UMass Extension

Vegetable Program
ag.umass.edu/vegetable

Agricultural Engineering Building • 250 Natural Resources Rd. • Amherst, MA 01003-9295 • p: 413.577.3976 • f: 413.545.5858

Growing Our Own Nitrogen: Results from 6 On-Farm Trials in MA

Katie Campbell-Nelson
413-834-1090 kcampbel@umass.edu

The goal of this trial was to find out if farmers could provide sufficient nitrogen for their cash crops using leguminous cover crops alone or with reduced nitrogen fertilizers and no additional phosphorus. We also hoped to increase the use of the pre-sidedress soil nitrate test (PSNT) as a tool for measuring soil nitrate sufficiency for multiple vegetable crops. We planted cover crops on six MA farms in a completely randomized block design. In early September 2016 plots were seeded using different implements on each farm with the following treatments: **1) No Cover Crop, 2) Rye (70lbs/A) and Vetch (20lbs/A), 3) Farmer Choice** (Table 1). The cover crops were sampled for biomass and incorporated using different implements in late May 2017. Two weeks later each plot was split with half receiving 60 lbs N/A in the form of Chilean Nitrate and the other half receiving none. Four weeks after incorporation, a cash crop of the farmer's choice was planted on each farm. We sampled soil nitrate 6-12" deep every two weeks beginning on the day of incorporation in late May until eight weeks after in late July. Finally, we measured yield of the cash crop planted into each of these treatments.

Table 1.

Farm	Farmer Choice (lbs/acre)	Cover Crop $/acre[1]	Cash Crop	Crop N needs lbs/acre	% Soil Organic Matter	2016 Fall NO_3 ppm	Soil Type
Langwater	Oat (90), Pea (50), Vetch (40)	$308	Winter Squash	110-140	6.8	105	Charlton-Paxton fine sandy loam
Lyonsville	Fria rye (15), Crimson clover (15), Vetch (18)	$136	Winter Squash	110-140	2.9	25	Occum fine sandy loam
Many Hands Farm Corp	*Summer 2016 seeded:* Sorghum Sudan (90) *Spring 2017 Seeded:* Oat (100), Pea (100)	$234 $251	Cabbage	160	6.2	5	Pootatuck fine sandy loam
Tangerini	Oat (90), Crimson clover (15), Vetch (18)	$205	Chard	105-130	3.4	30	Merrimac fine sandy loam
Twin Oaks	Fria annual rye (6), Crimson Clover (4), Tillage Radish (10)	$52	Cabbage	160	2.2	28	Deerfield loamy fine sand
UMass	Rye (60), Vetch (20), Tillage Radish (5)	$96	Sweet corn	100-130	1.7	20	Winooski silt loam

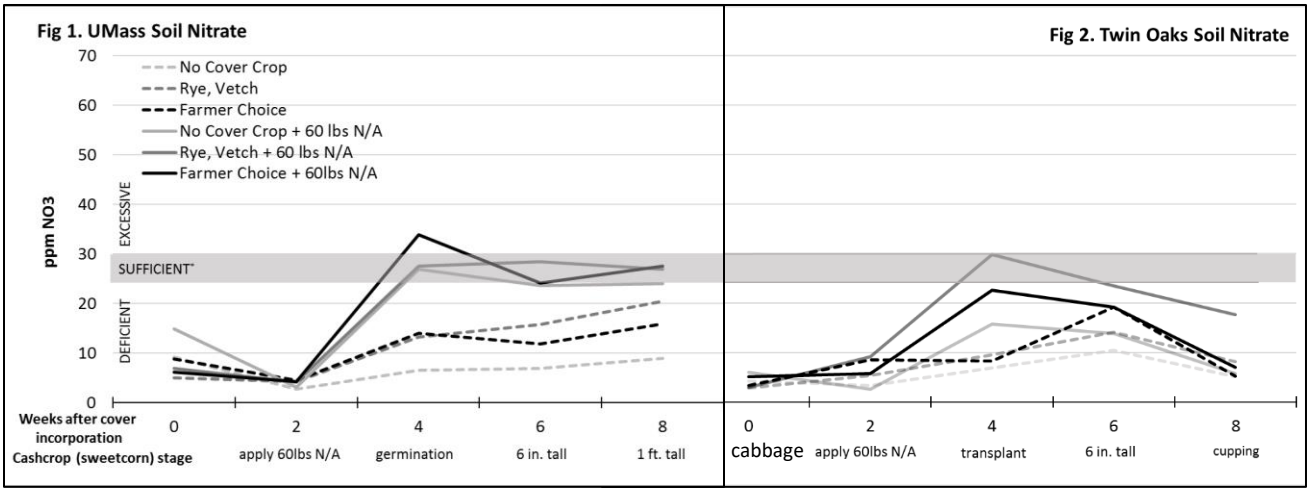
[1] The Rye (70lbs/A) and Vetch (20lbs/A) treatment cost $90/A and the additional 60lbs nitrogen cost $248/A.

