PEA (*Pisum sativum* 'Gallant')
Damping-off and root rot; *Pythium* spp.
Black root rot; *Thielaviopsis basicola*
Root lesion nematode; *Pratylenchus* spp.

A.C. Alcala[1], L.J. du Toit[1], M.L. Derie[1], B.J. Holmes[1], G. Coffman[2], E.W. Gatch[1], and L.D. Porter[2]; [1]Washington State University Mount Vernon NWREC, Mount Vernon, WA 98273; [2]USDA-ARS, Prosser, WA 99350.

Evaluation of priming and Nordox seed treatment for controlling damping-off in organic pea crops in central Washington, 2012.

Priming for 16 hr was shown to result in a significant increase in the emergence of pea seed; and Nordox, an organic cuprous oxide seed treatment, showed potential for the control of seed and root-rotting pathogens of pea, such as *Pythium ultimum* and *Rhizoctonia solani* (*unpublished data*). Priming is a process of imbibing seed to initiate germination until just prior to radicle protrusion. However, a limitation with priming large-seeded vegetables, such as peas, is the need to dry the imbibed seed adequately and immediately after priming to facilitate planting or storing of the primed seed if planting is delayed. This study attempted to address this limitation by using biochar, a highly porous, charcoal material that absorbs water readily, to the imbibed seed instead of forced air drying. Combinations of priming, biochar as a desiccant after priming, and Nordox seed treatment were evaluated in each of two field trials in certified organic, grower-cooperator, processing pea fields near Royal City, WA. Both fields had been planted to organic sweet corn in 2011. The cultivar Gallant was planted at both sites and in the surrounding commercial pea crops. Pea seed was primed by soaking in water for 16 hr, and the imbibed seed was immediately coated with biochar to dry the seed surface. Seed treatments evaluated included primed seed (PS) + biochar + Nordox 0.23 (full rate); PS + biochar + Nordox 0.12 (half rate); PS + biochar; dry seed (DS) + biochar + Nordox 0.23; and DS + biochar. Non-treated PS and DS served as two control treatments. Priming was done 24 to 48 hr prior to the expected planting date, with biochar and Nordox applied immediately after priming. Pea seeds with the various treatments were planted at the two sites on 6 Apr using a six-row belt planter to achieve 690 seeds/plot (110 ft^2/plot) at a seeding depth of 1.0 to 1.5 in., with rows 11 in. apart. At each site, treatments were arranged in a randomized complete block design with four replications. The trials were maintained by the grower-cooperator, following accepted organic fertilization, center-pivot irrigation, and weed management practices for the semi-arid Columbia Basin of Central Washington. Seedling stand counts were taken 14 and 28 d after planting (dap). Plant height was measured 35 dap for 10 seedlings sampled randomly from each of the two center rows/plot. Root rot severity ratings (0 to 5 scale, where 0 = no visible symptoms, and 5 = dead plant), plant height, and shoot dry weight evaluations were done at full bloom. Twenty plants were sampled/plot by digging five consecutive plants two feet from the ends of the two middle rows. The two trials were harvested manually on 27 Jun by removing plants from the center 5 ft of the four middle rows/plot, and a customized thresher was used to remove peas from the pods. Total pea weight and tenderometer readings (TR) were measured/plot. Data were analyzed using PROC GLM in SAS, and treatment means compared using Fisher's protected least significant difference (LSD, $P = 0.05$). If needed, transformations were used to satisfy assumptions for parametric analyses.

