ASSESSMENT OF VARIETAL RESISTANCE TO THE SUGARCANE BORER

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The sugarcane borer, *Diatraea saccharalis*, is the most destructive insect attacking the Louisiana sugarcane crop. Cultivar resistance to the sugarcane borer (SCB), is categorized as a combination of physical and chemical characteristics that impede larval feeding and stalk entry. The most common component to assess sugarcane cultivar resistance in the practice is the counting of bored internodes, but this practice does not incorporate the larvae that survived until adulthood inside of the stalk and by measuring the emergence per stalk the possible potential production of the pest can be measured, this two measures to evaluate resistance were merged in one single relative resistance ratio that incorporates both values.

Nine advanced experimental sugarcane cultivars of the L, HoCP, and Ho series, program and seven commercial varieties (L 01-299, HoCP 85-845, HoCP 96-540 and HoCP 00-950, HoCP 04-838, L 01-283, and HoCP 09-804) were evaluated for resistance/susceptibility to SCB during 2018. All varieties were planted on October 28, 2017 at the LSU AgCenter Sugar Research Station in St. Gabriel, in a randomized block design with five replications each. No chemical controls for SCB were applied in the test. A 12-stalk sample was cut from each plot on October 30, 2018, (five replications = 60 stalks per variety). The number of bored internodes, total internodes, and moth emergence holes from each sample was recorded. Relative survival was calculated as the ratio of emergence holes over the number of bored internodes. The relative resistance ratio is calculated based on rankings within replications for percentage borer internodes and relative survival. Ratios approaching 1 indicate a high degree of susceptibility relative to other cultivars evaluated. All data were analyzed with generalized linear mixed models (PROC GLIMMIX), and means were separated with Tukey's HSD.

Significant differences in percentage of bored internodes and relative resistance ratio among the varieties were detected, with HoCP 00-950 (21.37% bored internodes) and L 12-201 (20.81%) being the most susceptible cultivars. The cultivar HoCP 13-740 had the highest value of emergence per stalk (0.58 adults per stalk) and the highest survival ratio (0.15 adults per bored internode). The use of the relative resistance ratio classified cultivars in one highly resistant cultivar (HoCP 85-845) in three resistant cultivars (L 01-299, HoCP 04-838 and Ho 11-573), in five intermediate resistant cultivars (Ho 12-615, HoCP 96-540, HoCP 13-758, L 01-283 and Ho 13-708) and seven susceptible cultivars (Ho 13-739, HoCP 09-804, L 12-201, L 11-183, L 13-251, HoCP 00-950 and HoCP 13-740). Results from this study will be included in considerations of cultivar releases and cultivar-specific SCB management tactics.

Table 1. Sugarcane borer cultivar resistance among commercial and experimental sugarcane cultivars, St. Gabriel, LA, 2018

Cultivar	% Bored Internodes	Emergence/ stalk	Relative Survival	Relative Resistance Ratio	Classification
HoCP 85-845	4.00 a	0.02	0.03	0.19 a	Highly Resistant
HoCP 04-838	3.48 ab	0.03	0.06	0.27 ab	Resistant
Ho 11-573	6.44 ab	0.10	0.07	0.33 abc	Resistant
L 01-299	6.61 ab	0.03	0.08	0.33 abc	Resistant
Ho 12-615	8.30 abc	0.12	0.05	0.40 abc	Intermediate
HoCP 96-540	9.19 abc	0.22	0.09	0.46 abc	Intermediate
HoCP 13-758	13.07 abcd	0.12	0.04	0.48 abc	Intermediate
L 01-283	7.59 abcd	0.13	0.10	0.50 abc	Intermediate
Ho 13-708	18.68 cd	0.15	0.04	0.54 abc	Intermediate
Ho 13-739	12.34 abcd	0.27	0.10	0.61 abc	Susceptible
HoCP 09-804	12.14 abcd	0.27	0.12	0.63 abc	Susceptible
L 12-201	20.81 d	0.18	0.05	0.63 abc	Susceptible
L 11-183	15.77 bcd	0.37	0.12	0.64 abc	Susceptible
L 13-251	18.79 cd	0.20	0.08	0.67 abc	Susceptible
HoCP 00-950	21.37 d	0.38	0.09	0.70 bc	Susceptible
HoCP 13-740	16.78 bcd	0.58	0.15	0.76 c	Susceptible
P =	<0.0001	0.1310	0.7502	0.0012	
df =	15,60	15,60	15,60	15,60	
F =	7.03	1.51	0.72	3.03	

Means which share a letter are not significantly different (Tukey's HSD, α=0.05).

