

1. Comparison of Green Manure Mixes in Relation to Nitrogen Immobilization and Release  
FNE 01-390

2. The goal of this project was to test three green manure mixes for biomass production and effect on soil nitrate levels over three tillage dates.

3. This project was undertaken by farm managers Maggie and Lucian Smith on Beech Hill Farm, which is owned by the College of the Atlantic. Beech Hill Farm is an 84-acre, certified organic farm located on Mount Desert Island in Hancock County, Maine. There are six acres of vegetables, herbs, flowers and strawberries in production, as well as heirloom apples and forested land. Beech Hill Farm's livestock includes eight Scotch Highland Cattle, twenty-five laying hens, and six pigs are raised yearly. Beech Hill Farm markets its produce through a farmstand on site and wholesale to local restaurants and stores.

4. The technical advisor for the project was Marianne Sarrantonio Phd. Coordinator of the Sustainable Agriculture Program at the University of Maine at Orono, who viewed the project and gave technical advice. Will Brinton and Wayne Davis of Woods End Research Laboratory, Inc. collaborated with advice on experimental design, and performed the nitrate testing on the soil samples.

5. The cover crop mixtures were planted in production study areas in mid-September 2000. The planting method involved mowing crop residue, then broadcasting and discing in the appropriate seed mix. In the spring and summer of 2001 the three green manure mixes were trialed in separate plots, on two different fields.

ROVC using a rye/oats/vetch/red clover mixture  
PVO using a peas/vetch/oats mixture  
RV using a rye/vetch mixture

Each test bed was separated into three plots and tilled at three different dates: May 1, June 1, and July 1. Three tillage dates for each of the three methods equals a total of nine experimental plots. On May 1<sup>st</sup>, the first group of three plots representing each of the above mixes were tilled with a Perfecta field cultivator. On June 1<sup>st</sup> the second group of three plots were flail mowed once and then tilled. On July 1<sup>st</sup> the third group of three plots were also flail mowed (2x total) prior to tilling. May 1<sup>st</sup> Plots were tilled again on June and July 1<sup>st</sup>, and June 1<sup>st</sup> plots were tilled again on July 1<sup>st</sup>.

Soil sampling was done in each plot to test the soil for soluble nitrate levels after tillage. Sample dates were May 1,14, June 1,10,20, and July 1,11. Sampling was performed with a soil sampling tube in only the previously tilled plots. The experiment was intended to run longer with sampling as late as September, but a severe labor shortage prevented more sampling. Samples were frozen and shipped to the Woods End Research Lab. for nitrogen analyses.

The soil sample results were intended to demonstrate nitrogen availability in accordance with cover crop volume, carbon/nitrogen ratio and decomposition rates after tillage.

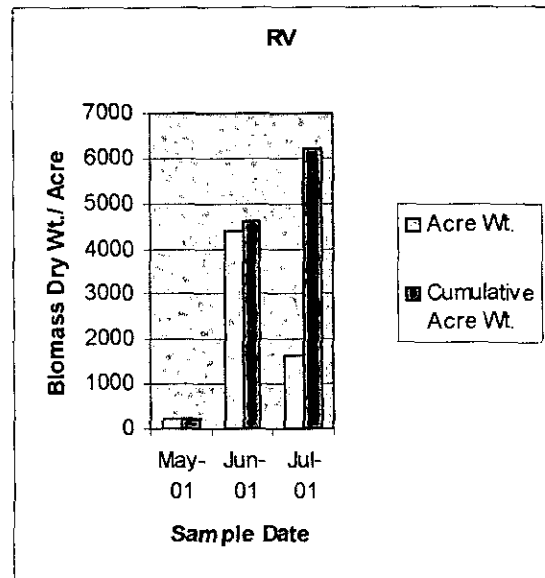
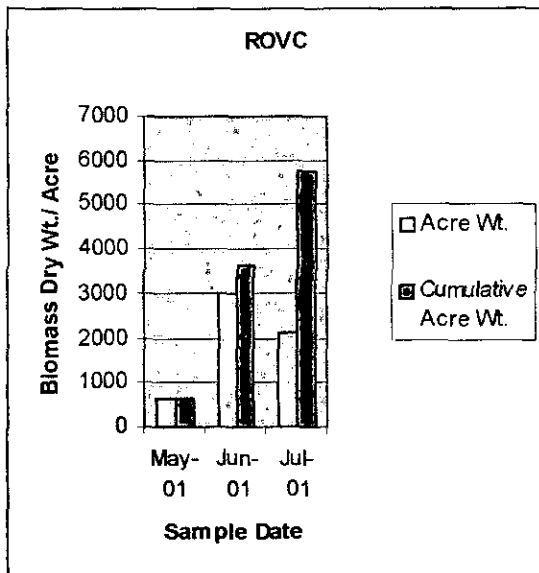
May - 3 plot samples x 2 sample dates = 6 samples  
 June - 6 plot samples x 3 sample dates = 18 samples  
 July - 9 plot samples x 2 sample dates = 18 samples  
 Total Soil Nitrate Samples Taken = 42

