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Managing the *Mexican Rice Borer* in Texas

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The Mexican rice borer (MRB), *Eoreuma loftini* (Dyar), is a stalk-boring insect which recently invaded south Texas from Mexico. This insect has caused serious economic losses in sugarcane, and as it moves northward, threatens other important crops such as sorghum, corn and rice. The purpose of this publication is to familiarize producers, consultants, Extension personnel and others with the description, biology and management of the Mexican rice borer.

Distribution

The MRB was first identified in western Mexico, southern Arizona and southern California. Now it is found across Mexico and south Texas. Since it was first reported in Texas in 1980, its distribution has expanded to include 40 south Texas counties (Fig. 1). It continues to spread northward. Traps baited with MRB sex pheromone are being used to monitor the spread of the borer in Texas and adjacent areas of Louisiana.

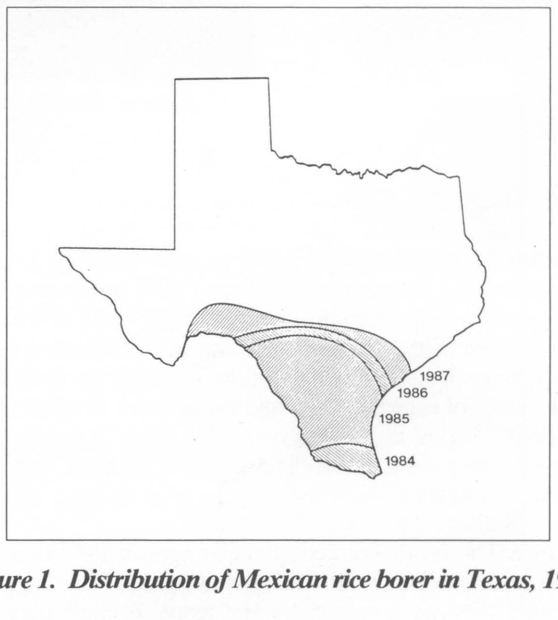
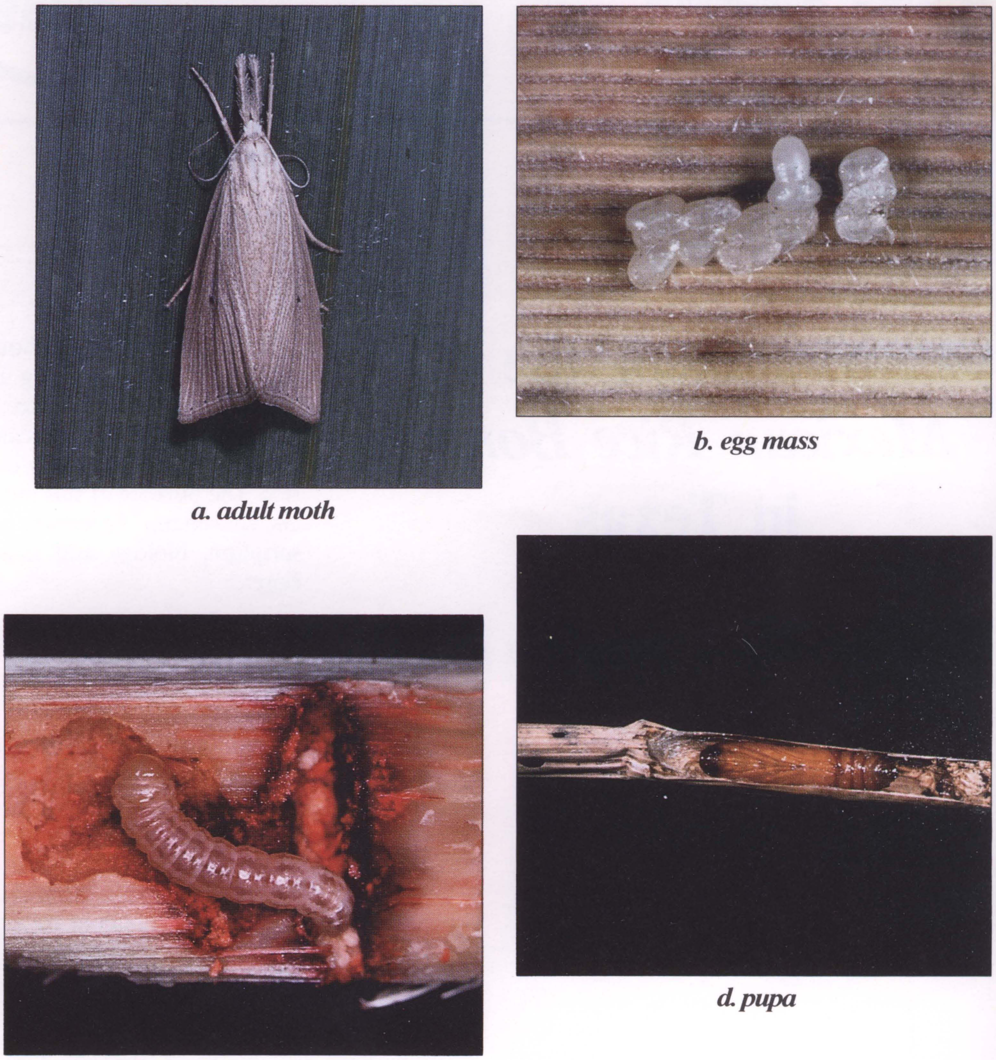


