

## ASSESSMENT OF VARIETAL RESISTANCE TO THE SUGARCANE BORER AND MEXICAN RICE BORER

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Sugarcane resistance to the sugarcane borer (SCB), *Diatraea saccharalis*, and Mexican rice borer (MRB), *Eoreuma loftini*, is categorized as a combination of physical characteristics that hinder boring (i.e. rind hardness, leaf-sheath appression), variety specific tolerance to boring, and antibiosis mechanisms that contribute to differences in survival in larvae that have bored into the stalks. However, the single greatest component of resistance to the Mexican rice borer shows to be characteristics of plant vigor minimizing leaf senescence and attractiveness for egg laying. The extent of this resistance is also influenced by the severity of infestations. Heavy borer pressure results in more bored internodes even in varieties considered highly resistant. Several factors contributing to seasonal area-wide SCB and MRB infestation levels include weather conditions, predator and parasite numbers, indigenous borer populations, and effectiveness of insecticidal controls. Expansive acreage of varieties with elevated moth production increases endemic SCB and MRB populations and imposes additional pressure on the remaining acreage of more resistant varieties. A minimal component in the practice of host plant resistance in entomology involves the encouragement of breeding programs not to release varieties more susceptible to key insect pests than those varieties already commonly grown. This is particularly important when there is evidence that the susceptible variety has the potential to enhance pest populations.

Eight sugarcane varieties of the L99, L01, and HoCP00 series, kept in the variety development program including three standard varieties (HoCP 85-845, LCP 85-384, and L99-226) were evaluated for resistance/susceptibility to SCB and MRB during 2007. All varieties were planted in 12-ft plots (5 stalks/variety/plot) on October 6, 2005 at Ganado, TX in a randomized complete block design with 5 replications. Mocap 20G was applied in furrow and immediately covered as rows were planted. Atrazine 4L was sprayed for preemergence weed control.

Mid-late season assessment of borer injury was recorded on August 21-22, 2007 by dissecting six randomly selected stalks from each replication of each variety (5 replications = 30 stalks per variety). Sampled stalks were examined to determine the number of bored internodes, moth emergence holes, and the total number of internodes. Significant differences were detected among cultivars with L 99-233 being the most susceptible and HoCP 85-845 and L 03-371 the most resistant cultivars (Figure 1). HoCP 85-845 (16.9% total bored internodes) is the least MRB susceptible cultivar in terms of total bored internodes, which is consistent with Reay-Jones et al. (2003, 2005). Analysis of damage caused by each borer revealed that MRB injury was higher than SCB for all varieties except L 03-371. L 03-371 suffered the least damage by MRB (7.1%). L 01-299 was the most susceptible variety with 26.1% MRB bored internodes, however, this variety was the least susceptible variety to SCB with 1.8% SCB bored internodes. HoCP 00-950 was the most susceptible to SCB and showed 10.9% SCB damaged bored internodes. These results are presented in Fig. 1.

