MONITORING THE MOVEMENT OF THE MEXICAN RICE BORER FROM THE TEXAS RICE BELT TOWARD LOUISIANA

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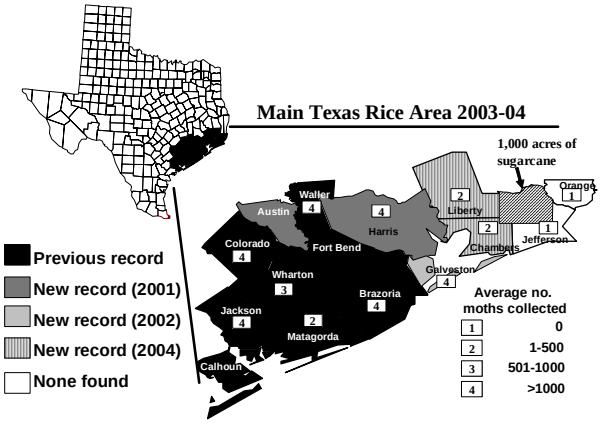
Pheromone trap sampling for the Mexican rice borer (MRB), *Eoreuma loftini* (Dyar) (Lepidoptera: Crambidae), was continued during 2004 adjacent to sugarcane or rice fields in Southeast Texas and Southwest Louisiana. These cooperative studies between Texas A&M and the LSU AgCenter were initiated in 2000 to define the insect's range and assess its increasing threat to Louisiana.

In May 2004, two bucket-type MRB pheromone traps were set up in each county of the Texas Rice Belt (Chambers, Liberty, Matagorda, Jefferson, Orange, Waller, Colorado, Wharton, Brazoria, Galveston, Jefferson and Jackson). Extensive monitoring was also conducted in two western Louisiana parishes (Calcasieu and Jefferson Davis) adjacent to sugarcane fields. Traps were additionally placed at two sugarcane mills in Iberia and St. Mary parishes. The synthetic female *E. loftini* sex pheromone (Luresept®) was used as lure and periodically replaced every 4-6 weeks. An insecticidal strip (Vaportape ® II) was placed in each bucket to kill all trapped insects and prevent them from damaging each other. Insecticidal strips were replaced every 6 weeks. The traps were attached to a metal pole at a height of 3 to 4 feet above ground. Traps were monitored every week from May to November in 2004 in Texas, and every two weeks from June to December in Louisiana.

In 2004, MRB were found in the newly infested counties of Chambers adjacent to sugarcane fields and Liberty adjacent to rice in Texas (See Figure). The insect is still not known to occur in Louisiana, but now occurs within 30 miles of the state border. From 1980 to 2001, the average rate of MRB spread toward Louisiana was 14.7 miles/yr. The rate slowed down to 12.2 miles/yr from 2001 to 2004. Assuming spread rates to remain constant, the distance between trap locations must not exceed 12.2 miles if yearly movement is to be detected. The accuracy of moth spread rate estimates decreases as distances between traps increase. Reducing distances between traps may assist in developing a more efficient monitoring program.



In addition to extensive participation by Texas rice belt county agents, western Louisiana sugarcane parish agents, personnel from both the Texas Department of Agriculture (S.S. Nilakhe) and the Louisiana Department of Agriculture and Forestry (Tad Hardy) supervised collection efforts.

Table 1. Pheromone trap collections of Mexican rice borer (*Eoreuma loftini*) moths in Southeast Texas during 2004[1].

Texas Counties	May	June	July	August	September	October	November	December	Total
Brazoria	115	240	284	531	1678	1569	216	-	4633
Chambers	0	0	0	0	3	3[2]	0	-	6
Colorado	109	211	171	248	649	1699	421	-	3478
Galveston	55	238	127	220	250	82	24	-	1311
Jackson	-	212	139	137	166	202	19	-	875
Liberty	0	0	0	42	138	152	81	-	413
Matagorda	88	24	33	54	127	70	-	-	396
Waller	26	144	144	219	389	824	154	4	1904
Wharton	22	117	25	6	113	206	75	-	564
No MRB Collected									
Jefferson	0	0	0	0	0	0	0		0
Orange	0	0	0	0	0	0	0		0

[1] Number of moths per two traps per month.
[2] Observed by Jerry W. McGee in two pheromone traps near Winnie on October 2; however, at routine collection time several days later, moths had disappeared from the trap.