EVALUATION OF INSECTICIDES, APPLICATION TIMING, AND WATER VOLUME FOR CONTROL OF SUGARCANE BORER

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The sugarcane borer, *Diatraea saccharalis* (F.), is an economically important insect pest of sugarcane in Louisiana. This pest also attacks other crops such as rice, corn, and sorghum as well as non-crop hosts. Currently, several insecticides are available to control this pest but the effective window for insecticide application is narrow. Thus, it is important to evaluate various facets to continually improve the efficiency of these insecticides. This study assessed (1) the efficacy of available insecticides, (2) the effects of application timing and residual activity, and (3) the effects of water volume on control of sugarcane borer infestation.

Three field experiments were conducted at Sugar Research Station in St. Gabriel, LA. In order to increase sugarcane borer population in the experimental plots, rows of corn were planted in between two-row plots and were inoculated with laboratory-reared sugarcane borer larvae early in the season. All experiments were conducted in plots of two 20-ft rows (0.0055 acres) of HoCP 00-950 plant cane with randomized complete block designs with four replications. In all experiments, insecticide applications were made with a two-row boom equipped with eight TeeJet TP11001VS nozzles spaced 18 inches approximately two ft above the canopy. In the product efficacy screening and application timing experiment, all treatments were applied without adjuvants at 15 gallons per acre. Applications were made 26 July 2018 (early application) and 13 August 2018 (all other treatments). Sugarcane infestations were assessed at the end of the growing season (19–28 Nov 2018) from 12 stalks per plot. The number and position of bored internodes, the number of total internodes, and the number of adult emergence holes per stalk were recorded. Percent bored internodes and emergence data were analyzed separately using generalized linear mixed models (PROC GLIMMIX). Means were separated using Tukey's HSD test ($\alpha = 0.05$).

Product efficacy screening

Efficacy of two rates of Diamond 0.83EC (AI: novaluron), two rates of Prevathon 0.43SC (AI: chlorantraniliprole), one rate of Confirm 2F (AI: tebufenozide), one rate of Besiege (AI: lambda-cyhalothrin and chlorantraniliprole), and a non-treated control were evaluated against sugarcane borer infestations in the field. Insecticide treatments reduced borer infestations by 48.1–76.4% relative to non-treated control, but were not significantly different with each other (Table 1). Increasing rates of insecticides did not improve control. Products containing chlorantraniliprole (Prevathon and Besiege) provided the highest levels of control. No differences in emergence per stalk were detected among treatments. Besiege contains a broad-spectrum pyrethroid which may disrupt natural enemy population in a commercial setting, thus this product is not widely used in Louisiana sugarcane.

Table 1. Sugarcane borer injury and adult emergence as affected by insecticide treatments, Sugar Research Station, St. Gabriel, LA, 2018.

Treatment/formulation	Rate/acre (fl oz)	% Bored internodes (LS means ± [2.3]SE)	Emergence/stalk (LS means ± [0.17]SE)
Nontreated	-	26.50a	0.63a
Diamond 0.83EC	9	13.75b	0.56a
Diamond 0.83EC	12	12.00b	0.25a
Confirm 2F	8	7.75b	0.19a
Prevathon 0.43SC	14	6.25b	0.15a
Prevathon 0.43 SC	20	6.75b	0.21a
Besiege	8	6.25b	0.12a
F value		11.09	1.41
P value		<0.001	0.26

Means within columns followed by the same letter are not different (P>0.05, Tukey's HSD)

Application timing and residual activity

In this experiment, three insecticides (Diamond 0.83EC, Confirm 2F, and Prevathon 0.43SC) were applied at early (approximately 3 weeks prior to infestation of sugarcane plots) and at threshold (>5% stalks with larvae feeding on plant surfaces). In this experiment plots were randomized within a six row block of sugarcane with a row of corn on either side. Pest pressure was sustained in all plots with active infestations occurring through September.

A reduction in percentage bored internodes was observed in both early and threshold Prevathon-treated plots compared to non-treated controls (Table 2). Prevathon provided comparable control when sprayed early and at threshold suggesting that this product maintained activity several weeks after initial spray. Diamond and Confirm were not different from controls regardless of application timing. Differences on emergences per stalk were not detected among treatments. Results from this study indicate the superior control achieved by Prevathon relative to Diamond and Confirm likely results from increased residual activity.

Table 2. Sugarcane borer injury and adult emergence as affected by insecticide treatments and application timing, Sugar Research Station, St. Gabriel, LA, 2018.

