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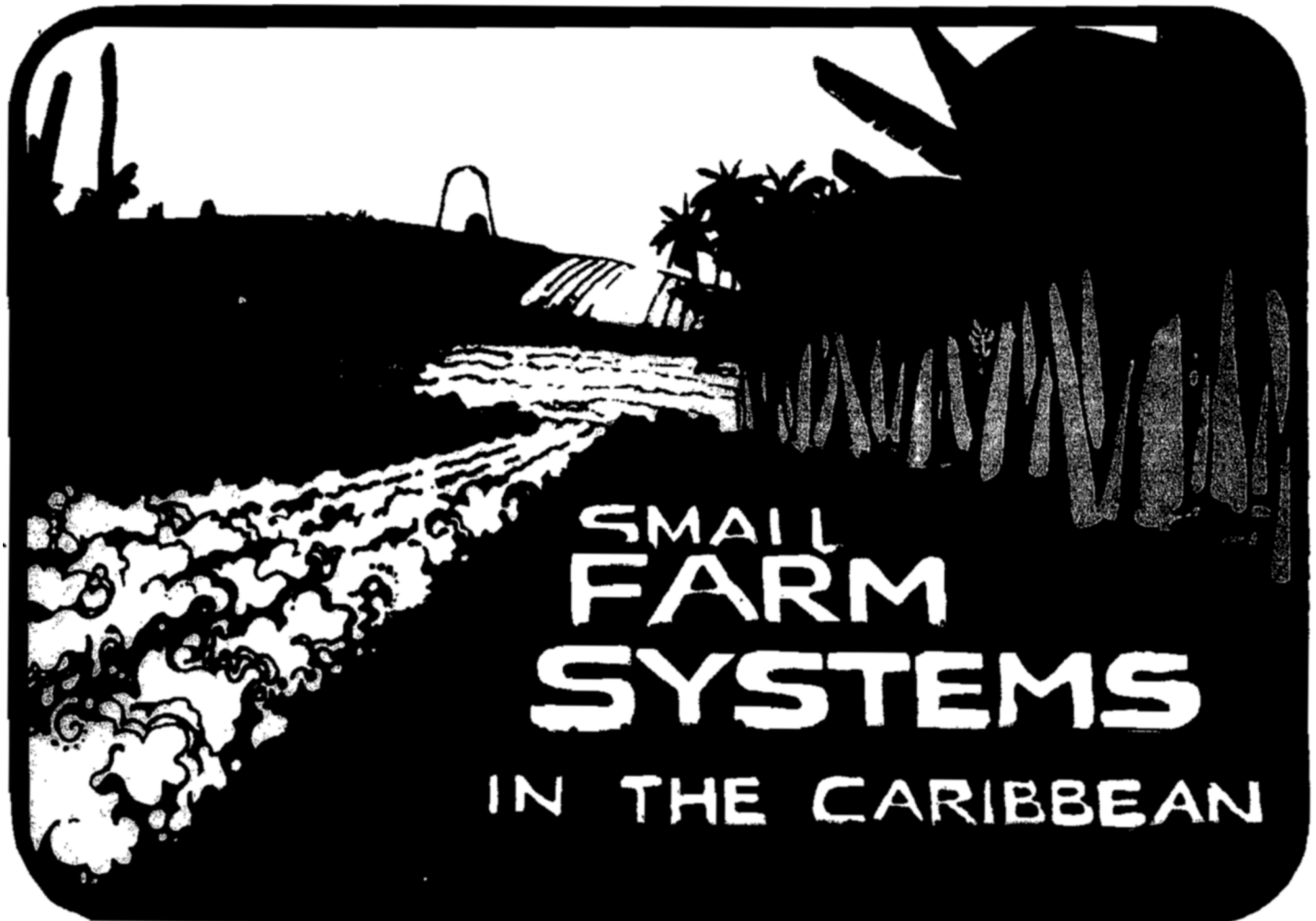
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Predators and Parasites of Insect Pests on Cantaloupe and Asparagus Bean, St. Croix, U.S. Virgin Islands

