Other Control


This research investigated how the striped cucumber beetle, *Acalymma vittatum* (F.) responds to the presence of a predator, the wolf spider *Rabidosa rabida* (Walckenaer). We answered four questions. (1) Does a beetle alter its behavior in the presence of a wolf spider in a laboratory microcosm? (2) Do striped cucumber beetles in nature modify their behavior when a wolf spider is nearby? (3) If beetles do respond to the presence of a wolf spider, what types of cues do the beetles use to detect the predator? (4) Does the proximity of other beetles affect how beetles respond to the predator? In laboratory microcosms, the presence of a spider reduced the frequency at which beetles fed, but beetles did not change their feeding behavior in the presence of a nontoxic arthropod, the cricket *Achaeta domestica*. Field observations conducted at night in cucurbit gardens revealed that a spider within 15 cm of groups of beetles increased by approximately 1.6-fold the rate at which beetles left the plant. The proportion emigrating was higher as group size increased, but group size did not affect the responsiveness to the predator. Further laboratory microcosm experiments revealed that the striped cucumber beetle consistently relies on tactile cues and sometimes on visual cues to detect the wolf spider. In one experiment, the presence of the wolf spider affected the feeding rate of a beetle when it was on the plant, but the most consistent behavioral response to the presence of the spider was to leave the plant at a higher rate.


Effective management of adult northern and western corn rootworms, *Diabrotica barberi* Smith & Lawrence and *D. virgifera virgifera* LeConte, respectively, requires knowledge of their emergence pattern so that scouting and adult insecticide applications can be accurately timed. The objective of this study was to develop and validate species- and sex-specific models that reliably predicted adult corn rootworm emergence in Iowa. Prediction began from a biofix defined as the date of first beetle emergence in a field. The models were fit with a 3-parameter Weibull function using emergence data collected in 57 Iowa cornfields over 5 yr. Models were validated with emergence data collected in 21 additional fields from a separate year. A single Pherocon CRW Trap per field was as effective as 13 emergence cages per field at detecting the biofix. Air temperature degree-days accumulated from the emergence cage biofix explained 85% of the variability in
total corn rootworm emergence over 5 yr. This model explained 89% and 83% of the variability in total beetle emergence observed in the validation year from the emergence cage and Pherocon CRW Trap biofixes, respectively. These models do not eliminate scouting for adult corn rootworms but should improve the scouting efficiency by allowing growers to focus scouting to key periods, such as peak beetle emergence, when populations should be at their maximum abundance in the field.


Bioassays of treated field-aged leaves were conducted in 1998 and 1999 to determine the efficacy of various chemicals for control of striped cucumber beetle (SCB), *Acalymma vittatum*. In 1998, imidacloprid (GAUCHO 480F) as a seed treatment was evaluated on cucumber (*Cucumis sativis*), cv. Pioneer, and squash (*Cucurbita maxima*), cv. Mini Green Hubbard. Three rates, 1.0 mg, 5.0 mg and 10.0 mg a.i./seed.


In response to increased grower concerns, research was undertaken to investigate field biology, insecticide resistance and integrated management of striped cucumber beetle (SCB), *Acalymma vittatum* (F.), the most important insect pest of Cucurbitaceae in Ontario. Mini-Masner and baited yellow sticky traps revealed that, in southwestern Ontario, SCB are univoltine, overwintered adults entering cucurbit fields as plants emerge or are transplanted. Field studies found that foliar application of currently recommended azinphosmethyl or endosulfan effectively protected cucurbit foliage for only four days. Laboratory bioassays identified acetamiprid, imidacloprid, thiamethoxam, carbaryl, and cypermethrin as potentially effective alternative insecticides for SCB control. Application of imidacloprid as a planting water or seed treatment respectively protected developing seedlings for as long as four and five weeks. Trap rows of squash grown from seed treated with imidacloprid did not provide consistent protection of cucumber seedlings. Planting water and, especially seed treatments for SCB control in cucurbits could realize significant economic and environmental benefits for Ontario growers. A sustainable integrated SCB management strategy for Ontario cucurbit growers is outlined.

Acalymma vittatum (F.) is the primary insect pest of fresh-market cucumber and melon crops in much of the eastern United States because of their herbivory and interactions with several diseases, most notably bacterial wilt. A study was conducted to determine how soil management affects viability and infectivity of an entomopathogenic nematode that may be used for the control of A. vittatum. Dose-mortality curves under laboratory conditions suggested several Steinernema spp. as potential biocontrol agents. Field injections combined with soil bioassays showed that Steinernema riobravis Cabanillas, Poinar & Raulston (Rhabditus: Steinernematidae) longevity exceeded A. vittatum immature development time in both conventional and organic soil management systems. Mean root length densities of cucumbers increased in both soil management systems with the inclusion of nematodes. Soil management alone also influenced A. vittatum larval survivorship, with higher survival rates in the organic compared with the conventional soil management system. A 50% reduction in A. vittatum larval survival rates in both soil management systems, as determined by adult A. vittatum emergence, demonstrated the potential of incorporation of entomopathogenic nematodes for integrated pest management of diabroticites in commercial cucumber production.


