



NNY Agricultural Development Program 2014-2015 Project Report

Project Title: Breeding Alfalfa Cultivars with Resistance to Alfalfa Snout Beetle

Project Leader(s).

- Donald Viands, Cornell University School of Integrative Plant Science, Plant Breeding and Genetics Section, 523 Bradfield Hall, Ithaca, NY; 607-255-3081; drv3@cornell.edu
- Julie Hansen, Cornell University School of Integrative Plant Science, Plant Breeding and Genetics Section, 101 Love Lab, Ithaca, NY; 607-255-5043; jlh17@cornell.edu
- Jamie Crawford, Cornell University School of Integrative Plant Science, Plant Breeding and Genetics Section, 101 Love Lab, Ithaca, NY; 607-255-5043; jln15@cornell.edu
- Elson Shields, Cornell University Department of Entomology, 4144 Comstock Hall, Ithaca, NY; 607-255-8428
- Antonio Testa, Cornell University Department of Entomology, 4144 Comstock Hall, Ithaca, NY; 607-591-1493

Collaborators:

- Farmers with ASB on-farm: Gary Berrus, Lowville, NY; Haskell Yancey, Croghan, NY
- Michael Hunter, Cornell Cooperative Extension NNY Field Crops Specialist, Jefferson-Lewis counties

Background:

Alfalfa snout beetle (ASB), *Otiorhynchus ligustica*, is the most destructive insect pest of alfalfa in Northern New York (NNY). Alfalfa snout beetle is currently infesting at least nine NNY counties and is known to exist in Canada across the St. Lawrence River from NNY. This pest causes severe yield and stand losses on alfalfa by larval feeding on alfalfa roots. The Cornell University alfalfa breeding program (led by D. Viands, J. Hansen, and J. Crawford) and the Cornell University entomology program (led by E. Shields and A. Testa) have been cooperating to develop a two-pronged approach to control ASB on alfalfa: 1) identify and incorporate resistance genes into alfalfa cultivars adapted to northeastern USA (breeding for resistance) and 2) identify and establish in NNY biological control organisms. Both of these insect control strategies are necessary to reduce ASB to sub-economic numbers.

We have been using the greenhouse screening method developed by E. J. Shields and A. Testa, with funding from Hatch and the Northern New York Agricultural Development Program, to identify and select alfalfa plants that appear to be resistant to root feeding damage by ASB larvae. Screening more than 30,000 seedlings annually, we have completed up to 13 cycles of selection in several alfalfa populations.

In previous proposals, we reported significant progress from selection in an experiment conducted under controlled greenhouse conditions. The greenhouse experiments are being complemented by field experiments in NNY. In this report, we review the alfalfa snout beetle breeding progress, and the results of two field trials: one on a farm in Lowville; one on a farm in Croghan).

Methods:

Plant Breeding: Plant Selections

On May 7, 2015, alfalfa snout beetles were collected in Carthage New York. The alfalfa populations for screening for resistance to alfalfa snout beetle were planted in greenhouses at Cornell in early June. About six weeks after planting, the seedlings were inoculated with alfalfa snout beetle eggs. After inoculating each tub with alfalfa snout beetle eggs, the tubs of alfalfa were left to grow in the greenhouse for another 6 to 8 weeks. Then, each alfalfa seedling in the tub was dug up and washed off to see the level of root scarring from the alfalfa snout beetle larvae. The seedlings that had no root feeding damage from the alfalfa snout beetle larvae were selected and grown in the greenhouse until flowering and pollinating to produce seed.

Results:

Plant Breeding: Plant Selections

More than 5,000 alfalfa snout beetles were collected in the spring of 2015 in NNY. The beetles were put in clean petri dishes for storage in a cooler and were put in clean petri dishes every month until the beetles were no longer needed for alfalfa inoculations. From the greenhouse selection protocol, six alfalfa populations were advanced one more generation this year so that some populations have been selected 13 cycles. Also, new alfalfa populations were developed from plants dug from trials on alfalfa snout beetle infested fields in the fall 2014. Specifically, one population was developed from a cross of Seedway 9558 Asb cycle 12 and potato leafhopper resistant alfalfa Asb cycle 12, and more than four pounds of seed for yield trials was produced in Idaho. A second population was developed from a cross of Guardsman II and Seedway 9558 Asb9 and more than four pounds of seed for yield trials was produced in Idaho. These two populations will be planted in yield trials in spring 2016 on fields that are not infested with alfalfa snout beetle. New trials on alfalfa snout beetle infested fields are in the planning stage for spring 2017. Two population crosses were completed in 2015 and seed was sent to Idaho for caged seed increases in 2016. The crosses were MIII Asb cycle 13 crossed to Guardsman II Asb cycle 2 and Seedway 9558 Asb cycle 13 crossed to Guardsman II Asb cycle 2.

Methods:

Field Trials:

Field Trials: Lowville, NY (Photos 1, 2): The trial on Gary Berrus's farm was harvested just one time on May 29th. Alfalfa plants had been dug from half of the trial in fall 2014 for root feeding evaluation, so only the four replicates that were undisturbed were harvested.

Field Trials: Croghan, NY: The replicated plot trial in NNY at Haskell Yancey's Farm in Croghan was sprayed with herbicides on April 21. This trial was evaluated for percent stand and yield in 2015. A field area separate from the main plot was inoculated with nematodes after the first harvest. This treatment will allow us to compare the effect of the combination of control measures (nematodes + moderately resistant alfalfa) with moderately resistant alfalfa alone, once the alfalfa roots are dug from each plot area in fall 2016.