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Cantaloupe (*Cucumis melo* L.) and asparagus beans (*Vigna unguiculata* subsp. *sesquipedalis* [L.] Verdc.), were sampled weekly for insect pests and their predators and parasites during the spring dry season. The three major pests of cantaloupe were melonworms (*Diaphania hyalinata* L.), melon aphids (*Aphis gossypii* Glover), and powdery mildew (*Erysiphe* sp.). Fire ants (*Solenopsis geminata* F.) became serious secondary pests by tending aphids. All four pests required chemical control. Syrphid, chrysopid, and coccinellid larvae preyed on

aphids but these predator populations were very low and developed too slowly to exert significant control. Two ichneumonid, one chalcid, and one tachinid species were reared from melonworm pupae and one of the ichneumonids, *Agrypon caribbaeum* Bland, occurred in sufficient frequency to consider its use as a biological control agent.

Keywords: *Aphis craccivora*, *Aphis gossypii*, asparagus beans, cantaloupe, cowpea aphid, *Diaphania hyalinata*, *Liriomyza sativae*, melon aphid, melonworm, parasites, predators.

Cowpea aphids (*Aphis craccivora* Koch) were the major pests on asparagus beans, but fair to good control was achieved on most plants from natural population increases of syrphid, chrysopid, and coccinellid larvae, and wasp parasites. Fire ants, leafhoppers (*Empoasca* sp.), and vegetable leafminers (*Liriomyza sativae* Blanchard), were secondary pests.

Only 6% of the fruit and vegetables consumed in the U.S. Virgin Islands are grown locally (Mullins and Bohall, 1974). These crops are produced in gardens for home use or in small commercial plots and sold at roadside stands or small, local grocery stores. The College of the Virgin Islands Agricultural Experiment Station and Cooperative Extension Service and the Virgin Islands Department of Agriculture continuously encourage island residents to establish more and improved home gardens and small farms to decrease dependence on imported food, provide local income, and reduce food costs.

St. Croix has more level and open terrain than the other two U.S. Virgin Islands and historically had been the center of the sugarcane industry. Eighty percent of this island is classified as subtropical, dry forest zone (Ewel and Whitmore, 1973). The remaining 20% is a region of steep slopes in the northwest corner and is classified as a subtropical, moist forest zone. The dry forest zone is the major agricultural region. The average maximum and minimum temperatures are 30° and 23°C, and the average annual rainfall near the experiment station is ca. 110 cm. However, irregular rainfall and high evapotranspiration typically cause a moisture deficit January through April so that crops are subject to periodic drought since ground and surface waters are not readily available for irrigation.

Cantaloupe, *Cucumis melo* L., is a nutritious and popular food on St. Croix. The vines are able to tolerate fairly low moisture conditions although disease can be a major problem during the wet season. Different varieties of this crop have been tested for productivity at the St. Croix experiment station.

Vigna unguiculata subsp. *sesquipedalis* (L.) Verdc., a subspecies of black-eyed peas (cowpeas or southern peas), is known as asparagus bean, Bodie bean, snake bean or yard-long bean. The

plant is grown in Southeast Asia and some areas of Africa and the West Indies (excluding the U.S. Virgin Islands) primarily for its immature pods which may attain a length of 1 m under optimum growing conditions (Purseglove, 1968). Asparagus beans are a climbing or bush-type annual, day-neutral, and tolerate heat and relatively dry conditions better than *Phaseolu vulgaris* L., the common bean. However, asparagus beans require a higher rainfall than the drought-tolerant, common black-eyed peas (Purseglove, 1968).

This research was conducted at the College of the Virgin Islands Agricultural Experiment Station (CVIAES), St. Croix. The objectives were to obtain data on insect pest, predator, and parasite populations on experimental plantings of cantaloupe and asparagus beans as the crops developed during the spring dry season.

METHODS AND MATERIALS

The Experiment Station soil is a Fredensborg clay loam, a highly calcareous, friable soil with a pH of 8 and 1.5 to 2.0% organic matter. It is very low in nitrogen, sulfur, and iron, and moderately low in phosphorous, copper, and manganese.

Cantaloupe v. 'Top Mark,' was seeded January 18, 1982, in shallow 0.1 m² depressions 2 m apart in 20 m rows. The six rows were spaced 2 m apart. Young plants were thinned to two per depression. Insect and other arthropod populations were monitored weekly on the entire plant surface and specimens were collected by hand for preservation or parasite rearing.

