Nota / Note

MANIPULATION OF FIRE ANT DENSITY, *Solenopsis* spp., FOR SHORT-TERM REDUCTION OF *Diatraea saccharalis* LARVAL DENSITIES IN BRAZIL

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ABSTRACT: The sugarcane borer, *Diatraea saccharalis* (Fabr.) is the main sugarcane pest in Brazil. In the State of São Paulo, the main active population control of *D. saccharalis* is by inundative releases of the exotic parasitoid, *Cotesia flavipes* (Cam.). However, the production of *C. flavipes* in sugar mills entails costs and few studies have evaluated the effects of native predators on sugarcane borer populations. Using a simple colony translocation method, we evaluated the effect of fire ants (*Solenopsis* spp.) on population densities of *D. saccharalis* and concurrently upon rates of parasitism by classical biological control agents in the São João sugar mill in the State of São Paulo, Brazil. The translocation technique proved to be feasible and economically possible. Sugarcane borers were sampled in each of the 5 areas for each treatment in two 1.4 x 5.0 m (7 m²) points (sample size), by opening and visually examining all canes. The average numbers and its respective standard deviations (SD) for *D. saccharalis* population densities before and after colony translocations considering 0, 5, 10 and 15 colonies added per 0.5 ha were, 9.2 ± 5.9, 8.4 ± 3.4, 9.0 ± 6.9, 9.4 ± 8.1 and 3.2 ± 1.8, 2.8 ± 2.7, 2.6 ± 1.5, 3.8 ± 2.8, respectively. However, we detected no significant changes in sugarcane borer densities with respect to ant colony densities over a two-week period, none of which were greater than for no colony additions. No effects of colony translocations on parasitism rates of braconid and tachinid parasitoids on *D. saccharalis* were detected. Thus, although the translocation technique was economically feasible, no reductions of *D. saccharalis* densities were produced by colony additions, and may not be a viable alternative for *D. saccharalis* population reduction, especially at the low population levels which prevail in Brazil.
Key words: sugarcane borer, predation, colony translocation, parasitoids

MANIPULAÇÃO DA DENSIDADE DE FORMIGAS LAVA-PÉ, *Solenopsis* spp., PARA REDUÇÃO A CURTO PRAZO DAS DENSIDADES LARVAIS DA *Diatraea saccharalis* NO BRASIL

RESUMO: A broca da cana-de-açúcar, *Diatraea saccharalis* (Fabr.) é a principal praga da cana-de-açúcar no Brasil. No Estado de São Paulo, o principal meio de controle desta praga é por meio de liberações constantes do parasitóide exótico *Cotesia flavipes* (Cam.). De qualquer forma, a produção de tais parasitóides nas usinas de cana-de-açúcar acarreta custos e poucos estudos tem avaliado os efeitos de predadores nativos nas populações da broca da cana-de-açúcar. Usando-se um método simples de coleta e liberação de colônias, avaliou-se o efeito de formigas *Solenopsis* spp. nas densidades das populações de *D. saccharalis*, bem como seu efeito na taxa de parasitismo imposta por agentes de controle biológico clássico. O estudo foi conduzido nos canaviais da Usina São João, município de Araras-SP. Esta metodologia mostrou ser apropriada e economicamente viável. Lagartas de *D. saccharalis* foram amostradas em cada uma das cinco áreas de cada tratamento em dois pontos de 1.4 x 5.0 m (7 m²) (tamanho amostral), através da abertura e observação de todas as plantas ali existentes. Os números médios e os respectivos desvios padrão para as densidades populacionais de *D. saccharalis*, antes e após a adição de 0, 5, 10 e 15 colônias por 0.5 ha, foram, 9,2 ± 5,9; 8,4 ± 3,4; 9,0 ± 6,9; 9,4 ± 8,1 e 3,2 ± 1,8; 2,8 ± 2,7; 2,6 ± 1,5; 3,8 ± 2,8; respectivamente. De qualquer forma, durante um período de duas semanas, nenhuma mudança significativa nas densidades de *D. saccharalis* foi detectada, as quais não diferiram das áreas onde não houve liberação de colônias. Nenhum efeito, devido à adição das colônias, nas taxas de parasitismo impostas pelos braconídeos e taquinídeos foi detectada. Portanto, embora esta metodologia foi economicamente viável, nenhuma redução nas densidades de *D. saccharalis* foi evidenciada devido à adição das colônias, não sendo uma alternativa viável para a redução das densidades populacionais de *D. saccharalis*.
Palavras-chave: broca da cana-de-açúcar, predação, manipulação de colônias, parasitóides

