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ATTEMPTS AT THE BIOLOGICAL CONTROL OF MAJOR INSECT PESTS OF MAIZE IN BARBADOS, W.I.

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SUMMARY

In Barbados, over seventeen species of insects have been found attacking maize.

Amongst the *Lepidoptera, Spodoptera frugiperda* is the leading pest, causing considerable damage to the young crop. Thirteen species of indigenous natural enemies, attacking eggs, larvae and pupae have been recorded. Because of the ineffectiveness of these natural enemies to control the pest, a number of exotic parasites were introduced from the Indian and Pakistani Stations of the Commonwealth Institute of Biological Control.

Of these imported species, an egg-parasite *Telenomus remus* and a pupal parasite, *Trichospilus pupivora* became established; the former now destroys over 80% egg-masses of *Spodoptera spp.*, contributing to the reduction of the pest populations in Barbados. At this stage, it is quite possible that the addition of some other larval/pupal parasite(s) in the existing complex should solve the pest problem permanently.

The establishment of *T. remus* in Barbados, is a step forward towards the final goal, and this parasite can now be supplied to other Caribbean territories, where *Spodoptera's* are the main problem.

INTRODUCTION

Due to the ever increasing demand of food throughout the world, maize, because of its high yield per hectare, and its ability to grow in varied climatic conditions, has become one of the leading food crops, and the area under it is increasing every year.

Like most other crops, maize also suffers a number of agronomic, pathological and entomological problems, which hinder the farmers from achieving maximum returns.

In Barbados, maize is attacked by a complex of insect pests, some of which are very serious and cause considerable damage. Such insects need special attention to reduce their ravages, while the others are of less economic importance, and need little or no control measures.

The insect pests and their natural enemies recorded in Barbados are listed in Appendix 1 and are discussed in the following pages.

There are a number of insects attacking stored grains, some of which are secondary pests, viz. saprophytic species, etc.

THE MAIN PESTS AND THEIR NATURAL ENEMIES.

THE FALL ARMY-WORM: *(S. frugiperda)*.

It is one of the most serious pests, attacking maize in the New World. In Barbados, the

leaves to a greater or lesser degree are skeletonized by the larvae, which usually appear in large numbers. Young corn, which has still not reached 34 to 40 cm height is often completely destroyed. On infested older plants, the mid-ribs are often left unharmed. Hybrid corn is more seriously attacked than the local varieties.

A female lays about 1,000 eggs in clusters of 30 to 250 eggs per cluster, on the underside of the leaves, and these are covered with felt-like scales from the female's body. The highest concentration of egg-masses is on the lower-most leaves of the plant. The young caterpillars feed in groups on the young leaves in the whorls of the plants. Full-grown larvae show great colour variation, but can be identified from the white, Y-shaped marking (epicranial suture) on the front of the head.

After destroying a crop in one area, the larvae migrate in large numbers to other areas in search of food. The larvae pupate in soil.

During wet weather infested plants are subsequently attacked by fungi and bacteria, which render the cobs unfit for human consumption.

Alternate host plants: The pest has also been recorded from sugarcane *(Saccharum officiarum)*, guinea corn *(Sorghum saccharatum)*, sweet potato *(Ipomoea batatas)*, cabbage *(Brassica oleracea)*, caulifolower *(Brassica oleracea var. botritis)*, cucumber *(Cucumis sativus)*, cucurbits *(Cucurbita spp.)*, beet *(Beta vulgaris)*, beans *(Phaseolus valgaris* and other *Phaseolus spp.)*, prickly and white caterpillars *(Amaranthus spinosus* and *Amaranthus viridis)*, and a number of other grasses and wild and cultivated plants.

These alternate host plants provide excellent breeding areas for the pest, and in the absence of its main host *(Zea mays)* in the field, support the pest throughout the year.

The biology of the pest in Barbados was studied in the laboratory. Generally the larvae pass through six, but in some cases seven instars. The period occupied by various developmental stages is given in table 1.

