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Induction of Resistance in Field Grown Soybean by the Bean Leaf Beetle, *Cerotoma trifurcata* (Forster) (Coleoptera: Chrysomelidae)

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SHORT COMMUNICATION

Induction of Resistance in Field Grown Soybean by the Bean Leaf Beetle, *Cerotoma trifurcata* (Forster) (Coleoptera: Chrysomelidae)

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ABSTRACT: A study was conducted during the summer of 1998 with soybean cultivar Colfax, germplasm line HC95-24MB and susceptible cultivar Williams 82 to investigate induced resistance in soybean. Bean leaf beetle adults were used to induce resistance in field and also in the dual-choice feeding preference tests that were done in the laboratory to assess induction. Pair-wise comparisons of leaflets from induced and control plants demonstrated that induced resistance was present. Preference index (PI) values were similar in the three soybean entries and were not significantly different. Further investigation is necessary to fully understand induced resistance under field conditions in soybean-insect systems.

Introduction

The bean leaf beetle, *Cerotoma trifurcata* (Forster), is a sporadic pest of soybean in Nebraska. For the past few years increased damage has been observed in soybean by this pest. Thus far, there is no report of bean leaf beetle being capable of inducing resistance in soybean to its subsequent feeding under field conditions. However, our greenhouse studies demonstrated that bean leaf beetle could induce resistance to its subsequent feeding as well as to herbivory by soybean looper, *Pseudoplusia includens* (Walker) (Lepidoptera: Noctuidae) (Srinivas et al., In press). The objective of the present study is to demonstrate induced resistance in field-grown soybean from bean leaf beetle feeding to its subsequent feeding.

Materials and Methods

Field-grown cultivars of Colfax (Graef et al., 1994), HC95-24MB, an insect-resistant soybean germplasm line (Cooper and Hammond, 1999), Williams 82, standard susceptible control cultivar (Bernard and Cremeens, 1988) were used as source material for laboratory experiments during summer 1998 to study the induced resistance in soybean from bean leaf beetle feeding. The planting was done in a randomized block design. Before induction, at the cotyledonary stage plants were covered with wire mesh cages (60 cm high and 30 cm diameter) to protect them from infestation by the bean leaf beetle and other insects. Care was taken to prevent insect damage by regularly observing the caged plants and removal of any insects present was accomplished when necessary. If insect damage was observed, then cages were moved to uninfested, undamaged plants. Developmental stages of soybean plants follow Fehr et al. (1971). Adult beetles collected from fields at UNL-ARDC in Saunders Co., NE, UNL East Campus and Havelock Farms in Lancaster Co., NE were used as stock to induce resistance and also for the dual-choice feeding preference tests.

Two undamaged plants at V6 growth stage from each of six plots planted to each of the test soybean entries were used as source material in this study. All plants were covered with cages fitted with vents for aeration and handling of the insects throughout the experiment until leaflet samples were collected for the feeding preference tests. Defoliation by adult beetles was produced by placing eight to ten adults in one cage from each of the six plots for 24–48 hr to allow 25–30% defoliation. Feeding preference tests were done in the laboratory using the apical trifoliate taken from V8 stage plants 2 weeks after beetle herbivory. Adult beetles were fasted for 24 hr prior to the tests and were supplied only with water during fasting. Beetles collected only within the previous 2 weeks were used for these tests.

Laboratory feeding preference tests were done to calculate the preference index (PI) following the method given by Kogan (1972) and Kogan and Goeden (1970). Our earlier studies (Srinivas et al. In press) demonstrated peak induced resistance at two weeks after initial herbivory. Six leaflet disks (6.0 mm^2 each) from each pair of experimental plants, assigned as control (C) and treatment (T), were obtained and arranged in an alternating pattern around the bottom of a petri dish. Four fasted bean leaf beetle adults were released into each petri dish, al-

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Table 1. Mean leaf disk areas of induced versus control soybean leaflets fed on by bean leaf beetle and preference indices for three soybean entries [1].

Soybean Entry	Mean leaf disk area consumed [2]		Preference Index (Mean ± SE)
	Control	Induced	
Colfax	2.129 a	0.945 a	0.615 ± 0.133 a
Williams 82	2.079 ab	0.994 a	0.649 ± 0.110 a
HC95-24MB	1.475 b	0.787 a	0.696 ± 0.074 a

[1] Means followed by same letter are not significantly different ($\alpha = 0.10$).
[2] Mean leaf disk area is expressed in sq. mm.

lowed to feed for 4 to 6 hr, and the remaining leaflet disk area was measured using LICOR-3000 area meter (LICOR, Lincoln, Nebraska). Differences in consumed treatment (T) and control (C) leaflet disk area were used to compute the statistical significance of differences in feeding preferences and to calculate the feeding preference index (PI), where PI = 2T/(T + C). The PI value ranges from 0 to 2, with PI = 1 indicating no feeding preference for either control or treatment disks, PI > 1 indicating preference for treatment disks, and PI < 1 indicating preference for control leaflet disks. PROC MIXED and PROC GLM procedures (SAS Institute, 1997) were used to analyze the feeding data and preference indices and compute LSD (Least Significance Difference).

Results and Discussion

Results from this experiment demonstrate that undamaged, field-grown plants in the V6 stage treated with 24–48 hr of bean leaf beetle herbivory were less preferred two weeks later by beetles than control plants. The preference indices for the three soybean entries were less than one indicating that prior bean leaf beetle herbivory induced resistance and leaf tissue was less acceptable for further feeding by the same insect species (Table 1). When the preference indices were compared among the three soybean entries the results were not significantly different ($\alpha = 0.05$ and $Pr > F = 0.7560$). Numerically, greater leaf disk areas were fed upon in control leaf disks of three soybean entries when compared to induced leaf disks (Table 1). The leaf disk areas of control leaflets from the entries in this study were found to be significantly different (F value = 2.84, $Pr > F = 0.0898$) and those of induced leaflets were not significantly different (F value = 0.68, $Pr > F = 0.5206$).

The data from this study demonstrates for the first time induction of resistance to bean leaf beetle from its prior herbivory in soybean under field conditions. Previous studies in the laboratory have documented that soybean exhibits induced resistance to soybean looper and Mexican bean beetle, *Epilachna varivestis* Mulsant (Coleoptera: Coccinellidae) (Lin et al., 1990; Fischer et al., 1990). Chiang et al. (1987) demonstrated that the Mexican bean beetle induced resistance to its subsequent feeding in soybean. Bean leaf beetle herbivory caused decreased foliage suitability to corn earworm, *Helicoverpa zea* as reported by Felton et al. (1994). Further research is necessary to investigate resistance induced by various inducers under field conditions and also the impact of this phenomenon to non-target species in various soybean-insect systems.

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