The biomass of each cover crop was recorded in each of the nine experimental plots before mowing and tilling of that plot. The biomass was measured by tossing a two square foot steel rod rectangle into the test plot and clipping all plants which originated within the quadrat at ground level with scissors. The samples were dried on screens and weighed with a postal scale after a determination of species composition and weed pressure was made.

### 6a. Green Manure Biomass Production

The vegetation samples we took showed an interesting change in species composition and biomass production over the three sample dates.

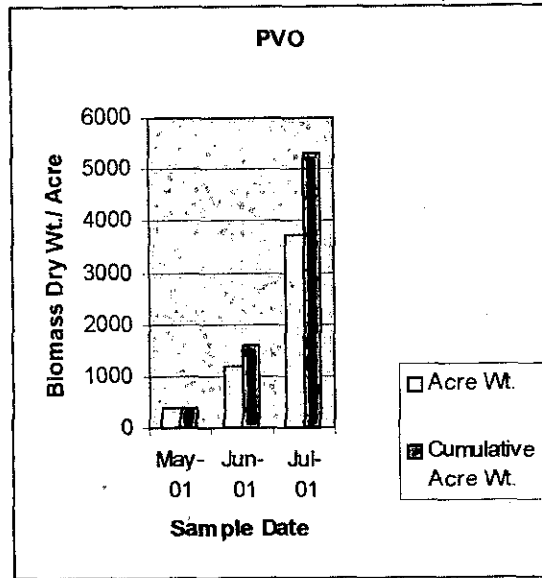
In the rye/vetch plot, rye predominated at the first mowing with the vetch increasing in ratio over time. The majority of the biomass was produced between May 1<sup>st</sup> and June 1<sup>st</sup> with growth slowing in June. Total biomass production was 6,236 # of dry matter per acre by July 1.



The rye/vetch/oats/clover plot plant composition changed from primarily rye and winter killed oats at the first sampling to an increasing ratio of vetch, a small amount of clover and no detectable oats in the second sampling. The third sample of ROVC had equal amounts of rye, vetch and clover.

