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A PRELIMINARY REPORT ON THE EFFICACY OF SYSTEMIC INSECTICIDE FOR BACKYARD VEGETABLE PRODUCTION

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Need for this IPM Project:

The availability of imidacloprid-containing systemic insecticide for home garden vegetable production is an exciting development. Imidacloprid is a systemic insecticide with LD_{50} of over 5,000 mg/kg and has good activity against many sucking insect pests and some beetles. Before 2010, imidacloprid for home use was largely restricted for tree and shrub pest control (e.g., Bonide's Tree & Shrub Insect Control, Bayer Advanced Merit Tree & Shrub Insect Control, Ferti-Lome Tree & Shrub Systemic Insecticide Drench, etc.). Concentration of imidacloprid in tree, shrub and lawn insecticides ranges from 0.2 to 1.5%. In 2010, Bayer Advanced has introduced the Fruit, Citrus and Vegetable Insect Control Concentrate **(Bayer FCV)** with a broad label; this new product has 0.24% imidacloprid. The insecticide is available in bright blue bottles at stores; it comes with a measuring cap on top.

Commercial vegetable producers have been using imidacloprid-containing insecticides for some time; however, data is lacking regarding the efficacy of imidacloprid as a general use pesticide for backyard vegetable production. Also, there is no data on how to integrate the use of imidacloprid with popular contact insecticides like carbaryl and malathion. Therefore the objectives of this study were:

1. To evaluate the effectiveness of imidacloprid as an early-season preventive insecticide (as on label)

2. Integration of contact insecticides at full and reduced rates for mid-season insect control

3. Demonstrate the effectiveness of insect pest detection and monitoring systems

Research Method:

On May 7, bell peppers ('Sweet Hybrid'), okra ('Clemson Spineless'), and tomatoes ('C44') were transplanted in a small vegetable garden (20 ft x 10 ft) established at the Gulf Coast Research and Extension Center, Fairhope, AL (in picture on right). 10-10-10 fertilizer was added about 10 days after transplanting. There were three IPM regimes with three replications each as listed in Table 1. Since there is no economic threshold for many insect pests of vegetables, foliar insecticides were applied when pests were seen on leaves or flowers, especially during early and mid-season. Presence of insect droppings on leaf surfaces was also indicative of pest presence (insect larvae may have dropped to the ground). Late season insecticidal applications on fruits were not made in this study. Also, activity of moths around the garden was monitored using pheromone traps besides direct crop scouting. Plants were harvested at weekly intervals starting in July and ending in September (Table 3). The yield data from various treatment regimes were subjected to the Analysis of Variance test using SPSS 13.0 software.

Table 1. IPM regimes with variable rates of general use pesticides for bell pepper, okra, and tomato production in the backyard garden, Gulf Coast Research and Extension Center, Fairhope, AL. Crops were transplanted on May 7, 2010.

	Application 1. Drench application of systemic insecticide (May 17)	Application 2. Foliar spray of contact insecticide (June 16)	Application 3. Foliar spray of contact insecticide (July 6)
IPM Regime 1	Imidacloprid (FR)*	Carbaryl (FR)**	Malathion (FR)***
IPM Regime 2	Imidacloprid (FR)	Carbaryl (HR)	Malathion (HR)
IPM Regime 3	UNTR. CHECK	UNTR. CHECK	UNTR. CHECK

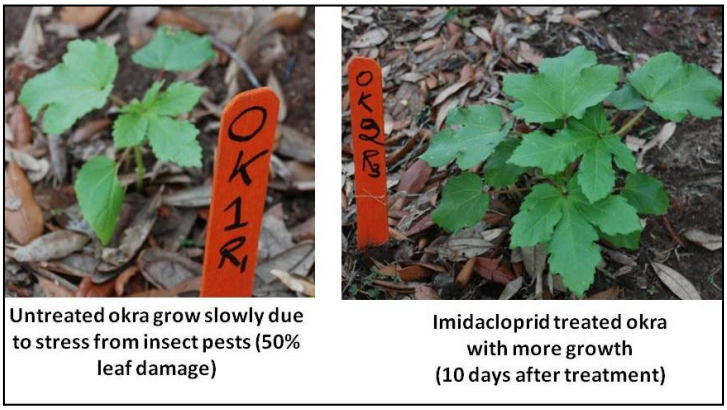
*Bayer FCV containing imidacloprid, full rate (FR) 0.05 oz per sq ft. Pre-harvest interval = 21 days.

