NORTHERN NEW YORK AGRICULTURAL DEVELOPMENT PROGRAM

Final Report of Work Completed
April 1, 2007 to December 31, 2008

(NYS Department of Agriculture Contract #C200187)

February 15, 2009

New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University
Ithaca, New York

The Northern NY Agricultural Development Program
Its Purpose and Background

In NYS, no area is more economically dependent on agriculture and more challenged in terms of the profitability and long term vitality of its farm businesses than the North Country. These challenges are exacerbated by factors that include, but are not limited to, the regions climatic constraints, its soil resources, and its distance from markets

In 2007-2008, the Northern New York Agricultural Development Program (NNYADP) continued to support agricultural research projects, demonstrations, and outreach in Jefferson, Lewis, St. Lawrence, Franklin, Clinton and Essex counties to help improve agricultural productivity and farm profitability. This report documents findings, results and impacts of the projects that were conducted in the time period covering April 1, 2007-December 31, 2008. Twenty-two (22) projects were conducted in the following areas:

- Dairy herd management
- Agricultural environmental management
- Integrated pest management
- Biofuels/biomass production
- Field crop production and improvement
- Maple production
- Fruit and vegetable production

The program is supported by funding from the NYS Senate though the long term sponsorship of the NYS senators that represent the 6-county Northern NY region. The program also receives support (funds, land, staff and expertise) from Cornell University's College of Agriculture and Life Sciences, the Cornell University Agricultural Experiment Station, the NYS Agricultural Experiment Station in Geneva, Cornell Cooperative Extension at Cornell and in each of the six NNY counties, the W.H. Miner Agricultural Institute, the U.S. Department of Agriculture, cooperating farmers and agri-service businesses.

For more information on the Northern NY Agricultural Development Program contact Jon Greenwood, Co-chair for WNNY, @ 315-386-3231, Joe Giroux, Co-chair for ENNY @ 518-563-7523 or girofarm@together.net or Dave Smith, Coordinator for Cornell University @ 607-255-7286 or rds4@cornell.edu. Additional copies of this report are available from Dave Smith.

Table of Contents

NNYADP Steering Committee Members

Jefferson County:
Ron Robbins, Dairy and crop farmer
Don Holman, Beef producer
Greg Mason, Dairy farmer
Dwight Greene, Dairy farmer
Doug Shelmidine, Dairy farmer
Harold Boomhower, Sheep producer

St. Lawrence County:
Jon Greenwood, Dairy farmer and Co-Chair
David Fisher, Dairy farmer
Bob Andrews, Dairy farmer
Kevin Acres, Dairy farmer
Bob Zufall, Dairy farmer
Earle Travis, Sheep producer
Dan Chambers, Dairy farmer

Lewis County:
Bernard Goehlert, Dairy farmer
Ralph Chase, Livestock farmer
Steve Nortz, Dairy farmer
Patty Beyer, Dairy farmer

Franklin County:
Charles Hesseltine, Crops
Harry Fefee, Dairy farmer
Kirby Selkirk, Livestock farmer
Doug Malette, Crop farmer
Randy Ooms Dairy farmer
Nate Beechy, Dairy farmer

Clinton County:
Joe Giroux, Dairy farmer/vegetables, Co-Chair
Dutch Rovers, Dairy farmer
Dan Guay, Dairy farmer
Bruce Dimock, Dairy farmer
John Rulfs, Dairy farmer
Tony Lapierre, Dairy farmer

Essex County:
Bernard Leerkes, Dairy farmer
Sam Sherman, Organic grain processing
Bob Perry, Dairy farmer
George Sayward, Dairy farmer

NNYADP Program Subcommittees

Dairy and Field Crop Production

Ron Robbins, Jefferson
Doug Shelmidine, Jefferson
David Fisher, St. Lawrence
Bob Zufall, St Lawrence
Bernard Goehlert, Lewis
Charles Hesseltine, Franklin
Randy Ooms, Franklin
Dutch Rovers, Clinton
Bruce Dimock, Clinton
Bernard Leerkes, Essex
George Sayward, Essex

Dwight Greene, Jefferson
Jon Greenwood, St.Lawrence
Bob Andrews, St. Lawrence
Dan Chambers, St. Lawrence
Steve Nortz, Lewis
Harry Fefee, Franklin
Joe Giroux, Clinton,
Dan Guay, Clinton
Jon Rulfs, Clinton
Bob Perry, Essex

Horticultural Crop Production

Doug/Rhonda Lamont; Lewis
Delta Keeney, Jefferson
Jack Adel, St. Lawrence
Donald Markey, St. Lawrence
Mark Rinehart; St. Lawrence
Beth Spaugh-Barber, Clinton
Pam Miller, Clinton
Rob Hastings, Essex

Michael Lisk, Lewis
Diane Smith, Jefferson
Kelly Jordan, St. Lawrence
James Miller, St. Lawrence
Catherine Watkins; St.Law.
Sam Dyer, Clinton
Jane Gregware, Clinton

Livestock Production

Patrick Kilcoyne, St. Lawrence
Harold Boomhower, Jefferson
George Smith, Jefferson
Gail Millard, Jefferson
Janice Gardner, Jefferson
Ralph Chase, Lewis
Scott Martin, Lewis
Donna Foley, Essex

Ken Theobald, St. Lawrence
Bob Wilson, St. Lawrence
Don Holman, Jefferson
Maria Chamberlain, Jefferson
Janet Schrader, Jefferson
Larry Herr, Lewis
Kirby Selkirk; Franklin

Maple and Forestry Products

Jeff Jenness; St. Lawrence
Dean Yancey; Lewis
Jeremy Youngman; Clinton

Kenneth Tupper; St. Law.
Haskell Yancey; Lewis
Jen Parker; Clinton

NNY Agricultural Development Program

2007-2008 Final Report

Project Title: **Treatment success and factors associated with treatment success of Klebsiella and E.coli mastitis in dairy cows in NNY**

Project Leaders: Ynte Schukken, Ruth Zadoks and Gary Bennett; Quality Milk Production Services; Cornell University.

Project Staff: Heidi Sharkey, Natalia Belomestnykh and Brad Rauch

Collaborators. ENNY - Franklin: V. Bilow (producer), WNNY - St. Lawrence county: D. Fisher (producer), A. Thompson (veterinarian); Jefferson: Murcrest farms, M. Thomas (veterinarian), Lewis: Demko farms, P. Ostrum (veterinarian), Washington: Woody Hill farms, B Ceglowski (veterinarian).

Executive Summary:
The Northern New York Agricultural Development Program (NNYADP) funded a large field study on treatment success of and risk factors for cure in cows with either E. coli or Klebsiella clinical mastitis. The funding from NNYADP was used to leverage support from a large NY pharmaceutical company. The study was performed in a total of 5 farms, of which 4 were located in NNY. A total of 119 cows with clinical mastitis were included in the trial. An extended therapy with the treatment that was evaluated in this study (Spectramast®) turned out to be very successful relative to untreated control animals. Treated animals showed an overall cure rate of 55% versus 21% in the control group. This difference is very important for dairy farmers in their day to day management and also statistically significant.
Further analysis of the bacterial strains collected showed a general resistance of these bacteria against most antibiotics with the exception of Ceftiofur, the antibiotic in Spectramast®.