EFFECTS OF DROUGHT STRESS AND SUGARCANE VARIETY ON RESISTANCE TO THE MEXICAN RICE BORER

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Cooperative studies on the Mexican rice borer, *Eoreuma loftini* (Dyar), between the LSU AgCenter and Texas A&M Research Stations at Beaumont and Weslaco continued in 2004. Greenhouse oviposition experiments on both sugarcane and rice were initiated in 2003 and completed in 2004. Sugarcane varieties LCP 85-384 and HoCP 85-845 were used under drought and non-drought stressed conditions at the 5 and 11 internode stage. Rice varieties Cocodrie and XL8 were used at the 3-4 leaf tillering stage, 6-7 leaf tillering stage, boot stage, and heading stage. Seven experiments were conducted with 4 treatments per experiment. The oviposition tests started with the release of 30 male and 30 female moths in each cage. The experiment ended 6 days after initial moth release. Number of leaves, number of dry leaves, dry weight, water potential (sugarcane only), number of tillers (rice only), number of eggs, number of egg masses and location on plant were recorded. Levels of free amino acid were also determined in sugarcane and rice leaves in selected experiments using high performance liquid chromatography.

A preliminary analysis of the data is presented in Table 1. On sugarcane, the majority of the variation in oviposition (94%), based on the number of eggs per plant, can be explained by methionone, dry leaves, and threonine, in respective order of importance. MRB oviposits in cryptic sites on dried sugarcane leaves located on the lower part of the plant, i.e. between soil surface level and 30 inches height. In our study, 100% (22,146) of the eggs on sugarcane were laid on dry leaves or dry tips of leaves. Enhanced MRB injury under stress conditions may partially be explained by increased oviposition on stressed sugarcane plants with more dry leaves. On rice plants where free amino acid data was collected, 97% of the variation in oviposition is explained by alanine levels. Oviposition on rice did not occur exclusively on dry leaves, with a significant portion of egg masses laid on green leaves or inserted behind leaf sheaths. The physical properties of the rice plant may therefore not be as important as its chemical quality.

A 2-year field study also assessed the role that irrigation, when used in combination with variety selection and insecticide application, plays on the effective management of MRB. To achieve the degree of insecticidal control shown in Figure 1, seven applications at the 8oz/acre rate of Confirm (tebufenozide) were sprayed every 2 weeks (June to mid August). In this four replication test, the untreated (non-irrigated) LCP 85-384 had an average of 66% MRB bored internodes across both years, compared to nearly 35% under the heavy insecticide pressure. Irrigation reduced injury levels in both varieties, which can be explained by the decreased attractiveness for oviposition on non-stressed sugarcane. Injury in both resistant and susceptible varieties still exceeded an average across both years of 23 and 35% MRB bored internodes, respectively, in untreated, irrigated plots. As shown in Figure 1, all management tactics were necessary to reduce injury below 10% MRB-bored internodes for both varieties in 2003, which was obtained only for the resistant variety (HoCP 85-845) in 2004.

Varieties Ho 95-988, L 97-128 and LCP 85-384 were evaluated for resistance to MRB at Ganado (TX) in 2004 (data not shown). A randomized complete block design was used with 5 replications. Differences were not detected among varieties for % MRB bored internodes (57.0 for Ho 95-988, 54.4 for LCP 85-384, and 47.4 for L 97-128).

Table 1. Oviposition preference estimates of the Mexican rice borer from greenhouse experiments, Weslaco, TX 2003-2004.

