JALISCO FLY FOR BIOLOGICAL CONTROL OF MEXICAN RICE BORER IN SUGARCANE AND OTHER GRAMINACEOUS CROPS

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ABSTRACT

The Mexican rice borer, *Eoreuma loftini* (Dyar) (Lepidoptera: Pyralidae) is the key pest of sugarcane in south Texas. Growers have abandoned insecticides as an economically viable control method. To mitigate economic losses, the USDA ARS Beneficial Insects Research Unit and the Texas Agricultural Experiment Station, both in Weslaco, initiated a collaborative research project to import and evaluate the Jalisco fly, *Lydella jalisco* Woodley (Diptera: Tachinidae), as a biological control agent. Collections of *E. loftini* were made at Los Lirios (Ejido Caimanero) in the Ameca Valley of Mexico. The highest numbers of parasitized *E. loftini* borers were collected from mid-August to mid-October, when parasitism was often between 20 to 30%. A greenhouse experiment was performed to evaluate *L. jalisco* on different graminaceous host plants (sugarcane, sorghum, rice, corn, and johnsongrass) which *E. loftini* may infest. In the experiment, *L. jalisco* parasitized *E. loftini* on all host plants, but parasitism levels were highest on sugarcane (81.4%) and lowest on rice (14.9%) and johnsongrass (10%). Parasitism of *E. loftini* on corn (54.6%) and sorghum (22.0%) was intermediate and not significantly different from the other host plants. We found no other studies indicating that *L. jalisco* could parasitize *E. loftini* on host plants other than sugarcane, either through surveys of endemic populations in Mexico or under experimental conditions. Our results indicate that *L. jalisco* has the potential to act as a biological control agent against *E. loftini* on corn, sorghum, and rice as well as on sugarcane. Currently, field experiments are underway to evaluate the fly using these host plants under more field-realistic conditions.

INTRODUCTION

Stalk boring pyralid moths have been the most serious pests of sugarcane in south Texas since the early 1970s. Currently, the key pest is the Mexican rice borer, *Eoreuma loftini* (Dyar) (Lepidoptera: Pyralidae), a pest from Mexico first recorded in Texas in 1980 (3). *E. loftini* damages about 20% of the cane internodes, causing economic loss estimated at $10—20 million (5). Growers do not treat sugarcane with insecticides largely because the cryptic lifestyle of the immature borer protects it from chemical control agents. To mitigate damage, much effort has focused on the

importation and release of biological control agents collected from different parts of the world. From 1982 to 1987, 21 species of parasitoids are known to have been released in sugarcane fields of south Texas. However, the parasitoids have had minimal effects against *E. loftini* (4). Parasitoids known to have established include two indigenous braconids, *Chelonus sonorensis* Cameron and *Digonogastra solitaria* Wharton & Quicke, and two exotic braconids, *Alabagrus stigma* (Brulle) (from Boliviaia) and *Allorhogas pyralophagus* Marsh (from Mexico). However, average seasonal parasitization of *E. loftini* larvae and pupae averages only about 6% (7).

The most promising biological control agent of *E. loftini* is the Jalisco fly, *Lydella jalisco* Woodley (Diptera: Tachinidae). The fly was initially collected from a commercial sugarcane field in Ejido Caimanero, near Ameca on 30 May 1988, during a survey of stalkboring pyralidae throughout major sugarcane growing areas in Mexico (9). The adult flies that emerged were recognized as a previously unreported tachinid parasitoid of *E. loftini*, later described as a new species (11). The host–parasitoid relationship may be restricted both biologically and geographically in Mexico. Extensive surveys failed to detect the fly in other areas or on other hosts (9). From April to November 1989, 3015 flies were released in sugarcane fields in the Lower Rio Grande Valley. Subsequent recovery attempts produced 13 parasitized larvae, which the authors considered encouraging (8).

In April 1998, the Beneficial Insects Research Unit of the USDA ARS Kika de la Garza Subtropical Agricultural Research Center and the Texas Agricultural Experiment Station, both in Weslaco, initiated a 3-year research project to import and evaluate *L. jalisco* as a biological control agent against *E. loftini*. The project was supported by the Department of Entomology, Texas A&M University (College Station) and the Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias (Mexico). In this paper, we report results of explorations in Mexico for parasitized *E. loftini* larvae, and greenhouse studies to test the efficacy of *L. jalisco* as a parasitoid of *E. loftini* using different host plants.