Table 1 – Life cycle of *S. frugiperda*

Incubation period:	3 days
Larval period:	
1st Instar	2 – 3 days, av. 2.8 days
2nd Instar	1 – 3 days, av. 1.6 days
3rd Instar	1 – 5 days, av. 2.4 days
4th Instar	1 – 5 days, av. 2.2 days
5th Instar	1 – 3 days, av. 2.5 days
6th Instar	1 – 3 days, av. 2.6 days
7th Instar	3 – 8 days, av. 5.5 days
Total larval period	16 – 20 days, av. 17.9 days
Pupal period	7 – 10 days, av. 8.8 days
Total development period	26 – 33 days, av. 29.7 days

From the development period studied in the laboratory, it appears that under ideal conditions, the pest can complete 9 to 10 generations a year.

a. Indigenous natural enemies: The eggs, larvae and pupae of *S. frugiperda* are attacked by a group of natural enemies in Barbados. These are –

Parasites:
Trichongrammatidae: Trichogramma fasciatum Perk. (An egg-parasite)

Braconidae: Apanteles sp. (Glomeratus group) (larval-parasite), *Chelonus antillarum* (Marshall) (egg-larval parasite)

Eulophidae: Euplectrus plathypenae How. (an ecto-larval parasite)

Tachinidae: Archytas analis Fab., *Archytas marmoratus* (Townsend), *Archytas piliventris Wulp and* Eucelatoria sp. australis *Towns. (larvalpupal parasites).*

Predators:

Coccinellidae: Cycloneda sanguinea (L.) and *Nephus sp.*
Chrysopidae: Chrysopa lanata Bks. and *Chrysopa limitata* Nav.
Carabidae: Calosoma alternans (F.)
Carcinophoridae: Euborellia sp.

Chelonus antillarum: An egg-larval parasite of *Spodoptera spp.* in Barbados. The female deposits its eggs into the eggs of its host, and the development is completed in the 3rd to 5th larval instar. The parasite appears during a certain time of the year, when it destroys up to 30! larvae.

Apanteles sp. (glomeratus group) – A solitary, larval parasite, attacks up to 12! of the young to half-grown larvae.

Euplectrus plathypenae – An ecto-larval parasite. The population of this parsite is the highest during wet season, when it attacks some 18.5! larvae. The female deposits 13-32 eggs on the host's body. On hatching, the grubs feed gregariously on the body fluids of the host larva. The parasitised larvae do not moult, though they continue normal feeding, throughout the development of the parasites. The full-grown parasite grubs move alongside the dead body of the caterpillar and spin brownish-yellow cocoons, in which these pupate. The total development period, i.e. egg to adult emergence occupies 12 to 13 days.

Archytas analis, Archytas marmoratus, Archytas piliventris and Eucelatoria sp. australis, collectively attacked only 6! of the larvae.

From the above information, it appears, that the combined effect of all these parasites on the larval population would be enough to bring the pest under reasonable control. But

unfortunately, these parasite species do not appear all at one time in the field, and therefore fail to produce the desired effect on the pest. *Euplectrus* is more abundant between August and December; *Apanteles* and *Chelonus,* between January and March; while the populations of the *Tachinids* fluctuate throughout the year. It is therefore, this seasonal appearance of these parasites, which provides a better chance for the pest to survive and continue inflicting heavy damage to the crop.

Despite such a wide range of parasites and predators present in Barbados, it was realised that these were ineffective in controlling the pest. It was therefore, decided to introduce some exotic natural enemies, and between 1969 — 76, the following were obtained and released in the field.

b. Exotic natural enemies:

Trichogrammatidae: *Trichogramma achaeae* Nagaraja and Nagarkatti and *Trichogramma chilotraeae* Nagarkatti; and

Scelionidae: *Telenomus remus* Nixon, (egg-parasites), from India.

Braconidae: Chelonus formosanus *Senan,* Chelonus heliopae *Gupta and* Chelonus texanus Cress (of U.S. origin) (egg-larval parasites), from India; *Apanteles sp.* and *Macrocentrus collaris Spen.* (larval parasites), from Pakistan.

Ichneumonidae: *Campolitischloridae (Ecphoropsis perdistinctus* Vierech) (a larval parasite), from India.

Eulophidae: *Trichospilus pupivora* Ferriere (a pupal parasite), from India.

Of these, *T. remus* and *T. pupivora* became established. *T. remus* now has a significant effect on the pest population in the island. This parasite not only attacks the egg-masses of *S. frugiperda,* but all other species of this genera, on a wide range of crops, vegetables and wild plants, and keeps these insects under reasonable control.

On maize, an average percentage destruction of egg-masses by various parasites and predators, recorded at different times in given in table 2.

Table 2: Average percentage destruction of egg-masses of *S. frugiperda,* at different times in Barbados.