Field experiments were performed in 2 locations in Indiana in 1993, 1994, and 1995 to determine the relationship between striped cucumber beetle, Acalymma vittatum (F.), density and the incidence of bacterial wilt in cantaloupe. The striped cucumber beetle is the primary vector of Erwinia tracheiphila (Smith) Holland, the causal agent of bacterial wilt in cucurbits, during the spring in the Midwest. Based on laboratory findings, initial densities of 0, 1, 5, and 15 beetles per cantaloupe plant were evaluated. Regression analyses showed that at beetle densities of 1-15 per plant there was a strong and significant linear relationship between numbers of beetles per plant and the percentage of cantaloupe plants with bacterial wilt. No cantaloupe plants developed bacterial wilt at a density of 0 or 1 beetle per plant during the 3-yr study at either location. To further define beetle density requirement, the densities of 0, 1, 2, 3, 4, and 5 beetles per plant were used in 1995. During these trials, there was no wilt at the 0 or 1 beetle per plant densities and significant wilt development did not occur until beetle densities reached 4 or 5 beetles per plant. Only 2 experimental trials showed significant yield losses from increasing beetle densities. In each trial, no yield loss was associated with beetle densities lower than 4 beetles per plant. Use of an economic threshold of 1 striped cucumber beetle per plant in the Midwest should greatly reduce insecticide applications in cantaloupe, while providing good control of the vector and bacterial wilt.

Cucumber (Cucumis sativus L.) and squash (Cucurbita pepo L.) were grown in a replicated trial on three types of plastic mulch: solid black plastic mulch, solid aluminum-coated plastic mulch with a silver reflective appearance, and black plastic mulch with two aluminum-coated strips attached. Striped cucumber beetle (Acalyphma vittata Fabricius) and spotted cucumber beetle (Diabrotica undecimpunctata howardi Barber) (Coleoptera: Chrysomelidae) counts on yellow sticky cards were obtained over eight weekly samplings. For cucumber, on the peak beetle population date, there were six times as many striped cucumber beetles in solid black plastic mulch as in aluminum-coated plastic mulch, and nearly three times as many as in black plastic mulch with aluminum strips. For squash, both striped and spotted cucumber beetle counts were significantly higher on solid black plastic mulch on three peak sampling dates than on aluminum-coated plastic mulch and black plastic mulch with aluminum strips, with counts 4.9 to 5.5 times higher in solid black plastic mulch than in aluminum-coated plastic mulch, and 2.2 to 2.6 times higher than in black plastic mulch with aluminum strips. Using a threshold of 15 beetles/sticky card, no insecticidal applications were needed on solid aluminum-coated mulch, while an average of 1.8 insecticidal applications were needed on solid black plastic mulch, and 0.8 insecticidal applications on black plastic mulch with aluminum strips. The cost of solid black plastic mulch and its insecticidal applications, $186/acre ($459/ha), was $102/acre ($252/ha) less than the cost of aluminum-coated plastic mulch without insecticidal application, $288/acre ($711/ha). However, squash fruit from plants grown on aluminum-coated plastic mulch could be direct marketed as pesticide-free, at a price 25% higher than fruit on which pesticide had been applied. For an average yield in Virginia of 600 boxes/acre (1,482 boxes/ha) [20lb/box (9 kg/box)] of squash, this translates to a $1200/acre ($2,964/ha) increase in revenue. Yield on aluminum-coated plastic mulch was delayed by one week, but there were no significant differences in cumulative yield over 14 harvests.


A buckwheat border was planted perpendicular to cucumber and squash rows to attract natural enemies of cucumber beetles. Sticky and modified Malaise traps were used to assess insect populations at incremental distances from the border. The density of Diptera declined from 19.5 insects/sticky card in the border to 2.8 insects/sticky card at 20 m from the border in 1995, and similar declines were seen in 1996. Densities of tachinid flies, Hymenoptera wasps, and the Pennsylvania leatherwing (Chauliognathus pennsylvanicus) also declined as distance from the border increased. Numbers of striped cucumber beetles (Acalyphma vittatum Fab.) increased linearly in 1995 but decreased quadratically in 1996, and crop yields were unaffected.

Field studies were conducted in 1994 and 1995 to quantify the relationship between simulated striped cucumber beetle, *Acalymma vittatum* (F.), defoliation and yield loss in ‘Carolina’ cucumber. Six simulated defoliation levels (0-100%) were imposed over five time intervals in 1994 and nine simulated defoliation levels were imposed over six time intervals in 1995. Time intervals began at cotyledon, 1st, 2nd, or 3rd true-leaf, or 1st flower growth stages, and were terminated at either 1st flower or harvest. There were no significant differences among timing of defoliation treatments for continuous defoliation, and significant yield loss occurred only when defoliation was > 25% in both years. One-time simulated insect defoliation treatments showed no significant differences in timing of defoliation and significant yield loss occurred only at >50% defoliation. Simulated defoliation results were used to estimate action thresholds. Results of the studies suggest that ‘Carolina’ cucumber can withstand high levels of defoliation before yield loss occurs, and that *A. vittatum* damage is primarily a concern during early plant growth stages.