Introduction. Mastitis is the most costly disease to animal agriculture in the U.S. and throughout much of the world. Mastitis is an inflammation of the mammary gland. It can be caused by many types of injuries, including infectious agents and their toxins, physical trauma, and chemical irritants. In dairy cows, mastitis is nearly always caused by bacteria or other microorganisms that enter the mammary gland. Gram-negative bacteria, mostly coliforms, cause 40% of all clinical mastitis (CM) cases (González et al., 1990; Hogan et al., 1989) and up to 15-25% of cows in well-managed herds are annually diagnosed with CM caused by coliforms (Hogan and Smith, 2003). The most common coliform species that cause CM are *Escherichia coli* and *Klebsiella* spp. (Erskine et al., 2002a, 2002b; Smith et al., 1985; Todhunter et al., 1991). In Northern New York, we have previously focused on *Klebsiella* mastitis and found it to be an important cause of both clinical and subclinical mastitis. Treatment of *E. coli* clinical mastitis with Spectramast® has previously been shown to be effective. Currently, this is the only product that is registered to be used in gram-negative *E.coli* mastitis. However, no efficacy data against *Klebsiella* mastitis are available. QMPS data from antimicrobial sensitivity testing of *Klebsiella* isolates from cows with CM show that the vast majority of isolates (ca. 90%) are susceptible to ceftiofur, the active ingredient of Spectramast®. We have now secured funding for performing a treatment efficacy trial of Spectramast® in NNY. This trial provides us with the opportunity to collect information and additional samples to answer some further outstanding questions.

The further questions that we attempted to answer in this study were:

1. What host level risk factors are present that predict the cure of *Klebsiella* and *E.coli* mastitis in cows?
2. Is there evidence for strain differences in Klebsiella isolates from cows with mastitis versus isolated that are collected from the environment of the cow ?

The research team has extensive experience with *E. coli* and *Klebsiella* infections in Northern New York dairy herds. In the past, the team has studied the effect of J5 vaccination on coliform infections (Wilson et al., 2007), and the impact of coliform mastitis on milk production and survival (Gröhn et al., 2004, 2005). The team is currently completing farm studies on *Klebsiella* in NNY and found it to be abundant in the cow environment (Munoz et al. 2006, 2007, 2008). Results from these studies have dramatically altered our understanding of the ecology of *Klebsiella* in an around cows. More specific recommendations can be provided to dairy producers, resulting in a true impact on *Klebsiella* incidence on their farms. The farms that participate in the current studies continue to have an interest in this important disease and are eager to participate in the next phase of developing workable solutions for this important problem in NNY dairy herds.

Research activities.

Treatment trial with Spectramast® (externally funded, no funding provided by NNYADP)

This trial was a multi-location study conducted on multiple dairy farms. At each farm-location, lactating cows with gram-negative (*Klebsiella* and *E.coli)* clinical mastitis were be randomly allocated to the following treatment groups:

1. Control group – Cows were not treated with an antibiotic. Normally, cows with Gram-negative mastitis would not receive any treatment other than frequent milk out on many farms.
2. Treatment group – Cows were be treated with Spectramast® via intramammary infusion at 24-hour intervals according to label standards with 5 treatments during 5 subsequent days. Intramammary treatments will be administered by trained farm personnel.

Cows were sampled before the first treatment, i.e. upon observation of clinical symptoms and assessment of clinical severity. Quarter milk samples from all affected quarters were taken using standard procedures. In case of on-farm culture laboratories, the result of the farm laboratory was be used for cow inclusion in the trial. For participating producers that have milk samples tested through the 24-hr turn-around program at QMPS or another laboratory, the laboratory results were be used for inclusion decisions. After completion of the treatment, two follow-up samples were collected by QMPS personnel at approximately 7 $\pm$ 2 days and 14 $\pm$ 2 days after the last treatment. All follow-up samples were submitted to a QMPS laboratory. Standard bacteriology according to NMC recommendations were performed (NMC Handbook for bacteriological procedures). Farms and cows per treatment group that were included in the trial are shown in the table below:

Table 1. Characteristics of cows with clinical mastitis included in the study.

Farm	Number of Cows	Avg Days in Milk	Avg Lactation number	# Production before mastitis
A	35	140	2.9	102
B	26	155	2.2	92
C	22	106	2.6	80
D	14	160	2.7	93
E	22	116	2.6	102
Total	119	134	2.6	95

The distribution of bacteria causing clinical mastitis, and the cure rate in treatment and control group is shown in the table below:

Table 2. Number of organisms and cure in treatment and control cows per farm.

Farm	# Cows *E. Coli*	% cure Trt Control	Number Cows *Klebsiella*	% cure Trt Control	# Cows Other	% cure Trt Control
A	2	50% N/A	17	55% 17%	15	80% 75%
B	18	82% 14%	10	67% 25%	0	N/A N/A
C	5	100% 0%	15	50% 0%	1	N/A N/A
D	7	60% 0%	7	40% 0%	0	N/A N/A
E	18	100% 67%	1	N/A 0%	1	0% N/A
Total	48	84% 41%	50	56% 14%	17	68% 75%

Project activities.

We have collected data on cow ID, date of diagnosis, dates of treatment, treatment product and duration of treatment, parity, DIM at diagnosis, days since last J5 vaccination, milk yield at last test day before diagnosis, most recent Linear S core (LS) and previous LS (to differentiate new vs. chronic infections), follow up data on linear score, milk production and herd survival. These data were routinely collected into computerized record systems (DC305®) on the farms that were included in the trial. Data were transferred to a spreadsheet and merged into a statistical analysis program (SAS®). Logistic regression was used to analyze the data and identify important risk factors for cure of infection. The table below shows the best fitting regression model predicting cure of infection:

Table 3. Result of logistic regression analysis of the probability of cure of mastitis.

Predictor	Coefficient	Standard error	Z -value	P-value
Constant	0.22	1.54	0.14	0.88
Lactation	0.81	0.33	2.50	0.01
E. coli present	- 1.87	1.31	-1.42	0.15
Klebsiella present	- 3.31	1.52	-2.18	0.02
Treatment	-1.28	1.68	-0.76	0.45
E.coli & treatment	4.59	2.01	2.28	0.022
Kleb & treatment	4.23	2.09	2.03	0.043

The results of the regression analysis indicate that older cows tend to cure better compared to heifers. Also, cows infected with *E. coli* and *Klebsiella* cure better when treated with Spectramast® compared to cows that are left untreated.

Additional milk samples were collected to precisely follow infection status in animals. Besides the samples taken for the treatment trial (before treatment and 7 and 14 days after last treatment), we collected samples every day during treatment, and 21 days after the last treatment.

Antimicrobial resistance.