MATERIALS AND METHODS

Field collections of the Jalisco fly. Collections of *E. loftini* larvae were conducted in a sugarcane field designated as Los Lirios (Ejido Caimanero), Ameca in the Mexican state of Jalisco from August 1998 to March 1999. Workers attempted to collect as many *E. loftini* larvae as possible during each collection effort. Sugarcane plants were examined for external damage (holes or purplish discoloration) characteristic of *E. loftini*. Borers collected were placed individually into 18.5 ml (5/8 oz) diet cups (Fill Rite, Newark, NJ), containing artificial diet (6), and covered with 37.5 mm polycoated pull tab caps (Stanpac, Lewiston, NY). The borers were quarantined at the Department of Entomology, College Station, Texas, and parasitized borers were then shipped to the Texas Agricultural Experiment Station in Weslaco, Texas for study.

Greenhouse experiment. Five species were selected as host plants of *E. loftini*: a) sugarcane, interspecific *Saccharum* hybrid var. 'CP70-321'; b) corn, *Zea mays* L. var. '3050 Pioneer'; c) sorghum, *Sorghum bicolor* (L.) Moench var. '5319 Garst'; d) rice, *Oryza sativa* L. var. 'Jefferson'; and, e) johnsongrass, *Sorghum halepense* (L.) Pers. For each host plant, seeds were placed into 16 plastic pots (16-cm-diam, Poly-Tainer-Can No. 1-C, Nursery Supplies, Orange CA) containing Metro

Mix® 300 Growing Media (Scotts-Sierra Horticultural Products, Marysville, OH). Four pots of each host plant were placed randomly into four, large, walk-in screened cages (192 x 191 x 264 cm) located inside a greenhouse. After three months, third instar *E. loftini* were placed on the plants at the rate of five larvae per pot. Larvae were given 7 days to establish on the host plants. Ten presumably-mated adult female Jalisco flies were then released into each cage, together with five male flies. Food was provided in the form of cotton balls soaked in a honey solution and tied to each upper corner of each cage. After 5 days, the plants were harvested destructively. All borers recovered were placed into 18.5 ml diet cups, containing artificial diet, and covered with 37.5 mm polycoated pull tab caps. The borers were placed in environmental chambers (Percival, Boone, IA) at constant conditions (28± 5°C, 40 ± 10%) and reared through to determine outcome: death, adult moth, or adult fly (by sex).

Data were pooled among identical host plant species within a cage. Percent parasitism was calculated using numbers of hosts parasitized divided by the sum of hosts parasitized and unparasitized. The effect of host plant on percent parasitism was analyzed by ANOVA using Systat (SPSS, Chicago, IL). Means were separated using Tukey HSD at $P = 0.05$. Percentage data were transformed using the arcsine-square root method prior to analysis but are presented as nontransformed means (10).

RESULTS AND DISCUSSION

The municipality of Ameca has about 6,300 ha planted to sugarcane, from a total of over 72,000 ha for the entire state of Jalisco (2). In comparison, Texas has about 18,000 ha of sugarcane crop. During the survey period from August 1998 to March 1999, numbers of borer larvae collected averaged 108.8 ± 32.0 ($\bar{x} \pm$ SE, range = 20 — 335) on each sampling occasion (Fig. 1). The highest numbers of parasitized *E. loftini* borers were collected from mid-August to mid-October (Fig. 1). Parasitism during this period was often between 20 to 30% of larvae collected. Future efforts to collect *L. jalisco* will focus on this time and place.

When offered *E. loftini* larvae on sugarcane, corn, sorghum, rice and johsongrass, *L. jalisco* parasitized *E. loftini* on all host plants in the greenhouse test (Fig. 2). Parasitism was significantly affected by host plant ($F = 5.9$; df = 4, 15; $P < 0.01$), being highest on sugarcane and lowest on rice and johnsongrass (Tukey HSD, $P < 0.05$). Parasitism on corn and sorghum was intermediate and not significantly different from the other host plants (Tukey HSD, $P > 0.05$). Percent parasitism on the host plants was: sugarcane, 81.4% ± 7.9 ($\bar{x} \pm$ SE; range = 66.7 — 100.0); corn, 54.6% ± 20.2 (6.2 — 100.0); sorghum, 22.0% ± 8.3 (9.1 — 45.5); rice, 14.9% ± 5.3 (7.7 — 30.0); and johnsongrass, 10.0% ± 10.0 (0.0 — 40.0).

