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Northern NY Agricultural Development Program
2005-2006 Project Report

The effect of $CuSO_4$ from Dairy Manure on the Growth, and Composition of Cool Season Forage Grasses and Corn

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Introduction

The use of copper sulfate ($CuSO_4$) in footbaths as a preventative maintenance for foot health has been a common practice on dairy farms for the last 10 years. In general the waste material from footbaths ends up in the manure storage system and then applied to fields. At Miner Institute, before $CuSO_4$ footbaths were employed, the manure slurry concentration of Cu was 4.8 g /1000 L. After $CuSO_4$ footbath use, the concentration of Cu reached a high of 88.6 g/1000 L in 2000. Records for manure analysis and application rates for Miner Institute over the last 10 years show single year application rates of Cu as high as 31.7 kg/ha, with 18% of annual applications of liquid manure above 4.54 kg Cu /ha. Spreading of manure slurry with high Cu concentrations may adversely impact crop growth and quality. In 2001 on average 1.93 ± 1.28 kg Cu/ha was imported on to farms surveyed in Vermont and New York (Flis *et al*., 2006). This decreased to 1.35 ± 0.75 kg Cu/ha in 2004 (Flis *et al*., 2006). For these farms the concentration of Cu (ppm) was higher in 2001 than in 2004 for both corn silage ($P = 0.04$) and haylage ($P = 0.009$, Table 1, Flis *et al*., 2006). Copper is not highly mobile in plants and toxicity affects root growth first, resulting in decreased root growth. Finally, when applied to the soil the Cu cation binds tightly to negatively charged soil particles, resulting in accumulation of Cu in the soil.

Table 1. Copper tissue concentration from surveyed farms for 2001 and 2004.

	Cu concentration (ppm)			
Forage	**2001**	**Standard Deviation**	**2004**	**Standard Deviation**
Corn Silage	11.97	6.94	6.56	2.24
Haylage	21.17	9.48	9.17	7.62

Therefore, the objectives of this study were to determine:

1. the effects of rate of application of copper sulfate from dairy manure on the establishment, growth, and quality of cool season forage grasses and corn
2. the fate of Cu applied from dairy manure containing copper sulfate in the soil.

Materials and Methods – Greenhouse Grass

Soils

Bulk soils were collected by removing the top 15 cm of soil was collected from the edges of fields for Trout River gravelly loamy sand (**sand**) and Roundabout silt loam (**silt**). The Trout River series is very deep, somewhat excessively well-drained soil formed in water-sorted deposits (USDA-NRCS). The Roundabout series is very deep, and somewhat poorly drained soils that formed in glaciolacustrine and glaciomarine deposits on lake or marine plains (USDA-NRCS). The total volume of soil collected was 0.42 m^3 for each type. After collection soil was dried at 105°C for 24 h and sifted to remove large rocks and debris. Pre-trial soil analysis was done at the UVM Agriculture and Environmental Testing Labs (Burlington, VT) on a dried soil sample. Soil was stored dry until potted.

Species Three cool season forage grasses were used; orchardgrass (*Dactylis glomerata* L.), timothy (*Phleum pretense* L.), and reed canarygrass (*Phalaris arundinacea* L.). The seeding rate used was 9, 6, and 10 lbs/acre (10, 6.7, and 11.2 kg/ha) for the orchardgrass, timothy, and reed canarygrass, respectively. After adjusting the seeding rates for the purity and germination, the seeding rate per pot was determined to be 0.037, 0.022, and 0.039 g/pot for the orchardgrass, timothy, and reed canarygrass, respectively. These seeding rates result in 35, 54, and 33 seeds per pot for the orchardgrass, timothy, and reed canarygrass, respectively.

Treatments For the 2 soil types there were 3 treatment levels with 6 replications for each of the 3 cultivars for a total of 108 pots. Treatments were 0 (**Control**), 2.27 (**Medium**), and 4.54 (**High**) kg of Cu/acre from $CuSO_4$. Soil was mixed by cultivar by treatment. Manure was added to treatments based on P requirement for establishment of a grass based on the soil test available P.

Manure Manure was colleted 1-week prior to mixing with soil and the treatment level of $CuSO_4$ was added. Copper sulfate was put into solution and mixed with the manure for each treatment level. After 1-week manure mixes were sampled and analyzed at the UVM Agriculture and Environmental Testing Labs (Burlington, VT).

Pots Soil and manure were mixed and transported to the greenhouse at Plattsburgh State University (Plattsburgh, NY). Pots were filled with 0.005 m^3 of the correct mixture. Seeding was done in the greenhouse and seeds were covered with 0.64 cm of the soil mixture and watered.

Water, Temperature and Lighting Pots received water twice daily as needed. Temperature was maintained above 13°C. Lighting was provided for a 12 h photoperiod. Due to differences in light intensity and temperature in the greenhouse, pots were rotated once a week.

Monitoring and Harvesting Percent germination of the pots was measured for two consecutive weeks after seedlings emerged. Growth was measured once weekly for each pot and recorded. Shoots were harvested when one treatment for that species and soil type reached 40.6 cm of growth or at least 7 weeks of growth after planting. Grasses were cut to leave 5.1 cm **of**

stubble for re-growth and were allowed to re-grow until one treatment reached 40.6 cm at which time the entire plant was harvested and the number of days after planting and height of each treatment was recorded. Roots were washed to remove soil, weighed, and dried at 55°C for 24 h to determine dry matter (DM) and mineral concentration. Shoots were harvested from each pot and dried at 55°C for 18-24 h to determine DM. Samples were ground to 2 mm and used to determine ash, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin (Miner Institute Forage Lab, Chazy, NY) and mineral analysis (UVM Agriculture and Environmental Testing labs, Burlington, VT). Soil tests were repeated at the end of the trial.

Statistical Analysis Analysis was performed for a treatment effect, species effect, the treatment by species interaction, and the linear effect of Cu treatment level. Differences were significant at $P \leq 0.05$ and tendencies at $P \leq 0.15$.

Materials and Methods – Corn Plots

Location, Plot size, Treatments, and Corn Hybrids Plots were located at The William H. Miner Agricultural Research Institute (Chazy, NY). Plots were 3.68 m (12', 4 rows of corn) wide and 7.62 m (25') long. Treatments were control, medium (8.1 lbs/acre or 9.12 kg/ha), and high (16.3 lbs/acre or 18.23 kg/ha). Additionally, the 3 treatment levels were tested on two corn hybrids, a short day corn (39D81 – 84 DRM, Pioneer Seeds) and a long day corn (36M28 – 103 DRM, Pioneer Seeds). Each corn hybrid at each Cu level were replicated 4 times for a total of 24 plots.

Manure Collection, Application, and Planting Approximately 105.9 L (28 gal) of manure was applied to each plot. Manure was hand applied and incorporated with a roto-tiller immediately following application. Corn was planted on May 9, 2006 in 72.6 cm (30") rows with plants within rows spaced at 17.15 cm (6.75"). At planting, 302.7 kg/ha (270 lbs/acre) of 14 – 21 – 21 + Zn was applied. Additionally, Force 3G (Syngenta) was applied for protection of early-season insect pests, including: corn rootworms, cutworms, wireworms, white grubs and seedcorn maggots. Approximately 45.7 cm 100 lbs/acre of N was also applied.

Soil Sampling A soil sample was taken on the harvest day for analysis of total P, K, Mg, Al, Ca, Zn, Na, Fe, B, Mn, Cu, and S.

Corn Measurements and Harvest Number of plants per plot was counted at the V1 stage to determine the plant population per plot. Corn height was measured at 5 different stages (V3: 9- 12 days after emergence, V5: 14 to 21 days after emergence, V6: 21 to 25 days after emergence, V13: 42 to 49 days after emergence, and R1 or silking: 63 to 68 days after emergence). At these times, days after planting, height, number of leaves, and stalk diameter were measured. Additionally, at R1, 4 plants were harvested from each plot in the center 2 rows. These plants were used for counts and measurements. At 1/3 milk line, 4 plants were harvested from each plot for dry matter determination. Corn was harvested at approximately 70 % moisture. At harvest, 10' (3.1 m) of length from the 2 center rows were hand harvested and weighed. From the plants harvested, 6 were chopped with a wood chipper and samples taken for chemical analysis of DM, NDF, ADF, lignin and CP (Miner Institute Forage Lab, Chazy, NY) and mineral analysis (UVM Agriculture and Environmental Testing labs, Burlington, VT).

Statistical Analysis Analysis was performed for a treatment effect, hybrid effect, the treatment by hybrid interaction, and the linear effect of Cu treatment level. Differences were significant at $P \leq 0.05$ and tendencies at $P \leq 0.15$.

Results and Discussion

Greenhouse Grass The method for seeding the pots resulted in poor germination and growth in the silt loam soil regardless of Cu treatment level. Based on this result, the silt loam treatments will be repeated beginning in November of 2006. Additionally, the reed canarygrass grown in the sand soil was cut too short at the first harvest and did not re-grow for the second harvest. Therefore, results are the comparison of the orchard grass and the timothy grown in the sandy loam soil only.

Tillering rate and re-growth rate both decreased as copper application level increased regardless of grass species (Table 2). A linear treatment effect was observed for harvest 2 number of shoots and the tillering rate from harvest 1 to harvest 2 (Table 2, Figure 1a). Additionally, there was a decreased shoot yield and dry root weight with increased copper application level (Table 2). A linear effect of Cu treatment on root dry weight suggests that there is a decrease root dry weight as the Cu treatment level increases (Figure 1b).These effects may result in a decrease in the longevity of the stand and an overall decrease in yield. There may be concern for a larger decrease in re-growth rate and yield in drought conditions due to the decrease in root dry matter with increased Cu application rate.

The Cu concentration of the shoots tended to increase in copper concentration with increased Cu application (Table 3). Additionally, there was a significant linear effect of Cu treatment level on Cu concentration in the shoots, with Cu concentration in the shoots increasing as Cu treatment level increases (Table 3, P =0.06). However, the Cu concentrations observed are with in the normal range for crop plants (0 – 50 ppm, Epstein and Bloom, 2005).

There was only a numerical increase in the Cu concentration in the roots with increased Cu application (Table 4). Overall, the Cu concentration in the shoots was lower than in the roots, 33.2 vs. 66.6 ppm, respectively. This is expected because Cu is a mineral that is generally sequestered in the roots (Epstein and Bloom, 2005).

Corn Plot Study There was no effect of copper treatment level on plant number per plot, total harvest weight, number of plants harvested, or the weight per plant harvested (Table 5). Long-term studies with the application of high Cu swine manure have consistently reported no effect of the level of Cu application on corn grain or silage yields (Mullins et al., 1982; Sutton et al., 1983; Payne et al., 1988a; and Payne et al., 1988b).

There was no effect of Cu treatment level on harvest DM or the Cu concentration of the plants (Table 6). Copper concentration in the corn was within the normal range for crop plants andmuch lower than the grass shoot Cu concentrations. Studies with long-term application of high Cu swine manure have consistently reported leaf or grain Cu concentrations that were not outside expected values (Mullins et al., 1982; Sutton et al., 1983; Payne et al., 1988a; and Payne et al., 1988b).

There was a significant effect of copper treatment on total soil Cu concentration (Table 7). This effect is further explained by a significant linear effect of treatment on soil Cu concentration (Figure 2). As expected the total soil Cu concentration increased as the copper treatment level increased. The difference in the Cu applied per acre and the difference of the soil test lbs/acre is approximately the removal of Cu in the shoots of the corn (3.7 and 1.9 lbs/acre removal from the soil for the medium and high Cu treatments, respectively, Table 8). This indicates that the only loss of Cu from the soil is from plant removal and with one application at these rates there is no leaching of Cu.

Conclusions and Further Research

A single high application of Cu appears to have greater effect on grass growth and yield than corn growth and yield. From the results reported here it appears that one year of application of at least 16 lbs/acre of Cu from dairy manure is not a concern for growth, yield, or plant Cu concentration. However, continued research is needed on the effect of multiple high application rates on corn since a single application of dairy manure to corn land is not a common practice.

Additionally, the method of soil analysis for Cu needs further examination. Differences in soil Cu concentration were observed in the corn soil samples when total mineral digestion was performed, but the typical test for soil is an extraction on available minerals which may not be showing actual increases in soil Cu loading.

Education and Outreach. Results of this research will be published in the monthly Miner Institute Farm Report, with readership of over 10,000. This newsletter is not copyrighted, and articles are often used by farm newspapers and county Cooperative Extension publications. Sally Flis presented these results on December 20, 2006 at a producer meeting for Carovail, Inc. (Salem, NY)

Northern NY Agricultural Development Program
2006 Project Report

Factors Affecting Milk Component Production in NNY Dairy Herds

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Farmer participants:

70 farms in NNY.

Background: The sale of milk protein and fat is the main income source for commercial dairy producers. At least one survey has indicated that the percentages of milk components is slightly lower in NNY than in other regions of the state. Numerous factors have been shown to influence both the amount and level of milk components. Our plan is to characterize the nutrition, cows and management of herds with both high and low levels of milk components. The objective is to identify factors that have the greatest influence on component production, and then to disseminate this information throughout NNY.

Methods: This past year we worked out the data collection protocols, specific analyses to be run on feedstuffs, and type of statistical analysis to perform. These nutritional, cow, and management variables will be evaluated by a statistical model in an effort to determine which variables are most influential on milk components.

Results: We received surplus funds to start this research project and try to streamline our data collection and analysis. Our goal was to visit and collect data from 20 NNY dairies with these funds. Unfortunately, the amount of time that I could dedicate to this project was much less in 2006 than I had anticipated. Briefly, I had committed to a transition cow trial using brown midrib corn silage at Cornell's Teaching and Research Center. This project started later and lasted longer than I had anticipated, and it took what limited time I have had available for research. This resulted in only two dairies being evaluated in 2006. We utilized the remaining NNY funds to prepay Dairy One for part of this year's sample analyses.

We had budgeted for a total of 70 dairies to be evaluated, and this remains our goal for 2007. We do have a plan for making this happen. First, the corn silage trial will be done by mid-February.

Secondly, I (Bill Stone) am taking a position in private industry, and will be providing technical support for nutritionists and veterinarians in the eastern part of the US, but with a strong emphasis on the northeast. I have discussed this project with my future employer (Diamond V Mills) and the interest I have in it. They have been fully supportive, and have told me I can dedicate the necessary time to it. All funds will remain at Cornell University and will be administered by the study's co-investigator, Dr. Larry Chase.

Northern NY Agricultural Development Program
2006 Project Report

Nitrogen Needs for Corn Following Grass/Legume Sods

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Cooperating Farms
- **Mike Kiechle** (Jefferson County)
- **Dave Fisher** (St Lawrence County).

Background:

Nitrogen prices and environmental concerns have caused many corn producers and advisors to rethink their current N management practices. From 2002 to 2004, laboratory and field trials were conducted in NY (including sites in St Lawrence, Jefferson, Essex, and Clinton County) to evaluate the performance of a new soil N test, the Illinois Soil N Test (ISNT, also referred to as the aminosugar N test) in identifying whether or not additional N is needed. This work showed great promise for the test in New York and has led to the development of critical ISNT values beyond which additional N from manure or fertilizer is not likely to result in a yield response. But, additional field trials needed to be conducted specifically focusing on N needs for corn in a corn-sod rotation.

Methods:

In 2006, we conducted 5 field trials; four second year corn sites (continuation of 2005 trials) and one new first year corn site. For the on-farm trials in St Lawrence and Jefferson County, each trial had 4 treatments (starter N only, starter plus 50, 100 or 150 lbs N/acre) in 4 replicates per treatment. In Willsboro, a fifth treatment was added: no N (no starter, no sidedress N). Each plot was 4 or 6 rows wide (depending on the planter) and 50 feet long. Soil samples were be taken at PSNT time and at harvest (0-8 and 0-12 inch samples) and analyzed for the standard soil fertility package and soil nitrate. Chlorophyll tests were done when the corn was in the 5 leave stage to assess potential N deficiency, and repeated at harvest. Plots were harvested for silage (2 rows of 40 feet each) and sub-samples were taken to determine moisture content, stalk nitrate, N removal and silage quality. Trials were located in St Lawrence (two trials), Jefferson, and Essex Counties

(Willsboro Research Farm). The "Essex 3" site was the only first year corn field. Three of the second year corn sites were low in potassium. For these sites additional K was applied (based on 2005 soil tests) to assure that K would not be a limiting factor for corn growth either.

Results:

Yields and Optimum Economic N Rates:

Yield results are shown in Table 1. The first year corn field at Willsboro and the two sites in St Lawrence County did not respond to additional N. Second year corn fields in Jefferson and Essex County were responsive to sidedress N application.

Table 1: Silage yields and moisture contents for the 5 Northern New York trials. All but one (Essex 3) were second year corn fields following sod turnover.

N Rate	Silage Yield (tons/acre 65% moisture)				
	St Lawrence 1	St Lawrence 2	Jefferson	Essex 1	Essex 3
No N				9.9 c	20.2 a
Starter N only	22.2 a	21.9 a	12.4 b	12.6 bc	20.9 a
Starter + 50 lbs N	23.1 a	24.4 a	14.0 ab	15.2 ab	22.1 a
Starter +100 lbs N	22.0 a	23.0 a	15.5 ab	18.5 a	23.5 a
Starter +150 lbs N	21.5 a	21.8 a	16.8 a	17.1 a	22.9 a
	Moisture Content at Harvest (% moisture)				
No N				54.7 a	54.8 a
Starter N only	60.6 a	63.0 a	66.0 a	52.7 ab	55.3 a
Starter + 50 lbs N	62.5 a	62.3 a	65.9 a	51.6 ab	54.8 a
Starter +100 lbs N	63.9 a	63.6 a	67.5 a	49.1 b	55.8 a
Starter +150 lbs N	63.4 a	63.6 a	67.6 a	51.0 ab	53.9 a

†Average values with different letters (a,b,c) are statistically different ($\alpha = 0.05$)

In the 2006 growing seasons, four 2nd year corn trials were conducted in NNY. Only two of these four trials showed a response to additional N small (~30 lbs N/acre) starter application. These sites were Essex 1 (2006), and Jefferson County (2006). The optimum economic N rate in Essex 1 was 135 lbs N/acre (30 in starter, the rest as sidedress N) assuming $0.40/lb N and a silage value of $35/ton (Table 2). The Jefferson County site was hit by a hail storm in July and the response may be partially a result of the damage suffered by the crop.

Table 2: Optimum economic N rates (30 lbs/acre starter plus side-dress N) for Essex 1. Under current price structure of $0.40/lbs of N and $35 corn value, the optimum economic N rate was about 135 lbs N/acre (30 lbs N/acre as a banded starter and 105 lbs N/acre sidedressed).

Essex 1		Fertilizer Price ($ per lbs of N)			
2006		$0.20/lbs N	$0.30/lbs N	$0.40/lbs N	$0.50/lbs N
Forage Value ($ per ton)	$25/ton	140	134	129	123
	$30/ton	142	137	133	128
	$35/ton	143	139	135	131
	$40/ton	144	141	137	134

Forage Quality

Neutral detergent fiber (NDF), digestible NDF (dNDF), lignin and starch were not impacted by N application rate except for higher dNDF and lower lignin without starter N in the 2nd year corn site in Essex County (Table 3). Protein increased with N addition, consistent with 2005 results.

Table 3: Impact of N application on crude protein and soluble protein for the 5 Northern New York trials in 2006.

	St. Lawrence 1	St. Lawrence 2	Jefferson	Essex 1	Essex 3
	2nd year corn	2nd year corn	2nd year corn	2nd year corn	1st year corn
	Non-responsive	Non-responsive	Responsive	Responsive	Non-responsive
	NDF (% of DM)				
No Starter				43.8 a	43.1 a
0	40.8 a	41.8 a	49.6 a	46.5 a	43.1 a
50	41.9 a	40.6 a	43.3 a	46.4 a	42.1 a
100	41.5 a	41.4 a	45.2 a	46.5 a	44.8 a
150	41.5 a	41.8 a	44.6 a	43.4 a	42.1 a
	dNDF (% of DM)				
No Starter				68.9 a	59.9 a
0	64.8 a	60.7 a	71.2 a	65.5 ab	61.3 a
50	64.5 a	60.6 a	71.3 a	65.7 ab	61.1 a
100	65.2 a	60.7 a	71.2 a	62.8 b	59.5 a
150	64.8 a	59.2 a	70.8 a	64.4 ab	60.6 a
	Lignin (% of DM)				
No Starter				2.9 b	3.5 a
0	3.1 a	3.2 a	3.2 a	3.1 ab	3.5 a
50	3.3 a	3.2 a	2.9 a	3.3 a	3.5 a
100	3.3 a	3.2 a	3.1 a	3.5 a	3.8 a
150	3.3 a	3.3 a	3.1 a	3.4 a	3.5 a
	Starch (% of DM)				
No Starter				34.2 a	33.2 a
0	35.0 a	35.1 a	25.0 a	32.1 a	33.2 a
50	32.1 a	36.1 a	30.5 a	32.4 a	32.7 a
100	32.1 a	34.9 a	27.1 a	32.3 a	29.9 a
150	31.6 a	34.4 a	27.7 a	34.7 a	31.9 a
	Crude Protein (% of DM)				
No Starter				4.9 a	6.3 b
0	6.5 b	6.3 d	5.4 c	5.0 a	6.3 b
50	7.3 ab	6.8 c	6.4 b	5.1 a	7.0 ab
100	7.5 a	7.2 b	7.8 a	5.5 a	7.0 ab
150	7.8 a	7.4 a	8.0 a	5.8 a	7.3 a
	Soluble Protein (% of DM)				
No Starter				1.2 a	1.3 b
0	1.6 a	1.6 a	1.2 c	1.1 a	1.3 b
50	1.8 a	1.7 a	1.5 b	1.2 a	1.5 a
100	1.8 a	1.7 a	1.7 a	1.2 a	1.5 a
150	1.8 a	1.7 a	1.8 a	1.3 a	1.5 a

†Average values with different letters (a,b,c) are statistically different ($\alpha = 0.05$).

Milk per Ton and Milk per Acre

Milk per acre and milk per ton are predictions of milk production based on forage quality and yield parameters developed by researchers at the University of Wisconsin's (Milk2006 program). The slight increase in crude protein and soluble protein did not result in an increase in estimated milk production per ton of silage (milk per ton) (Table 4). Significant differences at Essex 1 indicate the decrease in yield at lower N application rates. Despite the yield response at the Jefferson County there was no significant change in overall forage quality across the N application rates although a trend is clearly visible. This might be a result of the hail damage and an additional year of field trials at this location is needed to determine responsiveness to N.

Table 4: Impact of N application on estimated milk per ton and milk per acre for the 5 Northern New York trials in 2006†.

	Milk per Ton (lbs/ton)				
	St. Lawrence 1	St. Lawrence 2	Jefferson	Essex 1	Essex 3
	2nd year corn	2nd year corn	2nd year corn	2nd year corn	1st year corn
	Non-responsive	Non-responsive	Responsive	Responsive	Non-responsive
No Starter				3417 a	3259 a
0	3403 a	3319 a	3171 a	3229 a	3291 a
50	3325 a	3355 a	3368 a	3257 a	3303 a
100	3363 a	3328 a	3298 a	3166 a	3163 a
150	3351 a	3283 a	3334 a	3300 a	3239 a
	Milk per Acre (lbs/acre)				
No Starter				11844 c	23081 a
0	26600 a	25395 a	13828 a	14238 bc	24042 a
50	26944 a	28641 a	16485 a	17280 ab	25502 a
100	25946 a	26872 a	17876 a	20545 a	25983 a
150	25188 a	25072 a	19584 a	19753 a	25992 a

†Milk per ton and Milk per acre were calculated using the U. of Wisconsin's Milk2006 program.

Tools for N Management:

Pre-Sidedress Nitrate Test

The PSNT results predicted a need for addition N for all of the 2006 sites. However, only two of the sites (Jefferson and Essex 1) showed a response to sidedress N and the PSNT identified only these two sites correctly. The inaccuracy of the PSNT in 1st year corn is well documented, but the test is generally more reliable in the 2nd year and beyond than our 2nd year corn results from 2006 suggest. This might have been due to the large amount of rainfall in the spring of 2006, making it difficult to obtain reliable PSNT samples.

Chlorophyll at PSNT Time

A new procedure for chlorophyll testing to predict the need for sidedress N fertilizer developed by Penn State (Beegle and Piekielek) recommends no additional N if the first reading at the 6 leave stage is 46.0 or greater. For sites with readings below 42.0, sidedress N is recommended and for sites between 42.0 and 45.9, a second reading is recommended 4-7 days later for corn at the 7-8 leaf stage. If for this second reading, values are 43.0 or greater, no additional N is needed. It was not feasible to do repeated measurements but based on the one time reading, all of the 2006 sites would have called for additional N. Yield results indicate that only 2 of the sites were responsive to additional N at sidedress time. Hence, more work is needed to determine critical values for NYS if the test is found to be useful over multiple years.

Stalk Nitrate Test

Current interpretations of this test at Penn State suggest N deficiency if the stalk nitrate test is <700 ppm, optimum N management for 700-2000 ppm, and excess N if >2000 ppm (see http://www.aasl.psu.edu/Corn%20stalk%20nitrate%20interpretation.pdf). The five NNY sites showed a wide range of stalk N values; however, at all sites except Essex 1 there was a clear trend with increasing stalk N values as side-dress rates increased. None of the non-responsive sites showed a sufficient level of N at the no side-dress rate based on Penn State interpretations suggesting critical stalk nitrate ranges need to be developed for New York.

Chlorophyll at Harvest Time

The chlorophyll tests at harvest showed low levels for the two responsive 2nd year corn sites. An impact of N addition of chlorophyll in the ear leaves was observed in the other sites but for these non-responsive sites chlorophyll values at 0 N were high indicating that N was not limiting.

End-of-Season Soil Nitrate Test

End-of-season nitrate levels were very low for all trials. This is an indication of the wet year we had and provides evidence that any fertilizer N not taken up by the plant was lost to the environment by the end of the growing season.

Combined Results from 2005 and 2006

First Year Corn

Combining 2005 and 2006, six 1st year corn trials were conducted in NNY. These trials combined with ten others from around NYS showed no yield or forage quality response to sidedress N (Table 5). We concluded that first year corn does not require any additional N beyond the starter. This implies that there is no need to use any N management tools such as the PSNT, chlorophyll, or ISNT. For those that would normally sidedress first year corn, this could mean substantial savings in fertilizer costs and application costs (a minimum of $30-$40/acre).

Table 5: Overall yield and quality of 1st year corn.

	On-farm Sites (16 sites)		Research Farm Sites (3 sites)	
N Sidedress Rate	Corn Silage Yield (35% DM)	Milk per ton	Corn Silage Yield (35% DM)	Milk per ton
lbs N/acre	tons/acre	lbs/ton	tons/acre	lbs/ton
No Starter	.	.	19.6 b	3199 a
0	21.7 a	3193 a	21.1 ab	3195 a
50	22.2 a	3234 a	21.5 a	3257 a
100	22.4 a	3214 a	22.6 a	3194 a
150	22.4 a	3211 a	22.1 a	3168 a

†Average values with different letters (a,b,c) are statistically different ($\alpha = 0.05$)

Second Year Corn:

Combining 2005 and 2006, five 2nd year corn trials were conducted in NNY of which 2 were responsive to additional N and three were not. If we combine this with seven other trials from around NYS, we have a total of 7 non-response and 5 responsive sites. The range of responsive 2nd year sites and the difference in the calculated recommended N rate vs. the optimum economic N rate makes it clear better tools are needed to identify 2nd or 3rd year corn sites that are likely to be responsive. Since our trials only resulted in 5 responsive sites we will continue this work in 2007 on 2nd and 3rd year corn fields in NNY in order to gain more data on responsive sites.

Table 6: Reported yield potential and N needs vs. actual yield and optimum economic N rate.

	Recommended N Rate[1]	Optimum Economic N Rate[2]	Yield Potential[3] (35% DM)	Actual Yield[4] (35% DM)
	lbs N/acre	lbs N/acre	tons/acre	tons/acre
St. Lawrence 1	102	0	21.3	21.2
St. Lawrence 2	102	0	21.3	21.7
Jefferson	91	.	23.0	16.3[5]
Essex 1 (2006)	74	135	18.7	17.6
Essex 2 (2005)	74	140	18.7	25.0

[1] Required N based on N rate (lbs/acre) = [(Yield Potential*1.2) – Soil N – Sod N] / (N efficiency/100) assuming sod credits in year 2 following sod turnover.
[2] Optimum Economic N Rate based on a forage value of $35 per ton and $0.40 N cost.
[3] Yield potential is based on soil type and drainage.
[4] Actual yield is averaged for non-responsive sites and yield at the optimum economic N rate for responsive sites.
[5] This site was damaged by hail.

<u>ISNTxLOI</u>

The ISNT x LOI OM critical value curve worked very well in predicting the N needs of 2nd year corn, accurately predicting all sites in Northern NY and 11 out of 12 2nd year sites state-wide, with the one incorrect site having severe weed pressure which may have lead to its side-dress response. This is very encouraging for the potential of adopting the ISNT x LOI OM for predicting N response in corn sites that are in their 2nd year or beyond. The ISNT was more accurate than the PSNT in predicting a response to side-dressing for 2nd year corn which indicates the benefit of measuring a much more stable fraction of N with the ISNT that is not affected by precipitation around the time of sampling.

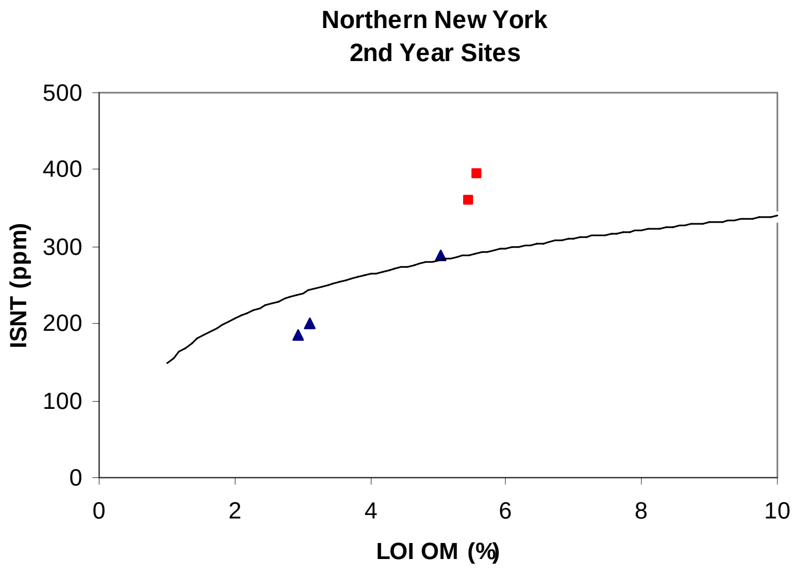

Figure 2: ISNT values of five 2nd year corn sites in Northern New York. Red squares represent non-responsive sites. Blue triangles are responsive sites.

Conclusions/Outcomes/Impacts to Date:

We conclude that no additional N beyond a starter is needed for first year corn. Given current prices for fertilizer in general and N fertilizer specific, this implies a potential for substantial economic savings of $30-$40/acre at a minimum. The ISNTxLOI test seems promising but the 2007 data need to be included for a final evaluation. The stalk nitrate test shows direct responses to N application but additional sites are needed to determine critical levels. End-of-season nitrate tests can be used to determine nitrate loss during the season and potential nitrate loss following harvest. Chlorophyll at harvest was useful in separating responsive from non-responsive sites but for this test, additional work is needed as well.

Outreach:

Results will be presented in the form of extension articles (upcoming editions of What's Cropping Up? and Northeast Dairy Business February issue as well as local extension newsletters) and through extension presentations (February 28, Corn Congress at the Miner Institute; March 14, 15 Winter Meetings for Jefferson and St Lawrence Counties). In addition, talks about the project were given at the 2006 Field Crop Dealer Meetings (200+ people). We developed a survey to be conducted at the upcoming winter meetings as well. A fact sheet on N needs for first year corn was developed and posted on the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu/publications/factsheets.asp). A postcard and this fact sheet will be distributed at the winter meetings and through mailings. One of the producers will be interviewed by Northeast Dairy Business for an article in the February issue of Northeast Dairy Business and an impact statement is being developed for the farm as well. For further information about our NNY extension projects, see: http://nmsp.css.cornell.edu/projects/nny.asp.