Treatment/formulation	Rate (fl oz/a)	Application time	% Bored internodes (LS means ± [1.6]SE)	Emergence/stalk (LS means ± [0.1]SE)
Nontreated	-	-	10.75a	0.33a
Diamond 0.83EC	12	Early	9.25ab	0.38a
Diamond 0.83EC	9	Threshold	7.75ab	0.25a
Confirm 2F	8	Early	8.50ab	0.17a
Confirm 2F	6	Threshold	6.25ab	0.06a
Prevathon 0.43SC	20	Early	3.25b	0.06a
Prevathon 0.43SC	14	Threshold	2.75b	0.02a
F value			3.65	2.06
P value			0.01	0.10

Means within columns followed by the same letter are not different (P>0.05, Tukey's HSD)

Effects of insecticides and water volume against sugarcane borer

In this experiment, two insecticides (Confirm 2F and Prevathon 0.43SC) were applied at 5 and 20 gallons per acre (GPA). All treatments reduced the percentage bored internodes relative to non-treated controls (Table 3). Prevathon at 20 GPA provided improved control over Confirm at 5 GPA. However, for each insecticide, application at 20 GPA did not provide better control that at 5 GPA. Emergence per stalk did not differ among treatments. These results suggest increasing water volume to 20 gallons per acre would have only minimal improvements to application efficacy. Future studies should include treatments applied at 2 GPA, a common practice among aerial applicators in commercial sugarcane.

Table 3. Sugarcane borer injury and adult emergence as affected by insecticide treatments and water volume in sugarcane, Sugar Research Station, St. Gabriel, LA, 2018.

Treatment/formulation	Rate/acre (fl oz)	GPA	% Bored internodes (LS means ± [3.2]SE)	Emergence/stalk (LS means ± [0.2]SE)
Nontreated	-	-	31.49a	0.58a
Confirm 2F	6	5	18.30b	0.29a
Confirm 2F	6	20	15.56bc	0.17a
Prevathon 0.43SC	14	5	9.14bc	0.23a
Prevathon 0.43SC	14	20	5.85c	0.02a
F value			15.26	1.86
P value			<0.001	0.17

Means within columns followed by the same letter are not different (P>0.05, Tukey's HSD)

RANGE EXPANSION AND PEST STATUS OF THE MEXICAN RICE BORER IN LOUISIANA

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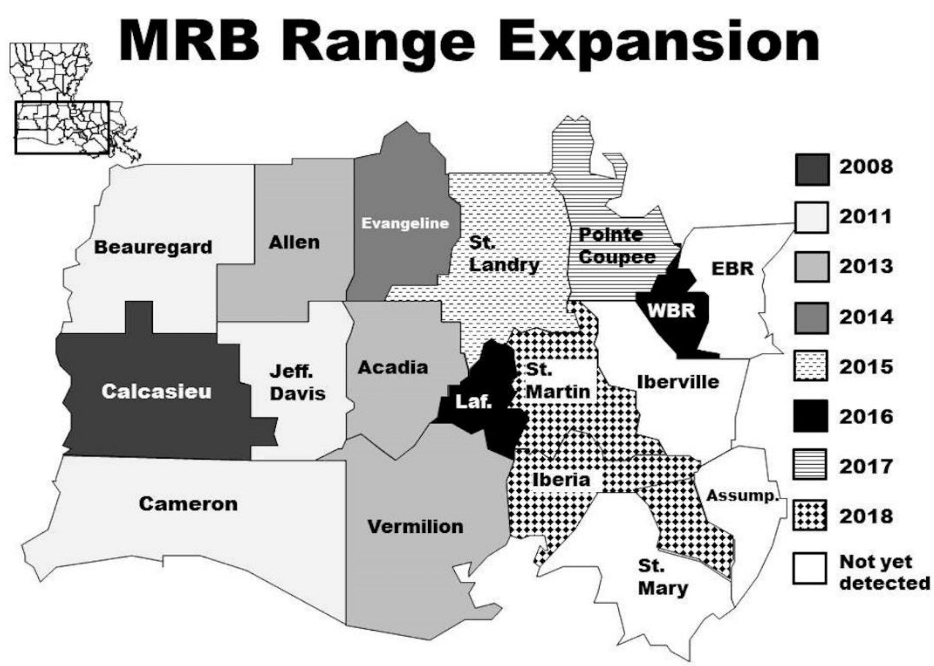
The Mexican rice borer (MRB), *Eoreuma loftini* (Lepidoptera: Crambidae), is a damaging pest of sugarcane and rice in Texas which has been expanding its range eastward along the Gulf Coast since 1980. The pest first reached Louisiana in 2008 and is now present in 14 Parishes. Range expansion is monitored primarily with pheromone traps. These traps attract male moths and are effective at detecting the pest even at very low population densities. In December of 2018, MRB moths were detected in two pheromone traps in St. Martin Parish and one pheromone trap in Iberia Parish (Fig. 1). This expansion is consistent with previous observations indicating eastward movement of approximately 15 miles per year.