Crop	Variety	Stage	Stress (sugarcane only)	Oviposition preference estimates[1]
Sugarcane	LCP 85-384	5 internodes	Non drought stressed	0.533
			Drought stressed	1.000
		11 internodes	Non drought stressed	0.646
			Drought stressed	0.575
	HoCP 85-845	5 internodes	Non drought stressed	0.318
			Drought stressed	0.683
		11 internodes	Non drought stressed	0.245
			Drought stressed	0.558
Rice	Cocodrie	Tillering 3-4 leaves		0.000
		Tillering 6-7 leaves		0.032
		Boot		0.160
		Heading		0.181
	XL8	Tillering 3-4 leaves		0.000
		Tillering 6-7 leaves		0.149
		Boot		0.320
		Heading		0.219

[1]Standardized oviposition preference estimates ranging from 1.000 (most attractive treatment) to 0.000 (least attractive treatment) based on number of eggs laid per plant adjusted for across experiment variability.

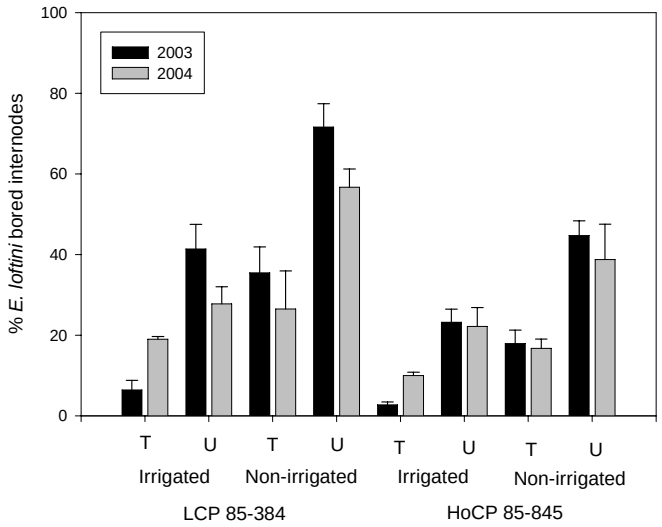

Fig. 1. Mean (± SEM) *E. loftini* percentage of bored internodes in sugarcane irrigation, cultivar, and insecticide (T=treated; U=untreated) experiment at Ganado, TX, 2003-2004.

This research is part of a Ph.D. Dissertation Research Program of Francis Reay-Jones. Appreciation is also expressed for participation and cooperation to additional technical personnel at Texas A&M Research Centers in Weslaco and Beaumont, respectively; and to Allan Showler at USDA-ARS, Kika de la Garza Subtropical Agricultural Research Center, Weslaco, TX.

ASSESSMENT OF VARIETAL RESISTANCE TO THE SUGARCANE BORER

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Sugarcane resistance to the sugarcane borer (SCB), *Diatraea saccharalis*, 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. The extent of this resistance also is 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 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 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. For this reason, we also report moth production for each variety in these tests.

Nine sugarcane varieties of the L02, HoCP01 series, kept in the variety development program and four standard varieties (HoCP 91-555, HoCP 85-845, LCP 85-384, and US 02-99) were evaluated for resistance/susceptibility to SCB during 2004. All varieties were planted on September 29, 2003, near Burns Point at the Bozo Luke farm in St. Mary Parish in a randomized complete block design with 4 replications each. No chemical controls for SCB were applied in the test, and SCB predation from fire ants was suppressed by applying Karate to the soil on July 7, 2004, and Dursban on July 22, 2004. A 16-stalk sample was cut from each plot on November 26, 2004, (four replications = 64 stalks per variety). Sample stalks were examined to determine the number of bored internodes, moth emergence holes, and the total number of internodes at the end of the season.

Significant differences among the varieties were detected, with HoCP01-561 (52.76% bored internodes) being the most susceptible. Among the standard varieties tested, HoCP 91-555 was the most susceptible (38.1% bored internodes) and HoCP 85-845 was the most resistant (14.8% bored internodes). Emergence per acre from each variety also differed significantly, with the highest numbers emerging from Ho95-988 (91,643), and the lowest number (13,687) emerging from the most resistant commercial variety to sugarcane borer, HoCP 85-845. Theses results are presented in Table 1.