Next steps:

Additional site years are needed to evaluate and derive critical values of current tools to predicted N responsiveness.

Acknowledgments:

This project was funded with a grant from the Northern New York Agricultural Development Program with additional support from the New York Farm Viability Institute (graduate student stipend).

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Northern NY Agricultural Development Program
2006 Project Report

Best Management Practices for the Use of Dairy Manure; Towards Calibration of the Phosphorus Runoff Index in Northern NY

Project Leader

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Project Coordinator

- **Greg Godwin,** Dept. of Crop and Soil Sciences, Cornell University

Collaborators

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- **Karl Czymmek**, PRODAIRY, Cornell University
- **Mike Davis**, E.V. Baker Research Farm, Cornell University

Cooperating Farms

- **Miner Institute** (Clinton Co.)
- **Dave Fisher** (St Lawrence Co.),
- **Chris Baker** (Lewis Co.),
- **Jeff Zimmer** (Jefferson Co.)
- **Judy Pierce** (Jefferson Co.)
- **Elmer Dart** (Jefferson Co.)
- **Alan Hunter** (Jefferson Co.)
- **Art Baderman** (Jefferson Co.).

Background

Environmental regulations, high fertilizer prices, improved manure handling and storage technologies, and steadily increasing animal densities on farms force us to re-examine manure management. Maintaining a high quality, high yielding crop has always been a priority for farmers. We must now work to sustain those yields while minimizing the potential for nutrient loss while providing farmers a set of management options that allows manure to be most efficiently used.

The greatest concern in applying manure is typically the fate of phosphorus (P) and nitrogen (N). These elements are macronutrients that are needed in large quantities so producers want to ensure these nutrients are readily available for crop uptake. But, both N and P could be potential pollutants if lost from the farm fields and transported to surface and/or groundwater. It is critical to understand the potential environmental loss pathways of these nutrients as minimizing loss through one pathway may lead to increasing losses through others. For instance, surface application of manure without incorporation may reduce N leaching but increase P accumulation and/or P runoff. Incorporation of manure may reduce P runoff but if amounts are not adjusted, it may lead to increase N leaching.

Our project has three components: (1) assessment of the amount of P needed to raise soil test P levels (related to a soil's storage capacity for P); (2) runoff versus leaching losses in tile drained systems; and (3) development of outreach materials on soil fertility management.

Phosphorus Runoff and Tile Drainage Project

Methods: Our primary objective for this study is to quantify losses of P and N in tile lines and surface runoff while evaluating the effects of manure application on orchardgrass yield, quality and nutrient uptake. We established 12 large (60' x 500') orchardgrass plots designed to collect runoff and drainage water on the Willsboro Research Farm. Baseline measurements for these plots collected in previous years include general fertility of topsoil, depth profiles, orchardgrass yield and quality, analysis of leachate samples collected from the lysimeter plot manhole sites and rainfall runoff simulations. Yields and analysis of leachate from natural flow were continued in 2006. The dates of these events are summarized in Table 1. Flow rate measurements taken in the spring combined with the flow histories of the plots enabled us to identify plots with similar flow characteristics. Three plots were chosen to receive each of three treatments for rainfall simulation runoff and leaching measurements. A control treatment received only inorganic fertilizer. The other two treatments involved the application of manure at a rate of 5000 gallons per acre (providing 25 lbs/acre P) in addition to the inorganic fertilizer. For one treatment, an Aerway soil aerator was run over the plot prior to manure application. Manure was applied to undisturbed ground for the final treatment. Manure was applied only within the area of the runoff frames. Manure treatments were applied after each cut. Rainfall simulations were performed from 4 to 6 days following the application.

The protocol followed for the rain simulation was modified from the protocol developed by the National Phosphorus Project. The equipment used and rainfall rates followed the protocol. For this experiment we did not saturate the soil the day prior to the rainfall simulation and each treatment was only rained on once. For the simulations following the first cutting, rain was applied at a rate of 125 ml/sec until runoff occurred. Water samples were collected from paired plots during simulated rain events with the sample collection lasting 30 minutes from the time of initial runoff. Samples were submitted to the Cornell Nutrient Analysis Laboratory for nitrate nitrogen and elemental analyses. During the simulation, all flow from the tile drain in the plot was weighed and retained to determine flow rate and total volume recovered. Samples were taken at 5 minute intervals for analysis. A bulk sample collected over the entire event was also obtained. Following the second cutting only drainage water was sampled. Due to dry soil conditions at that time, there was no runoff, characteristic for the soil type and summer weather conditions in NNY. The time of the rainfall event was standardized to 1.5 hours for treatments in plot 7. It was increased to 2.5 hours for plot 8 but even with this rainfall duration, no drainage occurred in plot 2. Prior to rainfall simulations, 8" soil samples were taken within the plot. Sample holes were plugged to prevent preferential flow. A hand harvest was performed with in the runoff frames at the second cutting.

Preliminary Research Results (Method Development):

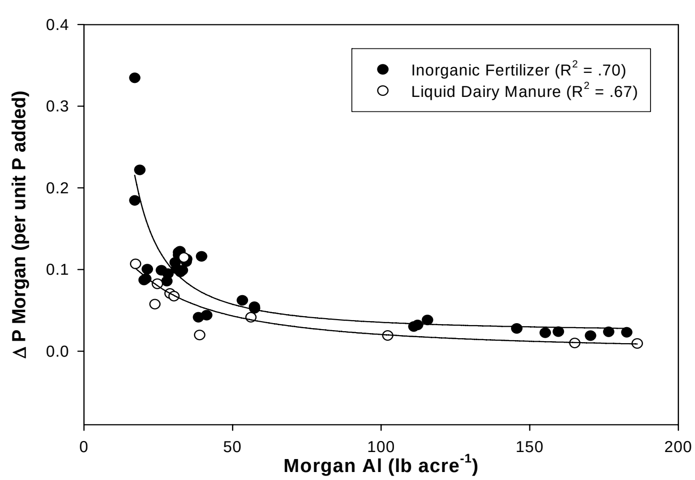
Yields: First and second cut yields of the larger plots (no manure applied) are shown in Table 2. The average 2006 yield was 3.88 tons of dry matter per acre, less than previous years. The yield reduction is primarily due to an early second cut. Yields and forage quality were very similar between plots, identifying uniformity of the plots.

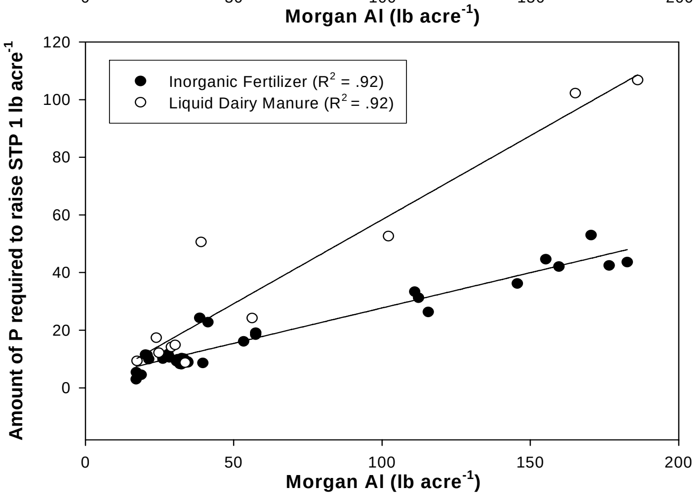
Leaching data – natural flow: Concentrations of phosphorus in water from the tile drains were very low throughout the season, as shown in Table 3. The concentration in the leachate does not appear to be related to the soil test P levels. The low levels of P and nitrates (Table 4) in the leachate allow us to choose plots for our rainfall simulations by flow rate, not soil nutrient levels.

Runoff data: The amount of rainfall needed to cause runoff varied greatly between plots, as did the volume of runoff (Table 5). The N and P concentrations in the runoff were more consistent (Table 6). When adjusted for source water N (0.304 mg N/L) and P (0.373 mg/L) concentration the net N and P loads were extremely low. Similar results were seen in the 2005 rainfall simulations at this site.

Leaching data: As with runoff, the amount of rainfall required to initiate flow from the tile lines was highly variable. Tile flow began as soon as 23 minutes after the rain simulation commenced. With the drier conditions in the fall tile flow took as long as 1 hour 43 minutes to begin. Phosphorus loss through the tile line was low overall, but was significantly higher for the plots that received manure (Table 7). Nitrate concentration levels in the leachate were higher in the manured plots (Table 8) but below the EPA limit of 10 ppm for drinking water. Average concentrations of P and nitrates were similar to concentrations at peak flow.

Phosphorus Accumulation Project





We conducted incubation studies using NNY soils to determine the efficiency of liquid dairy manure, NH_4HPO_4, and $Ca(H_2PO_4)_2$ in raising M-P and M3-P levels and the degree to which initial P and extractable Al impact the efficiency of applied P. The results are shown on the left. This work shows that (1) soils with high Morgan extractable Al levels need more P to achieve the same Morgan soil test P increase as a soil with lower Al levels; and (2) manure is less efficient in raising soil test P than fertilizer and equal total P levels. Our results suggest that the New York P index should account for the higher P sorption capacity of soils inherently high in extractable Al. Additional work will be done in 2007 to expand this dataset with more NNY soil series (samples were collected in fall 2006) and multiple P sources (different fertilizers).

Agronomy Fact Sheets

Pete Barney, St Lawrence County:

- Agronomy Fact Sheet # 8: Starter Phosphorus Fertilizer for Corn (10/22/2005)
- Agronomy Fact Sheet # 15: Phosphorus Soil Testing Methods (9/30/2006)
- Agronomy Fact Sheet # 20: Establishment & Management of Switchgrass (12/18/2006)

Mike Hunter, Jefferson County:

- Agronomy Fact Sheet # 7: Liming Materials (7/21/2006)
- Agronomy Fact Sheet # 21: Nitrogen Needs for First Year Corn (12/18/2006)

Jen Beckman, Lewis County:

- Agronomy Fact Sheet # 5: Soil pH for Field Crops (11/11/2005)
- Agronomy Fact Sheet # 6: Lime Recommendations (3/4/2006)

Conclusions/Outcomes/Impacts

Our measurements to date have provided us with a categorization of the lysimeter (drainage) plots at the Willsboro research farm. Initial runoff and leaching data showed very low levels of P movement over the surface and through the profile of the plots. Nitrate leaching to the tile line appears to be the area of greatest concern following manure application under 2006 conditions but additional measurements are needed.

Outreach

The rain simulator and leachate study was presented during the July 25 Field Day Open House attended by farmers and others. It was shown again as part of a farm tour for the Cornell EV Baker Research Farm Oversight Committee on July 26. Seven agronomy fact sheets were developed in collaboration with NNY CCE field crops extension educators.

Next steps

We will continue to measure orchardgrass yield and quality in 2007 in the 12 main plots and within the 9 runoff frames that receive treatments. We will install our runoff frames in plots 4, 5 and 6. These plots have slightly greater slopes and higher natural drainage rates. This should improve our runoff rates and our ability to generate flow in the tile lines. Rainfall simulations will be performed after each cutting. Both surface runoff water and leachate samples will be collected after manure application following 1st and 2nd cut. A new incubation study is currently ongoing and additional fact sheets will be written.

Acknowledgments

This work was funded by the Northern New York Agricultural Development Program. We thank Ev Thomas, Peter Barney, Mike Hunter and Jen Beckman for collecting soils for the laboratory incubation study. Soils came from the Miner Institute (Chazy, Clinton Co.), Canton Extension Farm and Dave Fisher (Canton, St Lawrence Co.), Chris Baker (New Bremen, Lewis Co.), Jeff Zimmer, Judy Pierce, Elmer Dart and Alan Hunter (Alexandria, Jefferson Co.) and Art Baderman (Rodman, Jefferson Co.).

Northern NY Agricultural Development Program
2006 Project Report

Nutrient Accounting for NNY Dairy Farms
Basis for Environmentally Sound Nutrient Management

Project Leaders:

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- **Larry Chase**, Department of Animal Science, Cornell University

Project Coordinator:

- **Caroline Rasmussen**, Dept. of Crop and Soil Sciences, Cornell University

Collaborators:

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- Cornell Cooperative Extension:
  - **Jen Beckman** (Lewis County)
  - **Julie Viveiros** (Clinton County)
  - **Matt Cooper** (Franklin County)
  - **Karl Tillinghast** (Franklin County)
  - **Pete Barney** (St Lawrence County)
  - **Mike Hunter** (Jefferson County)
  - **Amy Ivy** (Clinton County)
  - **Anita Deming** (Essex County)
- Miner Institute:
  - **Ev Thomas,** Vice President, Agricultural Programs
- Agricultural Industry:
  - **Peg Cook,** Cook's Consulting

Participating Farms:

- 22 farms in the 6 county region.

Background:

Our overall goal is to improve farm profitability while protecting the environment. Having a clear understanding of the imbalances between farm nitrogen (N), phosphorus (P) and potassium (K) imports and exports and the causes of these imbalances is necessary for the development of best management practices that address nutrient accumulation and aid in achieving long-term sustainability of the dairy and livestock industry in the Northern New York region. This project is in its second year. This project provides an assessment of the current status of N, P and K balances for the 11 Northern New York farms that participated in 2004/2005 and the 22 farms that participated in 2006. This assessment will facilitate evaluation of management opportunities that could lead to improved whole farm nutrient balances and hence reduced risk of losses to the environment over time. The database will be expanded with 20 continuing farms and 6 new farms in 2007 (2006 farm data). Once expanded upon with these additional farm years the database will include 11(2004), 22 (2005) and 26 (2006) farms for a total of 59 farm years of which we hope to have 9 farms that participated all 3 years and an additional 20 farms for which we have 2 years of data. This 3-year dataset will then be analyzed to determine what management decisions drive (im)balances and what the realistic opportunities are for nutrient use efficiency in Northern New York farms.

Methods:

We assessed farm N, P and K balances for Northern NY farms using an Excel software program "Mass Nutrient Balance" v.3 (http://nmsp.css.cornell.edu/projects/massbalance.asp). The Mass Nutrient Balance takes into account nutrients (N, P and K) inputs (feed, fertilizer, N fixation, bedding, animals) and exports (milk, animals, crops, manure) and inventories (feed, fertilizer). The software and the analysis were refined in 2006 in response to experiences in the first project year and input from participants and extension educators. The updated version of the Mass Balance calculator was expanded to include:

- Number of farm acres receiving manure;
- N, P and K composition of farm produced feeds;
- Manure application to legume crops;
- Number of mature cows.

Caroline Rasmussen worked with CCE field staff and consultants to collect and analyze the farm balances. Twenty-two farms were completed (six in Lewis, six in St Lawrence, three in Franklin, three in Clinton, and two each in Jefferson, and Essex Counties). Of the eleven farms participating in 2005 (data collection year 2004), nine continued to participate in 2006 (data for 2005 calendar year). All farms received a farm-specific report as well as an assessment of how their farm compared to others included in the project. Those farms that participated for 2 years received a progress report, comparing their year one and year two results.

Results:

General farm characteristics: The twenty-two farms varied in size from 38 to 475 milking cows representing animal densities of 0.19 to 1.05 animal units[1] per acre. Milk production ranged from 1,607 to 13,489 lbs of milk per acre and from 12,602 to 26,514 lbs of milk per cow per year. One of the participating farms had a beef cow-calf enterprise in addition to the dairy cows. Crop and tillable pasture acres ranged from 100 to 1,200 acres. Ten of the twenty-two farms sold crops off the farm. The percentage of purchased feeds (percentage of all livestock feed on a dry matter basis) ranged from 4% to 54%. General farm characteristics are shown in Table 1.

Nitrogen balances*:* Nitrogen balances are shown in Table 2. The percentage of N imported that did not leave the farm through exports of milk, animals, crops, and/or manure ([imported N–exported N]/imported N) ranged from 18 to 84%. The total annual lbs of N per acre "remaining" ranged from 10 lbs to 196 lbs N/acre N (Fig. 1).

[1] One animal unit equals 1000 lbs.

Purchased feed and fertilizer accounted for the bulk of N imported onto these farms. Together these major contributors accounted for 78% of all N imports (Table 3 and Fig. 2). On all of the farms except one, the largest N export was in the form of milk sales. On average, milk accounted for 78% of all N exports on these farms. The major N export vehicle for one farm was crop sales. None of the farms currently export manure. The N contribution from fixation by legumes was estimated from legume crop acreage, yield and crude protein content. Nitrogen fixation accounted for 5 to 46% of the total N imports on the farms.

Phosphorus balances: The study farms imported 0.14 to 16.03 tons more P than they exported annually (Table 4). The percent P remaining varied from 14 to 82%. As with N, milk was the major P export item on all of the farms expect one. Feed and fertilizer accounted for most of the P imports. The P remaining (imports – exports) per acre of tillable crop and pasture, varied from 1 to 28 lbs P/acre (Fig. 3).

Potassium balances: One case study farm exported more K than they imported; 78% of the K exported from this farm was in the form of crop sales resulting in a balance of -3.94 tons. The remaining farms annually imported 0.06 to 35.92 tons more K than they exported (Table 5). The remaining K was -44% (more K exported than imported) to +80 % of imports and -7 to +73 lbs of K[2] per acre (Fig. 4). The distribution of potassium imports differed from the distribution of N and P imports. For six of the farms purchased fertilizer was the major K import category. On nine participating farms most of the K was exported as milk. However, for the five farms that sold crops, off farm crop sales accounted for 18 to 72% of K exports.

Mass nutrient balance benchmarks: The quantity of excess nutrients on the case study farms varied considerably. Why? A sample size of 22 does not provide a sufficient database for rigorous statistical comparison and this is also why a third year of data is needed. However, some general trends can be observed. Figures 1, 3 and 4 display lbs of N, P and K remaining on each farm acre, ranked along the x-axis by farm size as measured by total animal units. Animal units per farm was a poor predictor for the amount of N and P remaining (Fig. 5) indicating nutrient excess. For N, animal density was a much better predictor for the amount of N remaining per acre. However, for P the animal density did not correlate well with the amount of P remaining per acre as total animal units (Fig. 5). These figures do, however, show opportunities for improvements for farms of all sizes.

Multiple year comparisons: Nine Northern New York dairy farms participated in the mass nutrient balance over two years, providing data for calendar years 2004 and 2005. On average, these nine farms had an increase in mature cows and total animal units from 2004 to 2005. Although there was also an increase in tillable acres the average animal density increased slightly from 0.71 in 2004 to 0.78 in 2005 (Table 6). The average N and P mass balance remaining (imports-exports) increased from 2004 to 2005; the average K mass balance remaining decreased. The changes from 2004 to 2005 for N, P and K remaining per tillable acre vary dramatically from farm to farm and between nutrients (Fig. 6). Eight of the nine farms had an increase in N remaining per tillable acre; the remaining farm showed a decrease of less than a pound per acre. Of the 9 farms, 4 had an increase and 5 had a decrease in P remaining per acre. Conversely, 5 farms had an increase and 4 showed a decrease in K remaining per acre. The

[2] Multiply by 1.2 to obtain units of K_2O.

dataset needs a third year for these farms to determine if changes between years reflect year to year variability or management changes.

Nutrient Use Efficiency: An important measure of environmental impact is a firm's productive efficiency. The efficiency with which the participating dairy farms use N, P and K to produce milk is presented in Fig. 7, 8 and 9. In each of these figures, the nutrient imports and exports are divided by the total quantity of milk sold (lbs nutrient per hundred weight of milk sold). The farms are ranked by annual per cow milk production. The green squares represent nutrient exports per hundred weight of milk sold; the blue diamonds represent nutrient imports per hundred weight of milk sold. Within and across all production levels, these NNY dairy farms vary widely in the total quantity of nutrients they imported per unit of milk production. *Some Northern New York farms imported more than 3 times as as much N, P and K as other farms producing the same amount of milk per cow*. Understanding the differences between these farms can help to find ways to improve dairy farm economics and reduce losses to the environment at the same time.

Crop Sales: In the 2004 Northern New York Mass Balance assessment, farms that sold crops had lower mass nutrient balances. In the 22 farms participating in 2005, this trend continued on average but there were large farm to farm deviations from the average. Farms with crop sales tended to be smaller with less crop acres and animal units than dairy-only enterprises (Table 7). Farms with off farm crop sales had a smaller percentage of purchased feeds and less N, P and K imported as feed per tillable acre. In 2004, the average of the 5 farms that sold crops imported about twice as much fertilizer N and P than the 6 farms that did not sell crops. In contrast, in the current dataset of 22 farms, farms that sell crops import N and P fertilizer per crop acre at about the same rate as farms and K fertilizer as a slightly lower rate than the farms that do not sell crops. Nutrients exported as milk was about the same for both groups. Even though the average N, P and K remaining per acre was lower for farms with crop sales, there was wide farm to farm variability that needs further investigation (Fig. 10).

Conclusions/Outcomes/Impacts:

Additional data (greater number of farms participating in the study and multiple years per farm) are needed to draw conclusions with regards to indicators of imbalances and improvement opportunities on the farm. This initial assessment suggests that there are great farm to farm differences in the quantity of nutrients remaining on farms. These disparities remain when nutrient loss is measured in total (tons/farm) and in proportion to farm size (animal units and tillable acres) and farm animal density (au/acre). The proportion of nutrients remaining on the farm as a percent of imports was generally lower for P than for N. This may be a reflection on the extensive education and policy efforts to reduce P loss from dairy farms over the past several years. An analysis of efficiency of farm nutrient use for milk production suggests that there are wide variations between farms with similar production levels. A more detailed comparison between groups of farms with divergent nutrient use efficiencies may provide an insight into the characteristics which make some farms more efficient than others. Such assessment should be accompanied by assessment of farm business summary data to explore the impact of nutrient management strategies on both farm profitability and nutrient source reduction. Prices paid by producers for imported nutrients may play an important role in farm nutrient balances. Realized and forecasted price increases in fertilizers and purchased feeds will give livestock producers additional incentives to minimize nutrient imports and recycle farm nutrients as effectively as possible.

Outreach

The project, by its nature, involves direct interactions between producers, consultants, extension, and on-campus research and extension teams in two departments (Animal Science and Crop and Soil Sciences). Producer involvement in the data acquisition and individualized farm analysis engaged producers to actively consider the causes of nutrient flows onto and off of their farms. Project results were communicated to each of the participating producers via farm specific reports. Summaries of all farms (without farm identification) were included in the report so producers could compare their nutrient balances to other farms in their region. This final report will be added to our website for Northern NY projects (http://nmsp.cornell.edu/projects/nny.asp). Additional outreach will occur this fall and winter (see next steps).

Next steps:

The 2004/2005 results will be presented at NNY winter meetings and distributed through a fact sheet that will be developed this fall. Each of the participating CCE offices agreed to continue with the project in 2005/2006 and the project will be expanded with a third year (2006) of data for farms that participated with 2004 and 2005 data and an additional 6 farms. A larger dataset is needed to investigate the impact of changes in management on whole farm balances and to derive management indicators that have major impacts on these balances (i.e. identify management options to reduce imbalances for long-term sustainability of the farms).

Acknowledgments:

Twenty-two farms participated in this study (six in Lewis, six in St Lawrence, three in Franklin, three in Clinton, and two each in Jefferson, and Essex Counties). Of the eleven farms participating in 2005 (data collection year 2004), nine continued to participate in 2006 (data for 2005 calendar year). We gratefully acknowledge the cooperation of the participating producers. We also acknowledge the participation of Peg Cook of Cooks Consulting for the work with the Lewis County farms. This project was funded by the Northern New York Agriculture Development Program (NNYADP). Software development was supported with a grant from the Upper Susquehanna Coalition.

Persons to contact for more information:

- Dr. Quirine M. Ketterings, Associate Professor, Nutrient Management Spear Program, Dept. of Crop and Soil Sciences, 817 Bradfield Hall, Cornell University.
- Dr. Larry Chase, Professor, Dept. of Animal Science, 272 Morrison Hall, Cornell University.

Table 1: General farm characteristics for twenty-two case study dairy farms located in Northern New York State (2005 data).

Selected farm characteristics	Mean	Median	Minimum	Maximum
Number of mature cows	169	101	38	475
Annual milk production per cow (lbs)	20,671	20,800	12,602	26,514
Animal units (1000 lbs live weight)	323	202	56	922
Animal density (animal units/acre)	0.66	0.67	0.19	1.05
Tillable crop and pasture (acres)	502	365	110	1,200
Manured cropland (acres)	280	195	83	800
Legume crop (%)[1]	42%	37%	12%	100%
Purchased feeds (% total feed dry matter)	22%	20%	4%	54%

[1] Legume crop acres as a percentage of total tillable crop and pasture acres.

Table 2. Nitrogen balance factors, mean, median, minimum and maximum for twenty-two case study dairy farms located in Northern New York State (2005 data).

	Mean	Median	Minimum	Maximum
Nitrogen Mass Balance				
Tons N remaining	26.63	18.51	2.57	82.98
N remaining/acre receiving manure (lbs)	211	199	18	564
N remaining/acre (lbs)	111	110	10	196
N remaining/au (lbs N per 1,000 lbs live weight)	164	175	36	277
% N remaining (import-export/import)	67%	68%	18%	84%
Distribution of imported N				
N from purchased feed (lbs N/tillable acre)	86	75	11	207
N from purchased fertilizer (lbs N/tillable acre)	43	40	-	107
N from N fixation (lbs N/tillable acre)	30	25	7	68
N from purchased animals (lbs N/tillable acre)	2	-	-	19
N from bedding (lbs N/tillable acre)	1	0	-	3
Distribution of exported N				
N from milk sales (lbs N/tillable acre)	39	35	8	75
N from animal sales (lbs N/tillable acre)	6	4	1	26
N from crop sales (lbs N/tillable acre)	6	-	-	28
N from manure export (lbs N/tillable acre)	-	-	-	-

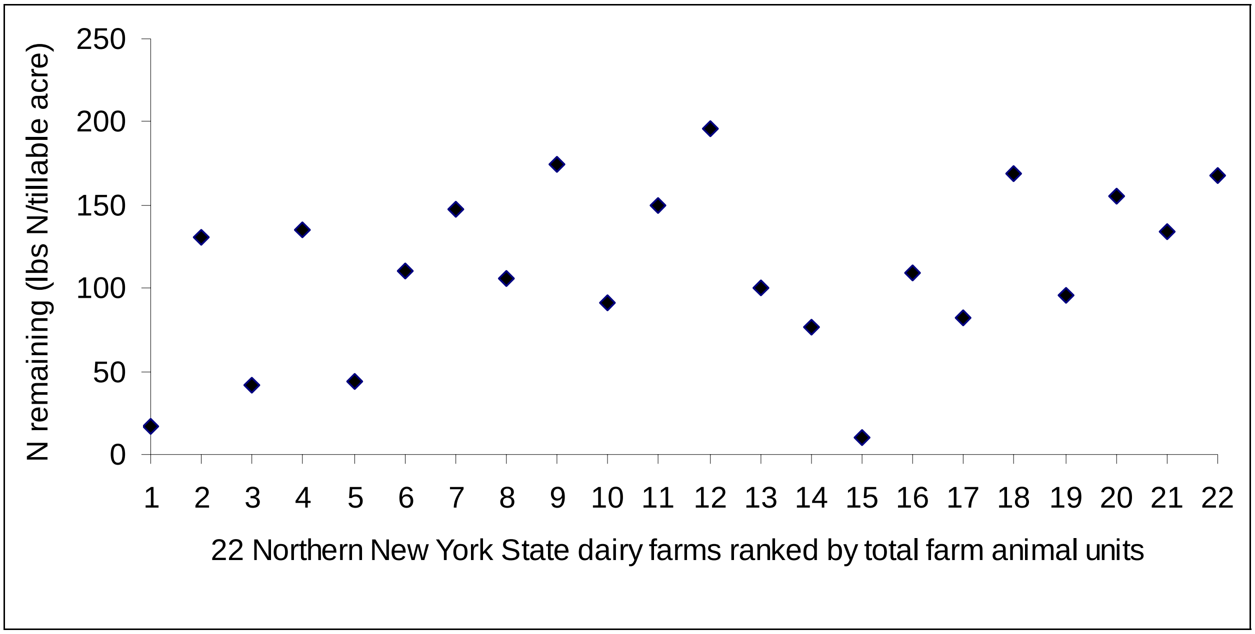


Figure 1: Nitrogen remaining (imports-exports) lbs per tillable acre on 22 Northern New York State dairy farms ranked by farm size (animal units); 1 animal unit = 1,000 lbs.

Table 3: The average distribution of nitrogen, phosphorus and potassium imports and exports for 22 Northern New York State dairy farms (2005).

	Nitrogen	Phosphorus	Potassium
Annual imports	----------------------	% of total annual imports	----------------------
Feed	53%	61%	60%
Fertilizer	25%	36%	39%
N fixation	20%		
Animals Purchased	1%	3%	0%
Bedding	0%	0%	1%
Annual exports	----------------------	% of total annual exports	----------------------
Milk	78%	75%	80%
Animals Sold	11%	14%	3%
Crops Sold	11%	11%	18%
Manure/Compost	0%	0%	0%

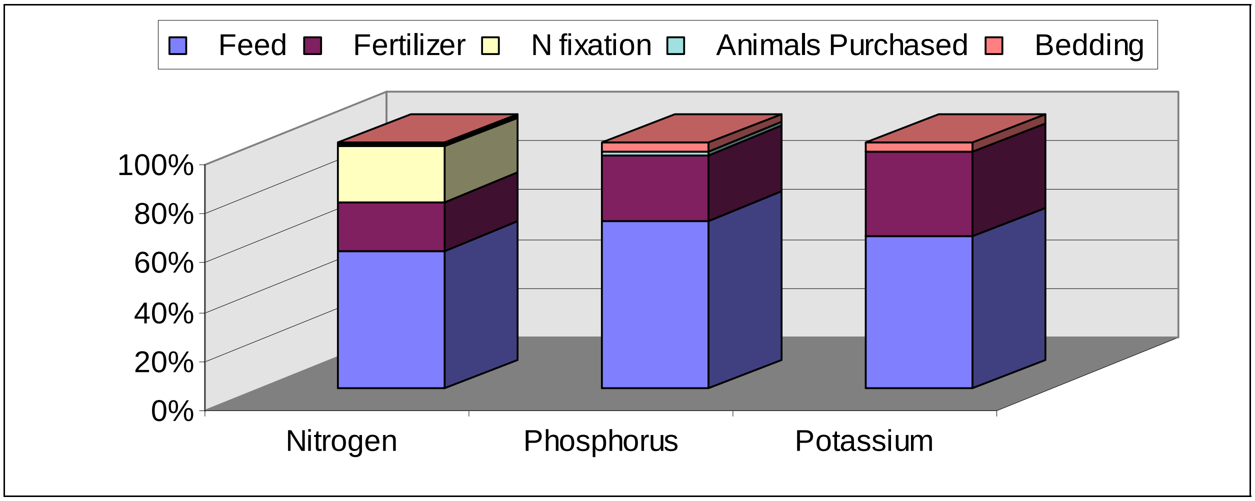


Figure 2: The average distribution of nitrogen, phosphorus and potassium imports for 22 Northern New York dairy farms. Imports items, feed, fertilizer, N fixation, animals purchased, and bedding as a percentage of total annual imports.

Table 4. Phosphorus balance factors, mean, median, minimum and maximum for twenty-two case study dairy farms located in Northern New York State (2005 data).

