PEA (*Pisum sativum* 'Boogie')
Damping-off and root rot; *Pythium* spp.

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

Evaluation of seed treatments and priming for controlling damping-off in organic pea crops in the semi-arid Columbia Basin and maritime Skagit Valley of Washington, 2012.

The potential benefit of combining priming and organic seed treatments for controlling damping-off in pea production was evaluated in two environments in WA: in a certified organic field near Ephrata, WA (semi-arid, irrigated Columbia Basin, with mean daily temp. of 52, 58, 63, and 73°F, and total rainfall of 0.61, 0.02, 1.12, and 0.89 in. for Apr, May, Jun, and Jul, respectively); and at the Washington State University Northwestern Washington Research and Extension Center in Mount Vernon, WA (maritime, Skagit region, with mean daily temp. of 50, 53, 56, and 61°F, and total rainfall of 4.31, 2.39, 3.15, and 1.30 in. for Apr, May, Jun, and Jul, respectively). Priming is a process of imbibing seeds to initiate germination until just prior to radicle protrusion, for the purpose of rapid and uniform emergence. Seven organic, biological and non-biological seed treatments applied to dry seed (DS) and primed seed (PS) were evaluated at the two sites. The cultivar Boogie, planted in the commercial crop at the Ephrata site, was used for both trials. Each seed treatment was applied at the highest rate on the product label. The priming protocol was a 16 hr seed soak in distilled water on a rotary shaker (150 rpm) to achieve uniform imbibition, followed by 10 hr drying in a fume hood. Each seed treatment was applied either as a slurry 3 to 4 d prior to planting, or as a dry powder 1 d before the expected planting date for the Mount Vernon trial, and 14 d prior to planting for the Ephrata trial because planting was delayed at the latter site as a result of poor weather. Plots planted with non-treated PS or DS served as the control treatments. Apron XL was included as a conventional fungicide seed treatment at the Mount Vernon trial. In addition, plots at Mount Vernon were inoculated with a pathogenic isolate of *Pythium ultimum* '030141' one week prior to planting. Non-inoculated plots planted with non-treated PS or DS served as additional control plots at Mount Vernon. The Ephrata trial was planted on 3 Apr, and the Mount Vernon trial on 23 Apr. A six-row cone planter was used to plant 690 seeds/plot (110 ft^2/plot) at a seeding depth of 1.5 to 2.0 in., with rows 11 in. apart at the Ephrata trial. For the Mount Vernon trial, a six-row cone planter was used with rows 7 in. apart and seed placed 1.5 to 2.0 in. deep for 690 seeds/plot (70 ft^2/plot). At each site, treatments were arranged in a randomized complete block (RCB) design with five replications. The trial at Ephrata was maintained by the grower-cooperator following accepted organic fertilization, center-pivot irrigation, and weed management practices for that region. The trial at Mount Vernon was maintained following recommended organic pea fertilizer and weed management practices for western Washington, without irrigation. Stand (emergence) counts were taken 14 and 28 d after planting (dap) in both trials. Plant height was measured 35 dap for 10 randomly sampled seedlings from each of the two middle rows/plot. Root rot severity rating (0 to 5 scale, where 0 = no visible symptoms of infection, and 5 = 81-100% of the roots with symptoms), plant height, and shoot dry weight evaluations were done at full bloom by digging five consecutive plants from each end of the two middle rows for a total of 20 plants/plot. The Ephrata trial was harvested on 2 Jul and the Mount Vernon trial on 19 Jul. Plants from the center 5 ft of the four middle rows/plot were harvested manually, and passed through a customized thresher to remove peas from the pods. Total pea weight and tenderometer readings (TR) were measured/plot. Data were analyzed as a RCB design with a factorial combination of two priming treatments and eight or nine seed treatments, using PROC GLM in SAS. Treatment means were compared using Fisher's protected least significant difference (LSD, $P = 0.05$).