Adult striped cucumber beetles, *Acalymma vittatum* (F.), were sampled in 20 fields during 1994-1995 in southern Minnesota. Data in both years were collected using a fixed sample unit of 7 consecutive plants within a row and a fixed sample size of 48. Sample units of 1 through 7 plants were separated out from each data set, and data sets for each sample unit of 1, 2, 3,... 7 plants each, were used for analysis. The sampling plan was analyzed and validated using resampling software, Resampling validation for sampling plans, which uses the Wald sequential probability ratio test to develop a binomial sampling plan. Based on actual alpha (type I) and beta (type II) error rates derived from the resampling analysis of 32-36 data sets, the optimum sample unit was determined to be 2 consecutive plants. Specifying nominal error rates of alpha = beta = 0.10, with a tally threshold = 2 and an action threshold = 0.25, the sample plan required an average of 14, 2-plant sample units per field. Actual alpha and beta error rates were 0.05 and 0.08, respectively. Analysis of the average sample number function indicated that a maximum of 29 samples would be required to classify *A. vittatum* populations near the action threshold of 0.25 proportion of samples infested with a tally threshold = 2. Binomial sampling plans should provide an efficient sampling program for use in managing *A. vittatum* infestations in cucurbits with minimal sampling costs.

The systemic nitroguanidine insecticide imidacloprid was investigated in cantaloupes, Cucumis melo L. variety reticulatus, for management of Acalymma vittata (F.) and bacterial wilt caused by Erwinia tracheiphila (E. F. Smith) Holland that is vectored by this beetle. The influence of management strategies using imidacloprid upon plant growth and development, beetle population dynamics, and bacterial wilt disease incidence and severity was evaluated. Application of imidacloprid to seedlings at higher doses caused short-term marginal leaf necrosis, and biomass of seedlings was reduced in an approximately linear pattern with increasing dose on a log scale up to 0.01 g (Al) per plant. Application to seedlings at doses low enough to avoid any phytotoxicity resulted in adult A. vittata mortality rates that declined exponentially with time. Exponential decay models of bioassay data suggested approximately 11 d of 100% adult mortality was achieved with low rates applied to seedlings before transplanting. Applications to seedlings delayed adult immigration, and the combination of seedling application and limited foliar sprays resulted in significant increases in yield. Addition of imidacloprid at low rates to seedings combined with 2 foliar sprays, or application to seedlings combined with an application through drip irrigation and 2 foliar sprays, was not effective in reducing the proportion of cantaloupe plants that showed bacterial wilt symptoms but did significantly reduce severity of the disease. The results suggest that low rates of imidacloprid applied before or near the time of transplanting, at times combined with few foliar sprays, could dramatically improve crop productivity via influence upon both a herbivore and a plant pathogen vectored by the herbivore.


Plant growth-promoting rhizobacteria (PGPR) strains INR7 (Bacillus pumilus), GB03 (Bacillus subtilis), and ME1 (Curtobacterium flaccumfaciens) were tested singly and in combinations for biological control against multiple cucumber pathogens. Investigations under greenhouse conditions were conducted with three cucumber pathogens-- Colletotrichum orbiculare (causing anthracnose), Pseudomonas syringae pv. lachrymans (causing angular leaf spot), and Erwinia tracheiphila (causing cucurbit wilt disease)-- inoculated singly and in all possible combinations. There was a general trend across all experiments toward greater suppression and enhanced consistency against multiple cucumber pathogens using strain mixtures. The same three PGPR strains were evaluated as seed treatments in two field trials over two seasons, and two strains, IN26 (Burkholderia gladioli) and INR7 also were tested as foliar sprays in one of the trials. In the field trials, the efficacy of induced systemic resistance activity was determined against introduced cucumber pathogens naturally spread within plots through placement of infected plants into the field to provide the pathogen inoculum. PGPR-mediated disease suppression was observed against angular leaf spot in 1996 and against a mixed
infection of angular leaf spot and anthracnose in 1997. The three-way mixture of PGPR strains (INR7 plus ME1 plus GB03) as a seed treatment showed intensive plant growth promotion and disease reduction to a level statistically equivalent to the synthetic elicitor Actigard applied as a spray.


Adult striped cucumber beetles, Acalymma vittatum (F.), were sampled in 20 fields during 1991-1993 in southern Minnesota. Data in both years were collected using a fixed sample unit of consecutive plants within a row and a fixed sample size of 48. Sample units of 1 through 7 plants were separated out from each data set, and data sets for each sample unit of 1, 2, 3,... 7 plants each, were used for analysis. The sampling plan was analyzed and validated using resampling software, resampling validation for sampling plans, which uses the Wald sequential probability ratio test to develop a binomial sampling plan. Based on actual alpha (type I) and beta (type II) error rates derived from the resampling analysis of 32-36 data sets, the optimum sample unit was determined to be 2 consecutive plants. Specifying nominal error rates of alpha = beta = 0.10, with a tally threshold = 2 and an action threshold = 0.25, the sample plan required an average of 14.2-plant sample units per field. Actual alpha and beta error rates were 0.05 and 0.08, respectively. Analysis of the average sample number function indicated that a maximum of 29 samples would be required to classify A. vittatum populations near the action threshold of 0.25 proportion of samples infested with a tally threshold = 2. Binomial sampling plans should provide an efficient sampling program for use in managing A. vittatum infestations in cucurbits with minimal sampling costs.


