Northern NY Agricultural Development Program
2008 Project Report

Breeding Alfalfa Snout Beetle Resistant Alfalfa Varieties

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Collaborator(s):
Chuck Burnett, Seed producer, Nampa, ID.
Mike Hunter, Extension Educator in Jefferson County, worked with growers to identify a field site for a new trial established in spring 2008.

Cooperating Producers:
Alfalfa snout beetles were collected along the roads closest to farms owned by John Peck and Howard Keefer in Carthage, NY. The alfalfa trial was planted on land prepared and owned by Doug Shelmidine, Sheland Farms in Adams, NY

Background:
Alfalfa snout beetle (ASB), *Otiorhychus ligustica*, is the most destructive insect pest of alfalfa in Northern New York (NNY) and is continuing to spread. Alfalfa snout beetle is currently infesting nine NNY counties and has invaded Canada across the St. Lawrence River. Otherwise, there is no other known infestation of this insect in North America.

Alfalfa snout beetle was introduced from Europe into the Port of Oswego during the middle to late 1800's in a ship ballast. It was first discovered as a problem around 1930 after alfalfa was introduced into Oswego County. This pest causes severe yield and stand losses on alfalfa by larval feeding on alfalfa roots. New infestations are often mistaken for winter injury since the majority of plants die after the last harvest and before spring growth. Until now, there have been no effective methods of controlling this destructive insect pest. We have been working on two strategies to reduce the insect populations and

plant damage to manageable levels. These strategies are 1) breed alfalfa with resistance to the insect and 2) identify and establish in NNY biological control organisms from the native home of ASB. The success of the second strategy is described in another NNYADP report. This report addresses the first strategy.

None of the alfalfa varieties grown in northern USA during the 1990s appeared to be resistant when grown on a field heavily infested with ASB. In 1998 at Watertown, NY, the perennial *Medicago* core collection and other germplasms were evaluated for resistance/tolerance to ASB. The 173 plant populations ranged from 3.7 to 4.8 (1 = no root damage, 5 = dead plant). This variability suggested that resistance genes may exist at a low level in a few populations. Therefore, we initiated selection breeding program to increase the level of resistance in several alfalfa populations. In addition, alfalfa varieties grown in Hungary in association with native ASB populations were obtained through contacts within Hungary. Therefore, we have been interested in selecting within these Hungarian varieties since ASB populations exist in Hungary and other parts of Europe, but are less destructive there than in NNY.

Breeding for ASB resistance/tolerance by screening plants in infested fields is time-consuming (2 years/screening), and not reliable because the insect pressure in fields is not uniform. In a field screening, susceptible plants may be selected because they escaped injury. In order to screen thousands of alfalfa plants for resistance to ASB, a reliable greenhouse screening method was needed. A greenhouse screening method was developed by E. J. Shields and A. Testa with funding from the NNY Agricultural Development Project. With this greenhouse screening method, the ASB population pressure can be controlled by the number of eggs applied uniformly to each container and by the length of time the larvae are allowed to feed on the alfalfa roots. Thus, plants with a low level of resistance can be selected over several cycles of selection, and the frequency of resistance genes can be increased in several alfalfa populations.

The ultimate goal is to develop alfalfa varieties that are resistant to ASB, and thus more persistent and productive in areas infested with ASB. Therefore, production of high quality forage for the dairy and other livestock industries would be achievable more economically in the North Country.

Methods:

During this past year, we completed the fifth or sixth cycle of selection for resistance in 16 alfalfa populations. Plants with the least injury were selected and seed produced for the next cycle of selection. Plant populations consisted of the most elite in the Cornell Forage Breeding Program, varieties from ASB-infested areas of Hungary, and plant introductions that we earlier identified with least injury on John Peck's farm in the North Country. Since 2003, a total of more than 130,000 plants have been evaluated for resistance to ASB. About 27,000 plants were evaluated in 2008.

From seed increases in Idaho of six alfalfa populations from the ASB breeding program, 12 plots of each population were seeded on April 21st at Adams NY (plot size 3.5 x 20 feet). The populations seeded were three unselected populations and three selected populations (four cycles of selection for resistance to ASB in the greenhouse), such that progress from selection could be evaluated under field conditions. Field conditions at the

time of seeding were excellent, and the field area outside of the trial was seeded by the producer at the same time that we seeded our trial. Alfalfa snout beetle adults were just beginning to emerge when the trial was seeded. The trial was sprayed with pesticides to control weeds and potato leafhoppers on July 2nd and was mowed off on August 1st.

