

**Evaluation of seed and drench treatments for organic management of soilborne diseases of spinach in Sequim, WA, 2007.**

A field trial was conducted in Sequim, WA in western Washington on a grower’s field certified for organic production by the Washington State Department of Agriculture. The trial was planted on 7 Aug in a Lummi silt loam soil with a pH of  $7.61 \pm 0.08$ . The field had been planted to Brussels sprouts (*Brassica oleracea* var. *gemmifera*) in 2006. Average daily temperature was  $14.8 \pm 4.0^\circ\text{C}$ , and temperatures ranged from 6.1 to  $30.4^\circ\text{C}$  for the duration of the trial. A total of 20.8 mm precipitation and irrigation was recorded for the duration of the trial. The trial was set up as a randomized complete block design with five replications of nine EPA-registered and OMRI-listed seed and/or drench treatments approved for use in organic production. Each plot was 3.0 m long x 1.5 m wide, with four rows of spinach planted at a 38 cm spacing between rows, with approximately 100 seed/3 m row. The trial was conducted in a field with a history of damping-off of spinach in previous years. Natural soilborne pathogen populations were determined from soil cores (30 to 50 cores of 25 mm diameter sampled over the area of the trial to a 15 cm depth) collected prior to planting. Three 10 g subsamples of the composite soil sample were used to prepare a dilution series, and a 0.5 ml aliquot from each dilution was spread onto Petri plates containing appropriate semi-selective agar media for *Pythium* spp. (Mircetich and Kraft) and *F. oxysporum* (Komada). The number of emerged seedlings and the incidence of damped-off or wilted seedlings were counted in 3 m of all four rows/plot every 7 d for 5 wk after planting. Isolations were conducted from healthy seedlings, and from seedlings exhibiting symptoms of damping-off at 14 d. Plots were weeded by hand on each rating day. Biomass was measured as above-ground dry weight of seedlings harvested from 1.5 m of each of the four rows/plot on 11 Sep, dried at  $32^\circ\text{C}$  for two weeks, and then weighed. Data were subjected to analyses of variance (ANOVA) and means comparisons using Fisher’s protected least significant difference (LSD).

Soil dilution plating determined a *F. oxysporum* population of  $8.5 \times 10^3 \pm 1.5 \times 10^3$  cfu/g, and *Pythium* spp. at a population of  $2.2 \times 10^3 \pm 1.0 \times 10^3$  cfu/g. However, the semi-selective agar medium used for quantifying *F. oxysporum* cannot differentiate the spinach pathogen, *F. oxysporum* f. sp. *spinaciae*, from other *formae speciales*, so the population of *F. oxysporum* quantified may not have been an accurate measurement of disease pressure from the spinach pathogen. The population of *Pythium* spp. detected was high enough to result in damping-off of the seedlings at 7 and 14 d, as isolations from all symptomatic seedlings resulted in development of *Pythium* spp. Seed and drench treatments had a significant effect on emergence for all weekly ratings (14, 21, 28, and 35 d), except at 7 d (data not shown). In contrast, the seed and drench treatments had a significant effect on post-emergence disease at 7 d, but not for any other weekly rating, because negligible numbers of diseased seedlings were recorded at subsequent ratings (data not shown). Similarly, the seed and drench treatments had a significant effect on the area under emergence progress curve (AUEPC) values, but not the area under disease progress curve values (data not shown). Kodiak Concentrate Biological Fungicide, Micro 108 Seed Inoculant+ Actinovate AG, PGPR Galaxy, and SoilGard 12G Microbial Fungicide treatments resulted in significantly lower post-emergence disease at 7 d compared to that of the non-treated seed. However, only the combination seed treatment with Micro 108 Seed Inoculant + soil drench with Actinovate AG resulted in significantly higher final emergence and AUEPC values compared to those of the non-treated seed. Kodiak Concentrate Biological Fungicide was the only treatment that resulted in significantly lower final emergence and AUEPC values compared to those of the non-treated seed. Although the seed and drench treatments had a significant effect on spinach biomass at the final rating (35 d), none of the treatments affected biomass significantly compared to that of seedlings that developed from non-treated seed. Overall, the results demonstrate the potential value of Micro 108 Seed Inoculant + Actinovate AG for organic production of spinach.

Seed and/or drench treatment (rate/100 kg seed or rate/100 liters water) <sup>z</sup>	Damping-off/12 m row	Emergence/12 m row	AUEPC <sup>y</sup>	Dry biomass (g/6 m row)
	(7 d)	(35 d)		
Non-treated seed.....	1.4 a	129.2 bcd <sup>x</sup>	3996 bcd	146.6 abc
Compost tea 50 liter.....	0.8 ab	163.6 ab	4558 ab	170.6 ab
Kodiak Concentrate Biological Fungicide 31.2 g.....	0.4 b	92.0 e	3200 e	119.2 c
Micro 108 Seed Inoculant 7.16 kg + Actinovate AG 2.58 g.....	0.2 b	194.4 a	5179 a	176.4 a
Mycostop Mix 625.7 g.....	0.8 ab	125.2 cde	4334 ab	137.4 bc
PGPR Galaxy 223 ml.....	0.0 b	117.2 cde	3546 cde	113.4 c
SoilGard 12G Microbial Fungicide 239.7 g.....	0.0 b	143.2 bc	4261 bc	132.0 c
T-22 Planter Box 250 g.....	0.6 ab	118.0 cde	3797 bcde	115.8 c
Yield Shield Concentrate Biological Fungicide 6.26 g.....	1.2 a	106.0 de	3352 de	131.2 c
LSD.....	Rank	35.65	Log	37.24

<sup>z</sup> Each treatment was applied as a seed treatment at the rate shown/100 kg seed, except for compost tea, Actinovate AG, and SoilGard 12G Microbial Fungicide which were each applied as a soil drench at the rate shown/100 liters water. Ingredients of the compost tea included vermicompost (5 liters), seaweed powder (100 ml), liquid humic acids (200 ml), and Azomite rock dust (300 g), which were aerated in 95 liters water for 24 h prior to application (Scheuerell and Mahaffee, 2004). The compost tea was applied as 7.58 liters tea in 15.16 liters water/plot. Actinovate AG was applied as 0.39 g product in 15.14 liters water/plot. SoilGard 12G Microbial Fungicide was applied as 141 g product suspended in 47.31 liters water/plot.

<sup>y</sup> AUEPC is a cumulative measure of emergence over time:  $[(\sum(y_i + y_{i+1}/2)(t_i - t_{i+1}))]$ , where  $y_i$  = the number of emerged seedlings at the  $i^{\text{th}}$  rating,  $y_{i+1}$  = the number of emerged seedlings at the  $(i+1)$  rating,  $t_i$  = the number of days at the  $i^{\text{th}}$  rating, and  $t_{i+1}$  = the number of days at the  $(i+1)$  rating.

<sup>x</sup> Each mean is averaged over five replications. Means followed by the same letter within a column are not significantly different based on Fisher’s protected LSD at  $P < 0.05$ . Log = original means presented but means separation is based on logarithmic transformation to meet requirements for parametric statistical analyses. Rank = original means presented, but means separation is based on Friedman’s non-parametric rank test because assumptions for parametric analyses could not be met using transformations.