Asparagus beans (Yates Co., New Zealand) were planted January 18, 1982, in shallow 0.1 m² depressions spaced 0.6 m apart in rows with 1 m centers. Rows were kept weed-free and the climbing vines were tied to poles. All insects on a plant sample were counted weekly. A plant sample consisted of one trifoliolate leaf (including the petiole) near the bottom, middle and top of a plant, and the length of the main stem. The first true leaf of a newly emerged seedling substituted for a trifoliolate. During the first four weeks after seedling emergence 96 plants were sampled weekly and thereafter 24 plants formed a plant sample, the reduction in number due to the increased plant size.

RESULTS

Nearly 7.5 cm of rain fell during the 10-week study. The average daily temperature was 29°C.

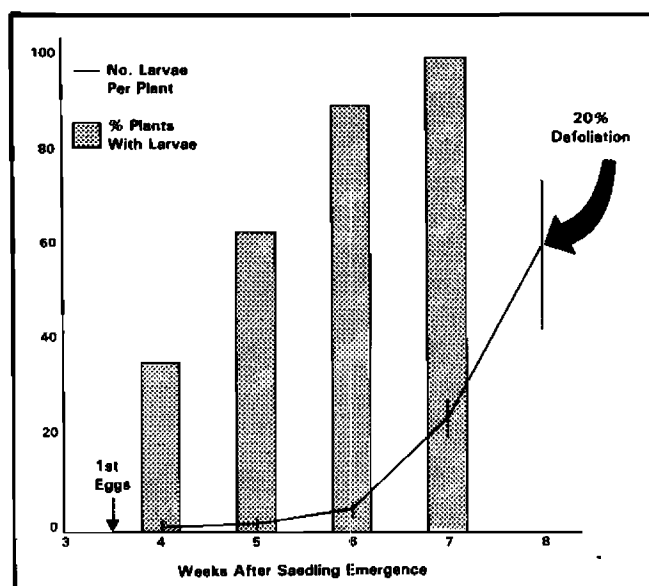
Cantaloupe

Only 69% of the seeds germinated, and during the following two weeks 12% died from damping-off (*Rhizoctonia* suspected). Powdery mildew (*Erysiphe* sp.) developed into a severe problem by the time the first fruit was approximately 8 cm in diameter. The mildew first appeared 17-18 days after seedling emergence and was observed on the underside of most leaves one week later. One or more fungicide sprays are needed when the first symptoms appear, otherwise the basal leaves die and leaf death slowly progresses distally on the vine until only the distal third or less of a plant remains green 12 weeks after seedling emergence.

Melonworms (Pyralidae)

Eggs of the melonworm, *Diaphania hyalinata* (L.), first appeared three and a half weeks after seedling emergence and 22% of the leaves had one or more eggs on them at this time. One week later 36% of the plants had larvae, 31% of the leaves had feeding damage and 12% of the leaf surface was eaten (Fig. 1). By the fifth week after emergence 63% of the plants had melonworms, and an average of 3.2 larvae occurred per plant. Larvae were on 89% of the plants by the sixth week and thereafter all plants were infested.

FIG. 1. Melonworm larvae on cantaloupe.



By the sixth week the ovipositional rate of the increasing adult population caused moderate-size plants (35-40 leaves/plant) with 3-5 melonworms to develop economically threatening populations two weeks later with 43-74 larvae and 20% of the total leaf surface eaten (leaf number ranged from 83-136/plant). If no insecticides were used at this point the plants would be heavily or completely skeletonized in about three more weeks.

Only 73% of the field-collected pupae were viable and 49% of these were parasitized. Seventy percent of the parasitism resulted from a new species of ichneumon wasp, *Agrypon caribbaeum* Bland. Rearing of this larval parasite for potential biological control of melonworms is being conducted by the USDA-ARS Southern Region U.S. Vegetable Laboratory, Charleston, South Carolina (personal communication, Kent D. Elsey). *A. caribbaeum* is described by Bland (1984).

A second ichneumon, *Eiphosoma dentator* (F.), accounted for only 3% of the emerged parasites. It ranges from southern U.S. and the West Indies to South America and is common in the tropics (Krombein et al., 1979). Most of its hosts are in the Pyralidae, subfamily Pyraustinae, but it had not been recorded as a melonworm parasite.