Time	*Telenomus*	*Trichogramma*	Predators
August	17.6	2.8	10.6
September	26.4	4.9	9.7
October	60.7	4.5	6.5
November	63.6	0.1	3.4
December	81.4	0.0	0.0
January	25.8	33.4	0.7
February	59.3	15.3	3.4
March	68.4	0.0	5.3

(Between April and July, there is no maize crop in the field)

The overall destruction of egg masses by these parasites and predators, during the years 1972 – 76 was:

1972 – 67.3 – 83.3%: average 63.2%
1973 – 75.5 – 100 %: average 79.3%
1974 – 43.6 – 100 %: average 47.4%
1975 – average 84.5%
1976 – 83.3 – 100 %: average 87.4%

From the above table it is quite evident that prior to the introduction and establishment of *T. remus,* the level of egg-destruction by the indigenous natural enemies was significantly low. The addition of this micro-wasp into the existing bio-complex enhanced the mortality factor many times, resulting in a great reduction in the post population.

As the addition of *T. remus* in a group of egg destroying natural enemies has increased the egg mortality considerably, so too the addition of some larval/larvalpupal parasite (s) in the existing complex of natural enemies should change the status of *S. frugiperda,* in Barbados. Efforts to achieve this goal are being continued.

S. latifascia and S. ornithogalli – These insects have occasionally been recorded in small numbers on maize.

Natural enemies: Same as under *S. frugiperda.*

THE CORN EAR-WORM: *(H. zea).*

It is a minor pest of maize in Barbados. The eggs are laid singly on the silks. The hatching larvae bore through the tip of the cob, and destroy the grains. The full-grown larvae migrate to the soil and pupate in U-shaped earthen cells,

Alternate host plants: The pest has been recorded from cotton *(Gossypium barbadense)* and tomato *(Lycopersicum esculentum).*

a. Indigenous natural enemies:

Tachinidae: A. piliventris, attacked some 30.8% larvae in the field.

Exotic natural enemies: A number of natural enemies were introduced against *(Heliothis spp,* particularly for *H. virescens,* (F.) a serious pest of pigeon pea *(Cajanus cajan).* These were:

Trichogramma spp., as under *S. frugiperda.* (egg-parasites).
Braconidae: Apanteles sp. and
C. chloridae (larval parasites) from Indian Station of C.I.B.C. None of these was recovered in the field.

THE SUGARCANE MOTH BORER: *(D. saccharalis).*

Besides sugarcane, which is the main host of this pest, maize serves as an important alternte host. Until recent years it was the most serious pest of sugarcane in Barbados, reponsible for the destruction of an average of 13,911 tons of sugar annually (Alam, et al., 1971).

The small succulent maize plants provide an easy entrance for the young larvae, and serve as excellent breeding ground for the pest. The number of larvae reaching maturity in this plant is far greater than/sugarcane, and therefore the maize when planted near sugarcane fields, considerably increases the pest population in the latter host. It is therefore generally advised to avoid planting maize near sugar estates.

Alternate host plants: Sugarcane *S. officinarum),* guinea corn *(S. saccharatum),* "Khus Khus" grass *(Vetiveria zizanioides)* and elephant grass *(Pennisetum purpureum).*

a. Indigenous natural enemies: *T. fasciatum.;*
Scelionidae: Prophanurus alecto (Crawf.) (egg-parasite).

b. Exotic natural enemies: As there were no indigenous larval and pupal parasites of this pest, a large number of these were obtained from the Americas, the Caribbean Islands, India and East Africa. Most of these were locally multiplied in large numbers and released in the fields, while the others were directly liberated in the heavily infested areas. Of these two species, i.e. a Tachinid – *Lixophaga diatraeae* (Tns.) (the Cuban fly) and a Braconid – *Apanteles flavipes* (Cam.) (Indian wasp) became established.

Since 1968, the moth-borer population in sugarcane has remained below economic level. As these parasites also attack their host (pest) in other host plants, the pest does not pose any serious problems to maize growers in Barbados.

THE SUGARCANE ROOT-BORER *(D. abbreviatus.)*

It is mainly a pest of sugarcane, but the young maize plants attract large numbers of adults and serve as the egg-laying and feeding grounds for them. The eggs are laid between the split leaf-tips. On hatching, the grubs fall on the ground and enter the soil. Initially these feed on fibrous roots, and in their advanced stage, bore into the main roots (Alam, 1976).

Alternate host plants: Sugarcane *(S. officianarum),* citrus *(Citrus spp.)* and grasses, etc.

