NNY Agricultural Development Program
2006-2007 Project Report

Breeding Alfalfa Snout Beetle Resistant Alfalfa Varieties

Project Leader(s):

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Collaborator(s):

- Chuck Burnett, Seed producer, Nampa, ID
- Mike Hunter, CCE Jefferson County

Cooperating Producers:

- John Peck and Howard Keefer in Carthage, 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. To date, there are no effective methods of controlling this destructive insect pest. With other introduced insect pests, two strategies have been effectively used to reduce the insect populations 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.

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 recurrent selection 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 fourth or fifth 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 100,000 plants have been evaluated for resistance to ASB. About 33,000 plants were evaluated in 2007.

Based on the data from the experiment conducted in 2006 (see Figures 1 and 2 for summary data), we contracted a collaborator in Caldwell, ID, to produce a few pounds of seed of the three alfalfa populations in which the most progress from selection had been realized. This seed will be used for a field experiment described below.

Results:

During 2007, experiments were not conducted for generating data. As described in the previous section, recurrent selection was continued, and seed was produced for further experiments.

Conclusions/Outcomes/Impacts:

As stated in last year's report, the significant progress from selection 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. A future experiment will provide this information, but we are continuing selection to enhance the resistance levels.

Outreach:

Updated progress on this research was reported to extension educators and seed company representatives during a field day presentation last summer. It also was reported to seed sales people and growers during a presentation in January. During a December meeting 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

Funding has been granted to continue the ASB breeding research into 2008.

Selection: Although progress from selection already has been realized, we will try to increase the resistance levels by continuing selection in the 16 plant populations under controlled conditions in Ithaca. A total of about 30,000 plants will be screened.

Heritability: We are continuing a heritability experiment to determine the most effective breeding method for continuing to increase the level of plant resistance. Parent plants have been randomly taken from two alfalfa populations selected for resistance to ASB, and open-pollinated seed will be produced on these plants during winter 2008. In summer 2008, the progenies (from seed of each parent plants) will be evaluated in a replicated experiment in the greenhouse for level of resistance or susceptibility to ASB. Heritability estimates for individual plant selection will be compared to that of progeny selection by using data from the parent plants and their progenies.

Field Experiment: Seed from the 2007 Idaho seed production cages will be planted in an ASB-infested field in NNY (likely Jefferson Co.) to compare Cycle 3 with the base populations for plant stand and forage yield during the next two or three years. Mike Hunter, extension specialist in Jefferson Co., is helping us to identify a field appropriate for this experiment. 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.

Acknowledgments:

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Reports and/or articles:

No reports have been published. Our collaborating seed companies are willing to pay for patenting of the resistant plant material, thus preventing us from publishing until we have sufficient evidence to warrant the patent.

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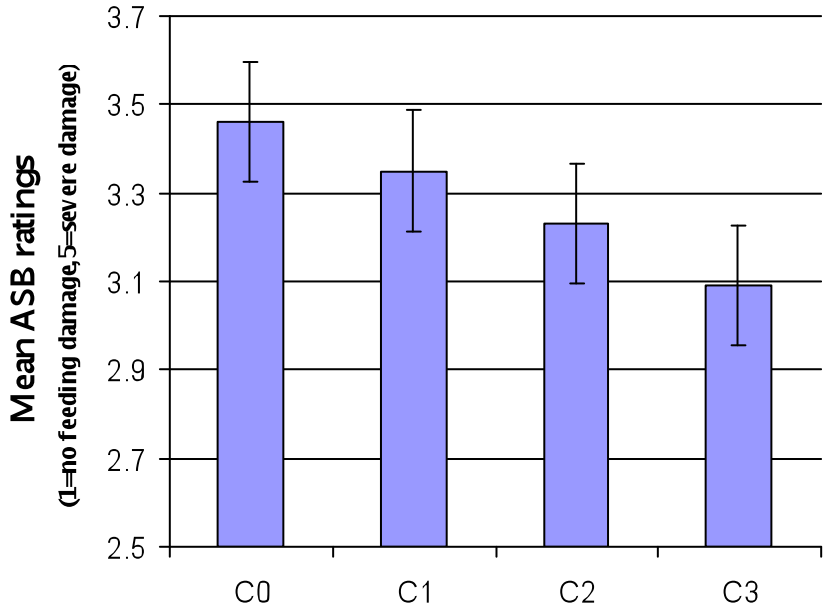
Base Population Cycle 1 Cycle 2 Cycle 3



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. Photo and histogram by Jamie (Neally) Crawford, Cornell Forage Breeding Project.