EFFICACY OF A XENTARI® DF/ CORAGEN® SEASON LONG PROGRAM FOR CONTROL OF BEET ARMYWORM IN FLORIDA

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Introduction

Armyworm is one of the most prominent and damaging pests of tomato in Florida. The insect feeds on both the foliage and the fruit and can greatly reduce the tomato crop yield and marketability.

One product that growers have used extensively for control of armyworm pests in tomato is the biological insecticide XenTari® DF. XenTari® is based on the natural *aizawai* strain of the bacterial agent *Bacillus thuringiensis* (Bt). It is a highly effective insecticide for control of armyworm (*Spodoptera* spp), diamondback moth (*Plutella xylostella*) and cutworms. XenTari® has a unique mode of action where upon ingestion, the natural insecticidal toxins bind to the gut of the insect and form pores causing the insect to stop feeding almost immediately, and thus protecting the crop.

XenTari® has received significant use in tomato because of its many positive attributes including efficacy, low toxicity for applicators and harvesters, low environmental impact, conservation of beneficial predators, parasite, and pollinator insects, resistance management due to the unique mode of action, and no residue (MRL) concerns.

Recently a new class of synthetic insecticides have entered the market place that have also been found to be generally selective for insects and have relatively low associated environmental toxicity concerns. Rynaxypyr™, the new active ingredient found in the DuPont insecticide Coragen®, has been demonstrated to be effective against a wide range of economically important Lepidoptera larvae and still maintain a favorable toxicological profile.

Concerns about impact on the environment, as well as the health and safety of applicators, harvesters, and ultimately the consumers buying and consuming the produce from treated crops has driven governments to ban or restrict some of the most broadly toxic of the insecticidal compounds and pushed growers to adopt newer chemistries.

In this study, we rotated XenTari® with Rynaxypyr® to demonstrate that a season long rotation program incorporating foliar application of these two insecticides could be highly effective in controlling armyworm in tomato. We also show that including XenTari® in a program with Rynaxypyr® can reduce fruit damage and can boost yields compared to a control program that relies solely on Rynaxypyr®.

Materials and Methods

Transplants of tomato (*Lycopersicon esculentum*, "SecuriTy 28") were set March 10, 2009, at a spacing of 18 inches apart within the row on 8-inch high and 32 inch wide beds of Myakka fine sand covered with white polyethylene mulch. Each plot consisted of a single 21-foot long row with rows spaced five feet apart across the beds and 5.5 foot down the beds. Treatments were replicaed four times in a randomized complete block design. Treatments were applied at 60 gpa using a 2.5 gallon hand-held CO2 sprayer fitted with D-5 disk and #45 core (Table 1). Coragen® was applied at a rate of 5.0 oz/acre while Xenari was applied at a rate of 16 oz/acre.

On April 8 and May 6, 10 plants in the middle of each plot were shook and the number of armyworm larvae were counted. Fruit were harvested on May 20 and June 3 and the number and weight of undamaged fruit and the number of fruit damaged by armyworm larvae were counted.

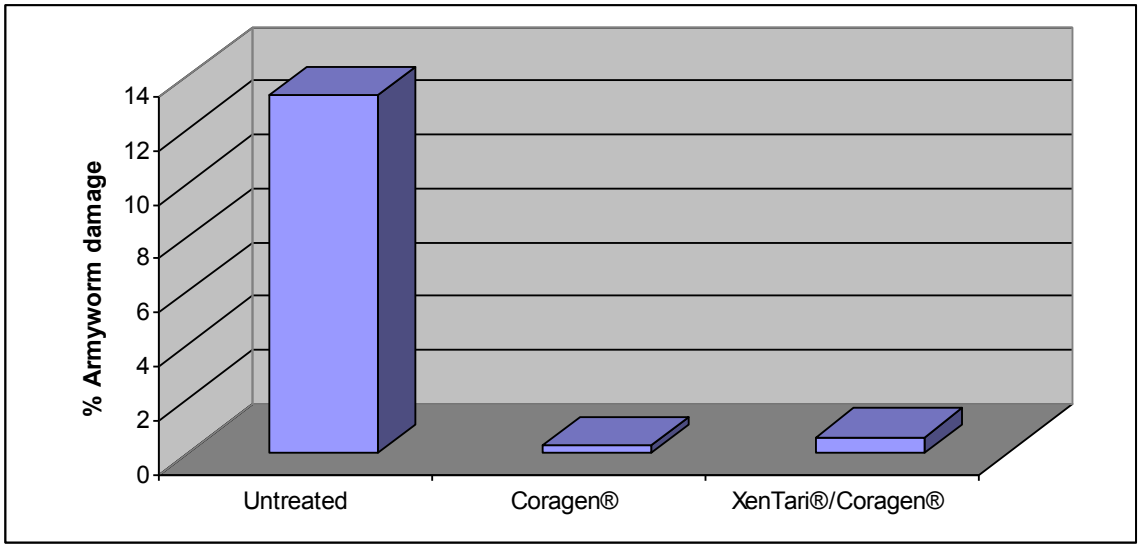
Table 1. Application timings for XenTari and Coragen season-long program.