**GardenTech Sevin Concentrate containing 0.26% carbaryl, full rate (FR) = 1.5 fl oz/ga water, half rate (HR) = 0.7 fl oz/ga water. Pre-harvest interval = 3 days.

***Hi-Yield Malathion Concentrate containing 55% malathion, full rate (FR) = 0.2 oz/ga water, half rate (HR) = 0.1 oz/ga water. Pre-harvest interval = 7 days.

Research Findings & Discussion:

Caution: This is a preliminary report for 2010 research. Trends reported herein have to be corroborated with repeat experiment next year.



Untreated okra grow slowly due to stress from insect pests (50% leaf damage)

Imidacloprid treated okra with more growth (10 days after treatment)

Untreated bell pepper plant stressed with insect injury

Imidacloprid-treated bell pepper plant with more growth (10 days after treatment)

In small test plots at the Gulf Coast Research and Extension Center, imidacloprid was applied when winged aphids and whiteflies were seen on the transplants in early May. It appears that as an early season insecticide, imidacloprid can benefit in plant establishment by reducing biotic stresses. The benefit of imidacloprid applications was noticeable on young okra plants and bell peppers (see pictures), and least visible on tomato seedlings. Treated plants had reduced feeding from early season pests such as flea beetles and thrips.

Caterpillar feeding injury was low in May-June (Table 2). In July, feeding injury from caterpillar pests (e.g., on untreated tomato plants) was very high with numerous caterpillars feeding on leaves and green fruits. Under the low (early-season) insect pressure, imidacloprid appeared to provide sufficient protection from pests for ~4 weeks. Contact insecticides were applied after the protection from imidacloprid reduced in order to manage the rising insect populations in late June to July. Both carbaryl and malathion did not provide a very high level of control from caterpillar pests indicating inadequate residual action beyond 10 days. Stink bug populations were also high in 2010 especially on okra and tomato plants; observations suggest that malathion may cause a short-term deterrence against these sucking pests. Pictures of some insect pests are provided on page 5 of this report.

Table 2. Detailed observations of insect pests and crop injury in the vegetable garden at Fairhope, AL, 10-14 days after foliar insecticide applications.

	25 June 2010 (10 days after carbaryl spray)			July 20, 2010 (14 days after malathion spray)		
	Bell pepper	Tomato	Okra	Bell pepper	Tomato	Okra
IPM Regime 1	1 looper, 1 damaged fruit	Whiteflies	Feeding holes on leaves	1 damaged fruit	1 BAW* larva, 1 hornworm, many aphid exuvia (molted skin), 1 stink bug, 1 damaged fruit	1 lady beetle, 1 stink bug, 1 three-cornered alfalfa hopper, many ants
IPM Regime 2	None	None	Worm holes on leaves, grasshopper damage to leaves	Plenty of feeding on lower leaves, 1 stink bug, 1 damaged fruit	1 CEW* larva, 1 hornworm, 1 FAW, 2 damaged fruits	1 stink bug
IPM Regime 3 (Untreated check)	1 hornworm, 1 looper	2 hornworms, 1 FAW*	Numerous holes on leaves	1 damaged fruit	2 large hornworms, 4 FAW larvae, 2 damaged fruits, many leaves missing	3 stink bugs, 3 damaged fruits

*BAW = beet armyworm; FAW = fall armyworm; CEW = corn earworm/tomato fruitworm

Note that imidacloprid-treated plants provided early harvest of crops – a benefit for the gardeners. Analyses of yield data indicated that only bell peppers provided a clear linear response to the insecticide regimes and treatment rates; treatment differences were undetectable for tomato and okra based on plant yield (Table 3). Imidacloprid and the full rate of foliar insecticides provided double the yield of bell peppers (3.6 lb/plant) compared to the untreated check (1.8 lb/plant). Results suggest that reduced rate of foliar (contact) insecticides applied to the undersurface of the okra and tomato leaves could be as effective as the full rate of

contact insecticide. The failure of significant results from tomato and okra could also be related to some wastage of the produce occurring between weekly harvests and severe heat stress in 2010.

