RADISH SEED CROP (*Raphanus sativus* 'Champion')
Fusarium wilt; *Fusarium oxysporum* f. sp. *raphani*

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**Effect of agricultural limestone amendment on Fusarium wilt in a radish seed crop, 2010.**

Five rates of limestone amendment were tested for suppression of Fusarium wilt in a radish seed crop trial established within a spring wheat crop on a Timmerman sandy loam soil near Quincy, WA. In 2006, the field had been planted to a radish seed crop which had succumbed to severe Fusarium wilt. A randomized complete block design was used with five replications of five rates of agricultural limestone amendment (Imperial Lawn and Garden Lime, Oregon Lime Score = 97, CCE = 97.0%, with 97% $CaCO_3$ and 38.8% Ca) at 0, 1, 2, 3, and 4 tons/A. Limestone was broadcast onto each plot (24 ft x 36 ft) on 15 Mar using a 6 ft wide Gandy drop spreader, and incorporated 6 in. deep the same day using a rototiller. A 15 ft alley separated adjacent plots in each replication to avoid mixing soil among plots. On 18 May, Dual Magnum was broadcast (1.33 pt/A) as a pre-plant herbicide application, and incorporated with a seed bed maker. Seeds of the open-pollinated radish cv. 'Champion' (treated with Apron and Thiram) were planted 0.5 in. deep on 26 Mar using a Monosem planter, with six rows/plot spaced 22 in. apart and a 2 in. spacing within rows. The same day, soil samples were collected from each plot (8 cores/plot) to a depth of 6 in. for pH and nutrient analyses. Soil samples were also collected from plots in three of the five replications on 16 Apr, and from all plots on 8 Jun, for pH and nutrient analyses. On 3 May, radish seedlings were severely wind- and sand-blasted by 50 mph winds. Most of the radish plants died. Therefore, the plots were mulched with a seed bed maker for re-planting. The plots were re-planted on 17 May with the same 'Champion' seed lot using a Gaspardo planter, with the row spacing described above. Lorsban Advance insecticide was applied (1.5 pt/A) on 19 May, and Lorsban 5 W (1 lb/A) was applied on 1 Jun because of a severe maggot (*Delia radicinum*) infestation. The trial was watered and fertigated by the grower-cooperator using a center-pivot irrigation system, using practices typical for spring wheat (the crop surrounding the radish trial) in the Columbia Basin of Washington. Alleys separating adjacent plots were cultivated regularly, and the plots hand-weeded through the season. Plant stand and incidence of wilted seedlings were counted in four 4 ft sections of row from the two center rows/plot on 8 Jun and 1 Jul. On 20 Jul, whole plants were sampled from 10 ft of row/plot, and rated for incidence and severity of wilt (latter on a scale of 0 to 6 where 0 = asymptomatic plant and 6 = dead plant). The plants were then dried at 100°F for 2 weeks, crushed, weighed, and subjected to nutrient analyses by a commercial lab. Plants from 15 ft of row were harvested from each of the two center rows/plot on 2 Sep. The plants were then dried in cloth bags at 80 to 90°F for 2 to 3 weeks, weighed, and seed pods collected and weighed. All data were subjected to analyses of variance and means separation using Fisher's protected least significant difference (LSD, $P < 0.05$). Mean temperature and total rainfall for Mar, Apr, May, Jun, Jul, Aug, and Sep were 47.1°F and 0.19 in., 50.3°F and 0.56 in., 54.6°F and 1.54 in., 62.5°F and 1.38 in, 72.1°F and 0.06 in., 69.6°F and 0.00 in., and 63.8°F and 0.00 in., respectively.

Following re-planting after the windstorm, the rates of limestone amendment showed no significant effect on radish stand counts on 8 Jun, 1 or 20 Jul, or 22 Aug. Incidence of Fusarium wilt averaged 35.5 ± 6.4% (mean ± standard deviation) by 1 Jul and 47.4 ± 8.2% by 20 Jul. However, warm temperatures after re-planting, plus decomposing radish plants from the first planting resulted in a severe cabbage maggot infestation that confounded Fusarium wilt ratings. In addition, the long day length by late May when seedlings emerged in the re-planted plots led to <40% bolting (plants converting from vegetative to reproductive growth) and, hence, poor pod set. Wilt incidence was not affected by limestone treatments on 1 Jul under these conditions. By 20 Jul, incidence of wilted and dead plants did not differ among treatments except for a greater incidence in plots with 1 ton limestone/acre. Wilt severity on 20 Jul was not affected by the treatments. Similarly, total plant biomass on 22 Aug and 2 Sep, and weight of pods harvested were not affected by rates of limestone amendment. Soil pH increased significantly with increasing rate of limestone, as did available soil calcium (Ca) on 26 Mar, 16 Apr, and 8 Jun. Soil manganese (Mn) was significantly less in limestone-amended vs. control plots on 8 Jun, but no other soil macro- or micro-nutrient was affected significantly by the treatments. Similarly, macro- and micro-nutrient concentrations in plants on 20 Jul were not affected by limestone amendments. However, the maggot infestation and poor bolting confounded the ability to detect potential beneficial effects of limestone soil amendment on suppressing Fusarium wilt in this radish seed crop trial.

| Rate of limestone amendment (tons/A) | Soil pH (1:1) | | Soil nutrient analyses: Ca (%) | | Soil nutrient analyses: Mn (mg/kg) | % Wilted and dead plants | Total plant biomass (g/30 ft row, 2 Sep) | Pods harvested (g/30 ft row, 2 Sep) |
|---|---|---|---|---|---|---|---|---|
| | 16 Apr | 8 Jun | 16 Apr | 8 Jun | 8 Jun | (20 Jul) | | |
| 0 …….. | 6.3 a | 6.4 a | 5.4 a | 5.2 a | 1.93 b | 43.6 b | 1,249 | 20.8 |
| 1 …….. | 7.2 b | 7.1 b | 8.3 b | 5.6 a | 1.40 a | 54.4 a | 1,476 | 8.4 |
| 2 …….. | 7.3 bc | 7.3 bc | 8.6 b | 7.4 b | 1.37 a | 46.1 b | 970 | 3.7 |
| 3 …….. | 7.5 c | 7.5 cd | 11.1 c | 8.6 bc | 1.27 a | 43.4 b | 1,081 | 3.6 |
| 4 …….. | 7.5 c | 7.6 d | 12.2 c | 9.0 c | 1.27 a | 49.6 ab | 1,064 | 20.3 |
| LSD …… | 0.36 | 0.33 | 1.64 | Log[z] | 0.456 | 7.96 | NS[y] | NS |

[z] Log: Original means shown but LSD based on log transformation because of heterogeneous variances in the ANOVA.
[y] NS = no significant differences among treatments based on Fisher's protected LSD.