

Alternative methods of raspberry production and root rot control

Primary objectives:

To determine whether cultural practices (raised bed vs. flat bed) in combination with applied materials helps to control disease in raspberries.

Key results:

Efficacy of treatments varied between raised and flat beds, with manures in general producing the highest yields. There were no differences in root rot ratings of fruiting canes due to any of the treatments.

Root rot (*Phytophthora fragariae* var. *rubi*) is of primary concern to all raspberry growers in Washington, and is of particular concern to organic growers who have fewer options for disease control. This trial is focused on organic root rot control; however all raspberry growers will benefit from new disease management strategies.

Our study builds upon research led by Dr. Pete Bristow from 1995 to 1998. That work demonstrated that raised beds reduced the habitat for *Phytophthora* by increasing drainage, but were not sufficient to control root rot. In spring 1999, in cooperation with Jan Pigman at Pigman's Organic Produce Patch, we began to study six organic treatments for the control of raspberry root rot.



Raspberry disease control research plots at Pigman's Organic Produce Patch in Nisqually, Washington.

Table 1. Treatments and application rates at Pigman's Produce in 1999 and 2000.

	April 1999	April 2000
1. Trichoderma (T-22)	4 g (2.4 lbs/acre)	75 g (10 lbs/acre)
2. Gypsum	7.5 lbs (1 ton/acre)	7.5 lbs (1 ton/acre)
3. Chicken manure	31 lbs (4 tons/acre)	57 lbs (8 tons/acre)
4. Horse manure	61 lbs (8 tons/acre)	57 lbs (8 tons/acre)
5. Horse manure + T-22	61 lbs and 4 g, respectively	57 lbs and 5 g, respectively
6. Control	no application	no application

Objectives

- Analyze and compare performance of organic methods to control raspberry root rot.

Procedures and methods

Pigman's Farm - 1999-2000. Research design is a split-plot where the main plot treatment is soil level (flat or raised). Sub-plot treatments and application rates in 1999 and 2000 are shown in Table 1.

Chicken manure is typically used on the farm and was included to evaluate this available resource for disease suppression. Horse manure was included because soil microbiologists felt its high C:N ratio may be conducive

to disease suppression, and it may enhance the activity of *Trichoderma*. Manure application rates in 1999 were based on nutrient analyses, whereas in 2000, application rates were based on estimated analyses. All sub-plots, except those that received chicken manure, were fertilized with blood meal at the rate of 100 lbs N per acre both years. Chicken manure had a high nitrogen content and a good C:N ratio and was therefore felt to be an adequate source of nitrogen.

The raspberry variety at this site is Chilliwack. The study includes 2 rows of newly established plants and 4 rows of 4-10 year old plants. Plots are 1 row wide, 16 feet long. On April 20, the new raspberries were planted and *Trichoderma* was applied in the root zone. At that time, raised beds were created in the study area. On May 11, all other treatments were applied in four-foot wide bands, centered on the row. *Trichoderma* and gypsum were lightly incorporated. Chicken and horse manure, and horse manure inoculated with *Trichoderma*, were applied as mulch.

In 2000, all treatments were applied on April 20. We increased the application rate of *Trichoderma* based on manufacturer recommendations. In 1999, raspberries were harvested in the center 5-feet in each plot. Whole-plant samples were collected for disease analysis from the area immediately adjacent to the yield-collection area. Disease analysis indicated that crown gall and *Armillaria* (shoe string) root rot were present in the field along with *Phytophthora* root rot. In 2000, raspberries were harvested in the center 3 feet in each plot and fruiting canes were evaluated for root rot incidence.

Results and discussion

In 1999, the efficacy of the treatments to control raspberry disease differed between

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Table 2.
Weight (g) and number of marketable and unmarketable fruit harvested at Pigman's Produce in 1999.

	Treatment	Wt. of marketable (g)	No. of marketable	Wt. of unmarketable (g)	No. of unmarketable
Raised bed	<i>Trichoderma</i> (T-22)	168.22	58.53	41.23	27.84
	Gypsum	165.51	52.79	52.79	23.65
	Chicken manure	217.44	79.81	61.09	36.44
	Horse manure	54.71	13.03	15.35	11.51
	Horse manure + T-22	137.41	42.60	36.47	22.55
	Control	78.86	23.94	41.37	44.21
Flat bed	<i>Trichoderma</i> (T-22)	234.90	91.81	62.15	42.06
	Gypsum	95.36	30.02	35.85	27.41
	Chicken manure	137.97	10.67	16.11	9.17
	Horse manure	241.98	97.74	59.87	38.48
	Horse manure + T-22	131.42	62.24	47.00	33.51
	Control	143.58	66.67	53.91	45.70

Table 3.
Fruit size and yield (hand harvest) of raspberries at Pigman's Produce in 2000.

Treatment	Berry yield (g)	% yield increase over control	Berry weight (g)	% weight increase over control
Horse manure	1137 A*	87.4	2.83 AB	19.9
T-22	1057 B	74.2	2.67 AB	13.1
Chicken manure	963 B	58.8	3.43 A	46.6
Gypsum	877 B	44.5	2.61 AB	10.6
Horse manure + T-22	737 B	28.8	2.34 B	-0.7
Control	607 B		2.36 B	
Raised bed	996 A	25.0	2.76	4.2
Flat bed	797		2.65 A	



Jan Pigman (farmer) and Pete Bristow (WSU Plant Pathologist) examine raspberry root rot damage on affected plants.

the raised and flat beds at Pigman's Farm (Table 2). On raised beds, chicken manure produced the highest yield while on flat beds, horse manure produced the highest yield. *Trichoderma* produced the second highest yield on both raised and flat beds. *Trichoderma* appeared to have a

beneficial effect in both the raised and flat bed rows, while chicken and horse manure appeared to work well in one or the other, but not both.

In 2000, fruit yield in raised beds was higher than on flat beds at Pigman's Farm, but this difference was not significant.

It should also be noted that in a comparative trial conducted at the WSU Research and Extension Unit in a conventional system, a dairy manure treatment applied at 1.75 tons/acre produced the highest yields (significantly), of 3307 grams (compared with yield values in Table 3).

Benefits of manure may be due to suppression of root rot pathogen and enhancement of beneficial fungi, as well as improved plant nutrition. There were no differences in root rot ratings of fruiting canes due to any of the treatments.

Raspberry plots at Pigman's Produce

are limited due to the overall size of the raspberry planting at this farm. Small plots have led to a lack in replications and we believe this has limited the scientific conclusions of this study at that location. To improve our on-farm experimental design, we will establish new on-farm plots with Sakuma Farms in Skagit County. Sakuma Farms have established 30 acres of 'transition to organic' raspberries and have made a portion of this planting available to us for this study. Our annual report and photos of the study are available on the WSU Agricultural Systems website, <http://agsyst.wsu.edu>.

A complete project report is available on the OFRF website or by mail. OFRF project Report #99-74 (6 pp, including 4 tables and results of additional trials carried out at WSU Vancouver Research and Extension Unit.)