COMPARATIVE SUSCEPTIBILITY OF CHRYSANTHEMUM CULTIVARS TO EUROPEAN CORN BORER

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ABSTRACT

Susceptibility between chrysanthemum varieties to the European corn borer, *Ostrinia nubilalis* (Hubner) was evaluated in both field and laboratory studies. Field studies showed significant differences with the varieties Debonair and West Point being the most heavily infested, and Grenadine, Patriot, Baby Tears, and Revere showing no larval feeding. Laboratory methods utilizing unrooted cuttings yielded inconsistent results. Laboratory screening with the use of stem sections was relatively consistent with Debonair and West Point being the most heavily infested while Revere and Pancho the least infested. A positive correlation between infestation levels and stem diameters indicated stem thickness may be a factor in expression of susceptibility. Debonair and West Point, the most susceptible varieties, had significantly larger stem diameters than the less susceptible varieties, Revere and Pancho.

Key Words: European corn borer, *Ostrinia nubilalis*, chrysanthemum, host plant resistance.

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INTRODUCTION

European corn borer (ECB), *Ostrinia nubilalis* (Hubner), is an important pest attacking not only corn but vegetable and ornamental crops as well. Despins and Roberts (1984) reported three generations in eastern Virginia the latter two developing on late season corn, bell pepper, snap bean and other truck crops (Jones et al. 1939). Periodic infestations of ECB have also been reported on chrysanthemum and other ornamental crops (Smith 1962). The hardy or outdoor chrysanthemum is one of the most popular fall blooming exterior landscape plants. Rooted cuttings are planted from late May to mid-June and plants are marketed in September. Injury in commercial nurseries is caused by the second generation ECB, which oviposits in mid-August. Any amount of injury results in an unmarketable plant, and commercial growers discard damaged plants when injury is initially observed. Commercial growers of hardy chrysanthemums aware of ECB damage apply costly, weekly prophylactic insecticide treatments. Observations at commercial nurseries in eastern Virginia suggest differences in host susceptibility to ECB exists between cultivars of hardy chrysanthemums. Several were found to be so highly susceptible that production was considered uneconomical. The identification of varieties exhibiting ECB resistance would be of economic benefit to the grower, retailer, and consumer.

The objectives of this study were to 1) identify and evaluate possible methods to screen chrysanthemum cultivars for ECB resistance and 2) to identify the susceptibility of hardy chrysanthemums varieties.

MATERIALS AND METHODS

Experiments were conducted in the field and laboratory of the Hampton Roads Agricultural Experiment Station in Virginia Beach, VA, during the summer and fall of 1985. Five different methods were evaluated and incorporated 3 phases of ECB, biology, oviposition, foliar feeding and stem feeding.

Field Study

Rooted cuttings of 11 varieties of hardy chrysanthemums were received June, 1985, from Yoder Brothers, Inc., and were immediately planted in one gallon containers. Forty containers of each variety were arranged in a completely random design and placed 100 m west of a 0.4 ha corn field. Oviposition on each variety was evaluated in mid-September by visually examining each plant for evidence of ECB injury.

Laboratory Study

Four laboratory methods were evaluated using the varieties of the field study. 1) Ten unrooted chrysanthemum cuttings from each variety were placed in plastic cups filled with water to evaluate foliar feeding. One egg mass which had reached the black-head stage was placed at the terminal of each cutting at a leaf node. Egg masses of ECB were obtained from the USDA Corn Insects Research Unit at Ankeny, IA. Plastic cylinders 0.3 cm thick, 7 cm in diameter and 15 cm high were placed around the cuttings to reduce larval escape. The study, maintained at 26°C and 14:10 h photoperiod in the laboratory, was repeated twice, in August and September. The cuttings were dissected after 2 weeks and examined for the presence of ECB larvae. 2) Each of the 11 varieties was evaluated for stem feeding in a non-preference test by placing 20 stem sections 3-cm in length from one variety in single petri dishes in late August. Black-headed ECB egg masses were placed in each of the petri dishes with moistened cotton balls to prevent desiccation. The dishes were placed in a growth chamber (Percival Mfg. Co., Boone, IA) maintained at 27°C D, 22°C N with 16:8 h photoperiod. The stem sections were dissected after 2 weeks and examined for the presence of ECB larvae. 3) In a preference test, a 3 cm stem section from each of the 11 varieties was placed in each of 20 petri dishes together with ECB egg masses. Environmental conditions and evaluation method were identical to the previous method. 4) The fourth laboratory method utilized polyvinyl chloride assay plates with ninety-six 0.3 ml capacity flat bottom wells per plate (Becton Dickinson Co.). Stem sectons 1.5 cm in length of each variety were placed in the wells in a randomized complete block design with 8 replications of each variety per plate and 6 plates. The assay plates were placed inside a glass culture dish in September with the ECB egg masses affixed to the lid of the dish. Environmental conditions and evaluation method were identical to the previous method. In all studies, the number of infested cuttings were recorded and analyses of variance were performed on all data. Significant differences among varietal means were determined by Duncan's multiple range test (Duncan 1955).

