

Table 9. Ranges in specific gravity and chip color of potatoes treated with soil fumigants or granular nematicides.

Test	Specific Gravity*		Chip Color**	
	High	Low	High	Low
Soil fumigants	1.0549	1.0478	5.33	3.67
Granular nematicides (3.0 lbs/acre ai)	1.0545	1.0523	5.33	3.67
Granular nematicides (5.0 lbs/acre ai)***	1.0585	1.0548	6.50	3.67
Control (all tests)	1.0594	1.0504	4.67	3.67

* Specific gravity differences were nonsignificant in all tests.

** Chip color based on rating of 1-10 with 1 being white and 10 being dark brown. Statistical, but not practical differences were observed in chip color.

*** Data from a test not reported elsewhere in paper.

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SOME INSECT-WEED INTER-RELATIONSHIPS THAT THE GROWER SHOULD KNOW

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Increasing restrictions on use of long residual and highly toxic insecticides may seriously handicap growers in their attempts to stay ahead of insect pests of vegetables and other crops. The changes necessitated in insecticidal programs are already reflected in new or more serious insect problems. To many growers it seems that the initiative has been passed to the insects and many of them, concerned over the situation that has developed regarding use of these food production tools—particularly since effective and economical replacement materials are not always available—are looking to other programs that may offer some relief. This increased awareness of some growers that supple-

mentary measures may enhance weakened insecticidal programs has led to questions on cultural practices, natural and biological control and host relations. Since weed hosts often have a strong effect on their abundance, and since the well timed manipulation of weed populations can control, suppress or delay the attack of certain insects in crops, a report on these relationships as observed in the Everglades and adjacent areas over a period of many years seemed timely, relevant, and desirable.

SOME FUNDAMENTALS

The degree of host specificity among insects varies greatly ranging from those that are essentially restricted to a single host species (Monophagous) through those with comparatively few but related orders, families, genera or species of hosts (Oligophagous) to virtual host non-specificity (Polyphagous). The boll weevil is a well known example of a practically one

host species—while known to occasionally feed on other malvaceous plants it can survive only on cotton. The imported cabbage worm is probably a good representative of those species with the broader yet restricted host range in the second category—attacking many crucifers and a few non-cruciferous species. The salt marsh caterpillar readily comes to mind as an excellent example of almost complete host non-specificity since it will feed on almost any green plant accessible to it. While such categories are usually convenient for classification of insect host relations, a number of insects do not fit neatly therein. For example, the cowpea curculio can feed and survive for prolonged periods on a heterogenous and widely unrelated flora composed of many weeds and crop plants, however, for reproduction it is restricted to a relatively small number of closely related cultivated and wild legumes and will disperse or die out in their absence.

Recognition of the importance of the weed-insect relationships to a considerable degree pervades the entomological literature. Any thorough life history study of an economic insect must include a delimitation and evaluation of its host species. This relationship has frequently been a key point in control, eradication or quarantine procedures. Wardles' (1) summation of the subject however will suffice for a long list of supporting citations, "If an insect which feeds upon a wide range of both cultivated and wild plants or upon domesticated and wild animals shows a preference however slight, for some particular wild host, the habit is of considerable importance to the entomologist or agriculturist since it bears on the advisability or otherwise of weed eradication or vermin suppression, it may even raise the question as to the advisability of deliberately encouraging such wild host whether weed or vermin."

INSECTS IN RELATION TO SPINY AMARANTH

Amaranthus spinosus

The granulate cutworm *Feltia subterranea* (Fabricus) and black cutworm *Agrotis ipsilon* (Hufnagel) are among the more serious general insect pests of southern Florida. In the Everglades area spiny amaranth *Amaranthus spinosus* (L.) is probably the preferred host plant and female moths will congregate in stands of this weed as preferential oviposition sites. These

cutworms also actually seem to prefer this weed over most crops as a food plant. It was frequently observed that in weedy fields of beans, cabbage and other crops that the worms would barely damage crops until spiny amaranth was destroyed by these larvae themselves or by cultural practices. Serious crop loss has occurred following weeding in these situations within a period of even a few hours, Genung (2).

The southern armyworm *Prodenia eridania* (Cramer) and various other *Prodenia* spp. also show a strong preference for spiny amaranth. These caterpillars are major pests on a number of crops, acting both as defoliators and fruit worms. These larvae will often completely defoliate their favorite host in fields and pastures and then acting as armyworms move out into the nearest vegetable or field crops.