Applications of chemical treatments directed at adult stages of the striped cucumber beetle, Acalymma vittatum (F.) were made during the period when eggs were being laid that were anticipated to produce late instar larvae at the time of harvest, approximately 20 to 30 days prior to harvest. In the first study (1995), methamidophos (Monitor 2WM), two formulations of carbaryl (Sevimol, Adios) and esfenvalerate (Asana XL) all provided acceptable control when applied sequentially on three dates, beginning 35 days prior to harvest. Systemic insecticide treatments (carbofuran, imidacloprid), applied as a band over the furrow after planting, and seed treatments with imidacloprid provided poor or unacceptable control. In the subsequent study (1996), the effect of different treatment timings was evaluated. Treatments applied 29 days before harvest provided significantly better control of later larval damage than did later treatments, 19 and 9 days before harvest. Somewhat greater control was observed with carbaryl (Sevin XLR-Plus, Adios) than with esfenvalerate. The use of cucurbitacin-based feeding stimulant baits (Adios)
does provide an effective treatment that is generally compatible with protection of pollinators present in fields at this time.


The phagostimulatory sensitivity of diabroticite (Coleoptera, Chrysomelidae, Galerucinae) species to cucurbitacins is not correlated with Cucurbitaceae specialization, indicating that other factors, including the absence of feeding deterrents, may influence host-plant affinities among these beetles. Quinoline, indole, and isoquinoline alkaloids and sesquiterpene lactones believed to antagonize gamma-aminobutyric acid/glycine Cl-ionophores mediating chemoreception were tested on squash blossom disks for antifeedant activity to four diabroticite species with different host plant specializations. Most alkaloids were antifeedant below 30 nmol/disk. Antifeedant concentrations of sesquiterpene lactones were higher than alkaloids for all species. Oligophagous Diabrotica virgifera virgifera was more sensitive to quinoline alkaloids than polyphagous D. undecimpunctata howardi. Diabrotica virgifera virgifera was also more sensitive to the indole alkaloids strychnine, brucine, eburnamonine, and vincamine than D. u. howardi. The closely related D. barberi had sensitivities similar to those of D. v. virgifera but the more distantly related Acalymma vittatum was less sensitive to the antifeedants than D. v. virgifera. The isoquinoline alkaloid hydrastine was uniformly antifeedant to all diabroticites. All the GABA/glycine neurotoxicants tested against diabroticites were feeding deterrents and suggest that beetles share a common antifeedant mechanism.


In 1992, sentinel squash plants treated with carbofuran successfully attracted and killed squash bug, Anasa tristis (De Geer), and cucumber beetle, Acalymma vittatum (F.), emerging from overwintering at 5 locations in Atoka County, Oklahoma. In 1993, responses of cucumber beetle and squash bug to carbofuran-treated squash trap plants and to Adios or Adios-AG attracticidal baits were compared in <1.0-ha plots of seedling cantaloupe, squash, and watermelon at Lane, OK. Regardless of crop, cucumber beetles and squash bug populations were highly attracted to 'Lemondrop' squash trap plants that amounted to <1% of the total crop area. Squash trap-plants attracted an estimated 39.7, 32.4, and 66.3% of the cucumber beetle population, respectively, observed in fields of cantaloupe, squash, and watermelon seedlings. In cantaloupe and watermelon, squash trap-plants attracted >90% of the estimated squash bug population but were less effective in squash. In all cases, squash trap plants treated with carbofuran killed >90 and 16-37%, respectively, of the cucumber beetles and squash bugs found on the plants. Single applications of attracticidal baits provided up to 70% cucumber beetle mortality for 3-5-d
post treatment. Studies conducted in 1994 showed that significantly greater numbers of cucumber beetles, primarily *Diabrotica undecimpunctata howardii* Barber, were attracted to 'Blue Hubbard' than Lemondrop squash trap plants that were treated with systemic insecticides, carbofuran at 0.15 g (AI) or imidacloprid at 0.04 g (AI), and positioned in a field of watermelon. Imidacloprid was as effective as carbofuran, each provided >90% cucumber beetle mortality. In this study, an estimated 46.7% of the total cucumber beetle population was attracted to the squash trap plants. Results from these studies suggest that minimal plantings of systemically treated squash can be used effectively to suppress early-season populations of cucumber beetle and squash bug in seedling cantaloupe, squash, and watermelon.


Select strains of plant growth-promoting rhizobacteria (PGPR) were evaluated in greenhouse experiments with cucumber for induction of resistance against cucumber beetle (*Diabrotica undecimpunctata howardi* Barber) feeding and the beetle-transmitted cucurbit wilt disease. When beetles were given a choice between PGPR-treated and nontreated cucumber, their feeding on stems and cotyledons and the severity of wilt symptoms were significantly lower on PGPR-treated plants. HPLC analysis demonstrated that cotyledons from PGPR-treated plants contained significantly lower concentrations of the cucumber beetle feeding stimulant cucurbitacin than nontreated plants. These results suggest that a mechanism for PGPR-induced resistance against cucumber beetle feeding may involve a change in the metabolic pathway for cucurbitacin synthesis.


