

TITLE: Nitrogen Supply and Partitioning in Managed Understories of Organic Apples

PRINCIPLE INVESTIGATORS:

John Reganold (WSU-Department of Crop and Soil Sciences, Pullman, WA)

Dan TerAvest (WSU-Department of Crop and Soil Sciences, Pullman, WA)

Lynne Carpenter-Boggs (WSU-CSANR, Pullman, WA)

COOPERATORS:

David Granatstein (WSU-CSANR)

Jeff Smith (USDA-ARS Land Management Research Unit, Pullman, WA)

Lori Hoagland (WSU-Department of Crop and Soil Sciences, Pullman, WA)

Mark Mazzola (USDA-ARS Tree Fruit Research Center, Wenatchee, WA)

SUMMARY OF PROJECT AND PROGRESS:

From 2005 thru 2007, an organically managed apple orchard was established to measure tree growth, soil quality, and nitrogen cycling under various groundcover management strategies. These strategies included living and non-living mulches, tillage versus no-till, and a brassicaceae seed meal amendment, all at various levels of N fertilization. We also added ¹⁵N-labeled compost to three of these treatments to better understand the fate of N under organic orchard management. In September 2007, these trees were excavated (Figure 1) and the individual parts (leaves, roots, etc) were destructively sampled (Figure 2). These samples are currently in the process of being analyzed to determine the “final resting place” of the compost-derived nitrogen. Various other tests have been completed to determine the levels of microbial activity in the soil under different treatments, while still other analyses are yet to be done. Soil properties completed include dehydrogenase enzyme activity, earthworm populations, and potentially mineralizable nitrogen; those remaining are carbon mineralization and mycorrhizal root colonization.

Comparing tree growth and yield data with the completed measurements indicate a trade-off between soil quality and tree growth in the early years of orchard establishment. The maintenance of a living cover crop clearly indicates how improving soil quality does not necessarily improve tree growth or crop yield. Other mulch materials, however, show promise in both improving soil quality and increasing yields and tree growth.

OUTPUTS:

Publications

Hoagland, L.A., L. Carpenter-Boggs, D.M. Granatstein, J.L. Smith, J.P. Reganold, M.R.

Wiman, D. TerAvest. 2007. Balancing N supply and weed control in newly established organic orchards. Washington State Horticultural Association Annual Meetings. Poster.

Hoagland, L., L. Carpenter-Boggs, D. Granatstein, M. Mazzola, F. Peryea, J. Smith, J.

Reganold. 2007. Nitrogen cycling and partitioning under alternative organic orchard floor management strategies. *Western Nutrient Management Conference 2007 Proceedings*. Salt Lake City, UT. pp. 117-123.

Hoagland, L., L. Carpenter-Boggs, J.P. Reganold, and M. Mazzola. 2008. Role of native soil biology in Brassicaceous seed meal-induced weed suppression. *Soil Biology and Biochemistry*. 40(7):1689-1697.

Hoagland, L., L. Carpenter-Boggs, D. Granatstein, M. Mazzola, J. Smith, F. Peryea, and J.P. Reganold. 2008. Orchard floor management effects on nitrogen fertility and biological soil activity in a newly established organic apple orchard. *Biology and Fertility of Soils*. DOI 10.1007/s00374-008-0304-4.

Outreach & Education Activities

Results were presented at the Western Nutrient Management Conference in Salt Lake City, UT, March 2007; at Washington State University-Pullman, April 2007; at the Washington Horticultural Society in Wenatchee, December 2007; and at the WSU Academic Showcase, Pullman, March 2008.

Lori Hoagland completed her PhD dissertation, *Impact of Soil Biology on Nitrogen Cycling and Weed Suppression under Newly Established Organic Orchard Floor Management Systems*, in May 2007.

Project results were also incorporated into presentations for classes or meetings as follows: “Organic Soil Management and Weed Control”, Far West Agribusiness Assoc., Kennewick, WA , 12/11/07.

“Organic Tree Fruit Research Update”, Northwest Wholesale Growers, Chelan, WA, 12/12/07.

“Sustainability in Fruit Production”, Agriculture Canada seminar, Summerland , BC , 2/7/08.

“Orchard Floor Management”, Hort 421, WSU-Pullman 2/14/08.

“Organic Agriculture”, Simplot Soilbuilders grower meeting, Yakima, WA , 2/19/08.

“Managing Organic Soils”, Wilbur Ellis grower meeting, Sunnyside , WA , 2/19/08.

“Orchard Floor Management”, Intern. Organic Fruit Conf. (ISHS), Vignola, Italy, 6/16/08.

“Benefits of Green Manures and Crop Rotations”, Soils 101, WSU-Pullman, 3/27/08.

“Farming Systems and Sustainable Agriculture”, Soils 201, WSU-Pullman,, 4/24/08.

IMPACTS:

Short-Term (knowledge gained and shared)

Data generated in this study have allowed us to evaluate the N availability of compost amendments and the impact of alternative understory management practices on available N and tree uptake.

Intermediate-Term (current & expected change in behaviors)

Having a better understanding of the short-term availability and long-term storage of N and C under various understory management schemes as well as their affects on soil quality will allow us to better prepare recommendations for both organic and transitional apple producers.

Long-Term (potential change in economic/environmental/social situations)

These recommendations will help improve the productivity of young organic orchards and help orchardists transition to organic production more efficiently by minimizing losses of both C and N from these systems.

GRADUATE STUDENTS FUNDED:

Dan TerAvest, M.S. Soil Science, Department of Crop and Soil Sciences, WSU

MEDIA COVERAGE OF THIS PROJECT: None

PROPOSALS AND FUNDING LEVERAGED (STEMMING FROM THIS BIOAG PROJECT): None

Figure 1

Figure 1. Dan TerAvest (in excavator) and David Granatstein digging up apple trees at the Wenatchee Valley College Auvil Demonstration Orchard in East Wenatchee, WA. Each tree was stripped of all leaves and a small excavator was used to first loosen the soil around the tree and pull the tree out. Pitchforks were then used to sift the soil and recover the roots.

Figure 2

Figure 2. Lynne Carpenter-Boggs dismantling a tree. Once the trees were excavated, each tree was broken down into sections (roots, new growth, frame, etc.) for analyses in Pullman, WA.