Many other insects show a considerable degree of fondness for amaranth. It is possibly the preferred wild host of the banded cucumber beetle *Diabrotica balteata* (Leconte). It is among the more important wild hosts of cabbage looper *Trichoplusia ni* (Hubner). The garden flea hopper *Halticus bracteatus* (Say) occasionally becomes very abundant in stands of this weed.

INSECTS IN RELATION TO VARIOUS WILD LEGUMES

A large number of relatively host specific as well as general feeder insects are found on wild legumes. Some of these insects build up large populations on these plants. The cowpea curculio *Chalcodermus aeneus* Boheman occurs abundantly on a rather small podded "wild cowpea" *Vigna marina* (Berm.) Merrill and in various wild beans *Phaseolus* spp.. *Strophostylus* sp. does not appear to be an important host in southern Florida. On the organic soils of the Everglades *V. marina* is the only important wild host and its manipulation can be an important factor in prevention of heavy infestation of the weevil in southern peas, snap beans and pole beans. The curculio has been found in the wild cowpea during every month of the year.

Crotalaria mucronatum L., *C. incana* L., *C. pumila* Ortega and probably other 3-foliate crotalarias are the principle host of the lima bean pod borer *Etiella zinckineella* (Treitschke) and from which it spreads in time of stress or poorly timed, or poorly managed manipulation to cultivated table legumes. Infestation in table legumes has ranged up to 75% and has appeared to be

associated with poor management of wild hosts Genung (3). It has not been found in the 1-foliate crotalarias (with the exception of an experimental fiber plant, Sunn Hemp *C. juncea* L.) possibly because the pods of these (except *C. juncea*) are either smooth or even slightly waxy so that eggs cannot adhere to them. Alkaloid content of the 1-foliate species may also be a factor in freedom from the pod borers.

The bean leaf roller *Urbanus proteus* (Linnaeus) is a common pest of fall planted snap beans, and can cause severe damage to young plantings although economic damage to older plantings is generally questionable. This hesperid builds up very heavy populations on tick clover *Desmodium* spp. and also occurs on the genera *Galactea*, *Clitoria*, *Phaseolus*, *Vigna* and others among wild legumes. However, because of their high suitability and abundance *Desmodium* species are the most important single factor in development of high populations of bean leaf roller that attack the early fall bean plantings.

A complex of stinkbugs occurs in wild legumes especially the southern green stinkbug *Nezara viridula* (Linnaeus) and *Euschistus* spp. on *Crotalaria* spp. and *Sesbania* sp.. Populations often become very dense on these hosts, and from which they spread into crops particularly where such lands are disked without consideration of the possibilities of their movement into crops. Other large plant bugs that occur with the stinkbugs including the leaf footed bug *Leptoglossus phyllopus* (Linnaeus) accompany them into crops and are similarly injurious.

INSECTS IN RELATION TO GRASSES AND SEDGES

Grasses and sedges are important natural hosts of a wide range of insects. It is widely held that grasses are the favorite hosts of the fall armyworm and that flights of moths from grassy sites such as pastures, ditch banks and fence rows initiate most early infestations in corn and other crops. These views appear as valid for the Everglades area as elsewhere and crabgrasses *Digiteria* spp. and goosegrass *Eleusine indica* (L.) Gaertn. are among the heavily attacked weed grasses.

Lesser cornstalk borer *Elasmopalpus lignosellus* (Zeller) is a sporadic but severe pest of many crops. Among weed hosts its first preference is probably purple nutsedge *Cyperus rotundus* L. followed in preference by grasses.

Its presence in these hosts is often indicated by a conspicuous wilted or browned deadheart. An alert grower should be able to quickly spot such infested areas.

While the corn stem weevil *Hyperodes humilis* (Gyllenhal) occurs quite widely in the United States it has been recorded as a pest only in the Everglades where it has caused serious injury in corn. It has been found attacking only grasses and sedges. Goosegrass and nutsedge are among the more important wild hosts. Harris (7), Harris and Orsenigo (8). When heavily grassy fields are planted in corn 50% or more of the crop may become infested resulting in stunting, stalk breakage and disease infection induced by the insects activity.

