Enhancing Alfalfa Yields and Stand Life by Improving Management of Seed Rot and Seedling Damping-Off

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Background

- Rapid and uniform seedling emergence is critical for obtaining a productive and persistent stand of alfalfa.
- A complex of soil-borne pathogens including Pythium spp., Rhizoctonia solani, Phytophthora medicaginis, and Fusarium spp. cause seed rot and damping-off of alfalfa seedlings resulting in thin stands, reduced yields, decreased winter survival, and shortened stand life.
- New tools are needed for producers to manage these diseases and obtain higher yields over a longer period.

Objectives

1. Test fungicides labeled for seed treatment to determine the concentration inhibiting growth by 50% (EC_{50}) against seed rot and seedling damping-off pathogens of alfalfa.
2. Test fungicide seed treatments against single pathogens in standard tests and soil infested with multiple pathogens.
3. Determine the benefit of fungicide seed treatments to seedling health of cultivars with genetic disease resistance.

Methods

In vitro assays for fungicide activity

1. Each fungicide was diluted in sterile distilled water, then added to corn meal agar.
2. A 6.5 mm-diameter plug from the colony edge of each pathogen was placed in the middle of a 90-mm Petri dish.
3. Relative growth was determined by comparing colony diameter of fungicide containing media with controls.
4. EC_{50} was estimated by plotting the percent inhibition against the log-scale of fungicide concentrations.

Seed treatments

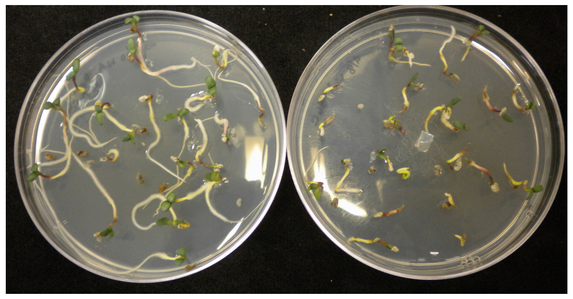
1. ApronXL, EverGol Energy, and Intego Solo were used individually to treat 'Vernal' alfalfa seeds at the manufacturers' recommended product rates.
2. Seeds of CROPLAN cultivars and Ladak65 were treated by Summit Seed Coatings.

Pathogen bioassays

1. The agar plate standard test of Pythium seed rot and damping-off resistance was conducted using treated seeds.
2. The NAAIC standard test protocols for Pythium seed rot and damping-off, Phytophthora root rot (PRR), and Aphanomyces root rot (ARR) were followed using treated seeds and untreated check cultivars (Saranac, WAPH-1, and WAPH-5).
3. Field soil was planted with treated seeds and check cultivars, flooded for 3 days after plant emergence, and rated 21 days after planting.

Field tests

1. Trials with treated seeds were conducted in commercial alfalfa production fields with a history of poor alfalfa seedling emergence in Wisconsin in 2022.
2. Plant counts were conducted twice during the season: once at the first trifoliate stage and again at the four to six trifoliate stages.
3. Plant dry matter was determined 67 days after planting and 35 to 37 days after the first harvest.



Pythium test with treated seeds (right) and control (left).

Results

- Doses of 10 commercial fungicides causing 50% reduction in pathogen growth were determined for 16 pathogen strains. Evergol Energy and Intego Solo had the broadest range of activity.

Table 1. Growth inhibition of seed rot and damping off pathogens by commercial fungicide preparations. EC_{50} values were calculated for each strain. Excellent (E)= <0.05-0.1 µg/ml, Very Good (VG) = 0.11-0.99 µg/ml, Good (G) = 1.0-9.9 µg/ml, Fair (F) = 10-99.9 µg/ml, Poor (P) = >100 µg/ml. ND= not determined.

Fungicide	Pythium (6)	Aphanomyces (4)	Phytophthora (3)	Fusarium (3)
ApronXL	E-VG	P	E	P
Rancona Dimension	E-VG	P	E	E-VG
Rancona Summit	E-G	P	E	VG
Rancona V RTU FS	E-VG	P	E	VG
Trilex	P	P	P	P
Dynasty	G-F	G	G-F	P
Evergol Energy	E-VG	G	E	G-F
Vibrance	P	P	P	P
Intego Solo	VG	E	E-V	P
Rizolex	ND	ND	ND	F-P

Pythium assay results

- Treatment of seeds with mefanoxam (ApronXL or Anchor 3L ST) or metalaxyl (Allegiance-FL) provided significantly higher levels of protection ($P < 0.05$) against the three Pythium isolates compared to the untreated control for all cultivars tested.
- The EverGol Energy treatment, which consists of a mixture of metalaxyl, prothioconazole, and penflufen resulted in 40 to 72% plants scoring 1 to 2.
- Results with ApronXL and Evergol Energy on the cultivar Vernal were not significantly different ($P > 0.05$).
- The percentage of protected plants after treatment with Intego Solo or Stamina were not different from the untreated controls (not shown).