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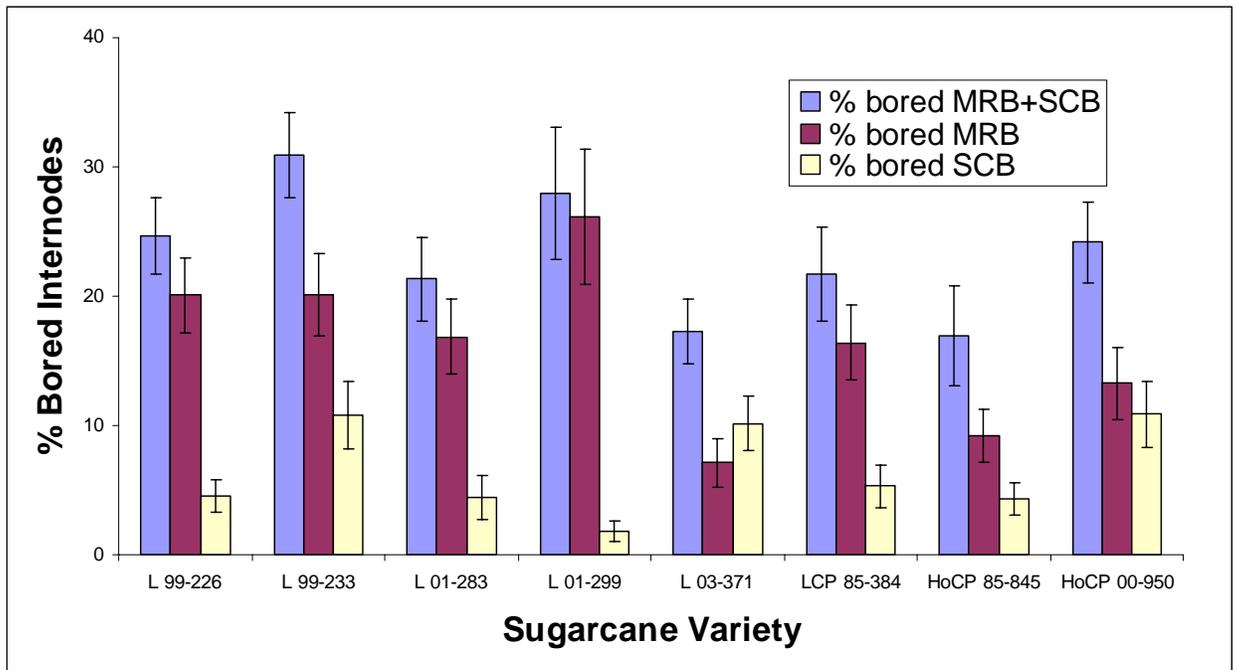


Fig. 1. Sugarcane borer and Mexican rice borer injury in ratoon cane L99, L01, L03, and HoCP00 series varieties along with three commercial varieties during 2007. Test was planted October 6, 2005, and destructive sampling conducted on August 21-22, 2007 at Ganado, TX.

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## AERIAL INSECTICIDAL CONTROL OF THE SUGARCANE BORER AND NON-TARGET ARTHROPOD ASSESSMENT, 2007

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Aerial insecticidal control of sugarcane borer (SCB), *Diatraea saccharalis*, was evaluated in a randomized complete block experimental design with five replications using variety 'HoCP 96-540' plantcane sugarcane near Broussard, Iberia Parish. The insecticides evaluated were two insect growth regulators (Confirm<sup>®</sup> and Diamond<sup>®</sup>) and one pyrethroid (Prolex<sup>®</sup>). Insecticide treatments were randomly assigned to field plots (5.3 acres/treatment). All insecticide sprays were applied in water and a non-ionic surfactant Latron CS-7 (at a rate of 0.25% vol/vol) on July 26, 2007 based on 5% live SCB larval infestations in the leaf sheath. The insecticides were applied to 12-row plots (664 ft/row) on July 26, 2007 using a helicopter calibrated to deliver 3 gpa. SCB infestations were monitored weekly, post treatment, by sampling 20 randomly selected stalks on the center rows of each treatment. Relative soil-surface associated arthropod abundance was also determined using two pitfall traps, placed 25-ft apart on the 6<sup>th</sup> and 7<sup>th</sup> row of each plot. Ethylene glycol was used to preserve specimens in pitfall traps. Traps were placed in plots on 27 Jun, with pretreatment sampling conducted from 17 to 25 Jul. Trap assessment of treatments was conducted from 25 Jul to 8 Aug, 8 to 31 Aug, and 31 Aug to 21 Sep. Arthropod specimens were sorted to four groups: red imported fire ants, spiders, predaceous beetles, and field crickets.

The minimum weekly infestation in the insecticide treated plots was 1.25% in plots treated with Confirm<sup>®</sup>, with all treatments significantly less than the untreated check of 8.50% average season-long infestation. Plant injury was significantly less for all treatments than the untreated check which had 8.60% bored internodes. The IGR Diamond<sup>®</sup> treatment had significantly less bored internodes than the pyrethroid Prolex<sup>®</sup>. However, the IGR Confirm<sup>®</sup> did not differ significantly from both Diamond<sup>®</sup> and Prolex<sup>®</sup>. Based on season-long control of SCB, novaluron showed a trend to be the best treatment as shown in Table 1.