INSECTS IN RELATION TO WILD CUCURBITS

Several species of wild cucurbits occur in Florida where they provide sustenance and a reproductive medium for several species of cucurbit loving insects. The pickle worm *Diaphania nitidalis* (Stoll) is the most destructive insect pest of squash, cumumbers and cantaloupe in the southeastern United States. These larvae are frequently found boring in fruit of the ubiquitous balsamapple *Momordica charatia* L., creeping cucumber *Melothria pendula* L., and Okeechobee gourd *Pepo okeechobeensis*, Small, Genung (4). The similar melonworm *Diaphania hyalinata* (Linnaeus) which is mainly a foliage feeder and fruit scarifier is also abundant on these hosts.

The striped cucumber beetle *Acalymma vittatum* (Fabricius) occurs on these weeds on Everglades organic soils and in sandy areas with interspersed muck pockets. The common squash bug *Anasa tristis* spp. (DeGeer) and related species *Anasa* spp. either alone or in a complex are also found on this flora, attacking foliage and fruit.

INSECTS IN RELATION TO ELDER

With one notable exception elderberry *Sambucus simpsoni* Rehder is not much favored by economic insect pests although a few general feeders occur on the bushes in moderate numbers and a few specialized insects attack elders almost exclusively. Patches of elder however, are the favorite oviposition site of the obscure bird grasshopper *Schistoceaca obscura* (Fabricius) and the plants are the preferred host of the

nymphs. Plants on considerable acreage may be completely defoliated and much of the bark eaten from the stems. Under these conditions nymphs will move into the nearest vegetation including crop plants. As a result of this movement crops and pastures may be damaged.

INSECTS IN RELATION TO CRUCIFEROUS WEEDS

Oddly, the wild cruciferous flora is of little importance to the cabbage looper, *Trichoplusia ni* (Hubner). Even wild mustard *Brassica juncea* L. and *B. Kaber* are only occasionally and very lightly infested. We have not found these loopers in any instance on pepper weed *Lepidium virginicum* L., Tansy mustard *Sisymbrium* sp. and wild cresses, Genung and Janes (6). All of these plants however are excellent hosts of the diamond back moth *Plutella Maculipennis* (Curtis) and turnip aphid *Hyadaphis pseudobrassicae* (Davis) and harbor large numbers of these insects throughout the growing season. They are good hosts of green peach aphid *Myzus persicae* (Sulzer) and occasional hosts of the imported cabbage worm *Pieris rapae* (Linnaeus) and gulf white cabbage worm *P. monuste* (Linnaeus). Other insects found abundantly on wild mustard and much less frequently on the other species are the Harlequin bug *Murgantia histrionica* (Hahn) and Southern green stink bug *Nezara viridula* (Linnaeus). Such general feeders as granulate cutworm *Feltia subterranea* (Fabricius) and salt marsh caterpillar *Estigmene acraea* (Drury) are also very fond of wild mustard.

INSECTS IN RELATION TO WILD MALLOWS

The noctuid genus *Anomis* is among the more distinctive elements of the insect fauna of the Malvaceae. *Anomis erosa* (Hubner) *A. illita* (Guenee) and *A. flava fimbriago* (Stephens) constitute a complex that builds up to defoliating proportions on Cadillo *Urena lobata* L., *Sida* sp. and *Hibiscus* sp. and possibly on other mallow genera. Okra, kenaf or ornamental hibiscus when under continuous oviposition pressure from these unregulated sources can be badly damaged. Another noctuid caterpillar sometimes found in outbreaks numbers on mallows and occasionally occurring with the *Anomis* complex is *Atethema subusta* Hubner.

Mallows are the preferred hosts of the cotton stainers including *Dysdercus suturellus*

(Hrrieh - Schaffer) and *D. mimulus* Hussey. These pyrrhocoreids will attack not only cultivated mallows but also eggplant, cucurbits and citrus.

Wild cotton eradication has figured prominently in the campaign against the notorious pink bollworm since this mallow is a good host for that species.

A number of quite general feeders find all malvaceous weeds to their taste; prominent among them are the cotton aphid (melon aphid) *Aphis gossypii* Glover, many caterpillars, plant bugs and leafhoppers.