Figure 1. Distribution of Mexican rice borer in Texas, 1988.

Figure 2. Life stages of the Mexican rice borer.



a. adult moth

b. egg mass

c. larva feeding in sorghum stem

d. pupa

Life Stages

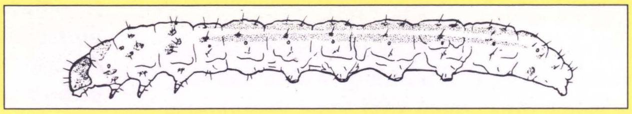
Adult Moth. The adult MRB is approximately 1/2 to 3/4 inches long and creamy white in color. It has enlarged mouthparts which protrude in front of the head when the moth is at rest **(Fig. 2a)**. This moth can be distinguished from other species of stalk borers found in Texas by the dark spot in the center of each forewing and the absence of other wing markings. Males are slightly smaller than females, but otherwise very similar. Moths are active at night and are attracted to lights.

Eggs. The cream-colored, globular eggs of the MRB are laid in masses of five to 100 or more **(Fig. 2b)**. The eggs are cemented between layers of dry leaf tissue. Because they are hidden, they are difficult to sample in the field. Most other North American stalk-borer moths lay flat eggs in masses on the open surfaces of green leaves or stems.

Larvae. Cream-colored larvae have two broken, purple-red lines along the length of the body on each side **(Fig. 2c)**. Newly molted or resting larvae may have less conspicuous stripes. Unlike many other borer species, they have no conspicuous hairy plates on the dorsal surface of the body. The orange-brown head capsule contrasts with the light color of the body. Mature larvae measure 3/4 to 1 inch long after undergoing five or six molts. The illustrations in **Fig. 3** will aid in distinguishing the MRB from the other stalk borers found in rice in Texas.

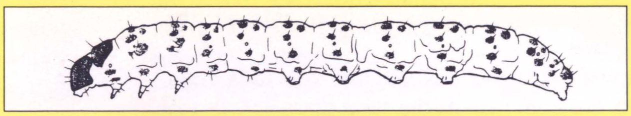
Pupae. The pupa is 3/4 to 7/8 inches long, orange-brown in color, with small projections (tubercles) toward the posterior of the abdomen **(Fig. 2d)**. As with adult moths, male pupae are smaller than females.

Figure 3. Common stalk-boring caterpillars of rice in Texas.