Differences in non-target arthropod relative abundance were not detected among plots prior to the use of insecticidal treatments. Over the entire post-treatment sampling period, none of the insecticides tested had a measurable impact on fire ants, predaceous beetles, or crickets (Table 2). However, spiders were less abundant in Prolex<sup>®</sup> - (pyrethroid) treated plots compared to Diamond<sup>®</sup> -treated plots, with Confirm<sup>®</sup> and the untreated check plots having intermediate abundances (Table 2). The differential spider abundance was detected during the second post-treatment sampling period (8-31 Aug) with fewer spiders in Prolex<sup>®</sup> -treated plots relative to the untreated and Diamond<sup>®</sup> -treated plots. During the third sampling period after treatment (31 Aug- 21 Sep), there was only a trend for fewer spiders in Prolex<sup>®</sup> -treated plots relative to the untreated plots.

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Calvin Viator, Ph.D. and Associates, LLC

Table 1. Insecticide treatment infestations of sugarcane borer (SCB) and end of season bored internodes. Test conducted (5 replication) at Broussard (Iberia Parish), La, on HoCP 96-540 plantcane.

Chemical	Rate (oz/ac)	Percent post-treatment infestations ( $\pm$ SEM)	Percent bored internodes ( $\pm$ SEM)
Diamond	9	1.5 (0.50)a	0.57 (0.29)a
Confirm	8	1.25 (0.69)a	1.20(0.64)ba
Prolex	2	2.25 (0.85)a	2.63 (0.41)b
<b>Untreated</b>	-	<b>8.5(1.84)b</b>	<b>8.60 (1.73)c</b>
<i>F-value</i>		10.10	45.57
<i>df</i>		3,9	3,12
<i>P-value</i>		0.0031	<0.0001

Means within columns followed by the same letter are not significantly different (Tukey's HSD test at  $\alpha=0.05$ ).

Table 2. Effect of insecticides on non-target arthropods sampled in pitfall traps.

Treatment	Rate (oz/ac)	No. non-target arthropods / plot <sup>a</sup>			
		Red imported fire ants	Spiders	Predaceous beetles	Field crickets
Diamond	9	140.8	39.2 a	23.2	29.6
Confirm	8	176.8	29.8 ab	20.6	35.8
Prolex	2	177.0	21.0 b	21.0	27.2
Untreated check	-	149.8	35.8 ab	27.0	38.3
<i>F-value</i>		0.24	5.95	1.01	0.62
<i>df</i>		3, 11.62	3, 10.85	3, 11.75	3, 14.84
<i>P-value</i>		0.8672	0.0118	0.4238	0.6153

Means were calculated adding up the frequencies for the two traps embedded in each plot.

Pre-treatment abundances (monitoring period from 07/25/07 to 08/08/07) were not different ( $P>0.05$ ) among plots.

## FIELD EVALUATION OF CURRENT SUGARCANE GERMPLASM FOR RESISTANCE TO APHIDS

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Population trends of the sugarcane aphid (white aphid) and yellow sugarcane aphid were monitored biweekly in 5–replication field plots of sugarcane cultivars LCP 85-384, HoCP 91-555, Ho 95-988, HoCP 96-540, and L 97-128. These varieties were planted in single row plots (24 ft) in a randomized complete block design on August 15, 2006 near Youngsville, LA. Data on aphids were collected biweekly from early April through early September 2007 by randomly selecting 10 plants from each plot and recording number of adults and nymphs on two leaves with maximum aphid aggregation.