INTRODUCTION

The sugarcane borer, *Diatraea saccharalis* (Fabr.) (Lepidoptera: Crambidae) is the main sugarcane, *Saccharum* spp., pest in Brazil (Gallo et al., 1988). It causes direct injury through gallery construction, leading to weight loss and germination failure, and indirect losses by facilitating fungus infections that lead to sucrose

inversion and a consequent loss of sugar during refinement (Gallo et al., 1988). In the São Paulo State, Brazil, the main active population control of *D. saccharalis* is by inundative releases of the exotic parasitoid, *Cotesia flavipes* (Cam.) (Hymenoptera: Braconidae) and current infestation rates are approximately 2% (Botelho, 1992; Botelho et al., 1999). However, the production of *C. flavipes* in sugar mills entails costs and few studies have evaluated the effects of native predators on sugarcane borer populations.

Generalist predators can be effective regulatory agents of pest populations because they can adjust predation between a number of prey population, whether these are primary or secondary pests (Luff, 1983). Ants are prominent among the fauna of generalist predators of the sugarcane borer (Botelho et al., 1986), and have been reported to be the primary predators of eggs (Degaspari et al., 1987). Of these, fire ants, *Solenopsis* spp. (Hymenoptera: Formicidae), are among the most prevalent (Fowler et al., 1991). Introduced populations of *S. invicta* (Buren) have been shown to have a strong role in the population suppression of *D. saccharalis* in the United States (Charpentier et al., 1967; Negm & Hensley, 1969; Reagan et al., 1972), and constitute the most abundant ant species in sugarcane (Adams et al., 1981). Fire ants have been shown to be key predators for row crop pests in the Neotropics (Risch & Carroll, 1982) and a variety of pests in Florida and Louisiana (Hu & Frank, 1996a, b; Fuller et al., 1997).

Fire ants are native to Brazil and are also prominent faunal elements of sugarcane plantations (Fowler et al., 1991). Because fire ants frequently nest in the upper soil layer and do not construct deep nests as most of the other native ants, fire ant nests could potentially be collected and translocated to other areas. In tropical tree crops, ant manipulation, through selective elimination, translocation, habitat modification, and other techniques, has been employed for pest control (Majer, 1982). Studying the effects of ant predation on *D. saccharalis* larval populations in artificially infested sugarcane fields (State of São Paulo, Brazil), Rossi & Fowler (2000) observed a clear trend of reduction in *D. saccharalis* larval densities in areas without ant suppression (insecticidal check techniques) and fire ants were always the most abundant ant. Could fire ant colony translocation be used to augment the natural control of pests in non-tree crop situations? Would a predator augmentation program interfere with other biological control agents?

Here we report on techniques for colony translocation and an experimental evaluation of differing colony density translocations on populations of *D. saccharalis* in sugarcane plantations in São Paulo, Brazil, as well as their interactions with native (Tachinidae) and exotic (*C. flavipes*) parasitoids.

MATERIAL AND METHODS

Studies were conducted for the sugarcane varieties SP79-1011 planted in the São Joao Sugar Mill, in Aguaí, São Paulo (lat. 22°04'00" long. 46°59'30"). Fire ant colonies [either *S. invicta* or *S. saevissima* (Forel)] were located by mound sightings along roadsides, collected during the morning with shovels and placed into individual plastic bags (20 liters). The plastic bags were then closed to prevent escape. To minimize fire ant stings, rubber gloves were dusted with baby powder during colony excavations. Vegetation-free mounds were chosen to speed colony excavation.

Collected colonies were placed in the back of a pick-up truck and in the afternoon were transplanted to experimental areas. Upon arrival in the experimental areas, bags were opened and dumped into 6 liter plastic buckets, and thereafter each was considered a standardized colony. Thus, extremely large colonies could be divided into two or more standardized colony transplants. Using this technique approximately 50 colonies were collected and translocated per day.

Experimental translocation colony densities were 0 (control), 5, 10, and 15 per 0.5 ha., each replicated five times. Each experimental area was comprised of 36 rows of sugarcane by 100 m in length (0.5 ha). A minimum spacing of 40 rows separated each experimental plot. For transplant densities of 15 standardized colonies, 5 were dumped between the 9th and 10th rows, 5 between the 18th and 19th rows, and 5 between the 27th and 28th rows. For areas in which 10 standardized colonies were transplanted, 5 were dumped between the 10th and the 11th rows and 5 between the 26th and 27th rows. For areas of 5 standardized colony additions, these were dumped between the 18th and 19th rows. For all colony translocation treatments, individual standardized colonies were dumped at a 15 m spacing. Sugarcane borers were sampled in each of the 5 areas for each treatment in two 1.4 x 5.0 m (7 m²) points, by opening and visually examining all canes. Data for each sampled area were summed to represent experimental area sugarcane borer densities. Samples were conducted prior to and fifteen days after colony translocations. Caterpillars collected during sampling were taken to the laboratory and reared on artificial diet in (65 mm x 30 mm) petri plates to evaluate parasitism [*C. flavipes* and the native tachinids *Lydella minense* (Towns.) and *Paratheresia claripalpis* (Wulp.)]. Parasitoid emergences from collected caterpillars were used to calculate percentage parasitism for each experimental area, both before and after colony transplants.