	Mean	Median	Minimum	Maximum
Phosphorus Mass Balance				
Tons P remaining	3.05	1.31	0.14	16.03
lbs P remaining/acre receiving manure	21	18	1	74
lbs P_2O_5 remaining/acre receiving manure	50	42	3	171
lbs P remaining/acre	10	10	1	28
lbs P_2O_5 remaining/acre	24	22	2	66
lbs P remaining/au	16	14	2	51
% P remaining (import-export/import)	50%	52%	14%	82%
Distribution of imported P				
P from purchased feed (lbs P/tillable acre)	12	12	0	29
P from purchased fertilizer (lbs P/tillable acre)	6	6	-	14
P from purchased animals (lbs P/tillable acre)	1	-	-	5
P from bedding (lbs P/tillable acre)	0	0	-	1
Distribution of imported P				
P from milk sales (lbs P/tillable acre)	7	6	1	12
P from animal sales (lbs P/tillable acre)	1	1	0	6
P from crop sales (lbs P/tillable acre)	1	-	-	6
P from manure/compost (lbs P/tillable acre)	-	-	-	-

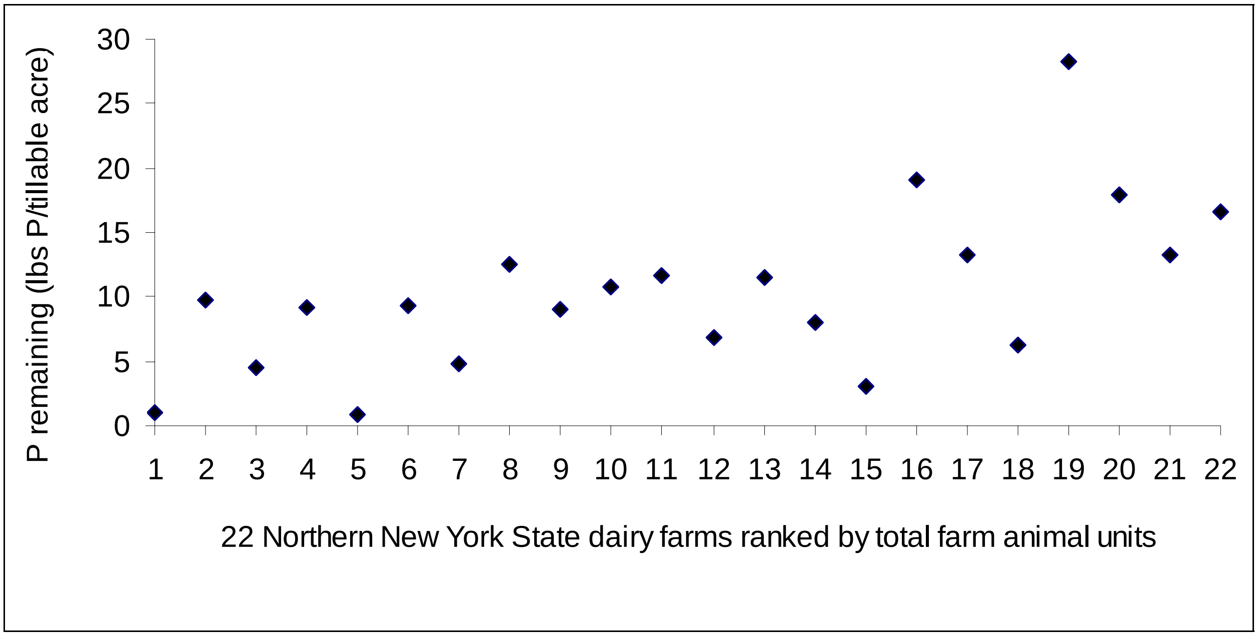


Figure 3. Phosphorus remaining (imports-exports) lbs per tillable acre on 22 Northern New York State dairy farms ranked by farm size (animal units); 1 animal unit = 1,000 lbs.

Table 5. Potassium balance factors, mean, median, minimum and maximum for twenty-two case study dairy farms located in Northern New York State (2005 data).

Potassium Mass Balance	Mean	Median	Minimum	Maximum
Tons K remaining	5.80	2.87	-3.94	35.92
lbs K remaining/acre receiving manure	48	38	-12	154
lbs K_2O remaining/acre receiving manure	58	46	-14	186
lbs K remaining/acre	23	18	-7	73
lbs K_2O remaining/acre	28	22	-8	88
lbs K remaining/au	33	29	-24	85
% K remaining (import-export/import)	50%	53%	-44%	80%
Distribution of imported K				
K from purchased feed (lbs K/tillable acre)	22	19	0	76
K from purchased fertilizer (lbs K/tillable acre)	16	14	-	48
K from purchased animals (lbs K/tillable acre)	0	-	-	1
K from bedding (lbs K/tillable acre)	0	-	-	6
Distribution of imported K				
K from milk sales (lbs K/tillable acre)	12	11	3	22
K from animal sales (lbs K/tillable acre)	0	0	0	2
K from crop sales (lbs K/tillable acre)	4	-	-	23
K from manure/compost (lbs K/tillable acre)	-	-	-	-

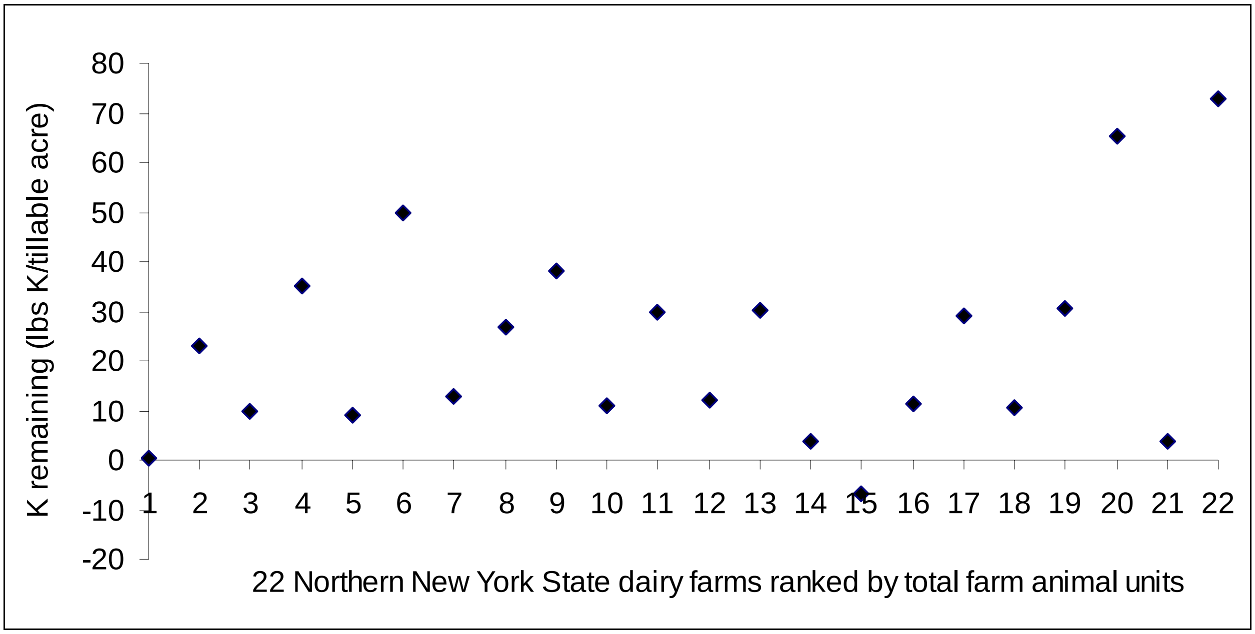


Figure 4. Potassium remaining (imports-exports) lbs per tillable acre on 22 Northern New York State dairy farms ranked by farm size (animal units); 1 animal unit = 1,000 lbs.

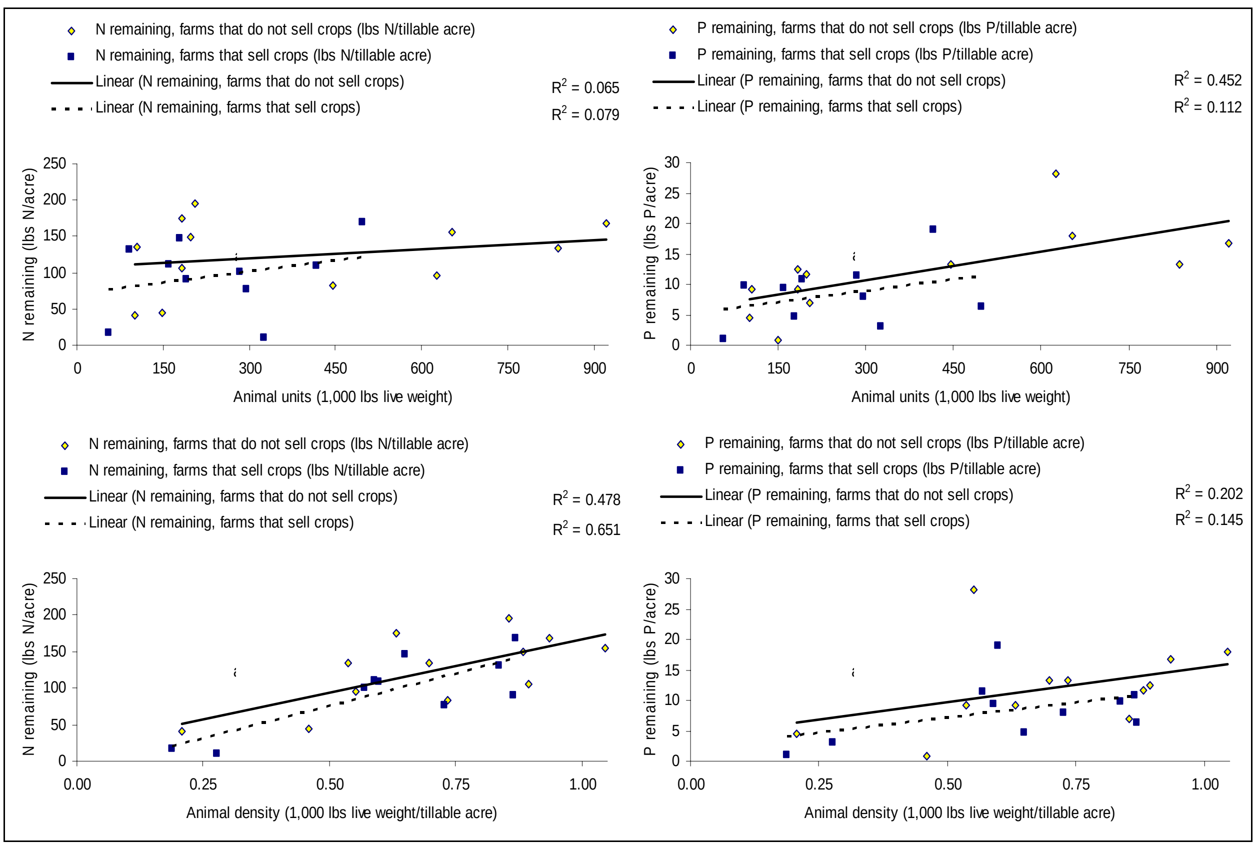


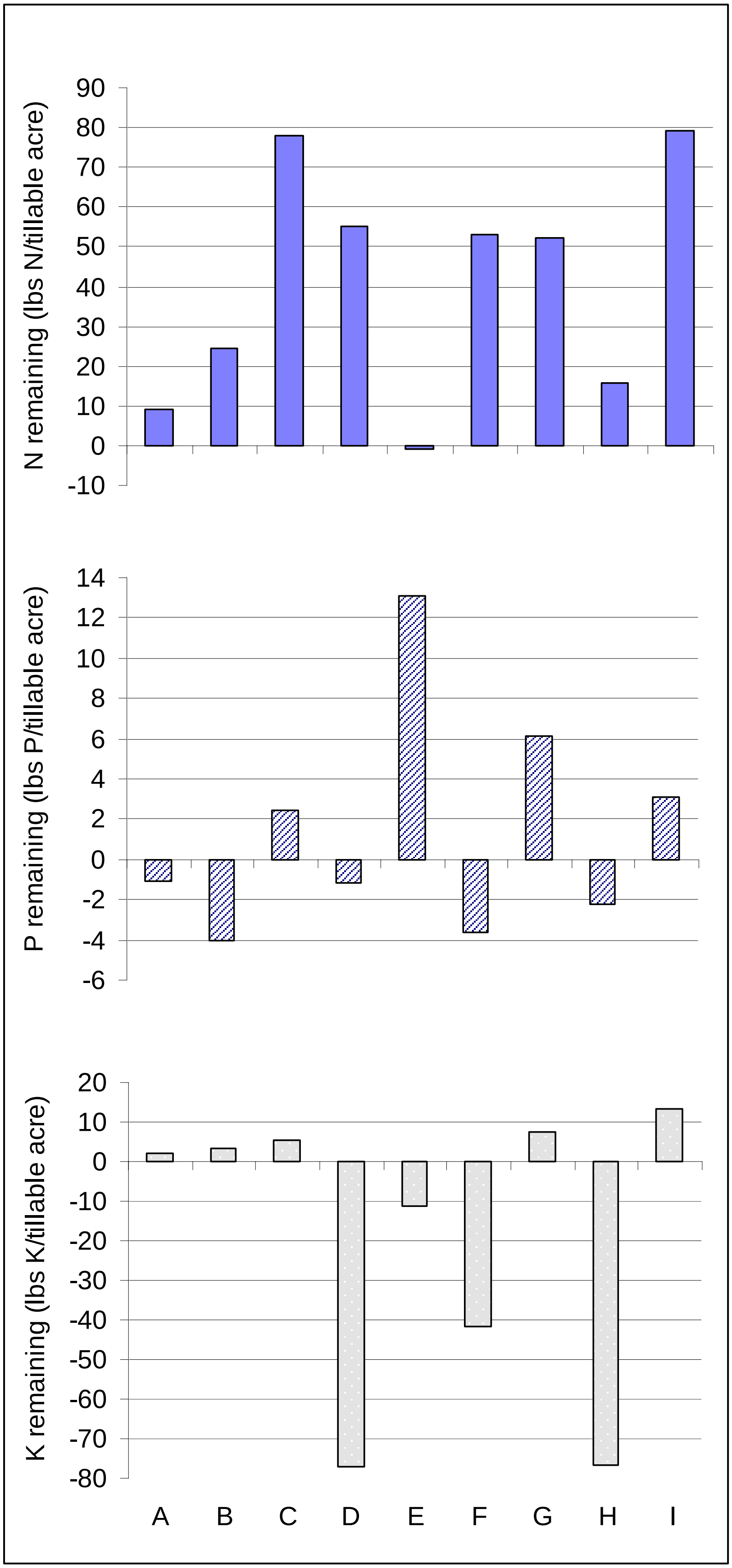
Figure 5. There is a closer relationship between animal density and excess nitrogen and phosphorus per acre than total animal units and excess nitrogen and phosphorus per acre for the group of 10 farms that sold corps and the group of 12 farms that did not sell crops.

Table 6. Selected farm characteristics and mass nutrient balance factors for 9 Northern New York dairy farms with balance data in 2004 and 2005.

Business Size and Production	2004	2005	Change
Mature Cows	146	170	1.16
Animal units	293.9	326.8	1.11
Animal density (animal units/tillable acre)	0.71	0.78	1.10
Milk sold (lbs/tillable acre)	7,891	8,730	1.11
Milk sold (lbs/cow)	21,945	22,019	1.00
Tillable acres	420	431	1.03
Acres receiving manure	*na*	266	na
% purchased feed (% of total feed DM)	27%	20%	0.74
% farm produced forage (% of total forage DM)	1%	1%	1.00
Nitrogen Mass Balance			
Tons N remaining	20.3	27.9	1.37
lbs N remaining/tillable acre	96	137	1.43
lbs N remaining/acre receiving manure	*na*	222	na
lbs N remaining/au	135	180	1.33
% N remaining (import-export/import)	0.64	0.69	1.08
Distribution of imported N			
% N from purchased feed	52%	48%	0.92
% N from purchased fertilizer	32%	29%	0.91
% N from N fixation	16%	22%	1.38
% N from purchased animals	0%	1%	na
% N from miscellaneous imports	1%	0%	0.00
Distribution of exported N			
% N from milk sales	79%	81%	1.03
% N from animal sales	10%	10%	1.00
% N from crop sales	11%	9%	0.82
% N from miscellaneous exports	0%	0%	1.00
Phosphorus Mass Balance			
Tons P remaining	2.3	3.3	1.43
lbs P remaining/acre	10	12	1.20
lbs P remaining/acre receiving manure	*na*	21	na
lbs P remaining/au	15	16	1.07
% P remaining (import-export/import)	54%	50%	0.93
Distribution of imported P			
% P from purchased feed	65%	67%	1.03
% P from purchased fertilizer	34%	30%	0.88
% P from purchased animals	0%	3%	na
% P from miscellaneous imports	0%	0%	1.00
Distribution of exported P			
% P from milk sales	72%	77%	1.07
% P from animal sales	15%	13%	0.87
% P from crop sales	12%	10%	0.83
% P from miscellaneous exports	0%	0%	1.00

Table 6 (continued). Selected farm characteristics and mass nutrient balance factors for the same 9 Northern New York dairy farms in 2004 and 2005.

Potassium Mass Balance	2004	2005	Change
Tons K remaining	9.8	6.0	0.61
lbs K remaining/acre	45	25	0.56
lbs K remaining/acre receiving manure	*na*	48	*na*
lbs K remaining/au	62	33	0.53
% K remaining (import-export/import)	0.64	0.53	0.83
Distribution of imported K			
% K from purchased feed	53%	59%	1.11
% K from purchased fertilizer	46%	40%	0.87
% K from purchased animals	0%	0%	1.00
% K from miscellaneous imports	1%	1%	1.00
Distribution of exported K			
% K from milk sales	79%	85%	1.08
% K from animal sales	3%	2%	0.67
% K from crop sales	18%	13%	0.72
% K from miscellaneous exports	0%	0%	1.00



N remaining (lbs N/tillable acre)
90
80
70
60
50
40
30
20
10
0
-10
P remaining (lbs P/tillable acre)
14
12
10
8
6
4
2
0
-2
-4
-6
K remaining (lbs K/tillable acre)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
A B C D E F G H I

Figure 6. The changes from 2004 to 2005 for N, P and K remaining per tillable acre vary dramatically from farm to farm and between nutrients.

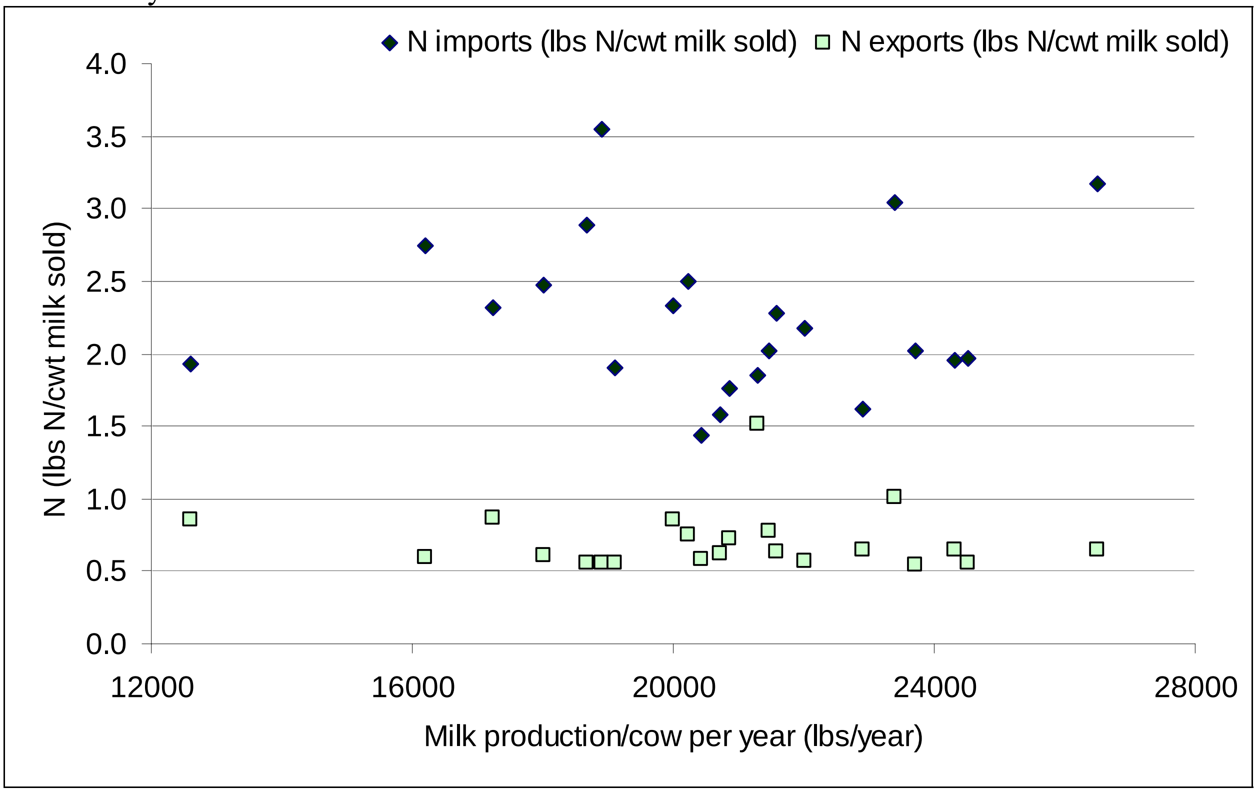
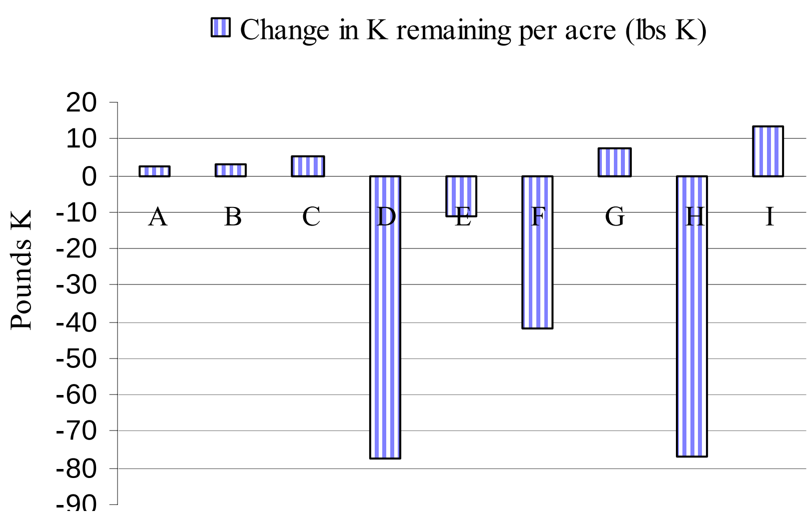


Figure 7. Nitrogen imports and exports per unit of milk for 22 Northern New York dairies in 2005 (lbs N/cwt milk sold).



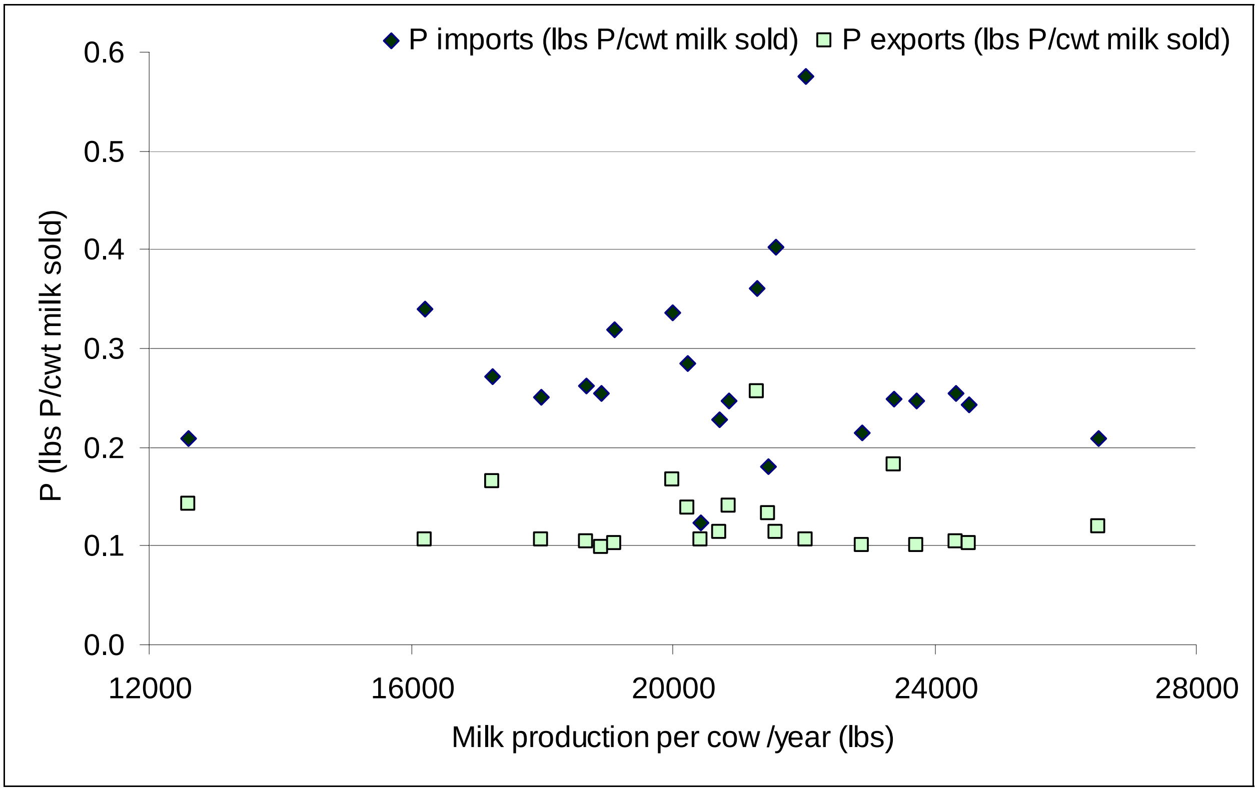


Figure 8. Phosphorus imports and exports per unit of milk for 22 Northern New York dairies in 2005 (lbs P/cwt milk sold).

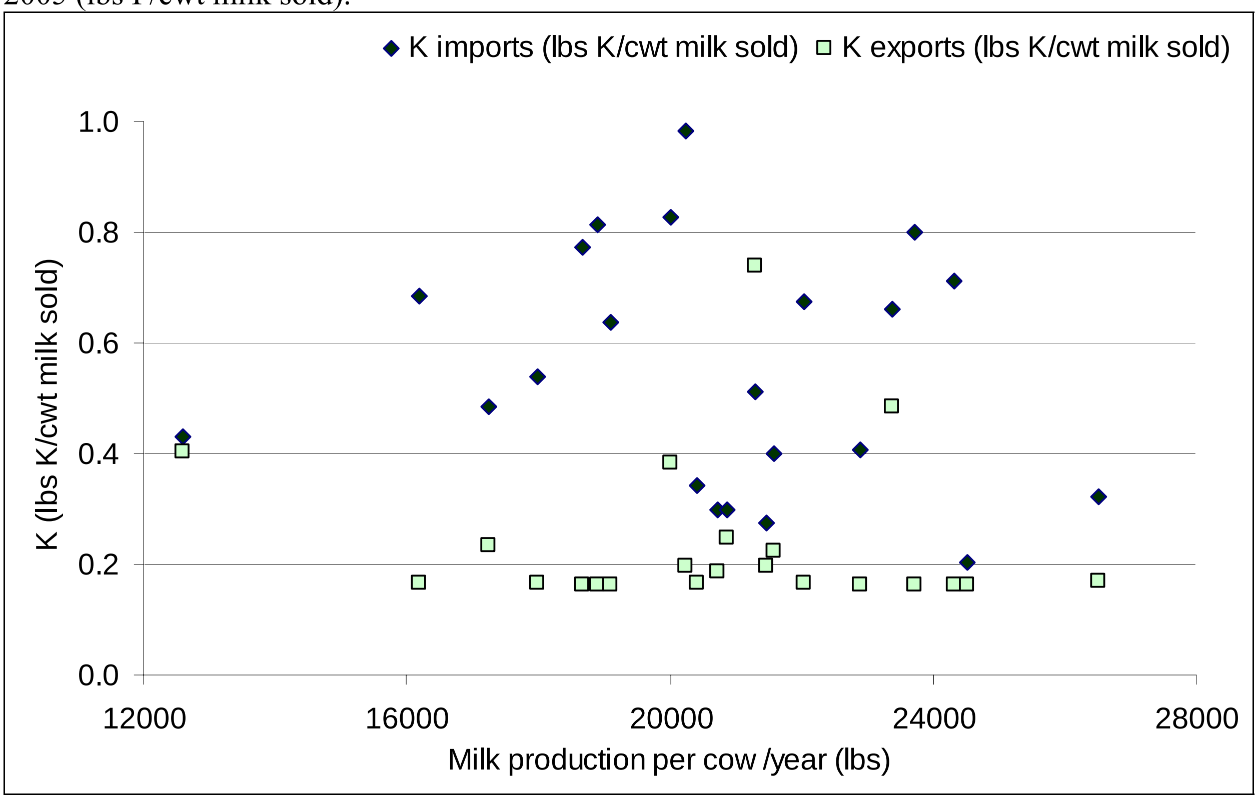


Figure 9. Potassium imports and exports per unit of milk for 22 Northern New York dairies in 2005 (lbs K/cwt milk sold).

Table 7. Selected farm characteristics and farm potassium balance factors, mean, median, min and max for 6 NNY dairy farms without crop sales and 5 NNY dairy farms with crop sales.

	12 farms with no crop sales				10 farms with crop sales			
	Mean	Median	Min	Max	Mean	Median	Min	Max
Animal units	384	202	101	922	250	238	56	498
Animal density (au/acre)	0.70	0.72	0.21	1.05	0.62	0.62	0.19	0.87
Tillable crop and pasture (acres)	543	407	194	1200	453	352	110	1181
Legume crop (acres)	209	163	65	488	218	152	21	555
Purchased feed %	23%	21%	11%	47%	21%	18%	4%	54%
Selected farm N balance factors (lbs N/tillable acre)								
N remaining (imports - exports)	123	134	41	196	96	105	10	169
N imported as purchased feeds	95	85	32	207	75	70	11	173
N imported as purchased fertilizer	42	38	4	107	45	40	0	96
N exported as milk sold	40	36	10	70	37	35	8	75
N exported as crop sales	0	0	0	0	13	12	2	28
Selected farm P balance factors (lbs P/tillable acre)								
P remaining (imports - exports)	12	12	1	28	8	9	1	19
P imported as purchased feeds	13	13	0	29	11	11	2	20
P imported as purchased fertilizer	6	6	0	14	7	7	0	13
P exported as milk	7	6	2	11	6	6	1	12
P exported as crop sales	0	0	0	0	2	2	0	6
Selected farm K balance factors (lbs K/tillable acre)								
K remaining (imports - exports)	30	29	4	73	15	11	-7	50
K imported as purchased feeds	25	25	0	76	18	16	3	43
K imported as purchased fertilizer	17	16	0	48	16	10	0	40
K exported as milk (lbs/acre)	12	11	3	19	11	11	3	22
K exported as crop sales (lbs/acre)	0	0	0	0	8	5	2	23

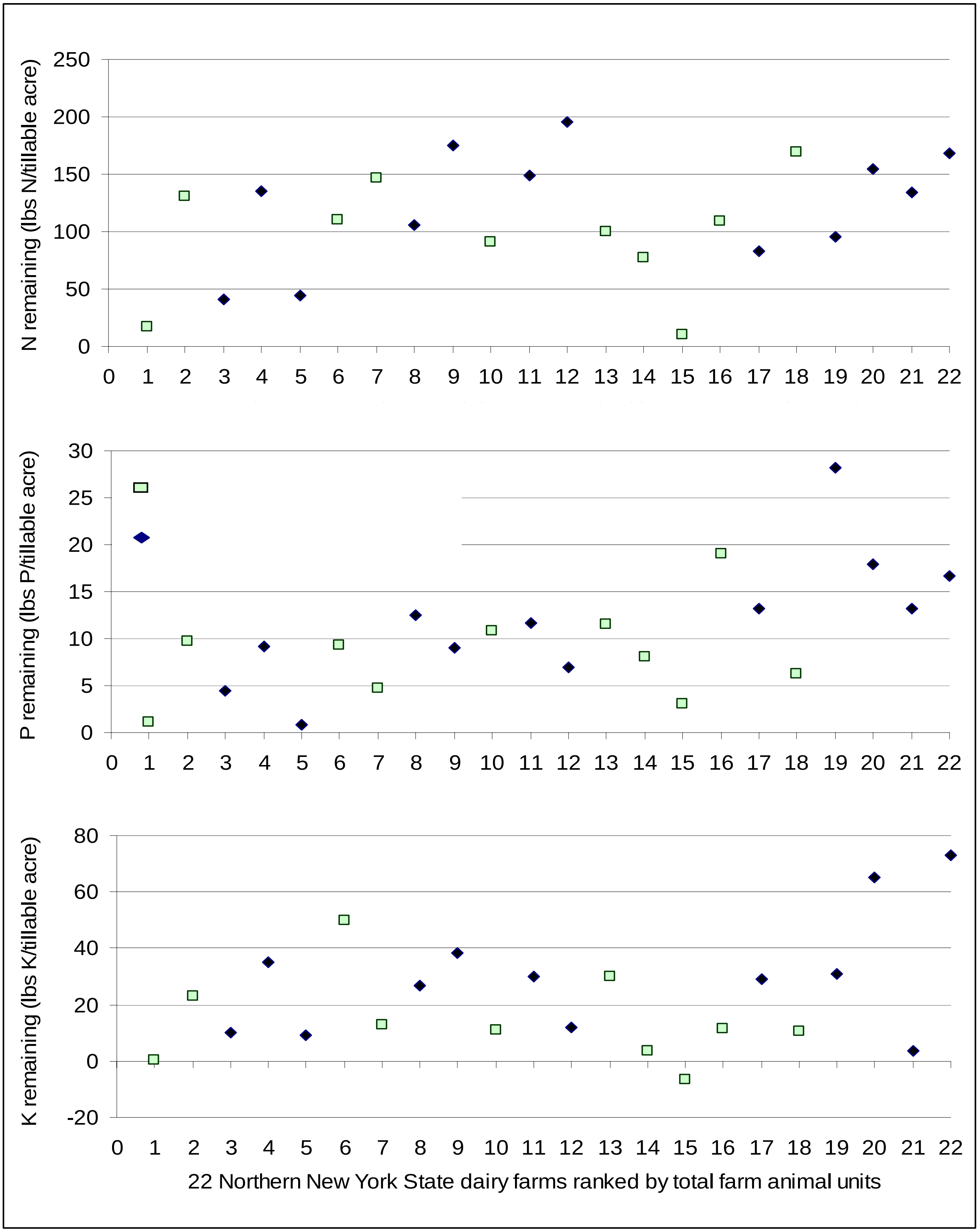


Figure 10. Dairy farms with off-farm crop sales generally had lower N, P and K remaining per tillable acre but there was wide farm to farm variability on 22 Northern New York State dairy farms ranked by farm size (animal units); 1 animal unit = 1,000 lbs.

