Soil quality and cover crops in red raspberry in the Pacific Northwest

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Introduction

• Red raspberry is a valuable crop to Washington

• Total acreage has increased in the Pacific Northwest (PNW), but crop longevity has decreased

• The decline is attributed to various factors

http://www.raspberries.us/
Soil management challenges

- Pathogenic fungi
- Pathogenic bacteria
- Plant parasitic nematodes
- Improper pH
- Soil nutrient deficiency
Soil management challenges

*Pratylenchus penetrans*, or root lesion nematode (RLN), is one of the most important raspberry pests

- Non-segmented roundworm
- Migratory endoparasite
- Feeds on roots, causes reduced uptake of water and nutrients
- Dark lesions develop on roots
- Plants can decline rapidly

[Image of nematode](http://extension.oregonstate.edu/umatilla/pests/rootlesionnematodes)
Current management practices

• Alleyways are commonly kept clean by repeated rototilling/cultivation and herbicides
• Alleyway cover cropping is not a common practice in PNW red raspberry systems
• Repeated cultivation can:
  • Increase soil erosion
  • Increase compaction
  • Contribute to loss of soil physical structure
  • Reduce nutrient and water holding capacity
  • Increase dust during the dry season
Potential benefits of cover crops

- Increased soil organic matter
- Weed suppression
- Soil structure improvement
- Pest and pathogen suppression
- Promotion of beneficial soil microorganisms
- Improved nutrient cycling/management
- Increased water infiltration
Keep in mind...

- Proper selection of cover crops is crucial because many cover crop species may serve as hosts for *P. penetrans*
  - White clover
  - Barley
  - Oat
  - Cereal rye

Photos by Brigid Meints
Field experiment: Cover crops and ground covers in established red raspberry alleyways
Objectives

• Measure the effects of alleyway cover cropping in established red raspberry on:
  • Soil quality—physical, chemical, biological
  • *P. penetrans* population dynamics
  • Soil microbial community structure
  • Plant competition

• Evaluate suitability of annual and perennial cover crops in PNW red raspberry production system.
Experimental design

• Fall 2014-Fall 2016
• Established commercial ‘Meeker’ red raspberry field
• History of RLN, but no root rot
• CRD, 9 treatments, 4 reps, untreated cultivated bare soil and weedy mown plots served as controls
• Treatment plots were 30 ft x 12 ft and spanned the entire alleyway on both sides of the row and a minimum of 60 ft were maintained between plots as buffer
• Treatments seeded twice over two years (once each fall)
Treatments

- W1: Hard, red winter wheat cv. Norwest 553 (*Triticum aestivum*)
- W2: Soft, white winter wheat cv. Rosalyn (*T. aestivum*)
- O1: Winter-hardy oats cv. TAM 606 (*Avena sativa*)
- O2: Winter-hardy oats cv. Nora (*A. sativa*)
- G1: *Ryegrass* (*Lolium* spp.) mix that included 51.25% intermediate ryegrass cv. Tetralite and 48.24% tetraploid perennial ryegrass cv. Kentaur
- G2: Perennial ryegrass (*L. perenne*) mix that included 43.93% ‘Esquire’, 31.44% ‘TopHat 2’, and 22.49% ‘Tetragreen’
- T1: Triticale cv. Trical 103BB (*Triticosecale* sp.)
- T2: Triticale cv. TriMark 099 (*Triticosecale* sp.)
- R: Generic cereal rye (*Secale cereale*)
- Mow: Control, weedy mow
- Till: Control, bare soil, repeatedly rototilled (common industry practice)
### Data collection

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fall 2014</th>
<th>Spring 2015</th>
<th>Summer 2015</th>
<th>Fall 2015</th>
<th>Spring 2016</th>
<th>Summer 2016</th>
<th>Fall 2016</th>
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<td><strong>Raspberry plants</strong></td>
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</tbody>
</table>
Take Home Message 1

Repeated cultivation did not significantly out perform ground cover treatments in any measured soil quality parameter.
Soil quality--physical

Spring 2015

Spring 2016

Fall 2015

Fall 2016

Lower bulk density = less compaction = better soil quality
Soil quality--chemical

• Cation exchange capacity (CEC), pH, % organic matter, N, P, K
• Few significant differences among treatments.
Soil quality—biological

- Data forthcoming
Take Home Message 2

Alleyway cover crops did not significantly affect yield or plant performance.
Summer 2015 estimated yield and fruit quality

No significant differences in fruit yield or quality among treatments
Summer 2016 estimated yield and fruit quality

- No significant differences in fruit yield or fruit quality among treatments in 2016
- Fruit quality in all treatments was significantly higher than 2015
Take Home Message 3

Alleyway cover crops are maintenance hosts for *P. penetrans*, but vary in host suitability.
**P. penetrans** densities in alleyway soil

- *P. penetrans* population densities in soil were low in both years.
- Till did not have significantly lower densities than many other treatments in both years.
P. penetrans densities in bed soil

Spring 2015 and 2016

Fall 2015 and 2016
## Average *P. penetrans* densities in bed vs. alleyway

<table>
<thead>
<tr>
<th></th>
<th>Pp/100 g of soil</th>
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<tr>
<td></td>
<td>Bed</td>
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<tr>
<td><strong>Spring 2015</strong></td>
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<td><strong>Fall 2015</strong></td>
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<td><strong>Spring 2016</strong></td>
<td>129</td>
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<tr>
<td><strong>Fall 2016</strong></td>
<td>129</td>
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</table>
Take Home Message 4

Alleyway cover crops do not impact *P. penetrans* population densities in the raspberry crop.
P. penetrans densities in raspberry roots

Spring 2015 and 2016

Fall 2015 and 2016

P. penetrans populations were lower in most treatments in both the spring and fall in 2016.
*P. penetrans* densities in raspberry roots over time
Conclusions

• Alleyway cover crops do not negatively affect raspberry yield or fruit quality compared to bare soil alleyways.

• Alleyway *P. penetrans* populations do not affect bed *P. penetrans* populations.

• Raspberry planted in plots with bare soil did not fare better than raspberry planted in plots with cover crops under any measured parameter.

• *P. penetrans* population densities did not increase over time in raspberry roots.

• Cover crops were hosts for *P. penetrans*, but some were less suitable than others.
Alleyway cover crops: Pros vs. Cons

• Pros:
  • Lower bulk density when left to grow over time
  • Easier management with mowing compared to rototilling
  • Less expensive?
  • No increase in *P. penetrans* populations over time in raspberry roots
  • No difference in yield or fruit quality compared to bare soil
  • Less dust/soil in the air during dry season
  • Less standing water in alleyways
  • Soil microbiological changes?

• Cons:
  • Cost of seed and planting
  • No increase in fruit yield or quality
  • Soil microbiological changes?
Acknowledgments

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Literature cited


Literature Cited