Table 1. Sugarcane borer injury and moth production in plant-cane L02, HoCP00 series varieties and four commercial varieties during 2004, Bozo Luke Farm near Burns Point, Louisiana. Test was planted September 29, 2003, samples harvested November 26, 2004.

Variety	% Bored internodes	Stalks/acre*	Moths/acre production
HoCP 01-561	52.76a	31763	84370a
HoCP 01-517	43.7ab	27301	66546ab
L 02-324	38.4abc	35415	71937ab
HoCP 91-555	38.1abc	36762	81566a
LCP 85-384	35.4abcd	36981	64139ab
HoCP 01-564	29.1bcd	31914	37898abc
HoCP 01-551	26.7bcd	32973	45338abc
L 02-316	25.7bcd	31082	35939abc
L 02-325	23.0bcd	29698	32482abc
HoCP 01-523	22.8bcd	37661	40603abc
US 2-99	21.7bcd	-	-
L 02-342	21.4cd	35393	38711abc
HoCP 85-845	14.9d	31120	18477bc

Means within columns followed by the same letter are not significantly different ($P \leq 0.05$, LSD).
*Stand counts provided by Dr. Kenneth Gravois, St. Gabriel Station.
¯No separate field test was conducted for this variety and stand counts were unavailable.

Acknowledgment: The sugarcane entomology program would like to express appreciation for help from other members of the sugarcane variety development and breeding program for their assistance in cutting the seed-cane, and helping to select the varieties for evaluation. Additionally, Dr. W. H. White (USDA-ARS) provided the USDA varieties used in these studies.

SMALL PLOT ASSESSMENT OF INSECTICIDES AGAINST THE SUGARCANE BORER

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A study was conducted at the Louisiana State University AgCenter Sugar Research Station, St. Gabriel, La., (Iberville Parish), to evaluate eight different insecticide treatments, in addition to an untreated check, for season-long control of the sugarcane borer (SCB) *Diatraea saccharalis* (F.) (Lepidoptera: Crambidae) in a randomized complete block design with five replications. Insecticide treatments were applied to 3-row plots (6 ft x 30 ft) of variety HoCP91-555 on 19 Jul and 10 Aug using a CO_2 sprayer mounted on an all-terrain vehicle with an 8005 flat-fan nozzle (one per row) delivering 10 gpa at 35 psi. In first week of July 2004 Lorsban 15G (15lb/acre) was applied to suppress fire ant predation on SCB larvae. SCB injury to sugarcane was assessed by counting the number of bored internodes and total number of internodes from 80 randomly selected stalks from each of eight treatments and the untreated check (16 stalks per plot) from each plot at the time of harvest (4 November). Data was analyzed using a one-way analysis of variance (Proc Mixed) with means separated with Tukey's HSD ($P<0.05$).

All of the insecticide-treated plots resulted in less than 18% bored internodes (economic injury level) and were significantly different from the untreated check of 50.7% bored internodes as shown in Table 1. None of the insecticides differed significantly from each other.

Table 1. Results of small plot test on (SCB) *Diatraea saccharalis* (F.), St. Gabriel Research Station, 2004.

Treatment/ Formulation[a]	Rate (oz/A)	% Bored Internodes[b]
Baythroid 2E	2.1	11.0b
Mustang Max 0.8EC	4	11.4b
Confirm 2F	8	12.2b
Denim	0.09	12.9b
Diamond 0.83EC	8.00	13.6b
XR-225 DOW	0.016	15.2b
Diamond 0.83EC	12	16.9b
Karate Z	1.92	17.3b
Check		50.7a
F-value		35.4

[a]All treatments were applied with Latron CS-7 at 0.25% vol/vol.
[b]Means within column followed by the same letter are not significantly different ($P<0.05$, Tukey's HSD).

