PROGRESS REPORT: ORGANIC FARMING RESEARCH FOR THE NORTHWEST

TITLE: Growing nitrogen in the organic orchard

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DATE (period which report covers): CY 2009

KEYWORDS: APPLE, NITROGEN, CLOVER, NITRATE, PLANT ROOT SIMULATORS

ABSTRACT (Maximum of 250 words in length, written in non-scientist/layperson language, briefly summarizes your work to date):

OBJECTIVES:
1. Field test four legume species for potential to provide N when grown in the orchard drive alley.
2. Compare cover crop seeding method using a no-till drill with and without a pre-plant burndown.

PROCEDURES:
1. The field trial was successfully established in May 2008 at Warren Morgan Orchards in Quincy, WA. Four different perennial legumes (alfalfa, birdsfoot trefoil, ladino clover, kura clover) were direct seeded in a four-foot wide strip in the middle of the drive alleys. Full length rows were planted. A normal grass cover crop control was included as a fifth treatment. The design is a randomized complete block with four replicates. Mow and blow operations were conducted on May 29, July 3, August 20, and October 1, 2009

Percent cover in the alley was determined three times using the point intersect method to separate cover crop, weeds, and bare ground. A biomass sample of each cover crop was collected just prior to mowing, dried, weighed, and will be analyzed for total N. Mowing was done as a 'mow and blow' system to deliver the biomass to the tree row. Once mowing started, soil samples were collected biweekly from the top foot of soil and analyzed for NO_3-N. Beginning in July (due to delay in procurement) Plant Root Simulator (PRS) probes were placed in the tree row to measure N mineralization for two-week periods consistent with the soil sampling intervals. Soil nitrogen status was evaluated with an early season and post harvest sample (3-ft depth, in 1-ft increments) for available N. Samples have been collected but analysis of post-harvest samples is not yet complete.

Tree nitrogen status was monitored with a leaf sample for total N collected in July and August. Tree canopy volume was also measured as another indicator of tree vigor. Tissue samples will be analyzed using dry combustion.

2. Pre-plant burndown effect. Percent cover in the alley was determined three times using the point intersect method to separate cover crop, weeds, and bare ground, comparing areas with and without pre-plant burndown in 2008 to determine how the effect changes over time. Separate biomass measurements were taken on three dates.

PROGRESS TOWARDS OBJECTIVES (Comparison of actual results with the original goals):

1. Measurements of several components in this study are ongoing. Although the early season with depth soil samples have been analyzed, post-harvest samples have not, so the data is not presented. In addition, tissue analysis from biomass and apple leaf has not yet been conducted, so the results are forthcoming.

There were significant difference in soil nitrogen (measured as nitrate) both with date of sample collection and with the different treatments. Overall, there was a spike in N release from all treatments on 23 July. On that date, Ladino had the highest and grass the lowest soil N (Fig. 1). However, Alfalfa had the greatest N concentration in the soil in the early and late season (Fig. 1) suggesting a more equal release throughout the growing season from this source.

Monitoring of soil nitrate nitrogen with PRS probes showed a slight significant difference in N with cover treatment but not with date, likely due to the relatively low number of sampling dates. Overall, Alfalfa showed the greatest seasonal release of N, with Ladino and Trefoil the next highest, Kura the lowest of the legumes but showing more N release than the grass treatment (Table 1). This, coupled with the soil nitrate data above, indicates that alfalfa likely releases a more consistent supply of N in orchards with this type of management.

Table 1: Average PRS nitrogen across all sampling dates for different covers as N sources in an orchard (significant at <0.10).

Cover	PRS NO3-N (ppm)
Alfalfa	251
Ladino clover	173
Trefoil	179
Kura clover	132
Grass	103

