POTENTIAL FOR USING MAIZE AS A TRAP CROP FOR THE FALL ARMYWORM, *SPODOPTERA FRUGIPERDA* (LEPIDOPTERA: NOCTUIDAE), WHERE SORGHUM AND MAIZE ARE INTERCROPPED ON SUBSISTENCE FARMS

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ABSTRACT

The effectiveness of a maize trap crop in reducing fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith), larval infestations on sorghum, *Sorghum bicolor* (L.) Moench. in areas where sorghum and maize, *Zea mays* L., are grown together in the same field was investigated in small plots at Choluteca, Honduras in 1984 and at Starkville, Mississippi in 1984 and 1985. Infestations of FAW larvae were similar on sorghum treatments with and without the maize trap crop in Honduras and in one test in Mississippi, 1984. Apparently, the area ratio of 2:1 for sorghum : maize plantings in close proximity did not differentially restrict FAW activity on the preferred maize plants. However, significantly higher FAW larval infestations and plant damage were observed on maize than on sorghum in pure stand or when grown together with maize as the trap crop in a second test conducted in 1985 in Mississippi. The results of these studies support reported observations in greenhouse and field cages showing higher oviposition by FAW moths on maize than on sorghum. The higher infestation of FAW on maize further suggests the potential for use of maize as a trap crop for monitoring insect populations and its possible use as a trap crop control tactic for FAW in areas of low rainfall where sorghum is grown as a main crop and this insect is a serious pest.

RESUMEN

Se investigó la efectividad del maíz usado como trampa para reducir infestaciones por larvas del gusano cogollero, *Spodoptera frugiperda* (J. E. Smith), en sorgo, *Sorghum bicolor* (L.) Moench., en áreas donde el sorgo y el maíz, *Zea mays* L., se cultivan juntos en el mismo campo, en pequeñas parcelas en Choluteca, Honduras, en 1984, y en Starkville, Mississippi, en 1984 y 1985. Infestaciones de larvas del gusano cogollero fueron similares en sorgo tratados con y sin trampas de maíz en Honduras, y una prueba en Mississippi en 1984. Aparentemente, la proporción de 2:1 de sorgo:maíz sembrados en corta proximidad, significativamente no restringió la actividad del gusano cogollero en las preferidas plantas de maíz. Sin embargo se observaron significativamente más altas infestaciones larvales y daño a las plantas de maís que en las de sorgo, o cuando cultivado junto con maíz como el cultivo de trampa en una sequnda prueba hecha en 1985 en Mississippi. El resultado de estos estudios apoyan las observaciones que se han reportado en invernaderos y jaulas en el campo que indicaron una mayor oviposición en maíz que en sorgo. La alta infestación de gusano cogolleros en el maíz sugiere además el potencial uso del maíz como un cultivo de trampa para chequear las poblaciones de insectos y su posible uso como táctica de control contra el gusano cogollero en áreas de pocas lluvias donde el sorgo es cultivado comc un cultivo principal y este insecto es una plaga seria.

The fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith), is a polyphagous insect that attacks 50 non-economically and 30 economically important plants (Ashley 1979). The FAW acts as a cutworm on young plants, cutting plants at soil level, and on more developed plants the larvae feed on foliage. When severe infestations occur on maize or sorghum, all the foliage may be consumed except the midrib (Andrews 1984). Yield reduction in maize by FAW feeding damage ranges from 20 to 87 percent (Henderson et al. 1966, Andrews 1980, respectively).

Fall armyworm infestations can be high on hosts in the grass family (Poaceae), wherein more oviposition occurs on maize than on sorghum, even when the two crops are grown together (Sifuentes 1967, Van Huis 1981). Resource management has received little attention in the past but is perhaps the most feasible overall approach to FAW control (Lewis & Nordlund 1980). Some research has been conducted using trap crops to attract a pest species or to provide a more favorable habitat to increase natural enemies. The interplanting of alfalfa strips in cotton fields is an example (Huffaker & Messenger 1976) since *Lygus hesperus* Knight prefers alfalfa over cotton as long as the alfalfa remains in a lush growing condition.

