Cleome viscosa and Gynandropsis gynandra, in Barbados, W.I.

Parasite	Host plants and rate of parasitism			
	B. oleracea var. capitata	C. spinosa	C. viscosa	C. gynandra
Brassicae:				
Apanteles spp. (2)	-	0-59.6% av. 9.7%	-	-
Bracon sp. ?hebetor Say.	60.7% (May 1979)	-	55.1-89.2% av. 64.5%	-
Chelonus sp. nr. mexicanus Brether	- -	11.3-61.9% av. 33.1%	-	0-69.6% av. 34.6%
Ichneumonidae:				
Eiphosoma annulatum Cresson	-	1.6-25.3% av. 9.8%	-	0-21.8% av. 12.9%
Tachinidae:				
Unidentified species	-	2.2%	-	-
Bethylidae:				
Perisierola sp.	11.8% (April 1980)	-	-	-

Distribution and Host Plants

The pest has been reported from Barbados, Trinidad, the Greater and Lesser Antilles, Puerto Rico, U.S. Virgin Islands, Mexico, Guyana (South America) and the Continental U.S.

During present studies, H. phidilealis was reported for the first time attacking Cleome spinosa, Cleome viscosa, Cleome spp., and Gynandropsis gynandra, in Barbados and other Eastern Caribbean islands. F.D. Bennett (pers. comm.) has also recorded the species from these hosts in Trinidad and Mexico. The larvae bore in the developing seed pods and growing shoots of these hosts. The average pod infestation on C. spinosa was 67.7%, on C. viscosa 69.3% and on G. gynandra 36%. The number of larvae per pod ranged from 1 to 8.

Alam et al. (1961-62) reported Helula undalis (F.) attacking C. viscosa in Pakistan.

In Barbados, H. phidilealis has been recorded from, cabbage (B. oleracea var. capitata), cauliflower (B. oleracea var. botrytis) and cultivated mustard (B. juncea). Other Crucifers such as radish (R. sativus) and wild mustard (Brassica integrifolia) may also serve as hosts. The population of the pest on cabbage increased steadily between 1976 and 1980, possibly due to increased reliance on permethrin (Ambush) (for the control of Plutella) and other non-systemic insecticides. These chemicals do not control larvae which have already bored into the tissues, and also reduce the effectiveness of natural enemies.

The Hellula population on cabbage appears to be cyclical in nature. The pest is more prevalent between May and July, when 44 to 73% plants are attacked and the number of larvae per plant ranged from 1.3 to 13. The plant damage is minimal, i.e. zero to 10% between November to January, with zero to 1.5 larvae per plant.

Indigenous natural enemies

Parasites

The parasite complexes recorded from different host plants vary considerably (Table 3).

On C. spinosa, the complex of natural enemies was the widest and more persistent throughout the year; only one was obtained from C. viscosa and two from G. gynandra.

Bracon sp. ?hebetor was also obtained from H. phidilealis larvae on C. viscosa in St. Vincent, St. Kitts, St. Lucia and Grenada.

In Barbados and other East Caribbean Islands, the more consistent attack and higher populations of H. phidilealis, with a wider complex of

natural enemies, on Cleome spp. and G. gynandra, suggests that these are the primary hosts. The cultivated hosts, such as cabbage and cauliflower, on which the pest population is more cyclical and the natural enemies are rare, are the alternate hosts.

(4) Cabbage white-butterfly - Ascia monuste monuste (L.) (Lepidoptera: Pieridae)

In Barbados, A. monuste monuste is active throughout the year, although through the greater part of the year its populations exist only at low densities. During the rainy season, i.e. early June to late October, it may reach outbreak proportions, when the number of larvae per plant range from 20 to 100, and plants are defoliated completely.

The larvae of A. monuste monuste are greyish-green with four longitudinal stripes on the dorsal surface and speckled with small yellow spots. The body is sparsely covered with fine setae. The pupae are greyish-brown, with two angular eminences at the middle. Eggs elongate-ovate, bright yellow in colour.

The whitish males and yellowish-white females mate soon after emergence. The eggs are laid in loose clusters on the upper or outer surface of the leaves, and the number of eggs per cluster range from 4-83, average 34. The incubation periods lasts 3 to 5 days. During the early instars, the larvae feed gregariously, but as these advance in age and size, they disperse and feed singly. The larvae pass through 4 instars, and occupy 11 to 13 days, average 12 days. The pupal period ranges from 6 to 7 days, average 6.2 days.

Distribution and Host Plants:

The pest has been reported from the Greater and Lesser Antilles, South and Central America and the U.S.A. (Fennah, 1947).

During present studies, the pest was recorded from cabbage (B. oleracea var. capitata), cauliflower (B. oleracea var. botrytis), broccoli (B. oleracea var. italica), Kohlrabi (Brassica caulorapa), turnip (B. rapa), Chinese cabbage (B. chinensis), cultivated mustard (B. juncea), wild mustard (B. integrifolia), Swiss Chard (B. vulgaris var. cicla), radish (R. sativus), nasturtium (Tropaeolum majus), garden cress (Lepidium sativum), pepper grass (Lepidium virginicum, stinking miss (G. gynandra), and spider plants (C. spinosa, C. viscosa and Cleome spp.).

Indigenous Natural Enemies

Parasites

Trichogramma sp. (Trichogrammatidae), was only recorded from eggs laid on spider plant, C. viscosa. The level of parasitism was very low.

