SOURCES OF RESISTANCE TO PINK STEM BORER AND EUROPEAN CORN BORER IN MAIZE

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ABSTRACT - The European corn borer (*Ostrinia nubilalis* Hbn) is an important insect pest of maize (*Zea mays* L.) in Europe. However, the larvae of pink stem borer (*Sesamia nonagrioides* Lef.) produce important damage to the stems, especially in Southern Europe. The first step in an insect-resistance breeding program is to identify sources of resistance. The objective of this work was to study the resistance/tolerance of several populations of maize to attack by corn borers in general, and of *Sesamia nonagrioides* in particular. Twenty landraces of maize were evaluated for two years at two locations under natural infestation. In one location most of the larvae that were found belonged to *Sesamia* while in the other location the larvae of *Ostrinia* were more abundant. Agronomic and resistant traits were analyzed in all trials and the best varieties for resistance, along with new material, were evaluated further under artificial infestation conditions with *Sesamia nonagrioides*.
The extraearly and early material suffered less borer damage than the late and midseason material, because the early populations probably escaped the second brood of borers. Moreover, the varieties with small proportion of damaged stems come from the Ebro valley. The germplasm of this area, then, could be a good source of resistance or tolerance to the borers. However, it showed a low yield. The EPS7(S)C2 synthetic also had good resistance under artificial infestations with *Sesamia nonagrioides*. Further, it showed better yield than the landraces because two cycles of S_1 recurrent selection for yield have been carried out in this synthetic. Therefore EPS7(S)C2 could be the base material in a breeding program to obtain resistant varieties to the pink stem borer.

KEY WORDS: Maize; Pink stem borer; *Sesamia nonagrioides*; European corn borer; *Ostrinia nubilalis*; Resistance.

INTRODUCTION

The most important maize (*Zea mays* L.) insect pest in North America and Europe is the European corn borer (*Ostrinia nubilalis* Hbn). However, the larvae of pink stem borer (*Sesamia nonagrioides* Lef.) cause significant damage to maize stems especially in Southern Europe (Anglade, 1972). This damage causes yield losses which can be greatly reduced by using resistant/tolerant cultivars, specially under subsistence farming conditions, as those in the Northwest of Spain where little or no pest control is carried out by the farmers.

The first step in developing insect resistant varieties is to identify sources of resistance. Searches for resistance to the European corn borer have been carried out in inbred lines (Guthrie and Dicke, 1972; Hudon and Chiang, 1985; Hudon and Chiang, 1991) and in populations (Sullivan *et al.*, 1974; Ordas *et al.*, 1988; Reid *et al.*, 1991). However, resistance to the pink stem borer has been less investigated and only in the sixties Anglade (1961a) and Anglade and Bertin (1968) reported that the inbred lines A257, F21 and Pa36 showed moderate levels of resistance to *Sesamia nonagrioides*. After these first efforts, the search for new sources of resistance ceased. The first objective of this work was to study resistance/tolerance of several populations to corn borers, in general, and to *Sesamia nonagrioides* in particular.

Moreover, the insect populations are changing as the environmental conditions change. In the beginning of the eighties few attacks of *Sesamia* were detected in the Northwest of Spain (Ordas *et al.*, 1988) but nowadays the pink stem borer populations have increased their rate. Thus, the second objective of this work was to determine the distribution and relative importance of the different borer species in the East and Northwest of Spain.

MATERIAL AND METHODS

Twenty landraces of maize, from several regions of Spain, along with four commercial hybrids were used for this study (Table 1).

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TABLE 1 - *Maize varieties tested for resistance to corn borer.*

Varieties	Origin
Moeche	Northwest of Spain
Coristanco	Northwest of Spain
Negreira	Northwest of Spain
Pontevedra	Northwest of Spain
Tuy	Northwest of Spain
Regadas	Northwest of Spain
Maceda	Northwest of Spain
Viana	Northwest of Spain
Recaré	Northwest of Spain
Gallego	Spanish race[1]
Azcoitia	North of Spain
Hembrilla	Spanish race[1]
Rastrojero	Spanish race[1]
Amarillo Aragón	Ebro valley
Rojo Aragón	Ebro valley
Sajambre	North of Spain
Valdeón	North of Spain
Fino	Spanish race[1]
Basto	Spanish race[1]
Ubeda	South of Spain
EPS5	Synthetics developed at the
EPS6(S)C2	Misión Biológica de Galicia
EPS7(S)C2	
Monsur 440	Commercial hybrids
P-3543	
P-3347	
AE703	
EVA	
DMB 15-70	

[1] SÁNCHEZ-MONGE, 1962.