Results:

The trial was surveyed on June 6th for seedling emergence. Many plots were noted to be very thin in plant stand (Table 1). It was determined that the seed germination was excellent as the ASB populations were seeded in other trials in Ithaca, and excellent stands were achieved. Some seedlings were found with circular bites in the first trifoliate leaflet, and so it may have been that small seedlings were eaten and thus killed by the ASB adults as they emerged. The producer's alfalfa stand in the same field also was thin in places.

Table 1: The average, minimum, maximum, and standard deviation in percent stand (visual estimate on September 17, 2008) of the alfalfa plots seeded in Adams NY (n=12).

Alfalfa Population	Average % Stand	Minimum % Stand	Maximum % Stand	Standard Deviation
CR - cycle 0	52	20	75	19
CR - cycle 4	48	20	75	22
Seedway 9558 - cycle 0	56	40	80	17
Seedway 9558 - cycle 4	57	30	75	18
9117 - cycle 0	64	50	85	12
9117 - cycle 4	52	20	80	19

Samples of plants from the edge of two plots per population were dug in the fall and roots examined. Only a few roots had any ASB feeding damage.

Conclusions/Outcomes/Impacts: As stated in previous reports, the significant progress from selection in the greenhouse provides the first real hope that we can develop alfalfa varieties with resistance to ASB. We anticipate that development of resistant varieties in combination with other control measures will provide protection of the alfalfa crop from ASB injury. Therefore, alfalfa production on land that is infested with ASB will be enhanced, thus making production more economical.

We do not yet know if the resistance levels achieved thus far are sufficient to protect the alfalfa crop in fields with ASB. Current and future field experiments will provide this information, but we are continuing selection to enhance the resistance levels.

Since the plant stand in the field trial is thin, this trial will not be useful for yield estimates; rather it will be used for root damage ratings of the alfalfa populations next year.

Outreach:

Updated progress on this research was reported to extension educators and seed company representatives during a field day presentation last summer. During annual meetings with seed companies closely associated with our program, the seedsmen expressed very strong interest in a new alfalfa variety with resistance to alfalfa snout beetle.

Next steps

Selection: Although progress from selection already has been realized, we will try to increase the resistance levels by continuing selection in the plant populations under controlled conditions in Ithaca.

Field Experiment: During spring 2009, a second field experiment will be established with some of the same alfalfa populations as the first experiment and with more advanced populations selected for higher levels of resistance to ASB. This experiment will provide information to determine if resistance in the greenhouse translates to resistance in the field, and the level of resistance needed to adequately protect the alfalfa crop. The trial will be planted after the risk of adult ASB feeding so that the seedlings will become well established.

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For more information:

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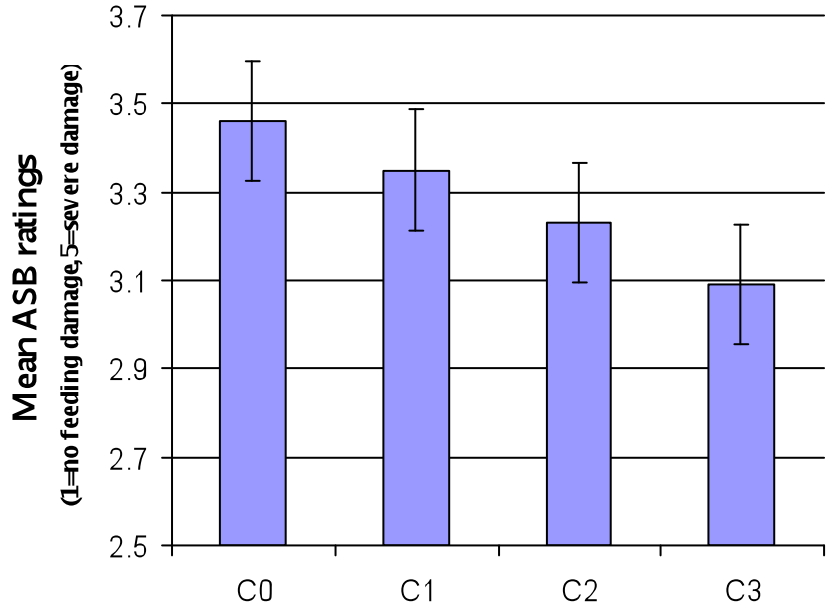
Base Population Cycle 1 Cycle 2 Cycle 3



Figures 1 and 2. Progress from selection for resistance to alfalfa snout beetle. From left to right, the base populations averaged a score of root damage (1=no root damage, 5=root totally chewed off or dead plant) of 3.46, Cycle 1 = 3.35, Cycle 2 = 3.23, and Cycle 3 = 3.09.