We evaluated antimicrobial resistance in a proportion of the bacterial isolates obtained from the trial. These were only isolates obtained from the clinical cases before any treatment had taken place (day 1). Antimicrobial sensitivity data reported as the percent of strains resistant to the indicated antibiotic is shown below. We report here on the more important veterinary antibiotics:

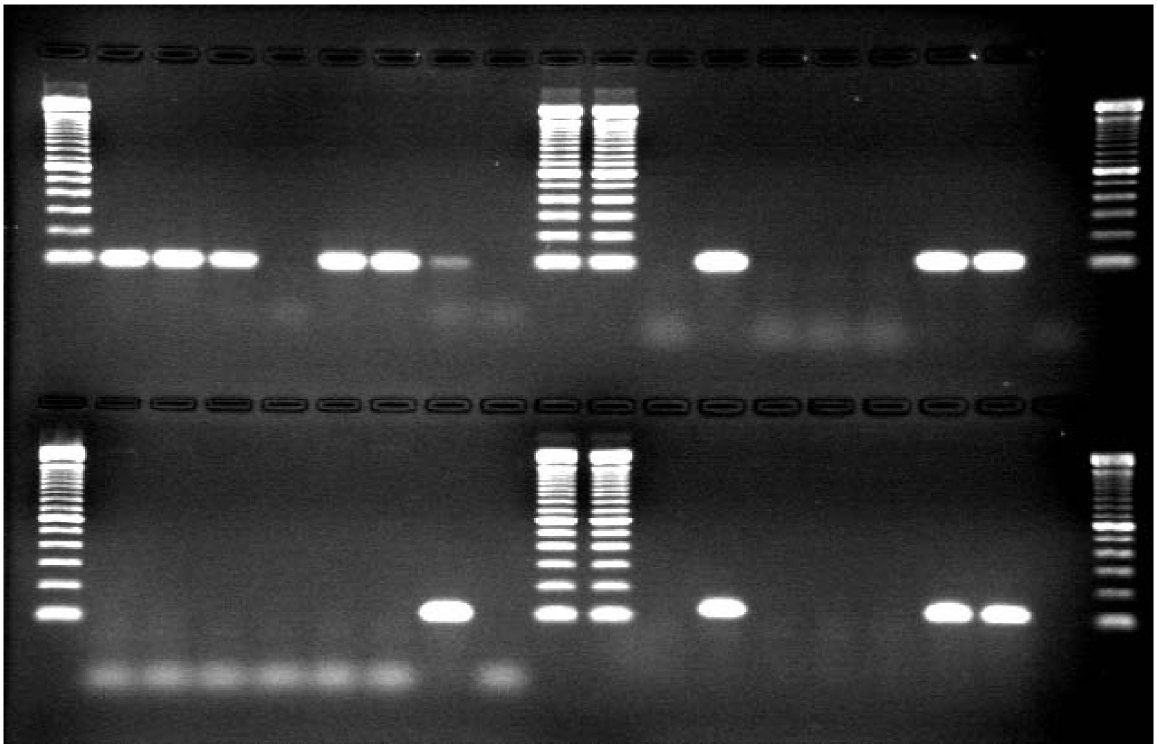
Table 4. Antimicrobial resistance against common antibiotics in *E. coli* and *Klebsiella* bacteria.

Antibiotic	*E. coli* % resistant	*Klebsiella* % resistant
Ampicillin	47%	100%
Penicillin	100%	100%
Oxacillin	100%	95%
Pirlimycin	100%	100%
Tetracyclin	29%	62%
Ceftiofur	18%	9%

Presence of virulence factors.

We evaluated the presence or absence of specific virulence factors in *Klebsiella* bacteria obtained from the dairy farms. We collected bacteria from the cases of clinical mastitis and identified a control group of similar size, consisting of bacteria that were found in the environment. The most important virulence factors that we evaluated were the so-called siderophores. These virulence

factors allow bacteria to take up iron from the environment, even when the environment is relatively low in available iron. This is important since bacterial growth is dependent on iron availability. The siderophores that we evaluated were Enterobactin receptor (*fepA*), Aerobactin receptor (*iutA*), Yersiniabactin receptor (*psn*) and Yersiniabactin siderophore (*irp2*). These siderophores were evaluated using molecular methods that are shown in the figure below:
Figure 1. PCR testing of four siderophores: Enterobactin receptor (*fepA*), Aerobactin receptor (*iutA*), Yersiniabactin receptor (*psn*) and Yersiniabactin siderophore (*irp2*).



The results indicated that clinical mastitis *Klebsiella* isolated had a significantly different siderophore profile compared to environment isolates. All clinical isolates had at least one of the tested siderophores, whereas 16% of environmental isolates had no siderophores at all. Approximately 6% of isolates had at least three different siderophores, whereas none of the environmental isolates had more than 1 siderophore.

Discussion and conclusion

The results of this field research indicated a high cure rate of a 5 day 'extended' Spectramast® therapy compared to untreated controls. This result is very significant for the dairy farmers in NNY as gram-negative mastitis is a very important disease on the farms and current practice on most farms is to not treat affected cows with antibiotics. It is important for the dairy farmers to work with their practicing veterinarians to implement this treatment protocol on their farms. Further analysis of the isolates obtained from the dairy farms in NNY indicated that isolates were multi-resistant against most currently used antibiotics, but generally sensitive to Ceftiofur, the antibiotic in our treatment product (Spectramast®). The *Klebsiella* isolates that caused clinical mastitis showed a significantly different profile of siderophores. These siderophores are important virulence factors for *Klebsiella*, and these results would indicate that there is a specific selection of more virulent bacteria to cause mastitis. Future research is aimed at identifying more detail on these virulence factors and evaluating the potential of preventative programs based on the identified virulence factor profile.

REFERENCE LIST

Barkema, H. W., Y. H. Schukken, T. J. G. M. Lam, M. L. Beiboer, H. Wilmink, G. Benedictus, and A. Brand. **1998**. Incidence of clinical mastitis in dairy herds grouped in three categories by bulk milk somatic cell counts. Journal of Dairy Science 81(2):411-419.

Diancourt, L., V. Passet, J. Verhoef, P. A. Grimont, S. Brisse. **2005**. Multilocus sequence typing of *Klebsiella pneumoniae* nosocomial isolates. J Clin Microbiol. 43(8):4178-82.

Erskine, R. J., P. C. Bartlett, J. L. VanLente, and C. R. Phipps. **2002a**. Efficacy of systemic ceftiofur as a therapy for severe clinical mastitis in dairy cattle. J. Dairy Sci. 85(10):2571-2575.

Erskine, R. J., R. J. Eberhart, L. J. Hutchinson, S. B. Spencer, and M. A. Campbell. **1988**. Incidence and types of clinical mastitis in dairy herds with high and low somatic cell counts. J. Am. Vet. Med. Assoc. 192(6):761-765.

Erskine, R. J., R. D. Walker, C. A. Bolin, P. C. Bartlett, and D. G. White. **2002b**. Trends in antibacterial susceptibility of mastitis pathogens during a seven-year period. J. Dairy Sci. 85(5):1111-1118.

González, R. N., D. E. Jasper, N. C. Kronlund, T. B. Farver, J. S. Cullor, R. B. Bushnell, and J. D. Dellinger. **1990**. Clinical mastitis in two California dairy herds participating in contagious mastitis control programs. J. Dairy Sci. 73(3):648-660.

Gröhn, Y. T., R. N. González, D. J. Wilson, J. A. Hertl, G. Bennett, H. Schulte, and Y. H. Schukken. 2005. Effect of pathogen-specific clinical mastitis on herd life in two New York State dairy herds. Prev.Vet.Med. 71:105-125.

Gröhn, Y. T., D. J. Wilson, R. N. González, J. A. Hertl, H. Schulte, G. Bennett, and Y. H. Schukken. 2004. Effect of pathogen-specific clinical mastitis on milk yield in dairy cows. J.Dairy Sci. 87:3358-3374.