Northern NY Agricultural Development Program
2006 Project Report

Soil Health and Conservation Agriculture in Northern New York

Project Leader(s):

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- **John Idowu**. Research Associate & Project Coordinator (Soil Health), Cornell University

Collaborator(s):

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- CCE collaborators in NNY Region: **Peter Barney** (St. Lawrence County), **Michael Hunter (**Jefferson County), **Jennifer Beckman** (Lewis County), **Anita Deming** (Essex County), **Carl Tillinghast** (Franklin County) and **Mathew Cooper** (Franklin County)

Farmer participants:

Growers collaborators in NNY Region: **Sam Hendren**, **Eric Leerkes** and **Chris Spaulding** (Essex County); **Dennis Egan**, **Ralph Child** and **Doug Malette** (Franklin County); **David Fisher**, **Dan Chambers** and **William White** (St. Lawrence County) **Don Nohle** (Jefferson), **Marc Laribee** and **Bernhard Gohlert** (Lewis County).

Background: Intensive use of land for crop production has contributed to reduced soil quality, and resulted in lower crop productivity and farm profitability. Among the causes are soil compaction, surface crusting, low organic matter, increased pressure and damage from diseases, weeds, insects and other pests as well as a lower density and diversity of beneficial soil organisms. Growers and land managers in Northern New York (NNY) have continued to show interest in assessing the health status of their soils and are willing to implement sustainable soil management practices. In 2006, we were able to develop and fine tune our soil health assessment protocol based on extensive research over the past five years. We developed a visually enhanced, grower friendly soil health report format, which enabled the growers to easily identify major soil constrains in their fields and the necessary management strategies to overcome them. The long-term research sites in Willsboro and Chazy as well as numerous samples collected from growers fields in NNY contributed significantly to the development of this new soil health test. This protocol was used in assessing fields in NNY. The results from these assessments gave a picture of the major areas to target soil management efforts in NNY, for increased farm profitability.

Methods: We have developed a cost effective soil health assessment method, which is planned to be offered as a for-fee service by Cornell University. We identified important soil health indicators that are relevant for the interpretation of key soil functions and processes in agronomic systems. This led to the development of the Cornell Soil Health assessment protocol. Table 1 shows these indicators and the associated relevant soil processes. We used these indicators to assess the state of soil health in NNY. We sampled over 40 fields from 17 farms during the spring of 2006 as part of the soil health project funded by the Northern New York Agricultural Development Program. These samples were taken across different parts of the region and also represent a range of management practices in the NNY counties. Samples were collected from both plow-till and no-till systems, dairy and non-dairy systems, field crops and vegetable systems and some orchards. This provided the opportunity to assess soil health in NNY under a variety of soil/crop management scenarios.

Table 1. Indicators of physical, biological and chemical health of soil and their respective soil processes.

Soil Health Assessment Indicator	Soil Functional Processes
Physical Indicators	
Aggregate Stability	aeration, infiltration, shallow rooting, crusting
Available Water Capacity (AWC)	water retention
Surface Hardness (SH)	rooting, water transmission
Subsurface Hardness (SSH)	rooting at depth
Biological Indicators	
Organic Matter Content (OM)	energy/C storage, water and nutrient retention
Active Carbon Content	organic material to support biological functions
Potentially Mineralizable Nitrogen (PMN)	N supply capacity, N leaching potential
Root Health Rating	soil-borne pest pressure
Chemical Indicators	
pH	toxicity, nutrient availability
Extractable Phosphorus	P availability, environmental loss potential
Extractable Potassium	K availability
Minor Element Contents	micronutrient availability, element imbalances

Results: Soil health assessment in NNY suggests that many farms can benefit from soil-building management practices (Figure 1). Thirty two percent of NNY fields sampled had poor aggregate stability, and 12% ranked in the medium range. The poor aggregate stability cuts across all the major textural classes that were sampled. Poor aggregation suggests that the soil will be easily prone to crusting, runoff and erosion. Since a significant number of sampled fields have concerns related to poor aggregate stability, there is a need to focus management efforts towards improving soil aggregation and structure. Available water capacity was generally high and did not appear to be a constraint to crop production for most NNY fields sampled in 2006, which is mostly related to the dominant medium and fine-textured soils in the region. Surface hardness (SH) and subsurface hardness (SSH) were not major concerns but may become a problem in the future (Figure 1). The majority of the sampled fields had medium SSH, indicating the need to carefully manage these soils to prevent further development of subsoil pans, and perhaps consideration of deep tillage or zone building.

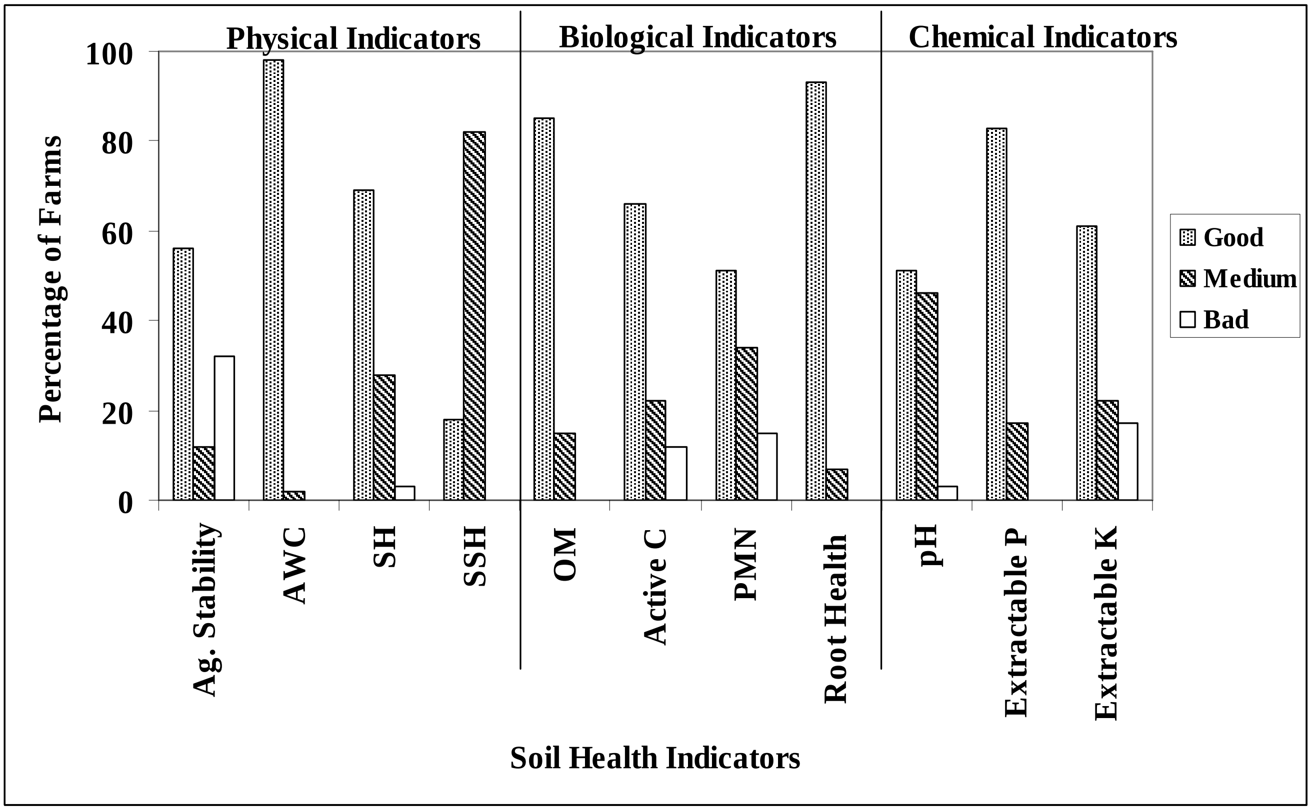

Figure 1. Percentage of NNY fields receiving sores of good, medium, or poor based on Cornell Soil Health Test.

NNY farms generally scored well for percent organic matter, unsurprisingly since 44% of the fields had received compost or manure. Root health scores were also high, as expected for field crops and pastures. Scores for active carbon and potentially mineralizable nitrogen (PMN) were less favorable indicating that some farms may need to pay attention to soil biological functions. Chemical analysis revealed that extractable potassium was the most frequent limiting macronutrient. Low pH was also detected in many of these soils, and pH correction was needed in a minority of soils.

Comparing results for different farms confirms that sustainable management practices (reduced tillage, organic matter additions, cover cropping) improves soil health. Manure applications on dairy farms apparently do not result in great soil biological or physical benefits with intensive tillage, soil compaction and lack of cover crops. Greater benefits are presumably attained with a more comprehensive approach to soil health management.

Conclusions/Outcomes/Impacts: The newly developed soil health assessment provided useful insights into potential yield-limiting factors for crop production in NNY. Many farms have soils that are in good health, mostly due to the addition of organic matter, good rotation, or reduced tillage. Many other fields are shown to have soil constraints that may result in yield declines or increased potential for environmental impacts. The reports allow farmers to identify such constraints and target management practices for soil improvement. The assessment protocols, reports and interpretations have been shared with growers and are currently being refined. Soil health assessment tests will be commercially offered in the near future.

Outreach: We have engaged many growers in discussions on soil health assessment and management, and demonstrated the basic concepts and measurements of soil health during our field meetings and farm visits. We carried out two major outreach activities in NNY during 2006. The first event took place in Willsboro, Essex County, NY with about 25 people in attendance. The second took place on Ellsworth Dairy Farm, Ft. Covington, NY in Franklin County with 20 people in attendance. During these field meetings, we demonstrated the new soil health assessment protocols and discussed with growers the specific interpretations of their soil health results. We also emphasized the importance of managing subsurface soil compaction in the soil to prevent adverse effects on crop growth and development. Specific techniques were suggested to growers on how to mitigate subsurface soil compaction. We published two extension articles on soil health in "What's Cropping Up?" a widely circulated journal for land managers and educators in the state. Copies of these articles are hosted on the NNYADP website.
The titles and links to the soil health articles are provided below:

1. Soil Health Assessment and Management: The Concepts
http://www.nnyagdev.org/PDF/soilhealthassmgmt.PDF
2. Soil Health Assessment and Management: Measurements and Results
http://www.nnyagdev.org/PDF/SoilHealthFSPart2.pdf

In addition, we have a growers-oriented soil health website (http://www.hort.cornell.edu/soilhealth/) which contains information on the soil health initiate at Cornell University. We are in the process of completing a Soil Health Manual which will be hosted on this website.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education.

Additional research work is needed for soil health assessment in dairy systems. Dairy farming constitutes a relatively large sector in NNY farming. A specific concern from dairy growers has been the soil health management with manure additions. Therefore, specific soil health assessment, interpretations and management strategies are needed for these soils. We plan to work on this in 2007.

In previous years of project implementation, we have focused mainly on the field crop growers in NNY. Management of vegetable fields for soil health improvement has received little attention. We plan to start addressing issues related to soil health in vegetable systems, by studying the impacts of reduced tillage on the management of vegetable soils in NNY. Another focal area for 2007 is to investigate how long term harvest of corn biomass affects soil quality.

This study is crucial in the debate on the use of plant biomass as an alternative energy source. We have identified a research site in NNY for this study. We also plan to continue with the soil health literacy campaign in the region through on-farm demonstration trials, field days, conferences and other growers meetings. The soil health issues listed above will be our target for 2007.

Northern NY Agricultural Development Program
2006 Project Report

Biological Control of Alfalfa Snout Beetle with Entomopathogenic Nematodes

Project Leader(s):

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Collaborator(s):

NNY Extension Educators

Farmer participants:

Carolyn McNamara & Dick Eakins, Franklin County
Eugene Poirier, Franklin County
Doug Shelmidine, Jefferson County
Mark Karelus, Lewis County
Mark Akins, St Lawrence County
Leslie (Skip) Putney, St. Lawrence County

Background:

Alfalfa snout beetle (ASB), *Otiorhychus ligustica*, remains the most destructive insect pest of alfalfa in Northern New York (NNY), and is continuing to spread as shown by the NNYADP funded county surveys conducted in 2005 and 2006.. Alfalfa snout beetle is currently infesting nine NNY counties and has invaded Canada across the St. Lawrence River. Otherwise, there is no other known infestation of this insect in North America.

Alfalfa snout beetle was introduced from Europe into the Port of Oswego during the middle to late 1800's in a sailing ship ballast. Alfalfa snout beetle was first discovered as a problem around 1930 after alfalfa was introduced into Oswego County. This pest causes severe yield and stand losses on alfalfa by larval feeding on alfalfa roots. New infestations are often mistaken for winter injury since the majority of plants die after the last harvest and before spring growth. To date, there are no effective methods of controlling this destructive insect pest. With other introduced insect pests, two strategies have been effectively used to reduce the insect populations to manageable levels. These strategies are 1) identify and incorporate resistant genes into acceptable alfalfa varieties (breeding for resistance) and 2) identify and establish in NNY biological control organisms from the native home of ASB.

On the John Peck farm located in Northern Jefferson Co. near Great Bend, ASB maintained a population of 1.0-2.5 million beetles per acre throughout the 1990s causing John to lose entire alfalfa fields at the end of the first production year (2^{nd} year of the stand). During those years, adult beetles emerged in very large numbers and the beetles were very easy to collect in mass. In 2002, the large adult ASB emergence of past years was strangely absent. The adult emergence on the Peck Farm was also absent in 2003, 2004, and 2005. A very few adult beetles were observed in 2006. Our fall 2005 larval survey of the farm showed that there was an absence of ASB larvae feeding on alfalfa roots and more alfalfa on the farm then we have ever seen since we began working on the farm in the early 1990s. The real question is: "What happened to the snout beetles"? Millions of ASB can still be observed and collected within a mile of the Peck farm. In the spring of 2006, we collected 20,000 newly emerged beetles in a 2-day period down the road from the Peck farm.

We initiated field research with entomopathogenic (insect attacking) nematodes on the Peck farm in the early 1990s and those field investigations have continued through 2006. Over the course of 15+ years of field research on the Peck farm, field plots of less than an acre in size has been established in several of John's fields and nematodes released in these plots during the course of the studies. Nematodes released in these plots were native nematodes from NNY that were collected during nematode surveys conducted in the early 1990s. Since these nematodes strains were collected in NNY, they are adapted to NNY conditions and they persist in the field for many years.

We believe that the entomopathogenic nematodes we released on the Peck farm over a 15-year period are responsible for the population crash on the Peck farm, the presence of very low numbers of ASB on the farm and the nice stand of alfalfa in many of John's fields.

Project #1: Extensive Survey of the John Peck Farm

Procedure: During the 2006 growing season, the John Peck farm located in Great Bend, NY (Northern Jefferson Co.) was extensively sampled for the presence of introduced entomopathogenic nematodes in all of the fields on the farm. Soil samples were collected during June and September. At each sampling, 1000 soil samples were collected with the distribution of the soil samples evenly distributed among all of the fields on the Peck farm. At each site, the soil sample was collected, separated into two sections, placed in individual containers, containers numbered, and GPS coordinates were recorded. The recording of GPS coordinates allows us to map the exact location of the nematode distribution, once the soil samples are bioassayed for the presence of nematodes. Each soil sample was taken to Cornell University and bioassayed in the laboratory for the presence of nematodes by using the multiple baiting technique on the soil sample with wax moth larvae purchased from a fishing bait supplier. A total of 2000 soil samples were collected and bioassayed from the Peck farm.

Results: Both species of entomopathogenic nematodes were found present in low numbers in all of the fields on the Peck farm, even in fields were they were not introduced through field plots. Nematodes were introduced onto the farm in a series of field plots to evaluate the effectiveness of these nematodes as biological control agents against alfalfa snout beetle starting in 1991. Since these nematode species are persistent and remain in the soil for many years, a different field needed to be selected each time a new series of field plots was established. New field plots were established in 1990, 1991, 1994, 1995, 1996/97 and 2004.

Impact: Results from this survey confirm that the entomopathogenic nematodes released on the Peck farm from 1990-97 were responsible for the population crash of alfalfa snout beetle on that farm. We also find the movement of the nematodes around the farm through the movement of soil during the farming operation, movement of infected beetles and on their own very encouraging and exciting. A relatively small number of nematodes were released in 5 different fields over a period of 7 years with the total treated area of each field being much less than one acre. The farm supported very high numbers of alfalfa snout beetles during this time with numbers exceeding 1 million beetles per acre. The high levels of snout beetle undoubtedly assisted the establishment of nematodes in the fields along with assisting the spread through movement of infected individuals before they died of the infection. Large-scale spring emergences were recorded on the farm from the late 1980s through 2001. Starting in 2002, large-scale adult snout beetle emergences were absent on the Peck farm and those emergences have remained very low in 2003-2006. Large adult snout beetle emergences were observed within a mile of the Peck farm so the snout beetle population decrease is unique to the Peck farm. It is interesting to note that the occurrence frequency of nematodes in soil samples taken on the Peck Farm in 2006 is very similar to the frequency of nematodes in soil samples in the parts of Hungary where snout beetle is not easily found and is not considered an agricultural pest of alfalfa. The information collected from extensively soil sampling the Peck farm for the presence and distribution of nematodes increases our belief that the snout beetle population crash on the Peck Farm was a result of the released nematodes.

<u>Project #2:</u> Developing a farmer-friendly method to inoculate their own farms

Now that we believe that entomopathogenic nematodes have a real demonstrated potential to reduce the snout beetle population throughout the infested area, the focus needs to be on the development of a farmer friendly system to culture the nematodes on the farm and allow the farmers to inoculate their own fields with this biocontrol organism. The focus of farmers producing their own nematodes and inoculating their own farm make sense to us because commercially available nematodes often have lost their ability to persist in the soil for long periods of time due to artificial rearing techniques and the commercially available nematodes are too expensive to purchase for a low value commodity like alfalfa.

On farm culture of nematodes: The infective juveniles of nematodes are free-living in the soil where they locate suitable insect larvae to attack, invade and kill. These dead insect larvae are then used as a food source to produce the next generation of free-living infective juveniles. A single moderate sized insect larvae will produce between 200,000 and 300,000 IJs. Insect larvae sold as fish bait are available for $35 per thousand larvae and those thousand larvae will produce between 200 million and 300 million infective juvenile nematodes for field release. The process of infecting insect larvae with nematodes is quite simple requiring only a limited amount of soil and a few shallow disposable pans. The final mass rearing technique is currently being worked out in the laboratory this winter.

Field nematode inoculation by farmers: The technique for farmers to inoculate their own fields is a bit more of a challenge. The IJs, once emerged from the insect cadaver are very sensitive to UV light exposure and desiccation. For research plots, we allow the IJs to emerge from the cadavers, suspend the nematodes in water and spray the nematodes onto the soil surface using a conventional sprayer. We replace the typical flat fan nozzles with a fertilizer stream nozzle and remove the screens from the nozzles. While this system works well, the handling of the delicate IJ nematodes makes this system less desirable for the producer. There are two other possibilities where the nematode IJs are more protected. The first is to broadcast the insect cadavers into the alfalfa field before the IJs emerge. While within the insect cadaver, the IJs are protected from UV, handling damage and desiccation. The second method is to allow the IJs to emerge into soil where they are protected from UV and desiccation and broadcast the soil onto the soil surface of the field. With the second technique, the soil containing nematodes could be broadcast from a small fertilizer spreader mounted to a 4-wheel ATV.

Project #3: 2006 Field study:

Procedure: In the early summer of 2006, we attempted to inoculate six different snout beetle infested fields in four different counties by spreading nematode infected insect cadavers on the soil surface after the first cutting. The plots were designed in the following manner. The plot was laid out with the grain of the field and measured 2 ft x 500 ft. The plot consisted of a single row of 50 flags set 10 ft apart and the farmer was asked to leave the narrow strip of alfalfa surround the row of flags during the 2^{nd} and 3^{rd} harvest of the field. At each flag, two insect cadavers were laid on the top of the soil. One cadaver contained the NY001 nematode strain and the other cadaver contained the Oswego nematode strain. Each field plot (6 total) was visited every two weeks for the remaining of the growing season and soil samples were collected at selected flags throughout the plot to track nematode establishment and nematode spread away from the point of inoculation. These data would document nematode establishment and establish a rate of spread away from the point of establishment. These data would then be used to evaluate the potential of using cadavers for nematode field inoculation and suggest the density of cadavers required to fully inoculate a field with nematodes.

Results: At all sites, there was an extremely low establishment of released nematodes. We were very surprised because when these nematodes are sprayed onto the soil surface with a conventional sprayer, we have always achieved a very high level of establishment. A very careful search in the vicinity of each plot flag failed to find the remains of any insect cadaver, typically remaining after nematode emergence. We strongly suspect that the placed cadavers were consumed by the resident population of mice, shrews and skunks which are present in every alfalfa field. In addition, we left a very easily trail to follow from flag to flag for the dining pleasure of these residents. The total lack of nematode establishment strongly suggests that the consumption of cadavers by the resident varmints occurred within 36 hours of cadaver placement on the soil surface. We were convinced that this method was a sure-fire method for field inoculation but as we all know, “ the best plans of mice and men . . . . “.

Plans for 2007 In 2007, multiple field sites will be selected in the same four counties to continue with these investigations. An array of multiple inoculation techniques will be compared in each of the fields to establish the best techniques with a focus on farmer simplicity.

Outreach Results to date have been discussed in various Extension Education meetings and will be included in future meetings particularly in the NNY infested regions of the state.

Person(s) to contact for more information (including farmers who have participated:

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Northern NY Agricultural Development Program
2006 Project Report

Breeding Alfalfa Snout Beetle Resistant/Tolerant Alfalfa Varieties

Project Leader(s):

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J. Neally, Technician, Department of Plant Breeding and Genetics; 101 Love Lab; Cornell University; 607-255-5043; jln15@cornell.edu

A. Testa, Research Support Specialist, Department of Entomology; 4142 Comstock Hall; Cornell University; 607-255-8142; at28@cornell.edu

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Farmer participant:

John Peck, Great Bend, Jefferson County, NY

Background: Alfalfa snout beetle (ASB), *Otiorhychus ligustica*, is the most destructive insect pest of alfalfa in Northern New York (NNY), and is continuing to spread. Alfalfa snout beetle is currently infesting nine NNY counties and has invaded Canada across the St. Lawrence River. Otherwise, there is no other known infestation of this insect in North America.

Alfalfa snout beetle was introduced from Europe into the Port of Oswego during the middle to late 1800's in a sailing ship ballast. It was first discovered as a problem around 1930 after alfalfa was introduced into Oswego County. This pest causes severe yield and stand losses on alfalfa by larval feeding on alfalfa roots. New infestations are often mistaken for winter injury since the majority of plants die after the last harvest and before spring growth. To date, there are no effective methods of controlling this destructive insect pest. With other introduced insect pests, two strategies have been effectively used to reduce the insect populations to manageable levels. These strategies are 1) identify and incorporate resistance genes into acceptable alfalfa varieties (breeding for resistance) and 2) identify and establish in NNY biological control organisms from the native home of ASB.

None of the alfalfa varieties grown in northern USA during the 1990s appeared to be resistant when grown on a field heavily infested with ASB. In 1998 at Watertown, NY, the perennial *Medicago* core collection and other germplasms were evaluated for resistance/tolerance to ASB. The 173 plant populations ranged from 3.7 to 4.8 (1 = no root damage, 5 = dead plant). This variability suggested that resistance genes may exist at a low level in a few populations. Therefore, we initiated recurrent selection to increase the level of resistance in several alfalfa populations. In addition, alfalfa varieties grown in Hungary in association with native ASB populations were obtained through contacts within Hungary. Therefore, we were interested in selecting within these Hungarian varieties since ASB populations exist in Hungary and other parts of Europe, but are less destructive there than in NNY.

Breeding for ASB resistance/tolerance by screening plants in infested fields is time-consuming (2 years/screening), and not reliable because the insect pressure in fields is not uniform. In a field screening, susceptible plants may be selected because they escaped injury. In order to screen thousands of alfalfa plants for resistance to ASB, a reliable greenhouse screening method was needed. A greenhouse screening method has recently been developed by E. J. Shields and A. Testa with funding from the NNY Agricultural Development Project. With this greenhouse screening method, the ASB population pressure can be controlled by the number of eggs applied uniformly to each container and by the length of time the larvae are allowed to feed on the alfalfa roots. Thus, plants with a low level of resistance can be selected and over several cycles of selection, and the frequency of resistance genes can be increased in several alfalfa populations.

The ultimate goal is to develop alfalfa varieties that are resistant to ASB, and thus more persistent and productive in areas infested with ASB. Therefore, production of high quality forage for the dairy and other livestock industries would be achievable more economically in the North Country.

Methods: Since 2003, we have completed three to four cycles of recurrent selection in 15 plant populations for lower level of root damage from the ASB larvae from egg infestation on plants in the greenhouse (Figure 1). Plants with the least injury were selected and seed produced for the next cycle of selection. Plant populations consisted of the most elite in the Cornell Forage Breeding Program, varieties from ASB-infested areas of Hungary, and plant introductions that we earlier identified with least injury on John Peck's farm in the North Country. Since 2003, a total of 83,000 plants have been evaluated for resistance to ASB. About 35,000 plants were evaluated in 2006. This fall, we completed a replicated experiment under controlled greenhouse conditions to determine the progress from selection for resistance to ASB up to three cycles of selection.

Results: Averaged across six plant populations, three cycles of selection for resistance to ASB significantly reduced root damage from larval feeding. Visual scores (1=no root damage, 5=root totally chewed off or dead plant) were 3.46 for the base populations, 3.35 for Cycle 1, 3.23 for Cycle 2, and 3.09 for Cycle 3 (Figure 2). In one plant population, the root damage decreased from 3.86 to 2.90 after three cycles of selection. This is the first evidence that breeding can increase resistance levels in alfalfa.

Conclusions/Impacts: The significant progress from selection provides the first real hope that we can develop alfalfa varieties with resistance to ASB. Development of resistant varieties in combination with other control measures will provide protection of the alfalfa crop from ASB injury. Therefore, alfalfa production on land that is infested with ASB will be enhanced, thus making production more economical.

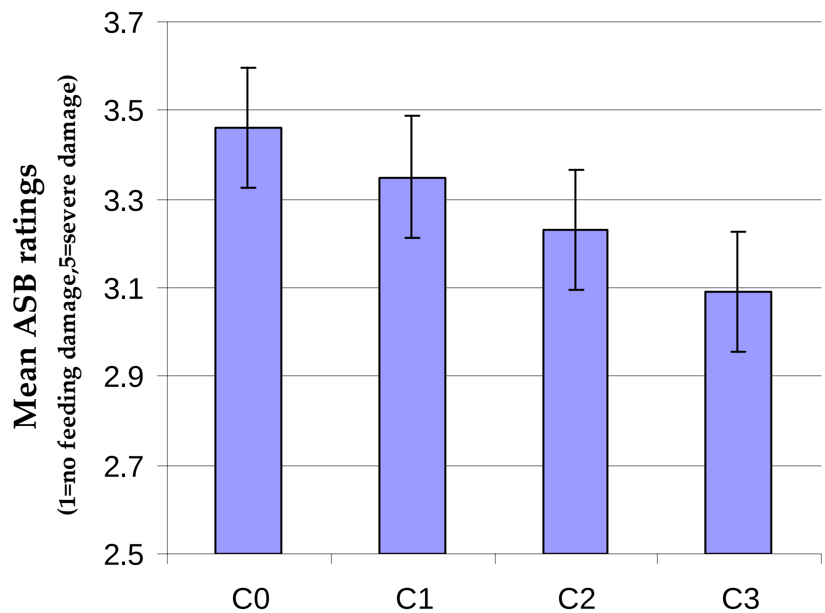
Progress on this research was reported to extension educators and seed company representatives during a field day presentation last summer. It also was reported to seed sales people and growers during a presentation in January.

Next steps if results suggest continued work is needed. Although significant progress has been made in breeding for resistance to ASB, more progress probably will be needed. Therefore, we plan to continue with another cycle of selection during 2007. In addition, we plan to work with a producer and extension educator in NNY to establish a replicated field experiment with small plots to evaluate yield and persistence of some of the Cycle 3 populations compared to the base populations under conditions of natural field populations of ASB. Establishment of this experiment will need to done in spring 2008. During 2007, seed of these populations will be produced in quantities sufficient for establishment of the plot experiment.

Acknowledgments:

Project Funders: Northern New York Agricultural Development Program
Hatch Multistate Project NE-1010

Figure 1. Gabe Neumann, Entomology student from Hungary, is infesting containers of alfalfa with alfalfa snout beetle eggs suspended in a dilute agar solution. Photo by Antonio Testa.



Figures 2 and 3. Progress from selection for resistance to alfalfa snout beetle. From left to right, the base populations averaged a score of root damage (1=no root damage, 5=root totally chewed off or dead plant) of 3.46, Cycle 1 = 3.35, Cycle 2 = 3.23, and Cycle 3 = 3.09. Photo and histogram by Jamie Neally, Cornell Forage Breeding Project.

Northern NY Agricultural Development Program
2006 Project Report

Field Survey of Alfalfa Snout Beetle

Project Leader(s):
Pete Barney (CCE of St. Lawrence County,)
Mike Hunter (CCE of Jefferson County,)
R. David Smith (Dept. of Animal Science, Cornell,)

Collaborator(s):
Jen Beckman (CCE of Lewis County)
Matt Cooper (CCE of Franklin County,)
Ev Thomas (WH Miner Institute,)
Elson Shields, Department of Entomology, Cornell University

Farmer participants:

Background: Alfalfa Snout Beetle is a pest only found in N.Y.S. and Canada in North America. Much time, effort and resources have been spent to better understand and control this pest. The six counties of Northern New York all have documented infested areas of Snout Beetle. For the past several years' researchers have run major studies to learn more about this insect. Recently, the question has been asked, "Just how bad and widespread is this insect?" In order to answer this question, more field assessment must be done. This is a costly and time-consuming venture.

The field crop staff of the North Country was approached by members of the NNYADP Committee to consider doing a field assessment of the problem. Dr. Elsen Shields, Extension Entomologist at Cornell has agreed to backstop this project. Dr. Shields will offer training in identification and field assessment.

Methods: Surveys for he presenct of the alfalfa snout beetle will be conducted the Fall of 2005 and 2006 as follows.

Farms will be selected In each county, such that the survey will start at the edge of the previously know infestation. Alfalfa and clover fields with alfalfa and clover plants present will be selected for digging to inspect for snout beetle larval feeding. Field surveys will radiate out from the areas of known infestations. When 3 consecutive fields in a direction have been inspected and found free from snout beetle, then the survey should return to the edge of the known infestation and survey in a different direction. For survey purposes, older fields with surviving alfalfa and clover are best to detect ASB infestations. In most cases, 3 year and older fields should be selected.