Because FAW prefer to oviposit on maize, we investigated the hypothesis that a maize trap crop would concentrate FAW larval populations in sorghum production fields. Thereby, insecticide applications for control of this pest could be limited to the area occupied by the trap crop. This pest management tactic has application in high technology agricultural production areas and would be of value to subsistence farmers in developing countries, such as Honduras, where 93% of the sorghum is intercropped with maize (Donaire 1982).

Materials and Methods

1984 Study I. In 1984 FAW larval infestations in sorghum grown with a maize trap crop were compared to infestations in pure stand sorghum (adjacent plots) (Fig. 1A) at Choluteca, Honduras. Sorghum and maize were planted on June 14 and June 21, respectively. Maize, planted in a block in the middle of the sorghum, comprised 20% of the total area in the trap crop treatment. Each treatment plot was 40 x 40 m arranged in a randomized complete block design with four replications. Infestation by FAW larvae and damage ratings (on a scale of 0-9; 0 = no damage, 9 = plant dead (Wiseman et al. 1966, Wiseman & Davis 1979) were recorded weekly, for six weeks, on 20 plants selected at random in each treatment plot. To find larvae feeding in the whorl, plants were pulled from the ground and the whorl leaves were separated. Using this destructive sampling technique, the whole plant was searched for larvae. The data were analyzed by analysis

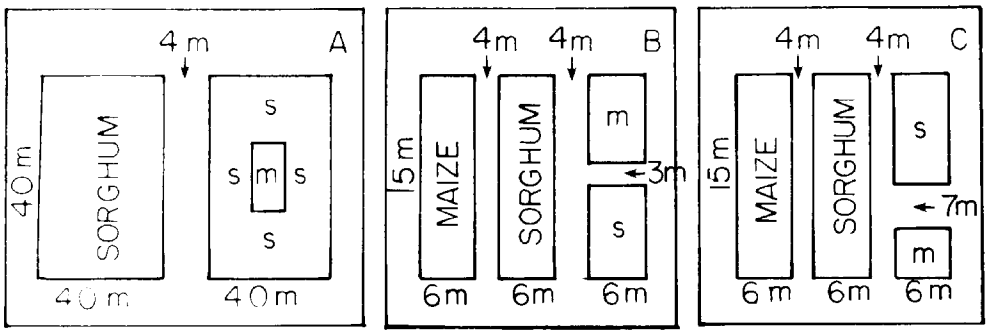

Fig. 1. Sorghum (S) and sorghum-maize (M) trap crop planting designs. A. 1984 Honduras; B. 1984 Mississippi, USA; C. 1985 Mississippi.

of variance and treatment means were separated by Duncan's multiple range test (Duncan 1955).

1984 Study II. Treatments included pure stand maize and sorghum and a trap crop plot with one-half of the area of each crop separated by 3 m of uncultivated land (Fig. 1B). Each treatment plot was 6 x 15 m separated by a 4 m uncultivated alley. Sorghum was planted on May 28 and maize on June 3 at Starkville, Oktibbeha County, Mississippi. The delay in maize planting was not intended. The experimental design, sampling of plants for FAW larvae, estimates of FAW larval feeding damage, and analysis of the data were as described for the 1984 study I.

1985 Study. In this study, sorghum and maize in pure stands were compared with a sorghum-maize trap crop where maize and sorghum occured in an area ratio of 1 maize : 2 sorghum (Fig. 1C). Sorghum was planted on May 28 and maize on June 3 to duplicate the 1984 Study II in the same field. Maize and sorghum in the trap crop treatment plots were separated by a 7 m uncultivated alley. The test design, sampling procedures, and analysis of data were as described above.

Results

Numbers of FAW larvae per plant or plant damage ratings did not differ significantly ($P>0.05$) on any sample date in the 1984 study in Honduras and the 1984 study in Mississippi. There was a trend for more larvae on maize than on sorghum in the Mississippi study in 1984. However, numbers of larvae per plant (Fig. 2) and plant damage ratings (Table 1) differed significantly on sorghum and maize in the different planting systems on all sample dates in the 1985 Mississippi study. More larvae infested maize than sorghum in pure stand or when grown together with maize as the trap crop. Fall armyworm larval feeding damage was consistently greater on maize than sorghum in these systems.

