PEA (*Pisum sativum* 'Ice Pack')
SWEET CORN (*Zea mays* 'Bodacious')
Damping-off and root rot; *Pythium ultimum*

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Evaluation of organic seed and drench treatments for controlling damping-off in pea and sweet corn in Mount Vernon, WA, 2011.

Sixteen seed and drench treatments were evaluated for control of Pythium damping-off in pea and sweet corn experimental field trials at WSU NWREC in Mount Vernon, WA. The ground was in transition to organic certification following small fruit production. Plots were inoculated with a known pathogenic isolate of *Pythium ultimum* 'VSP 030141'. Inoculated plots planted with non-treated seed (NTS), non-inoculated plots planted with NTS, and inoculated plots planted with NTS followed by drenching with water served as three control treatments in each trial. To assess the potential impact of the inoculum carrier on the crop, a fourth control treatment of soil-oatmeal (the inoculum carrier) applied in non-inoculated plots planted with NTS was also included. Each trial was laid out in a randomized complete block design with five replications. Treatments included biological and non-biological organic products, primed seed, and a conventional seed treatment, Apron XL. Priming of pea seeds was done by soaking seeds for 16 hr on a rotary shaker (150 rpm), and then air drying the seeds for 12 hr in a fume hood. Sweet corn seeds were primed as above with air-drying reduced to 8 hr. For the pea trial, seeds were planted on 21 Apr using a six-row belt planter (60 ft^2/plot). Plots were inoculated with *P. ultimum* in soil-oatmeal carrier at 2.2 x 10^4 cfu/g soil, and organic fertilizer (Wilbur-Ellis Proganic 8-2-4) was applied at 9 lb/1,000 ft^2 at planting. Each plot was planted with 690 seeds at a depth of 1.5 to 2 in. with rows 7 in. apart. Drench treatments were applied immediately after planting. Stimplex, Soilgard 12G, and the water drench treatments were reapplied 14 days after planting (dap). Emergence (stand) counts were done 14, 21, 28, and 35 dap from the center 10.76 ft^2/plot. Five plants from three replicate plots were sampled randomly 35 dap to isolate for root rot pathogens onto agar media. Root rot rating (0 to 5 scale, where 0 = no visible symptoms and 5 = dead plant), plant height, and shoot dry weight evaluations were done for 16 plants sampled randomly/plot at full bloom. Peas were harvested on 11 Jul from the center 3.28 ft of the four middle rows/plot by passing the plants through a customized thresher to remove peas from the pods, and taking pea weights and tenderometer readings. For the sweet corn trial, organic fertilizer (Wilbur-Ellis Proganic 8-2-4) was broadcasted and incorporated at 15 lb/1,000 ft^2 one week before planting. On 20 to 21 May, *P. ultimum* in soil-oatmeal carrier was applied manually at 1.5 x 10^4 cfu/linear ft in four open furrows/plot (200 ft^2/plot), spaced at 2.5 ft apart. After application, 40 seeds were placed 6 in. apart in each furrow, and furrows immediately closed after seeding. Drench treatments and the repeat applications of Stimplex, Soilgard 12G, and water control treatment were done at planting and 14 dap, respectively. Emergence (stand) counts were done weekly from 14 to 35 dap. Plants were collected from 10 ft of the two middle rows/plot 60 dap to assess plant height and shoot dry weight. Data were analyzed using SAS Proc GLM and means compared using Fisher's protected least significant difference (LSD, $P = 0.05$). If needed, transformation (log, arcsine, or square root) were used to satisfy assumptions for parametric analyses, or Friedman's non-parametric rank test was used if assumptions could not be met.

Spring and summer of 2011 were generally very cold and wet in Mount Vernon (mean daily temperature of 45, 52, 57 and 60°F; and total rainfall of 3.9, 4.2, 0.9, and 1.4 in. for the months of Apr, May, Jun, and Jul, respectively), resulting in poor germination for both the pea and sweet corn trials. Weed competition, predominantly tall oat grass (*Arrhenatherum elatus* var. *bulbosum*), was also a problem in the trials. Emergence was very slow in the sweet corn trial (avg of 2, 13, 15, and 15% of the seeds planted had emerged 14, 21, 28, and 35 dap, respectively). For the pea trial, Apron XL alone significantly increased emergence 14 and 35 dap compared to emergence in NTS, inoculated soil and NTS, inoculated soil + water drench control plots. For plots planted with primed seeds, emergence 35 dap was significantly less than in the control plots. Non-adjusted pea yields were significantly greater with Apron XL treated seed compared to all other treatments, while mean adjusted yields in plots of all the other treatments were not significantly different from each other. The other treatments evaluated did not show significant differences from that of the control plots for the other parameters measured (emergence, root rot, plant height, shoot dry weight, tenderometer readings, and yield). For the sweet corn trial, there was a significant increase in emergence 14 dap in plots with Natural II and Apron XL treated seed; and at 35 dap for plots with Natural II, primed seed, and Apron XL treated seed compared to the NTS, inoculated soil plots and NTS, inoculated soil + water drench control plots. Shoot dry weight was also significantly greater in plots with Natural II, primed seed, Nordox, and Apron XL treated seed compared to the NTS, inoculated control plots. The sweet corn trial was not taken to harvest as there were not enough plants in some plots to obtain sufficient data for statistical analyses. At this *Pythium* inoculated field site where cold and wet conditions at planting favored disease development, none of the organic seed treatments evaluated in the pea trial showed potential for managing damping-off. However, Natural II, primed seed, and Nordox seed treatments showed the greatest potential efficacy for the control of damping-off for organic sweet corn.