Phorocera sp. ?parviteres Aldr. (Tachinidae), is a larval-pupal parasite. Generally the level of parasistism is low; 8% of the larvae collected on C. viscosa, during May 1973 and 14% on B. oleracea var. capitata in November 1973 were parasitized. Eggs are laid on the head capsule or on pro-thorax of the host larvae. On hatching, the parasite larvae penetrate into the host body; development is completed in the host pupae.

Brachymeria ovata Say. (Chalcididae) - a pupal parasite, is the most common indigenous parasite. It attacks pupae on cabbage, Cleome and other host plants. Parasitism on B. oleracea var. capitata between April to December, 1979 ranged 24.5 to 61.3%, average 36.4%. On C. spinosa, between December 1979 and October 1980, the level of parasitism ranged from 33.3 to 83.9%, average 50.3%, and on C. viscosa, between April and October 1980, from 22.2 to 52.5%, average 35.2%.

The parasite mates soon after emergence, and the female inserts a single egg into the thoracic region of the host pupa. During their life, the female lays from 5 to 12 eggs, average 6.2. However, females when dissected, contained 6 to 27, average 12.5 eggs in their ovaries. The total development period of males was 9 to 16, average 13.7 days, and that of females 11 to 18, average 14.4 days.

The males and females when fed on diluted honey live 3 to 6, average 5 and 5 to 10, average 7.8 days, respectively.

Predators:

The most common predators recorded were: C. sanguinea; C. lanata, C. limitata, Chrysopa sp.; A. marginalis, Athrostictus sp., C. alternans, S. affinis, S. macleayi, S. parvus, S. striatopunctatus; P. bellicous, P. (=A.) cinctus barbadensis, P. (=F.) fuscatus fuscatus; B. heeri var. obscurior; and the blackbird or Carib Grackle (Quiscalus lugubris).

During the outbreaks of the pest, some 93.7% larvae on B. oleracea var. capitata, and 94% on C. viscosa, were destroyed by these predators.

In the wet season, some 20% full-grown larvae and 95% pupae, including those parasitized by B. ovata are killed by a Polyhedrosis virus.

Parasite Introductions

During 1970-72, the larval parasites, Apanteles sp.; Horogenes sp. (Ichneumonidae), and the pupal parasite, Pteromalus puparum L. (Pteromalidae), of Pieris brassicae (L.), were obtained from CIBC, Pakistan Station, Rawalpindi.

Apanteles sp. and Horogenes sp. failed to develop, although the females of both parasite species stung Ascia larvae in the laboratory and in the field.

P. puparum: Ten shipments, containing 128 parasitized pupae of P. brassicae arrived from CIBC, Pakistan Station, in good condition.

Some 13,000 adults were reared on A. monuste monuste in the laboratory. Ninety-five percent of the emergents were released on B. oleracea var. capitata and C. viscosa, attacked by the pest, and the remainder were obtained for breeding purposes.

Although the parasite bred readily in the laboratory, it was never recovered in the field.

During 1981, Mr. J. Jones, Entomologist, Ministry of Agriculture, Food and Consumer Affairs, Barbados, imported Diadegma sp. (Ichneumonidae) and P. puparum, from CIBC, Pakistan; these were released in a cabbage plot, in which the pest population was build up artificially. Later some of the pupae collected from this plot were parasitized by P. puparum (Jones, 1981, pers. comm.).

(5) Minor pests

Army-worms - Spodoptera spp. (Lepidoptera:Noctuidae) - During these studies, Spodoptera spp. recorded on cabbage and cauliflower were: Spodoptera eridania (Cramer), Spodoptera frugiperda (J.E. Smith), Spodoptera latisfacia (Walker) and Spodoptera sunia (Guenee). The population of these insects was very low. The number of egg-masses per infested plant ranged from 1-7, average 2.

Regular applications of pesticides against Plutella and Ascia, usually kill larvae of Spodoptera spp. before they damage the crop.

Telenomus remus Nixon (Scelionidae), introduced from India, is an important egg parasite. The range of parasitism recorded was, 37.5-64.3%, average 53.3% during 1978, 33.3-75%, average 52.2% in 1979 and 16.7-100%, average 41.1% in 1980.

The predatory insects recorded were, C. sanguinea, Pullus (Scymnus) sp. and Chrysopa spp.

The cabbage aphid - Brevicoryne brassicae (L.) (Hemiptera:Aphididae)

Generally the pest is of little economic importance, though it may become abundant seasonally and cause heavy losses to the crop. Some cabbage varieties, especially Chinese cabbage show greater susceptibility to this pest. Another aphid, Myzus persicae (Sulz.), is recorded from cabbage in the region.

High populations of these pests are attacked by Lysiphlebus (=Aphidius) testaceipes (Cress.) (Braconidae).

The predatory insects recorded on B. oleracea var. capitata were, C. sanguinea, Pullus sp.; C. lanata, C. limitata and Chrysopa spp.; and Allograpta exotica Wied. (Syrphidae).

Other minor pests recorded during the investigations were: Drepanocyrtus spp. (2) (Entomobryidae:Collembola); Xenylla grisea Axelson (Poduridae:Collembola); Acheta (=Gryllus) assimilis (Fab.) (Gryllidae Orthoptera); Schistocera pallens Thunberg (Acrididae:Orthoptera); Nysius ericae (Schill.) and Pachybrachius servillei (Guer.) (Lygaeidae:Hemiptera); Myochrous barbadensis Blake (Eumolpidae:Coleoptera); Liriomyza munda (Frick) (Agromyzidae:Diptera). Megaselia sp. (Phoridae:Diptera) and Fannia pusio (Wiedemann) (Muscidae:Diptera) were reared from rotting plants.

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