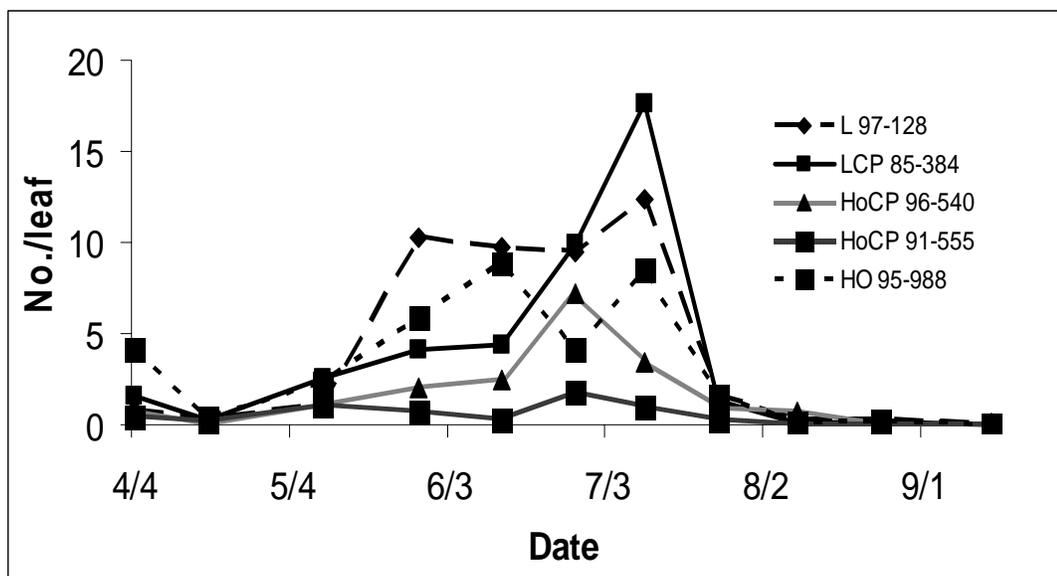
The yellow sugarcane aphid was the dominant aphid on most varieties in the beginning of the season (April through mid May) except on Ho 95-988. By late May and onward, more white aphids than yellow sugarcane aphids were recorded on all varieties except HoCP 91-555. The total aphid population was very low early in the season with maximum of 4.13 aphids per leaf on Ho 95-988 on April 4, 2006. At this time, L 97-128 had only 0.81 aphids/leaf. However, the increase in aphid numbers on this variety was the quickest with 10.22 aphids per leaf recorded on May 28. The peak aphid population of the season was recorded on July 10 on LCP 85-384 (17.6 aphids/leaf) and L 97-128 (12.4 aphids/leaf). By late July, the populations had crashed in all varieties and never increased again. HoCP 91-555 was the most resistant variety throughout the season with maximum of 1.77 aphids/leaf recorded on June 27. at peak population times (mid June to mid July), HoCP 91-555 had significantly less numbers of aphids than the most susceptible cultivar L 97-128 ( $P < 0.05$ ). Based on the season-long average aphids/leaf, the varieties can be ranked from most to least susceptible as L 97-128 > LCP 85-384 > Ho 95-988 > HoCP 96-540 > HoCP 91-555. These results are presented in Fig. 1.

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This research is part of Ph.D. dissertation research program of Waseem Akbar.

**Fig. 1.** Total number of aphids per leaf on different sugarcane cultivars during 2007 crop season, Youngsville, LA.



## IMPACT OF PLANTING DATES ON SUGARCANE BORER POPULATIONS

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Two field experiments were conducted to determine the role of planting date and varietal resistance on the sugarcane borer (SCB), *Diatraea saccharalis*, populations in sugarcane. In 2006, a 10-replication field study near Patoutville was initiated with L 97-128 (SCB susceptible) and L99-226 (SCB moderately resistant) in four planting dates (Aug. 4, Sept 2, Oct. 5, Nov. 22). In 2007, a 4-replication field study near Bunkie was initiated with Ho 95-988 (SCB susceptible) and L99-226 (SCB moderately resistant) in four planting dates (Aug. 6, Sept 5, Oct. 10, Nov. 21). These experiments were arranged following a split plot design. Planting dates were assigned to the main plot level, and varieties to the subplot level. Assessment of infestations for potential overwintering involved deadheart counts for each subplot in the fall.

The number of SCB-related deadhearts recorded on Nov. 22, in both 2006 and 2007, showed that early August planting dates have important SCB infestations and the potential to host major overwintering populations (Table 1). Later planting dates likely minimize overwintering populations.

Table 1. Number of SCB-related deadhearts occurring during the fall for three planting dates.

a. Data collected on November 22, 2006			b. Data collected on November 22, 2007		
Planting date	SCB-caused deadheart/acre <sup>a</sup>		Planting date	SCB-caused deadheart/acre <sup>a</sup>	
	L97-128	L99-226		HoCP 95- 988	L99-226
Aug. 4	3,049	2,033	Aug. 6	1,068	705
Sept. 2	327	799	Sept. 5	23	91
Oct. 5	73	73	Oct. 10	0	0