Field studies were conducted in 1993 and 1994 to evaluate the effects of induced resistance in cucumber by plant growth-promoting rhizobacteria (PGPR) on numbers of the spotted cucumber beetle, *Diabrotica undecimpunctata howardi* Barber, and the striped cucumber beetle, *Acalymma vittatum* (F.). Cucumber plant growth and yields were significantly (P < 0.05) greater, and populations of cucumber beetles were significantly lower, on PGPR-treated cucumber than on nontreated cucumber. On dates when peak beetle populations were present, PGPR treatment resulted in significantly (P < 0.05) greater cucumber beetle control than weekly applications of esfenvalerate insecticide. In no-choice greenhouse cage experiments with 3 cucumber cultivars, beetles infected with the cucumber wilt pathogen, *Erwinia tracheiphila*, were released and allowed to feed on PGPR-treated or nontreated cucumber plants. The incidence of cucurbit wilt disease was significantly (P < 0.05) lower on PGPB- treated cucumber
plants than on nontreated plants. These results indicate that PGPR-induced resistance may be more effective than insecticides for control of cucumber beetles and cucurbit wilt disease on cucumber. Possible mechanisms for PGPR-induced resistance against cucumber beetles are discussed.


A scheduled, weekly spray program was compared with a program that determined the need for treatment based on sampling (threshold) and an untreated control for management of the striped cucumber beetle, *Acalymma vittatum* (F.), a vector of the pathogen that causes bacterial wilt in muskmelon. Treatments were compared at 2 locations during 2 yr for their effects on prevention of bacterial wilt, melon yield, and net income. Insecticides were applied in the threshold treatment whenever beetle populations reached or exceeded a threshold of 0.5 beetle per plant before melon fruit appeared, and 1 beetle per plant when fruit set. Yields in the threshold treatment were equal to or better than the schedule treatment at 3 of the 4 study sites. The threshold treatment generated higher net income than the other treatments. In addition to economic considerations, the use of fewer insecticide sprays for striped cucumber beetle management is favorable for protecting natural enemies, insect pollinators, and prolonging the usefulness of a limited number of insecticides registered for use on muskmelon by reducing selection for resistance.


Sticky traps with and without the attractant TIC (1,2,4-trimethoxybenzene, indole, and trans-cinnamaldehyde) were evaluated in cucurbits for capture of striped cucumber beetle, *Acalymma vittatum* (F.), spotted cucumber beetle, *Diabrotica undecimpunctata howardi* Barber, western corn rootworm, *Diabrotica virgifera virgifera* LeConte, and northern corn rootworm, *D. barberi* Smith & Lawrence, in New York and western striped cucumber beetle, *Acalymma trivittatum* (Mannerheim), and western spotted cucumber beetle, *Diabrotica undecimpunctata undecimpunctata* Mannerheim, in California. Traps with TIC lures captured more beetles than unbaited traps for all species except for western spotted cucumber beetle in 1 of 2 California trials. Yellow traps captured more striped cucumber beetle and western spotted cucumber beetle than did white traps but did not increase capture of spotted cucumber beetle or western striped cucumber beetle. The response of the western corn rootworm and northern corn rootworm to TIC varied by time of day, the greatest response occurring around midday. Increases in TIC per trap resulted in increases in capture of western spotted cucumber beetle, western striped cucumber beetle, western corn rootworm, and striped cucumber beetle, but not for northern corn rootworm or spotted cucumber beetle. For cucurbits with short plant
canopies, traps were most effective when placed close to the ground. In pumpkins with
taller canopies, traps at canopy and midcanopy height captured the most beetles. The
effect of trap height varied by time of day for spotted cucumber beetle, western corn
rootworm, and northern corn rootworm, and the pattern varied for the species. Sex ratio
of captured beetles varied among species and time of day. Overall, western corn
rootworm and northern corn rootworm were captured in greatest numbers during the
middle of the day whereas the greatest captures of striped cucumber beetle occurred
between 1800 and 0600 hours EST. Significantly greater numbers of striped cucumber
beetle, western corn rootworm, and northern corn rootworm were captured on the
downwind side of traps. Traps replaced 2 times per day had greater captures than traps
replaced 1 time per day or 1 time every 2 days.

of Semiochemical Baits for Management of Southern Corn Rootworm (Coleopter:

Field trials to test the efficacy of insecticidal semiochemical baits for management of the
southern corn rootworm, Diabrotica undecimpunctata howardi Barber, in peanuts were
conducted in 1992, 1993, and 1994 in North Carolina and Virginia. The baits contained a
mixture of cucurbitacins as a feeding arrestant, volatile feeding attractants (1,2,4-
trimethoxybenzene, indole, and trans-cinnamaldehyde), and carbaryl as a toxicant.
Results were similar in both North Carolina and Virginia. In 1992 and 1993, there were
no statistically significant differences in in-shell yield because of treatment. Numerically
highest yields were always obtained in the chlorpyrifos-treated plots; numerically lowest
yields occurred in the semiochemical bait-treated plots in 1993 and 1994. In 1994, in-
shell yield was significantly higher in the chlorpyrifos-treated than in granular
semiochemical bait-treated peanuts. Percentage of undamaged pods was highest in
chlorpyrifos-treated and lowest in bait-treated peanuts. Possible reasons for lack of
efficacy of baits as applied are discussed relative to the biology of southern corn
rootworm in peanuts.

