Effect of intercropping sorghum and maize on Neotropical cornstalk borer, *Diatraea lineolata* (Lepidoptera: Pyralidae), in Honduras

Marco T. Castro[1], Henry N. Pitre[1] and Dan H. Meckenstock[2]

Abstract. The neotropical cornstalk borer, *Diatraea lineolata* (Walker), is an important pest of sorghum and maize in Central America. Infestation of and damage to four varieties of sorghum, *Sorghum bicolor* (L.) Moench, by *D. lineolata* were studied in central Honduras in 1987. Sorghum varieties were intercropped with two maize, *Zea mays* L., varieties in three cropping systems: sorghum and maize in the same hill, sorghum and maize in alternate rows, and sorghum planted 25 days after maize in alternate rows. In addition, the sorghum varieties planted on two dates were evaluated in monoculture. Sorghum planted 25 days after maize had a lower percentage of infested plants, fewer larvae per infested plant, and less damage than sorghum planted simultaneously with maize in the same hill or in alternate rows. Planting sorghum with a hybrid maize reduced *D. lineolata* infestation in and damage to sorghum compared with sorghum planted with a native maize. The sorghum DMV-134, (TAM428 x Porvenir), an improved variety, had fewer larvae than its native landrace parent Porvenir. Sorghum in monoculture had higher stalk borer infestation and damage than sorghum intercropped with maize.

Keywords: Sorghum, maize, intercropping, *Diatraea lineolata*.

Resumen. La especie noetropical del barrenador del tallo *Diatrea lineolata* (Walker) es una plaga importante del sorgo y el maíz en América Central. En 1987 en la región central de Honduras se estudio el grado de infestación y daño que causó *D. linoelata* sobre cuatro variedades de sorgo *Sorghum bicolor*. Se intercalaron las variedades de sorgo con dos variedades de maíz *Zea mays* en tres sistemas de producción: el sorgo y maíz en la misma hilera, el sorgo y maíz en hileras alternas y el sorgo sembrado a los 25 días después del maíz en hileras alternas. También se evaluaron las variedades de sorgo como monocultivo sembrados en dos fechas diferentes. Se observo que en el sorgo que se sembró a los 25 días después del maíz hubo menor porcentaje de plantas infestadas, menos larvas por plantas infestadas y menor daño que en el sorgo sembrado simultáneamente con el maíz, ya fuese en la misma hilera o en hileras alternas. Cuando se sembró el sorgo con un híbrido de maíz en vez de una variedad nativa, se redujo la infestación y el daño. El sorgo DMV-134 (TAM428.x Provenir) una variedad mejorada, mostró menor cantidad de infestación de larvas que la variedad parental Porvenir. El sorgo sembrado en monocultivo mostró mayor infestación del barrenador del tallo que el sorgo intercalado con maíz.

Palabras claves: Sorgo, maíz, intercalado, *Diatrea lineolata*.

INTRODUCTION

In southern Honduras, cropping systems involving sorghum, *Sorghum bicolor* (L.) Moench and maize, *Zea mays* L., vary in relative time of planting and spatial arrangement of the crops (Arias and Gallaher 1987, Diaz 1982). Simultaneous plantings of sorghum and maize may have seeds planted in the same hill (casado, in Spanish), alternate hills (golpe alterno), or alternate rows (surco alterno). Sorghum may be planted 25-30 d later than maize, usually at cultivation of maize (aporque). As a rule, the closer sorghum is planted to maize and/or the later it is planted relative to maize planting, the quicker it is dominated by maize. Thus, sorghum experiences

[1] Department of Entomology, Mississippi Agricultural and Forestry Experiment Station, Mississippi State University, Mississippi State, MS 39762, USA

[2] Department of Soil and Crop Science, Texas A&M University, College Station, TX 77843, USA

greatest competition with maize in casado and least competition when it is planted in alternate rows.

The neotropical cornstalk borer, *Diatraea lineolata* (Walker), a pest of sorghum and maize, is distributed throughout agricultural areas of Honduras (Passoa 1983, King and Saunders 1984). Larvae of *D. lineolata* diapause during the dry season (January-April) and remain in the stalks until the beginning of the rainy season (May-June). Diapause termination is triggered by rainfall (Kevan 1944, Van Huis 1981). *D. lineolata* densities in sorghum usually increase during the year. Sequeira (1986) sampled various sorghum-maize cropping systems in southern Honduras and found no differences in stem borer infestations during the growing season. However, these systems did not include sorghum planted later than maize. He did observe a 10% yield reduction in comparisons of *D. lineolata*-infested versus non-infested sorghum plans.

Damage to sorghum by *D. lineolata* includes tunneling in the stalks. This allows an assessment of the percentage of plant stalks infested by larvae and cumulative amount of damage for the whole season. The population of diapausing larvae also may be determined by destructive plant sampling at harvest.

Rodriguez-del-Basque *et al.* (1988) presented a bibliography of *D. lineolata* and recognized that this pyralid borer "has been poorly studied in spite of its wide distribution and importance as a pest of corn in the neotropical region." As this stalk borer is an important pest of grain crops in Central America, the objective of this work was to determine infestations of *D. lineolata* in various sorghum-maize cropping systems and damage to sorghum in central Honduras.