Hogan, J. S., K. L. Smith, K. H. Hoblet, P. S. Schoenberger, D. A. Todhunter, W. D. Hueston, D. E. Pritchard, G. L. Bowman, L. E. Heider, B. L. Brockett. **1989.** Field survey of clinical mastitis in low somatic cell count herds. J. Dairy Sci. 72(6):1547-1556.

Munoz, M. A., C. Ahlstrom, B. J. Rauch, R. N. Zadoks. **2006**. Fecal shedding of *Klebsiella pneumoniae* by dairy cows. J Dairy Sci. 89(9):3425-30.

Munoz, M. A. and R. N. Zadoks. **2007**. Short communication: Patterns of fecal shedding of *Klebsiella* by dairy cows. J. Dairy Sci. 90:1220-1224.

Munoz MA, Bennett GJ, Ahlström C, Griffiths HM, Schukken YH, Zadoks RN. **2008.** Cleanliness scores as indicator of Klebsiella exposure in dairy cows. J Dairy Sci. 91:3908-16.

Munoz MA, Welcome FL, Schukken YH, Zadoks RN. **2007.** Molecular epidemiology of two Klebsiella pneumoniae mastitis outbreaks on a dairy farm in New York State. J Clin Microbiol.

45:3964-71.
Schukken, Y. H., and H. A. Deluyker. **1995**. Design of Field Trials for the Evaluation of Antibacterial Products for Therapy of Bovine Clinical Mastitis. Journal of Veterinary Pharmacology and Therapeutics 18(4):274-283.

Smith, K. L., D. A. Todhunter, and P. S. Schoenberger. **1985**. Environmental mastitis: cause, prevalence, prevention. J. Dairy Sci. 68(6):1531-1553.

Todhunter, D. A., K. L. Smith, J. S. Hogan, and P. S. Schoenberger. **1991**. Gram-negative bacterial infections of the mammary gland in cows. Am. J. Vet. Res. 52(2):184-188.

Wenz JR, Garry FB, Lombard JE, Elia R, Prentice D, Dinsmore RP. **2005.** Short communication: Efficacy of parenteral ceftiofur for treatment of systemically mild clinical mastitis in dairy cattle. J Dairy Sci. 88:3496-9.

Wilson, D. J., Y. T. Gröhn, G. J. Bennett, R. N. González, Y. H. Schukken, and J. Spatz. 2007. Comparison of J5 vaccinates and controls for incidence, etiologic agent, clinical severity, and survival in the herd following naturally occurring cases of clinical mastitis. J. Dairy Sci. 90:4282-4288.

NNY Agricultural Development Program
2008 Project Report

Title: **The Effect of the Silage Fermentation Process on *Mycobacterium avium* subsp. *paratuberculosis***

Project Leader(s): Sally A. Flis, Catherine S. Ballard, Everett D. Thomas, Heather M. Dann, and Jeffrey W. Darrah**,** *W.H. Miner Agricultural Research Institute, Chazy, NY*

Collaborator: Kimberly Cook, *USDA-ARS Bowling Green, KY*

Background: Johne's disease, which is caused by Mycobacterium avium subsp. paratuberculosis (MAP), is a chronic, progressive, enteric disease of ruminants. Cattle generally become infected with MAP as calves and often do not show clinical signs until 2 to 5 years of age. The primary route of infection is through the ingestion of fecal material, often from contaminated feed or water, milk, or colostrum containing MAP (Stabel, 1998; Manning and Collins, 2001). Multiplication of MAP occurs only in a susceptible host within a macrophage, making it an obligate pathogenic parasite (Collins, 2003). As a result of this, MAP cells that are shed in the feces or milk of a cow are extremely tolerant to environmental stresses.

Heat tolerance was demonstrated when MAP was recovered after pasteurization treatments of up to 140°F (60.1°C), however no MAP was recovered when temperatures exceeded 150°F (65.5°C) (Stabel, 2001). Further, it has been reported that pasteurization at 161°F (71.7°C) for 15 to 20 seconds achieved complete kill of MAP (Stabel et al., 2004). *Mycobacterium paratuberculosis* is also very cold tolerant. Richards and Thoen (1977) reported that even with a 1:10,000 dilution of feces contaminated with MAP they were able to recover the organism after 15 weeks of being frozen at -94°F (-70°C).

The MAP cells in excreted feces can remain alive for more than a year, depending on the conditions (Collins, 2003). Therefore, health programs such as New York State Cattle Health Assurance Program (NYSCHAP) strongly recommend no manure application to grass or alfalfa fields until the final crop has been harvested, especially forages intended for cattle less than 24 months of age. Those farms participating in the NYSCHAP program find it challenging to adhere to these restrictions on manure application. In addition, little research has been conducted to determine the impact of ensiling forages on the survivability of MAP.

In past studies at Miner Institute, the maximum temperature reached during the fermentation process for grass/alfalfa forages was only 103.8°F (39.9°C), suggesting that temperature will not be a factor in killing MAP during silage fermentation. The impact of pH during fermentation was evaluated by ensiling 100 g of re-hydrated grass hay in a vacuum bag system (Katayama et al., 2000). This study found that when pH was less than 4.8, MAP did not survive. Another study reported that MAP will survive pH levels between 5.3 and 8.0. (Manning and Collins, 2001). In grass/alfalfa silage at Miner Institute the average pH after fermentation was 4.7 and 4.5 in 2004 and 2005, respectively. Silage pHs below 4.8 indicates that MAP excreted in feces and applied to forages at Miner Institute may be killed during the fermentation process.

Results from a preliminary study in which 4 replications of 600g of grass/alfalfa silage were inoculated with 5.5 x 10^6 cells of MAP per gram of forage and placed in vacuum sealed bags for 30 days showed an average decrease of 97% in the number of MAP cells per gram of forage as determined by polymerase chain reaction (PCR) which is a rapid and sensitive test able to detect MAP DNA in fecal samples. These results indicated that there is a potential to decrease the contamination of MAP through fermentation of grass forages. However, there was still a detectable amount of viable MAP DNA in the sample.

Therefore, the objective of this study was to determine how many days of ensiling of grass/alfalfa forages should be recommended to eliminate MAP DNA from the fermented feed. This study's findings may warrant a follow-up investigation conducted on a more practical, farm-scale system.

Methods:

Fecal Inoculant: Fecal samples were taken from cows in the dairy herd at Miner Institute that were identified as Johne's positive by the dairy herd's management protocol (500 ml per cow). Half of each sample was shipped overnight to the USDA-ARS Animal Waste Management Research Unit (Bowling Green, KY) for determination of MAP cells per gram of manure by PCR. The other half of the sample was frozen at -112°F (-80°C). Manure from infected animals averaged 2.0 X 10^6 MAP cells/g manure, resulting in the diluted infected manure mix having a concentration of 1.0 X 10^5 MAP cells/g manure.

Forage Sample, Inoculation, Fermentation, and Sampling: Fresh grass/alfalfa forage was collected at harvest from a field that had not received manure application in the 2007 crop season. The unfermented forage was frozen at -4°F (-20°C). After thawing, dry matter (DM) was determined for each sample and used to calculate the amount of water that could be added to the forage to achieve an ideal DM for fermentation. Additionally, a sample was taken before and after inoculation for MAP determination at the USDA-ARS Animal Waste Management Research Unit (Bowling Green, KY).