TABLE 2 - *Number and proportion of larvae of* Ostrinia nubilalis *and* Sesamia nonagrioides *in two locations.*

		Items	*Ostrinia nubilalis*		*Sesamia nonagrioides*	
		No.	No.	%	No.	%
PONTEVEDRA						
1990	Ear	2140	24	12	180	88
	Stem	576	30	6	480	94
	Total		54	8	660	92
1991	Ear	4939	299	26	844	74
	Stem	1612	191	8	2143	92
	Total		490	14	2987	86
1992	Ear	2716	12	3	363	97
	Stem	1952	21	4	465	96
	Total		33	4	828	96
Total	Ear	9795	335	19	1387	81
	Stem	4140	242	7	3088	93
	Total		577	11	4475	89
ZARAGOZA						
1991	Stem	1891	318	68	150	32
1992	Stem	675	336	58	247	42
Total	Stem	2566	654	62	397	38

The materials were cultivated in 1990 and 1991 in two locations in Spain: Pontevedra, in the Atlantic coast of the Northwest with a humid, mild climate and Zaragoza, in the Ebro valley, a dry and hot area in the East where maize must be cultivated under irrigation.

Each experiment was arranged in randomized complete blocks with three replications. In Pontevedra, 2-row plots, spaced 80 cm apart, were used. Within each row, 26 two-kernel hills were spaced 20 cm apart. In Zaragoza the varieties were planted in 2-row plots. They consisted of 15 two-kernel hills with 20 cm between hills in 1990 and 24 two-kernel hills in 1991. The distance between rows was 75 cm. After thinning, one plant per hill was left in all experiments.

Data were recorded on days to silking, stem lodging (percentage of plants with the broken stem at or below the uppermost ear), grain moisture at harvest and grain yield.

At harvest eight plants in Pontevedra and four plants in Zaragoza were randomly chosen. From these plants stem height, number of entry holes and number and length of tunnels were recorded. The number of entry holes and the tunnel length per stem were divided by the height of the stem and were multiplied by 100 to estimate holes per meter of stem and the proportion of damaged stem.

In Pontevedra, the larvae of *both Sesamia* and *Ostrinia* reach the full development, at the same time, in November. The larvae from stems and ears were then counted and classified to determine the proportion of *Ostrinia nubilalis* and *Sesamia nonagrioides*. At that time the ears had been already harvested in Zaragoza. For this reason only the larvae from stems were counted in the latter location.

Migration is common in both species. Because of this, the number of larvae per plant was not used for selecting resistant genotypes as the larvae could have left a susceptible stem before the time of the examination.

Individual analyses of variance were carried out in each experiment for each trait and then pooled into a combined analysis over years in each location. The sums of squares for varieties, interaction, and pooled error were orthogonally divided into components due to groups of maturity (extraearly, early, midseason, and late).

Comparisons of means were made by the Waller-Duncan method for each trait. The ranks obtained in Zaragoza and Pontevedra were compared using Spearman's coefficient for tunnels per stem, holes per one meter of stem and percentage of damaged stem (STEEL and TORRIE, 1980). Partial correlation coefficients among traits analyzed to measure the corn borer damage were obtained in both locations. All analyses were made with the SAS package (SAS, 1988).

The best varieties for resistance or tolerance in these trials were evaluated again in 1992 at Pontevedra under artificial infestation with *Sesamia nonagrioides*. Two commercial hybrids and three synthetics (EPS5, EPS6, and EPS7) obtained at the Misión Biológica de Galicia were also evaluated. EPS5 had been formed with 14 inbred lines derived from very diverse germplasm excluding B14 and B14 derivatives. Four landraces from humid Spain formed the EPS6, while populations from dry Spain formed the EPS7 (ORDAS, 1991). Two cycles of S_1 intrapopulation recurrent selection for yield had been carried out in both EPS6 and EPS7 synthetics.