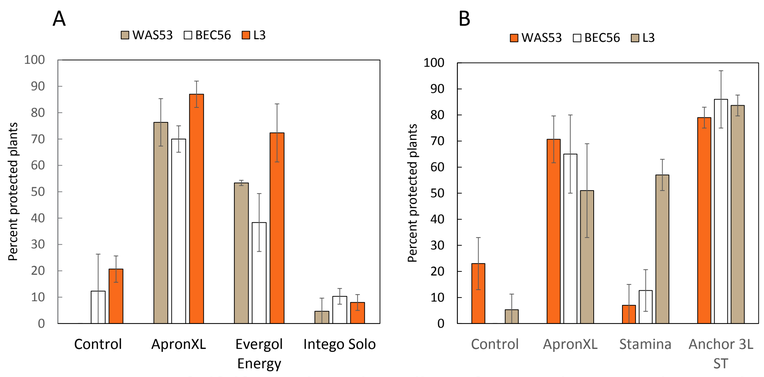


Fig. 1. Protection of alfalfa seeds and seedlings from Pythium seed rot and damping-off by P. ultimum WAS53, P. irregulare BEC6, and P. paroecandrum L3. Disease symptoms were rated after 5 days on a 1 to 5 scale. Protected plants had scores of 1 or 2. A, Vernal. B, Ladak65.

Bioassay with field soil and treated seeds.

Bioassay results for PRR and ARR

- Evergol Energy was effective against Phytophthora root rot, but less effective than ApronXL.

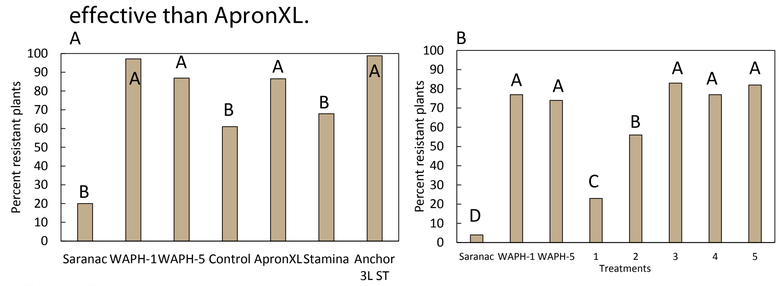


Fig. 3. Protection of alfalfa seedlings by single and multiple seed treatments from root rot by Phytophthora medicaginis. A, Percent resistant plants of cultivar Ladak65. B, Percent resistant plants of CROPLAN cultivar 1. 1= control; 2 = Evergol Energy; 3 = Apron + Stamina; 4 = Apron + Stamina + Intego Solo; 5 = Apron + Stamina + Intego Solo + Maxim

- Only the Stamina seed treatment was effective against Aphanomyces root rot race 2.

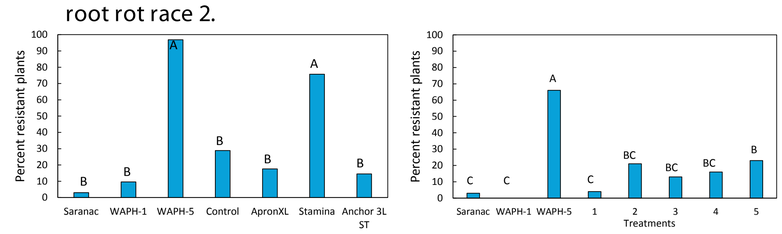


Fig. 4. Protection of alfalfa seedlings by single and multiple seed treatments from root rot by Aphanomyces euteiches race 2. A, Percent resistant plants of cultivar Ladak65. B, Percent resistant plants of CROPLAN cultivar 1.

Field soil bioassay results

- No treatment was effective in field soil with Pythium spp. and Aphanomyces root rot.

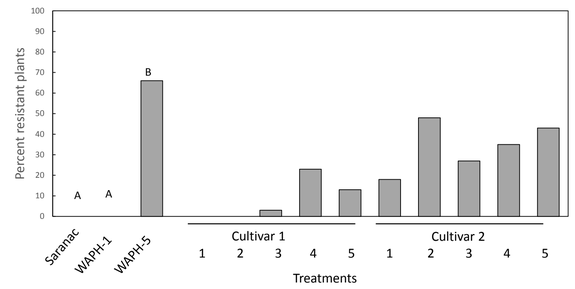


Fig. 5. Field soil bioassays testing multiple seed treatments.

Conclusions

- Seed treatments had only modest effects in field soil and field environments
- Evergol Energy (prothioconazole, penflufen, metalaxyl) could be used to replace Apron/Apron XL for early season protection against Pythium spp. and PRR, with some protection from ARR
- Evergol Energy provided some protection for cultivars susceptible to PRR
- Genetic resistance to Pythium spp. and enhanced resistance to ARR race 2 would provide early and season-long protection
- Can we improve seed coating technology with use of multiple products to obtain effective concentrations of active ingredients?