To survey effectively, plants should be selected which have either died, declining with yellow foliage or are generally unthrifty. Particular attention should be directed to the edges of fields adjoining older grass/alfalfa fields where ASB may have moved into the field. These selected plants should be dug and the roots inspected for the characteristic severing of the taproot or the spiral groves in the taproot. One ASB damaged plant is sufficient to designate the field infested. If 50 plants are inspected throughout the field without sign of ASB feeding damage, the field can be considered as free from ASB infestation. GPS coordinates should be taken in each field, which is found to be infested with snout beetle. The GPS coordinates will allow the infested areas to be mapped with some accuracy.

Results:

Franklin:

1. 2005
    - 19 farms, 106 fields
    - No evidence of ASB: Burke-Chateaugay area; Fort Covington-Constable area; west side of Brushton to Dickenson and N. of Rte 11 east of Malone
    - 5 Farms Positive for ASB. They cover the following areas. Malone to Brushton between Rte 11 and 11B and some fields south of 11B; some fields east of Malone (as far as 6 miles.)
2. 2006 –No survey was conducted due to a staff vacancy in CCE Franklin County.

Clinton

1. 2005--4 farms at high risk for infestation; at least 2 fields per farm--No evidence of
2. 2006—3 high farms at high risk for infestation; at least 2 fields per farm—no evidence of ASB

Essex

1. 2005--No survey
2. 2006--Cornell E.V. Baker Research Farm---Beetles continue to be present in 2006, but not in sufficient numbers to continue the insecticidal fungi expt.

Lewis

1. 2005
    - 102 fields --Number of farms not specified
    - Compared to 1998 --Infestation in Lowville area has spread north to Copenhagen and South to Martinsburg and stretches west to rte 12 and east of rte 26
    - Confirmed ASB in Croghan, but unable to determine if it has spread.
    - Infestation now covers 90 sq. miles (56,000 acres). In 1998 "only a few acres" in a small area North of Lowville.

2. 2006

- Sampled 7 fields in 5 towns where ASB had not previously been found.
- One positive field which was adjacent to and directly south of a field that tested positive in 2005

St. Lawrence

1. 2005

- 26 farms; 88 fields
- Area above Black Lake and west of the Oswegatchie River has been infected for several years and continues to be so
- Infested area has move west, north and east and doubled in size (Lisbon)
- Hopkinton--new area of infestation
- Madrid-Waddington Area (adjacent to the Lisbon area)--no ASB
- Depeyster area--No ASB

2. 2006

- 19 farms; 90 fields
- No new infested fields.

Jefferson

1. 2005

- 8 farms; 24 fields in 8 different townships
- ABS not found in towns of Rodman or Hounsfield
- ABS present in town of Philadelphia in one area of lighter soil and in Rutland, Ellisburg, Adams and Henderson.

2. 2006

- 23 farms and 63 fields in 15 townships,
- ASB found in 9 of 44 fields studied in 6 new townships

Conclusions/Outcomes/Impacts: The areas infested with the alfalfa snout beetle continue to expand in counties where the insect was found in 1008 (Lewis, Jefferson, St. Lawrence and Franklin Counties.) The expansion of the area of infestation in these counties is extensive and significant. Although ASB was detected at one site in Clinton County in the '90s, that particular field was rotated out of alfalfa for several years and is now free of ASB. ASB has not spread from this confirmed site, nor has it migrated from Clinton County. ASB infestation in Essex county seems confined to the Cornell E.V. Baker Research Farm in Willsboro and the population there has apparently diminished. Surveys should continue to monitor the spread of this insect pest. Farmers, custom operators, construction companies and other businesses that move soil from one location ot another (like road crews who are cleaning ditches adjacent to hedgerows adjacent to alfalfa fields) should be alerted to the danger of inadvertently enhancing the migration of this pest to new farms and fields.

Northern NY Agricultural Development Program
2006 Project Report

Manure Management on Grasses

Project Leader(s):

- **Jerry Cherney**, Forage Specialist, Dept. of Crop & Soil Sciences, Cornell University
- **Mike Davis,** Manager, Cornell Baker Farm, Willsboro, NY
- **Quirine Ketterings**, Nutrient Management Specialist, Dept. of Crop & Soil Sciences, Cornell University

Background: Manure management has received environmental scrutiny in recent years due to potential nitrate contamination in ground and surface waters, and more recently due to similar concerns with phosphorus. Increased recovery and recycling of manure phosphorus by crops on dairy farms is needed to minimize environmental problems. Precise management of P nutrition in dairy cattle to optimize performance and minimize P excretion is also crucial. However, with increasing manure production per unit of cropland available for its disposal, animal waste has become one of the major sources of N and P pollution from agricultural sources. Perennial cool-season grasses provide alternative land area for in-season manure applications. Spring application of animal manure should maximize efficiency of manure nutrients applied to perennial grass stands, but the impact of manure applications at other times of the year on yield, forage quality, and nutrient recovery is not clear. These studies were designed to assess the relative impacts of N fertilization and manure application on yield, quality and nutrient utilization by perennial grasses. This information should be useful for refining CAFO guidelines for responsible nutrient management practices on dairy farms.

Methods: Our objective is to investigate the effect of manure timing on orchardgrass yield, quality and nutrient utilization under an intensive 3-cut management system. In the spring of 2003, 6 replicates of 9 different treatments were established in a field of Pizza orchardgrass at the Willsboro farm (Table 1). These treatments were designed to determine the impact of timing of manure applications, compared to recommended N fertilizer application.

Plots were harvested on June 2, July 12 and Oct. 6, 2006. In 2006 dry matter yield was determined and samples taken for forage quality analysis. Standard soil samples were taken in 2006, as well as deep soil cores in the fall for nitrate analysis. Deep core samples are still undergoing analysis.

Results: Spring harvest was later than normal, with very high yields and correspondingly lower forage quality. All manure treatments were numerically higher yielding than the commercial N treatment in the spring, this was also true for the total annual yields (Table 1). Treatments with manure application late during the previous year consistently had somewhat higher yields in the spring of 2006, compared to treatments without a late season manure application. After 4 years of application, it does not appear that split application of manure results in any increased yield over a single manure application.

Slightly delayed spring harvest had a much greater effect on forage quality of manure treatments compared to the commercial N treatment. Crude protein was very low in manure treatments, almost as low as the check plots (Table 2). In general, commercial N application results in higher CP values, but lower yields. Fiber digestibility values for spring harvest also reflect the late harvest date (Table 3). Fiber digestibility averaged 77% for 2005 spring harvest and 65% for 2006 spring harvest. As is generally the case, unfertilized checks were higher in fiber digestibility in the spring than fertilized treatments. Fiber digestibility in the fall was predictably low, with no differences in NDFD among all manure treatments.

Conclusions/Outcomes/Impacts: After four years of manure applications to orchardgrass it appears that manure timing does not significantly impact dry matter yield. Over half the manure treatments are now yielding statistically higher than recommended N fertilized plots. It remains to be seen if manure treatment effects have stabilized, or if another year of manure applications will push all manure treatment yields higher than recommended commercial N rates. The impact of late season manure application on soil nitrates going into the winter has yet to be determined.

Outreach: This is a long term study that is not yet completed. Preliminary results have been reported in statewide extension meetings. Final results will be developed into one or more agronomy factsheets and posted on websites.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. Although this project has been funded for 4 years and we were told it is time to move on to some form of on-farm trials, the fact remains that the final impact of treatments in this experiment is not yet clear. It will take at least another season of manure applications to clarify treatment differences. Therefore, we are continuing the experiment unfunded through 2007 and at least the spring of 2008 to properly evaluate treatments.

Acknowledgments: All work was completed with the assistance of the Chazy-Willsboro farm crew.

Person(s) to contact for more information (including farmers who have p articipated:

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Northern NY Agricultural Development Program
2006 Project Report

Exploring the Options for Meat Animal Livestock Production and Marketing

Project Leader(s): Bernadette Logozar, Rural & Ag Economic Development Specialist, 355 West Main Street, Suite 150, Malone, NY 12953
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Farmer participants: please see attached registration sheets coming via US Post.

Background: Interest in the area of grass-based, natural, organic, and value-added livestock production is growing in NNY. There are a growing percentage of farms that are diversifying into livestock-based farm ventures. According to the 2002 Ag Census 36% of farmers in Northern New York are non-dairy livestock farms. These farms are raising beef, chicken, turkey, pork, lamb, eggs and other diversified agricultural products for sale. These farms represent both newer and emerging livestock operations that utilize smaller land areas. These lands may have been dairy farms, and are no longer in operation. Many of these properties have a few beef, hogs, sheep or goats for personal consumption.

Some of these farms are selling their products through conventional market channels; others have not only diversified the farm operations but also have diversified their marketing outlets. The range of marketing options include direct marketing via the freezer trade, community supported agriculture (CSA's) also referred to as subscription farming, farmers' markets, direct to local retail stores and restaurants or even establishing a retail outlet on their farm or website to connect with their customers. The range of direct market opportunities for diversified livestock farmers are varied and currently underutilized.

Methods: This proposal reviewed the current existing marketing materials that are available to farmers from the industry itself. For example, the American Lamb Board has developed a number of promotional items such as stickers, signs and brochures to assist farmers in educating their customers about the quality of lamb they are selling.

In addition to the review of the industry marketing materials, was an outreach plan as well as a scholarship fund to help pay for conference and registration fees so that farmers from NNY could attend larger conferences out of the area. We have been able to send farmers to conferences in Vermont and other areas on NYS, as well as offset the cost to put on programs in NNY. Farmers who have been wishing to attend conferences but were unable to afford the registration fees or travel costs were able to attend these conferences. (please see attached letter from a farmer stating how this information would help him and his farm).

Results: A review of the beef, pork and lamb industries was conducted and materials gathered from these. After conversations with farmers what was found was that the use of these promotional materials were intermittent at best. We found that most farmers either did not know about the industry materials or if they did were not using these to their fullest advantage. What also because quite obvious was that farmers needed help with planning their marketing strategies which required a step back in the outreach to providing farmers with the Livestock Marketing Toolkit as a foundation to start with.

Therefore a collection of the marketing materials that are available through the various industry councils was compiled as well as a guide as to how to find these materials on the internet. These slick marketing materials coupled with the Livestock Marketing Toolkit, farmers in NNY region and beyond have a very good foundation in developing their own marketing strategy for their farm. Furthermore, this project helped to compile the resources these farmers need in order to talk knowledgeably to their customers.

Another aspect of this grant was creating a scholarship fund to help cover the costs for farmers who would like to attend conferences out of the area. These have been great opportunities for farmers to connect with like-minded folks from other areas and network with them as well as take advantage of significant learning opportunities they were unable to afford themselves. Each has expressed the desire to share what they have learned with farmers in NNY, which will help to encourage and strengthen farmer-to-farmer networking here in NNY.

We have been able to provide scholarships to the following farmers to attend conferences or programs out of their area:
Chris Sunderland – 5058 State Route 11, Ellenburg Depot, NY 12935
Connie Vitale & Stephen Lindberg – 275 County Route 23, Malone, NY 12953
Diane Dumont—P.O. Box 266 Brainardsville, NY 12915
Additional Requests have been made on the scholarship fund for conferences that will be happening in March-July. We have allotted the remaining amount to a designated fund to assist farmers with cost for these out of area conferences.

Regarding the Livestock Marketing Toolkit: Requests for the Livestock Marketing Toolkit and the success of these two sessions far surpassed the expectations of the organizers. It should be noted that the original idea for the Livestock Marketing Toolkit came directly from farmers. In February of 2003 we held a workshop called "Marketing Concepts for Rural Entrepreneurs" (which was funded in part by a Small Farms Grant) at which the 15 producers came up with the Tool-Kit as a practical means of passing on marketing knowledge.

The total number of toolkits that have been distributed to farmers either via the Livestock Marketing Workshops held in Lowville and Saranac Lake or via direct requests made to CCE Franklin office is 40. Additionally every CCE office in NNY has been provided with a copy of the Marketing Toolkit to have available to their staff. A complete list of this is included in the attached packet sent via US post.

Conclusions/Outcomes/Impacts: The information that has been compiled through this project is another building block and 'tool' that is available to farmers at no or low cost investment which can help them develop their marketing strategy or if they are already marketing directly to customers these resources will help them to strengthen these connections. The Livestock Marketing Toolkit and the Industry materials that exist are tools that farmers can use and implement now. This project brought these resources and materials out in user-friendly manner so that farmers can easily access and utilize these marketing materials to their fullest advantage.

Included with this report is compilation of the evaluations from the Saranac Lake Session of the Livestock Marketing Workshop.

A secondary outcome has been a desire to move forward with actively exploring market options available to livestock producers specifically beef producers in NNY. CCE Franklin County has had producer meetings to gauge the interest in establishing a weaned pool program (such as Mike Baker has in Central NY) in NNY. Beef producers from the area have expressed a strong interest in having a local central farm where they can send their animals to be backgrounded, and be able to supply more consistent quality animals to buyers. This outcome is a growth from this project as well as the New Strategies Project funded through NY Farm Viability Institute.

Outreach: Due to the fact that farmers needed help with basic marketing skills, guidance on developing their marketing strategy and tips on how to reach their customers the scope of the outreach of this project was adapted to better need these more pressing needs of the farmers in the NNY region. Two meetings were planned (one for ENNY and one for WNNY) which included industry representatives, Marketing experts and Food Safety Inspectors from NYS Department of Ag and Markets, Cornell University and CCE staff. These sessions were geared towards providing farmers with a comprehensive breadth of information related to marketing their livestock products and providing them with the skills to make sound marketing strategies and decisions. This included providing farmers with the Livestock Marketing Toolkit (which was developed in 2004 with funds from Cornell's Small Farm Program). Total number of participants who came to the two NNY sessions was 50 livestock producers. There were a higher percentage of beef producers, but also represented were sheep, pork and poultry farmers as well.

Since these December and January meetings, speaker requests have come from CCE Saratoga-Washington (scheduled to speak there in April), and speaker request to be part of the 2007 Cornell Sheep & Goat Symposium as these regions would like to have a similar presentation of the Livestock Marketing Toolkit and industry materials available to their audiences.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education: Next steps include continued market programming for farmers that is tied to production practices on the farm. Currently I am working with counties across the region in NNY to plan programs which will strengthens the connection between farmers and their customers. One such program in the preliminary stages is carcass evaluation for beef and sheep farmers. Both groups of farmers have expressed interest in learning about grading their animals in the field before shipping the animals to market. Accurate grading in the pasture will help farmers to know whether they need to feed a bit longer to finish an animal completely so the carcass can yield a higher grade. This program would have some hands-on seminars where farmers can learn how to grade the animals in the pasture, followed by a visit to a local slaughterhouse where farmers can see what the different grades look like on the rail. As well, farmers would have the opportunity to talk with local chefs who are buying local and find out what the restaurants are looking for in the meat they are purchasing.

There has been an expressed interest in the above program by both sheep and beef farmers, I have been working with my colleagues in the region to be able to offer a comprehensive program for both of these audiences.

Additional next steps that are needed are a continued progress and programming related to quality, consistency and quantity of the livestock produced in this region. If farmers are going to garner a better return on their investment then they need to be able to provide buyers with these three traits. To this end, we continue to work with Cornell's Beef Cattle Specialist and the Sheep and Goat Marketing program to offer comprehensive programs that help farmers to work towards greater consistency in the livestock they are sending to market. For the beef producers this involves looking at alternative market streams and considering the market BEFORE the production. To this end, NNY CCE educators are working to provide regular pasture walks, seminars and hands-on workshops to help farmers plan for the markets they are going towards when they are considering the production side of the farm. This is especially significant for those farmers who are transitioning from one area of agriculture to another or are new or beginning farmers.

Acknowledgments: The overall success of this project and related programs would not have been possible without the assistance of my colleagues in the region and around the state. Most instrumental in helping to ensure we offered a quality program was Michele Ledoux, Exec. Director, CCE Lewis County mel14@cornell.edu phone: 315-376-5270

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Northern NY Agricultural Development Program
2005-2006 Project Report

The Effect of Manure Application on Yield and Quality of Alfalfa Harvested in Northern New York

Project Leaders: **C.S. Ballard, K. W. Cotanch, H. M. Wolford, S. A. Flis, E.D. Thomas,**
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Introduction: Dairy manure slurry is usually applied to fields cropped to corn or grass. The addition of alfalfa fields could provide an alternative land-base for manure application. While dairy manure can be an excellent source of phosphorus and potassium for alfalfa stands, it must be managed properly to avoid negative impacts on the stand and environment. The potential for alfalfa injury arises from the salts in the manure (including free ammonia), soil compaction and physical damage to the crowns during application (Kelling and Schmitt, 2003). Research conducted in Wisconsin demonstrated that topdressed manure decreased crop yields and damaged alfalfa crowns in wheel track areas (Kelling and Schmitt, 2003). More studies are needed to assess the impact of manure application and compaction of equipment on the survivability and quality of the alfalfa stand. Timing of manure application after harvest should also be evaluated to determine if negative impacts of spreading increase when regrowth has occurred.

Objectives:

1. To evaluate the impact of applying dairy manure slurry to harvested alfalfa.
2. To evaluate the impact of applying dairy manure slurry to alfalfa after 4" of regrowth.

Materials and Methods: Following a randomized block design, four plots were divided into three strips per plot. One of three manure treatments were randomly assigned to each strip/plot; 1) Control (no manure); 2) Manure applied after harvest – 0-3 days; or 3) Manure applied after 4 inches of regrowth ~7-10d. After first harvesting at 4-inch cutting height, manure treatments were applied after their respective regrowths at approximately 11,000 gallons/acre. At the time of manure application, flags were used to mark the area where wheel tracks were made. These areas were used for alfalfa plant sampling at the time of second and third harvest.

At the time of second and third cutting, alfalfa was harvested at 4-inch cutting height. Yield was estimated and chopped forages were dried and ground for chemical analysis. Crown damage to alfalfa was qualitatively assessed within wheel tracks following second cutting. No manure was applied after second cutting to assess the residual effects of the initial manure application on yield and chemical analysis of alfalfa at the time of the third cutting. Crown damage was also assessed following third cutting to determine regeneration of plants damaged at the time of manure application.

Prior to second and third cutting, six alfalfa plants from the wheel track area where manuring equipment passed after initial harvest were randomly selected and removed from each treatment strip. Numbers of shoots per plant were counted and plants were assessed for crown and root health. A rating system (0-5) was used when evaluating the condition of each plant (Table 1) (Undersander et al. 1998).

Table 3. Rating alfalfa crown and roots

Rating	Condition
0	Healthy
1	Some discoloration
2	Moderate discoloration/rot
3	Significant discoloration/rot
4	Greater than 50% discoloration/rot
5	Dead

Yield and chemical composition of forages harvested from the field were analyzed as a randomized complete block design using Proc GLM in SAS (version 9.1). When $P \leq 0.05$, orthogonal contrasts were analyzed to determine effect of manure application and comparing times of manure application (3 d versus 7 d post-harvest). Categorical data used for assessing alfalfa plant health were analyzed using the Friedman's Chi-square statistic.

Results: Dry matter yields of second and third cutting and combined yields are presented in Table 2. Manure application does not appear to have any influence on yield. It should be noted that the high standard errors contributed by a malfunction of a load cell in the scales used to measure crop yields may have reduced the sensitivity of this comparison.

Table 2. Dry matter yield (T/acre) of grass/alfalfa following manure application after first harvest as calculated for second cut, third cut, and combined cutting yield.

	Manure application treatment*				
Cutting	0	3d	7d	sem	*P*
Second	0.43	0.50	0.49	0.09	0.856
Third	0.66	0.56	0.60	0.04	0.370
Combined	1.09	1.06	1.09	0.10	0.984

*Manure application treatment: 0=no manure applied; 3d=manure applied 3d after first harvest; 7d=manure applied 7d after first harvest.

Manure application after first cutting did not have a significant impact on the quality of forage harvested at second and third cutting (Tables 3-5). While ash content was significantly higher for forages receiving manure application at second and third cutting, (average of cuttings: 8.14, 8.64, and 8.62 for no manure, manure 3 d, and manure 7 d, respectively P=0.002), ash concentration less than 10% is considered acceptable for an alfalfa/grass mix. From the nutrient composition of the forages harvested, it is evident the composition of the field was predominantly grass with smaller percentage of alfalfa than anticipated. This study will be repeated in 2007 using a field with a higher composition of alfalfa.

Table 3. Chemical composition and digestibility of grass/alfalfa following manure application after first harvest – second cutting.

	Manure application treatment*				
Item	0	3d	7d	sem	*P*
CP (%DM)	17.13	17.32	17.66	0.19	0.206
NDF (%DM)	44.80	45.80	45.85	0.42	0.214
ADF (%DM)	29.63	29.91	29.59	0.33	0.756
Lignin (%DM)	5.92	5.69	5.64	0.13	0.310
Ash (%DM)	8.22	8.75	8.93	0.08	0.003**
DMd_{24} (%DM)	79.96	80.68	81.14	0.42	0.208
$NDFd_{24}$ (% original NDF)	55.82	57.77	58.69	0.83	0.119

*Manure application treatment: 0=no manure applied; 3d=manure applied 3d after first harvest; 7d=manure applied 7d after first harvest.
**Contrast *P*-value: Control vs. manure application *P*=0.001; 3d vs. 7d *P*=0.182

Table 4. Chemical composition and digestibility of grass/alfalfa following manure application after first harvest – third cutting.

	Manure application treatment*				
Item	0	3d	7d	sem	*P*
CP (%DM)	17.73	17.81	17.62	0.26	0.873
NDF (%DM)	46.18	46.41	46.34	0.30	0.862
ADF (%DM)	28.28	29.18	28.84	0.28	0.145
Lignin (%DM)	5.59	5.79	5.70	0.11	0.484
Ash (%DM)	8.05	8.52	8.31	0.07	0.007**
DMd_{24} (%DM)	82.24	81.85	82.05	0.38	0.778
$NDFd_{24}$ (% original NDF)	61.51	60.90	61.24	1.01	0.915

*Manure application treatment: 0=no manure applied; 3d=manure applied 3d after first harvest; 7d=manure applied 7d after first harvest.
**Contrast *P*-value: Control vs. manure application *P*=0.004; 3d vs. 7d *P*=0.063

Table 5. Chemical composition and digestibility of grass/alfalfa following manure application after first harvest – 2nd and 3rd cutting combined.

	Manure application treatment*				
Item	0	3d	7d	sem	*P*
CP (%DM)	17.43	17.56	17.64	0.21	0.776
NDF (%DM)	45.49	46.10	46.10	0.39	0.466
ADF (%DM)	28.95	29.55	29.21	0.28	0.339
Lignin (%DM)	5.76	5.74	5.67	0.08	0.721
Ash (%DM)	8.14	8.64	8.62	0.09	0.002*
DMd_{24} (%DM)	81.10	81.26	81.59	0.42	0.702
$NDFd_{24}$ (% original NDF)	58.67	59.34	59.96	1.10	0.712

*Manure application treatment: 0=no manure applied; 3d=manure applied 3d after first harvest; 7d=manure applied 7d after first harvest.

**Contrast *P*-value: Control vs. manure application *P*=<0.001; 3d vs. 7d *P*=0.910

There was no difference in number of shoots per alfalfa plant at second cutting when no manure was applied, manure applied 3d after harvest or 7d after harvest, 4.3, 4.0, 4.2 respectively (*P*=0.929). Understandably, no difference was also seen in number of shoots per plant at the time of third cutting, 7.8, 8.8, and 8.1, respectively (*P*=0.787). The amount of damage to alfalfa plants caused by applying manure after first cutting was negligible as demonstrated by the condition rating crown size and symmetry of alfalfa crowns of plants after second and third cutting (Tables 6-8).

Table 6. Condition rating of alfalfa plants at time of second and third cutting after manure was applied 3d or 7d following first cutting (% plants in each rating classification).

	Second Cutting			Third Cutting		
Rating	0*	3d	7d	0	3d	7d
0	4.17	0.00	0.00	4.17	0	8.33
1	4.17	0.00	0.00	8.33	4.17	4.17
2	50.00	57.14	70.83	45.83	70.83	66.67
3	16.67	19.05	12.50	0	8.33	8.33
4	16.67	14.29	4.17	20.83	4.17	12.50
5	8.33	9.52	12.50	20.83	12.50	0
	P-value			0.072		

*Manure application treatment: 0=no manure applied; 3d=manure applied 3d after first harvest; 7d=manure applied 7d after first harvest.

Table 7. Crown size of alfalfa plants at time of second cutting after manure was applied 3d or 7d after first cutting (% plants in each rating classification).

	Second Cutting			Third Cutting		
Crown Size	0	3d	7d	0	3d	7d
Large	16.67	9.52	4.17	16.67	29.17	29.17
Medium	25.0	33.33	25.0	37.50	41.67	29.17
Small	58.33	57.14	70.83	41.67	25.0	37.50
Extra small	0	0	0	4.17	4.17	4.17
P-value	0.405			0.487		

*Manure application treatment: 0=no manure applied; 3d=manure applied 3d after first harvest; 7d=manure applied 7d after first harvest.

Table 8. Symmetry of alfalfa plant crowns at time of second cutting after manure was applied 3d or 7d after first cutting (% plants in each rating classification).

	Second Cutting			Third Cutting		
Crown Symmetry	0	3d	7d	0	3d	7d
Symmetrical	29.17	28.57	12.50	39.13	45.83	50.0
Less symmetrical	29.17	14.29	20.83	26.09	20.83	16.67
Poor symmetry	41.67	38.10	54.17	26.09	20.83	20.83
No symmetry	0	19.05	12.50	8.70	12.50	12.50
P-value	0.803			0.770		

*Manure application treatment: 0=no manure applied; 3d=manure applied 3d after first harvest; 7d=manure applied 7d after first harvest.

Conclusions

Application of manure after first cutting did not appear to cause notable damage to alfalfa plants recovered from areas trafficked by the manuring equipment. Impact of manure application on forage quality as assessed by nutrient composition and digestibility will need to be reassessed in 2007 using a field with higher alfalfa composition.

Education and Outreach Plan

Results of this research will be published in the monthly Miner Institute Farm Report, with readership of over 10,000. This newsletter is not copyrighted, and articles are often used by farm newspapers and county Cooperative Extension publications. Ev Thomas presented the results of this study at the 2006 Dairy Day held at Miner Institute.

Northern NY Agricultural Development Program
2006 Project Report

Evaluation of Wide Swathing of Haylage in Northern NY

Project Leader(s):

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Farmer participants:

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Bernie Moultan, St. Lawrence County

Background:

Dairy farming is the primary agricultural enterprise in northern NY. High quality forage is essential to the profitability of this enterprise. There are two management factors that have primary control of forage quality. The first is harvesting at the optimum quality stage; NDF can increase more than one percentage unit per day in late May. The second is the ability to maintain a high quality forage throughout the harvest process, particularly during the typically wet spring season. We have known for decades that laying out cut forage in a wide swath will speed up the drying process. Rapid drying early in the field curing process can minimze losses (Rotz and Muck, 1994). However, when haylage replaced dry hay as the primary method of preserving high quality forage for dairy cattle, the practice of conditioning forage into a narrow swath became popular. It potentially saved a trip across the field and minimized knocking off of leaves, compared to the raking of relatively dry forage in a wide swath.

Conditioning into narrow windrows gained rapid acceptance for alfalfa across the U.S., almost all haylage made in the early years of haylage was alfalfa. When grass haylage became popular as well, the same management practices were used. The transition from dry hay to haylage came at a time when the importance of forage quality for dairy cattle was not as well understood or appreciated as it is now. Improvements in haylage harvesting since then have been primarily driven by engineers interested in improving the efficiency of the haylage harvesting system. Better mowers, conditioners, tedders, rakes, and harvesters have improved harvest efficiency. With the recent development of forage macerators, the importance of a wide swath of cut material for effective drying became readily apparent. The idea of simply cutting forage and laying it out in a wide swath for rapid drying, however, is not a concept that many engineers and equipment companies are likely to readily embrace. It is running contrary to several decades of machinery development. However, there are some mowers currently available that allow wide swathing and do not have conditioner rollers.

The goal for good haylage making is to reduce moisture to an acceptable level (usually below 70%) and ensile the product as quickly as possible. Alfalfa forage laid out in a wide swath should dry to 70% or below with or without conditioning, grass may be able to do this as well. Research to-date indicates that forage quality may actually increase in wide-swathed forage, because most of the cut plants are exposed to the sun and continue to photosynthesize. If wide-swath forage is harvested the same day it is cut, with high levels of sugars, it should ensile faster and better.

Particularly for dairy farms attempting to improve their economic bottom line by utilizing high forage diets, excellent forage quality is critical. Any harvest system that can prevent the overnight losses of sugars in cut forage will result in forage that has the best chance of successful ensiling and maximum silage stability, with minimum soluble protein. Wide swathing has the potential to become a commonly accepted practice on New York State dairy farms.

Tom Kilcer, cooperative extension educator from Rensselaer County, states that wide swathed first cut alfalfa haylage produced 13% more milk than narrow swathed haylage. The economic cost of making wide swath haylage without conditioning may be lower than narrow swath haylage. No conditioning means less power requirements. If wide swath haylage is higher in quality and costs less to make, the potential economic impact is very high. With the anticipated rise in corn grain prices due to the widespread expansion of corn for ethanol, it will become even more critical to have the highest possible forage quality to minimize the need for concentrates. Our objective was to determine if wide swathed forage would dry to a moisture content appropriate for ensiling on the same day that it was mowed.

Methods:

If wide swathing allows us to harvest haylage on the same day that it is cut, we can avoid large overnight losses of sugars. For wide swathing to become a common practice it is essential that cut forage drop to under 70% moisture in time to allow same day harvest. Our original plan was to attempt wide swathing in three counties: Essex, Lewis and St. Lawrence. The amount of equipment and personnel needed, and the difficulty in moving this equipment around made this plan untenable. After assessing fields in Lewis County, it was decided to focus on St. Lawrence County fields. Potentially available fields in St. Lawrence County were higher yielding, more uniform, and were concentrated in a small region, making movement of equipment between sites possible.

After numerous discussions with equipment dealers in northern NY several issues became apparent. Most equipment dealers did not believe it was possible to get a truly wide swath (90% of the cut area covered with swath) with modern equipment. Dealers were either firmly in favor of conditioning rollers, or firmly in favor of tine or finger conditioners. Eventually we contacted Kuhn Farm Machinery's North American Headquarters in Vernon, NY. Kuhn manufactures both roller and tine conditioners, and their experts stated that proper adjustment of conditioners is much more important than which type is chosen. We also discovered that Kuhn Equipment of France makes a wide swathing kit for their mowers in Europe, although none were being used in North America. This kit allows a wide swath of approximately 90%, if a few other minor adjustments were made to the mowers. Since Kuhn has 9 ft wide disc mowers with and without conditioners, it was possible to generate several different treatment combinations. Kuhn provided us with a 9 ft. mower without conditioner that allowed a wide swath, a 9 ft mower with tine conditioner and wide swathing kit that allowed both a narrow and wide conditioned swath. A Kuhn gyro-tedder allowed us to tedd a narrow-conditioned swath out to a 100% wide swath. Kuhn also provided a rotary rake to windrow all treatments at the appropriate time. Two large tractors with cabs were rented for the test period, and a smaller tractor from the St. Lawrence County extension farm was used for tedding and raking. All equipment worked with a 9 ft swath, which made the treatment comparisons possible. A large crew was required to deal with all treatments in a timely fashion, extension personnel from St. Lawrence and Lewis Counties assisted with the operation.

Fields of reed canarygrass (less than 20% alfalfa), a 50:50 alfalfa-orchardgrass mixture, and alfalfa (less than 10% grass) were selected near Madrid in northern New York. The primarily grass and alfalfa-grass mixtures were on Bernie Moultan's farm, while the alfalfa field was on Jon Greenwood's farm. Four treatments were evaluated: 1) mowing without conditioning into a wide swath (WS), 2) mowing with conditioning into a wide swath (CWS), 3) mowing with conditioning into a narrow swath (CNS), and 4) mowing with conditioning into a narrow swath, immediately followed by tedding the cut forage into a wide swath (CTNS). Mower width for all treatments was 9 ft, using disc mowers. Swaths from WS and CWS covered approximately 90% of the mowed surface, swaths from TNS covered approximately 100% of the mowed surface. Four swaths approximately 60 m in length were cut per plot and three replicates were sampled for yield and quality periodically through the day. Swath samples from a 0.9 x 2.4 m quadrat were collected using a hedge trimmer and chopped for subsampling. Samples taken when forage reached approximate silage moisture content were chopped and immediately ensiled in vacuum-packed bags.

