



Northern New York Agricultural Development Program 2019 Project Report

Brown Root Rot of Alfalfa: Field Rotation and Preparation

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Background:

Phoma sclerotoides, causal agent of brown root rot (BRR), is a soil-borne fungal plant pathogen causing root and crown rot of alfalfa, other perennial legumes, and overwintering grasses. This pathogen is unusual in that it is primarily active during late winter and early spring. It is sometimes described as a 'snow mold' because it actively grows when the ground is covered by snow. Brown root rot has been reported in Northern New York fields and in the Northeast, and is associated with yield loss, winterkill, slow emergence from winter dormancy, stand decline of alfalfa, winterkill of grasses, and economic losses for farms.

From the USDA Fungal Database (<http://nt.ars-grin.gov/fungaldatabases/>), *Phoma sclerotoides* is listed as a low temperature parasite. No management tools currently exist for BRR in NY. Alfalfa varieties with resistance to BRR and adaptation to the Northeast are not available. Crop rotation is not an effective alternative; *P. sclerotoides* produces

resting structures that can persist extended periods in the soil without a suitable substrate, has a very broad host range, and can survive on organic matter in the soil.

A field at the William H. Miner Agricultural Research Institute at Chazy in northern NY has been set aside for research on BRR of alfalfa

This field was inoculated with several biotypes of BRR in 2009 and then an alfalfa trial was planted. The 2009 trial winterkilled in 2011-2012. In early summer 2012, surviving alfalfa was propagated and eight new alfalfa populations were developed. These eight populations were planted back to that same BRR field at Chazy in 2014. In late 2018 surviving plants from the Chazy trial were selected and five new alfalfa populations were developed. These new populations are second-cycle selections from the BRR field at Chazy.

This report is about the results of the NNYADP grant project in 2019 re: the BRR field at Chazy that was in a crop rotation program to prepare for future BRR research projects. The results of the trial planted in 2014 at Chazy were reported in the 2017-2018 NNYADP BRR Project Report. The activities from 2019 and summaries of other trials are in this report. This and previous NNYADP alfalfa BRR reports are posted on the Brown Root Rot page of the NNYADP at <https://www.nnyagdev.org/index.php/field-crops/research-brown-root-rot/>.

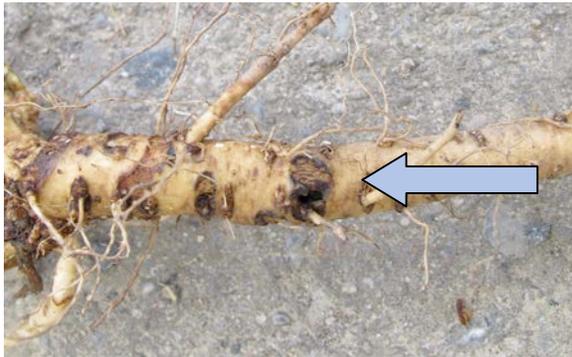


Photo 1: Arrow shows typical brown root rot (BRR) symptom on a surviving alfalfa plant from Cornell experimental alfalfa populations in the NNYADP-funded BRR research trial planted in 2014 on the dedicated BRR field at Chazy, NY. Photo by J. Hansen.

Methods:

Research activities

An alfalfa trial was planted in spring 2014 at the William H. Miner Agricultural Research Institute at Chazy, NY. The trial entries are the eight populations developed from stem cuttings taken from the 2009 trial that winterkilled, plus the six base varieties: Ezra, Regen, N-R-Gee, Guardsman II, Oneida Ultra, and Seedway 9558.

The surviving plants by fall 2018 were presumed to be valuable genetic material with the potential for BRR-resistance and five populations were developed for future trials.

Seed produced on plant cuttings of the five populations: NY1914, NY1915, NY1916, NY1917, and NY1918 was sent to cooperators in Idaho in April 2019 for caged seed increases (Table 1, see Results). Caged seed increases are a way plant breeders use to produce seed of promising experimental alfalfa populations in quantities sufficient to plant several yield trials to evaluate the yield capability of the experimental populations.

For this grant, the field at Chazy was sprayed with a burn-down herbicide on May 8, 2019, and plowed one week later, followed by sorghum sudangrass seed planted on June 7. Sorghum sudangrass was planted because it would grow quickly and vigorously and reduce weed seed production during 2019 growing season. The sorghum sudangrass was mowed in late August. In this way, the field was prepared to receive planting of the five new experimental populations (see more information in Results).

Results:

Chazy BRR on alfalfa research field:

The field at Chazy was in crop rotation in 2019 and is prepared for future research projects on alfalfa BRR.

Second-Cycle Alfalfa Populations for BRR Resistance:

From the surviving plants in the trial planted in 2014, five new alfalfa populations were developed in 2018 (Table 1) with seed sent for caged increase production in 2019.

Table 1: Alfalfa experimental populations developed from 2014 BRR trial at Chazy, NY.