MATERIALS AND METHOD

Study 1: This experiment was conducted at the Panamerican Agricultural School at El Zamorano, Honduras (14°00'N,87°02'W) in 1987. The field was planted the previous year with sorghum. Cropping systems used were sorghum and maize planted simultaneously in the same hill or in alternate rows on May 30, 1987, and sorghum planted 25 days after maize in alternate rows. These systems were chosen because they are commonly used by subsistence farmers in Honduras and El Salvador. The maize varieties used included the commercial hybrid H-27 of the Honduran Ministry of Natural Resources and a native variety called Maicito collected in the hamlet of Tierra Blanca, Namasiqüe, Choluteca, southern Honduras. The hybrid H-27 is taller and later maturing than Maicito. Consequently, Maicito was doubled over to dry on 9 September, whereas H-27 was doubled on 18 September. After doubling, the sorghum grew through the maize canopy. Doubling is a common agronomic practice among farmers who plant maize intercropped with sorghum. When the maize ears are fully developed and the plants begin to dry, the stalks are broken so that the ears point toward the soil. This limits the entry of rain water into the ear allowing faster drying and reduced fungal infections. Doubling often corresponds with floral differentiation of the sorghum in September; thus, the sorghum crop can develop without competition with the maize plants. Cultural practices usually employed in growing sorghum and maize in the central region of Honduras were used in this study as well as in the next study.

The sorghum varieties used were the landraces Porvenir and San Bernardo III, and the improved sorghums (TAM428 * Porvenir)-20-2-6, F7 (DMV-134) and (TAM428 * San Bernardo III)-23, F6 (DMV-143). These are all photoperiod sensitive types that require 12h daylight for floral initiation. Thus, internode elongation and reproductive growth occurred after maize was doubled.

A split-split-plot design with four replications was used. Main plots were cropping systems, sub-plots were maize varieties and sub-sub-plots were sorghum varieties. Plant samples were taken at sorghum harvest (December 18, 1987), at which time the sorghum stalks were split with a knife. Records were taken on the number of neotropical cornstalk borer damaged (tunneled) plants, amount of damage (measured as cm of stalk tunneled), and number of diapausing larvae (Kevan 1944) in the stalks. Ten plants were sampled per treatment combination per replication, giving a total of 320 plants from each planting system.

Data were analyzed using analysis of variance as a split-split-plot design, and means were separated using Duncan's multiple range test (Duncan 1955).

Study 2: A field site directly adjacent to Study 1 was planted on two dates to sorghum in monoculture as main plots in a split plot design. The first planting date was the

same as the first planting date in Study 1 and the second planting date was the same as the planting date for sorghum in the aporque system. The four sorghum varieties used in Study 1 were the sub-plots, each with four replications. Sampling was as described in the previous study and included a total of 160 plants for each main plot. Analysis was as previously described.

RESULTS AND DISCUSSION

Study 1: The number of diapausing *D. lineolata* larvae in sorghum stalks was lower in aporque (= 0.23 larvae per plant for H-27 plus Maicito) than casado or surco alterno (= 0.59 and 0.54 larvae per plant, respectively). (table 1). Fewer larvae were found in sorghum intercropped with the hybrid maize (= 0.4 larvae per plant for the three planting systems) than with the native maize (= 0.5 larvae per plant). However, at the highest infestation (in casado), similar numbers of stalk borer larvae occurred in sorghum regardless of the maize cultivar.

The percentage of sorghum plants infested with *D. lineolata* was similar in both casado (= 58% when planted with the two maize cultivars) and surco alterno (60%); these results support similar observations by Sequeira (1986). The lowest percentage of sorghum plants infested by this borer was in the aporque planting system (= 26%). The maize cultivar planted in the system influenced the percentage of sorghum plants that were infested with and damaged by borers. Sorghum planted with the hybrid maize had fewer plants infested and damaged (= 44% and 5.8 cm, respectively, when planted in the three systems) than when planted with the native maize (= 51% and 8.4 cm, respectively). When sorghum and maize were planted in the same hill, sorghum was equally infested when planted with the hybrid maize (60%) or with the native maize (55%). Differences (44-51%) in infested plants among the sorghum cultivars within the planting systems were not significant.

Sorghum plants in the aporque system had less damage to the stalks (= 4.2 cm tunnels per stalk when planted with the two maize cultivars) than plants in the casado (= 8.5 cm) or surco alterno (= 8.8 cm) systems. Total damage to sorghum in the three systems when planted with H-27 was lower (5.8 cm for the three systems) than when planted with Maicito (8.5 cm). Damage to sorghum was generally higher when planted with the native sorghum than when planted with the hybrid in the three planting systems.

Table 1. Density of diapausing *Diatraea lineolata* larvae and damage to sorghum in intercropped planting systems with maize, El Zamorano, Honduras, 1987.

