GREENHOUSE SCREENING OF SOYBEAN VARIETIES FOR RESISTANCE TO CORN EARWORM *Heliothis zea* (BODDIE)

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ABSTRACT

This paper reports a greenhouse screening test comparing soybean, *Glycine max* (L.) Merrill genotypes IR-81296, CO-686, Lamar and D75-1016 with the susceptible varieties Centennial and Cobb, and the resistant genotypes Braxton, PI-227687, and Crockett (V2 stage) infested with neonate corn earworm larvae, *Heliothis zea* (Boddie). Larvae could move freely among soybean plants arranged in a randomized complete block with four replications. Trifoliate leaves were infested with three neonate larvae. Visual estimation of leaf area consumed was done at seven and 12 days post-infestation. No significant differences were detected among the varieties at day-7. Variety CO-686 had levels of defoliation not significantly different from the susceptibles ones at day-12. The varieties IR-81296, Lamar and D75-1016 behaviored as resistant genotypes. The visual estimation of leaf area removed at day-12 was consistent with the results of the video digitation of damage leaves and computer analysis.

KEY WORDS: Insecta, corn earworm, antixenosis, plant resistance, soybean.

RESUMO

Avaliação de Variedades de Soja Visando Resistência a *Heliothis zea* (Boddie)

Avaliou-se o comportamento dos genótipos de soja *Glycine max* (L.) Merrill IR-81296, CO-686, Lamar e D75-1016 em presença de variedades susceptíveis (Centennial e Cobb) e resistentes (Braxton, PI-227687 e Crockett) infestadas com *Heliothis zea* (Boddie). Plantas no estágio V2, foram infestadas com três larvas de primeiro estádio da praga, sendo dispostas de forma que as larvas escolhessem livremente entre as variedades do mesmo bloco. O experimento seguiu o delineamento estatístico de blocos completos casualizados com quatro repetições. Os resultados foram obtidos mediante avaliação visual da percentagem de área foliar removida aos sete e 12 dias pós-infestação. A avaliação aos sete dias não mostrou diferença significativa entre as variedades, porém a avaliação aos 12 dias mostrou que as variedades D75-1056, Lamar e IR-81296 não diferiram significativamente das variedades

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resistentes. A variedades CO-686 apresentou nível de desfolhamento igual aos das variedades susceptíveis. Os resultados das estimativas visuais não diferiram significativamente daqueles obtidos através da técnica vídeo-digital.

PALAVRAS-CHAVE: Insecta, soja, antixenose, resistência de plantas.

INTRODUCTION

The primary objective of breeding programs incorporating pest resistance in crop plants is to develop cultivars with improved agronomic characteristics while sustaining less pest damage or less yield reduction from a given level of pest damage. Resistant cultivars may need less frequent treatment with a pesticide or may require lower rates of application. Greenhouse procedures of screening cultivars for insect resistance has been an important method in soybean, *Glycine max* (L.) Merrill, breeding programs (Clark 1972, Hatchet *et al.* 1979, Lambency & Kids 1984) with high correlated results when compared with field conditions (All *et al.* 1989). In recent years many soybean genotypes have been tested in breeding programs for leaf-feeding resistance to various lepidopterans, including the corn earworm, *Heliothis zea* (Boddie). However, the development of an acceptable soybean cultivar, with resistance to insects, diseases and nematodes has been tried without much success. The cultivar PI-227687, for instance, is considered insect resistant but it is agronomically poor and susceptible to diseases and nematodes (Lambert & Kilen 1984). Clark *et al.* (1972) evaluated the susceptibility of some varieties to corn earworm including PI-227687 (also Hatchet *et al.* 1976) and PI-229358, stressed that both had antibiosis to larvae. Results found by Hatchet *et al.* (1979) proved that PI-229358 had high levels of resistance to several insects (including corn earworm) also fewer, undesirable agronomic characteristics. Since then that variety has been used intensively as a source of resistance to defoliators. The varieties Centennial (Lambency & Kids 1984) and Cobb (All *et al.* 1989) are considered susceptible varieties to different insect defoliators, being recommended in resistance evaluation.

The aim of this test was to identify resistance characteristics through antixenosis mechanisms in the soybean genotypes IR-81296, D75-1016, Lamar and Coker 686 to corn earworm using visual estimation of the foliar area removed.

MATERIAL AND METHODS

The experiment was done in a greenhouse facility at the University of Georgia, Athens. The genotypes IR-81296, D75-1016, Lamar and Coker 686 were compared with others soybean varieties: Cobb, Centennial (susceptible) Crockett, Braxton and PI-227687 (resistants). Three seeds of each genotype were planted in a 450 ml styrofoam cup filled to 2 cm from the top with a mixture of three parts soil and one part sand sterilized by methylbromide fumigation. Each cup had three 8 mm diameter holes puched into the botton for water infiltration. At VC stage, plants were thinned to one plant per cup. At the seventh day, plants were fertilized with N-P-K (20-20-20, 227 g per gallon). Until infestation plants were watered daily over the top.

Cups were arranged in a stainless steel tray in a randomized complete block design with four replications. The cups touched each other; so that, soybean canopy intermingled enabling larvae to move freely among plants in the same block (All *et al.* 1989). When plants reach V2 stage (14 days old), three corn earworm neonate were placed on trifoliate leaves in each plant using a hairbrush.

Plant defoliation was evaluated at seven and 12 days post-infestation. Each plant was examined and the percentage of leaf area removed was estimated by a visual estimation method. Mean differences of leaf area removed among treatments were compared using an analysis of variance (ANOVA) and separated by Duncan's new multiple test (SAS 1982). At day-12 after the plants were visually evaluated, all the leaves were clipped, removed and photocopied to obtain the true leaf area consumed for each cultivar though a computer-based leaf defoliation analysis system (Hargrove & Crossley Jr. 1988). The accuracy of the visual estimation was than tested against the results of the computer technique using Duncan's multiple test (SAS 1982).