Six replications were prepared for sampling at 30, 45, 60, 75, and 90 days after ensiling. For each replication, 700 g of forage was inoculated with the diluted manure and mixed. From the inoculated silage, 600 g was placed in a vacuum-sealed bag and labeled with the number of days of ensiling until sampling. All bags were placed in a dark room at room temperature (68°F or 20°C) until final sampling. For each replication, the remaining inoculated unfermented forage was sent for MAP determination by PCR at the USDA-ARS Animal Waste Management Research Unit (Bowling Green, KY).

After the assigned number of days of ensiling the samples were removed from the bags. The pH, DM, and organic acid concentration were determined on each replication (Dairy One Forage Testing Lab, Ithaca, NY) to examine the quality of the sample fermentation. A sub-sample from each bag was frozen and sent for MAP determination by PCR at the USDA-ARS Animal Waste Management Research Unit (Bowling Green, KY).

Statistical analysis was done to determine means of the silage fermentation characteristics for each sampling day.

Results:

Forage Fermentation: Forage fermentation profiles of MAP inoculated forage did not differ from control bags (Table 1). Further, fermentation profiles of all days were within the range for the sample average reported by Dairy One Forage Lab (Ithaca, NY; Table 1). An interesting finding of this research was that the acetic acid concentration of the samples was higher for the 45, 60, 75, and 90 days than at 30 days of fermentation ($P < 0.05$, Table 1). Although visually the forage appeared to ensile properly, perhaps freezing the forage prior to fermentation impacted fermentation.

MAP Concentrations: Control samples had MAP concentrations below the detection limit of the PCR test, which indicated the forage did not have any background contamination of MAP prior to dilute manure application. Total bacterial counts of the silage were similar between control samples and MAP inoculated samples at all samplings (Figure 1), which indicate similar bacterial populations during fermentation for both control and treated samples.

The MAP concentrations persisted in the silage for the duration of the experiment (90 days; Figure 1) although target sequences were decreasing from day 60 forward. The levels detected at all ensiling times were adequate to infect susceptible animals ($1.9 \pm 0.87 \times 10^5$ cells/g silage.

Conclusions/Outcomes/Impacts: Unfortunately, the fermentation of forage through ensiling did not eliminate the presence of MAP in contaminated forage. Previous research conducted showed a much larger decrease in MAP populations after silage fermentation. The levels detected at all ensiling times for the current study were adequate to infect susceptible animals (1.9×10^5 cells/g silage). While the use of PCR to detect MAP DNA is a quick and reliable method, it is not able to discern between live and dead cells. The question that arose from these findings was if the ensiling process preserves the target DNA sequence measured by the PCR method, keeping the counts higher than expected on all sampling days.

Future Investigations: Based on these study results, a second research project was started in October 2008 where 3 treatments were used: a control (no MAP inoculated), forage inoculated with live MAP, and forage inoculated with dead MAP. These treatments will provide information on how long a dead versus live MAP will persist in fermented forage. This finding will help determine if the use of PCR for MAP detection is a suitable methodology for examining MAP presence in ensiled forage. If it is found to be unsuitable, the traditional bacterial culture method would need to be used for future studies evaluating the survivability of MAP during ensiling. Unfortunately, the culturing method takes months to determine MAP presence. The follow-up study will be published in the 2009 NNYADP Report.

Outreach: Data will be summarized and presented at local meetings (Miner Institute Corn Congress and/or Dairy Day). In addition, articles summarizing the results will be published in Miner Institute's *Farm Report* and other popular press publications.

Reports and/or articles in which the results of this project have already been published: The results of this project were presented as a poster presentation and published as an abstract for the Joint Meeting of the Geological Society of America, and the ASA-CSSA-SSSA in Houston, Texas. Survival of bovine *Mycobacterium avium* subsp. *Paratuberculosis* during grass silage forage fermentation. *S. A. Flis, K. L. Cook, C. S. Ballard, E. D. Thomas, and H. M. Dann.*

Person to contact for more information:
Catherine S. Ballard, P.O. Box 90, Chazy, NY 12921. (518) 846-7121 x 112.
ballard@whminer.com.

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **ISNT Implementation on NNY Farms and Protected N Sources to Meet N Needs for Corn Where N is Needed**

Project Leader: Quirine M. Ketterings, Nutrient Management Spear Program (NMSP), Cornell University

Collaborators:

- Cornell University: Anne Place (NMSP graduate student); Greg Godwin, (NMSP staff;) Karl Czymmek, (PRODAIRY) ;Mike Davis, (E.V. Baker Research Farm, Willsboro NY)
- Cornell Cooperative Extension: Mike Hunter (CCE of Jefferson County); Joe Lawrence (CCE of Lewis County); Mike Stanyard (NWNY Dairy, Livestock, and Field Crops Team; one of two identical trials funded with federal formula funds)
- Consultants: Peter Barney (Barney Agronomic Services;) Peg Cook, (Cooks Consulting;) Eric Beaver and Mike Contessa, (Champlain Valley Agronomics)

Cooperating NNY Producers:

- Larato Farms, Mooers NY; Swanton Farms, Burke/Chateaugay NY; Darren McIntyre, Watertown NY; Reed Haven Farms, Adams Center NY; Benware Dairy, Madrid NY

Background: Nitrogen prices have risen to very high levels in recent years. A new soil N test was evaluated for use in New York with several test sites in NNY. This work led to the release of this new test (ISNT) for New York as it was shown to be 83% accurate in identify site responsiveness to additional N. We also successfully calibrated the late season stalk nitrate test. The next step in this work is to do whole farm assessments to determine ISNT and stalk nitrate distribution of corn fields on dairy farms in each of the NNY counties. The greatest benefits of the ISNT are its great compatibility with regular soil testing (8 inch depth) and the ability to determine before the growing season if additional N is needed, enabling early season decision on N use reducing unnecessary N fertilizer additions to field that have sufficient organic N.

New technologies have focused on reducing N volatilization and leaching losses increasing N use efficiencies of fertilizer materials to reduce overall N fertilizer costs and environmental losses. Two such new technologies that have shown promise in resent research trials are: (1) ESN (Environmentally Smart Nitrogen, developed by Agrium Inc.), and (2) NutriSphere-N (by Specialty Fertilizer Products Inc.). ESN is a polymer-coated controlled-release N fertilizer. It has a semi-permeable polymer coating that allows water to enter the urea granule and dissolve the N over time. The N release rate is controlled by soil temperature, which similarly determines plant growth and nutrient demand, thus better synchronizing N release and plant uptake. NutriSphere-N is also a polymer and can be used for urea as well as liquid N sources such as UAN. Especially in situations where N fertilizer demands are high and N cannot be incorporated into the soil (e.g. N application to grasses), the use of polymer-coated controlled-release N fertilizers could possibly reduce both N fertilizer loss and fertilizer costs, and enhance yields. Although research trials indicate benefits of the use of both products over surface application of urea or UAN in various states in the USA, no research has been conducted in New York with the exception of limited field experimentation in western NY that showed promise for ESN as an N source. Research is needed to investigate the potential of both products to reduce overall N fertilizer costs and reduce environmental losses for corn production systems under Northern New York soil and weather patterns.