Plots planted with PS had significantly greater pea emergence compared to plots planted with DS in both trials, except for plots planted with PS + biochar in trial 2 at 28 dap, in which stand counts did not differ significantly from the stand in plots with DS + Nordox 0.23. Emergence was greater in plots planted with PS + biochar + Nordox 0.23 compared to plots with non-treated PS or PS + biochar at 14 dap in trial 1, and compared to plots with PS + biochar at 28 dap in both trials. Plots planted with PS + biochar + Nordox 0.12 or PS + biochar did not have greater emergence compared to the non-treated PS plots for both trials at 14 and 28 dap; however, emergence 28 dap in trial 2 in plots with PS + biochar + Nordox 0.12 was significantly greater than in plots with PS + biochar, and the same as in plots with PS + biochar + Nordox 0.23. In plots planted with DS, application of Nordox 0.23 alone or with biochar did not affect emergence compared to non-treated DS at both sites at 14 and 28 dap. Plant height 35 dap in plots planted with PS + biochar + Nordox (0.23 or 0.12), or PS + biochar did not differ significantly from height of pea plants in the non-treated PS control plots. Similar results were observed for plots planted with DS, i.e., addition of Nordox 75WG, with or without biochar, did not improve plant height compared to DS alone. However, the plots planted with non-treated PS had significantly taller plants compared with plots planted with non-treated DS in both trials. No significant differences in root rot severity ratings were observed among treatments in each trial (*data not shown*); however, in general, plants in trial 2 showed more severe root rot (mean ± standard error of 3.0 ± 0.3) compared to trial 1 (1.5 ± 0.1). Although isolations from symptomatic plants sampled confirmed the presence of *P. ultimum* in both sites, plants in trial 2 also showed severe black roots and stunting that were not typical of *Pythium* infection. Examination of these symptomatic roots revealed the presence of *Thielaviopsis basicola* and the root lesion nematode, *Pratylenchus*. TR of peas harvested from DS and PS control plots did not differ significantly in trials 1 or 2. In general, combining seed treatments with PS resulted in greater TR than planting DS, which reflected the fact that emergence was more rapid in the former than the latter plots. However, TR in trial 2 revealed no significant differences among treatments. In trial 1, plots with PS + biochar + Nordox at either 0.12 or 0.23 oz/100 lb seed had significantly greater yields compared to plots planted with DS; and yield from plots with PS + biochar + Nordox 0.23 also was significantly greater than the yield from plots with DS + Nordox 0.23; but not different than the yield of plots with DS + biochar + Nordox 0.23. In trial 2, no significant differences in yields were observed among treatments. Plant height and shoot dry weight at full bloom were not affected significantly by any of the treatments (*data not shown*). Overall, the results demonstrated the potential for faster emergence of pea seeds and reduced severity of damping-off as a result of combining seed priming with biochar as a desiccant followed by Nordox seed treatment, which could translate to greater pea yields.

Alcala et al. 2013. Evaluation of priming and Nordox seed treatment for controlling damping-off in organic pea crops in central Washington, 2012. Plant Disease Management Reports 7:ST002.

Seed treatment and rate	Trial 1					Trial 2				
	% Seedling emergence[z]		Plant height (in.)[y]	TR[x]	Yield (lb/A)[w]	% Seedling emergence		Plant height (in.)	TR	Yield (lb/A)
	14 dap	28 dap				14 dap	28 dap			
Seed treatments										
PS + biochar + Nordox 75 WG 0.23 oz/100 lb seed …….	59 a[v]	93 a	3.9 a	91 a	6,280 ab	47 a	83 a	3.2 ab	110	5,528
PS + biochar + Nordox 75 WG 0.12 oz/100 lb seed …….	54 ab	91 ab	3.9 a	94 a	6,255 a	37 a	83 a	3.2 ab	111	4,512
PS + biochar……	45 b	86 b	3.7 ab	91 a	5,444 abc	36 a	73 bc	2.9 abc	109	4,286
DS + Nordox 75 WG 0.23 oz/ 100 lb seed……..	8 c	70 c	3.1 c	81 c	4,092 c	14 b	69 cd	3.1 abc	103	4,084
DS + biochar + Nordox 75 WG 0.23 oz/100 lb seed …….	9 c	68 c	3.3 c	82 c	4,499 bc	7 b	60 d	2.6 c	98	2,983
Control treatments										
DS non-treated……	9 c	66 c	3.4 bc	83 bc	4,449 c	10 b	57 d	2.9 bc	100	3,224
PS non-treated ……	47 b	88 ab	3.8 a	89 ab	6,089 a	38 a	81 ab	3.4 a	105	5,087
LSD.....	9	6	0.4	6	Rank[u]	12	Rank	1.3	NS	NS

[z] Seedling emergence = the mean percent emergence of 230 seeds planted in the center two rows/plot measured 14 and 28 days after planting (dap), respectively.

[y] Plant height was measured for 20 plants/plot from the center two rows at full bloom.

[x] TR = the mean of two tenderometer readings of peas harvested/plot.

[w] Yield was measured from the center 5 ft. of the four middle rows/plot.

[v] Means followed by the same letter are not significantly different based on Fisher's protected LSD ($P = 0.05$). Dependent variables with no significant effects in the ANOVA are not shown, except for TR and yield in trial 2. NS = no significant differences among treatments.

[u] Rank = original means are shown but means separation is based on rank transformations due to heterogeneous variances.