Results:

Field Trials:

Field Trials: Lowville, NY (Appendix A. Table 1.)

Field variability was higher in 2015 than in 2014. Eight replicates were harvested in 2014, but after plants were dug from four replicates, these plots were not harvested. The four replicates that were harvested had a group of 12 top yielding populations out of 16 populations, based on the statistic of least significant difference ($P < 0.05$). In 2014, the eight replicates that were harvested had a group of 10 top yielding populations out of 16 populations. The top yielding populations over the two years were Seedway 9558 cycles 4, 7, and 9. Also the cycle 9 for Oneida VR, MIII, Saranac AR and NY9117 were in the top yielding group over the two years.

Field Trials: Croghan, NY (Appendix A. Table 2.)

For the six replicates for yield, three replicates had a higher stand in the first production year (90% stand, Trial 1) than the other three replicates (82% stand, Trial 2). Thus the two sets of three replicates were analyzed as separate trials. In Trial 1, there were no significant differences among the alfalfa populations and yields ranged from 2.81 to 2.06 tons per acre dry matter. In Trial 2, yields ranged from 2.09 to 1.12 tons per acre dry matter and there were significant differences among the alfalfa populations. Also, four of the seven selected populations were in the high yielding group (Seedway 9558 SBR, Potato leafhopper resistant (PLH) Asb cycle 9, ASB Cross, NY9117 Asb cycle 9). Additionally, two unselected populations were in the high yielding group; NY9117 and Guardsman II. NY9117 is a selection from John Peck's farm in 1990. (Peck Homestead Farm in Jefferson County was the site of the first NNYADP-funded alfalfa snout beetle research trials.)

From the results of the trials planted in Lowville, Croghan, and Adams (results from ASB resistance field trials at Sheland Farms in Jefferson County have been report in past NNYADP grant reports), six populations have been selected for further cycles of breeding for resistance to alfalfa snout beetle and for crosses among resistant lines. These six populations are Seedway 9558, MIII, three Potato leafhopper resistant populations, and Guardsman II.

Conclusions/Outcomes/Impacts:

From the results of several field experiments, progress is being made in selection for alfalfa with resistance to alfalfa snout beetle. The first cultivar released from this breeding program, Seedway 9558 SBR, is now being used by growers in NNY. This cultivar has moderate resistance to alfalfa snout beetle, and when used in combination with the entomopathogenic nematodes that have been released by Dr. Elson Shields' NNYADP ASB research project should provide some control against this destructive crop pest. However, our goal is to continue to develop resistant cultivars that have higher levels of resistance to alfalfa snout beetle and to continue to test the breeding lines developed in field trials in NNY. We believe that higher levels of resistance are achievable and would provide more effective control.

Outreach:

Articles in NNY newspapers:

A Watertown Times story ran in the May 10, 2015 Sunday edition also appeared in the Carthage Republican Tribune, Massena-Potsdam Courier, Ogdensburg Journal, Lowville Journal and Malone Telegram.

The progress in developing alfalfa snout beetle resistant alfalfa was shared at the 2015 Seedsmen's Field Day on July 7, 2015, in Ithaca, NY, and at Cornell Cooperative Extension In-Service Meeting on November 3, 2015.

Next Steps:

Although significant breeding progress has been accomplished, we believe that much higher levels of resistance will be needed and can be achieved through further breeding efforts. Thus selection and breeding work need to continue to develop alfalfa with lower root damage score. Additional field experiments are needed to determine the benefits (higher yield and less root feeding damage) of higher levels of resistance under actual growing conditions and climate as these plant populations are developed. Also of interest is to concentrate on combining resistances to ASB and potato leafhoppers into new cultivars of alfalfa.

Acknowledgments:

NNYADP, CUAES Hatch Funds, NE1010 Multistate Research Funds, Seedway, and Allied LLC.

Reports and/or articles in which results of this project have been published.

Yields of Seedway 9558 SBR on fields that are not infested with alfalfa snout beetle: New York Forage Legume and Grass Cultivar Yield Trials Summary for 2015–Season Totals. J. Hansen, D. Viands, R. Deubler, J. Crawford, J. Schiller, R. Crawford, Department of Plant Breeding and Genetics, College of Agriculture and Life Sciences, Cornell University, Ithaca, NY 14853; <https://plbrgen.cals.cornell.edu/research-extension/forage-project/ny-forage-yield-results>.

For More Information:

Dr. Donald R. Viands; Cornell University Department of Plant Breeding and Genetics, 523 Bradfield Hall, Ithaca, NY 14853-1902; 607-255-3081; drv3@cornell.edu; <http://plbrgen.cals.cornell.edu/people/profiles/viandsdonald.cfm>.

Dr. Julie L. Hansen; Cornell University Department of Plant Breeding and Genetics, 101 Love Lab, Ithaca, NY 14853-1902; 607-255-5043; jlh17@cornell.edu.

Mr. Doug Shelmidine, Sheland Farms, 12043 Co. Rt. 79, Adams, NY 13605; 315-846-5640; dshel@frontiernet.net.

Gary Berrus, Limestone Ridge Farm, 9373 Delles Road, Lowville, NY 13367.

Haskell and Tim Yancey, 7981 Long Pond Road, Croghan, NY 13327-2508.