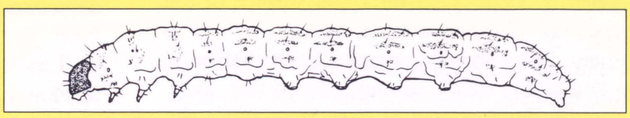
Rice stalk borer
***Chilo plejadellus* (Zinck)**

- Nearly white body
- Two broad, light brown to purplish stripes along the length of the body when viewed from the top
- A second fainter stripe on the sides, along the spiracular (breathing pore) area
- Light brown head
- Yellow cervical shield (the plate just behind the top of the head on the first body segment), anal plate and thoracic legs, with some pigment spots
- Brown setae (hairs) arising from light-colored pinacula (plates)
- 30-33 mm long



Sugarcane borer
***Diatraea saccharalis* (Fabricius)**

- Nearly white body
- Rich brown head merging to black at the mouthparts
- Light brown setae (hairs) and pinacula (plates) on the body, except during the winter when pinacula and cervical shield almost lack pigmentation
- 26 mm long



Mexican rice borer
***Eoreuma loftini* (Dyar)**

- Nearly white body
- Orange-brown or reddish head
- No conspicuous pinacula (plates) bearing setae on dorsal (upper) surface of body
- Two broken, purple-red stripes running the length of the body on the sides
- 26 mm long

Biology

The developement and behavior of the MRB are largely dependent on the host plant and its stage of growth. The adult moth prefers to lay its eggs on dry leaf material close to the ground. However, oviposition can occur to a lesser extent on green leaf material and on dry leaf material on upper portions of the plant. Larvae hatch during early morning hours and then move to a feeding site on leaf blades or leaf sheaths.

Approximately 20 to 30 percent of larvae hatching on sugarcane are successful in locating a leaf sheath upon which to feed. Larvae then chew into the soft tissue inside the sheath which wraps around the stalk. Tunneling within the leaf sheath produces a blotch mine, often with small perforations and discoloration of the tissue **(Figs. 4b-d).** The discolored areas usually are dark red or purple, although both the hue and extent of discoloration vary with the host plant. Discoloration on sorghum is dramatic **(Fig. 4d);** on corn it is faint or absent. On rice the damaged leaf sheath is tan to orange **(Fig. 4c).** Leaf sheath discoloration often is the first evidence of infestation by the MRB, and this symptom is monitored during population sampling.

Larvae feed in leaf sheaths for several weeks and molt two or three times during this period. As they complete the third or fourth instar and are 3/8 to 1/2 inch long, they enter the plant stem, usually chewing directly into the internode adjacent to the leaf sheath on which they were feeding. Within a few hours the larva has completely disappeared into the stalk interior, where it continues to bore through the internode of the plant.

In small-stemmed plants such as rice and bermuda grass, the larva is nearly the same size as the stem diameter. In this case, the larva excavates the entire stem cross-section and is restricted by the stem epidermis and surrounding leaves **(Figs. 4e-f).** In large-stemmed grasses such as corn, sweet sorghum and sugarcane, tunneling behavior is quite different. Larvae are not restricted by the stem diameter and excavate only a portion of the stem cross-section **(Figs. 4g-h).**

Tunneling behavior of the MRB in large stems varies from that of the other North American stalk borers, in that a majority of the tunneling occurs near the outer surface of the stalk adjacent to the rind. Tunnels may be vertical, which is typical of most borers, but also may wander horizontally or diagonally within the stem. MRB tunnels also differ from those of other borers by the presence of frass throughout the tunnel. Other borers, notably the Southwestern corn borer, sugarcane borer and neotropical cornstalk borer, periodically remove frass from their tunnels to the outside, leaving deposits in the area between the leaf sheath and the stalk. MRB rarely remove the frass to the outside, and therefore have tunnels which are packed with frass.

As the larva develops, the tunnel enlarges and the extent of the damage increases. Generally the MRB does not cross the nodal area in sugarcane stalks, but restricts its feeding to one internode. Other cane borers normally tunnel through three or more internodes during development. However, MRB larvae occasionally exit the stalk, move to another internode, re-enter the stalk and resume feeding.

The mature larva constructs a pupal chamber near the stalk surface. The resultant "window" in the stalk is quite thin, consisting of a layer or two of leaf tissue **(Fig. 4j).** Pupation occurs within the protection of the stalk, and the moth emerges through the window.

Each generation requires about 45 to 50 days under warm summer conditions. But the duration of development depends upon the host plant species, the larva's location within the plant and the temperature. The seasonal abundance patterns are also complicated by the occurrence of overlapping generations, as all stages of the borer can be found generally throughout the year in the field. During winter larval development takes much longer, but feeding continues during periods of warmer temperatures. Moth emergence, oviposition and larval infestation also progress during winter, but at a slower rate than during summer months.