Treatment	Application Dates			
	April 2	April 30	May 8	May 15
1. UTC	--	--	--	--
2. Coragen®	X			X
3. XenTari® Coragen®	X	X	X	

Results and Discussion

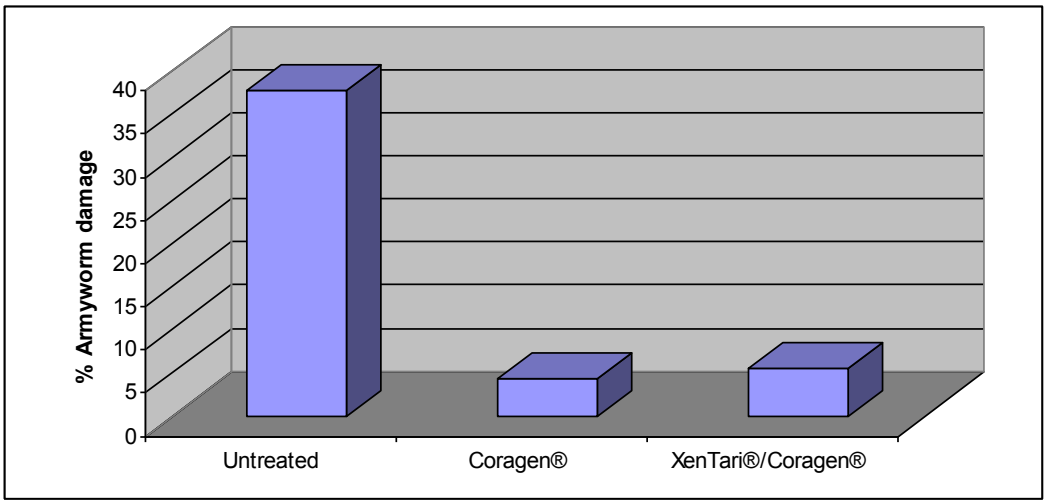
To determine comparative efficacy of the three treatment programs, tomatoes were first harvested on May 20 and the fruit damaged by armyworm was recorded. The XenTari®/Coragen® program and the Coragen® alone program resulted in a lower percentage of damaged fruit than did the untreated check (Figure 1).

Figure 1. Percentage of tomato fruit damaged by armyworm for the May 20 harvest.



Approximately two weeks later a second harvest was made and percent insect damage and number of non-damaged fruit was recorded. Due to the insect pressure, the damage was extensive for the untreated check. As with the May 20 harvest, both the XenTari®/Coragen® program and the Coragen® only program showed significantly lower levels of armyworm damage compared to the untreated check (Figure 2). There was no significant differences between the armyworm damage observed in the XenTari®/Coragen® program compared to the Coragen® alone program.

Figure 2. Percentage of tomato fruit damaged by armyworm for the June 3 harvest.



When the number of undamaged fruit was compared between the treatments, both the XenTari®/Coragen® program and the Coragen® alone program showed significant efficacy against worm damage. Although not statistically significant, the XenTari®Coragen® program yielded slightly higher number of undamaged fruit (Figure 3) and greater overall fruit weight compared to either the Coragen® alone program or the untreated check (Figure 4).

Figure 3. Number of undamaged tomato fruit yielded from the three treatments.