Averages and standard deviations for *D. saccharalis* population densities and parasitism subjected to differing levels of fire ant colony translocations in sugarcane plantations were calculated, considering the five experimental plots used for all colony addition treatments. Because of the non-normality of the data, the

Kruskal-Wallis test (Zar, 1984) was used to evaluate treatment effects on larval sugarcane borer densities and parasitism percentages before and after colony translocations.

RESULTS AND DISCUSSION

Means and standard deviations for *D. saccharalis* population densities and parasitism subjected to differing levels of fire ant colony translocations are shown (Table 1). No differences were found in larval sugarcane borer densities before and fifteen days after colony translocations at any colony addition level (P = 0.9423) (Table 2). The same was true for parasitism percentages before and after colony translocations (P = 0.1401 and P = 0.8308, respectively) (Table 2).

Our experimental manipulation of fire ant densities in sugarcane fields was used to test an economically feasible alternative for the control of *D. saccharalis* in São Paulo, Brazil. Colony collection and translocation was cheap, quick, and could be easily incorporated into the strategy of sugar mill operations, especially since unqualified labour could perform this task. Fire ant mounds were easily identified and collected.

No differences in *D. saccharalis* were found with respect to colony additions, at any level, over the 2 weeks time period examined. Parasitism also showed no effects due to either colony additions or to changes in *D. saccharalis* densities, and thus could likewise not be responsible for the observed *D. saccharalis* declines in all experimental units. However, since *D. saccharalis* population levels are now extremely low in cane plantations of São Paulo State (Botelho, 1992), our experimental design reflected reality, as well as did the time period evaluated. Shorter or longer time periods would not be economically feasible. Additionally, colony transplants, which may or may have not included queens, but did include brood, resulted in rapid nest reconstruction, and may not have lasted more than a few weeks, due to colony death or potential movement from the transplant area (Harold G. Fowler, personal communication). Even though this technique was not successful in reducing larval numbers, it may be used to reduce larval numbers if the ants were added when the eggs or early instars were present in the field (Rossi & Fowler, 2000). The short-term (2-week) timeframe of this study may not have detected effects that would not have been noticed until several weeks later. Because of the patchiness of *D. saccharalis* in Brazilian sugarcane this does not imply that ants may have a regulatory capability at higher *D. saccharalis* densities, not evaluated here.

In spite of the lack of a clear effect of fire ant augmentation on cane borer populations, colony translocations may be useful for other cropping systems.

ACKNOWLEDGMENTS

Table 1 - Averages and standard deviations (SD) for *Diatraea saccharalis* population densities and the percentage of parasitism subjected to differing levels of fire ant colony translocations in sugarcane plantations in São Paulo, Brazil. Five experimental plots were used for all colony addition treatments, and sugarcane borers were sampled in each of these 5 areas for each treatment in two 1.4 x 5.0 m (7 m²) points (sample size).

Colonies added	Mean ± SD number of *D. saccharalis* larvae sampled before colony addition	Mean ± SD number of *D. saccharalis* larvae sampled after colony addition	Mean ± SD percentage of *D. saccharalis* larvae parasitized before colony addition	Mean ± SD percentage of *D. saccharalis* larvae parasitized after colony addition
0	9.2 ± 5.9	3.2 ± 1.8	9.0 ± 5.3	12.0 ± 17.9
5	8.4 ± 3.4	2.8 ± 2.7	19.9 ± 6.0	16.7 ± 15.6
10	9.0 ± 6.9	2.6 ± 1.5	13.3 ± 10.3	10.7 ± 15.3
15	9.4 ± 8.1	3.8 ± 2.8	11.6 ± 13.8	29.0 ± 41.3

Table 2 - Ranked population parameters for *Diatraea saccharalis* population changes and parasitism subjected to differing levels of fire ant colony translocations in sugarcane plantations in Sao Paulo, Brazil. Five experimental plots were used for all colony addition treatments. For all measured parameters, no differences were found with respect to the number of colonies added.

Colonies added	Mean rank difference of *D. saccharalis* before and after colony addition	Mean rank of % parasitism before colony addition	Mean rank of % parasitism after colony addition
0	10.4	6.9	9.5
5	11.1	15.3	11.7
10	11.3	10.6	9.2
15	9.2	9.2	11.6

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