Results:

Wide swath treatments reached silage moisture the day of cutting. The CTNS treatment dried faster than WS or CWS for all three studies. Tedding has been recommended to maximize drying rate (Shinners, 2006). No differences were detected in drying rates between conditioned and unconditioned wide swaths. Grass and alfalfa-grass dried quickly, due to optimum drying conditions on those dates.

For pure alfalfa, CTNS dried at 2.5%/h and reached 65% moisture in 5.3 h. CWS and WS dried at about 2.0%/h and reached 65% moisture in 6.6 h. CNS dried at 1.6%/h and took over 8 h to reach 65%, making silage in a day unlikely.

For pure alfalfa, pH of silage from NS (4.6) was significantly higher than from CNS (4.5). All treatments ensiled well. Total sugars were 23% higher in CTNS compared to CWS, and fiber digestibility in CTNS and WS was 36 g/kg higher than NS. Wide swath mowing to 90% or more of the cut width should consistently result in dry down to silage moisture on the same day, when mowing occurs on a day with reasonable drying conditions.

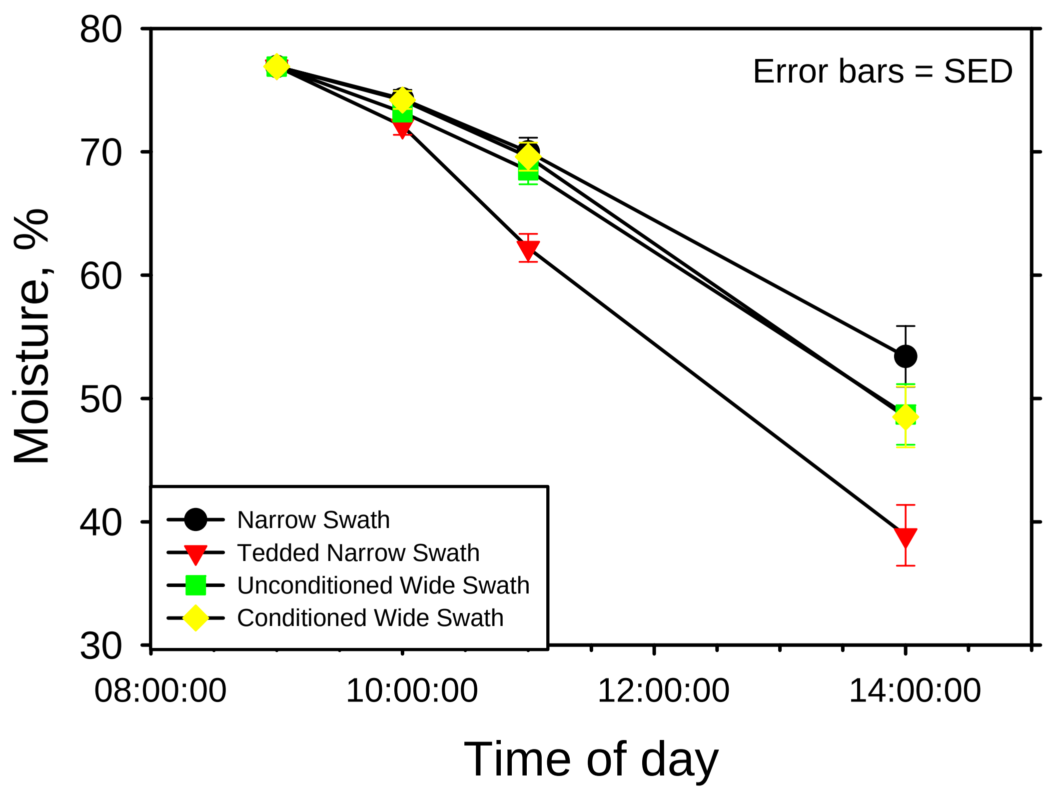

Figure 1. Alfalfa-grass dried very quickly, resulting in silage moisture levels in one day, even in narrow swaths. Tedding resulted in faster drying than other treatments. The pattern above for the four treatments was consistent for all three fields tested.

Conclusions/Outcomes/Impacts:

- Forage quality is maximized by ensiling on the same day that forage is mowed.
- It is possible to harvest forage for silage on the same day it is cut in the Northeast USA, using wide swathing.
- Considering the additional power requirements for conditioning as well as the increased machinery cost, conditioning of a wide-swathed grass-legume silage crop in the Northeast is questionable.
- Tedding immediately after mowing will speed up drying over wide swathing alone.
- Farmers in northern NY should seriously consider wide swathing without conditioning.

Outreach

Wide swathing results were presented at the November 2006 CCE Inservice training session, to inform extension educators statewide of the results obtained. Wide swathing results will be reported at a number of cooperative extension meetings across NYS during the winter 2007 meeting season. Results will be reported at the American Forage and Grassland annual meeting in June 2007 in Lancaster, PA. This is a farmer-oriented forage meeting.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education.

More research is needed in a variety of areas. Mowing needs to be completed in a relatively short time period in the morning, in order to make silage in a day. Is wide swathing feasible on farms with a large acreage of forage that needs to be cut quickly? If forage is cut late in the day and laid in a wide swath, is the loss in sugars through respiration overnight compensated for by the higher level of sugars found in forages later in the day? Will wide swathing work with large scale mowers?

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Photos

Kuhn mower without conditioner. This mower can produce a wide swath of approximately 90% by removing swath adjusters. Photo credit: D. Cherney.

Kuhn mower-conditioner with wide swath attachment. A wide swath attachment allows an approximately 90% wide swath with conditioning. Photo credit: D. Cherney.

Northern NY Agricultural Development Program
2005-2006 Project Report

The Effect of Cutting Height on Yield and Quality of Alfalfa in Northern New York

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Introduction: The increased use of disc mowers, which are much less susceptible to damaged knives than sicklebar mowers, has resulted in many farmers mowing alfalfa fields considerably closer to the soil surface, less then 3" of stubble height. Decreasing the amount of stubble left in the field will increase yields. Canadian research reported that cutting 5 different varieties of alfalfa at 2-inch versus 4-inch increased yield in the first cutting by 588 tons/acres and by 172 tons/acre in the second cutting (www.agr.gc.ca/pfra/csidc/alfacut_e.htm). Research done in Wisconsin also reported that for each cutting of alfalfa the forage yield increased as cutting height was reduced.However, since the increased yield is due to the harvest of more stem material and not more leaf material forage quality may decrease. The Canadian research reported a decrease in % protein as cutting height decreased (www.agr.gc.ca/pfra/csidc/alfacut_e.htm). The Wisconsin researchers concluded that for each 1-inch reduction in cutting height forage quality decreased an average of 4 units of relative feed value (Wiersma and Weiderholt, 2001). Finally, some forage labs are reporting unusually high ash levels, possibly due to soil contamination from mechanical
Harvesting are of concern.

Objective: To evaluate the current university recommendation to mow alfalfa at a 2-inch cutting height.

Materials and Methods: Two studies were conducted to determine if harvesting alfalfa at 2-inch and 4-inch cutting height influences forage quality and yield. The first study involved the hand-harvesting of forage from second year stand of alfalfa.

Hand harvest (Prior to field harvest) Three 24" X 36" areas were selected randomly within four plots and hand-harvested at 2-inch cutting height for first and second cuttings, while harvest of two areas provided adequate sample for third cut. Sward composition of the field was evaluated by separating forage species, drying and calculating sward composition based on dry weights. Two inches of stems were removed, weighed, dried and ground for analysis from harvested material. Remainder of harvested plants was weighed, dried and ground for analysis and this material was used to estimate 4-inch cutting height yield and forage quality. The 2-inch cutting height data was determined by mathematically calculating the yield and forage quality from the weighted average of 2-inch stems removed from the plants and the remainder of the plants for alfalfa and grass species. Alfalfa and grass species harvested were sent to a commercial lab for wet chemistry analysis (Cumberland Valley Analytical Services, Hagerstown, MD) for determination of NDF, ADF, lignin, and ash. In vitro 24-h DM and NDF digestibility was evaluated using the Ankom system at the Miner Institute Forage Laboratory. Chemical and digestibility parameters of alfalfa and grass species were reported individually and as a combined value representative of field composition determined by calculating the weighted average of the alfalfa and grass.

Mower Harvest: A limitation of the hand-harvest trial was the lack of foreign material including soil and debris that may be inadvertently harvested when disc mowing. Therefore, a second study involved areplicated field harvest of alfalfa at theoretical cutting heights of 2-inch and 4-inch. Actual cutting height was determined after harvest by measuring stubble height from 15 random locations within each harvest plot. Yield was estimated and chopped forages were dried and ground for chemical analysis.

Statistical Analysis: Data were analyzed as a randomized block design using Proc GLM procedures of SAS (version 9.1).

Results and Discussion

Field Composition At first harvest there was 15.81% more grass in the plots than alfalfa (Table 1). However, at the second and third cuttings there were 49.43 and 40.61% more alfalfa than grass, respectively (Table 1). The difference in the composition of the plots is likely due to multiple environmental and management practices. Prior to the first cut total rainfall for May 2006 was 3.8" compared to an average of 2.5". Additionally the average daily temperature was only 63.5°F. These environmental conditions favor grass over alfalfa growth. In the 2nd and 3rd cuttings the frequency of cuttings and leaving a stubble height of 2-inch may have caused reduced re-growth in the reed canary grass. In Minnesota when an alfalfa grass mixture was cut 3 times in a season the reed canarygrass was nearly eliminated at one location in the study (Sheaffer et al., 1990). Additionally Davis (1960) reported that close-cutting reduced both tillering and yield in reed canarygrass.

Table 4. Forage composition of field during first, second and third cuttings (% wet weight).

	Alfalfa		Grass		Other	
Cutting	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
First	41.77	9.15	57.58	8.58	0.65	0.84
Second	74.41	5.74	24.98	5.64	0.61	0.51
Third	69.67	16.96	29.06	17.31	1.27	1.35

Yield Expectedly, dry matter yield of hand-harvested alfalfa/grass was significantly higher for all 3 cuttings and for the combined yield at the 2-inch cut height (Table 2). The greatest yield difference was at first cutting when the 2-inch cut height yielded 0.3 T DM/acre more (Table 2). Yield of field-harvested material was unable to be calculated due to malfunction of a load cell in the scales used to measure crop yields in the field.

Table 2. Dry matter yield of alfalfa/grass hand harvested at 2- and 4-inch cutting height as calculated for first, second and third cutting, and combined cutting yield.

DM Yield (T/acre)	2-inch	4-inch	SE	*P*
First	1.99	1.69	0.02	0.001
Second	0.79	0.71	0.002	<0.001
Third	1.43	1.33	0.01	0.002
Combined	4.22	3.73	0.01	<0.001

Forage Quality – Alfalfa/Grass Hand Harvest The calculated chemical analysis of all three cuttings of hand-harvested alfalfa/grass showed that the 4-inch cut was higher than the 2-inch in CP, ash, and DMd % DM (Table 3). The NDF, ADF, and lignin (% DM) were all lower in the 4-inch than the 2-inch (Table 3). Additionally, the NDFd (% original NDF) was higher in the 4-inch than in the 2-inch (Table 3). This was as expected for all measurements but ash. While the 4-inch was significantly higher in ash, which was not the expected result, the largest difference in ash for all three cuttings was only 0.12% DM in the third cutting (Table 3). Further no ash values for either cutting height were more than 9.08% DM (Table 3). These results indicate that differences in ash for cutting height will be due to equipment picking up soil, not the ash content contributed by the lower part of the plant. Overall, differences in chemical analysis were small and not biologically significant.

Milk per acre When yield and quality of the alfalfa/grass hand harvested material was used in the Milk2000 model, the 2-inch cutting resulted in more milk per acre at each cutting and for the average of all three cuttings (Table 4). Despite the statistically significant differences in the chemical analysis of the two cutting heights, they are not biologically different. However, the higher yield/acre for the 2-inch cutting height will result in more milk per acre. Additionally, the largest difference in milk per acre was realized when the largest difference in yield was seen (Tables 2 and 4). Work done in Wisconsin using the Milk95 model reported similar results, with milk yield per acre increasing as cutting height decreased (Wiersma and Weiderholt, 2001). The Wisconsin researches concluded that totaled over the 3-cut season, milk yield increased by 900 lbs/acre with each 1-inch reduction in cutting height (Wiersma and Weiderholt, 2001).

Table 4. Milk per acre calculated from Milk2000 for all three hand harvested cuttings and combined.

Cutting	2-inch	4-inch	Difference (2" – 4")
First	5448	4726	722
Second	2555	2355	200
Third	4293	4119	174
Combined	12596	11377	1219

Forage Quality – Alfalfa and Grass Hand Harvest Alfalfa and grass that was hand harvested were chemically analyzed separately and had the same trends as the calculated hand harvested alfalfa/grass mix for all parameters except ash. Additionally, in the first cutting alfalfa the lignin (% DM) was not statistically significant, but the numerical difference was 0.23% DM higher in the 2-inch than the 4-inch cutting height (Table 5). However, the difference in the first cutting 2-inch and 4-inch cutting height for the alfalfa/grass mix was 0.30% DM, which was statistically significant (Table 3). Again, the 4-inch cut was higher than the 2-inch in CP and DMd (% DM, Tables 5 and 6). The NDF, ADF, and lignin (% DM) were all lower in the 4-inch than the 2-inch (Tables 5 and 6). Additionally, the NDFd (% original NDF), was higher in the 4-inch than in the 2-inch (Tables 5 and 6). The separate analysis of the alfalfa and the grass for ash showed that there was no difference in the ash content of the grass for first and third cutting and in the second cutting the 4-inch was significantly lower than the 2-inch cutting height (Table 6). The alfalfa analysis for ash showed the same results as the alfalfa/grass mix, with the 4 inch cutting height always higher than the 2-inch cutting height (Tables 3 and 5).

Mechanical (Field) Harvest – Actual Cut Height and Forage Quality The actual cutting height for the forage harvested using the conventional mower was not exactly 2 or 4 inches, but was significantly different for the first and second cuttings (Table 7). The actual difference between cutting height for the first cutting was 1.46 inches and 1.23 inches for the second cutting (Table 7). There was only a 1.0 inch difference in the actual cut height of the third cutting. This was likely influenced by a high rate of lodging due to a storm.

Table 7. Actual cutting height of forage harvested using a conventional mower.

Cutting	2-inch	4-inch	SE	*P*
First	2.94	4.40	0.10	0.002
Second	2.64	3.87	0.05	<0.001
Third	3.75	4.75	0.38	0.158
Overall	3.11	4.34	0.13	<0.001

The chemical analysis of the mechanically-harvested alfalfa/grass mix showed the same trends for all parameters except ash (Figure 1 a,b,c). The lignin (% DM) and NDFd (% of original

NDF) were the only two parameters that were significantly different, with lignin lower and NDFd higher in the 4-inch (Table 8). The numerical difference between the 4-inch and the 2-inch cutting height at the first harvest was greater for the mechanical harvest for lignin and DMd (% DM), and NDFd (% original NDF, Figure 1a). The ADF and DMd (% DM) were significantly different in the second cut of the mechanically harvested alfalfa/grass with ADF lower and DMd higher in the 4-inch (Table 8). The numerical difference between the 4-inch and the 2-inch cutting height at the second harvest was greater for ADF, lignin, and DMd (% DM) and NDFd (% original NDF) for the mechanically harvested versus the hand harvested (Figure 1b). The chemical analysis of the mechanically harvested alfalfa/grass was not significantly different for the third cutting (Table 8). Again in the third cutting the numerical difference between the 4-inch and the 2-inch cutting height for ADF, lignin, and DMd (% DM) and the NDFd (% original NDF) were larger for mechanically-harvested versus hand-harvested forages (Figure 1c). Finally, the numerical difference in ash % DM was opposite in the mechanically harvested from the hand harvested, with the 4-inch having a lower ash value than the 2-inch (Figure 1 a,b,c). This was the expected result. The action of the mechanical cutting and chopping is adding some soil to the forage. However, the highest ash in the mechanically harvested alfalfa/grass was only 8.92% DM. An ash concentration less than 10% is considered acceptable for an alfalfa/grass mix.

The milk per ton, calculated from Milk2000, was 2615 and 2813 lbs of milk/ton for the average of the 2-inch and 4-inch mechanically-harvested alfalfa/grass. This indicates that despite the lack of significant differences in forage quality there is a difference in the potential milk yield from the forage. However, without accurate yield data available for the mechanically-harvested alfalfa/grass the calculation of milk per acre is not possible.

Conclusions Overall, there is little or no difference in the quality of forage harvested when an alfalfa/grass mix is cut at 2 or 4 inches. There is an indication of a difference in the yield from the hand harvest data, with the 2-inch cutting height yielding more forage, as expected. More accurate data on yield from the field harvest of the two cutting heights is needed to determine the milk per acre. It appears that the decision of alfalfa/grass cutting height should be made based on field conditions, needs for forage, and grass species planted.

Education and Outreach Plan. Results of this research will be published in the monthly Miner Institute Farm Report, with readership of over 10,000. This newsletter is not copyrighted, and articles are often used by farm newspapers and county Cooperative Extension publications. Ev Thomas presented the results of this study at the 2006 Dairy Day held at Miner Institute.

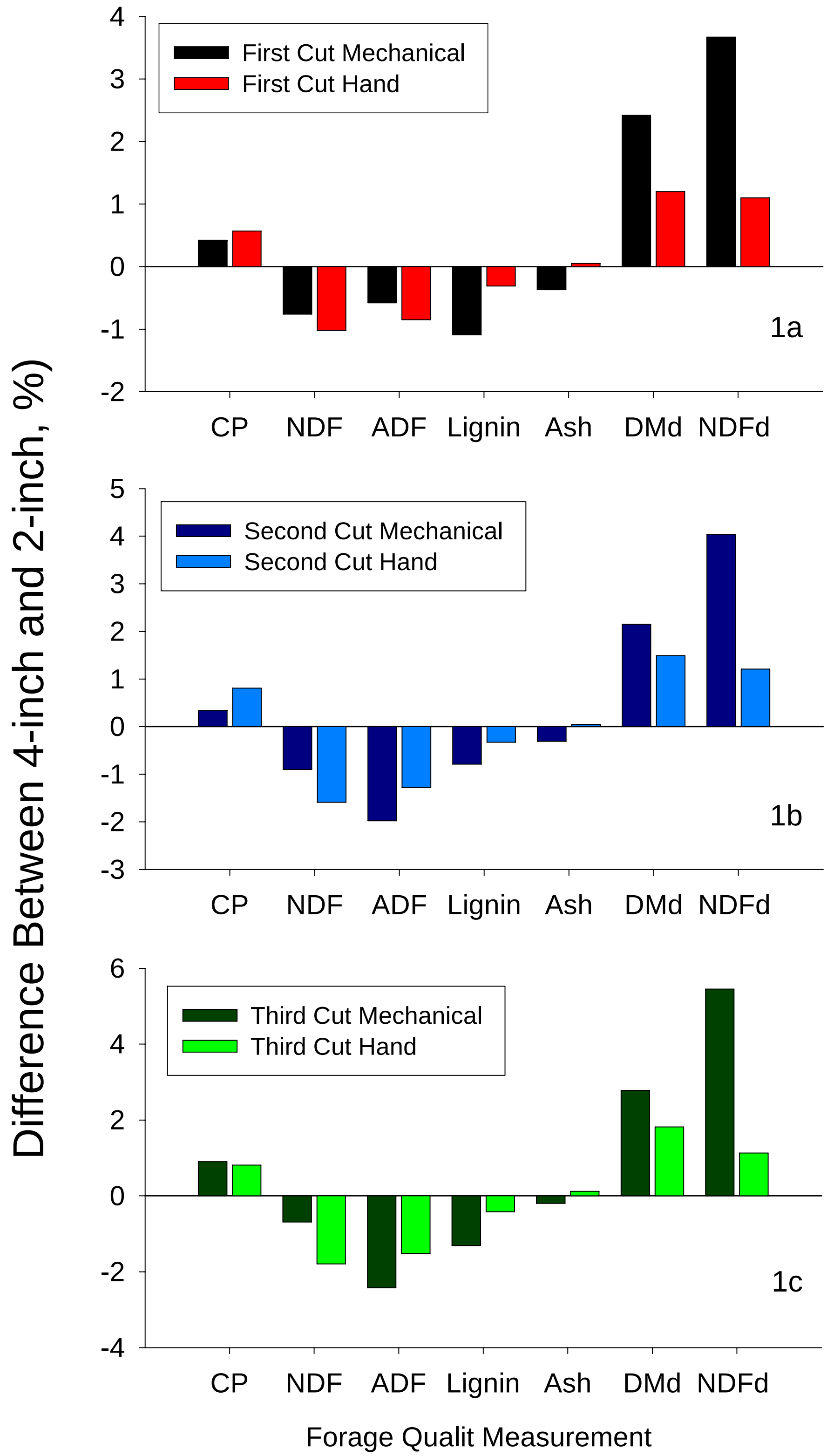

Figure 1 (a,b,c). Difference in forage quality measurements of the 4-inch and 2-inch cutting heights for the mechanical and hand harvest.

Northern NY Agricultural Development Program
2006 Project Report

Corn Silage Hybrid Trials in Northern NY

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Background: Corn silage is a major crop in New York because dairy producers prefer this high-energy forage in the feed ration. Dairy producers in the six-county region (Lewis, Jefferson, St. Lawrence, Franklin, Clinton, and Essex) of Northern NY have planted about 100,000 acres of corn silage annually since 1999, which represents almost 85% of the annual corn acreage in Northern NY. Consequently, dairy producers in Northern NY plant about 20% of the New York corn silage crop (~500,000 acres). Clearly, corn silage is an important crop in Northern NY and Northern NY is an important region of the state for corn silage production. Corn silage research in Northern NY would greatly benefit both Northern NY and New York State.

We have evaluated numerous corn hybrids under different management practices including planting date, plant density, row spacing, N rate and timing, harvest date, and harvest cutting height. In most instances, the hybrid planted had a greater influence on silage quality than have management practices. Consequently, we believe that hybrid selection is the most important management practice affecting corn silage quality in most growing seasons.

Until 1990, most agronomists and animal nutritionists believed that high-yielding grain hybrids were the best corn silage hybrids. In the 1990s, however, it became increasingly clear that high-yielding silage hybrids with excellent quality do not require high grain content. In fact, many agronomists and animal nutritionists now believe that stover fiber digestibility is the most important hybrid characteristic affecting silage quality. Consequently, seed companies have recently released brown midrib and leafy hybrids, which have high stover fiber digestibility. Corn silage hybrid trials, however, have shown that some of the new silage hybrids have reduced emergence in cool wet springs, poor kernel set in warm dry summers, and poor standability at harvest. Corn silage hybrid trials can provide excellent information on the agronomic performance and silage quality of corn silage hybrids grown in specific regions, such as Northern NY, in normal growing conditions, years of cool and wet springs, or years of warm and dry summers.

Methods: Corn silage hybrids were tested at three locations in Northern New York in 2006. We evaluated 75 to 100 day hybrids in relative maturity (RM) at John Greenwood's farm in Madrid (St. Lawrence Co.) , at the Miner Institute in Chazy (Clinton Co,), and at Ron Robbins's farm in Sackets Harbor (Jefferson Co.). All three sites average about 2100 GDD from May through September.

We planted all hybrids with a 2-row plot planter at t 36,000 plants/acre to achieve harvest populations of 32,000-34,000 plants/acre. The Sackets Harbor site was planted on 3 May, the Madrid site was planted on 4 May and the Chazy site on 10 May. All hybrids were grouped within a 5-day RM (i.e. 91-95 day RM, 96-100, etc.), and planted in a randomized complete block design with four replications. Each individual plot consisted of two 22-ft. rows spaced 30 inches apart. Each individual plot received about 250 lbs/acre of 10-20-20 at planting. The Sackets Harbor and Chazy sites received about 140 lbs N/acre of fertilizer N either pre-plant or at the 4 to 5-leaf (V4 to V5) stage. The Madrid site was a well-manured dairy site so it received no additional fertilizer N. We used preemergence herbicides and hand-weeding to control weeds.

Both rows, trimmed back to an 18-foot length, of each hybrid were harvested for silage yield with a retrofitted 3-row New Holland Chopper with a platform and a weigh- basket, mounted on load cells. The goal was to harvest all hybrids in the 60-70% moisture range but at Sackets Harbor the moisture was below 60% for three of the 75-85 day hybrids. All hybrids were harvested at Madrid on 12 September, at Sackets Harbor on 15 September, and at Chazy on 22 September.

An approximate 10,000 g well-mixed sample was originally collected from each plot. The 10,000 g sample was then ground further in the field with a chipper-shredder. An approximate 1,000 g subsample was then weighed with a gram-scale and stored on ice packs in a cooler or refrigerated in a generator-powered freezer (samples were not frozen). At the end of each day, the samples were brought back to a Cornell Research Farm for drying. The samples were dried at 140^0F in a forced-air drier to constant moisture and then weighed to determine moisture content of each sample.

Samples were processed and analyzed by Cumberland Valley Analytical Services, Inc. Samples were analyzed by wet chemistry for neutral detergent fiber (NDF), according to procedures by Van Soest et al. (1991). Samples were incubated for 30 hours at 39^oF in a buffered rumen fluid, according to procedures by Van Soest and Robertson (1980) using a flask system and Van Soest buffer. Following fermentation, residues were analyzed for

NDF by wet chemistry to determine 30-hour NDF digestibility (dNDF). The NDF digestibility was calculated as ([1-NDF residue/initial NDF] x 100). The 30-hour dNDF values were then multiplied by 1.16 to estimate 48-hour dNDF values for the Milk2000 and Milk2006 programs. Other inputs for Milk2000 and Milk2006 were determined using NIRS, including crude protein (CP), starch, ether extract, and ash. The NDF-CP default value of 1.3 was used for the Milk2000 calculations. The Milk2006 program does not have NDF-CP as an input parameter. Milk per ton and milk per acre were then calculated using the Milk2000 and Milk2006 spreadsheet programs (Tables 2-7). As you can see, there are some minor differences in milk/ton rankings among hybrids but almost no differences in milk yield rankings among hybrids when comparing Milk2000 and Milk2006 results. We will present results from both programs this year, the transition year, but will report only Milk2006 results in subsequent years.

Data were analyzed using the PROC GLM procedure of SAS. The LSD values for separating hybrid means were generated at the P = 0.10 level. Hybrids are considered above-average for calculated milk yield, milk/ton, or silage yield when the hybrid's value is 100.5% or more of the mean value within their RM group.

Results: The 2006 growing season in Northern NY was warmer than normal with above-average GDD in May and July at Canton (a few miles from Madrid), Chazy, and Watertown (a few miles from Sackets Harbor, Table 1). All sites, however, were dry in July and August, especially at Madrid and Watertown where only 3.02 and 2.76 inches of precipitation were recorded in July and August, respectively. Nevertheless, yields were quite high at Madrid, despite the very dry conditions.

Four hybrids at Madrid, Chazy and Sackets Harbor had above-average milk yields in the 75-85 day RM group (Tables 2, 3, and 4). HT7220BT/RR2 from Hytest and 377BWR from Doebler's, 85 day hybrids, had above-average milk yields at all sites. TA208-00F from T.A. Seeds and HL S011 from Hyland had above-average milk yields at Madrid and Sackets Harbor. HL SR22 from Hyland and HT1701RR from Hyland had above-average milk yields at Chazy. When averaged across sites, HT7220BT/RR2 and 377BWR had much-above-average silage yields and HL SR22 had above-average milk/ton values.

Three hybrids at Madrid and at Chazy and four hybrids at Sackets Harbor had above-average milk yields in the 86-90 day RM group (Tables 2, 3, and 4). TMF2L412 from Mycogen had above-average milk yields at all sites. HL S034 from Hyland and N29-A2, an NK Brand, had above-average milk yields at Madrid. N31-P2, an NK brand, and TA310-00F from T.A. Seeds had above-average milk yields at Chazy and at Sackets Harbor. 38R50 from Pioneer also had above-average milk yields at Sackets Harbor. When averaged across sites, TMF2L412 and N31-P2 had much above-average silage yields, and N29-A2 had above-average milk/ton values.

Seven hybrids at Madrid and eight hybrids at Chazy and Sackets Harbor had above-average milk yields in the 91-95 day RM group (Tables 4 and 5). 946LRR from LICA, 468RB from Doebler's, and TNT-92CRW/RR2 from Hytest had above-average milk yields at all sites. 4453XRR from Growmark FS and TA450-11 from T.A. Seeds had above-average milk yields at Madrid and Chazy. 38K46 from Pioneer and TMF2R336 from Mycogen, had above-average milk yields at Chazy and Sackets Harbor. When averaged across sites, 468RB, 946LRR, and 4453XRR had much above-average silage yields and 946LRR and TNT-92CRW/RR2 had above-average milk/ton values.

Excluding the check hybrids, only 964L from LICA had above-average milk yields in the 96-100 day RM group at all sites (Tables 2, 3 and 4). HT7435BT/RR2 from Hytest and 8744YPL from Garst had above-average milk yields at Madrid. DKC48-53 from Dekalb and 8815CB/LL from Garst had above-average milk yields at Chazy. When averaged across sites, only 964L had above-average silage yields.

When excluding the BMR hybrid (UFO996B from LICA), silage yields at Madrid averaged 28.2 tons/acre in the 75-85 day RM group, 31.1 tons/acre in the 86-90 day RM group, 30.1 tons/acre in the 91-95 day RM group, and 29.9 tons/acre in the 96-100 day RM group. At Chazy, silage yields averaged 20.5 tons/acre in the 75-85 day RM group, 22.3 tons/acre in the 86-90 day RM group, 22.5 tons/acre in the 91-95 day RM group, and 23.2 tons/acre in the 96-100 day RM group. At Sackets Harbor, silage yields averaged 19.3 tons/acre in the 75-85 day RM group, 20.3 tons/acre in the 86-90 day RM group, 20.8 tons/acre in 91-95 day RM group, and 19.6 tons/acre in the 96-100 day RM group.

Conclusions: The 2006 growing season in Northern NY was somewhat warm and wet into July, but then became dry for the remainder of July and August. The results from this study reflect well the yield and quality of corn silage that was planted in April and May of 2006 in Northern New York, and did not suffer stress from the excessive rains in June.

The results of this study indicate that excellent corn silage yields can be obtained by growing 75-100 day hybrids in Northern NY. At two of the three sites, either the 86-90 or the 91-95 day hybrids had higher average yields than the 96-100 day hybrids probably because the dry conditions in July and August hurt the later-maturing hybrids more than the earlier hybrids. Dry conditions often occur in Northern NY in August so growers in Northern NY could consider selecting hybrids that are shorter than 95 days in length to avoid some of the droughty conditions that can occur in late August/early September. Hybrids shorter than 95 days in length also increase the probability of a timely harvest before the first fall frost.

Outreach: The results of the two most-uniform sites (Madrid and Chazy) were used to recommend corn silage hybrids in Northern NY in our **What's Cropping Up?** newsletter that was published in December of 2006 (Vol.16, No.6, p.1-2). Furthermore, the results will be incorporated into the recommended corn silage tables in our **2008 Cornell Guide for Integrated Field Crop Management**. We only list hybrids that have above-average relative calculated milk yields in their hybrid RM group (i.e. 96-100, 101-105 day RM, etc.). We also list the relative silage yields and milk/ton values for the recommended hybrids. The **2007 Cornell Guide for Integrated Field Crop Management** is now at our web site: www.fieldcrops.org.

Northern NY Agricultural Development Program
2006 Project Report

Corn Grain Hybrid Testing Program for Northern New York

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Background: Corn is the primary row crop grown in northern New York (NNY), harvested from about 125,000 acres and providing essential feed for the dairy industry. Roughly 38,000 acres of this total were harvested as grain in 2005 – about one third of NNY's total corn acreage. When the ethanol production facilities currently being constructed in New York come on line, the increased demand for corn grain as feedstock for those facilities will provide new grain marketing opportunities for NNY farmers and increase interest in corn production for grain in this region. Furthermore, grain yield is an important contributor to silage yield, so grain yield evaluation provides an indication of which hybrids would be good candidates for silage use. It is important to evaluate silage quality on these hybrids as well, but seed companies will often enter their hybrids into grain evaluation trials as a first step in determining what is worth marketing in a region for either grain or silage. Thus grain yield evaluations of commercial hybrids provide essential comparative information to farmers interested in grain production in NNY and to seed companies who make marketing decisions based initially on performance in grain yield trials and may or may not do subsequent silage evaluations.