Treatment and rate	Pea trial					Sweet corn trial		
	Seedling emergence		Plant Height	Yield	Adjusted yield	Seedling emergence		Shoot dry weight
	14 dap	35 dap	(in.)	(lb/A)	(lb/A)[z]	14 dap	35 dap	(oz)
Seed treatments								
Acadian Marine Plant Extract 8 oz/ 100 lb seeds	27 bc[y]	77 b	8.3 b-d	5,006 bc	7,114	3 cd	19 d-f	0.048 cd
Actinovate STP 4 oz/100 lb seeds	25 b-d	64 b-d	8.1 cd	4,325 bc	6,510	2 cd	12 f	0.031 cd
Apron XL 1.28 fl oz/100 lb seeds	76 a	118 a	10.9 a	8,939 a	14,435	21 a	85 a	0.341 a
Germains II proprietary rate	23 b-d	57 d	8.0 d	3,723 bc	5,685	3 cd	11 f	0.062 b-d
Heads Up Plant Protectant 0.01 oz/100 lb seeds	26 bc	75 bc	8.2 cd	4,602 bc	7,544	2 cd	16 ef	0.041 cd
Myco Seed Treat 4 oz/100 lb seeds	25 b-d	66 b-d	8.2 cd	3,986 bc	5,796	1 d	17 ef	0.054 cd
Mycostop Mix 8 oz/100 lb seeds	27 b-d	68 b-d	8.2 cd	4,671 bc	6,944	1 d	16 ef	0.053 b-d
Natural II proprietary rate	25 b-d	66 b-d	8.5 b-d	3,983 bc	6,114	9 b	35 c	0.116 b
Nordox 75 WG 0.23 oz/100 lb seeds	25 b-d	78 b	8.5 b-d	4,627 bc	5,677	3 b-d	27 cd	0.080 bc
Prestop Mix 8 oz/100 lb seeds	25 b-d	61 cd	7.9 d	3,850 bc	5,608	2 cd	24 de	0.069 b-d
Prestop WP 8 oz/100 lb seeds	-	-	-	-		1 d	13 f	0.056 b-d
Primed seed	18 d	43 e	8.1 cd	3,407 c	4,911	7 b-d	59 b	0.269 a
T-22 HC 2 oz/100 seeds	29 bc	64 b-d	8.4 b-d	4,837 bc	6,546	1 d	15 ef	0.050 cd
CO_2 backpack sprayer treatment[x]								
Prestop WP 3.48 oz/A	25 b-d	72 bc	8.1 cd	5,266 bc	7,142	-	-	-
Drench treatments[w]								
Serenade Soil 192 fl oz/A	21 cd	69 b-d	8.3 cd	4,050 bc	5,841	2 cd	17 ef	0.054 b-d
Soilgard 12G 8 lb/A	25 b-d	63 cd	8.1 cd	4,255 bc	5,119	1 d	18 d-f	0.046 cd
Stimplex 1.5 qt/A	24 b-d	66 b-d	8.0 d	4,316 bc	6,668	2 cd	19 d-f	0.046 cd
Control treatments								
Non-treated seed (NTS), non-inoculated soil control	27 bc	68 b-d	8.2 cd	5,564 bc	7,060	1 d	17 ef	0.049 cd
NTS, inoculated soil control	21 cd	59 d	8.3 b-d	4,232 bc	4,521	1 cd	18 d-f	0.023 d
NTS, inoculated soil + water drench control	21 cd	58 d	8.7 bc	3,748 bc	5,966	1 d	16 ef	0.062 b-d
NTS, non-inoculated soil + soil-oatmeal control	31 b	77 b	9.0 b	5,135 bc	7,506	1 d	14 f	0.078 b-d
LSD	9	Log	1.7	1,714	NS	Arcsine	9	Square root

[z] Adjusted yield was calculated based on a tenderometer correction factor of 105 tenderometer reading following the method described by Anderson and White (1974) for green pea yields ranging between 81 and 120 tenderometer reading.

[y] Means followed by the same letter are not significantly different based on Fisher's protected LSD. For transformed data, original means are shown but mean separation letters are based on the transformation used (log, arcsine, or square root). Dependent variables with no significant effects in the ANOVA are not shown, except for adjusted yield for the pea trial, for which NS = no significant differences among treatments based on Fisher's protected LSD.

[x] For the pea trial, Prestop WP was applied by CO_2 backpack sprayer at 30 psi and 350 gpa.

[w] For drench treatments, each product was applied with 2.9 gal water/plot (70 ft^2) for the pea trial and 1.6 gal water/plot (40 ft^2) at planting and again 14 dap.