A randomized complete-block design with four replications was used. A two-row plot (3.15 m long and 1.6 m wide) was overplanted and then thinned to 60000 plants/ha. Each plant was artificially infested at flowering with one mass of eggs (approximately 50 eggs/plant). The eggs were obtained following Eizaguirre's method (EIZAGUIRRE, 1989) and the artificial infestations were made according to Anglade's technique (ANGLADE, 1961b). Data were collected for the same traits as in the previous evaluations.

TABLE 3 - *Means of seven traits for 24 varieties classified by groups of maturity grown in Pontevedra for two years.*

Varieties	Silking	Tunnels per stem	Holes per 1m of stem	Damaged stem	Lodging	Grain moisture	Yield
	days	No.		%			t/ha
EXTRAEARLY							
Sajambre	46n	1.22c-f	1.68bc	13.0a	52.5b-d	25.1e	4.3c-f
Valdeón	45n	0.97f	1.50c	15.6a	66.0ab	27.6c-e	2.9f-h
EARLY							
Gallego	59j	1.92a-d	2.58a-c	22.7a	51.9b-e	28.3c-e	4.7b-f
Viana	52m	1.19d-f	1.75a-c	14.3a	71.0ab	27.0c-e	3.6d-h
Regadas	59j	1.71a-f	2.05a-c	17.0a	59.4a-c	26.1c-e	4.1c-g
Coristanco	57kl	1.56a-f	2.14a-c	17.2a	21.9f-i	27.2c-e	3.2e-h
Maceda	54m	1.08ef	1.79a-c	15.4a	70.6ab	28.3c-e	3.0f-h
Rojo Aragón	59jk	1.29b-f	1.52c	16.3a	32.8d-h	28.2c-e	2.2gi
Azcoitia	56l	1.58a-f	2.33a-c	19.0a	50.7b-e	26.9c-e	5.8bc
MIDSEASON							
P-3543	66c-e	1.86a-e	2.01a-c	14.0a	11.6g-i	27.5c-e	8.7a
Monsur 440	66de	1.90a-d	2.41a-c	14.8a	26.5e-i	27.6c-e	9.5a
Tuy	63f-h	1.79a-e	2.61a-c	17.8a	40.2c-f	28.9b-e	4.5b-f
Negreira	62hi	1.67a-f	2.67a-c	21.5a	52.6b-d	27.5c-e	4.5b-f
Pontevedra	60ij	2.00a-c	2.40a-c	18.3a	23.6f-i	27.0c-e	4.9b-f
Moeche	64e-g	2.04ab	2.92ab	23.7a	37.2c-f	27.9c-e	4.0c-g
Recaré	63f-h	1.94a-d	2.73a-c	22.0a	37.6c-f	27.8c-e	3.5e-h
Ubeda	65d-f	1.63a-f	2.50a-c	19.3a	80.0a	27.1c-e	1.8hi
Amar. Aragón	62gh	1.21c-f	1.65bc	17.7a	74.9ab	25.4de	3.0f-h
LATE							
P-3377	72b	1.89a-d	2.33a-c	19.0a	15.4f-i	30.4a-e	10.5a
AE-703	71b	1.94a-d	2.30a-c	20.7a	9.8hi	31.4a-c	10.7a
Basto	72b	1.94a-d	2.58a-c	18.7a	37.0c-g	34.3ab	6.4b
Fino	67cd	2.19a	2.95ab	24.7a	51.8b-e	30.8a-d	5.6b-d
Hembrilla	81a	1.65a-f	3.03a	12.0a	4.4i	34.8a	0.5i
Rastrojero	68c	1.69a-f	1.91a-c	15.0a	29.5d-i	31.3a-c	5.2b-e
Mean	62	1.67	2.27	18.0	41.8	28.5	4.9
LSD	2	0.79	1.34	14.1	25.6	5.8	2.0

Means with the same letter in the same column do not show significant differences after Waller Duncan test at the 5% level.

RESULTS AND DISCUSSION

Significant differences among varieties were found for all traits in the combined analysis of variance except for proportion of damaged stem in Pontevedra and for number of entry holes in both locations. However, in these cases the F values were close to the critical value at the 0.05 probability level. Because of this the Waller-Duncan method detected significant diferences among varieties also for these traits.

In Zaragoza, the two-factor interactions for lodging, grain moisture, yield and number of tunnels were significant indicating some lack of consistency in the performance of varieties over years. In Pontevedra, year x varieties interactions were significant for grain moisture, yield and proportion of damaged stem.