Methods: During 2006, we summarized the results of early and medium-early maturity corn grain testing done in 2005 and tested a new set of hybrids in each of these maturity groups at NNY locations. Seed companies marketing corn in New York were contacted to request entry of commercial and near-commercial hybrids into these evaluation tests.

We evaluated 17 early maturing hybrids (1400-1900 growing degree days, 70-90 days relative maturity) at two locations in NNY: one at the Miner Institute's research farm in Chazy, Clinton County, and one at Jon Greenwood's farm in Madrid, St. Lawrence County. In addition, we evaluated 33 medium-early maturing hybrids (1900-2400 growing degree days, 85-100 days relative maturity) at Ron Robbins's farm in Sackets Harbor, Jefferson County. These evaluations were designed to identify hybrids that can meet the grain and silage needs of farmers in the region.

Each hybrid was planted in three replications per location, with each replication consisting of a two-row plot, 17.5' long and thinned to a density of 28,000 to 30,000 plants/acre. Data was collected at thinning time (late June to early July) on plant counts and unusually good or poor plant vigor. In September, plots were evaluated for reaction to any disease or insect pests that occur at each site, for unusually tall or short plants (indicative of potential value as a silage hybrid), and for early-season stalk lodging, root lodging, and animal damage. At harvest time (November), data was collected on final stalk and root lodging, animal damage, grain weight, grain moisture, and test weight. These data were used to calculate grain yield per acre and yield:moisture ratio (a measure of hybrid efficiency in producing high yield under short-season conditions). Results of 2005 testing were published in the 2005 Hybrid Corn Grain Performance Trial Report (Plant Breeding Mimeo 2006-1) and were incorporated into the tables of recommended hybrids in the 2007 Cornell Guide for Integrated Field Crop Management (Cornell University, 2006). These results are available for farmer and seed company use in selecting hybrids best adapted to the challenging soils and climates of NNY. Results from 2006 trials, which were harvested during October and November, will soon be available in the 2006 Hybrid Corn Grain Performance Trials Report (Plant Breeding Mimeo 2007-1) and will be incorporated into the tables of recommended hybrids in the 2008 Cornell Guide for Integrated Field Crop Management (to be published by Cornell University in fall 2007).

Results: The 2006 growing season had rainfall well distributed through much of the summer at our trial sites. Generally seasonal or slightly warmer than average temperatures and a long t frost free period in the fall helped the corn grain crop mature well. The lack of drought stress during flowering combined with mild temperatures during grain filling made for some good corn yields in the region. In Madrid, above-average May through July rainfall combined with above-average temperatures in July and a dry October for grain dry-down resulted in excellent grain yields. Conditions in Sackets Harbor were not as favorable – warm temperatures prevailed from May through August, but rainfall was alternately below average (May, July, August) and quite a bit above average (June, September, and especially October), resulting in some drought stress during flowering and very wet conditions as harvest approached. Our trial at Chazy began the season with some minor plant stand problems (due to flooding in the field shortly after planting). Nonetheless, we were on the way to collecting good data from this trial until, just days before harvest, a herd of deer moved in and ate almost all the ears! Thus, we have no data to report this year from the early maturity trial at Chazy. Results for the better hybrids from our other two hybrid evaluation trials are shown in Tables 1 and 2 below.

The quality of our testing data this year was excellent, as reflected in the low coefficients of variation (CVs) for yield in the trials (11% at Madrid and 13% at Sackets Harbor). These low CVs indicate that the values in these tables are quite reliable and not overly influenced by random variation in the testing fields. Results present information on a broad array of commercially available hybrids, allowing farmers and seedsmen to compare productivity and adaptation of hybrids from various seed companies

Table 1. 2006 Early Maturity Hybrids, Madrid, St. Lawrence County.

Brand	Hybrid	Yield bu/A	% Mois-ture	Yield: Moisture Ratio	Stand-ability 1-9 scale	% Stalk Lodging	% Root Lodging	Test Weight lb/bu
NK	N20-R7	246	20.3	12.1	9	1	1	51
Hyland	HLB264	219	20.6	10.6	8	2	0	48
Hyland	HLR228	180	20.6	8.7	8	10	0	48
Dekalb	DKC41-64RR2YGCB	248	20.7	12.0	8	3	1	49
Mycogen	2P172	213	20.7	10.3	9	1	0	51
Doebler's	277XB	241	20.8	11.6	8	1	0	49
Hytest	HT7226TS	237	20.9	11.3	8	6	0	49
TA Seeds	TA290-11	240	21.0	11.4	8	7	0	47
TA Seeds	TA221-13	196	21.0	9.3	9	3	0	49
FS Seeds	FS 3967XRR	205	21.1	9.7	9	0	0	48
Doebler's	377BWR	235	21.3	11.0	8	3	0	48
FS Seeds	FS 4146	199	21.4	9.3	8	4	0	47
Dekalb	DKC44-92RR2	221	22.4	9.9	8	2	0	47
Hytest	HT7220BTRR2	232	22.7	10.2	9	1	0	49
	Mean	212	21.0	10.5	8	5	0	49
	CV	11	2		7			5
	LSD	39	0.7		1			4
	SD	24	0.4		1			2

Table 2. 2006 Medium-early Maturity Hybrids, Sackets Harbor, Jefferson County.

Brand	Hybrid	Yield bu/A	% Mois-ture	Yield: Moisture Ratio	Stand-ability 1-9 scale	% Stalk Lodging	Test Weight lb/bu
Golden Harvest	L7H07BT	173	20.3	8.5	7.3	3	66
NK	N29-A2	162	20.3	8.0	6.0	0	65
Dyna-Gro	53P30	142	20.3	7.0	6.7	1	64
FS Seeds	FS 4453XRR	163	20.5	8.0	7.7	5	66
TA Seeds	TA450-11	149	20.5	7.3	7.3	1	65
Chemgro	5570BT	147	20.5	7.2	6.0	0	68
Mycogen	2R426	161	20.6	7.8	6.7	0	63
Hyland	HLB282	158	20.6	7.7	7.0	0	65
FS Seeds	FS 4464	151	20.6	7.3	7.0	3	71
Golden Harvest	H6466CB/GT	143	20.6	6.9	7.0	1	63
NK	N45-A6	159	20.7	7.7	6.3	0	62
Dekalb	DKC45-82RR2	155	20.7	7.5	7.7	1	65
NK	N34-Y9	145	20.7	7.0	6.7	3	66
Hyland	HLB264	134	20.7	6.5	7.7	4	66
Hyland	HL2515	177	20.8	8.5	7.0	6	64
Mycogen	2A498	160	20.8	7.7	7.3	3	66
Hyland	HLB33R	151	20.8	7.3	7.0	0	65
Hytest	HT7428BTRR2	189	21.0	9.0	7.3	1	63
Hyland	HLB43R	182	21.0	8.7	7.0	0	65
Dekalb	DKC54-46RR2YGPL	174	21.2	8.2	6.7	4	65
NK	N39-Q1	174	21.2	8.2	6.0	8	67
FS Seeds	FS 4819	188	21.3	8.8	7.0	0	64
Doebler's	468RB	184	21.3	8.6	7.0	2	66
Dyna-Gro	53F09	137	21.3	6.4	7.3	4	65
Hytest	HT7435BTRR2	183	21.5	8.5	6.7	0	62
Doebler's	494RYG	157	21.5	7.3	6.3	0	64
FS Seeds	FS 4458XRR	135	21.5	6.3	7.0	0	62
FS Seeds	FS 4860	172	21.7	7.9	7.7	0	66
FS Seeds	FS 4955XRR	164	21.9	7.5	7.0	1	65
Dekalb	DKC48-53RR2YGCB	144	21.9	6.6	5.7	4	62
TA Seeds	TA500-00	177	23.0	7.7	7.0	6	64
Hytest	EXP4421RR	171	23.0	7.4	6.7	4	64
Doebler's	525BW	191	23.1	8.3	6.7	0	63
	Mean	163	21.2	7.7	6.9	2	65

CV	13	3.6	12.7	3
LSD	35	1.2	1.4	3
SD	22	0.8	0.9	2

Conclusions/Outcomes/Impacts: Data in the hybrid production tables in this report shows a number of hybrids that had excellent performance in NNY in 2006. However, hybrid choices should always be made based on the most comprehensive data available, usually multi-year and/or multi-location data. Multi-year data is available in the Cornell Guide for Integrated Field Crop Management and this publication should be consulted, in combination with the individual test data presented here, when making hybrid choices.

Outreach: Results of 2005 testing were published in the 2005 Hybrid Corn Grain Performance Trial Report (Plant Breeding Mimeo 2006-1) and were incorporated into the tables of recommended hybrids in the 2007 Cornell Guide for Integrated Field Crop Management (Cornell University, 2006). These results are available for farmer and seed company use in selecting hybrids best adapted to the challenging soils and climates of NNY. The publications are distributed through extension offices and at various extension and outreach meetings. Results from 2006 trials, which were harvested during October and November, will soon be available in the 2006 Hybrid Corn Grain Performance Trials Report (Plant Breeding Mimeo 2007-1) and will be incorporated into the tables of recommended hybrids in the 2008 Cornell Guide for Integrated Field Crop Management (to be published by Cornell University in fall 2007).

Next steps if results suggest continued work is needed: In future years, we will plan to continue testing hybrids in the NNY region to ensure that farmers and seed companies have a solid basis for their choices of corn grain hybrids for this important region of the state.

Acknowledgments: Funding by the Northern New York Agricultural Development Program and by the participating seed companies is gratefully acknowledged. Collaborating farmers included Jon Greenwood, Madrid, St. Lawrence County and Ron Robbins, Sackets Harbor, Jefferson County. The collaboration of Pete Barney, CCE-St. Lawrence County and Mike Hunter, CCE-Jefferson County is gratefully acknowledged.

Northern NY Agricultural Development Program
2006 Project Report

Small Grain Variety Trials

Project Leader:

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Collaborators:

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- **Anita Deming** (ald6@cornell.edu), Extension Director, Cornell Cooperative Extension of Essex County

Background: Small grain variety trials have been conducted at the Cornell University E.V. Baker Research Farm since the 1980's. Trials of spring and winter wheat, spring and winter triticale, winter rye, barley, and oat varieties provide northern New York farmers with evaluations of the performance of available varieties grown under local conditions.

The size of the spring and winter wheat variety trials has grown considerably in recent years with the increased regional interest in organic bread wheat production. Champlain Valley Milling, a specialty organic flour mill located in Westport, NY, provides local farmers with a premium market for organically grown wheat. As specialty flour markets have very specific quality standards, it is essential that we be able to identify varieties that will meet the requisite standards when grown in northern New York. Our wheat trial entries include established varieties from area seed companies, in addition to promising advanced lines from private company breeding programs, Mark Sorrells' breeding program at Cornell, and public breeding programs from the Upper Midwest (primarily North Dakota State University).

Objectives:

(1) To acquire spring wheat, winter wheat, and winter triticale varieties and promising advanced breeding lines from regional seed companies, and public and private breeding programs.
(2) To evaluate the agronomic performance of these varieties in replicated trials on the E.V. Baker Research Farm plots.

Methods: 2006 trials included twenty-four winter wheat entries, eighteen spring wheat entries, and four winter triticale varieties. Replicated trials were conducted at the Baker Research Farm in Willsboro, NY. A randomized complete block design was employed with three replications for each trial. Plots were located on a Rhinebeck sandy clay loam soil with tile drainage. 200 lb/acre 6-24-24 was broadcast applied and incorporated with a spring-tooth harrow prior to planting each trial. No herbicides were used. Winter wheat and triticale were seeded at a rate of 2bu/acre on 9/28/05 and harvested on 7/31/06. Spring wheat was planted 4/12/06 at a 2.5bu/acre seeding rate and harvested 8/02/06.

Results:

Table 1. Northern New York 2006 Winter Wheat Variety Trial Results

Brand/Company Source	Hybrid/Variety Name	Market Class	Yield	Test weight	Moisture	Plant height	Lodging
			bu/a	lb/bu	%	inches	1-10
		Trial Mean	57.3	52.7	17.5	34.5	0.1
		LSD	12.2	2.1	1.4		0.5
		LSD P >	0.05	0.05	0.05		0.05
		CV	13.0	2.4	4.9		289
		F Test	0.0001	0.0003	0.0095		0.0002
Cornell	NY 88024	SW	69	54.0	17.7	34	0
Agriculver	AC Morley	HRW	69	56.0	17.5	29	0.7
Cornell	99-53	SRW	68	53.0	16.4	32	0
Agriculver	7730R	SRW	67	55.7	17.3	35	0
JGL Inc.	Kristy	SRW	65	53.0	17.4	31	0
Agriculver	Richland	SW	64	53.7	17.3	38	0
Agriculver	Caledonia	SW	64	53.3	15.9	40	0
Pioneer	Piovar25W33	SW	62	53.7	16.7	36	0
Agriculver	Genesis	SRW	60	52.3	16.3	34	0
JGL Inc.	Harvard	HRW	59	56.0	18.0	37	0
JGL Inc.	Gryphon	HRW	59	54.0	18.2	32	0
Agriculver	Ashlund	SRW	59	51.7	18.2	37	0
Cornell	Geneva	SW	58	54.0	16.7	35	0.3
Cornell	NY Batavia	SW	56	52.7	17.8	33	0
JGL Inc.	CM98091	HRW	56	55.0	17.5	34	0
Agriculver	Harus	SW	56	54.0	17.1	37	0
Cornell	Freedom	SRW	56	51.3	17.0	35	0
Cornell	Cayuga	SW	55	55.7	18.2	31	0
Cornell	Lindon	HRW	53	55.3	17.7	37	1.3
JGL Inc.	HR45-104J	HRW	51	53.0	17.3	33	0
JGL Inc.	Maxine	HRW	47	54.3	17.8	36	0
JGL Inc.	HR45-063J	HRW	40	52.3	18.3	33	0
JGL Inc.	HR45014J	HRW	37	52.7	18.9	34	0

Winter Wheat Trial: The 2006 winter wheat trial consisted of eight soft white (SW), six soft red winter (SRW), and nine hard red winter (HRW) varieties (Table 1). Yields ranged from 37 bu/acre to 69 bu/acre with a trial mean of 57.3 bu/acre. While soft red and soft white varieties tended to have higher yields than the hard red winter entries, *AC Morley (HRW)* yielded at the top of the test averaging 69 bu/acre. 2006 plots were harvested a few days early due to a threatening weather forecast, and as a result grain moisture levels at harvest were on the high side (averaging 17.5%). There was no significant lodging in the winter trial.

Table 2. Northern New York 2006 Spring Wheat Variety Trial Results

Source	Hybrid/Variety Name	Market Class	Yield	Test weight	Moisture	Plant height
			bu/a	lb/bu	%	inches
		Trial Mean	61.2	60.1	14.4	35.1
		LSD	5.8	1.3	0.5	1.5
		LSD P >	0.05	0.05	0.05	0.05
		CV	5.7	1.3	2.2	2.3
		F Test	0.0001	0.0001	0.02	0.0001
JGL Inc.	HRS6002J	HRS	77	60.3	14.5	43
Champlain Valley Milling	Freyr	HRS	69	60.7	14.8	34
JGL Inc.	HRS45-025J	HRS	67	61.7	14.5	36
Champlain Valley Milling	Russ	HRS	67	60.3	14.3	37
Champlain Valley Milling	Knudson	HRS	66	60.3	14.4	29
JGL Inc.	HRS45-035J	HRS	64	60.3	14.5	34
NDSU	Dapps	HRS	63	59.7	14.7	39
NDSU	Parshall	HRS	62	61.3	14.6	37
JGL Inc.	HRS6001J	HRS	62	61.7	14.5	36
NDSU	2375	HRS	61	60.3	14.9	33
JGL Inc.	CM606	HRS	61	61.7	14.5	34
JGL Inc.	Profit	HRS	60	58.7	14.2	31
Champlain Valley Milling	Hannah	HRS	60	60.7	14.3	37
NDSU	Alsen	HRS	59	61.3	14.2	32
Champlain Valley Milling	Gunner	HRS	57	61.7	13.9	38
NDSU	Butte 86	HRS	56	59.0	14.3	37
JGL Inc.	SD45-015J	HRS	53	55.3	14.2	27
Champlain Valley Milling	Coteau	HRS	38	56	13.9	39

Spring Wheat Trial: Eighteen spring wheat varieties were entered in the 2006 test (Table 2). Mean yields ranged from 53 bu/acre to 77 bu/acre with a trial mean of 61.2 bu/acre. *Coteau* was an outlier in that it had significant lodging problems and only yielded an average of 38 bu/acre. Trial test weights averaged 60.1 lbs/bu, and moisture levels at harvest averaged 14.4% overall. HRS6002J, an experimental line from JGL Inc., stood out in the 2006 trial as it outyielded all other entries and had good test weights. While HRS6002J was also the tallest entry, it exhibited no lodging problems.

Table 3. Northern New York 2006 Winter Triticale Variety Trial Results

Source	Hybrid/Variety Name	Yield	Test weight	Moisture	Plant height	Lodging
		bu/a	lb/bu	%	inches	Scale 0-10
	Trial Mean	49.6	45.1	14.8	46.2	4.8
	LSD	9.1				
	LSD P>	0.05				
	CV	11.5				
	F Test	0.0001				
Agriculver seeds	Trical 102 lot# T521	23.6	40	15.7	51	9.8
Agriculver seeds	Trical 103BB T412B	36.0	42	14.0	52	9.3
Agriculver seeds	Trical 336	69.8	50	15.1	41	0
Agriculver seeds	Alzo	68.8	48	14.6	41	0

Winter Triticale Trial: Four winter triticale lines from Agriculver seeds were tested in 2006 (Table 3). The 2005-2006 winter was milder than normal and no winter injury was observed in the plots. *Trical 336* and *Alzo* performed well, yielding 69.8 bu/acre and 68.8 bu/acre, respectively. These two varieties both averaged 41 inches in height and had no lodging. In contrast, *Trical 102 lot#T521* and *Trical 103BBY412B*, which were 10 inches taller than *Trical 336* or *Alzo*, were almost completely lodged, and yielded poorly. Test weights for the *Trical 102 lot#T521* and *Trical 103BBY412B* were also markedly lower than *Trical 336* and *Alzo*.

Outreach: Tabulated trial results will be posted on the Northern New York Agricultural Development Program website www.nnyagdev.org and in the variety trial section of the online journal Plant Management Network www.plantmanagementnetwork.org. Results will also be presented at regional extension meetings and wheat production workshops.

Acknowledgments: Small grain variety trials were funded by a grant from the Northern New York Agricultural Development Program.

Northern NY Agricultural Development Program
2006 Project Report

Developing New Cropping System Options for Organic Grain Production in Northern New York

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Background: Organic grain production is one strategy that Northern New York farmers could use to diversify their operations and increase profitability. Fifteen to twenty percent annual increases in the organic food market coupled with the premium prices paid for certified organic grains have prompted many farmers to explore the organic option, and the amount of NNY acreage. Committed to organic field crop production has increased significantly in recent years.

Cropping system work in the organic rotations at the Cornell E.V. Baker Research Farm has primarily focused on the production of spring and winter wheat, grain-type soybeans, sweet corn, and alfalfa/grass hay. Solid regional markets for certified organic wheat and soybeans have helped to encourage local farmers to experiment with organic cropping systems, and most of the certified organic grain production in the area thus far has focused on these two crops. The challenge now is to find additional crop options that can be effectively and profitably inserted into the rotations. Sunflowers, flax, specialty grain corn, and dry (Adzuki) beans have been suggested by organic farmers or marketers as possible options.

Objectives:

(3) To develop cropping system strategies to insert sunflowers, organic flax, and dry beans into the organic rotations at the Cornell E.V. Baker Research Farm.
(4) To acquire and test the agronomic performance of available sunflower, flax, and dry bean varieties in replicated, organically managed trials.

Baker Farm Organic Rotations: A six acre field at the Baker Research Farm in Willsboro has been certified organic since 1993. The six acres were divided into ten equal blocks that have been allocated to two five-year rotations (a Wheat rotation and a

New Crop rotation). The New Crop rotation initially involved three years of alfalfa/timothy sod, followed by one year of food-grade soybeans, and one year of sweet corn. Two to three years of alfalfa/timothy sod forms the heart of all our organic rotations. The perennial sod serves to recharge soil health as it provides an extended period without tillage, fibrous grass roots contribute significant organic matter to the soil system, and alfalfa roots fix nitrogen. Weed seed banks are also reduced when the sod is mowed or hayed at regular intervals.

In an effort to diversify the cropping and marketing options in the New Crop rotation, food-grade soybeans were replaced with dry beans, sunflowers replaced sweet corn, and flax followed the sunflowers (essentially taking the place of one year of alfalfa/timothy sod). Inserting sunflowers (*Asteraceae* family) and flax (*Linaceae* family) into the rotation adds two new plant families to the system and could function to reduce the incidence of pathogen and pest problems. The advantage to adding a third annual grain crop to the rotation is that it could improve economic returns over a five year period. The downside of having three annual crops and only two years of alfalfa/timothy sod, is that the soil system has less time to recharge and soil health could potentially be compromised.

Organic Flax Producition

Fertility:

Flax was grown in the New Crop rotation block 12-O-6 on Rhinebeck clay loam soil in 2006. In 2005, this block received 3 tons/acre composted chicken manure ('Giroux Doo' with NPK of 2-2-1.5) and 500 lbs/acre Northcountry Organics 5-3-4 Pro Gro granulated fertilizer in preparation for sweet corn. Wet weather in 2005 resulted in a failed sweet corn crop that was plowed under in July. Since Flax is not a heavy feeder, no additional fertilizer was added to the block prior to the 2006 flax seeding. Flax is known to be sensitive to zinc deficiency and in future years soils will be tested for zinc and fertilized accordingly.

Weed Control:

Flax does not compete well for either above or below ground resources, so it is essential to minimize weed pressure. Block 12-O-6 was fallowed following the failed 2005 sweet corn crop and this appeared to greatly reduce annual and perennial weed pressure ahead of the 2006 flax crop. A stale seed bed approach was also used in the spring to take out the first flush of annual weeds prior to planting the flax trial on May 8, 2006. No weed control measures were taken after planting, and weed control in the plots was excellent.

Trial Establishment:

Untreated seed for five flax varieties were obtained from Albert Lea Seedhouse in Minnesota, and the Flax Institute at North Dakota State University. The variety trial employed a randomized complete block experimental design with six replications. Plots were 10' wide and 30' long and planted at a 7" row spacing with a 3 point hitch mounted 5' wide grain drill (equipped with press wheels). Flax was seeded at 56 lbs/acre rate, which is slightly higher than the 35-50 lb/acre rate that is typically recommended for treated seed. Target seeding depth was 1" (0.5"- 1.5"). As flax seeds are relatively small and seedlings have difficulty pushing through soil crusts, it is important not to plant too deep. Plots were seeded on May 8, 2006 and harvested on October 9, 2006.

Results and Discussion:

The flax trial included four brown seeded varieties and one yellow seeded ("golden") variety (Table 1). While yellow and brown seeded varieties do not differ in their composition, the yellow color is considered more desirable for use in human consumption.

The tallest variety, *Omega*, differed significantly in height from the shortest variety, *York*; none of the other varieties differed significantly in height. No lodging problems were observed in the trial. No statistically significant differences in yield were found among the varieties. Yields ranged from 636 lbs/acre to 738 lbs/acre with a trial mean of 672.3 lbs/acre. These yields are consistent with yields reported for the same varieties in conventionally managed trials at NDSU's Williston Research Station, indicating that these flax varieties may be well suited for Northern New York growing conditions, and that they can perform well in an organically managed cropping system. Two or more additional years of data are needed to further refine organic flax production strategies, and to confidently gauge the potential of these flax varieties for use in organic production systems in Northern New York.

Table 1. 2006 Organic Flax Variety Trial

Source	Hybrid/Variety Name	Seed Color	Yield	Plant height
			lb/a	cm
		Trial Mean	672.3	51.4
		LSD	134	4.4
		LSD P >	0.05	0.05
		CV	16.6	6.5
		F Test	0.5603	.0264
NDSU	Nekoma	Brown	676.3	52
Albert Lea Seeds	Omega	Golden	738.8	54
NDSU	Pembina	Brown	636.3	52
NDSU	Rahab 94	Brown	654.4	50
NDSU	York	Brown	655.8	48

Photo: 2006 Organic Flax Trial Plots at the Cornell E.V. Baker Farm (photo by Jerry Cherney)

Organic Dry Bean Production

Fertility: Dry beans replaced food-grade soybeans in the rotation in 2006 and were grown in Block 12-0-8 on a Rhinebeck clay loam soil with tile drainage. Dry beans followed a plowed down legume/grass sod, and since beans fix their own nitrogen, no additional fertilizer was added to the field.

Trial Establishment: Certified organic seed of four dry bean varieties was obtained from High Mowing Seed Company in Vermont. A randomized complete block trial with six replications was designed. Trial plots were 10' wide by 20' long and consisted of four rows with a 30" spacing between the rows. Our target planting date was mid-May, but unusually wet weather delayed planting until June 16, 2006. Target planting depth was 1" and all seed was inoculated with the appropriate *Rhizobium* sp. prior to seeding. The trial was harvested by hand on November 1, 3, and 6, 2006.

Weed Control: Block 12-0-8 was plowed in August 2005 and fallowed the remainder of the growing season to kill the sod and reduce perennial and annual weed populations. Additionally, a stale seed bed strategy was used to take out two flushes of annual weeds in the spring. In a normal spring the beans would have been planted by mid May, and there wouldn't have been enough time to germinate and cultivate a second flush of weeds, but the delayed planting in 2006 allowed for an additional stale period prior to seeding. Wet weather continued after planting and there were no opportunities to do any blind cultivating with a rotary hoe. The plots were cultivated using sweeps between the rows on July 6, 2006. Weed control in the plots was generally good, primarily due to the effectiveness of the late season fallow period and stale seedbed.

Results and Discussion: While the entire dry bean trial was surrounded by three strands of electrified tape, deer browsing damage was noted in the plots. It is difficult to assess the impact of the browsing damage on yields. Most of the browsing occurred on the leaves and the deer appeared to browse the four varieties indiscriminately. All four varieties appeared to set a large number of pods per plant, but final yields varied significantly between the entries with *Black Turtle* averaging over twice the yield of any other variety (Table 2).

All four varieties set some pods very close to the ground, making it impossible to mechanically combine the plots without leaving significant numbers of pods in the field. Our inability to mechanically harvest any of the dry bean varieties suggests that they may not be suited to larger scale plantings. In future dry bean trials efforts will be made to locate varieties that don't set many pods close to the ground.

Table 2. 2006 Organic Dry Bean Variety Trial

Source	Hybrid/Variety Name	Seed Color	Yield	Moisture
			lb/a	%
		Trial Mean	1134.2	9.6
		LSD	149.6	
		LSD P>	0.05	
		CV	8.7	6.3
		F Test	0.0001	0.1621
High Mowing Seeds	Black Turtle		2113.5	
High Mowing Seeds	Soldier		953.4	
High Mowing Seeds	Maine Yellow Eye		685.7	
High Mowing Seeds	Jacobs Cattle		784.3	

Organic Sunflower Production

Fertility: Sunflowers replaced sweet corn in the New Crop rotation, and were grown in a block (12-0-7) that had produced food-grade soybeans in 2005. Three tons/acre composted chicken manure ("Giroux Doo" with an NPK of 2-2-1.5) was broadcast onto the field and then disced in prior to fitting the field for planting. Since sunflowers are considered fairly heavy feeders, and there was concern that the heavy rains in May and June had flushed much of the available nitrogen out of the soil, the plots were topdressed with 200 lbs/acre 5-3-4 Pro Gro granular fertilizer from Northcountry Organics on July 10, 2006 (40 days after planting).

Weed Control: Weed control in the preceding food-grade soybean crop was poor due to a very wet spring and early summer in 2005. Several annual grasses and dicotyledonous weeds went to seed, and the annual weed pressure in block 12-0-7 was expected to be high in 2006. Block 12-0-7 was mowed and then plowed in October 2005 following the soybean harvest. The field was worked as early as possible in spring 2006 to stale seedbed the plots and eliminate a flush of annual spring weeds prior to planting. May 15 was the target planting date, but frequent rains delayed planting until May 31. Continued wet weather after planting inhibited timely cultivation of germinating weeds; we were not able to cultivate the plots until July 10 (40 days after planting) when we used sweeps in an effort to set back weeds growing between the rows. In plots with good plant populations, the sunflowers competed well with the weeds. Plots located in the wetter sections of block 12-0-7 had poor sunflower stand establishment and serious weed problems

Trial Establishment: Untreated seed of one edible seed variety (*Mammoth*) and one oil seed variety (*Black Oil*) was obtained from Albert Lea Seedhouse in Minnesota. Two hybrid oil seed varieties, *6949* and *Defender HO* were contributed by Seeds 2000 (Minnesota organization). A test was established with 15 replications. Many of the replications located in the wetter areas of block 12-0-7 had poor stand establishment; the trial was eventually reduced to four complete replications. Plots were 10' wide, 20' long, and consisted of 4 rows with 30" between row spacings. Sunflowers were planted with a two row cone planter (two passes per plot) on May 31. Final plot evaluations and harvest data were taken on November 6.

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Results and Discussion: All four varieties grew well in plots that had good stand establishment. Mammoth was almost twice as tall as the three oil seed varieties (Table 3). Selected heads were hand harvested from plots in replications one through four in November, but extensive bird damage to the heads made it impossible to collect meaningful yield data. The sunflowers matured slowly in the fall and in many plots the heads started to mold and rot before they had dried enough to combine. The apparent slow maturation may be explained by the delayed planting date, but is also possible that these varieties are too late maturing for Northern New York growing conditions. More trial years are needed for a complete assessment of the potential for organic sunflower production in NNY.

Table 3. 2006 Organic Sunflower Variety Trial

Source	Hybrid/Variety Name	Seed Type	Height (cm)	
		Trial Mean	189.6	
Albert Lea Seeds	Mammoth	Edible seed	284.6	
Albert Lea Seeds	Black Oil	Oil seed	156.9	
Seeds 2000	6949	Oil seed	166.1	
Seeds 2000	Defender HO	Oil seed	150.6	

Photo: *Mammoth* sunflowers at harvest (10/26/06) at the Cornell E.V. Baker Farm (photo by Michael H. Davis)

Outreach: Tabulated trial results will be posted on the Northern New York Agricultural Development Program website www.nnyagdev.org, and included in regional extension publications and meetings. A workshop on the organic flax production was presented at the NOFA-NY winter conference in Syracuse, NY, January 27, 2007.

Northern NY Agricultural Development Program
2006 Project Report

Forage Soybean Advanced Breeding Line Evaluations

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Background:

Forage soybeans may be a viable alternative legume crop for Northern New York dairy farms that have difficulty growing alfalfa. Soybeans historically functioned as a forage crop, and some Northern New York farmers have recently experimented with harvesting grain-type soybeans for forage. More widespread adoption of soybeans as a forage crop in the future will depend on the development of regionally adapted forage-type varieties that have desirable agronomic characteristics. Thomas Devine, soybean breeder based in Beltsville, Maryland, started developing forage-type soybeans in the 1980's, and field evaluations of advanced lines from his program were first conducted in the Cornell Chazy research plots in 1995. Dr. Devine's early breeding work with forage-type soybeans produced very tall, relatively late maturing (maturity groups V – VIII) lines that generated high shoot biomass, but few seeds when grown at northern latitudes. Several advanced lines in the 1998 Chazy test were over 8' tall and yielded more than 10 tons/acre dry matter. Two major problems with the large, later maturity lines were

(1) high NDF levels – a low proportion of which was digestible. While the yields with these lines were impressive, the thick stems that were required to hold the plants up resulted in a forage with undesirably high fiber levels. Tall lines without thick stems tended to have a viney growth habit that produced a tangled, lodged canopy. Dense, thick canopies are difficult for some machinery to handle, and may also result in lower canopy conditions that favor white mold growth.
(2) Lower crude protein levels. When grown in Northern New York, the late maturing varieties didn't produce much seed, and as a result crude protein levels were consistently lower than those in early maturing grain-type soybeans harvested for forage at the R6 (full seed) stage.