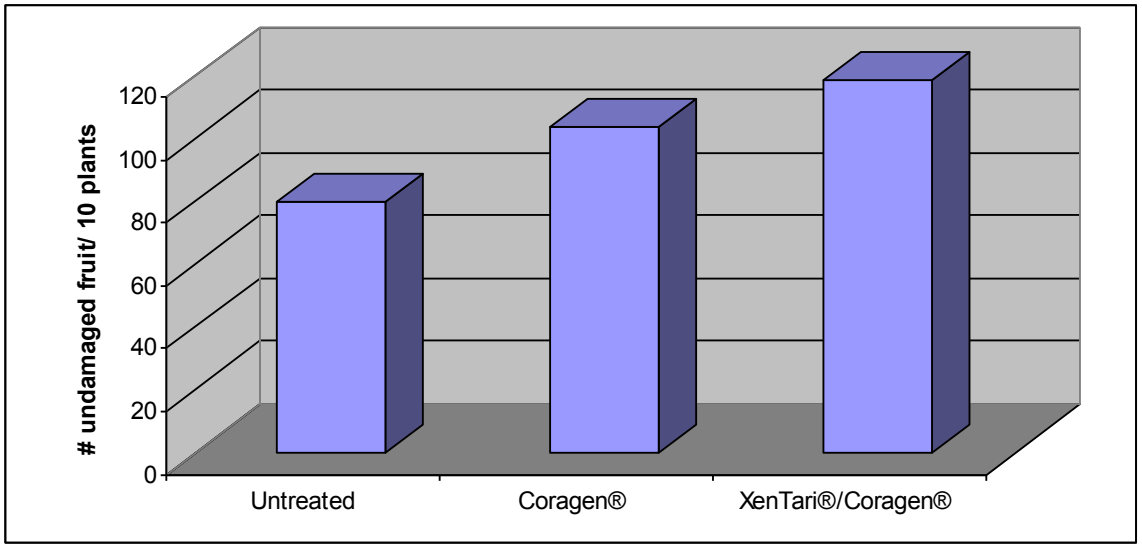
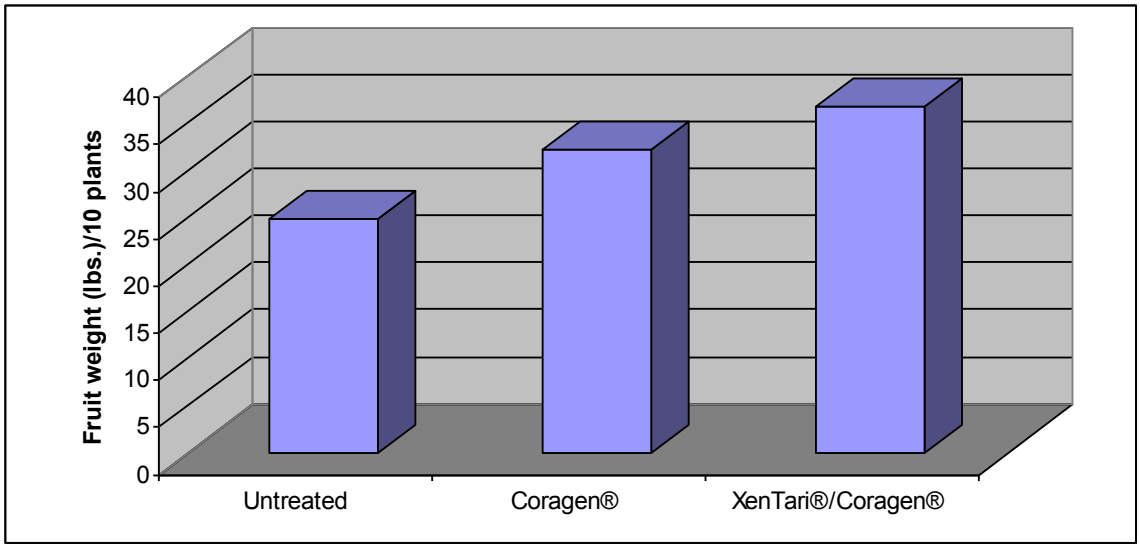
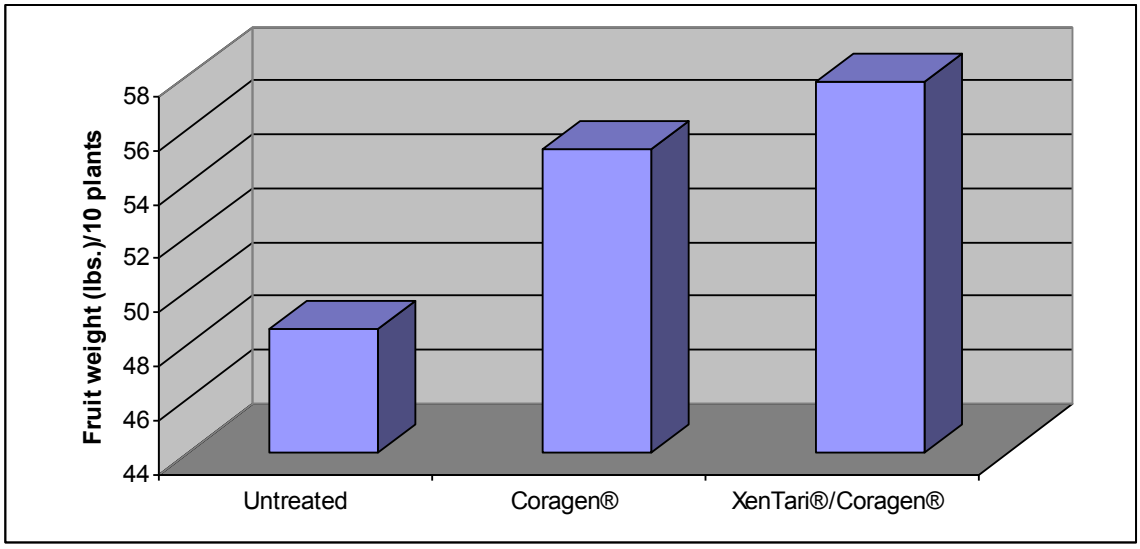