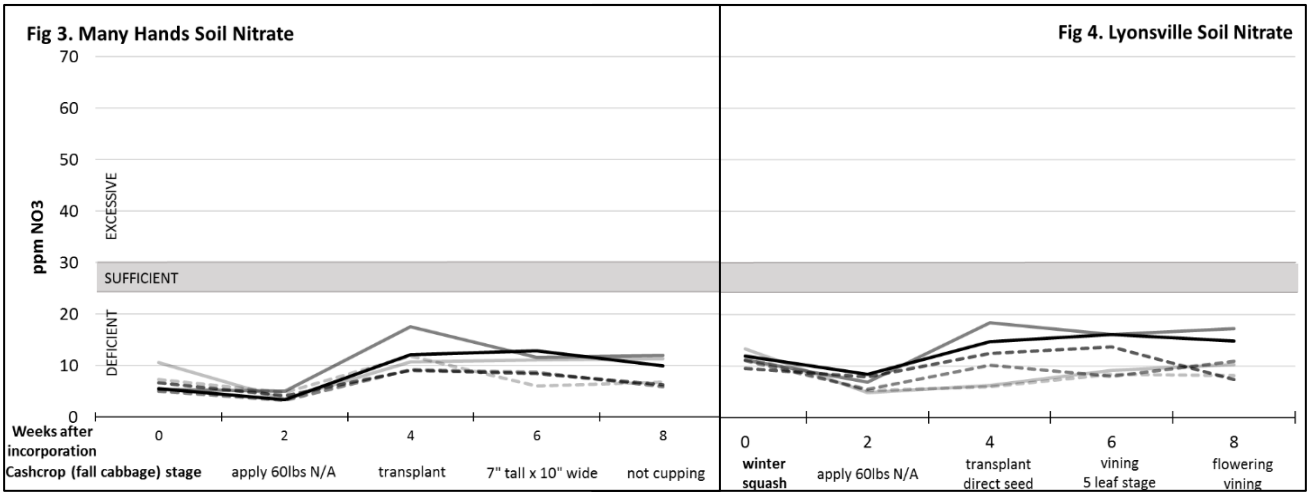
Results: Not surprisingly, there were statistically greater nitrates (NO_3) in plots with additional fertilizer on all farms and in most cases there were statistically greater nitrates in plots with cover crops than those without. Treatments in 5 of 6 locations resulted in greatest NO_3 to least NO_3 in the following order: Farmer Choice plus 60lbs N/A, Rye Vetch plus 60lbs N/A, No Cover plus 60 lbs N/A, Farmer Choice, Rye vetch, No Cover. Farmers were better at choosing treatments providing additional N compared to the traditional Rye/Vetch. In many locations, 'good' to 'excellent' cash crop yields according to those published in the *New England Vegetable Management Guide* were achieved with a combination of cover crops and less than half the required N rates applied or only with the use of cover crops.