Treatment [a]	Larvae plant^{-1}	Infested (plants) (%)	Tunnel length (cm)
Planting System (PS)			
Casado	0.59a[b]	58a	8.45a
Surco Alterno	0.54a	60a	8.80a
Aporque	0.23b	26b	4.18b
Maize Variety (MV)			
H-27	0.40b	44b	5.79b
Maicito	0.50a	51a	8.36a
Sorghum Variety			
Porvenir	0.53a	51a	7.9a
San Bernardo III	0.47ab	49a	7.9a
TAM428*Porvenir	0.38b	46a	6.1a
TAM428*San Bernardo III	0.42b	44a	6.3a
PS x MV			
Casado * H-27	0.60a	60ab	8.1bc
Casado * Maicito	0.58a	55bc	8.8b
Surco Alterno * H-27	0.42b	53c	6.5c
Surco Alterno * Maicito	0.66a	66a	11.0a
Aporque * H-27	0.17c	20e	2.8d
Aporque * Maicito	0.28c	32d	5.6c

[a] Casado: Sorghum and maize planted same date, same hill; Surco alterno: Sorghum and maize planted same date in alternate rows; and Aporque: Sorghum planted 25 days after maize in alternate rows.
[b] Means in a column not followed by the same letter are significantly different at P=0.05 level by Duncan's multiple range test.

The number of *D. lineolata* larvae was lower on the derivative of Porvenir with TAM428 in comparison with Porvenir, but this effect was not observed with San Bernardo III. The sorghum crosses (TAM428 * Porvenir) and (TAM428 * San Bernardo III) had less stalk damage (6.1 and 6.3 cm tunnels, respectively) than the native sorghums Porvenir and San Bernardo III (7.9 cm tunnels), but the differences were not significant.

Our results show that planting sorghum after maize resulted in less damage by *D. lineolata* than sorghum planted concurrently with maize. At the time sorghum was planted in the aporque system, maize plants were in early whorl stages and were generally colonized by a complex of insects. In time, the larger maize plants were physically more visible than the smaller sorghum plants, therefore, possibly attracting ovipositing adults to the maize and away from sorghum. Support for this hypothesis comes from a comparison of damage by *D. lineolata* to sorghum planted with a native maize or a hybrid maize. Sorghum in the hybrid maize system was damaged less by *D. lineolata* than sorghum in the native maize system. The hybrid maize has more foliage area than the native maize, and thus, may be more attractive to *D. lineolata.* This relationship requires further examination.

The line TAM428 was identified as resistant to a *Diatraea* sp. using artificial infestations (Guiragossian and Mihm 1985). The genetic contribution of this line may be responsible, in part, for the observed reduction in number of *D. lineolata* larvae in sorghum crosses. In India, several lines with resistance to the stemborer *Chilo partellus* Swinhoe have been identified. These lines may have yields of 4-5 ton/ha, similar to high yielding susceptible lines (Srivastava 1985). Evaluation of these lines for resistance to *Diatraea* spp. would be desirable.

Study 2: Comparison of sorghum in monoculture (Study 2) with sorghum intercropped with maize (aporque) (Study 1) indicated a much higher percentage of *D. lineolata* damaged plants, number of larvae, and level of damage in the monoculture sorghum. The presence of maize appears to influence the attack on sorghum by this insect. Even though no statistical comparisons can be made between sorghum in monoculture (Study 2) and sorghum intercropped with maize (Study 1), sorghum in monoculture had higher infestations (77 and 70% for first and second planting dates, respectively) than sorghum intercropped with maize (58, 60 and 26% for casado, surco alterno and aporque, respectively - Study 1). Average number (both plantings) of stalk borer larvae per plant was also higher for monoculture sorghum (0.85 larvae) than for intercropped sorghum (0.45 larvae, of the three planting systems - Study 1). Damage to sorghum was greater when grown in monoculture (18.8 cm stalk tunnels) than when grown intercropped with maize (7.1 cm, of three systems - Study 1). Similar observations were made in Africa where the incidence of stemborers was lower in intercropped systems, which included sorghum, maize and cowpea, than in monocultures (Adesiyun 1983, Omolo and Seshu Reddy 1985).

The results of this study provide evidence of significantly less *D. lineolata* damage to sorghum when planted 25 days after maize (aporque) than when sorghum and maize are planted at the same time in a sorghum-maize cropping system. The sorghum crop not only benefits from reduced stalk borer infestations and damage in plantings that have been delayed after the initiation of the first rains, but damage to the crop by lepidopterous defoliators ("langosta" complex) is minimized (Vergara and Pitre, unpublished). Non-crop vegetation becomes established soon after the first rains and before the crops are planted. These larger plants serve to attract the lepidopterous moths and other insect species to this habitat.

The subsistence farming intercropped systems that include maize and sorghum may result in lower *D. lineolata* infestations of and damage to sorghum than sorghum planted in monoculture in Honduras. Stalk borer damage to sorghum also appears to be more serious if sorghum is planted simultaneously with maize. In central Honduras and other areas in Central America with similar cropping practices, and where *D. lineolata* occurs in damaging numbers, farmers can be advised to plant sorghum after the maize has been planted (example, aporque system). It is suggested that this proposed planting strategy should alleviate some stalk borer damage to the sorghum crop.

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