Overall, the mean emergence across plots 14 dap was greater at the Mount Vernon trial (mean ± standard error of 62 ± 1.1%) compared to the Ephrata trial (31 ± 1.4%), probably as a result of rainfall at the former site soon after planting. Inoculation of plots at the Mount Vernon trial with *P. ultimum* did not increase the incidence of damping-off (*data not shown*). Analysis of the priming treatments showed that the use of PS did not improve emergence for any of the treatments compared to DS in either trial (*data not shown*). In fact, the PS treatments resulted in significantly less ($P = 0.001$) emergence than the DS treatments 14 dap (mean of 26 ± 1.9% for PS treatments and 35 ± 1.7% for DS treatments in Ephrata; and 56 ± 1.4% for PS and 66 ± 1.2% for DS treatments in Mount Vernon). By 28 dap, similar differences were observed between plots with PS vs. DS treatments (60 ± 2.7% for PS and 80 ± 1.5% for DS in Ephrata; 68 ± 1.6% for PS and 80 ± 1.1% for DS in Mount Vernon). By14 dap in Ephrata trial, no significant difference in emergence was noted in the PS and DS control plots. Plots planted with PS + Acadian or DS + Natural II had significantly greater emergence compared to plots with non-treated DS, but not compared to plots with non-treated PS. In contrast, plots with PS + Natural II or PS + Heads Up Plant Protectant had significantly fewer plants compared to the PS and DS control plots. By 28 dap in this trial, emergence was greater in plots with DS + Acadian Marine Plant Extract, Heads Up Plant Protectant, Myco Seed Treat, or Nordox 75 WG compared to plots with non-treated PS or DS; and plots with DS + Mycostop Mix had more plants than the PS control plots. In contrast, three of the five PS combinations resulted in significantly fewer plants than both the DS and PS control plots, and plots with the other two PS combinations had fewer plants than the DS control plots. In the Mount Vernon trial, emergence 14 dap was greatest in three of the four control plots: DS + Apron XL, PS + Apron XL, and DS alone; which all had greater stand counts than the PS control plots. Furthermore, plots with DS + Acadian Marine Plant Extract or DS + Nordox 75 WG had similar emergence to the DS + Apron XL control plots, and the five other DS combination treatments resulted in similar emergence to the DS control plots. In contrast, in plots for all seven of the PS treatment combinations, emergence was significantly less than in the DS control plots, and the PS + Nordox 75 WG plots also had fewer plants than the PS control plots. By 28 dap in the Mount Vernon trial, plots with DS + Apron XL, PS + Apron XL, and DS alone still had greater stand counts than the PS control plots, and stand counts in plots of all seven DS treatment combinations did not differ from stands in the DS control plots. In contrast, plots of all seven PS treatment combinations had reduced stand counts compared to the DS alone, DS + Apron XL, and PS + Apron XL control plots; and PS + Nordox 75 WG resulted in even lower stand counts than the PS control plots. Mean TR was not affected by any of the treatments in either of the sites. Overall, the DS treatments at the Ephrata trial resulted in significantly greater yields ($P = < 0.001$, mean of 12,434 ± 335 lb/A) than the PS treatments (9,937 ± 451 lb/A), although this yield difference was not observed in the DS and PS control plots in this trial. Although DS + Myco Seed Treat plots had the greatest yield numerically in the Ephrata trial, this yield was not

significantly different than the yield of the control plots. Two PS treatment combinations, PS + Heads Up Plant Protectant and PS + Natural II resulted in significantly reduced yields compared to both control plots. In the Mount Vernon trial, yield was not affected significantly by any of the treatments. Other parameters measured (plant height 35 dap and at bloom, root rot, and shoot dry weight) were not affected significantly by any of the treatments at both sites. Overall, priming did not result in a significant increase in emergence compared to DS treatments at either site, except for PS + Acadian Marine Plant Extract planted in the Ephrata trial, but only at 14 dap. Although most of the DS treatment combinations improved emergence compared to PS control plots at both trials, the treatments only improved emergence compared to the DS control plots in the Ephrata trial, but did not improve pea yields significantly in either trial, indicating limited potential benefits of these treatments even when applied to DS. In fact, two of the treatments applied to PS (Heads Up Plant Protectant and Natural II) adversely affected both emergence and yield in the Ephrata trial.