Nearly 15% of the parasites were a chalcid wasp, *Brachymeria ovata* Say, a known pupal parasite of melonworms. It occurs throughout most of the U.S. and Mexico and has been recorded from the West Indies (Thompson, 1955; Krombein et al., 1979).

A tachinid fly, *Nemorilla pyste* Walker formed 12% of the parasite complex. It is found in most of North America including Mexico and has been recorded as a melonworm parasite (Arnaud, 1978).

Leafminer Flies (Agromyzidae)

The vegetable leafminer, *Liriomyza sativae* Blanchard, first appeared in cotyledons four days after seedling emergence and, by the following week when the leaves were open, nearly 50% of the cotyledon surface was mined. The third week after emergence when up to three pairs of leaves were open, most of the mines were on the first pair of leaves and averaged 0.5 mines per leaf. New miner damage decreased by the fourth week and damage appeared negligible thereafter.

Aphids (Aphididae)

Melon aphids, *Aphis gossypii* Glover, first appeared on the ventral leaf surfaces ten days after seedling emergence and the population increased rapidly thereafter. The population was localized on a few vines at first but spread to all plants by the sixth week. No aphid-infested young plants (6-20 leaves) survived to bear fruit unless they were sprayed with an insecticide. Leaves of young plants with high aphid populations (ca. 40 aphids/16 cm² leaf surface) curled downward and the plants became stunted. Aphid control is needed before leaf curling begins. Older plants (with more than 85 leaves) with moderate to high infestation grew poorly. Complete spray coverage of a leaf's ventral surface is important for effective control, but this can be difficult to accomplish due to the horizontal position of leaves and their proximity to the ground.

Aphidophagous syrphid larvae, *Pseudodorus clavatus* F., first appeared four weeks after seedling emergence (two weeks after aphids were first recorded). However, the syrphid population increased at a slow rate and occasional clusters of 3-5 larvae/leaf were not observed until nearly ten weeks had passed and significant aphid damage had occurred. Even at this time the syrphid population was too low (1 larva/42 leaves) to exert sufficient control of the high aphid population.

Lacewing larvae, *Chrysopa* sp., were occasionally observed after the ninth week, but their population never exceeded 1 larva/85 leaves. Lady beetle larvae, *Cycloneda sanguinea* Casey, were less common and averaged 1 larva/428 leaves.

Ants (Formicidae)

Workers of the fire ant, *Solenopsis geminata* F., were first observed on plants four days after seedling emergence and the ant population increased parallel with the aphid population. Plants with the highest aphid populations generally had large numbers of ants tending the aphids. It was not uncommon to find a leaf with 400 aphids and 75 ants. Occasionally ants were observed transporting aphids. On young plants (6-20 leaves) ants frequently covered part to nearly all of the basal leaves with soil while they tended the aphids. Ant control would probably reduce aphid dispersal and increase their susceptibility to parasites.

Coreid Bugs (Coreidae)

Two specimens of *Anasa scorbutica* F. were recorded. This species has been reported as an occasional pest of melons in Puerto Rico (Wolcott, 1948).

Asparagus Beans

Damping-off (*R. solani* suspected) killed 5% of the seedlings. Nearly 50% of the deaths occurred during the first four days after emergence; the disease ceased 19 days after emergence. Powdery mildew (*Erysiphe* sp.) occurred on the basal third of ca. 75% of the plants 45 days after emergence. It was visible on most leaves by the last harvest date (70 days after emergence) and ca. 50% of the leaves had fallen by this time. It was difficult to determine if fungicide applications would have been cost-effective because leaf-drop from water stress and early senescence are complicating factors. Asparagus beans are reported to be disease-susceptible although less so than common beans (Martin and Ruberté, 1980).

Aphids (Aphididae)

The cowpea aphid, *Aphis craccivora* Koch, first appeared four days after seedling emergence and reached a peak population of 155 individuals per plant sample approximately one week prior to the first harvest (Table 1). One week later the population had decreased by over 90% to 8.5 aphids per sample, followed by a slight increase during the remainder of the harvest period. Aphids were concentrated on the main and lateral stems, the underside of the leaves near the petiole and, toward the end of the harvest period, on the basal half of nearly-mature pods.