Methods: In 2008, we conducted three field trials. Two trials were conducted on research farms in Essex and Cayuga counties. These were harvested for silage. A 3rd on-farm trial in Wayne County was harvested for grain. Characteristics for these trial sites are listed in Table 1. All trials had five treatments:

1. Starter N only
2. Starter N + UAN at sidedress (150 lbs N/Acre)
3. Starter N + Urea at planting (150 lbs N/Acre)
4. Starter N + NutriSphere-N at planting (150 lbs N/Acre)
5. Starter N + ESN at planting (150 lbs N/Acre)

There were 4 repetitions of each treatment. Plots in the silage trials were 8 rows wide and 50 feet long. Plots were 300 feet long and 30 feet wide in the grain trial. On the research farms, N treatments at planting were broadcast and incorporated just prior to planting. The UAN treatment was injected when the corn was between 6 and 12 inches tall (standard starter plus sidedress treatment). Eight inch soil samples were taken at planting, sidedress time and at harvest and analyzed for basic soil fertility and Morgan extractable soil nitrate. At sidedress time, 12 inch PSNT samples were taken and analyzed for Morgan extractable nitrate (PSNT). Basic fertility data at planting are summarized in Table 2. Silage plots were hand harvested (2 rows of 40 feet each) and sub-samples were taken to determine moisture content and silage quality. Late-season-stalk-nitrate samples were also taken in each of the three trials.

In addition, five Northern New York farms (two in eastern NNY and three in western NNY) were sampled for whole farm ISNT. Where possible, corn fields were sampled for stalk nitrate as well (all western NY farms). Farms were given a field history form which was completed with the help of the local collaborator.

Results:

Protected N trials

Yield data are shown in Table 3. There was a yield response to N addition beyond the starter in the Essex and Wayne sites and a similar trend in Aurora but for the latter site, differences were not statistically significant due to large variability in the plots. There was, however, no difference among N sources or timing of application in any of the three sites. The low grain yields in Wayne County were due to a combination of heavy insect pest pressure and hail damage (picture included at end of report). At the Cayuga site, clover was planted following wheat in 2007. It was sprayed with Atrazine and Banvel on

April 10 and the residue plowed under May 10. As a result of the clover biomass this site, normally N deficient, showed high soil nitrate values throughout the year, with PSNT levels prior to N addition (i.e. starter N only) of 28-31 ppm, indicative of adequate N from the clover cover crop. This could explain the lack of a significant response to the different N sources. The trial will need to be repeated next year (without the carryover of the clover). The Essex and Wayne sites showed N deficiency (PSNTs less than 21 ppm; Table 4), consistent with the significant yield response to N addition. Trends in the soil nitrate data were also visible in the stalk nitrate values (Table 5). The highest levels were seen in the Cayuga site where large PSNT and end of season soil test N values were measured. Addition of N beyond the starter resulted in excessive stalk nitrate levels in Cayuga County. In the Essex county site, all plots had low stalk nitrate values whereas in the Wayne County site side-dressing with UAN and the ESN treatment resulted in optimal stalk nitrate values while in all other treatments, levels were low. The low stalk nitrates in the Cayuga site upon starter N addition only is consistent with low levels found in first year corn sites following sods and most likely reflective of slow release of N over time. These results of the other sites are consistent with N limited sites. Thus, we had ideal conditions to test nutrient use efficiencies among the different N sources and conclude that the 2008 data do not show significant differences in N release from the various N sources. The results also show considerable carryover of the urea that was applied at planting (the cheapest way to apply N). Forage quality was not impacted (Table 6) with the exception of crude and soluble protein content (sites in Essex and Wayne county only; Table 7) where N addition resulted in an increase in crude and soluble protein but there was no difference among the different N sources. This did not impact the overall quality of the silage as expressed in estimated milk per ton of silage (Table 8).

Whole Farm ISNT assessment

Five NNY farms participate in this project. The corn acreage on these farms ranged from 28% of the total acres to 54% (total acres ranging from 295 to 514 for three farms for which field history forms were completed). Samples are being analyzed for ISNT and final field history data are being collected. Results will be summarized once the ISNT assessments have been completed.

Conclusions/Outcomes/Impacts: An additional year of data is needed for this project but so far, the data do not support the hypothesis that protected N sources increase nutrient use efficiency. The data this year indicate a broadcast incorporation of urea was as effective as application of ESN or NutriSphere on two of the three locations while at the 3rd site, no additional N was needed at all (clover contributions exceeded expectations). We hope to be able to continue the sites to see if under different growing conditions, there will be a difference among the N sources.

Outreach: Presentations were given on N management for corn (including ISNT and stalk nitrate) at a series of winter meetings in NNY in 2008 (co-presented with CCE field crops extension educators):

1. Determining starter and broadcast fertilizer needs. Presented at: “Making the most of your fertilizer dollars” (2008). Series of 5 meetings in Northern NY, March 17-21, 2008. ~90 people.
2. Tools for N management – what worked, what didn’t. Presented at: “Making the most of your fertilizer dollars” (2008). Series of 5 meetings in Northern NY, March 17-21, 2008. ~90 people.

The findings were also presented statewide during the Field Crop Dealer Meetings:

1. Tools for optimizing nitrogen management of corn: ISNT and stalk nitrate tests; a package deal (2008). 2008 Field Crop Dealer Meetings. October 28 (Albany, NY), October 29 (New Hartford, NY), October 30 (Batavia, NY) and October 31 (Auburn, NY). ~240 people.

In addition, the following factsheets relevant to N management of corn were generated:

- # 36: Illinois Soil Nitrogen Test for Corn (1/17/2008)
- # 39: Nitrogen Fixation (4/16/2008)
- # 41: Organic Matter (5/8/2008)
- # 43: Nitrogen Benefits of Winter Cover Crops (11/26/2008)

The ISNT project (including the additional funding sources) resulted in two journal articles:

1. Lawrence, J.R., Q.M. Ketterings, M.G. Goler, J.H. Cherney, W.J. Cox and K.J. Czymmek (2009). Accuracy of the Illinois Soil Nitrogen Test (ISNT) in predicting N responsiveness of corn in rotation. Soil Science Society of America Journal 73(1): (*in press*).
2. Lawrence, J.R., Q.M. Ketterings and J.H. Cherney (2008). Effect of nitrogen application on yield and quality of first year corn. Agronomy Journal 100: 73-79.

In addition, we published a “What’s Cropping Up?” article:

1. Lawrence, J.R., Q.M. Ketterings, and K.J. Czymmek (2008). Illinois Soil N Test (ISNT) useful tool for NYS corn producers. What’s Cropping Up? 18(3): 4-5.

A Northeast Dairy Business article on ISNT and stalk nitrate assessment will appear in January 2009.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. The next steps are to (1) continue the protected N sources trials for an additional year (second year of a two-year project); and (2) complete the 2008 assessment and work with additional producers to do whole farm ISNT and stalk nitrate assessment. We plan to generate three additional factsheets: “N fertilizers”, “Protected N sources”, and “Optimizing N management with ISNT and

CSNT". Farmer impact stories are planned for 2009 once full assessments have been completed and given to the farms.

Acknowledgments: The project was funded through NNYADP, federal formula funds (stalk nitrate sampling and the additional sites for the protected N trials), and NYFVI (funding the graduate student on the whole-farm ISNT project).