Brust, Gerald E., and Foster, Rick E. 1995. Semiochemical-Based Toxic Baits for
Control of Striped Cucumber Beetle (Coleoptera: Chrysomelidae) in Cantaloupe.

A semiochemical-based toxic bait was compared with the standard treatment weekly
carbaryl sprays, for control of adult striped cucumber beetle, Acalymma vittatum (F.) in
cantaloupe in 1991 and 1992. The striped cucumber beetle transmits the bacterium
Erwinia tracheiphila (Smith) Bergey, Harrison, Breed, Hammer and Huntoon, which
causes bacterial wilt in cantaloupe. The toxic dry bait contains 0.3% carbaryl, a feeding
stimulant (cucurbitacin, 5.0%), and several floral attractants (0.5%). In 1992, a dry-
flowable bait (liquid-bait) also was tested. The baits reduced beetle numbers on
cantaloupe plants but not as quickly as the carbaryl spray. It took < 2 h to eliminate
beetles with carbaryl spray treatments and 24-48 h with dry- or liquid-bait treatments.
However, dry bait continued to control beetles for 7 d, but beetle populations increased in carbaryl spray and liquid-bait treatments 4-5 d after application. Beetle damage and percentage of plants with bacterial wilt by first harvest were similar in the carbaryl and bait treatments. Significantly more flowers were pollinated and more early fruit were produced in the bait treatments and the control (no insecticides) compared with the carbaryl spray treatments. In 1991, dry-bait treatments had significantly greater yields than carbaryl treatments because of an outbreak of aphids in the carbaryl spray treatment. Final yields in 1992 were similar for carbaryl and both bait treatments.


*Abstract Missing


Foliar insecticides applied to control the striped and spotted cucumber beetles, Acalymma vittatum (Fab.) and Diabrotica undecimpunctata howardi Barber, on watermelon, Citrullus lanatus, were of little or no value in three studies conducted in two locations over 2 years. However, an at-planting application of the systemic, soil insecticide carbofuran resulted in higher early yields, although the differences were not statistically significant in small plots. In 1991, large plots comparing carbofuran-treated watermelons with untreated watermelons in two commercial fields showed large and statistically significant increases in melon yield when carbofuran was applied, especially in early yield. Studies in 1992 and 1993 showed that the application of carbofuran at planting stimulated root and shoot growth after transplanting and increased yields when compared with untreated plots, plots treated with methyl bromide, or another soil insecticide, terbufos. These studies suggest that carbofuran may be acting as a growth stimulant, as well as an insecticide


Esfenvalerate was sprayed on green pepper and pumpkin plants at 7.0 g (AI)/ha to control adult striped cucumber beetle, Acalymma vittatum (Fabricius), and spotted cucumber beetle, Diabrotica undecimpunctata howardi (Barber). Following spraying, residues of esfenvalerate in the two crops were determined and adult insects were swept and counted. Esfenvalerate was extracted using n-hexane from representative plant samples collected at different time intervals following spaying for residue analysis. Determination of
residues using gas chromatography (GC-ECD) indicated initial deposits of 3.34 and 1.18 ppm on pumpkin and pepper leaves, respectively. Only trace levels were detected on pepper fruits on day 21 (0.0001 ppm). Half-Life values were 1.11 and 2.79 d on pumpkin and pepper fruits, respectively, whereas the values were 1.92 and 3.38 d on pumpkin and pepper leaves, respectively. Periodic sweep-net collections from treated and untreated plots revealed mean beetle reductions of nearly 100% 1 h post-treatment and > 60% 2 wk after treatment on both crops. Results obtained may be useful for developing IPM strategies to reduce pesticide residues on produce.


The influence of kairomonal baits, containing curcurbitacins, bloom volatiles, and carbaryl, on Diabroticite adult survivorship and trophic interactions with cucurbits was examined. Enrichment of cantaloupes using rubidium (Rb) was developed for monitoring trophic interactions. A soil-soak method was developed to enrich plant Rb concentrations. Beetle uptake of Rb followed a rectangular hyperbola and elimination after transfer to clean plants followed an exponential decay. Models showed beetle uptake occurred within 1 h and the mark is retained up to 2 wk. Naturally occurring endogenous Rb concentrations in beetles varied with species and sex. Baselines were established to allow determination of the incidence and intensity of beetle feeding on Rb-enriched plants. In field cages, kairomonal baits reduced the probability and intensity of feeding on cucurbits by Diabrotica undecimpunctata howardii (Barber) and Acalymma vittata (F.). In one trial, kairomonal baits totally blocked feeding interactions. In field plots, baits also significantly reduced feeding incidence and intensity in D. u. howardii and D. virgifera virgifera (LeConte), but not in A. vittata. Where the bait reduced feeding, males showed less reduction than females. In D. v. virgifera, there was a higher probability of capturing live males than females regardless of kairomonal treatment. Adult survivorship was reduced by the kairomonal bait in both field and cage experiments. These novel methods allow the monitoring of trophic interactions under field conditions in the presence of behavior-modifying semiochemicals. Hypotheses to explain variation among species and sex and implications of using kairomonal baits to manage vectoring of a pathogen are discussed.