Low-level infestations have been observed in sugarcane fields in Vermilion, West Baton Rouge, St. Landry, Lafayette, and Pointe Coupee Parishes. High trap captures have been recorded in western rice producing Parishes since 2012, and widespread infestations have been observed in rice fields in Calcasieu, Cameron, Jefferson Davis, and Acadia Parishes.

Sugarcane infested with MRB being transported to sugar mills during harvest may contribute to more rapid range expansion in coming years. There is potential for MRB to have an enormous impact to Louisiana's sugarcane, however, its remains unknown if the pest will reach the severe levels commonly seen in sugarcane in the Rio Grande Valley. High annual rainfall and successful integrated pest management programs developed for the sugarcane borer, should help to mitigate the impact of this invasive pest in Louisiana.

Figure 1: Mexican rice borer range expansion in Louisiana 2008–2018



EVALUATION OF SOIL-APPLIED INSECTICIDES FOR CONTROL OF WIREWORMS AT PLANTING

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Wireworms (Coleoptera: Elateridae) are sporadic pests of sugarcane which feed on seed cane at planting and have potential to reduce plant populations. One of two currently labeled organophosphate insecticides is applied at planting to approximately 25% of plant cane acres. Applications of these insecticides are frequently based on a preventative approach with no sampling conducted for pest densities. The benefits of soil-applied insecticides to crop yields are not well understood. Further, a new neonicotinoid insecticide, thiamethoxam (Platinum®, Syngenta) is anticipated to receive EPA registration for use in sugarcane in coming years but the product has not been tested for efficacy against wireworms. Field studies conducted in the 2017/2018 sugarcane production cycle evaluate phorate (Thimet®, AMVAC) at two rates and a single rate of thiamethoxam in large plot trials on commercial sugarcane farms.

Two separate experiments conducted at Iberville Parish and St. Mary Parish included 4 treatments randomized to 0.6–1.0 acre plots planted and applied 13 August (Iberville) and 7 Sept 2017 (St. Mary). Three 50 foot transects were established in the two center rows of each plot. Stand counts were taken in each transect twice during the fall and again during the spring. A single stand count was made during the fall in St. Mary Parish. During each sampling, gaps >3 ft were dug up for the presence of wireworms. At the spring sampling dates, test tubes baited with hotdogs were placed in each transect for 1 hour in to assess populations of the red imported fire ant, *Solenopsis invicta*, a key beneficial insect in the sugarcane agro-ecosystems. All data from each experiment was analyzed separately using generalized linear mixed models (PROC GLIMMIX) and Tukey's HSD was used for all means separation.

No differences in stand per acre were detected in either test at any of the sampling dates (Tables 1 and 2). Plant stand at the Iberville experiment was uniform and no gaps >3 ft were observed. Numerous gaps were recorded in the St. Mary experiment, but none were attributed to wireworm infestation. No wireworms were recovered from soil sampling at either experiment. Ant populations in Platinum-treated plots were reduced relative to non-treated controls in the Iberville Parish experiment. These results indicate the benefits of soil applied insecticides at planting are highly variable. Approximately 30% of plant cane acres are treated with insecticides with no sampling for soil insects conducted prior to application. Further research is needed to identify conditions in which these applications will provide increases in sugar yields. Reductions in ant populations in Platinum treated plots indicate this product has potential to exacerbate infestations of the sugarcane borer during the summer.

Table 1. Sugarcane plant density and fire ant populations as affected by soil insecticide treatments, Iberville Parish, 2017–2018.

Treatment	Stand per acre 7 Sept 2017 (±1495 [SE])	Stand per acre 11 Nov 2017 (±1316 [SE])	Stand per acre 14 May 2018 (±5240 [SE])	Ants/trap (14 May) (± 49.7[SE])
Thimet (5 lbs/acre)	13,056	36,190	65,100	126.2ab
Thimet (15 lbs/acre)	11,969	36,938	63,649	78.3ab
Platinum	11,528	36,691	65,633	30.7b
Non-treated	13,394	37,983	66,612	169.1a
F =	0.63	0.33	0.14	3.43
df =	3,9	3,12	3,9	3, 8.2
P =	0.611	0.804	0.936	0.071

Table 2. Sugarcane plant density and fire ant populations as affected by soil insecticide treatments, St. Mary Parish, 2017–2018

Treatment	Stand per acre 18 Dec 2017 (±3546 [SE])	Stand per acre 17 May 2018 (±5874 [SE])	Ants/trap (17 May) (±26.2 [SE])
Thimet (5 lbs/acre)	23115	43832	18.5
Thimet (15 lbs/acre)	25936	48831	14.6
Platinum	25711	53669	17.9
Nontreated	22528	40268	67.7
F =	0.60	0.99	1.75
df =	3, 6	3, 8	3, 39
P =	0.640	0.444	0.172