<sup>a</sup> determined from a 21-ft-row sampling units per subplot

<sup>a</sup> determined from two 40-ft-row sampling units per subplot

## STEM BORER INFESTATIONS IN NON-CROP HOSTS: A SENTINEL PLANT EXPERIMENT

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A 4-replication sentinel plant experiment involving five weed species selected according to species abundance near sugarcane and rice production fields, and according to their potential as stem borer alternate hosts was conducted during the summer of 2006. Johnsongrass (*Sorghum halepense* [L.] Persoon), Amazon sprangletop (*Leptochloa panicoides* [Presl] Hitchc.), broadleaf signalgrass (*Urochloa platyphylla* [Munro ex C. Wright] R. D. Webster), vaseygrass (*Paspalum urvillei* Steud.), barnyardgrass (*Echinochloa crus-galli* [L.] P. Beauv.), and rice (cultivar Cocodrie) were grown for eight weeks in a greenhouse prior to being carried and transplanted in a rice field.

Destructive sampling at 30 days post transplanting showed that both Mexican rice borer (MRB) and sugarcane borer (SCB) attacked all weed species and rice, and that all stages of both borer species were found in johnsongrass, Amazon sprangletop, vaseygrass, and rice (Table 1). Indicating lifecycle completion, the percentage of large larvae and pupae collected from the following grasses on a per plant basis were 50%, 20%, and 7% for Amazon sprangletop, johnsongrass, and vaseygrass, respectively. However, only small larvae were found in broadleaf signalgrass and in barnyardgrass. Thus, stem borers are unlikely to complete their life cycle on these two grasses, maybe due to a smaller stem diameter. These results show that large-stemmed non-cultivated plants likely play an important role in the inter-year population dynamics of stem borers in the rice agroecosystem.

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\*M.O. Way and L.T. Wilson are affiliated with the Texas A&M University Center at Beaumont, and Dr. Wilson is on the Ph.D. advisory committee of Julien Beuzelin.

This research is part of Ph.D. dissertation research program of Julien M. Beuzelin.

Table 1. Attributes of stem borer infestations in non-crop grasses after a 4 weeks exposure to natural infestations, Aug-Sep 2007, Ganado, TX.

	% of plants with <sup>a</sup>			No. stem borer immature/plant <sup>b</sup>	% MRB vs. SCB <sup>c</sup>
	Bored Stems	Stem borer immatures	Large borer immatures		
Sprangletop	97.5 a	67.5 a	60.0 a	2.35 a	55.4
Rice	72.5 b	70.0 a	22.5 ab	1.33 ab	43.2
Johnsongrass	62.5 b	42.5 ab	25.0 ab	0.98 b	42.6
Barnyardgrass	72.5 b	20.0 bc	10 b	0.45 b	73.6
Broadleaf signalgrass	55.0 bc	30.0 abc	7.5 b	0.35 b	58.1
Vaseygrass	25.0 c	5.0 c	2.5 b	0.10 b	50.0
F value	11.44	11.39	7.35	8.63	2.09
Pr> F	<0.0001	<0.0001	=0.0007	=0.0003	=0.1238

<sup>a</sup>Arcine transformed data, SAS, Proc Mixed, <sup>b</sup>SAS, Proc Glimmix (Poisson distribution), <sup>c</sup>SAS, Proc Glimmix (Binomial distribution). Means within a column with the same letters are not significantly different (Tukey's HSD,  $\alpha=0.05$ ).

## IMPORTANCE OF NON-CROP GRASSES IN STEM BORER POPULATION DYNAMICS

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Three farms were selected in the upper (N 30.059°, W 94.279°), middle (N 29.855°, W 94.544°), and lower (N 29.027°, W 96.439°) Texas rice production area. On each farm, non-cultivated habitats (i.e. field margins) were sampled to estimate stem borer natural infestation densities in non-crop grasses. Two transects were drawn along field margins. Each transect was sampled at three random locations, with at each location three 1-m<sup>2</sup> quadrats randomly selected within a 10-m radius. For each quadrat, grasses were cut at soil level. Grasses were identified and their relative abundance visually estimated before being dissected to recover stem borers. Surveys were conducted during the first week of April, the last week of May, and the third week of December, 2007 to estimate stem borer population density during the early rice growing season as well as during the post season before the winter.