Aphid damage varied depending on the age of the bean plant and the aphid population. Ten days after seedling emergence when the second pair of trifoliolate leaves were expanding, high populations of 50-150 aphids on the entire plant were recorded on some seedlings. These plants became stunted and did not resume growth until the aphid population was nearly eradicated by predators six weeks later. The plants then grew rapidly and produced a crop; although the plant size was only about 75% and the yield less than 50% of the average plant.

Bean plants that developed moderate to high aphid populations (6-20 aphids per plant sample; plant height was 80-110 cm) four weeks after emergence were able to tolerate aphid damage reasonably well for an additional three weeks. Some leaf curling and growth reduction occurred, but few pods had aphids on them. After this time, predators greatly reduced the aphid population on ca. 75% of the plants with high populations. Parasitized aphids and parasitic wasps were also observed but not collected. Plants that still had high aphid populations at harvest also had aphids on the basal half of the pods that were ready for picking. The pods were slightly curled and generally unacceptable because of the crushed aphids left on the pod during picking.

Plants with low aphid populations four weeks after emergence (1-5 individuals per plant sample) grew well and the size and crop yield were satisfactory (approximately 4400 kg/ha or 4000 lb/acre). The pods were generally aphid-free.

Aphid Predators

P. clavatus larvae (Syrphidae) appeared ten days after plant emergence and reached a peak population of 38 larvae per plant sample five weeks later (one week prior to harvest) (Table 1). The maximum populations of syrphid larvae and aphids were recorded on the same sampling date although the aphids had nearly reached this peak the previous week, whereas syrphid larvae were less than half their maximum population at that time. One week later (at harvest) the syrphid population had decreased by 85% and the aphids by over 90%. No syrphids were recorded during the remaining two weeks on plant samples although they were observed on other bean plants in the rows.

Chrysopa sp. larvae (Chrysopidae) with a white, waxy covering were first recorded 24 days after seedling emergence. The population increased to 25 larvae per plant sample two weeks later and peaked at 65 larvae per plant sample the following week which was the same date as the maximum aphid population (one week before harvest) (Table 1). By the next week the lacewing population had declined 81% along with an even greater reduction in the aphid population. Adult lacewings were not commonly observed.

C. sanguinea adults (Coccinellidae) were first recorded 24 days after seedling emergence. They reached a maximum number of nine per plant sample three weeks later when the aphid population peaked, and rapidly decreased thereafter (Table 1). Unlike lacewing adults, lady beetle adults were much in evidence. Larvae were not recorded until nearly seven weeks after seedling emergence and their population peaked two weeks later, during the middle of harvest, at seven larvae per plant sample. Lady beetle larvae continued the predation pressure as the impact of the syrphid and lacewing larvae declined during the last three weeks of harvest.

Ants (Formicidae)

S. geminata were tending cowpea aphids and the ant populations increased parallel to the aphid populations. The ant number peaked at 6.3 individuals per plant sample during the same two weeks of maximum aphid populations (Table 2) and declined rapidly thereafter. Small ant nests were common at the base of bean seedlings with the highest aphid and ant numbers, but gradually declined as the plants matured so that few nests were still present by the time harvest occurred. Ants did not cause any direct damage to bean plants although nests at the base of seedlings may have increased soil desiccation.

TABLE 1. Population development of aphids and aphid predators on asparagus beans.

Date	Mean No. Specimens per Plant Sample ^a				
	<i>Aphis</i>	<i>Pseudodorus</i>	<i>Chrysopa</i>	<i>Cycloneda</i>	<i>sanguinea</i>
	<i>craccivora</i>	<i>clavatus</i>	sp.	adults	larvae
		larvae	larvae		
1/28 ^b	2.5				
2/4	4.6	1			
2/11	23.3	2			
2/18	40.6	12	1	2	
2/25	43.8	13	2	2	
3/5	151.3	16	25	4	
3/11	155.2	38	65	9	1
3/19 ^c	8.5	5	12	0	6
3/25	18.3		4	1	7
4/1	16.4		7		6

^a A plant sample consisted of 1 trifoliolate (including petiole) near the bottom, middle and top of plant, and the length of the main stem. The first true leaf substituted for a trifoliolate on newly emerged plants.