The success of mixed cropping systems in nematode management is determined not only by the associated plant's ability to decrease numbers of phytoparasitic nematodes, but also on the ability of the target crop to compete successfully for nutrients and light. Field studies were conducted to investigate the effects of a legume/cucurbit intercrop and a marigold/cucurbit intercrop on the ecology of the system in terms of nematode root.
galling, soil nutrient concentrations, energy allocation, yield, and economic profitability. The intercrop systems were less productive and less profitable than monocultures, although no differences in energy allocation, soil nutrients, or root galling were observed. As it is likely that competition between the cucurbits and associated plants decreased the productivity of the mixed cropping systems, plants used in nematode suppressive intercrops should be chosen for their compatibility with the host crop.


Experiments were conducted to evaluate the potential for controlling striped cucumber beetle (StCB). *Acalymma vittata* (F.), on cucumber, *Cucumis sativa* (L.), using a squash trap crop. A squash, *Cucurbita maxima* (Duch.) cv. ‘NK530’, was identified in greenhouse choice assays as being exceptionally attractive to StCB. Trap crop experiments were conducted using 50% and 15% of experimental plots planted to the trap crop. In both sets of experiments, plots which contained squash were more attractive than plots which did not. In 50% experiments, at least 70% of beetles found in plots were found on squash plants throughout the sampling period, with 90% on squash during the first 5 d. The use of a feeding deterrent on cucumbers did not significantly enhance the attractiveness of squash. In 15% experiments, over 70% of beetles were found on squash plants initially, although this number declined after 3 d. Two planting arrangements were tested and found not to differ. These experiments demonstrate strong potential for the use of this control strategy.


Soils traditionally used for muskmelon, *Cucumis melo* L., production in Indiana were studied for their capacity to develop enhanced (rapid) rates of carbofuran (2,3-dihydro-2,2- dimethyl-7-benzofuranyl methylcarbamate) breakdown. The rate of carbofuran degradation in soils with a history of carbofuran treatment was compared with similar soils with no previous carbofuran treatment. Degradation estimates were based on bioassay with larval western corn rootworms, *Diabrotica virgifera virgifera* LeConte, and measurement of the release of C-14-CO2 from C-14-carbofuran. Uptake of carbofuran by muskmelon plants growing in enhanced (soil in which a pesticide is rapidly degraded by populations of microorganisms previously exposed to the pesticide or a structurally related compound) and nonenhanced soils was also estimated. Both estimates of degradation showed rapid loss of carbofuran occurring in history soils as opposed to a much slower rate of degradation in nonhistory soils. Plant uptake of carbofuran, measured by bioassay with striped cucumber beetle, *Acalymma vittatum* (F.), and residue
analysis by gas chromatography-mass spectrometry was dependent upon the concentration of the insecticide in soil. The control of striped cucumber beetle on plants growing in history soils was reduced compared with plants growing in nonenhanced soil.


The striped cucumber beetle, *Acalymma vittatum* (F.), and the spotted cucumber beetle, *Diabrotica undecimpunctata howardi* Barber, are important pests of cucurbits throughout Missouri. A study was conducted that examined the effects of a black plastic mulch on the soil and plant distributions of immature and adult cucumber beetles. Muskmelon plants were subjected to one of three treatments: mulch and herbicide, herbicide, or untreated (control). The presence of a black plastic mulch significantly reduced the number of beetle eggs and larvae found within the top 5 cm of soil around plants. At greater soil depths, there were no differences in egg and larval densities among treatments. Adult cucumber beetles were most often found on the flowers of plants in all treatments.


Tests were conducted to determine the effectiveness of various row covers for excluding certain insect pests from broccoli, *Brassica oleracea* L. *Italica* group, and summer squash, *Cucurbita pepo* var. *melopepo* (L.) Alef., plantings. Kimberley Farms (Kimberley-Clark Corporation) and Agronet (CDK International Corporation) fabric row covers effectively excluded Lepidoptera from broccoli, as well as several species of flea beetles and striped cucumber beetles, *Acalymma vittata* (F.) from summer squash. A slit, clear-plastic row cover was also effective in excluding pests of squash, but allowed more lepidopterous insects to reach broccoli plants than the fabric row covers. None of the row covers was initially successful in excluding *Delia* spp. from broccoli plantings. The presence of *Delia* spp. adults under row covers was most likely the result of life stages in the soil before the placement of the row covers and the subsequent development and emergence of the adults. Once in place, however, row covers appeared to be successful in preventing the entrance of the adults from the outside into the covered plantings. Delays in maturation of broccoli and summer squash were detected during one year for plants under row covers. No significant differences, however, were found in the total harvest means for head or fruit numbers and weights.

Leaf-disk feeding tests were conducted to determine the effect of various chemicals on southern corn rootworm, *Diabrotica undecimpunctata howardi* Barber, larval feeding. Ethanolic extracts of plant seeds from the family Meliaceae were all highly active feeding deterrents, while hexane extracts were ineffective as deterrents. In leaf disk feeding tests, the fungicide thiram (tetramethylthiuram disulfide), as technical material or formulated as thiram 50% or 75% (AI) was also an effective feeding deterrent. In choice tests, a thiram-based deterrents were equally effective, while in no-choice tests, thiram-75 was most effective at preventing feeding. Thiram-75 was also effective in protecting corn seedlings in a soil bioassay [missing] the field environment. It was determined that the formulation of thiram-75 used in these tests had bee contaminated with 0.87% dieldrin (by weight). The contaminated thiram-75 had a toxic action, [missing] as a deterrent effect of southern corn rootworm larvae and both factors contributed to overall feeding inhibition. Toxicity was not found in technical thiram or in thiram-50. The mode(s) of action of the various deterrents are discussed in relation to screening procedures.