Figure 4. Fruit weight of undamaged tomatoes from the June 3 harvest.



If the fruit weight of both harvests are combined and compared among the treatments, both insecticide programs did numerically better than the untreated check and the XenTari®/Coragen® combination provided better yield than did the Coragen® alone treatment (Figure 5). Differences were not significant however.

Figure 5. Total fruit weight of undamaged tomatoes from the combined May 20 and June 3 harvests.



To determine the return on investment (ROI), the cost and yield economics of the treatments were extrapolated to a per acre basis and compared across the treatments. As can be seen in table 2 the insecticide input costs for the XenTari®/Coragen® program was

less per acre than that for the Coragen® alone program. As outlined above, the tomato number and weight yield was slightly better than for the Coragen®/XenTari® program than for the Coragen® alone program. This yield enhancement combined with the lower insecticide costs calculated to a higher per acre net profit, based on available input costs and tomato prices at the time of the study.

Table 2. Insecticide costs and ROI associated with a XenTari®/Coragen® rotation program or a Coragen® alone program*.

Treatment	Yield (Boxes/acre)	$ value/acre	Product cost ($)/acre	Net profit/acre ($)
UTC	432	5616		5616
Coragen® Alone	561	7293	65.00	7228
XenTari®/Coragen® Rotation	641	8333	59.50	8273

*Yields are extrapolated from plot data, net profit is estimated based on tomato prices at time of harvest.

Conclusion

This study demonstrates that the use of XenTari® in combination with Coragen® is economical and highly effective for control *Spodoptera* pests in tomato. This combination of green chemistries also provides other benefits including resistance management since XenTari® works at the insect midgut site while Rynaxypyr™ acts at the sites in the insect muscle. To show resistance against this combination, the insect populations would have to develop resistance to both modes of action simultaneously; an unlikely event.

Other advantages to using this combination are that both insecticides are relatively benign for the environment and have low toxicity for applicators, and field workers. Re-entry interval is short, and residue management is less of a concern compared to most other insecticides.

A rotation program such as outlined in this study provides promise as an excellent method of armyworm control, good economics, while decreasing the environmentally harsh insecticide footprint associated with the use of many older chemistries.