Host Plants

Host plants of the Mexican rice borer include many agricultural crops grown in Texas and several non-crop species.

Crop Hosts	Non-Crop Hosts
sugarcane	johnson grass
corn	pampas grass
sorghums	cat-tail
rice	canna
wheat	bristle grass, Setaria spp.
oats	
forage bermuda grass	

Damage

MRB feeding on leaves and stems causes many kinds of damage. The timing of infestation dictates the type of damage which results. Crop plants are susceptible to attack from the early stages of growth to well beyond normal crop maturity, and the extent of the damage which occurs is determined by crop phenology and the size of borer populations. Larval feeding near the growing point of the plant early in the season can cause "deadheart," a green shoot having a dead whorl center **(Fig. 4a).** If the borer population is large at this stage of growth, many young plants can be affected. However, final plant stand is not necessarily reduced since natural thinning often occurs in agronomic production. Deadhearts are the site of MRB egglaying at a time when there is little dry leaf material in the field.

Leaf sheath feeding by early instars of the borer is evidenced by a blotch mine as described earlier **(Figs. 4b-d).** Such feeding disrupts normal leaf function. Damaged leaves often die, which can reduce plant productivity.

Larval tunneling within the stem affects the plant in several ways, depending on the plant species **(Figs. 4e-h).** Tunneling in sugarcane stems directly influences the production and deposition of sugar and reduces the quality of the sugar present in the damaged internode. There is also a systemic effect on the plant because of damage to the vascular system which moves water and nutrients within the plant.

In grain crops such as sorghum and rice, stem damage often leads to incomplete head fill or aborted development. The effect on rice results in panicle abortion, blasting or incomplete fill **(Fig. 4i)**.

Tunnel openings allow secondary organisms to invade plants, which may cause decomposition in the region of the borer damage. This decomposition, in concert with the structural damage to the stem, is responsible for plant lodging. Lodging has been observed in all host plants attacked by this insect, and may contribute significantly to losses at harvest **(Fig. 4k-l)**. Lodging is particularly important in crops producing seed, where the additional weight of the head (rice, sorghum) or ear (corn) promotes lodging. Plants with stem damage often break or fall during harvesting, which results in yield or quality loss.

The MRB does not feed on the seed of most plants, but small larvae may feed on rice panicles, and corn ears often are tunneled. No evidence of seed feeding on sorghum has been observed.

Following are details of MRB damage on specific plants.

Sugarcane. Deadhearts are evident in young cane when larvae are actually feeding below the soil level on the crown of the plant **(Fig. 4a)**. Leaf sheath feeding begins near the top of the sheath and mining within the sheath produces purple discoloration **(Fig. 4b)**. Tunneling is often close to the rind of the stalk and winds horizontally as well as vertically, as described earlier **(Fig. 4g)**. Reddish discoloration caused by a fungus infection is usually seen in the damaged internode. Feeding injury is not restricted to the main stem since side shoots often are attacked by the borer late in the season.

Rice. Damage to rice varies from deadhearts to unfilled kernels in panicles. Leaf sheath feeding causes orange-brown discoloration **(Fig. 4c)**. Larvae usually tunnel stems earlier in rice than in larger stemmed hosts. Tunneling is extensive **(Fig. 4e)** and often results in lodging of the stem **(Fig. 4k)**. Head formation can be interrupted at different stages, resulting in various visible symptoms **(Fig. 4i)**.

Sorghum. Leaf sheath feeding shows up as extensive dark purple discoloration, particularly early in plant growth **(Fig. 4d)**. Stem tunneling is very similar to that observed in sugarcane **(Fig. 4b)**, and often includes red discoloration of the pith **(Fig. 4h)**. In sweet sorghum varieties the MRB traverses several internodes while feeding and is highly successful in developing on this crop. In south Texas five or more borers per sweet sorghum stalk often are observed. Lodging is often extensive on forage sorghum **(Fig. 4l)**. Tillers and post- harvest regrowth are susceptible to MRB attack throughout the year.