^b Seedlings emerged Jan. 24-25, 1982.

^c First harvest was March 22, 1982.

Leafhoppers (Cicadellidae)

A population of pale green leafhoppers (*Empoasca* sp.) developed parallel to the aphid and ant populations, reaching a peak of two per plant sample nearly two weeks prior to the first harvest and then rapidly declining (Table 2). Most of the population was concentrated below 45 cm on the plant and single leaflets in this height range averaged two individuals each. Damage symptoms occurred as weak chlorotic areas on some leaves, but otherwise the damage from leafhoppers appeared minimal.

Leafminer Flies (Agromyzidae)

L. sativae first appeared four days after seedling emergence and produced an average of 2.5 mines per leaflet (range, 1-17) one week later (Table 2). At that time and during the following week approximately 16% (range, 1-50%) of the leaf surface was damaged. As plant growth progressed over the next three weeks, these percentages declined and then began to slowly increase to infestation levels similar to the second and third week of growth. Leaf damage was confined to the basal ¼ of the plant during the last ½ of the growth period. By the time the harvest was completed, mines had also appeared in the middle and terminal leaves apparently due to an increase in population from a new generation. Immediate destruction of the plants should help limit this new population.

The effect of leafminers on plant growth was difficult to estimate because leaves with mines did not turn brown or drop off. During the ten weeks between emergence and last harvest, 18% of the leaves were infested and about 7% of their surface was mined by larvae. However, between the third and eighth week the percentage of leaves mined was low because of the rapid production of new leaves and an apparent plateau in the leafminer population growth. In general, the impact on plant growth appeared to be minimal. Johnson et al. (1983) noted that

TABLE 2. Population development of secondary insect pests on asparagus beans.

Date	Mean No. per Plant Sample ^a			
	<i>Solenopsis geminata</i>	<i>Empoasca</i> sp.	<i>Liriomyza sativae</i>	% of leaf w/damage
1/28 ^b	0.6	0.04	<1	0.02
2/4	1.9	0.08	16	2.5
2/11	1.8	0.6	15	1.1
2/18	2.4	1.0	3	1.0
2/25	4.3	1.3	1.5	0.3
3/5	6.3	1.2	2	0.3
3/11	5.6	2.0	3	0.7
3/19 ^c	0.7	0.5	7	1.5
3/25	0.8	0.5	12	1.6
4/11	0.6	0.4	10	2.0

^aA plant sample consisted of 1 trifoliolate (including petiole) near the bottom, middle and top of plant, and the length of the main stem. The first true leaf substituted for a trifoliolate on newly emerged plants.
^bN=96 for weeks 1-4 and n=24 thereafter.
^cSeedlings emerged Jan. 24-25, 1982.
^dFirst harvest was March 22, 1982.

although *L. sativae* mining in tomato leaves could greatly reduce the photosynthesis rate, it may not reduce the rate to a level that decreases fruit production.

Wasps in the family Braconidae (*Opius* sp.) and Eulophidae (*Diaulimopsis* sp. and *Chrysonotomyia* sp.) were observed parasitizing leafminer larvae in the field and adult wasps were reared from leafminer pupae. In one instance 42 adult leafminers and 20 wasps emerged from one group of leaves.

Miscellaneous insects and mites

Table 3 lists all insects and mites recorded on asparagus beans. Those not previously discussed were observed sporadically.

TABLE 3. Arthropods collected from asparagus beans.

Plant feeders

- Thysanoptera
 - Thripidae - Thrips
- Hemiptera
 - Pentatomidae - Stink bugs
 - Nezara viridula* (L.) - Southern green stink bug
 - Thyanta* sp.
 - Delphacidae - Planthoppers
 - Sogata* sp.
 - Cicadellidae - Leafhoppers
 - Empoasca* sp.¹
 - Agallia albidula* (Uhler)¹
 - Aphididae - Aphids
 - Aphis craccivora* Koch - Cowpea aphid
- Coleoptera
 - Chrysomelidae - Leaf beetles
 - Ceratomya ruficornis* Oliver
- Lepidoptera
 - Noctuidae - Noctuid moths
 - Spodoptera* sp. - an armyworm
- Diptera
 - Agromyzidae - Leafminers
 - Liriomyza sativae* Blanchard - Vegetable leafminer
- Acarina
 - Tetranychidae - Red spider mite
 - Tetranychus* sp.