Early in the spring, prevalent grasses were annual grasses such as *Phalaris* spp., *Lolium* spp., and *Bromus* spp., but also johnsongrass and vaseygrass. Stem borer densities observed are reported in Table 1. Vaseygrass harbored 64% of the stem borers, while no immatures were found in johnsongrass. Later in the spring, the prevalent grasses were johnsongrass and vaseygrass. At this time of the year, rice plants were still too small and do not host stem borers. Johnsongrass and vaseygrass harbored 39% and 51% of stem borer infestations, respectively. Early in the winter, vaseygrass and senescing johnsongrass were the most prevalent grasses. However, senescing annuals such as hairy crabgrass (*Digitaria sanguinalis* (L.) Scop.) or fall panicum (*Panicum dichotomiflorum* Michx.) represented more than 25% of the grasses dissected. Johnsongrass and vaseygrass harbored 35% and 53% of stem borer infestations, respectively.

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This research is part of Ph.D. dissertation research program of Julien M. Beuzelin.

Table 1. Stem borer infestations in rice field margin grasses during the pre-, early, and postproduction season in different southeast Texas regions, April, May and December, 2007.

Date/Region	No. stem borer immatures / m <sup>2</sup>			
	Total MRB	Large MRB	Total SCB	Large SCB
<b>April 2-6</b>				
Upper	0	0	0	0
Middle	0.61	0.28	0	0
Lower	0.06	0	0	0
<b>May 22-26</b>				
Upper	0.39	0.22	0	0
Middle	1.72	0.94	0	0
Lower	2.3	1.22	0.11	0.06
<b>December 18-20</b>				
Upper	1.33	0.89	0.89	0.78
Middle	5.72	3.05	0.17	0
Lower	2.28	1.17	0	0

## MONITORING MEXICAN RICE BORER MOVEMENT

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Cooperative studies on the Mexican rice borer (MRB), *Eoreuma loftini* (Dyar), between the LSU AgCenter, the Texas A&M University research station at Beaumont, the Texas Department of Agriculture and the Louisiana Department of Agriculture and Forestry were conducted to monitor the movement of this insect towards Louisiana and to study the population dynamics of this devastating pest of sugarcane that can not be controlled with simple insecticide applications. The MRB has been the major economic pest in Texas sugarcane since it established in 1980, quickly surpassing the pest severity of the sugarcane borer, *Diatraea saccharalis* (F.).

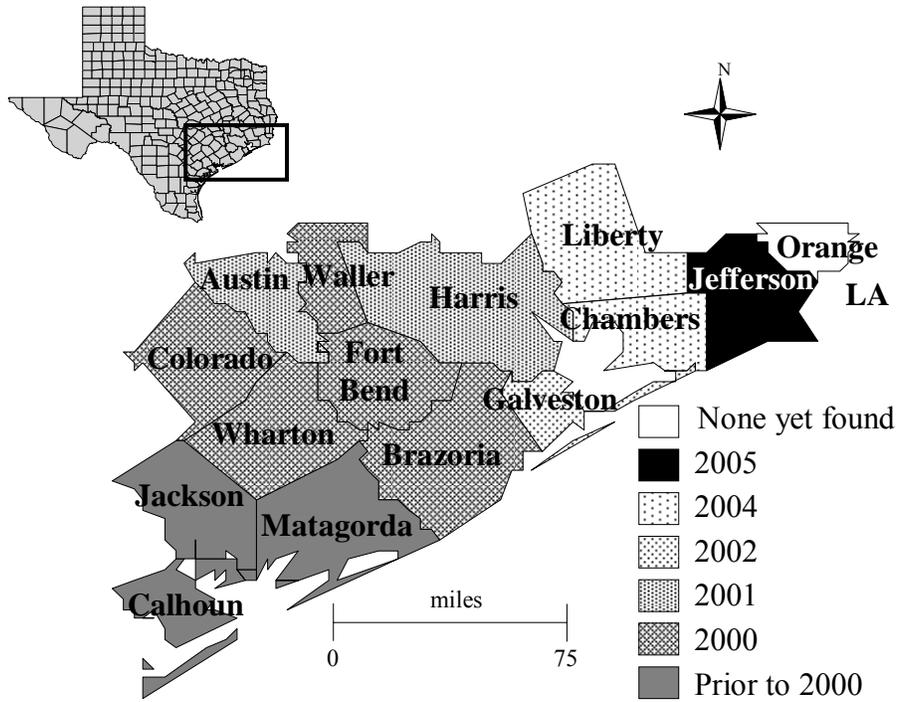
A major monitoring effort has been on-going since 2000 with the various cooperating agencies as well as with the assistance from farmers, county agents, and consultants. After the discovery in Brazoria, Colorado, Fort Bend, Waller and Wharton Counties in 2000, Harris and Austin Counties in 2001, Galveston in 2002, Chambers and Liberty in 2004, a new county was documented with MRB invasion (Jefferson) in 2005 (Fig. 1 and Table 1). The MRB is now found within seven miles of Beaumont, less than 25 miles from the Louisiana border and has been moving at a rate of 14.4 miles/year since it was discovered in Texas in 1980. Each year, infestations in newly invaded counties were initially low, but increased the following years (Table 2). Regulatory activities involving both Departments of Agriculture will continue to be important to Louisiana sugarcane farmers in order to delay the invasion of this very serious pest.