From its initial report in Texas in 1980, *E. loftini* had increased its known northward distribution to include 40 counties in south Texas by 1987 (1). The projected continued migration of the borer along the Gulf Coast constitutes a threat to sugarcane, and other graminaceous crops, such as corn, rice, sorghum, wheat and forage grasses, throughout the southern U.S. (1). Therefore, the effectiveness of *L. jalisco* on a range of graminaceous crops is important, especially because they are more economically important to U.S. agriculture than sugarcane. In this study, we included the weed, johnsongrass, as a test plant because of its possible role as an alternative host plant. During its

migration into the U.S. in the 1970s, *E. loftini* was reported in Arizona on non-cultivated sugarcane and johnsongrass (3), which may have facilitated its entry.

From 1981 — 1989, a large-scale survey for stalkborers and their parasitoids was conducted throughout the major sugarcane growing areas of Mexico (9). In addition to sugarcane, insect samples were taken from field corn, grain sorghum, johnsongrass, and other noncultivated wild grasses near sugarcane fields. *L. jalisco* was reared only from *E. loftini* and only from borers collected from the Ameca Valley. Laboratory host specificity experiments using alternative hosts [*Diatraea considerata, D. grandiosella, D. saccharalis*, and *Galleria mellonella* (L.) (Lepidoptera: Galleridae)] further indicated that *L. jalisco* was specific to *E. loftini.*

We found no reports in the literature indicating that *L. jalisco* parasitizes *E. loftini* on host plants other than sugarcane, either through surveys of endemic populations in Mexico or under experimental conditions. Our results indicate that *L. jalisco* will search for and parasitize *E. loftini* on other graminaceous hosts, despite its host insect specificity and apparent geographical restriction to the Ameca Valley of Mexico. The preferred host plant was sugarcane, but *L. jalisco* has the potential to act as a biological control agent against *E. loftini* on corn, sorghum, and rice, possibly as a component in an integrated pest management program. Currently, field experiments are underway to evaluate the fly using these host plants under more field-realistic conditions.

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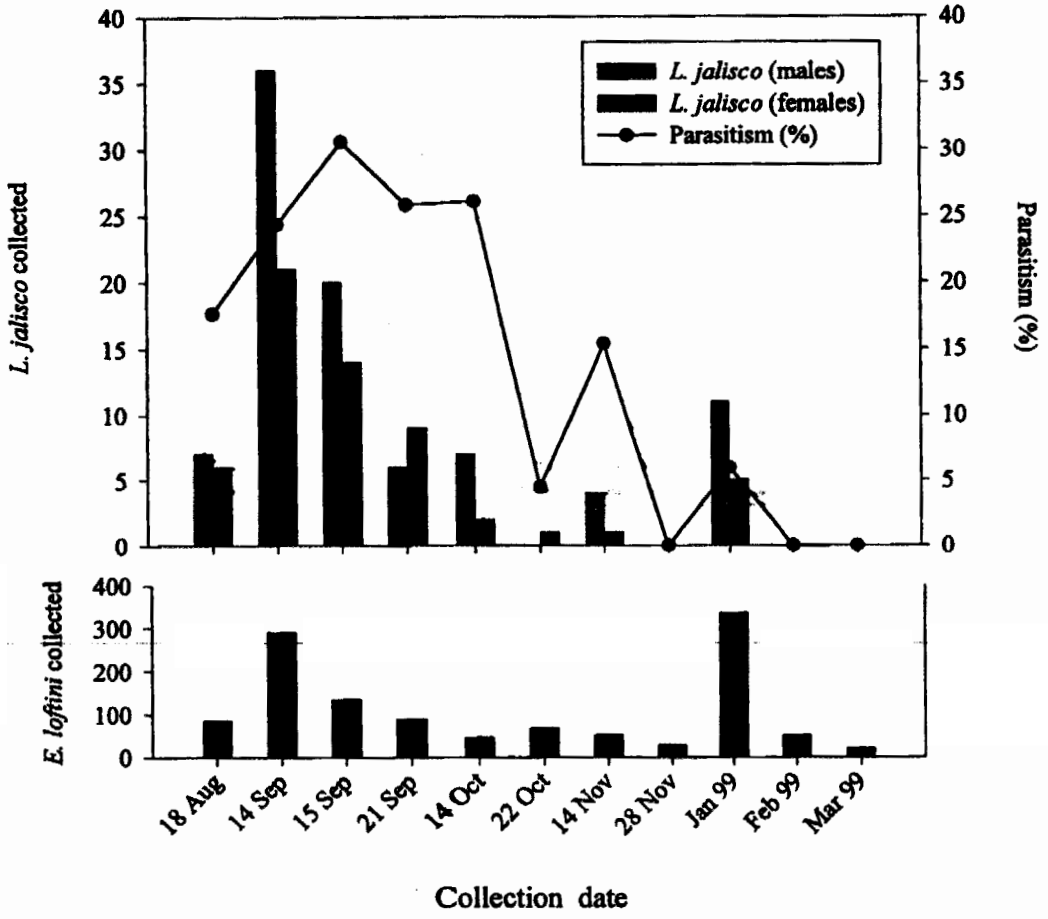