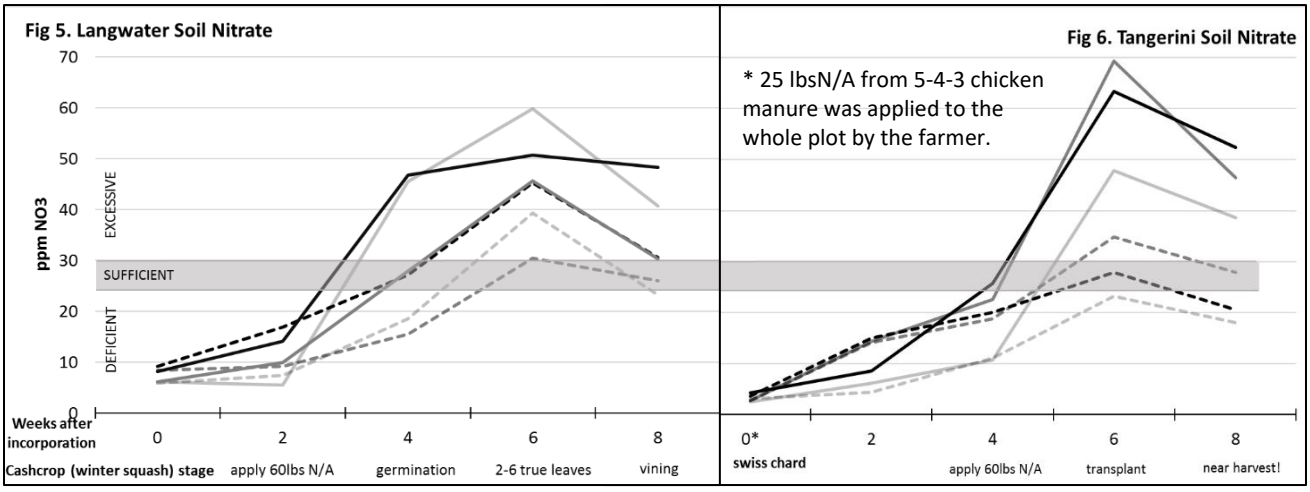
Despite these overall trends in the data, varying soil type, microclimate, and cultural practices all affected the great variability in nitrate release from treatments on each farm. Some farms achieved sufficiency ranges for their cash crops (Fig 1. UMass and Fig 2. Twin Oaks). Some farms did not achieve the sufficiency range due to poor cover crop establishment, high soil organic matter but wet soils with low mineralization rates (Fig 3. Many Hands) or poor cover crop establishment, low soil organic matter, and sandy soils with high mineralization rates (Fig 4. Lyonsville). Some farms exceeded the sufficiency range of NO_3 required for their cash crops because of prior compost applications (Fig 5. Langwater) and an early spring 5-4-3 chicken manure fertilizer application of 25 lbs N/acre to the entire plot (Fig 6. Tangerini). 25-30ppm NO_3 is considered 'sufficient' soil nitrate for most crops at the time a PSNT is taken *(New England Vegetable Management Guide 2016-2017, Nitrogen Management Section.)*

In this parable of the three bears (too much N, not enough N, and just the right amount of N), it may seem challenging to walk away with clear conclusions due to the diversity of results on each farm. However, we would like to make the following tentative **conclusions:**

- Cover cropping takes practice and finesse, but will pay off in the end. At $4.00 per lb/N for organic fertilizer ($434-660 per acre) or $0.85 per lb/N ($89.25-136 per acre) for conventional fertilizer, a farmer is saving themselves money by planting a nitrogen fixing cover crop. The cost of 60lbs N/A in this trial was $248 while most cover crop treatments cost less than that per acre (Table 1).
- If leguminous cover crops are well managed they can provide all the nitrogen needs of a cash crop without any additional phosphorus in 4 out of 6 locations in this trial.
- It is possible to exceed sufficiency ranges for cash crop N requirements with the use of cover crops and/or compost; no commercial fertilizer necessary.
- Peak NO_3 was released 4-6 weeks after cover crop incorporation or 2-4 weeks after additional N application on all farms. Growers can take an inexpensive soil nitrate (PSNT) test 4-6 weeks after incorporating cover crops to determine if they are in the sufficiency range for their cash crop (25-30ppm NO_3), then make additional N applications if necessary.







This research was funded by the Sustainable Agriculture Research and Education (SARE) program and the New England Vegetable and Berry Growers Association (NEVBGA). Thanks to the following farms for participating: Langwater Farm, Lyonsville Farm, Many Hands Farm Corp, Tangerini's Spring Street Farm, and Twin Oaks Farm. Thanks to Seedway for providing the cover crop seed for this trial.