The possible correlation between ECB infestation level and stem diameter was investigated. Six mature plants of each variety were clipped to a height of 15 cm. Stem diameters of 5 randomly selected stems on each plant were measured with a vernier caliper. The diameters were analyzed for mean separation by the procedures previously described. Correlation coefficient analysis was performed.

RESULTS AND DISCUSSION

Field Study

Injury caused by ECB was most severe on the chrysanthemum varieties West Point and Debonair (Table 1). The varieties Patriot, Baby Tears, and Revere had no apparent feeding injury while the remaining varieties had intermediate injury levels. Light trap data in 1985 confirmed that 3 generations occur in eastern Virginia and that the second generation occurs in mid-August when the chrysanthemum is in rapid vegetative growth. The potential impact of ECB on a chrysanthemum crop is related to the stage of the corn plant when adult flight occurs. When corn plants have progressed beyond the silking and tasseling stage, the moths seek alternate hosts for oviposition, such as chrysanthemum which is actively growing and irrigated daily.

Table 1. Susceptibility of chrysanthemum varieties to natural infestation of ECB.

Variety	Percent infested*
Revere	0.0 c
Baby Tears	0.0 c
Patriot	0.0 c
Grenadine	2.8 c
Compatriot	2.8 c
Pancho	2.8 c
Sunbeam	2.8 c
Jackpot	5.7 bc
Roll Call	8.3 bc
Debonair	14.2 ab
West Point	21.6 a

* Means followed by the same letter are not significantly different using DMRT, P = 0.05.

Laboratory Study

Dissection of stems of the unrooted cuttings showed that the variety Debonair had the highest mean infestation level (Table 2), and Revere and Baby Tears had the lowest infestation levels. Plastic cylinders that were placed around each cutting were open at the top and ECB larvae were observed crawling outside the cylinders. These data had the highest coefficient of variation, and should be interpreted with reservation.

In the non-preference test, Debonair and West Point had infestation levels of 100%, significantly greater than the other varieties (Table 3). In contrast, Revere had 0% infestation and Pancho and Patriot had 10% infestation.

High levels of infestation occurred with the varieties Baby Tears, Debonair and West Point in the preference test (Table 3). These three varieties had significantly higher levels than the varieties Pancho, Patriot, and Compatriot. Revere had infestation levels of 0 to 10% in the previous methods, but increased to 60% in this study. An advantage of the stem section methods was the ECB egg masses were placed in covered petri dishes which minimized larval escape. The ECB larvae appeared to prefer Baby Tears, Debonair, and West Point over the other varieties.

Table 2. Percent infestation of unrooted chrysanthemum cuttings by ECB larvae Aug and Sept, 1985.

Variety	Percent infested*
Revere	10 d
Baby Tears	15 d
Compatriot	30 cd
Patriot	32 cd
Jackpot	40 cd
Pancho	50 bc
Grenadine	50 bc
West Point	53 bc
Roll Call	55 bc
Sunbeam	60 abc
Debonair	90 a

* Means followed by the same letter are not significantly different using DMRT, P = 0.05; cv = 96.8.

Table 3. Infestation of chrysanthemum stem sections by ECB larvae.