Fig. 1. Collections and parasitism of *E. loftini* larvae and subequent recoveries of *L. jalisco* parasitoids from Los Lirios, Ejido Caimanero in the Ameca Valley of Mexico (August 1998 to March 1999).

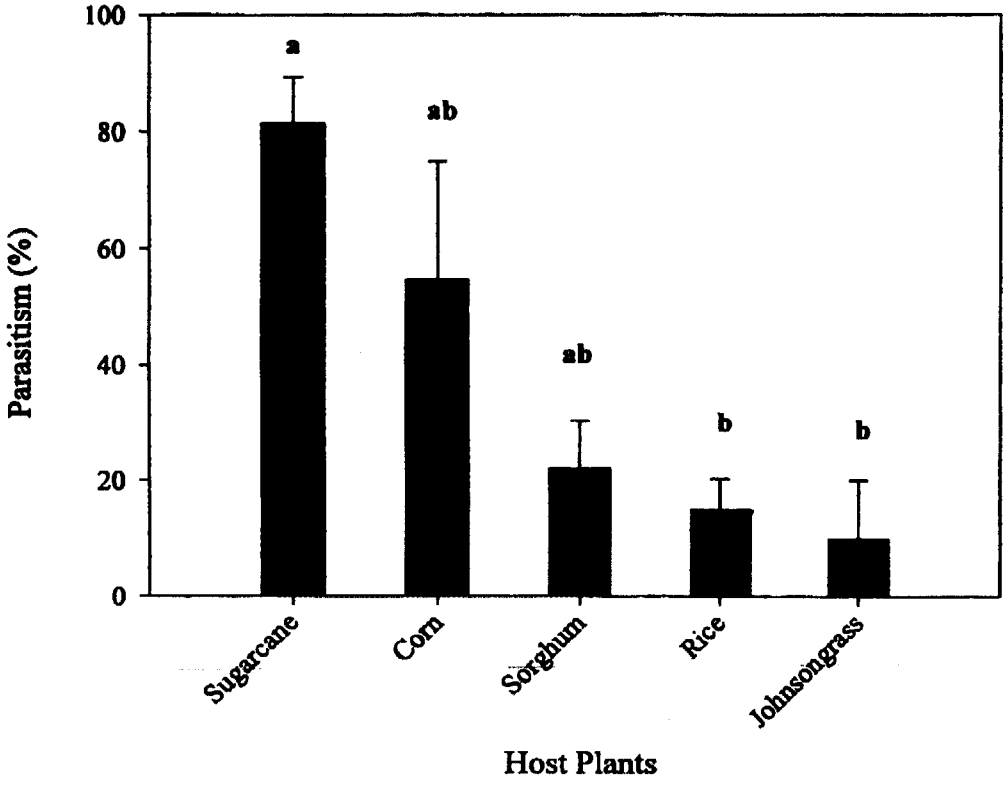

Fig. 2. Parasitism of *E. loftini* by *L. jalisco* using different host plants determined in a greenhouse experiment (mean % ± SE). Bars with different letters indicate means that are significantly different (Tukey HSD, $P < 0.05$). *Eoreuma loftini* larvae were placed on the plants at the rate of five per pot. Four pots of each host plant were placed into four large walk-in screened cages, together with 10 adult female flies. Jalisco flies were allowed five days to parasitize host larvae, after which plants were harvested, larvae collected and assessed for parasitism.