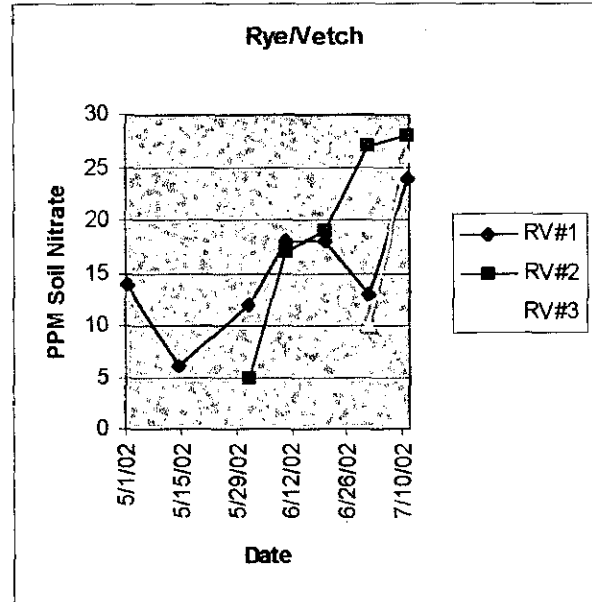
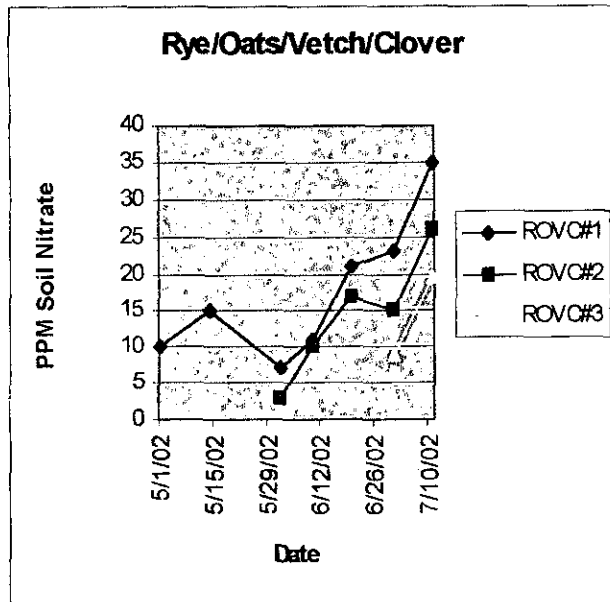
Biomass production varied less over time than the RV plot. Total biomass production was 5,763 # per acre by July 1st.

The PVO sample was primarily dead oats at the first sample date, the peas did not appear to put on much top growth before winter. Later sample dates were primarily vetch with some weed material as well. It is interesting to note that the sample weights kept increasing over all three sample dates. Total biomass production was 5,334# per acre by July 1st.



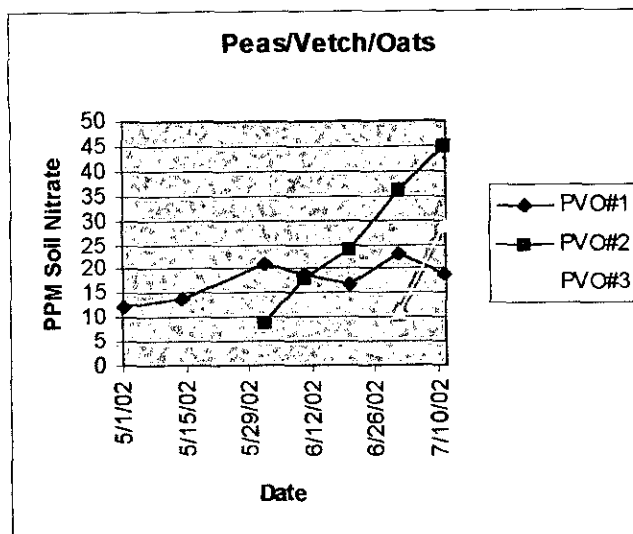
### 6b. Soil Nitrate Levels

Contrary to what we were expecting to find, there did not seem to be any appreciable difference between the RV and ROVC plots in terms of soil nitrate levels. Considering the fact that the



experimental plots were in two different fields with varying organic matter levels, no conclusive statement can be made about the addition of clover to the green manure mix increasing soil nitrate levels..

The plot which showed a radical difference in soil nitrate levels from the others was the PVO plot, which showed the highest nitrate levels. This indicates that vetch can be used effectively as a cover crop without tying up soil nitrogen. Weed pressure could possibly be decreased by the use of another winter grain besides rye, or the oat seeding rate could be increased to create a more effective mulch.