Extensive attempts involving several millions of dollars in research to introduce MRB parasites have not resulted in effective control in the Lower Rio Grande Valley of Texas. In our program, alternative control methods involving varietal resistance and cultural practices were investigated. In a field experiment conducted in 2007, the new variety L01-299 suffered 26.1% bored internodes. L 03-371 suffered the least damage by MRB (7.1% bored internodes). Based on results for the last several years, moderate levels of resistance are recorded in HoCP 85-845 (16.9% bored internodes in 2007 test at Ganado, TX). Our work for the last several years on this devastating pest has emphasized the importance of using multiple tactics in combination to manage this pest, which will be necessary when MRB becomes established in the Louisiana sugarcane industry.

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\*M.O. Way and L.T. Wilson are affiliated with the Texas A&M Research and Extension Center at Beaumont.

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**Fig. 1.** Movement of the Mexican rice borer through the East Texas rice and sugarcane area, 2000-2007.

Table 1. Pheromone trap collections of Mexican rice borer (*Eoreuma loftini*) moths in Southeast Texas during 2007<sup>1</sup>.

Texas Counties	April	May	June	July	August	September	October	November	Total
<b>Previously Known Counties</b>									
Chambers	-	222	531	353	656	1117	846	440	<b>4165</b>
Colorado	243	106	116	112	264	218	269	343	<b>1671</b>
Galveston	-	-	68	110	224	303	456	245	<b>1406</b>
Jackson	97	137	242	110	189	175	266	199	<b>1415</b>
Jefferson	21	19	49	43	135	187	240	23	<b>717</b>
Liberty	-	-	239	207	-	564	810	270	<b>2090</b>
Waller	-	104	448	313	862	1801	2216	1079	<b>6823</b>
<b>No MRB Collected</b>									
Orange	-	-	0	0	0	0	0	0	<b>0</b>

<sup>1</sup>Number of moths per two traps per month  
 - collections not complete for this month

In addition to work of the county agents, trap sampling was also conducted by technicians in M.O. Way's lab (Mark Nunez and Rebecca Pearson).

Table 2. Pheromone trap collections of Mexican rice borer (*Eoreuma loftini*) moths in Southeast

Texas from 2003 to 2007, i.e. MRB range expansion.

Texas counties	2003	2004	2005	2006	2007
Liberty	0	413	1586	8672	<b>2090</b>
Chambers	0	6	3843	7321	<b>4165</b>
Jefferson	0	0	5	239	<b>717</b>

## INSECTICIDE APPLICATIONS FOR 2007

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For the 2007 sugarcane growing season, there was on average 0.56 acre applications on total plantcane and 0.62 acre applications on total cane harvested. By far, the predominate insecticide used was Confirmed, which was followed by Karate Z and Mustang Max. A total of 233, 775 acres received an insecticide application.

Table 1. Insecticide applications for 2007.

<b>Insectide</b>	<b>Rate</b>	<b>Acres (percentage)</b>
Confirm IGR	13,328 gallons @ 8 oz/a	213,250 (91.2%)
Karate Z	372.5 gallons @ 2.56 oz/a	18,624.4 (8%)
Mustang Max	59.4 gallons @ 4 oz/a	1900 (0.8%)
<b>Total Acreage</b>	<b>Total Harvested Acres</b>	<b>Total Sprayed Acres</b>
415,264.6	377,891	233,774.5