Reports and/or articles in which the results of this project have already been published. For Agronomy Fact Sheets: http://nmsp.css.cornell.edu/publications/factsheets.asp. The "What's Cropping Up?" article can be downloaded from the CSS extension website: http://css.cals.cornell.edu/cals/css/extension/upload/wcu_vol18no3_2008a3isnt.pdf. The harvest pictures of the Essex County site are included in this report.

Person(s) to contact for more information (including farmers who have participated: The initial trials were conducted at the Willsboro Farm, the Aurora Research Farm, and on a farm in Wayne County. Participating consultants include Peter Barney (St Lawrence County farm) and Eric Beaver (two eastern NNY farms). Mike Hunter (Jefferson County CCE) collected samples on a farm in Jefferson County while Joe Lawrence (Lewis County CCE) worked with Peg Cook to collect ISNT samples on a farm in Lewis County.

Photos

Silage harvest at E.V. Baker Research Farm, Willsboro NY, 2008, and hail damaged grain corn in Wayne County.

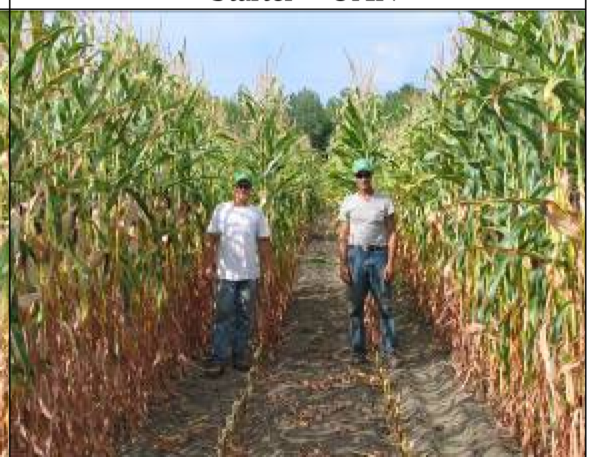
	
Starter Only	Starter + UAN
	
Starter + Urea	Starter + NutriSphere
	
Starter + ESN	Hail Damaged Corn (Wayne County)

Table 1: Site characteristics for the 3 Protected Nitrogen studies in 2008.

	Essex	Cayuga	Wayne
	Stafford fine sandy loam	Kendaia fine loam	Wallington silt loam
Planted	5/2/2008	5/7/2008	5/14/2008
Sidedressed	6/12/2008	6/11/2008	6/24/2008
Harvested	9/3/2008	9/8/2008	11/12/2008
	Cropping History (Dry Matter Yield)		
2007	Corn (6.5 tons/acre)	Wheat (NA)	Soybean
2006	Corn (7.8 tons/acre)	Soybean (NA)	Corn
2005	Corn (7.8 tons/acre)	Corn (NA)	NA
2004	Grass (NA)	Corn (NA)	NA
	Fertilizer Addition at Planting (2008)		
lbs N/acre	15	20	17
lbs P_2O_5/acre	60	20	23
lbs K_2O/acre	60+60[1]	20	0+200[1]

[1.] Additional K_2O broadcast and incorporated prior to planting at the Essex and Wayne County sites.

Table 2: Soil management groups (SMG), soil series and general soil fertility data at planting for the 3 Protected Nitrogen studies in 2008. L=low; M=medium, H=high, VH=very high, N=normal, E=excessive.

	Essex	Cayuga	Wayne
	Stafford fine sandy loam	Kendaia fine loam	Wallington silt loam
SMG	4	2	3
pH	6.6	8.1	6.4
OM (%)	1.6 (2.7% LOI)	1.8 (2.9% LOI)	4.1 (2.6% LOI)
P (lbs/acre)	22 H	9 H	16 H
K (lbs/acre)	62 L	56 L	154 H
Mg (lbs/acre)	77 M	480 VH	182 H
Ca (lbs/acre)	1964	5003	1922

Table 3: Silage and grain yields and moisture content for 3 protected N trials in 2008.

Treatment	Silage Yield (tons/acre 65% moisture)				Grain Yield (bu/acre)	
	Essex		Cayuga		Wayne	
Starter Only	18.8	b	24.6	a	35.8	b
Starter + UAN	21.6	a	25.6	a	86.4	a
Starter + Urea	23.5	a	25.5	a	86.3	a
Starter + NutriSphere	24.1	a	26.2	a	86.9	a
Starter + ESN	22.6	a	27.2	a	86.6	a
	Moisture Content at Harvest (% moisture)					
Starter Only	59.7	a	64.7	a	18.1	a
Starter + UAN	57.8	a	65.7	a	18.1	a
Starter + Urea	58.0	a	66.6	a	17.8	a
Starter + NutriSphere	58.9	a	66.5	a	18.0	a
Starter + ESN	58.9	a	66.4	a	18.2	a

[†]Average values with different letters (a,b,c) are statistically different (α = 0.05)

Table 4: Soil nitrate values for samples taken at planting, sidedress and harvest from the Protected N trials in 2008. The Essex and Wayne sites are 4th year corn site. The Cayuga site followed a clover cover crop.

Treatment	Soil Nitrate at Planting - 8" depth (ppm)					
	Essex		Cayuga		Wayne	
Starter Only	3.2	a	4.0	a	9.4	a
Starter + UAN	3.7	a	2.5	a	9.8	a
Starter + Urea	2.0	a	4.0	a	10.0	a
Starter + NutriSphere	2.3	a	1.7	a	11.5	a
Starter + ESN	2.3	a	1.5	a	10.8	a
	Soil Nitrate at Sidedress - 8" depth (ppm)					
Starter Only	5.9	b	28.9	b	15.3	a
Starter + UAN	5.9	b	33.4	b	17.9	a
Starter + Urea	10.7	b	97.9	a	34.9	a
Starter + NutriSphere	19.5	a	80.3	a	39.2	a
Starter + ESN	10.8	b	81.0	a	26.2	a
	PSNT at Sidedress - 12" depth (ppm)					
Starter Only	8.2	bc	30.7	b	12.9	a
Starter + UAN	5.4	c	27.6	b	16.8	a
Starter + Urea	22.5	a	74.2	a	23.4	a
Starter + NutriSphere	29.7	a	67.4	a	42.2	a
Starter + ESN	18.6	ab	73.8	a	21.9	a
	Soil Nitrate at harvest - 8" depth (ppm)					
Starter Only	0.0	a	1.3	a	0.0	a
Starter + UAN	1.4	a	30.9	a	0.0	a
Starter + Urea	2.2	a	27.5	a	0.0	a
Starter + NutriSphere	1.3	a	22.4	a	3.2	a
Starter + ESN	1.0	a	34.2	a	1.2	a

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

Table 5: Late Season Stalk Nitrate Test results for 3 Protected N Trials in 2008. L = Low (less than 250 ppm N), O = Optimal (250 to 2000 ppm N) and E = Excess (greater than 2000 ppm N). The Essex site is a 4th year corn site. The Cayuga site followed a clover cover crop.

Treatment	Essex			Cayuga			Wayne		
	Stalk Nitrate Test (ppm)								
Starter Only	35	a	L	144	b	L	33	b	L
Starter + UAN	142	a	L	3058	a	E	1446	a	O
Starter + Urea	128	a	L	3536	a	E	115	b	L
Starter + NutriSphere	57	a	L	3177	a	E	74	b	L
Starter + ESN	39	a	L	3147	a	E	444	b	O

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

Table 6: Impact of N source on NDF, dNDF, starch and lignin for 2 sites in 2008. The Essex site is a 4th year corn site. The Cayuga site followed a clover cover crop. The UAN was sidedressed. All other N sources were applied at planting.