RESULTS AND DISCUSSION

Mean percentages leaf area removed (% LAR) are showed in Table 1. The day-seven data showed no significant differences between treatments though the varieties IR-81296, Lamar and D75-1016 showed almost half of the feeding damage observed for the variety Centennial. Though a comparison of percentage of larval survival between treatments is not a consistent criteria a large numerical difference among the susceptible varieties Centennial and Cobb and

Table 1. Mean percentage of leaf area removed (LAR) by *Heliothis zea* in soybean varieties at two different dates post-infestation and results of the percentage of leaf area removed evaluated though the computer digitizer technique.

Variety	7 days	12 days	
	Mean % LAR[1]	Mean % LAR[1,2]	% LAR Digitizer[2]
Centennial	20.00 a	33.25 a A	27.18 A
CO-686	15.50 a	31.25 ab A	23.22 A
Cobb	18.00 a	25.25 abc A	29.31 A
Braxton	16.50 a	22.25 abcd A	16.40 A
PI-227687	17.00 a	19.25 bcd A	19.78 A
IR-81296	13.25 a	18.00 bcd A	13.97 B
Lamar	11.75 a	17.25 cd A	14.62 A
D75-1016	13.75 a	15.75 cd A	12.44 A
Crockett	14.50 a	9.75 d A	10.16 A

[1]Treatments in the same column followed by the same small letter are not significantly different at p=0.05 using Duncan's new multiple range test.

[2]Treatments in the same row at 12 days followed by the same capital letter are not significantly different at p=0.05 using Duncan's new multiple range test.

the genotypes Crockett, D75-1016 and Lamar was observed (Fig. 1). Possibly seven days were not enough time for resistance to develop.

At day-12, a significantly lower mean leaf loss was observed for Crockett confirmed that this variety exhibits resistance qualities. The mean percent of leaf removed showed the varieties D75-1016, Lamar and IR-81296 with a significantly lower leaf losses in comparison with the susceptible variety Centennial. They sustained about one-half of the damage observed for variety Centennial in the test. The significant difference observed confirmed that these varieties exhibit resistance qualities. The means did not differ from the those got for the resistant lines, in special Crockett and PI-227687. Although the results for the tested genotypes were not statistically different from Cobb, there was a distinct trend in damage reduction. Works by Beach & Todd (1988a) and All *et al.* (1989) confirmed the presence of multiple resistance in the variety IR-81296. The genotypes CO-686 and Braxton have been commercialized as resistant varieties (H. Boerma, personal communication), however in the test they presented the same level of larval damage as Cobb and Centennial. Results confirm that the breeding lines D75-1016, IR-81296 and Lamar exhibited a level of resistance comparable to the known resistant varieties Crockett and PI-227687 deserving field tests.

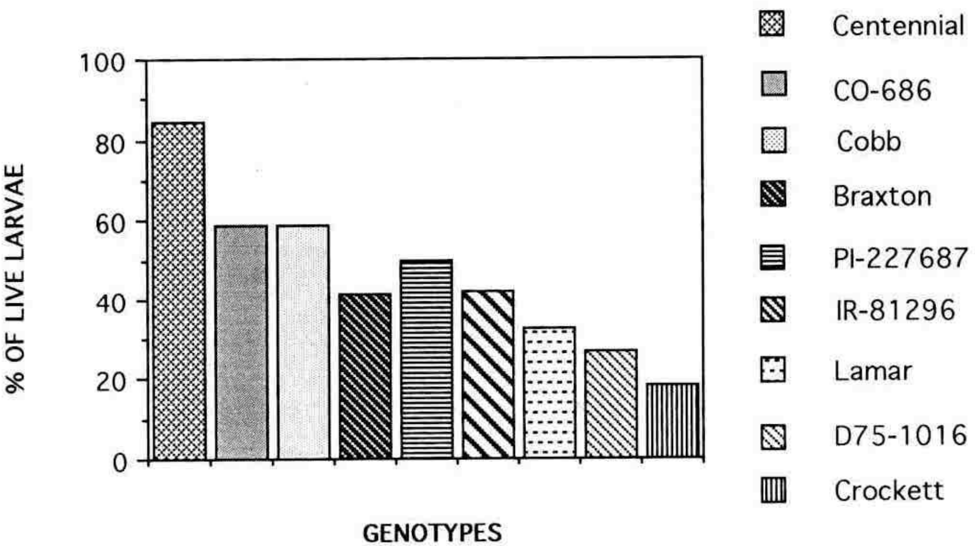

Figure 1. Percentage of live larvae of *Heliothis zea* in soybean varieties with variable resistance at seven days post-infestation.

Results obtained from the leaf area removed by the visual method and the results from the computer-digitizer technique (Table 1) indicated that estimating leaf area loss is a particularly useful tool in determining economic injury level and economic threshold (Nolting & Edwards 1985), and in programs of insect control (Hargrove & Crossley Jr. 1988). Lindow & Webb (1983) applied for the first time a microcomputer digitizer to quantify leaf removed. Hargrove & Crossley Jr. (1985) improved the technique by combining a video digitizer and a highlight pen device with a video camera. Except for the variety IR-81296, no other significant difference was observed between the estimations. Therefore, the fast and accurate visual estimation of the leaf area removed by corn earworm in soybean is very consistent and can be adopted as the primary screening procedure in the greenhouse as well as in the field.

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