	Percent infested	
Variety	non-preference test*	preference test*
Revere	0 d	60 a-d
Patriot	10 d	25 e
Pancho	10 d	35 de
Sunbeam	14 d	50 cde
Compatriot	15 d	30 de
Grenadine	45 c	55 bde
Roll Call	50 c	50 cde
Jackpot	65 bc	60 a-d
Baby Tears	75 b	90 a
West Point	100 a	75 abc
Debonair	100 a	85 ab

* Means within columns followed by the same letter are not significantly different using DMRT, P = 0.05; cv = 83.9 preference, 86.9 non-preference.

The varieties Debonair and West Point had significantly high infestation levels in the stem section study using the assay plates (Table 4). The variety Revere had a significantly lower level of infestation than five of the 10 other varieties. Baby Tears reversed its position in susceptibility between stem secton methods and unrooted cuttings. In the unrooted cutting study, Baby Tears ranked tenth in susceptibility (15%), but was high in susceptibility with the stem piece methods (75 - 90%). Like the preference test, the assay plate method provided equal access of ECB to all varieties. In addition, this method had the largest number of replications (48) and had the lowest coefficient of variation.

There is a positive correlation between ECB infestation level and chrysanthemum variety stem diameter (r = 0.57) (Table 4). The susceptible varieties Debonair and West Point had the second and third widest stems (after Grenadine). Pancho and Roll Call had significantly smaller stems and also had significantly lower infestation

Table 4. Infestation of chrysanthemum stem sections by ECB larvae using assay plates and stem diameter of 11 varieties.

Variety	Percent infested*	Stem diameter (mm)*
Revere	22.9 d	3.66 bc
Patriot	27.1 d	4.06 abc
Pancho	29.2 d	2.93 d
Compatriot	29.2 d	3.85 abc
Roll Call	35.4 d	2.88 d
Sunbeam	39.6 d	3.64 bc
Jackpot	70.8 c	3.70 bc
Grenadine	70.8 c	4.32 a
Baby Tears	75.0 bc	3.84 abc
West Point	89.6 ab	4.32 ab
Debonair	93.8 a	4.31 a

* Means within columns followed by the same letter are not significantly different using DMRT, P = 0.05; cv = 80.8.

levels than Debonair and West Point. Cartier (1963) and Tingey and Leigh (1974) have shown that plant characteristics can influence expressions of resistance. It is plausible stem diameter could affect the ability of larvae to complete development.

Summary

The varieties Debonair and West Point were heavily infested in four of the five methods evaluated and appear to be the most susceptible to ECB. Baby Tears showed high susceptibility in the stem section methods, but showed evidence of non-preference in the field study and using unrooted cuttings. The latter methods evaluated oviposition and foliar feeding which would affect the potential for stem damage. Revere and Pancho appeared to offer the least preference to ECB, having very low infestation in four of the five methods. Stem diameter may be a factor influencing resistance in chrysanthemums.

Of the five methods, the stem section methods showed consistent results, with the assay plate study as the best of these methods. The unrooted cutting method gave inconsistent results with a high degree of larval escape and the highest coefficient of variation. This method should be modified to assess foliar feeding preference.

These methods and results have demonstrated that recognition of host plant preference in chrysanthemums could be a viable method of reducing ECB problems and frequent pesticide applications.

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LITERATURE CITED

Cartier, J. J. 1963. Varietal resistance of peas to pea aphid biotypes under field and greenhouse conditions. J. Econ. Entomol. 56: 205-13.

Despins, J. L., and J. E. Roberts, Sr. 1984. Phenology of adult European corn borer in Virginia. J. Econ. Entomol. 77: 588-90.

Duncan, D. B. 1955. Multiple range and multiple F tests. Biometrics 11:1-41.

Jones, D. W., H. G. Walker, and L. A. Anderson. 1939. The European corn borer on the eastern shore of Virginia. Va. Truck Exp. Stn. Bull. 102: 1621-48.

Smith, F. F. 1962. Controlling insects on flowers. USDA Info. Bull. 237. 78 pp.

Tingey, W. M., and T. F. Leigh. 1974. Height preference of lygus bugs for oviposition on caged cotton plants. Environ. Entomol. 3: 350-51.