Populations developed from 2012 BRR Trial		New Populations developed from 2014 BRR Trial	
	Pedigree		Number of Plants Selected
NY1322	Guardzman II + N-R-GEE	NY1918	93
NY1318	Guardzman II + N-R-GEE	NY1915	104
NY1323 and NY1319	Seedway 9558	NY1914	144
NY1325 and NY1321	Oneida Ultra	NY1917	144
NY1324 and NY1320	Ezra + Regen	NY1916	144

The caged seed increases in Idaho in 2019 of the experimental populations NY1914, NY1915, NY1916, NY1917, and NY1918 were failures. High winds just prior to seed harvest blew the cages away and seed that had been produced was not harvestable. The seed was to be used to plant in yield trials and in research breeding plots in 2020. However, now this research will be delayed by one year so that seed from the same second-cycle populations can be produced in Idaho in 2020 at no additional cost. The BRR field at Chazy will be frost seeded with red clover as a cover crop.

Yield Results for First Cycle Populations for BRR Resistance:

The cycle 1 alfalfa populations developed from the 2009 BRR trial were planted in a trial

in Ithaca, NY, in 2017. This trial had winter injury in 2018-19. The yields of the populations developed from selections from the BRR field at Chazy are shown in Table 2. The two populations with the highest percent stand: NY1322 and NY1323 (Table 2, Photos 2 and 3) were also top yielding populations in the 2014 BRR yield trial at Chazy. Based on these trial results, efforts are now focusing the breeding trials on these top yielding and most promising populations in addition to evaluation of the potential for the second-cycle populations. Second cycle population of NY1322 and NY1323 may be improved over the base population but until these populations are tested in field trials, this is still an unknown.

Table 2: Yield and Stand Percentage Results of the Brown Root Rot Trial, Ithaca, 2018-2019. This trial was planted in Ithaca, NY, in 2017 to compare cycle 1 brown root rot populations selected at Chazy, NY, for yield. The trial had winter injury in Ithaca in 2018-19. Key: T/A = tons per acre dry matter, LSD (0.05) = least significant difference at the 95% confidence level, CV is coefficient of variation.

2017 Brown Root Rot Trial			
Ithaca NY; Harvested in 2018, 2019			
Population	Base Variety	Total Yield 2019	% Stand 19-Sep
		T/A	
NY1322	Guardsman II + N-R-Gee	4.92	82
NY1318	Guardsman II + N-R-Gee	4.47	74
NY1323	Seedway 9558	4.44	76
NY1321	Oneida Ultra	4.40	71
NY1319	Seedway 9558	4.27	73
NY1325	Oneida Ultra	4.18	70
NY1324	Ezra + Regen	4.00	74
NY1320	Ezra + Regen	3.91	68
Variety Mean	Avg. of 6 Base Var.	4.29	70
LSD (0.05)		0.57	9
CV		10.4%	9.7%



Photo 2, left: View of three plots in Ithaca alfalfa BRR trial that had winter injury in second production year. Plots from left to right are Ezra, NY1322, and NY1321. Note less winter injury in NY1322. Photo by J. Hansen.

Photo 3, right: View of three plots in Ithaca trial that had winter injury in second production year. Plots from left to right are NY1319, NY1322, and NY1323. Note less winter injury in NY1322 and NY1323. Photo by J. Hansen.

Conclusions/Outcomes/Impacts:

Cold Tolerance/Winter Survivability

A few alfalfa experimental populations developed from surviving plants in a winter-killed trial at Chazy, NY, appear to be more tolerant of cold winter temperatures than other varieties and experimentals. February 2018 temperatures in Ithaca, NY, fell to a low of -14°F. The alfalfa populations NY1322 and NY1323 had significantly higher yield following winter injury in 2019 than other populations.

Five new alfalfa populations selected under the harsh NNY climatic/environmental conditions on the BRR field at Chazy were developed in 2018. These populations are the second generation/second cycle of selection from this field that was inoculated with BRR and most likely have a high pathogen load. The alfalfa populations NY1918 (selected from NY1322) and NY1914 (selected from NY1323) appear to be the most promising populations for brown root resistance at this time.

The BRR field was in cover crop in 2019 and is ready for the next trial when the cage increased seed is available in 2021.

Outreach:

The progress in developing BRR resistant alfalfa was shared at:

- July 2, 2019: Seedsmen's Field Day, Ithaca, NY; 65 participants
- November 6, 2019: Cornell Cooperative Extension In-Service Meeting, Ithaca, NY; ~ 20 participants.
- January 16, 2020: Annual Meeting with Seedway and Allied Seed LLC, Ithaca, NY: 6 participants.

Outreach to extension educators extends the project value to farmers in NNY and statewide.

Next Steps:

Evaluate the second generation of experimental alfalfa populations developed from the BRR field at Chazy, NY. Due to seed increase failure in Idaho in 2019, this research will be delayed by one year.

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