Corn. Infestation generally occurs from tasseling until senescence of the plants. Most damage occurs on the stalk below the ear, so lodging can become severe when the population is large. Leaf sheath feeding does not result in the discoloration seen in other host plants, and stalk tunneling is not accompanied by pith discoloration. Occasionally, the corn ear petiole is tunneled by MRB, causing the ear to cease development. MRB larvae and pupae have been recovered from the ear itself, indicating that this is a suitable feeding site. As corn stalks senesce, MRB populations decline dramatically and fewer larvae inside the stalks survive.

Johnsongrass. Infestation of johnsongrass generally occurs as the plant matures. Leaf infestations are evidenced by dark purple discoloration. Larval tunneling **(Fig. 4f)** often causes lodging and dead tops.

Management

In order to manage MRB populations on Texas crops, it is important to evaluate the extent of damage caused by the insect. Then the benefits of implementing controls can be weighed against the costs. The degree of risk of significant loss depends on seasonal population pressure and crop phenology. Perennial crops such as sugarcane are subject to infestation for approximately 9 months, while annual short-season crops such as corn have a narrower window of susceptibility. Due to a short period of susceptibility, crops such as rice, corn and sorghum may escape significant damage because the highest pest pressure may occur after the crop is harvested. Therefore, monitoring field populations is essential to determinig whether pest levels economically justify remedial action.

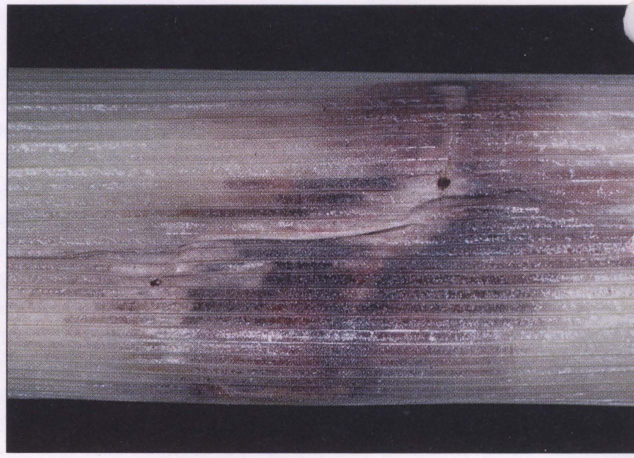
In sugarcane, treatment is justified whenever 10 percent or more of the plants inspected are infested with young larvae in leaves or sheaths. However, economic thresholds for MRB in other crops have not been developed. Economic thresholds for other borer species (i.e., southwestern corn borer in corn, see TAEX publication B-1366) may not be applicable or accurate for the MRB.

Several management options may be considered. The main objective of crop production is to promote healthy plant growth which can withstand pests and other stresses. Thus pest populations must be maintained below damaging levels to reduce the potential for damage. Only when pests reach damaging levels should control measures be considered. The integration of cultural, biological and chemical pest control procedures is a valid approach to managing the MRB, as it is for many other pests.

Chemical Control. Currently, no insecticide is registered specifically for the MRB, although a few products are registered for other borer species on some crops (corn - see TAEX publication B-1366, "Managing Insect and Mite Pests on Corn," sorghum - see B-1220, "Managing Insect and Mite Pests on Sorghum," and sugarcane.) The target of chemical control efforts must be the young larvae feeding in leaf sheaths. These larvae, by virtue of their location in the plant and their size, are most vulnerable to pesticides. Larvae within the stems of host plants are protected to varying degrees by the stem, and are unlikely to come into direct

Figure 4. Mexican rice borer damage symptoms on various host plants.