INSECTS IN RELATION TO COMPOSITACEOUS WEEDS

The large family Compositae contains many species attractive to a great array of insects. The long horned stem borer *Hippopsis lemnescata* (Fabricius) breeds in the stems of many species particularly ragweed *Ambrosia artemisiifolia* L. and beggar tick *Bidens pilosa*. The beetle showed a great potential as an economic pest in the 1950's by attacking commercial and experimental plantings of kenaf. Infestation in some instances was up to 75% of stems bored. More recently it has attacked okra and soybeans, Genung and Green (5) and may eventually become a pest of various crops. Various composites, particularly ragweed, boneset *Eupatorium* spp. and beggar tick are favorite hosts of the salt marsh caterpillar and infestation in crops is often traceable to mishandling of these weed stands. Similarly some of the heaviest infestations of red-legged grasshoppers *Melanoplus femurrubrum propinquus* occurs in stands of ragweed. Many insects that are not now known to be serious pests of any crops are more or less specific to composites. These include several species of stem borers including especially long-horned beetles and curculionids.

Hairy galinsoga *Galinsoga ciliata* is a favorite wild host of cabbage looper *Trichoplusia ni* (Hubner) and of various species of the very injurious genus *Prodenia*. Wherever this plant grows in fairly heavy stands it is likely to become very heavily infested with these larvae.

There are many additional relationships of weeds to crop pests. Wild morning glories *Ipomoea* spp. are known to maintain populations of the sweet potato weevil *Cylas formicarius elegantulus* (Summers) and at various times have figured prominently in quarantine measures, (9). Several other pests of sweet potato are commonly

associated with morning glory including southern armyworm, sweet potato hornworm and others. In the Everglades are a common purslane *Portulaca oleracea* is almost as excellent a host of cutworms as amaranth and very heavy populations build up where the weed is allowed to grow. Among the solanaceous weeds nightshade *Solanum* sp. is among the preferred hosts of green peach aphid *Myus persicae* (Sulzer) and the main host of *Microtalus malleifera* Fowler a membracid vector of pseudo curly top virus, (10). The large convict bug *Coreocoris* sp. which has occasionally caused serious damage locally to eggplant and pepper also hosts on nightshade by preference.

SUMMARY

We have attempted to show herein some of the important relationships of insects and weeds and how these relationships further relate to production of crop plants. The grower who knows the weed flora and its relationship to the injurious insect fauna can utilize this information to control, delay or reduce occurrence of particular insects in crops. The following suggestions based on many years observations are offered to enhance or supplement normal chemical control procedures:

1) If land contains large areas of amaranth or purslane a thorough inspection should be made prior to planting to ascertain the cutworm situation. If cutworms are present in numbers the land should be thoroughly disked and after the weeds have rotted a suitable bait should be applied for the now hungry worms. After baiting the land may be safely planted in 5 to 7 days. Where complete flooding is feasible it is possible to drown cutworms in 72 hours.

2) Where crotalaria, sesbania or other legumes with heavy stinkbug populations are to be disked this should be done, if possible, several days prior to planting adjacent areas to allow for the bugs dispersal. Otherwise, chemical control should be obtained prior to diskings.

3) When *Crotalaria mucronatum* and other 3-foliolate crotalarias are growing near table legume plantings they have usually effectively trap cropped lima-bean pod borer. If the crotalarias are to be disked this should be done prior to blooming of table legumes to allow dispersal of ovipositing female moths.

4) When southern armyworm and other *Prodenia* sq. defoliate amaranth they should be

destroyed by using an approved insecticide before they can move into crops.

5) Growers of table legumes in the Everglades can eliminate damage by the cowpea curculio by destroying wild host plants prior to planting. Where the wild host plant is especially dense the weed control can be preceded or followed by an application of a recommended insecticide. It is believed that attention to wild hosts would delay attack in adjacent sand areas although more wild host species occur there.

6) Elimination of wild hosts adjacent to cucurbit plantings has appeared to delay attack by the pickle worm and melon worm.

7) It appears that various stemmy crops are subjected to attack by *Hippopsis lemnescata* if diskings of adjacent ragweed and other composite weeds is not properly timed, before crop plants are large enough to be attractive to the adult beetles.

8) Where concentrations of grasshopper nymphs occur on a preferred host as, for example, *Schistocerca obscura* on elder in the Everglades, they should be destroyed on the wild host with a recommended insecticide before they destroy the wild host and move into crops.

Finally, it should be stated that every grower who watches his insects, wild hosts and crop plants closely will see various ways in which he can take advantage of the insect-wild host relationship through weed control, through host trapping action, and by properly timed application of insecticides to insects concentrated on the weeds and therefore before severe crop damage can occur.

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