Natural enemies: (a) Indigenous: *Eulophidae: Tetrastichus sp.* (egg-parasite).

b. Exotic natural enemies: *Elateridae: Pyrophorus luminosus* Illiger. The larvae of this beetle attack the grubs in the soil. The giant toad, *Bufo marinus* (L). feeds on grubs and adults. (For other details, see Alam, 1976).

The pest can also be controlled by other means, viz., by ploughing the infested fields or by the use of chemicals, like Chlordane, Heptachlor and Aldrin, etc.

THE CORN LEAF-APHID *(A. (R.) maidis.)*

The insect attacks the young leaves and whorls. Dark green to bluish aphids in their various development stages feed and cause yellowing and yellowish-brown spots on the leaves. The infested plants are impregnated with honeydew, on which sooty mould develops, and inhibits photosynthesis. The young infested leaves curl, become stunted and die.

Alternate host plants: Sugarcane *(S. officinarum)*, imphee *(Sorghum sp.)*, guinea corp *(S. saccharatum)* and para grass *(Panicum muticum)*.

Natural enemies:

Parasite:
Braconidae: Aphidius sp.

Predators:
Coccinellidae: C. sanguinea and *Nephus sp.*
Chrysopidae: C. lanata and *C. limitata.*
Syrphidae: Allograpta exotica Wied., *Baccha clavata* F. and *Baccha dimidiata* F.

Generally these natural enemies keep the pest under control.

THE CORN LEAF-HOPPER – *(P. maidis).*

Normally a minor pest. The nymphs and adults feed in the whorl of young plants. It is a known vector of a virus causing "Stripe disease", which can be identified by the longitudinal yellow streaks in the leaves, and the stunted and distorted plant growth.

Though, generally the pest does not build-up high populations in Barbados, being a vector of the virus, it needs close attention, to avoid any serious damage to the crop.

Natural enemies:
Predators:
The same as under *A. maidis.*

OTHER PESTS.

The Cicadellids, Coreids, Lygaeid, Pentatomid, Cixiid and Agromyzid pests, occur is mall numbers, and do not cause much damage to the crop.

A major pest of stored maize – Sitophilus zeamais can infest the dry cobs in the field and the eggs and larvae contribute to rapid population build-up in storage.

Several other Nitiduliids infest injured cobs but are considered secondary or minor pests.

Rats and birds and in some parts of Barbados, monkeys are serious pests of this crop.

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APPENDIX

LEPIDOPTERA:

Noctuidae:

Spodoptera frugiperda (S. & A.) — The Corn Ear-Worm/The Fall Army-Worm.

Spodoptera latifascia (Walker)
Spodoptera ornithogalli (Gn.)
Heliothis zea Boddie

Pyraustidae:

Diatraea saccharalis (F.) — The Surgarcane Moth-Borer

COLEOPTERA:

Curculionidae:

Diaprepes abbreviatus (L.) — The Sugarcane Root-Borer

HEMIPTERA:

Delphacidae:

Peregrinus maidis (Ashmead) — The Corn Leaf-Hopper

Aphididae:

Aphis (Rhopalosiphon) maidis (Fitch) — The Corn Leaf-Aphid

Lygaeidae:

Pachybrachius sp. ? bilobatus scutellatus Dall.

Coreidae:

Liorhyssus hyalinus F.
Stenocoris (Oryzocoris) filimoronis (Fabr.)

Pentatomidae:

Nezara viridula L. — The Green Stink-Bug

Cicadellidao:

Balclutha sp.
Balclutha rosea (Scott.)
Baldulus maidis DeLong and Wolcott

Hortensia similis (Walk.)
Cixiidae:
Oliarius maidis (Fennah)

DIPTERA:
Agromyzidae:
Agromyza sorosis Williston — *The Corn Leaf-Miner*

ACARINA:
Tyroglyphidae:
Tyroglyphus sp.
An unidentified mite.

NAME OF PAPER: Attempts at the biological control of major insect pests of maize in Barbados W.I. (N.N. Alam)

Question by: Remillet
Country: French Guyana

QUESTION: A propos de *Spodoptera spp* et *d'Heliothis spp* a Barbados, monsieur Alam a t'il repertorie d'autres ennemis tels que champignons pathogenes, maladies ou nematodes parasites.

Are there found any pathogenic fungi or nematodes at Barbados.

ANSWER: Metarhizium has been found recently on *Diatraea sacdioralis, Anomis argellicaea & Anticarcia gemmatatis* in Barbados & Guyana.