Table 3. Comparison of insecticidal treatment regimes based on crop yields at the Gulf Coast Research and Extension Center, Fairhope, AL, 2010.

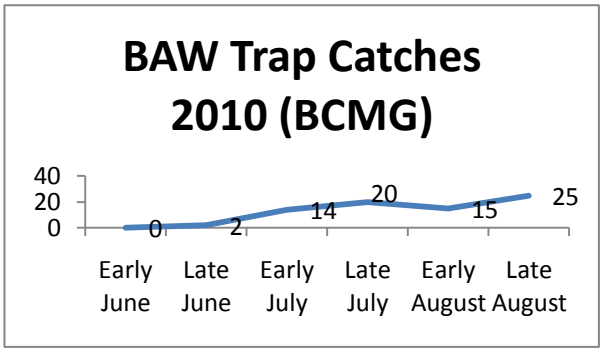
	Details	Bell pepper yield, lb per plant ± standard deviation	Okra yield, lb per plant ± standard deviation	Tomato yield, lb per plant ± standard deviation
IPM Regime 1	Imida + Carb FR + Mala FR	3.6 ± 0.3	1.1 ± 0.6	1.9 ± 0.5
IPM Regime 2	Imida + Carb HR + Mala HR	2.1 ± 0.1	1.7 ± 0.5	3.2 ± 1.0
IPM Regime 3	Untreated check	1.8 ± 0.8	1.3 ± 0.7	2.2 ± 1.5
	F	*10.829*	*0.624*	*1.107*
	P	*0.010***	*0.567*	*0.390*

Final harvest dates: Okra = Sept. 15, tomato = Aug. 30, bell pepper = Sept. 25

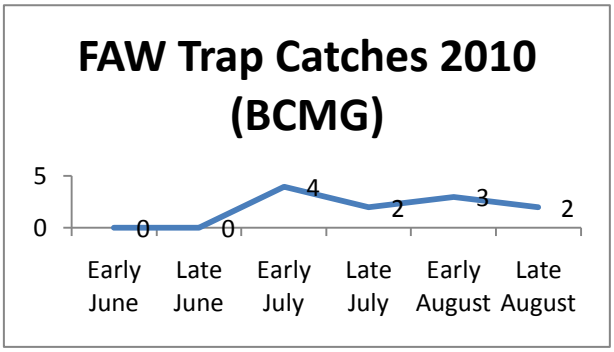
**Significant at 95% probability.

Lastly, the vegetable plot also provided an opportunity to demonstrate the use insect pheromone traps for recording moth activity for some critical insect pests that can be found in any typical garden. Common sticky wing traps were deployed around the study site and moth counts on sticky bottoms were taken every 15 days. Below are some graphical representations of trap catches (moth numbers shown in graphs) from June to August. It is evident from the graphs that most moth activity occurred in early July (e.g., fall armyworm, squash vine borer) or late July (e.g., beet armyworm, corn earworm/tomato fruitworm, tobacco budworm, lesser cornstalk borer). The high moth numbers coincide with the high caterpillar numbers on plants in July (Table 2). Although not relevant to this insecticide study, readers should take note of the unusually high number of squash vine borer moths in insect traps across the state.

