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Detecting Genetic Difference between European Corn Borers in the Midwest

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Abstract
Recent scientific investigations indicate insects are capable of becoming resistant to a variety of insecticidal agents, the most well-known being corn rootworm pyrethroid resistance in east central Nebraska. Larvae of the Diamondback and Indian meal moths show resistance to moderate levels of *Bacillus thuriengensis* (Bt) toxins, similar to the proteins expressed by transgenic corn plants (e.g., Yieldgard,). The European corn borer (ECB) is a major corn pest in Iowa and the Midwestern United States. Any spread of potential resistance in field populations will depend on movement of moths between different locations. In the Midwest, two ECB ecotypes are present that differ in the number of generations (flights) per year: bivoltine (2 flights) and the more northern univoltine (one flight). Our lab developed genetic markers that detect European corn borer DNA differences between individual moths. Our objective was to estimate DNA difference between collection sites and observe level of relatedness and moth movement in the Midwest. Field movement of moths may impact the potential spread of Bt resistance.

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Detecting Genetic Difference between European Corn Borers in the Midwest

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Introduction

Recent scientific investigations indicate insects are capable of becoming resistant to a variety of insecticidal agents, the most well-known being corn rootworm pyrethroid resistance in east central Nebraska. Larvae of the Diamondback and Indian meal moths show resistance to moderate levels of *Bacillus thuriengensis* (Bt) toxins, similar to the proteins expressed by transgenic corn plants (e.g., Yieldgard). The European corn borer (ECB) is a major corn pest in Iowa and the Midwestern United States. Any spread of potential resistance in field populations will depend on movement of moths between different locations. In the Midwest, two ECB ecotypes are present that differ in the number of generations (flights) per year: bivoltine (2 flights) and the more northern univoltine (one flight). Our lab developed genetic markers that detect European corn borer DNA differences between individual moths. Our objective was to estimate DNA difference between collection sites and observe level of relatedness and moth movement in the Midwest. Field movement of moths may impact the potential spread of Bt resistance.

Materials and Methods

Between 20 and 400 European corn borer moths were collected in light traps at each of 15 different Midwestern locations during the summers of 2001 and 2002. Trap sites with less than 45 samples were not analyzed. At Lamberton, MN, and Rosemount, MN, sites, univoltine and bivoltine populations were present and were separated by flight times for separate analysis. DNA analysis was conducted using four restriction fragment length polymorphism (RFLP) genetic markers, named *Dde*I, *Hae*III, *Msp*I, and *Sau*3AI, on 912 individual moth DNA samples from 12 different trap sites.

Results and Discussion

The allele frequency for each RFLP genetic marker from individuals collected at 12 light trap collection sites are shown in Table 1. The frequency of each marker was fairly consistent for each RFLP genetic marker comparing between light trap locations. Thus, no significant genetic difference was observed at sites in Indiana, Iowa, Nebraska, and South Dakota, and free movement of moths between sites can be assumed. Based on the *Hae*III RFLP genetic marker, frequencies for bivoltine moths at Rosemont, MN, were different from others in the Midwest. Similar results were observed from Lamberton, MN, bivoltine and univoltines moths based on *Hae*III and *Msp*I genetic markers. Also, bivoltine and univoltine moths, respectively, showed significant *Hae*III and *Msp*I genetic marker frequency differences at Lamberton, MN, and Rosemont, MN, sites. Data suggests ecotype, not geographic location, might impede movement of ECB resistance alleles in the Midwest.

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Table 1. Midwest European corn borer genetic frequency data. Highlighted frequencies show statistically significant differences between moths collected at one or more other collection sites.

		RFLP genetic marker allele frequencies			
Light trap location	Ecotype	*Dde*I	*Hae*III	*Sau*3AI	*Msp*I
Franklin Co., IN	Bivoltine	100.00	2.35	1.18	3.53
Crawfordsville, IA	Bivoltine	96.87	6.25	2.08	0.00
Hubbard, IA	Bivoltine	100.00	7.29	1.04	1.04
Kanawha, IA	Bivoltine	100.00	2.35	1.18	3.53
Nashua, IA	Bivoltine	100.00	2.17	2.17	4.35
Garden City, KS	Bivoltine	96.89	4.17	4.17	4.21
Lamberton, MN	Bivoltine	96.83	0.00	4.76	4.76
	Univoltine	96.43	**10.71**	0.00	0.00
Rosemount, MN	Bivoltine	100.00	**13.63**	4.55	0.00
	Univoltine	87.50	**18.75**	6.25	**9.38**
Aurora, NE	Bivoltine	97.92	3.08	4.57	3.24
Mead, NE	Bivoltine	98.96	6.33	3.13	1.04
Brookings, SD	Univoltine	94.44	1.85	3.70	3.70
South Shore, SD	Univoltine	100.00	3.74	0.00	5.61