The varieties in both locations were classified according to maturity groups. The hybrids P-3543 and Monsur 440 belonged to the midseason group in Pontevedra while in Zaragoza they showed silking and grain moisture similar to the late group. Two populations also showed different behavior in both locations. Gallego and Rastrojero were classified in the midseason group in Zaragoza while they belonged to the early and late group in Pontevedra respectively.

The means of the different traits in Pontevedra are shown in Table 3 for varieties, and in Table 4 for groups of maturity. The results obtained in Zaragoza are shown in Table 5 and Table 6. In general, late material stands up until harvest better than early germplasm,

TABLE 4 - *Means of seven traits for four groups of maturity grown in Pontevedra for two years.*

Varieties	Silking	Tunnels per stem	Holes per 1m of stem	Damaged stem	Lodging	Grain moisture	Yield
	days	No.		%			t/ha
EXTRAEARLY	45d	1.10b	1.59b	14.3a	59.2a	26.4b	3.6c
EARLY	56c	1.49ab	2.03ab	17.4a	50.7ab	27.4b	3.8bc
MIDSEASON	63b	1.78a	2.43a	18.8a	42.7b	27.4b	4.9bc
LATE	72a	1.89a	2.50a	18.5a	25.2c	32.1a	6.7a
LSD	2	0.43	0.75	8.3	14.06	4.56	1.7

Means with the same letter in the same column do not show significant differences after Waller Duncan test at the 5% level.

TABLE 5 - *Means of seven traits for 24 varieties classified by groups of maturity grown in Zaragoza for two years.*

Varieties	Silking	Tunnels per stem	Holes per 1m of stem	Damaged stem	Lodging	Grain moisture	Yield
	days	No.		%			t/ha
EXTRAEARLY							
Sajambre	53j	0.96f	2.34cd	9.1b	14.1a-d	15.8a-d	1.0h
Valdeón	53j	1.00f	3.16a-d	8.1b	5.9b-d	14.5c-f	1.3gh
EARLY							
Viana	61i	1.42b-f	2.77a-d	14.6ab	27.0ab	15.6a-e	1.9e-h
Regadas	64h	1.75b-f	2.36cd	12.5ab	23.7a-c	14.8b-f	2.1e-h
Coristanco	65h	2.29a-e	4.28ab	20.2ab	10.3a-d	14.8b-f	2.7d-h
Maceda	64hi	1.33d-f	2.43b-d	7.7b	19.6a-d	14.1f	2.3e-h
Rojo Aragón	65h	1.13ef	1.99d	13.8ab	8.8b-d	14.7b-f	1.9f-h
Azcoitia	65h	1.88b-f	2.74a-d	13.0ab	11.9a-d	14.1f	2.8d-g
MIDSEASON							
Gallego	68g	1.58d-f	2.72a-d	13.4ab	19.0a-d	15.1a-f	2.5e-h
Tuy	72de	2.13a-f	2.68a-d	14.3ab	30.0a	15.6a-e	3.6c-e
Negreira	70e-g	2.29a-e	3.14a-d	18.1ab	16.7a-d	14.3ef	2.7d-h
Pontevedra	68g	1.83b-f	3.10a-d	13.9ab	17.9a-d	14.5d-f	2.9d-g
Moeche	73d	2.00b-f	3.53a-d	18.6ab	15.1a-d	14.0f	1.8f-h
Recaré	71d-f	2.08b-f	2.15d	16.5ab	19.4a-d	14.9b-f	2.1e-h
Ubeda	73d	1.58d-f	2.86a-d	15.4ab	22.5a-d	15.4a-f	2.0e-h
Rastrojero	72de	1.63c-f	1.74d	12.5ab	14.8a-d	14.9b-f	4.2cd
Amar. Aragón	69fg	1.42d-f	1.89d	12.0ab	17.8a-d	14.8b-f	2.9d-g
LATE							
P-3377	80ab	1.88b-f	2.97a-d	16.4ab	9.5a-d	16.1ab	8.0a
P-3543	77c	2.04b-f	2.67a-d	17.7ab	5.1cd	15.1a-f	5.2bc
AE-703	81ab	2.79a-c	3.36a-d	25.9a	4.1cd	15.7a-d	7.7a
Monsur 440	77c	3.29a	4.08a-c	20.1ab	8.7b-d	15.2a-f	6.3ab
Basto	79bc	2.83ab	3.42a-d	21.7ab	18.2a-d	16.5a	4.4cd
Fino	77c	2.38a-d	2.67a-d	16.6ab	24.6a-c	15.9a-c	3.4c-f
Hembrilla	82a	2.06b-f	4.38a	14.0ab	2.3d	16.1ab	1.4gh
Mean	70	1.90	2.87	15.3	15.5	15.1	3.2
LSD	3	1.18	1.91	15.1	21.2	1.4	1.7

Means with the same letter in the same column do not show significant differences after Waller Duncan test at the 5% level.