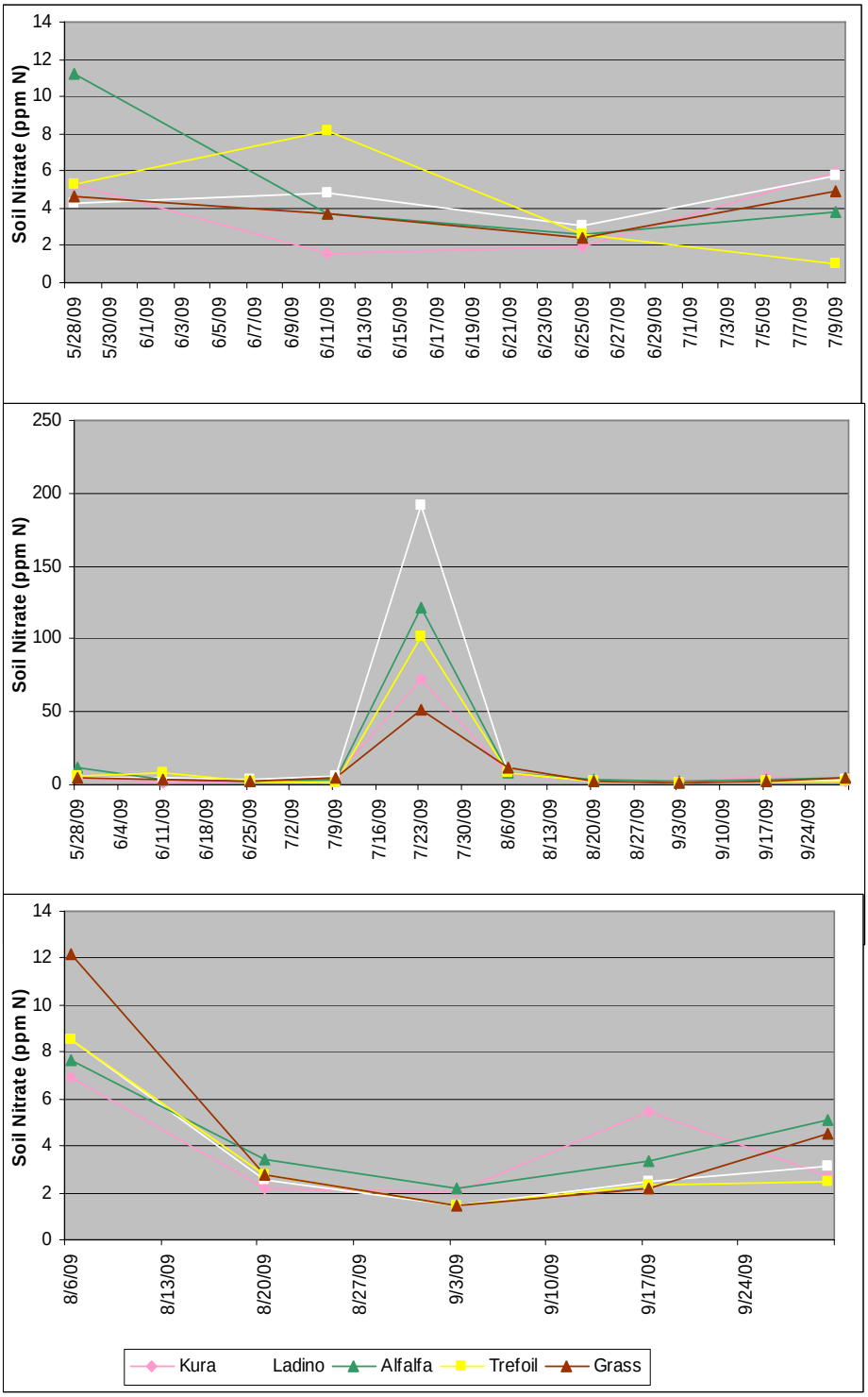

Figure 1: Soil nitrate nitrogen concentration in the early season (top), whole season (middle) and late season (bottom) in orchards where the cover crop was blown under the tree for decomposition and N release. (significant difference by treatment * sampling date at <0.01)

Cover crop biomass over the growing season (4 mowings) was greatest for alfalfa, similar for ladino clover, trefoil, and grass, and lowest for kura clover (Fig. 2). Kura clover did increase its

biomass as the season progressed. Total biomass was similar between sprayed and unsprayed areas, but sprayed areas had a higher percentage of legume (Table 2), which boosted the total contribution of nitrogen due to the higher N content in the legumes (Table 3). Estimated seasonal total N (kg/ha) in the cover crop biomass was 48 (alfalfa), 28 (ladino clover), 29 (trefoil), 15 (kura clover), and 15 (grass control), using the 2008 tissue N values. More precise totals will be calculated once 2009 cover crop tissue N samples are analyzed.