Discussion

The effective size and location of a maize trap crop in small production areas was not determined in these studies. Due to adjacent stands of maize and sorghum in the 1984 Study I, the FAW larvae and damage to both crops were distributed uniformly within and among treatment plots. With a 1:1 ratio of area planted to each crop separated by 3 m of uncultivated land (1984 Study II), the crops obviously attracted moths into the test area, but due to the relatively large area planted to maize and the close proximity of the crops, the FAW larval population and plant damage to maize and sorghum were uniformly distributed and similar among treatments. Where sorghum and maize were planted in a 2:1 ratio (1985 Study), there were significantly ($P>0.05$) fewer larvae on sorghum than maize in the trap crop system. The larger numbers of larvae on maize than sorghum in the pure stand and trap crop planting systems resulted in significantly ($P>0.05$) more damage to the maize than the sorghum. Fall armyworm larval infestations and damage on sorghum grown in pure stand did not differ significantly ($P>0.05$) from sorghum grown with a maize trap crop. In the relatively small test area, the FAW infestations on sorghum in adjacent treatments were uniform reflecting the equal attractiveness of the sorghum treatments in the test, whereas maize apparently attracted a higher population of FAW. The maize plantings in this study appeared to serve as the trap crop for all sorghum plantings regardless of treatment design. The close spatial arrangement of treatment plots, allowing for uniform dispersal of larvae, negated the possible separation of treatment effects on FAW infestations on sorghum in pure stand and with a maize trap crop.