TABLE 6 - *Means of seven traits for four groups of maturity grown in Zaragoza for two years.*

Varieties	Silking	Tunnels per stem	Holes per 1m of stem	Damaged stem	Lodging	Grain moisture	Yield
	days	No.		%			t/ha
EXTRAEARLY	53d	0.98b	2.75a	8.6b	10.0a	15.2a	1.2b
EARLY	64c	1.63ab	2.76a	13.6ab	16.9a	14.7a	2.3b
MIDSEASON	70b	1.84ab	2.65a	14.9a	19.2a	14.8a	2.7b
LATE	79a	2.49a	3.31a	19.1a	10.7a	15.8a	5.4a
LSD	2	1.11	1.51	9.2	16.5	1.3	1.7

Means with the same letter in the same column do not show significant differences after Waller Duncan test at the 5% level.

TABLE 7 - *Spearman's coefficient of rank correlation between damage produced mainly by* Ostrinia nubilalis *at Zaragoza and by Sesamia nonagrioides at Pontevedra for two years.*

	Tunnels per stem	Holes per 1m of stem	Damaged stem
With 24 varieties	0.66**	0.42*	0.44*
With 22 varieties (without extraearly varieties)	0.58**	0.32	0.31

TABLE 8 - *Partial correlation coefficients among traits to measure the damage in Zaragoza (above the diagonal) and in Pontevedra (below the diagonal).*

	Tunnels per stem	Holes per 1m of stem	Damaged stem
Tunnels per stem		0.45**	0.50**
Holes per 1m of stem	0.62**		0.63**
Damaged stem	0.64**	0.75**	

which becomes dry sooner and is more fragile (HUDON *et al.*, 1979; JARVIS and GUTHRIE, 1980; HUDON and CHIANG, 1991). However, in this work the extraearly and early varieties suffered less borer attack than the late and midseason material in both locations. This may be due to large differences in days to flowering among the varieties. Valdeón had 45 and 53 days from planting to silking in Pontevedra and Zaragoza, respectively and it was the earliest variety while Hembrilla was the latest population with 81 and 82 days for silking. When the second generation appeared the early material was too dry and the moths preferred the more tender material for egg deposition and so the extraearly group escaped to the borer attack. These results are in agreement with DICKE and GUTHRIE (1988) who proposed that late-maturing corn is more attractive to the moths of the second generation.

Sesamia nonagrioides was the principle borer pest

TABLE 9 - *Means of seven traits for eight varieties evaluated under* Sesamia nonagrioides *artificial infestations.*

Varieties	Silking	Tunnels per stem	Holes per 1m of stem	Damaged stem	Lodging	Grain moisture	Yield
	days	No.		%			t/ha
EPS5	55d	2.00c	10.5a	56.7a	65b	29.6bc	4.3c
Rojo Aragón	56d	1.90c	6.8c	38.1bc	85a	37.1a	1.9e
EPS6(S)C2	58d	2.00c	9.2ab	46.5ab	68b	33.1abc	2.7d
Amar. Aragón	60c	1.50c	4.4d	24.8d	93a	31.1bc	1.9de
EPS7(S)C2	61bc	2.00c	7.6bc	32.6cd	87a	33.6abc	2.7d
Eva	61bc	2.59b	10.1a	45.8ab	15d	29.4c	6.5a
DMB15-70	63b	3.06ab	9.5a	48.0ab	20d	32.1bc	5.5b
Rastrojero	67a	3.31a	6.7c	37.8bc	51c	34.6ab	2.5de
Mean	60	2.29	8.1	41.3	61	32.6	3.5
LSD	2	0.57	1.9	11.9	14	5.0	0.8

Means with the same letter in the same column do not show significant differences after Waller Duncan test at the 5% level.

found in Pontevedra (Table 2). It seems that *Ostrinia* has been negligible for the last few years. In Pontevedra, the early varieties Rojo Aragón, Maceda and Viana showed few tunnels and holes in the stem and the proportion damaged stem was low. However, Maceda and Viana were earlier than Rojo Aragón and so they could have escaped to the pest. Among the midseason and late populations Amarillo Aragón and Rastrojero showed the least damage from *Sesamia*. Hembrilla had many holes but few and short cavities. This variety is too late for maturing well in the environmental conditions of the Northwest of Spain, though.