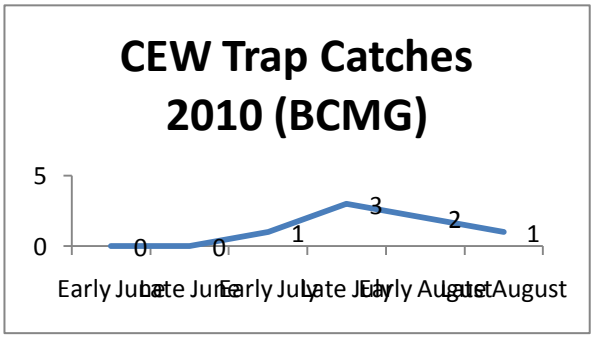
Beet armyworm



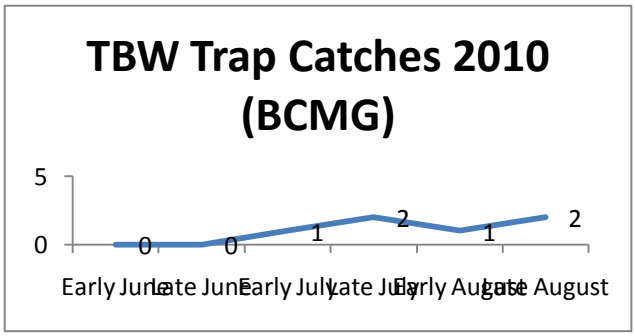
Fall armyworm



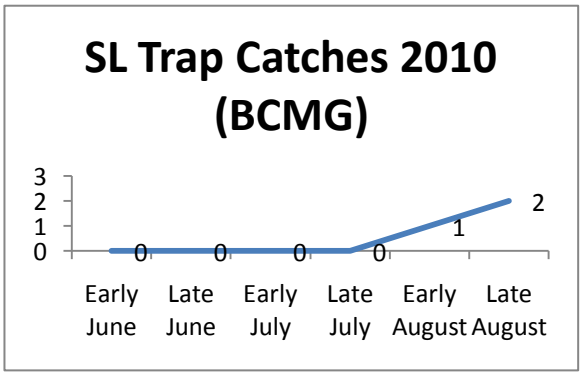
Corn earworm/tomato fruitworm



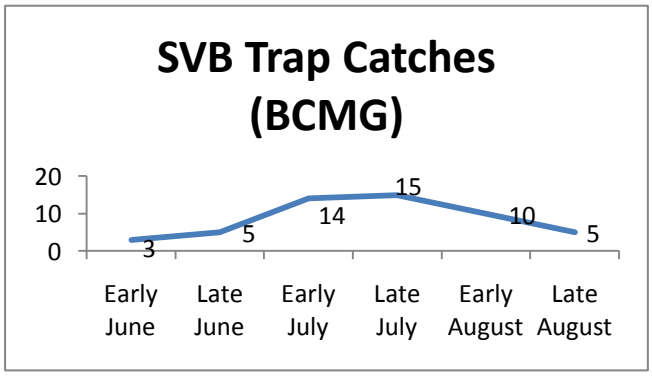
Tobacco budworm



Soybean looper



Squash vine borer



Conclusion

Insect pest populations in the small vegetable garden were at low to moderate levels and high pheromone trap catches coincided with increasing number of caterpillars in the main crop. It seems that imidacloprid is a good product to protect fruiting vegetables against the early season insect pests. More research is needed in future years to study the best timing for the application of systemic insecticide. Popular contact insecticides may be applied at reduced or full rates late in the season if needed; however, insecticide persistence may not be adequate to provide prolonged protection against rising insect populations under high heat levels (situation in 2010). Contact insecticides also do not provide protection to the new growth (leaves, fruits), so repeated applications may be necessary. With the increasing menace of stink bugs and leaffooted bugs on fruiting vegetables in southwest AL, future research may focus on integrating vigorous crop hybrids with trap crops and synthetic insecticides for the better management of sucking insect pests in the vegetable garden.

Note that the pre-harvest interval for Bayer FCV is **21 days** which means gardeners have to apply the product timely to avoid eating contaminated produce. Do not spray imidacloprid on leaves or fruits as a rescue treatment late in the season. Bayer FCV can only be applied once per season on garden vegetables. Always read the insecticide label before applying the product. While spraying contact insecticides, it is a good idea to turn the spray nozzles to reach the underside of leaves because insecticides applied to the top may lose efficacy rapidly from sunlight. To see some IPM training videos (recorded during a field day), please visit http://www.youtube.com/user/IPMNews and watch IPM Reports 3 and 4. For additional information, please call 251-331-8416 or email bugdoctor@auburn.edu.

Master Gardener research plot, 2010

Armyworms on crop

Stink bugs on okra