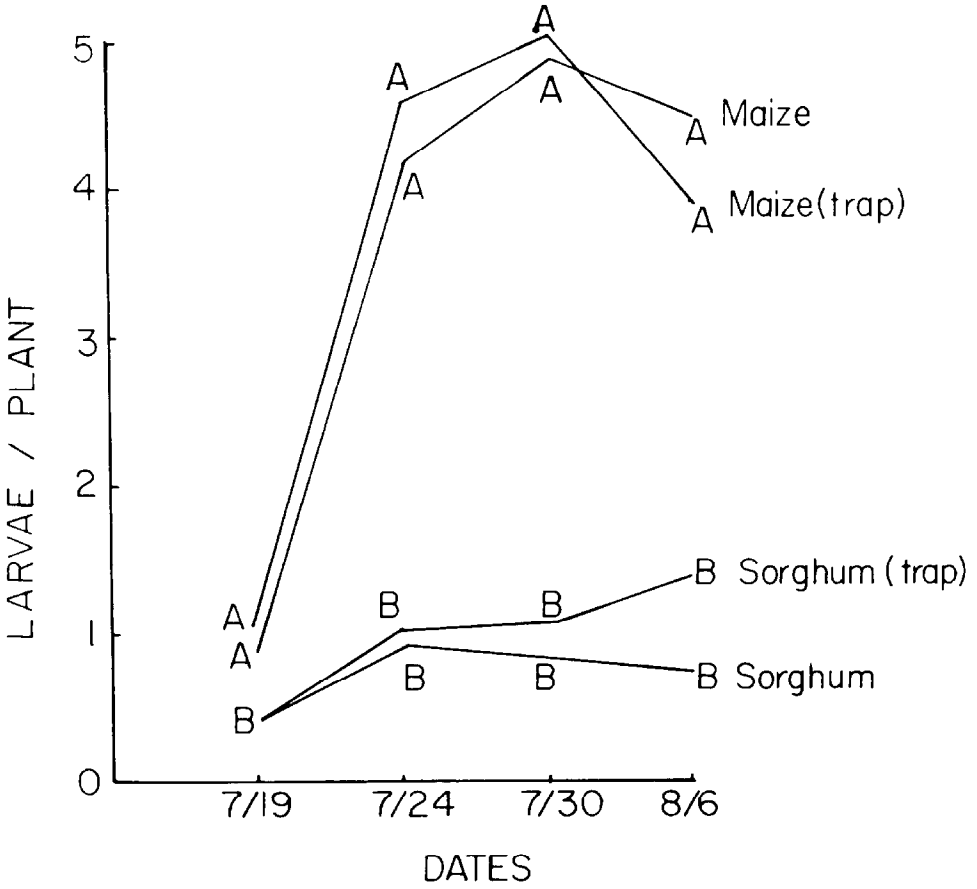

Fig. 2. Fall armyworm larvae on sorghum and maize in different treatment plots [trap indicates that sorghum and maize (the trap crop) in 2:1 crop area ratio (See Fig. 1C)]. Starkville, Mississippi. 1985 Study. Means on each date followed by the same letter are not significantly different [P>0.05; Duncan's multiple range test Duncan 1955)].

TABLE 1. FALL ARMYWORM LARVAL FEEDING DAMAGE TO SORGHUM AND CORN PLANTS IN DIFFERENT CROPPING SYSTEMS, STARKVILLE, MS, 1985.

System	Mean damage rating[1] per plant on dates				
	7/11	7/19	7/24	7/30	8/6
Trap Crop					
Corn	1.15 b[2]	2.70 a	2.40 a	3.70 a	3.40 a
Sorghum	0.72 bc	1.70 b	1.80 b	2.30 b	2.40 b
Pure Stand					
Corn	2.08 a	2.70 a	2.60 a	3.60 a	3.90 a
Sorghum	0.68 c	1.70 b	1.90 b	2.10 b	2.20 b

[1]Damage rating: 0 = no damage, 9 = dead plant.

[2]Means in a column followed by the same letter are not significantly different at [P>0.05; Duncan's multiple range test Duncan 1955)].

Where sorghum is intercropped with maize in many developing countries, the infestations of FAW on both the sorghum and maize plants would be expected to be high and similar due to the closeness of the plants in the system, often in the same hill. Due to general dispersal characteristics (Green & Morrill 1970, Morrill & Green 1973) of FAW larvae and competition for space and food resources, the larvae can readily disperse from the preferred maize plants to adjacent sorghum plants. Therefore, both maize and sorghum in intercropped plantings can be damaged severely by high FAW infestations.

These data support observations by others (Van Huis 1981) of higher FAW larval infestations on maize than sorghum as a result of the greater attractiveness of maize for oviposition. A reduction in area planted to maize compared to that planted to sorghum (less area planted to maize than the 2:1 sorghum : maize ratio used in the present study) and a greater separation of maize from sorghum in a trap crop planting system may improve the effectiveness of the trap crop management tactic by limiting FAW damage to the sorghum. This would be especially important in Honduras and surrounding areas, for example, during the early part of the crop growing season when the plants are attacked by a complex of lepidopterous defoliators, but this needs to be investigated. Additionally, the initial concentration of eggs and larvae on the maize in a relatively restricted cropping area, the maize trap crop, would provide pest survey information required for recommending the application of some pest control tactics. The early detection of FAW egg masses and small larvae should be made easier on the maize in the area of the concentrated trap crop. The dispersal of larvae and infestation on the sorghum crop can be reduced significantly by timely application and concentration of insecticide on the limited area of the maize trap crop. This will result in restricting the use of insecticides to a relatively small area compared with the total area on which the crop is produced and will represent a reduction in production cost to the farmer. The reduction in insecticide use will be less disruptive to the environment and particularly the associated beneficial organisms in the total cropping system.

These benefits would be desired in crop production systems experiencing pest problems regardless of the level of technology involved in producing the crop. In developing countries, where the subsistence farmer can ill afford the use of expensive production practices, the planting of a preferred host plant, in a small area relative to the total area of the main crop with little cost to the farmer to achieve an easy, deliberate method of detection and control of lepidopterous defoliators on crops in early growth stages, can be a valuable tool for the farmer. However, the use of this planting strategy to achieve insect pest control with minimal economic sacrifice must be evaluated in the field in large plots for effectiveness and acceptance.

Endnote

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