a. deadheart on sugarcane



b. leaf sheath feeding on sugarcane

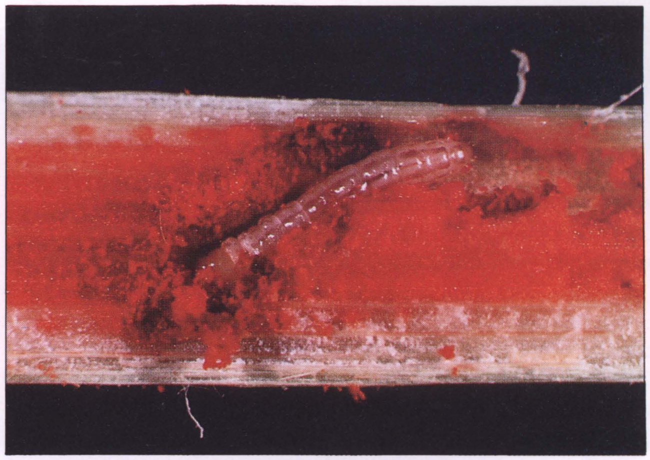
c. leaf sheath feeding in rice

d. leaf sheath feeding in sorghum

e. tunnel in rice

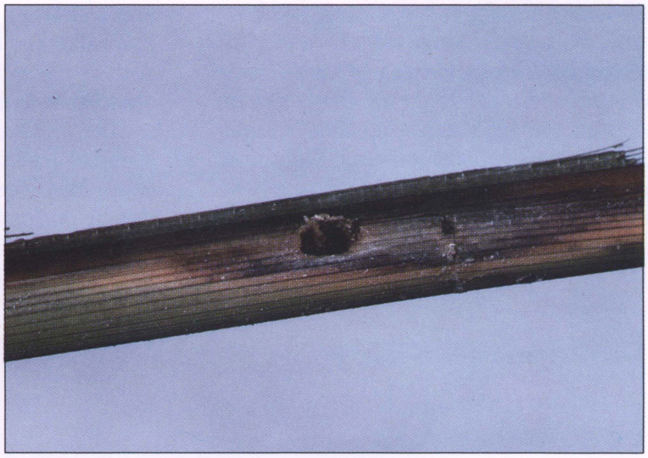
f. tunnel in johnsongrass

g. tunnel in sugarcane



h. tunnel in sweet sorghum

i. head damage in rice



j. moth emergence window in rice stem

k. lodging in rice

l. lodging in forage sorghum

contact with a foliar pesticide application. Systemic insecticides could potentially provide a means of reaching larvae within tunnels, but currently they are unavailable.

Regardless of the crop, thorough coverage is extremely important for borer control. To be effective, the insecticide must reach larvae in or behind the leaf sheath. The choice of insecticide must also be tailored to the crop situation, which includes the ultimate use of the crop and other arthropods present. Instructions on the label must be followed carefully. These instructions include rate, timing, re-entry interval, harvest restrictions and safety considerations.

Biological Control. Biological control involves the release of natural enemies, such as parasites, predators and pathogens which attack the MRB. Since the MRB originated in Mexico, the approach has been to bring parasites from its native environment and other areas with similar borer pests. Once the parasites are imported, they are screened in quarantine, reared and then released in the field. Any species which becomes established can assist in suppressing MRB by attacking eggs, larvae or pupae. Since 1982, some 20 species of natural enemies have been released in south Texas sugarcane, sorghum, corn and rice. Eight of these species have been recovered from the field following their release, and several appear to be permanently established. Only time will tell how effective they are in reducing MRB numbers, but any mortality they cause will assist in managing the borer.

Cultural Control. Production practices can influence the size of MRB populations in individual fields, and can be manipulated to help control the pest. For example, since the MRB prefers to lay its eggs in dry leaf material, plowing under debris before planting and maintaining healthy plants early in the season may reduce the amount of dry leaf material available and thus postpone borer infestation. Similarly, eliminating fall and winter crop residue and weeds may reduce the population of borers beginning the new season. In general, sanitation within and around fields will aid in borer management as it often does in disease management.

In crops such as sugarcane, which rely on vegetative propagation, selecting clean planting material will reduce the losses to poor germination and also eliminate the introduction of borers with the seed pieces at planting.

Planting and harvesting dates can be manipulated to reduce borer damage. It appears that in Texas, damage to corn and sorghum is minimized when the crops are planted and mature at normal times. If planting or harvest is delayed, borer damage increases dramatically. Similarly, ratoon crops, such as the second crop of rice in Texas, may be particularly vulnerable to borer attack.

The selection of resistant or tolerant varieties is a management technique which deserves attention. Varietal differences have been observed in some crops, but little information is currently available on varietal susceptibility in rice, corn and sorghum. Further research may provide producers with options for selecting resistant varieties.

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