AERIAL INSECTICIDAL CONTROL OF THE SUGARCANE BORER AND NON-TARGET ARTHROPODS ASSESSMENT

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Aerial insecticidal control of SCB was evaluated in a randomized complete block experimental design with four replications using variety 'LCP 85-384' plant-cane sugarcane at Broussard Plantation, Cheneyville, La., in Rapides Parish. Insecticide treatments were randomly assigned to field plots (almost 5 acres/treatment/plot). All insecticide sprays were applied with water on 16 Jul and 13 Aug using a Turbo Thrush Commander aircraft (60-foot spray swath) calibrated to deliver 5 gpa. All treatments were applied with the surfactant Latron CS-7 at a rate of 0.25% vol/vol. SCB infestations were monitored weekly and plots were initially treated when 5% of the sugarcane stalks contained live larvae in the leaf sheaths. Relative soil-surface associated arthropod abundance was determined using three pitfall traps placed in the center row of each plot at 100-ft intervals, 100-ft from the beginning of the plot (100 ft, 200 ft, 300 ft). Ethylene glycol was used to preserve specimens in pitfall traps which were then identified and sorted to family level in the laboratory. Pre-treatment pitfall trap sampling was conducted from 11 Jun to 2 Jul, and from 2 to 15 Jul. Trap assessment of treatments was conducted from 20 Jul to 4 Aug, 4 to 17 Aug, and 17 Aug to 2 Sept.

Both rates of novaluron (Diamond 0.83EC) had significantly lower end of season SCB percent bored internodes than either tebufenozide (Confirm 2F) or the untreated check, and novaluron-treated plots also had significantly fewer moth emergence holes than the untreated plots (Table 1). None of the insecticides tested had a measurable impact on ants, spiders, or other non-target arthropods over the entire sampling period (Table 2). However, during the fourth sampling period (4-17 Aug), no click beetles were collected in the lower rate novaluron-treated plots, and a trend was observed for a lower number in the higher rate novaluron-treated plots.

Table 1. Aerial application study for control of the sugarcane borer, Broussard Plantation, Chenyville, Louisiana, 2004.

Treatment/ Formulation	Rate oz/acre	%bored internodes	No. exit holes[a]
Novaluron 0.83EC	8.0	1.58c	0.0b
Novaluron 0.83EC	12.0	2.45c	277.4b
Tebufenozide 2F	8.0	7.88b	1664.6ab
Untreated control		19.29a	2496.9a
P > F		< 0.0001	0.0073

Means within the same column followed by the same letter are not significantly different ($P < 0.05$; Tukey's HSD).
[a] Estimated as the product of the mean number of exit holes and the number of stalks per acre.

Table 2. Mean number of non target arthropods in treated and control plots at Broussard Plantation, Chenyville, Louisiana.

		Average no. arthropods/trap/sampling period								
Treatment/ formulation	Rate oz/ac	Ants	Crickets	Spiders	Ground beetles	Click beetles	Rove beetles	Scarab beetles	Other beetles	Other insects
Novaluron 0.83EC	8.0	48.9a	5.8a	9.5a	2.0a	0.9a	1.8a	1.3a	1.4a	7.5a
Novaluron 0.83EC	12.0	61.0a	4.1a	8.7a	2.7a	0.9a	1.4a	2.0a	1.1a	7.1a
Tebufenozide 2F	8.0	41.6a	6.4a	9.7a	2.7a	1.4a	1.4a	0.9a	1.5a	8.8a
Untreated control		38.9a	6.5a	8.8a	2.0a	1.4a	2.0a	0.7a	1.8a	7.1a
F value[a]		1.34	0.26	0.16	0.11	0.63	0.19	0.68	0.93	0.09
P > F		0.3216	0.8528	0.9215	0.9531	0.6126	0.9036	0.5849	0.4661	0.9636

[a] df = 3.9

Count data was analyzed using a generalized linear mixed model with a repeated measures statement for the five sampling dates and a Poisson distribution. Means followed by the same letter are not significantly different ($P < 0.05$).

Insecticide plots were treated 16 Jul and 13 Aug.