NORTHWEST CROPS & SOILS PROGRAM

2018 Hemp Greenhouse Seed Treatment Evaluation

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THE UNIVERSITY OF VERMONT EXTENSION

HEMP GREENHOUSE SEED TREATMENT EVALUATION

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Hemp is a non-psychoactive variety of *cannabis sativa L*. The crop is one of historical importance in the U.S. and reemerging in worldwide importance as manufacturers seek hemp as a renewable and sustainable resource for a wide variety of consumer and industrial products. The fiber has high tensile strength and can be used to create a variety of goods. Hemp fiber consists of two types: bast and hurd. The bast fiber are the long fibers found in the bark of hemp stalks and are best suited for plastic bio-composites for vehicles, textiles, rope, insulation, and paper. The hurd fiber are short fibers found in the core of the stem and are suited for building materials, such as hempcrete and particle boards, bedding materials, and absorbents.

For twenty years, U.S. entrepreneurs have been importing hemp from China, Eastern Europe and Canada. Industrial hemp is poised to be a "new" cash crop and market opportunity for Vermont farms that is versatile and suitable for rotation with other small grains and grasses. To help farmers succeed, agronomic research on hemp is needed, as much of the historical production knowledge for the region has been lost. In this trial, we evaluated hemp seed treatments to determine best practices to optimize seed germination and vigor in the presence of wilt disease. A greenhouse study to evaluate the impact of treated seed versus non-treated seed was initiated in January of 2018.

MATERIALS AND METHODS

Prior to planting the trial, soil medium had to be inoculated with *Rhizoctonia solani*, a soil borne fungal pathogen with a wide host range and is responsible for damping off and other symptoms in seedlings and mature plants. The isolates were obtained from local potato; sclerotia were excised, surface sterilized, and cultured on 64 dishes of acidified potato dextrose agar medium (aPDA). Sixty-four 1 liter polypropylene Nalgene bottles were filled with 192 g sand, 8 g corn meal, and 30 mL DI water. Bottles were sterilized through autoclaving over the course of two consecutive days. After culturing *R. solani* at 68° F for 2.5 months in a laminar flow hood, three 1 cm^2 sections of the cultured *R. solani* aPDA were taken and placed in each of the 64 prepared Nalgene bottles. All bottles of inoculated soil medium were mixed together to provide a homogenous source of inoculum and then mixed into soil media at a rate of 50 g *R. solani* inoculum to 1 liter of Sungro Professional Growing Mix. Forty-eight 72 ct seedling flats were filled with the inoculated mixture, 6 seedling flats were filled with un-inoculated Sungro Professional Growing Mix, and trays were watered inside the greenhouse 48 hours prior to planting. In the experiment, 9 seed treatments (7 applications, 2 controls) were applied to Tygra hemp seeds prior to planting (Table 1). Tygra seeds were obtained from Schiavi seeds.

Table 1. Seed treatments and application rates for Tygra seeds.

#	Seed Treatment	Application rate
1	K5 (Trichoderma)	0.19ml/454g seed/10ml H_2O
2	K5As2 (Trichoderma/Bacillus)	0.19ml/454g seed/10ml H_2O
3	Naturall	0.19ml/454g seed/10ml H_2O
4	Captan4	1.77ml/454 g seed/ .034ml H_2O
5	Actinovate	.295g/.174gal/tray

6	PreFence	.174g/.174gal/tray
7	Rootshield	.522g/.174gal/tray
8	Control, not inoculated	10g seed/10ml H_2O
9	Control, inoculated	10g seed/10ml H_2O

K5, K5As2, Naturall, Captan4, and the two controls were prepared as direct seed treatments in which each seed treatment received the calculated application rate directly to seed and was allowed to dry overnight before planting. Actinovate, PreFence, and Rootshield treatments were all applied after planting each tray as a soil drench.

Seventy-two seeds were planted per tray in 6 replications for the 9 different treatments in the UVM Greenhouse in house #6. The temperature was maintained around 60° F during the day and 50° F at nights with a 15.5 hour photoperiod. Seed germination counts and seedling vigor (expressed as the time required for 50% emergence) were monitored over a 3 week period starting on 16-Jan 2018.

The data was analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and varieties were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$).

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown, except where analyzed by pairwise comparison (t-test). Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two treatments. Treatments that were not significantly lower in performance than the top-performing treatment in a particular column are indicated with an asterisk. In this example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another. The asterisk indicates that hybrid B was not significantly lower than the top yielding hybrid C, indicated in bold.