	Ephrata trial				Mount Vernon trial			
	Seedling emergence[z]			Yield[w]	Seedling emergence[y]			Yield
Treatment and rate	14 dap	28 dap	TR[x]	(lb/A)	14 dap	28 dap	TR	(lb/A)
Primed seeds (PS)								
Acadian Marine Plant Extract 8 oz/100 lb seed	39 ab[v]	63 ef	106	11,928 ab	57 ghi	66 h	83	7,580
Heads Up Plant Protectant 0.01 oz/100 lb seed	15 ef	44 fg	107	7,797 c	54 i	65 h	81	7,689
Myco Seed Treat 4 oz/100 lb seed	25 de	63 de	106	10,325 b	59 f-i	71 d-h	84	8,684
Mycostop Mix 8 oz/100 lb seed	32 a-d	71 cde	105	10,338 b	60 e-i	70 e-h	82	8,348
Natural II proprietary rate	12 f	34 g	105	6,522 c	56 hi	67 gh	82	7,796
Nordox 75 WG 0.23 oz/100 lb seed	29 bcd	66 def	109	10,877 b	40 j	50 i	80	6,437
Acadian powder 8 oz/100 lb seed[u]	-	-	-	-	54 hi	69 fgh	83	8,063
Dry seeds (DS)								
Acadian Marine Plant Extract 8 oz/100 lb seed	37 abc	80 a	115	11,353 b	70 ab	82 a-c	81	8,297
Heads Up Plant Protectant 0.01 oz/100 lb seed	35 a-d	90 a	103	12,709 ab	63 b-g	74 c-f	83	7,934
Myco Seed Treat 4 oz/100 lb seed	37 abc	82 a	112	14,110 a	60 d-i	78 b-e	82	7,533
Mycostop Mix 8 oz/100 lb seed	32 a-d	79 ab	104	12,297 ab	61 c-i	75 c-f	84	7,849
Natural II proprietary rate	40 a	75 bc	111	12,296 ab	67 b-f	80 a-c	82	7,992
Nordox 75 WG 0.23 oz/100 lb seed	36 a-d	82 a	106	12,192 ab	68 a-e	79 bcd	83	8,189
Acadian powder 8 oz/100 lb seed[u]	-	-	-	-	62 b-h	78 b-e	83	8,685
Control treatments								
PS non-treated	33 a-d	72 cd	105	11,771 ab	57 ghi	71 e-h	81	8,217
PS + Apron XL 1.28 fl oz/100 lb seed[u]	-	-	-	-	70 a-c	84 ab	80	8,426
DS non-treated	28 cd	75 bc	104	12,079 ab	69 a-d	81 a-c	79	7,510
DS + Apron XL 1.28 fl oz/100 lb seed[u]	-	-	-	-	76 a	89 a	81	8,555
LSD	11	Rank[t]	NS	2,439	9	8	NS	NS

[z] Seedling emergence = mean percent emergence of 230 seeds planted in the center two rows/plot.

[y] Seedling emergence = mean percent emergence of 490 seeds planted in the center four rows/plot.

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

[w] Yield was taken 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 treatment effects in the ANOVA are not shown, except for tenderometer readings (TR) for both trials, and yield data for the Mount Vernon trial. NS = no significant differences among treatments.

[u] Seed treatment was not certified for use in organic pea production in Washington, so this treatment was not evaluated in the Ephrata trial which was in a certified organic, grower-cooperator's field.

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