A large field trial was conducted to determine if cucurbitacin baits could reduce WCR beetle populations sufficiently to reduce egg laying and thus prevent larval damage to a subsequent corn crop. The field was divided into 8 plots, four untreated and four treated with dried Cucurbita baits. Beetle abundance declined abruptly after treatment (84.8% vs 37.6% for the treated and untreated plots, respectively). After the first application, beetle counts were still higher than the threshold, so baits were reapplied 1 week later. Again, beetle densities declined sharply in the treated plots. The highest beetle mortality due to baiting was achieved one day after treatment. The sex ratio (male:female) of the beetles collected prior to and post-treatment was 0.62, whereas this ratio for the dead beetles collected was 1.56. This could indicate that the males were more likely to come in contact with the bait than the females. Other results from this study were that females in the untreated plots had the opportunity to remain alive and develop further, whereas the existing females in the treated plots were killed by the bait. There were no statistical differences for the number of eggs extracted from the soil between the untreated and treated plots.

Hexane and ethanol extracts of seeds from 22 species of plants of the family Meliaceae from a number of countries were prepared. The extracts were submitted to antifeedant and toxicity bioassays utilizing fall armyworm [*Spodoptera frugiperda* (J.E. Smith)] (Lepidoptera: Noctuidae) larvae and striped cucumber beetle [*Acalymma vittatum* (F.)] (Coleoptera: Chrysomelidae) adults. Toxicity tests were also performed with brine shrimp, *Artemia salina* Leach. Feeding inhibition and mortality produced by some of these extracts were comparable to and, in certain cases, slightly greater than the effects produced by comparable neem (*Azadiracta indica* A. Juss.) seed preparations. Brine shrimp toxicity data do not extrapolate to insect activity, and vice versa.


Sampling of cantaloupe fields was conducted during three growing seasons to determine insect pests present on melons in the lower Rio Grande Valley. Comparisons were made between two sampling methods (visual observations and a combined suction/visual technique) and three sample area sizes (1, 2, and 3 m super(2)) during two of the seasons to determine sampling precision and efficiency. Five species and one species complex of insects considered as pests were monitored. Means, relative variation (RV), and relative net precision (RNP) for sampling techniques and sample area sizes were compared. Suction sampling followed by immediate visual examination of the plant material vacuumed yielded lowest RV values and highest RNP values. The largest-size area sampled resulted in lowest RV and RNP values for both techniques. The required number of samples associated with differing degrees of precision for both methods and all sample areas was very large.


Infective juveniles of *Neoaplectana carpocapsae* Weiser were successfully recovered in a uniform distribution from both biwall and triwall trickle tube irrigation emitters, indicating that this method of nematode distribution may be feasible in controlling soil insects in irrigated vegetables *Heterorhabditis* sp. and *N. carpocapsae* were both highly effective in laboratory experiments against striped cucumber beetle, *Acalyymma vittatum* (F.), larvae. Field tests, in which *Heterorhabditis* sp. infective juveniles were introduced manually and through trickle irrigation, were inconclusive due to low levels of striped cucumber beetles, however, the technique of application of nematodes through trickle irrigation should be more thoroughly tested.

Crude extracts of five plant species which in previous experiments significantly limited corn wireworm, *Melanotus communis* Gyllenhal, feeding damage were tested for deterrence of the southern corn rootworm *Diabrotica undecimpunctata howardi* Barber. When offered extract-treated and untreated corn seeds, rootworms damaged significantly fewer treated seeds than untreated seeds with four of the extracts. In a “no-choice” test design, with the tree most effective extracts, there was a significantly lower frequency of damage to treated baits compared to control baits.


Laboratory tests with striped cucumber beetle, *Acalymma vittatum*, adults indicated that a number of aromatic tetrahydropyrany1 ethers were promising as antifeedants at dosage rates of 0.1 and 0.5%.


In a 2-year study, fruits from 21 plant types of 15 species from 6 genera (*Citrullus Cucumis, Cucurbita, Lagenaria, Luffa, and Momordica*) of Cucurbitaceae were exposed to a natural population of *Diabrotica undecimpunctata howardi* Barber to determine relative attractance of the fruits to that insect. Analysis of cucurbitacins and their glycosides in the fruits revealed a positive correlation between their concentration and the number of spotted cucumber beetles attracted by the various plant species. This correlation demonstrated the attraction properties of low concentration (0.0-0.56 mg/g) of cucurbitacins and their glycosides. *Cucurbita foetidissima* H. B. K. and *Cucumis dipsaceus* Ehrenb., the 2 most attractive species, were high in cucurbitacin concentration. The technique of exposing fruits to *D. undecimpunctata howardi* has potential as a bioassay to screen cucurbitacins in the fruits of other species. Attractant cucurbitacins can be useful in population assessment and in luring the beetle to an insecticide or to an adhesive.