Treatment	**Yield**
A	6.0
B	7.5*
C	**9.0***
LSD	2.0

RESULTS

The various seed treatments had different germination rates throughout the study (Figure 1). The inoculated control, inoculated with only *R. solani*, showed the highest germination rates alongside the biological seed treatment of K5As2 at 72.5% and 72.2% respectively. The Naturall and Actinovate were the poorest performing treatments with germination rates each of 64.1%.

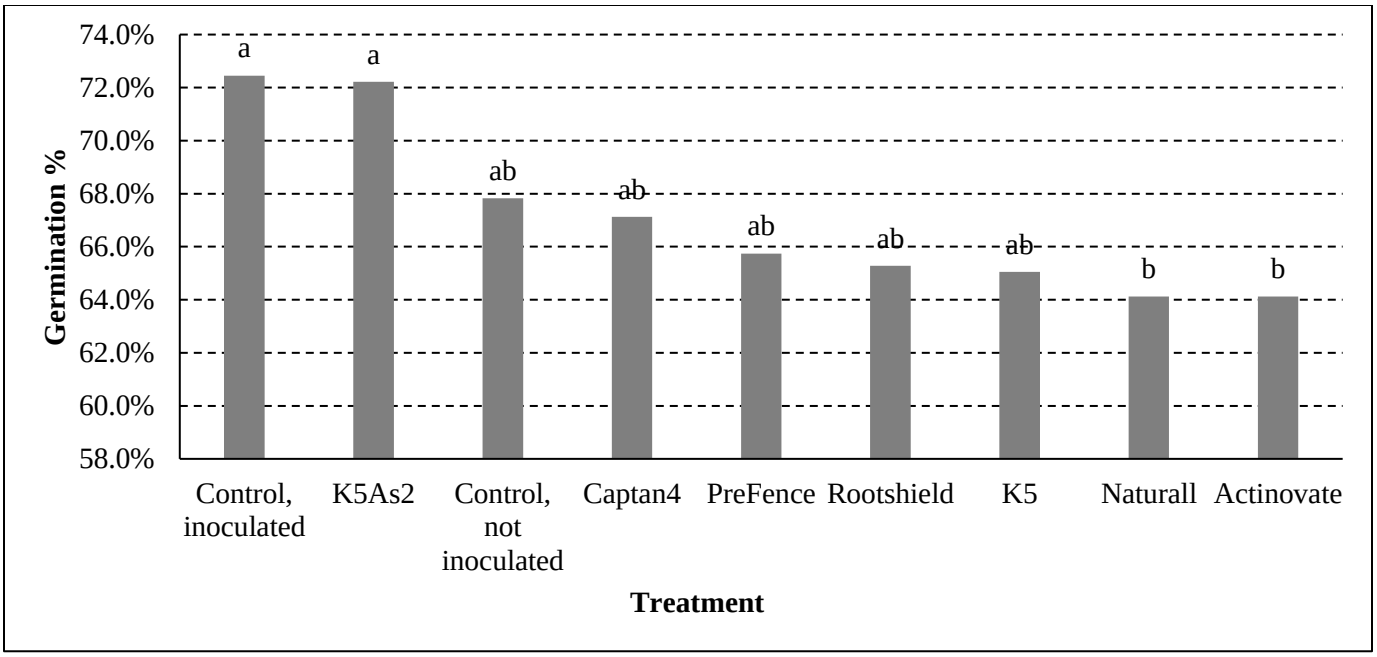

Figure 1. Germination rates for hemp seed treatments.

Table 2 shows seed vigor for each seed treatment. While Actinovate and the inoculated control took roughly two days less to reach 50% germination, the difference between these top performers and other treatments is not statistically significant. This study showed no statistical significance in overall seed vigor amongst seed treatments.

Table 2. Seed vigor of each treatment expressed as average number of days to reach 50% germination.

Seed Treatment	Average days to 50% germination
K5	12.00
Captan4	11.50
Rootshield	11.33
PreFence	11.17
Naturall	11.17
K5As2	11.00
Control, not inoculated	10.33
Control, inoculated	10.17
Actinovate	10.17
LSD (p=0.10)	NS
Trial Mean	10.98

NS, no statistical significance.

DISCUSSION

Farmers have experienced issues with early season stand establishment. Seed treatments help to improve germination and establishment of seedlings. Treating hemp seed with a biological treatment appeared to have minimal impact on the germination of hemp. Seed treatments also appeared to have no impact on seed vigor. As the hemp industry continues to grow, additional efforts to evaluate seed treatments and cultural practices will continue to be important. More research needs to be done to determine the effects of various chemical and biological seed treatments on germination and seed vigor.

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