In Zaragoza, the most prevalent borer was *Ostrinia nubilalis* but larvae of *Sesamia nonagrioides* were also found in the stem (40% approximately) (Table 2). Amarillo Aragón and Rastrojero were also the best varieties for the corn borer resistant traits in this area. Hembrilla showed the least proportion of damaged stem and the least amount of lodging among the late varieties, but the number of holes was high. The larvae bore into the stem of this race but they are not able to eat the pith. This race could be considered tolerant enough to the corn borer.

Hembrilla, Rastrojero and Amarillo come from the Ebro valley. The germplasm of this area, then, could be a promising source of resistance or tolerance to the corn borers. In a previous study these populations also showed low levels of attack in comparison with American germplasm (ORDAS *et al.*, 1988).

As expected, the greater yields belonged to commercial hybrids which showed less proportion of lodging than the populations.

Material which is considered resistant in its natural country can show intermediate resistance or susceptibility in other countries (HUDON and CHIANG, 1991). To know if the damage to the varieties was similar in both locations, Spearman´s coefficient of rank correlation was calculated for the traits which measured the resistance to the borer pest (Table 7). There were significant correlations for all the traits when all varieties were included in the analyses. As the extraearly group escaped to the borer attack in both locations the analyses were made again excluding this group. In this case the correlation was signifitcant only for number of tunnels per stem. The rank of varieties for tunnels in the stem was similar in both locations but it was not alike for rind and pith resistant (holes per one meter of stem and proportion of damaged stem). Therefore, one population considered as resistant to the European corn borer must be tested for resistance to pink stem borer and viceverse.

On the other hand, significant partial correlations coefficients were found among the three traits analyzed to measure the corn borer damage. The highest coefficient was between number of holes and proportion of damage stem. Therefore, pith and rind hardness are related (Table 8).

Natural field conditions can be used to screen for resistance but artificial infestations are much more efficient (WISEMAN and DAVIS, 1990). The best varieties in the trials carried out under natural conditions were chosen, along with new material, to be evaluated under artificial infestation with *Sesamia nonagrioides* (Table 9).

The varieties that were tolerant to the borers in natural conditions were also tolerant to attack in artificial conditions. However the differences among varieties were greater in artificial than under natural conditions especially for the proportion of damage stem.

The hybrids showed the best values for yield and lodging. Thus Eva yielded less under artificial infestation than under natural infestation in the same year, and the same location (8.1 t/ha). The landraces showed the least damage from *Sesamia*, but their yields were very low. Rastrojero and Amarillo Aragón included in the constitution of EPS7(S)C2 were also studied in this work. Both showed good results for number of holes and proportion of damage stem. This trait seems to be maintained in the new synthetic. Two cycles of S_1 recurrent selection for yield have been carried out in the EPS7, so this material showed a higher yield and could be used as donor of resistance.

There are few and inconclusive studies about the inheritance of resistance to *Sesamia nonagrioides*. Only ANGLADE and BERTIN (1968) have showed that for resistance to pink stem borer the dominance was partial or incomplete. However, reports of studies on inheritance of resistance on other corn borers, mostly on *Ostrinia* showed that resistance is quantitatively inherited with a preponderance of additive gene action (SCOTT *et al.*, 1964; JENNINGS *et al.*, 1974; GUTHRIE, 1989; WILLIAMS *et al.*, 1989; AJALA, 1992). Therefore recurrent selections schemes are the best methods to improve the corn borer resistance (RUSSELL *et al.*, 1979; GUTHRIE, 1989). We expect that the inheritance of resistance to *Sesamia nonagrioides* is not too different from the resistance to other borers. A recurrent selection program could begin with the synthetic EPS7(S)C2 as the base material with resistance to *Sesamia nonagrioides* being the selection criterion.

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