7. The 2001 growing season was characterized by a late spring and the worst drought on record. It snowed 8" on April 10<sup>th</sup> yet the last frost was on May first and it was so warm that we did not need to cover our solanum crops with row covers. The drought started in June and has not abated by winter, with many wells going dry locally and statewide. This is most likely the cause of the low biomass production for the July first sample date. The dry soil could also have affected the nitrogen release rates of the study plots.

8. Economic analyses were not included in this study.

9. The results from this experiment have quantified the amount of organic matter that can be grown in place while still producing a crop in the same year for this area. This would seem of more importance now that the USDA organic rules are making certifiably acceptable compost more expensive than it has been previously.

Ideally the tillage and biomass sampling dates would be more closely spaced (weekly) and correlated to growing degree days, so that a more useful predictive model could be developed which could determine the length of the nitrate depression period for various green manure mixes at different biomass volumes and growing degree day combinations.

The experimental design would also have been improved by the inclusion of control plots with no green manure, and by having the experiment all in one field. Instead of expensive soil nitrate tests, crops could be grown in the study areas which could be tested for nitrate levels.

10. I have continued to experiment with mixtures of green manures to stabilize soil, limit weeds, and add organic matter. We plant strips in succession for continuous crop availability, yet want to keep the soil covered as much as possible. The addition of oats for reducing understory weeds by forming a winterkilled mulch and the addition of clover to increase regrowth after summer

mowing, has worked well in conjunction with the rye and vetch mixture. A spring sown mix for the same use includes oats/field pea/crimson clover. I now disc after flail mowing, then use the field cultivator because of the problem of crop trash clogging the field cultivator.

11. Outreach includes a report posted on the Beech Hill Farm website ([www.coa.edu/beecehill/](http://www.coa.edu/beecehill/)) Farm and project tour during Maine Open Farm Day on July 29, 2001 when over fifty individuals were shown the experiment. The results will be submitted to the MOFGA newspaper which reaches all of the certified organic farmers in the state.

12. Name and date *Lucian Smith 1/5/03*

| <u>Samples</u> | <u>Date</u> | <u>Sample Wt.g</u> | <u>Acre Wt.lb.</u> | <u>Cumulativ<br/>e Acre<br/>Wt.</u> | <u>Plant<br/>Composition</u>   |
|----------------|-------------|--------------------|--------------------|-------------------------------------|--|
| PVO#1          | 1-May       | 9                  | 401.7857           | 401.7857                            | winter killed<br>oats, vetch<br>4:1 ratio                                    |
| PVO#2          | 1-Jun       | 26.5               | 1183.036           | 1584.821                            | budding<br>vetch,<br>weed(shepard<br>s purse) 6:1                            |
| PVO#3          | 1-Jul       | 84                 | 3750               | 5334.821                            | pure flowering<br>vetch, little<br>chicory, chick<br>weed                    |
| RV#1           | 1-May       | 5                  | 223.2143           | 223.2143                            | rye, little<br>vetch 6:1   |
| RV#2           | 1-Jun       | 98.3               | 4388.393           | 4611.607                            | jointed rye,<br>bud vetch 3:2  |
| RV#3           | 1-Jul       | 36.4               | 1625               | 6236.607                            | rye shedding<br>pollen, full<br>flower vetch,<br>some clover<br>and s. purse |
| ROVC#1         | 1-May       | 14                 | 625                | 625                                 | rye,<br>winterkilled<br>oats with<br>vetch 1:1:0.2                           |
| ROVC#2         | 1-Jun       | 67.5               | 3013.393           | 3638.393                            | budding<br>vetch, jointed<br>rye, small<br>clover 1:1:0.1                    |
| ROVC#3         | 1-Jul       | 47.6               | 2125               | 5763.393                            | pollinated<br>rye, red<br>clover, vetch<br>1:1:1                             |