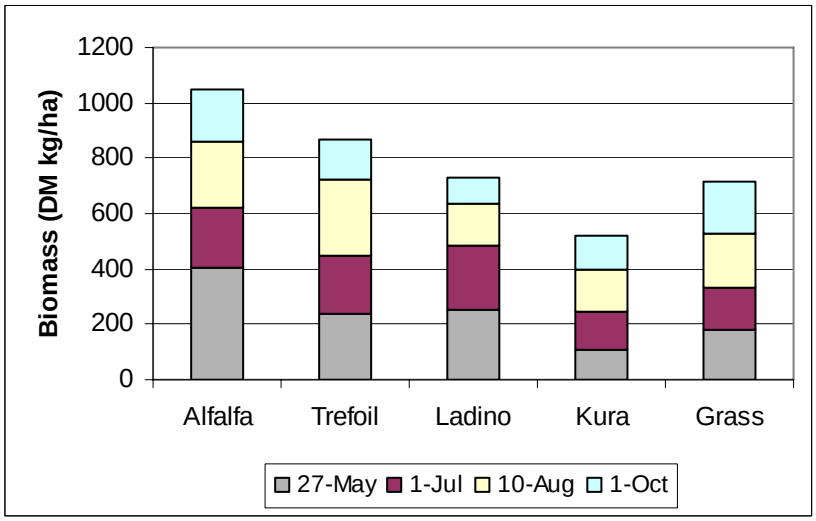

Figure 2. Cover crop biomass (dry matter) for each mowing in 2009.

Table 2. Effect of pre-seeding treatment (with or without herbicide suppression) on total and legume biomass dry matter.

	Sum of biomass DM 8/08, 7/09, 8/09 cuttings		Legume biomass only, 7/09	
	Sprayed	*Unsprayed*	*Sprayed*	*Unsprayed*
	- - - - - - - - - Dry matter (kg/ha) - - - - - - - -			
Alfalfa	759 a	685 a	157 a	105 b
Ladino	701 a	719 a	191 a	131 b
Trefoil	783 a	716 a	141 a	74 b
Kura	476 a	486 a	56 a	18 a

Table 3. Cover crop biomass tissue N concentration and C:N (August 2008).

	% N	C:N
Alfalfa	4.06	10.6
Ladino	3.77	11.2
Trefoil	3.36	13.0
Kura	2.83	14.9
Grass	2.15	18.8
Non-legume	2.32	17.7

Table 4. Total seasonal biomass dry matter from the planted strip.

Treatment	Dry matter (kg/ha)
Alfalfa	1049 a
Ladino clover	730 b
Trefoil	865 b
Kura clover	519 b
Grass (control)	713 b
(p=0.0002)	

A wider strip planted to legumes would very likely increase the nitrogen contribution measurably. Ability of the legume species to persist under the wheel tracks is being visually monitored. Legume species bred for pasture may perform better in this respect than the hay types we used (S. Fransen, pers. comm.).

OUTPUTS (Publications including newsletter articles, workshops and meetings, presentations, web sites or pages, field days):
2 field days (August 10 and 11), about 35 participants. Individual field visits with NRCS staff, fruit company staff, WSU faculty, individual growers, and a group of organic orchardists from Italy. Presentations at WA Hort (12/08), Tilth Producers (11/09), Northwest Wholesale organic grower meeting (12/09)

IMPACT (In what way has your work influenced organic agricultural practices, economics/marketing and environmental stewardship):
The cooperating orchardists are planning to expand their use of legume cover crops into new orchard blocks. Attendees at the field days included hops growers who planned to test legumes in a new style of hop yard being developed. An organic soft fruit grower using winter legume green manures switched to direct seeding in 2009 based on our trial. Also, USDA-NRCS personnel visited the trial and are considering how to include this practice of legume mow and blow farm programs such as EQIP.

INSTITUTION: Washington State University

STATE: Washington

FUNDING SOURCE: CSANR organic farming research special grant

FUNDING AMOUNT: $13,013

ORGANIC RESEARCH LAND (indicate number of acres on all that apply):

Station	**____non-organic**	**____transitional**	**____certified**
On-farm	**__12 non-organic**	**____transitional**	**____certified**

FARMER COOPERATOR(S): Number_1__
Name(s): Warren Morgan Orchards