In an effort to address these limitations and develop lines that are well suited for production in more northerly latitudes, Dr. Devine crossed some of the original forage-type lines with earlier maturing varieties. Promising advanced lines, identified in 2005, were selected for the 2006 test.

Objectives:

(1) To support efforts to develop forage-type soybean varieties that are well adapted to Northern New York growing conditions by evaluating the agronomic performance of elite forage soybean breeding lines in replicated field trials.
(2) To see how an earlier harvest date (less mature plant) influences forage quality.

Methods: Four advanced breeding lines and two named varieties were obtained from Dr. Devine's forage soybean breeding program. Field trials were established at two sites in Northern New York: the Cornell research plots at the W.H. Miner Institute in Chazy, and the CCE St. Lawrence County Research Farm in Canton. Extensive deer damage wiped out the Canton site; Chazy methodology and results are reported below.

Chazy Trial: A randomized complete block experimental design with four replications was employed. Plots were located on a Roundabout silt loam soil with tile drainage. 200 lbs/acre 6-24-24 was broadcast applied and incorporated with a spring-tooth harrow prior to planting. Broadstrike+Dual herbicide was also pre-plant applied. Four-row plots were planted with 30" row spacings on May 25, 2006.

The "early" forage quality harvest was taken on August 24, 2006 (91 Days after planting). Plots were scored for stage of development, and three plants were hand harvested from each plot in replications one, two, and four. Sample plants were run through a chopper and immediately dried in ovens at 60^{o} Celsius.

Final harvest occurred on September 15, 2006 (113 Days after planting). Entries were scored for plant height, maturity, leaf type, and lodging. In each plot a single 20' long row was chopped with a Carter harvester, weighed, and oven dried for yield and dry matter determinations. An additional three plants per plot were sampled for quality analysis.

Results: The 2006 trial included four advanced lines, and two named varieties as checks. Data for all entries are tabulated in Tables 1&2.

Donegal (check)—Donegal, one of the first tall, forage-type varieties released from Dr. Devine's breeding program, is a maturity group V soybean with large leaves. The variety has a viney growth habit that tends to result in a tangled canopy and accounts for its relatively high lodging scores. Donegal's 2006 performance was consistent with past years as it reached the R5 development stage at the late harvest date, had an average yield of 4.0 tons/acre dry matter, NDF of 40.8, and crude protein at 17.9%.

Tara (check)—Tara is also a tall, large leaved, maturity group V release from Dr. Devine's program. Tara stands well and had few lodging problems in the 2006 trial. Yield and forage quality measures were similar to Donegal.
XB17—A tall, large leaved line that was similar to Donegal and Tara in maturity. XB17 exhibited a viney growth habit, especially toward the top of the plant, and had some

lodging problems. The line yielded well (4.2 tons/acre dry matter), but had an unusually high average NDF (45.7) and a very low relative feed value (128) compared to the other entries.

97NYCZ33-1—A tall, large leaved selection that stands well and had no lodging problems in 2006. 97NYCZ33-1 matured slightly later than Donegal, Tara, and XB17, and was only at the R4 development stage at the late harvest. While forage quality was similar to Donegal and Tara, the line produced the lowest average yield in the trial (3.1 tons/acre dry matter).

IA2068—This selection is short and stocky in stature with relatively small leaves. IA2068 was the shortest and earliest maturing entry in the trial. It reached development stage R6 by the late harvest, had no lodging, yielded well (3.8 tons/acre dry matter average) with favorable quality measures (NDF at 34.4, 20.6% crude protein), and had the highest average relative feed value in the trial (183). This entry was the second favorite in the trial based on visual field assessments.

IA3023—A relatively short soybean with large leaves and no lodging in 2006. Another early maturing line, IA3023 developed just slightly behind IA2068 and was at R6 at the late harvest. This entry yielded with the taller, later maturing entries (4.1 tons/acre dry matter), but was similar to IA2068 in quality measures (35.1 NDF, 21.4% crude protein, and a relative feed value of 178). Selected as the favorite 2006 entry based on visual field assessments.

Early vs Late Harvest Date:

Crude Protein—Mean crude protein increased between the early and late harvest with both early maturing entries. Crude protein levels are know to increase as the pods fill, so protein levels were expected to rise in IA3023 and IA2068 as the plants progressed from R4/R5 to R6 (full seed). Harvest date did not appear to consistently influence crude protein levels in the four late maturing entries that never reached R6, indicating that crude protein doesn't change markedly in the developmental stages immediately preceding seed filling (R2-R5).

NDF—A consistent trend toward slightly higher NDF levels at the late harvest compared to the early harvest in all four late maturing varieties was noted (Table 1). In contrast, the two earlier maturing entries exhibited a slight trend toward decreased NDF between the early and late harvest, suggesting that percent fiber may decrease some as the seeds fill.

Conclusions/Outcomes/Impacts:

The performances of IA3023 and IA2068 in the 2006 test were very encouraging. These relatively early maturing lines reached the target R6 (full seed) stage of development by the late harvest, had yields that were comparable to the taller, later maturing varieties and advanced lines, and produced forages with higher quality measures than any of the other entries. IA3023, in particular, may be well suited for Northern New York as it provided an optimal combination of yield and quality in the 2006 Chazy test. Additional trial years will be required to thoroughly assess the potential of the two IA lines.

Outreach: Tabulated trial results will be posted on the Northern New York Agricultural Development Program website www.nnyagdev.org, and presented at regional extension meetings and field days.

Acknowledgments:

The Forage Soybean Advanced Line Trials were funded by a grant from the Northern New York Agricultural Development Program

Person(s) to contact for more information (including farmers who have participated:

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Michael H. Davis (mhd11@cornell.edu), Research Associate, Dept. of Crop and Soil Sciences, Cornell University E.V. Baker Research Farm

Table 1. Stage of development and forage quality means at the early and late harvests in 2006.

	R stage		NDF		% Crude Protein		9/15/06	
Entry	Early Harvest 8/24/06	Late Harvest 9/15/06	Early Harvest 8/24/06	Late Harvest 9/15/06	Early Harvest 8/24/06	Late Harvest 9/15/06	% Fat	Rel. Feed Value
IA3023	4	6	35.8	35.1	20.2	21.4	3.9	178
97NYCZ33-1	2	4	40.6	41.0	17.7	17.0	2.4	147
IA2068	5	6	37.0	34.4	19.0	20.6	4.6	183
XB17	3	5	38.9	45.7	18.1	17.2	2.3	128
Tara	3	5	38.4	39.8	16.7	18.1	2.5	154
Donegal	2.5	5	39.5	40.8	17.0	17.9	2.3	149

Table 2. Mean mid-season relative maturity and lodging scores, final height, and yield for 2006 forage soybeans.

		Scale 1-10	Scale 1-10*		(tons/acre)
Entry	Ht. (cm) 9/15	Maturity Score on 8/9/06	Lodging Score on 8/9/06	Percent Dry Matter on 9/15/06	Dry Matter Yield on 9/15/06
IA3023	97.5	10.0	1.0	22.7	4.1
97NYCZ33-1	138	5.3	1.0	21.3	3.1
IA2068	92	9.3	1.0	25.6	3.8
XB17	166.3	5.1	1.8	22.9	4.2
Tara	161.8	6.3	1.3	23.3	4.1
Donegal	179.5	4.3	3.5	19.9	4.0

*1=no lodging, 10=completely lodged

<u>Photo:</u>

Forage soybean advanced line test at the Cornell Research Plots in Chazy, NY. (photo by Michael H. Davis)

Northern NY Agricultural Development Program
2006 Project Report

Improving Growth of Sugar Maples in Northern NY

Project Leader(s):

- **Brian Chabot,** Professor, Cornell University, 102 Little Rice, Ithaca, NY 14853 (607) 254-4234, bfc1@cornell.edu
- **Michael Farrell,** Director, Uihlein Forest, 157 Bear Cub Lane, Lake Placid, NY 12496 (518) 523-9337, mlf36@cornell.edu

Collaborator(s):

- **Peter J. Smallidge**, NY State Extension Forester, Cornell University, Fernow Hall, Ithaca, NY 14853
- **Stephen Childs,** NY State Maple Specialist, Cornell University, 110 Fernow Hall, Ithaca, NY 14853

Farmer participants:

- **Burnham Family** (Jefferson County)
- **Jason and Barbara Zehr** (Lewis County)
- **Jim and Christine Mueller** (Franklin County)
- **Joeseph and Irene Schork** (Franklin County)
- **Tony Corwin** (Essex County)
- **Kim LaDuke** (Essex County)
- **Art Person** (Essex County)
- **Parker Family Maple** (Clinton County)
- **Mike Hill** (Warren County)

Background: The two objectives of this project are 1) to evaluate ways to improve the growth of maple trees in order to increase yield of sap sugar, and 2) to improve sugarbush/forest management practices in NNY. Maple sugar is a high value crop in all counties in NNY and is a sustainable use of the natural resource base for this area. Even though fast growing trees are known to produce more sugar, recommendations on how to manage trees for fast growth in the NNY environments are poorly developed. Also, the relation between sugar yield per tree and sugar yield per acre under different tree stocking densities has not been established anywhere. Developing this relationship is essential in being able to recommend forestry practices that maximize syrup production per acre.

The success of any maple operation begins with the ability of trees to produce sap, remain healthy, and sustain production over a long period of time. We intend for this research to lead to better recommendations about how manage the NNY maple resource to maximize sugar yield and net income to the producer. We also will seek ways to improve tree health and sustainable sap yields.

Methods: Research on the effects of thinning on maple growth and sap sweetness is underway at the Uihlein Forest and 9 producer locations throughout Northern NY. Many other locations were visited and rejected either because of forest condition or because there was not enough uniformity to have replicated plots. We are still searching for one or more acceptable sites in St. Lawrence County and will be establishing additional plots on the Uihlein Foundation property in Lake Placid. Three plots were established at each location representing two levels of thinning and one control. The thinning produced two levels of residual basal area, one representing a light thinning and the other a heavier cut. The forests are reasonably close in age and structure. Prior to undertaking thinning, the project leaders were trained in chain saw safety and use in directional felling through the Game of Logging program. The benefits of directional felling techniques became evident to the cooperating maple producers and we will be sponsoring offerings of the Game of Logging in 2007 for interested producers.

Results: We learned there is a wide range of forest management practices from those undertaking regular thinning to many who are not doing any regular forest management. Most NY sugarbushes are over stocked with too many trees having minimal growth. Thinning in most forests should have happened years before we arrived. Many trees below the 10 inch dbh limit are being tapped and many trees are being over-tapped. Density management works best if started when trees are less than 10 inches.We also have made progress on improving our understanding of the theory behind optimizing tree density. A draft of a paper on this has been developed.

Outreach: The immediate impact this year has been with the maple producers involved in the project where they were able to learn proper management techniques in their own woods. At each location we educated the producers about techniques of forest inventory, tree measurement, selecting trees for removal, and using the thinning tables to reach target residual basal area.
What we learned from these activities has been incorporated into presentations for larger audiences in winter maple schools. Forest management presentations were made in January 2006 at three NNY workshops in Lewis, St. Lawrence and Warren Counties, for maple producers.

Information on forest management was made available to maple producers through three newsletters (Short and Sweet) distributed in NNY in 2006 and two state-wide publications:

- Smallidge, P.J. and Farrell, M.L. 2006. Thinning in Your Sugarbush. Pipeline
- Heiligmann, R.B., Koelling, M.R. and Perkins, T.D. (Eds) 2006. North American Maple Syrup Producers Manual. Ohio State University Extension Bulletin 856. (Chapter 5)

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. This is a multiyear project. We will add at least one more site in St. Lawrence County. During 2007, we will be monitoring tree response to thinning treatments along with sap sugar and volume. This will be done using the producer cooperators so as to give them additional experience with research techniques. Workshops on forest management will occur in 2007 at the January Maple Schools. We are planning three forest management workshop at producer cooperator locations. One thinning workshop is scheduled for September 8, 2007 in Franklin County and we anticipate hosting two others in NNY during Fall 2007. Direct engagement in the woods is the most useful learning technique, so we hope to reach over 50 producers through these hands-on workshops.

Acknowledgments: Funding is from the Northern NY Agricultural Development Program, the McIntire-Stennis Program of the U.S.D.A. and the Cornell Maple Program.

Northern NY Agricultural Development Program
2006 Project Report

Grapevine Trials for Cold Hardiness—Essex

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Collaborator(s):

- **Mike Davis** – Research Associate Cornell University in Willsboro
- **Steve Lerch** – Research Support Specialist 2 NYS Experiment Station in Geneva

Farmer participants:

- **Rob McDowell** – Lake Champlain Grape Growers Association in Clinton Co
- **Kathryn and Will Reinhart** - Lake Champlain Grape Growers Association in Essex Co
- 22 additional farmers attended our training sessions and workshops see appendix.

Background: This is continuing project from May of 2005 to evaluate 25 varieties of grapes for cold hardiness. The initial planting was primarily funded by a Farm Viability Institute grant. This is a transition year where the grapes were to be matured in preparation for a crop in 2007. We have been using the project to teach local farmers about raising grapes and how to care for them. The funds for this project were primarily used for mileage, and salaries to bring the viticulture experts to the Champlain Valley. There was also a $1,000 of mowing done by Willsboro Farm equipment to maintain the aisle ways and parking area for the meetings.

Methods: In 2006 "working seminar sessions" enabled volunteers and Cornell researchers Steve Lerch and Kevin Iungerman to accomplish trellising, vine pruning and training, comparative berry tasting, and complete harvest clean-up – and in the process, dealt with many of the horticulture skills and crop management practices needed for vineyard operation. This hands-on instruction also served to illustrate the relative merits of the different vines, and set the stage for dormant season evaluations of winter acclimation, survival performance, and vigor.

The Northeast Fruit Program succeeded in establishing a unique, 300-vine trial of 25 different cold-hardy-wine-grape cultivars at the Cornell E. V. Baker Research Farm in Willsboro in 2005. This was achieved with the help of private and land-grant collaborators, and funding partners.

2006 served as a second establishment year. Growth performance and vine pruning and training practices largely mitigated initial differences; cropping was largely avoided to focus on vine maturation. A small amount of cropping was permitted for vigor control and also for identification and educational purposes.

An interim and on-going purpose of the Willsboro Trial is to foster horticulture skills and crop management practices while learning about the relative merits of the different vines. On-site educational sessions and especially "working seminar sessions" (where participating volunteers assist the Cornell researchers at different seasonal points) were the chosen instructional approaches.

In 2005, volunteers and visitors had learned about the purpose of the trial, site preparation, vine planting, trickle irrigation and early care, small sprayer use, and trellising posts and deer fence construction.

In 2006, our "working seminars" continued:

- April 13 - **String up trellis wiring and complete trellis construction**.
- April 28,29 - **Shoot selection, positioning, training, and tying. Bud and growth stage evaluation introduction based upon Eichorn and Lorenz scheme.**
- April 29 - **Grape IPM Presentation and Question and Answer Session** with Tim Weigle of the NY IPM Program.
- July 18 - **Second shoot selection, positioning, training, and tying session.** Examination for pest and disease problems.
- August 8 - **Joint Apple- Grape Field Day**. (Grape Timing: mid season, pre-veraison [i.e. coloration])
- September 23 - **Final maturity review and examination, and grape tasting with discussion of flavor.** Completed vine harvest and sanitation. Crop shared with participants. (Regular participants/workers take the excess grape crop to learn how to make wine and other grape value added products)

While timing and various standardized protocols prevent the Willsboro Trial from being a fully recognized NE 1020 site, the Formal Organizing Participants to the USDA NE 1020 Multi-state Grape Clonal Evaluation Program have invited Kevin Iungerman to maintain an auxiliary and supportive role in all developing 1020 proceedings. A component sub-group represents cool climate growing conditions and very cold winters similar to our region. These NE 1020 researchers, and the participants as a whole, will prove to be valuable resources to the Willsboro and northern NY grape efforts in the coming years. The University of VT for instance, will be planting a NE 1020 in 2007.

Results: Vine growth performance differences were extensive; however, these were not site, nor climate induced. Rather, initial vine variability was the presenting problem -- largely as a result of procurement issues. The very uniqueness of the vines meant that a variety of different nurseries served as sources for the final vine complement at Willsboro.

Variation also was due to other factors: the differences in available planting stock (bare root or softwood cuttings); the lateness of order placement (arising from uncertainty as to support funding and the cooperative consultative process in planning the trial; and -- in limited instances -- the necessity of multiple planting dates. Softwood plants could not be planted with bare rootstock due to greenhouse readiness issues as well as concerns with early shipping or planting freezes. Despite these initial obstacles, the trial was put in place in record-time (comparable to similar evaluative trials). These were ongoing issues from the 2005 planting. However, this year's good growing season saw all cultivars gain equal footing or readiness for the 2007 cropping year.

Fifteen regular volunteers assisted the researchers over the 2006 growing season, and 25 growers and guests attended the various events. Participants from Vermont, Canada, and the Capital District of NYS are regulars at the working sessions. The growers have opportunities to work and talk to seasoned veterans of viticulture research for 2 to 4 hours as they learn with hands-on experience. Growers bring samples from their vineyard to the meetings to share and discuss at the meetings as well.

Conclusions/Outcomes/Impacts: By early October, the vines had achieved relatively comparable establishment across the different replications. The trial's overall good condition should afford a fairer comparison of winter acclimation, survival performance, and future growth and cropping comparisons over the 2006-2007 dormant period and the 2007 growing season.

Farmers report an intense learning curve that has helped them with their home plantings. We have had 3 expansions and 2 new plantings on the NY side of Lake Champlain since this project started. The farmers have been very active in helping design the research projects, implement the projects, and trying new things at home. Among the comments:

Norbert St. Pierre – I have been able to talk to State experts and to ask every question I can think of. They have helped me with pest issues, pruning and trellising issues. I have taken cuttings home and planted them in the clay soil that I have available in Crown Point and the sandy soil in Witherbee. I have made wine from several varieties without the use of sulfur.

Kathryn Reinhart – My husband and I have planted some of the varieties at home. We have started a more aggressive weed control program based on what I have seen at the Willsboro site. We are making wine now for our use and for gifts.

Rob McDowell – This has been a tremendous experience for all of us. I am surprised at how many people are interested in this project. We have had the Channel 5 news out for our workshops, people call frequently to ask questions about what is the best variety (we

don't know yet). Our membership is increasing. I really want to look at organic production.
Libby Treadwell – we have planted 300 vines in Westport on a clay slope. The bugs are a problem and we are hand picking. It is good exercise.

Outreach: Workshops are promoted on the **cce_cold_country_viticulture-L** list serve, in NNY newsletters, in Glens Falls, Albany, Plattsburg, Watertown and weekly newspapers, and by word of mouth. The Valley News, the Press Republican and the Times of Ticonderoga have run articles on the research project in Willsboro. The Channel 5 WPTZ news has been to the site and reported on the project. There were 4 articles in the NE NY Small Fruit Newsletter about the grape planting and growing grapes in general.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. 2007 and the next 4 to 5 years will be the true test of the cold hardiness of the cultivars selected. A number of ambitious lab and field procedures will describe comparative survival, hardiness, vigor, and maturity indices of these grapes. The envisioned work will:
A) Conduct an examination of the extent of each wine grape cultivar's site adaptation responses as suggested by a 2006-2007 dormant season examination of its vigor and growth habits as indicated by its 2006 wood production.
B) Conduct an examination, tabulation and summarization of various dormant season acclimation and over-wintering capability (mortality) indicators
C. Develop cultivar-specific, degree-day related, base-line information profiles regarding flowering onset, berry and cluster formation incidence, and maturity and yield component

indices (via limited, sequenced weekly berry sampling and development evaluation in August and September 2007).
D. Normal research maintenance as well as pest, and vine growth condition monitoring will be carried out and these activities will be included among outreach activities.

Acknowledgments:

- Northern NY Agricultural Development Program for funding
- Cornell E. V. Baker Research Farm Willsboro for land, and labor from Mike Davis
- NYS Experiment Station, Geneva for work and education esp Steve Lerch and Bob Pool and Hatch funding for Steve's travel and time.
- NYS Farm Viability Institute for the initial planting grant
- Lake Champlain Grape Growers Association for work done and organizing meetings

Northern NY Agricultural Development Program
2006 Project Report

Grapevine Trails for Cold Hardiness--Jefferson

Project Leader(s):

- **Mike Hunter** and **Sue Gwise**, Cornell Cooperative Extension of Jefferson County

Collaborator(s):

- **Bob Pool,** Professor of Viticulture, Cornell University (deceased)

Farmer participants:

- **Duane Smith**, Evans Mills, Jefferson County
- **Mike Stone**, Rodman, Jefferson County

Background: Farmers in the North Country have been looking for alternative crops and interest has been expressed by many people concerning the production of cold hardy grapes in northern New York. Two growers have been successfully growing cold hardy grapes for over 4 years and propagating selected varieties. These varieties are now planted in vineyards in several locations throughout Jefferson County, Clinton County and in Essex and St. Lawrence Counties. The recognition and development of grape growing as an agricultural enterprise in the North Country will have many beneficial effects, one of which is the development of value added products. This can only serve to increase farm income and tourism for northern New York.

Methods: Weather stations were set up at the two sites listed above. Each grower has over 30 varieties of grapes in their vineyard. Data collection began on November 1, 2006. The weather stations are tracking low temperature and wind run. The growers will measure snow depth. These factors are important in determining what grape varieties will survive in northern New York.

Results: Data from each weather station is forwarded to CCE of Jefferson County on a monthly basis. The data is then complied in charts and forwarded to grape growers and placed on the CCE Jefferson website. Currently, we only have data from the Rodman site. There were technical problems with the station in Evans Mills and it did not begin collecting data until January 1, 2007.

WEATHER STATION DATA
Rodman
November 2006

DATE	LOW TEMP.[1]	AVG. TEMP.[1]	AVG. WIND RUN[2]	SNOW DEPTH[3]
11/1	32.1	40.4	0.76	
11/2	28.2	35.4	0.98	
11/3	29.8	34.5	1.04	
11/4	30.1	33.9	0.61	
11/5	31.8	37.3	1.23	
11/6	39.8	46.1	0.93	
11/7	46.1	48.8	1.37	
11/8	46.2	51.5	0.46	
11/9	45.2	51.3	1.21	
11/10	33.8	41.5	0.62	
11/11	33.7	44.9	1.00	
11/12	33.7	35.3	0.81	
11/13	36.5	42.8	0.15	
11/14	42.2	45.8	0.77	
11/15	41.1	44.3	0.21	
11/16	51.2	59.0	0.91	
11/17	38.9	45.2	2.09	
11/18	31.8	36.7	0.40	
11/19	30.6	31.6	0.55	
11/20	27.8	30.2	0.61	
11/21	25.3	31.3	0.35	
11/22	21.2	31.2	0.23	
11/23	22.7	33.8	0.18	
11/24	23.9	33.3	0.29	
11/25	24.8	45.3	0.93	
11/26	45	49.5	0.96	
11/27	45.3	50.6	0.62	
11/28	38.9	45.5	0.41	
11/29	49.1	55.5	2.32	
11/30	38.3	56.0	2.38	

WEATHER STATION DATA
Rodman
October 2006

DATE	LOW TEMP.[1]	AVG. TEMP.[1]	AVG. WIND RUN[2]	SNOW DEPTH[3]
10/1	49.9	53.4	1.0	
10/2	41.7	50.7	.40	
10/3	49.6	59.0	.83	
10/4	46.2	57.5	1.1	
10/5	37.4	44.0	.47	
10/6	31.8	45.1	.14	
10/7	33.0	45.1	.32	
10/8	32.5	48.6	.38	
10/9	43.7	56.9	.53	
10/10	44.4	50.5	.21	
10/11	44.9	57.7	.97	
10/12	39.1	49.6	1.8	
10/13	32.5	39.7	1.8	
10/14	35.6	40.3	1.5	
10/15	34.4	40.3	.76	
10/16	34.4	44.3	.55	
10/17	44.3	49.9	1.0	
10/18	51.1	52.8	1.4	
10/19	47.7	53.9	1.0	
10/20	31.8	38.5	.37	
10/21	27.9	36.0	.43	
10/22	30.7	42.1	.62	
10/23	38.6	41.5	1.6	
10/24	36.1	38.4	.91	
10/25	33.5	39.2	1.3	
10/26	28.7	36.2	.79	
10/27	23.0	36.4	.20	
10/28	37.1	43.3	1.5	
10/29	36.1	39.6	3.5	
10/30	34.7	42.2	1.5	
10/31	37.9	54.7	1.6	

[1]Temperature is measured in degrees Fahrenheit.

[2]Wind run is measurement of the "amount" of wind passing the station during a given period of time, expressed as "miles of wind". Wind run is calculated by multiplying the average wind speed for each archive record by the archive interval.

[3]Snow depth is measured in inches.

Conclusions/Outcomes/Impacts: This project will continue until the last frost date in the spring when all grape vines at the project sites will be assessed as living or dead. This information will then be complied and made available to growers. The project will begin again next fall. With the data that is gathered growers will be able to determine what varieties of grapes to plant based on their survivability in northern New York. Growers will not have to waste resources planting varieties that will not survive our cold winters.

Outreach: Growers are contacted via email as new data is posted on the CCE Jefferson website. After the vines are assessed in the spring, we will put together a reference sheet for growers listing what varieties survived and what temperatures they withstood. This will be printed for distribution and will be posted on the CCE Jefferson website. The Seaway Wine and Viticulture Association is very interested in the results of this study as per the article in Country Folks by Kara Dunn:

Bring on the Cold! North Country Growers Tracking Winter Hardiness of Grapes

How low will temperatures go this winter? Data from two new North Country weather stations installed in early October at Rodman and Evans Mills with Northern New York Agricultural Development Program (NNYADP) funding - will help North Country grape growers evaluate the winter hardiness of their favored fruit.

Cornell Cooperative Extension of Jefferson County Horticulture Educator Sue Gwise says the NNYADP project will track temperature, winds, snowfall and humidity and correlate data with a spring 2007 assessment of how well different varieties of grapes have weathered the North Country winter. The varieties have been planted for different purposes – for red and white winemaking, juice production and harvest as table grapes. Gwise says, "The growers have planted varieties that are expected to do well in cold climates. Some are able to survive temperatures of thirty degrees below Fahrenheit."

At Otter Creek Winery set to open in spring 2007 as "Jefferson County's newest winery" in Philadelphia, NY, Rick Hafemann says, "I have seen temperatures than 50 degrees below zero and difference in temperatures from the top to the bottom of the hill here. Some of our varieties are producing beyond my expectations in spite of the weather, while some varieties that will not grow here are thriving in Clayton."

Hafemann, who calls Northern New York "the biggest growth area in the state for grape plantings and wine tourism," says the grape boom in the 1000 Islands Seaway area represents hope for the future of his family farm. He says, "My wife and I were going to be the last generation on the farm before our son Kyle became excited about building the winery."

Although the Hafemanns have their own weather station, they are interested in seeing the data from the two NNYADP-funded stations and from other growers' stations. The data will help drive their variety choices as they add one acre of new grapes each year.

Near the St. Lawrence River in Clayton, Bill and Sarah Bourquin have concentrated on tending their 2,800 vines of cold hardy grapes for sale to the regional winemakers. Due to full-time job commitments and time constraints, they have used only a vineyard thermometer to track temperatures. Bill says, "For us, having the weather stations through the Northern New York Agricultural Development Program will definitely provide good data for the different areas in the region and will help us assess winter damage and future variety options based on the temperature and other data."

For more information on the Northern New York Cold Hardy Grape Project, contact Sue Gwise, Cornell Cooperative Extension of Jefferson County, 315-788-8450. For information on the Northern New York Agricultural Development Program that funds research and education outreach for Essex, Clinton, Franklin, St. Lawrence, Lewis and Jefferson counties, go online to www.nnyagdev.org. # # #

Next steps: Continued monitoring of winter vineyard temperatures for the life of the weather stations.

Person(s) to contact for more information (including farmers who have participated:

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Northern NY Agricultural Development Program
2006 Project Report

Organic Grapevine Management

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Collaborator(s):

- **Mike Davis** – Research Associate Cornell University in Willsboro
- **Steve Lerch** – Research Support Specialist 2 NYS Experiment Station in Geneva

Farmer participants:

- **Rob McDowell,** Lake Champlain Grape Growers Association, Clinton County
- **Kathryn and Will Reinhart** - Lake Champlain Grape Growers Association in Essex Co served as co-collaborators and used some of the information developed from this project.

Background: Lake Champlain Grape Growers Association wanted to minimize pesticide usage while protecting their investment in vines. They are meeting with Vermont farmers who were growing grapes organically. They are working with Mike Davis at the Willsboro Farm, who has considerable experience growing organic grains and vegetables.

They wanted to test several organic compounds for effectiveness in grapes to control powdery mildew, downy mildew, black rot, and phomopsis. They decided to try Milstop – a potassium bicarbonate, Champion – a copper hydroxide, SMS Stylet oil, Bordeaux Mixture – Copper sulfate, Milk, and Compost Tea. We were unable to use the compost tea, as we were unable to identify a protocol that could be recommended by any NY advisor.

They ended up using JMS Stylet Oil, Champion WP Wetted Powder (Copper Hydroxide), Baking Soda (potassium bicarbonate), whey (from Sam Hendren), and a Control.

2006 was a heavy disease pressure year for black rot, downy and powdery mildew due to high rainfall and humidity. However, the variety that we chose for the trial, Frontenac, was partially resistant to mildew pressure.

Methods:

- Started with 4 year old Frontenac vines (which have some innate resistance to mildew but not black rot)
- Set up a random spray protocol with 5 reps with the help of Mike Davis.
- Kevin Iungerman, Regional Fruit specialist, trained Rob McDowell in identification of pests and provided Integrated Pest Management disease identification worksheets for future reference.
- Spray applications
  a. Used separate sprayers for each application. Sprayed each rep separately then moved to next spray application
  b. Followed label instructions for mixing, rates and spraying for Stylet Oil and Champion.
  c. Used generic Organic recommendations from NOFA of 5 pounds per acre of Baking Soda on grapes
  d. Used an Australian web site recommendations for whey application
  e. All sprays were contact based and not systemic. Since it rained so much the sprays were washed off
  f. Used "New Film" (pinolene) as a spreader sticker to keep spray on the plant for Champion and Baking Soda applications.
- Sprayed on
  a. First spray was post bloom which was late. There should have been a pre-bloom and a bloom spray. We had trouble getting started.
  b. Then we sprayed 7 to 10 days after that five separate times until veraison (color change). However, some sprays were put on under wet conditions as it never stopped raining.
  c. There was one spray after veraison.
  d. The vines were sprayed on 7/5, 7/12, 7/27, 8/8, and 8/24.
  e. The mildew pressure subsided as the weather conditions dried up. The black rot pressure was not increasing either so sprays were stopped.
- The reps were scouted and infestation of Powdery Mildew, Downy Mildew, and Black Rot were scored on a 0 to 4 basis (None, Some -, Some, More, More +).

Results:

- The crop in terms of quantity was excellent.
- The black rot did impact the quality, however, Rob McDowell was able to pick infested berries out and find good clusters for wine making from all replications including the control.
    a. Powdery Mildew was ranked "Some -" on all blocks including the control. However it was ranked "Some" in nearby Lemberger and Cab Franc.
    b. Downy Mildew was ranked "Some -" all blocks including the control. However, it was ranked "More +" on nearby Leon Millot.
    c. Black Rot was ranked "Some" and "More" on all blocks except those with Champion WP which ranked "Some-" indicating a beneficial impact from this application.
    d. Phomopsis was never positively identified on this farm.

- The entire crop of Leon Millot was lost on one farm due to downy mildew so the pressure was high. The Saint Croix was reasonably untouched.

Conclusions/Outcomes/Impacts:

- Need to start early with controls, before bloom to keep pest and disease pressure from ever building up.
- Selecting resistant varieties is as important as reducing pesticide usage.
- IPM/Sustainable growing methods are superior to organic grape production at this time. We need training on sustainable IPM spraying.
- True organic testing is very expensive and requires trained researchers and professors multiple replications.
- Black rot is hard to control effectively organically.

Outreach

- Results were sent out on the **cce_cold_country_viticulture-L** list serve,
- Discussions of spray alternatives were held at the Cold season workshops in Willsboro.
- 22 farmers attended workshops on the Cold Season varieties and Rob discussed his project and organic alternatives.
- Class is planned for April of 2007 on IPM for grape pest control.

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