Miscellaneous feeders

- Coleoptera
 - Pselaphidae - Shortwinged mold beetle
- Hymenoptera
 - Formicidae - Ants
 - Solenopsis geminata* (F.) - Fire ant
 - Halictidae - Halictid bees

Predators

- Neuroptera
 - Chrysopidae - Green lacewings
 - Chrysopa* sp.
- Coleoptera
 - Coccinellidae - Lady beetles
 - Cycloneda sanguinea* Casey
- Diptera
 - Syrphidae - Flower flies
 - Pseudodorus clavatus* (F.)¹

Parasites

- Diptera
 - Tachinidae - Tachina flies
- Hymenoptera
 - Braconidae - Braconid wasps
 - Opius* sp.
 - Eulophidae - Eulophid wasps
 - Diaulimopsis* sp.¹
 - Chrysonotomyia* sp.¹

¹Not listed in Miskinen and Bond (1970).

DISCUSSION

Chemical pest control does not always offer the small farmer engaged in traditional subsistence farming a sufficient increase in productivity to compensate for the costs of applying insecticides over a whole field (Brader, 1982). Pesticide usage has primarily benefited larger farmers with substantial cash crops. Although subsistence farming is uncommon in the U.S. Virgin Islands, there are small home gardens and some small cash crop farms. The CVIAES and Cooperative Extension Service have encouraged these endeavors and are continuing to apply simplified integrated pest management principles where possible.

Melonworm control on cantaloupe by the ichneumon *A. caribbaeum* may be feasible and its future use will depend on experimental field releases currently planned. Satisfactory aphid control on cantaloupe from predators and parasites did not occur and insecticides were needed when the plants were young or leaf-curling and death would soon follow on these relatively sensitive plants. Ant control measures such as bait applications or soil drench treatment of nests may help to delay aphid population buildup. This would provide more lead time for natural control agents to establish high populations.

In contrast to cantaloupe, moderate to good aphid control on asparagus beans by natural enemies did occur, although there may be a high degree of risk unless predator populations are monitored. Asparagus bean seedlings with high initial aphid populations (50⁺ aphids per entire plant) grew poorly and mature plants with high populations had inferior quality pods and aphid masses on the basal portions of the pods. The use of insecticides for aphid control is warranted in these cases. Plants with moderate to high aphid populations (6-20 per plant sample) four to seven weeks after emergence developed severe infestations as harvest approached but most of the aphids were killed by

predators and parasites over a one- to two-week period. Syrphid larvae initiated aphid predation followed shortly by lacewing larvae and lady beetle adults. One week before the simultaneous peaks of these predator populations, the rapidly developing aphid population reached a plateau apparently because predation coupled with wasp parasitism were nearly equal to aphid reproduction. Lady beetle larvae continued the predation pressure and the aphid population declined dramatically along with the adult lady beetles and lacewing and syrphid larvae. In this case it is difficult to determine whether an insecticide should be used when the aphid infestation becomes severe or whether a farmer could monitor the natural enemy populations to determine if they will be effective in controlling the aphids.

Augmentation of the natural enemy population with releases of predators (especially lacewings and lady beetles) or perhaps with parasites when the plants have low to moderate aphid populations may make insecticide application to asparagus beans unnecessary. The cost to purchase and apply these natural control agents, if a source were available, would need to be competitive with insecticide costs. In addition, encouraging non-pest aphid species that are specific to plants that border the crop fields would help maintain higher endemic populations of predators and parasites that may in turn respond more efficiently to aphid infestation of a crop. A survey of the aphid species on local weed and non-weed plants may be useful in determining what host plants to seed in border areas or as intercrops. The development and dissemination of simple, practical methods such as these for the small farmer are needed. In a recent review, Matteson et al. (1984) deal with the problems of pest management in small farming systems and conclude that traditional cropping practices often supply a basis for improved pest control that can be adapted to the existing socioeconomic conditions.

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