Treatment	Essex		Cayuga		Essex		Cayuga	
	NDF (% of DM)				dNDF (% of DM)			
Starter Only	44.4	a	39.9	a	64.9	a	64.6	a
Starter + NutriSphere	43.4	a	39.9	a	62.4	a	64.8	a
Starter + ESN	40.4	a	39.3	a	64.3	a	65.0	a
Starter + Urea	41.5	a	38.1	a	62.4	a	65.6	a
Starter + UAN	41.7	a	39.4	a	64.9	a	66.3	a
	Starch (% of DM)				Lignin (% of DM)			
Starter Only	35.1	a	37.1	a	2.9	a	2.8	a
Starter + NutriSphere	33.7	a	35.4	a	3.1	a	2.8	a
Starter + ESN	36.9	a	35.8	a	2.8	a	2.8	a
Starter + Urea	35.7	a	37.0	a	2.9	a	2.7	a
Starter + UAN	35.1	a	36.6	a	2.8	a	2.7	a

Table 7: Impact of N source on crude protein and soluble protein for 2 sites in 2008. The Essex site is a 4th year corn site. The Cayuga site followed a clover cover crop. The UAN was sidedressed. All other N sources were applied at planting.

Treatment	Essex		Cayuga	
	Crude Protein (% of DM)			
Starter Only	5.2	b	6.2	b
Starter + UAN	6.6	a	6.8	a
Starter + Urea	6.3	a	7.1	a
Starter + NutriSphere	6.4	a	6.9	a
Starter + ESN	6.2	a	7.0	a
	Soluble Protein (% of DM)			
Starter Only	1.3	b	1.6	b
Starter + UAN	1.6	a	1.7	ab
Starter + Urea	1.6	a	1.8	a
Starter + NutriSphere	1.5	a	1.7	ab
Starter + ESN	1.5	a	1.8	a

Table 8: Impact of N source on estimated milk per ton and milk per acre using Milk2006 in 2008. The UAN was sidedressed. All other N sources were applied at planting.

Treatment	Essex		Cayuga		Essex		Cayuga	
	Milk per ton (lbs/ton)				Milk per acre (lbs/acre)			
Starter Only	3427	a	3514	a	22497	b	30292	a
Starter + UAN	3491	a	3569	a	26418	a	31957	a
Starter + Urea	3435	a	3576	a	28280	a	31854	a
Starter + NutriSphere	3386	a	3506	a	28506	a	32108	a
Starter + ESN	3514	a	3529	a	27858	a	33714	a

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

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Reducing Phosphorus and Nitrogen Loss with Aerway Incorporation of Manure**

Project Leader(s): Quirine M. Ketterings, Nutrient Management Spear Program (NMSP), Cornell University

Collaborator(s):

- Cornell University: Anne Place (NMSP graduate student;) Greg Godwin, Kevin Dietzel, and Chie Miyomoto (NMSP staff;) Karl Czymmek (PRODAIRY.)
- Cornell Cooperative Extension: Joe Lawrence (CCE of Lewis County)
- Consultants: Peter Barney (Barney Agronomic Services;) Peg Cook, (Cooks Consulting)

Cooperating Producers:

- Jake Ashline, Miner Institute (Clinton County) Darren McIntyre (Lewis County) Dave Fisher (St Lawrence County) Dan Chambers (St Lawrence County)

Background: Phosphorus (P) and nitrogen (N) runoff, leaching and/or volatilization are of great concern to our farming community and their neighbors. In addition, soil erosion loss can greatly impact soil productivity and more producers are exploring reduced tillage option. A better quantification of such P and N losses and best management practices that can reduce losses without negatively impacting crop production is needed.

In discussions with NNY stakeholders, questions were raised about manure management options that are compatible with reduced-till corn systems and reduce runoff, leaching (tile drain) and volatilization risks.

The manure application method of most interest is surface application followed by partial incorporation with an Aerway. A 3-yr trial in central NY (Lawrence et al., 2008) showed Aerway incorporation following spring manure application for corn resulted in N conservation and subsequent yields similar to those obtained with chisel plowing. Additional research was needed to see if the results at the central NY farm could be duplicated on farms throughout the state.

Methods: Four farm fields were selected, two in St Lawrence County, one in Lewis County and one at the Miner Institute. We compared surface application (no incorporation until 5+ days after application) with (1) Aerway incorporation or (2) chisel incorporation directly following manure application. Each trial was conducted in 4 replications resulting in 12 strips per field. Strips ranged in length (spreader pattern and planter/harvester determined) and, depending on the field, 300+ feet long. Each strip was monitored for N dynamics (sampling prior to manure application, at planting, at PSNT time, and after harvest), soil fertility, residue coverage, compaction (penetrometer readings), soil moisture content. With joint NYFVI and NNYADP funding, we were able to establish 10 on-farm locations, of which four were in NNY.

Results: Results for the four NNY locations are shown in the tables at the end of this report. At all sites, there was no significant difference in yield or quality between chisel and Aerway incorporation. At two sites, the surface application did result in a yield reduction although for one of the two sites, late harvest had resulted in lodged corn and yield loss. Given high PSNT and soil nitrate levels for this site, a yield response might not have occurred under more regular harvest conditions (to be evaluated in 2009). At a third site, that suffered from a late summer storm following water logged conditions early in the season, trends were the same but the differences between the surface application and the two incorporation treatments was not statistically significant. At the fourth location, nitrate levels were so high that nitrogen was not a production limitation as confirmed by the soil N levels, PSNT results and stalk nitrate results.

Conclusions/Outcomes/Impacts: An additional year of data is needed before we can draw final conclusions but these preliminary results suggest that Aerway incorporation is as effective as chisel plowing in conserving N and incorporation will result in higher yields under N limiting conditions. In situations where N is not limiting, incorporation will not benefit the crop. Stalk nitrate sampling seems an effective tool to evaluate the N status of the crop during the growing year.

Outreach: Preliminary results of the trial at Aurora were presented at the series of winter meetings in NNY in 2008 (co-presented with CCE field crops extension educators):**"Tillage options for conserving manure N".** Presented by Joe Lawrence at: Making the most of your fertilizer dollars" (2008). Series of 5 meetings in Northern NY, March 17-21, 2008. ~90 people.

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

This was the first year of the project. All plots are marked to enable data collection for a second year so we have two years of data for all sites and so we can monitor changes in soil fertility levels over the two years. Farmer interviews will be done this winter, once the final results are reported to all farms (currently ongoing).

Acknowledgments: The project was funded through NNYADP and the NYFVI.

Reports and/or articles in which the results of this project have already been published. A Northeast DairyBusiness article written by Anne Place, graduate student on the project, will appear in the January 2009 issue. This issue has quotes from Dan Chambers, one of the participating farms.

Person(s) to contact for more information (including farmers who have participated: Quirine Ketterings, Nutrient Management Spear Program, 323 Morrison Hall, Department of Animal Science, Cornell University (qmk2@cornell.edu or 607 255 3061).

Table 1: Stand density, corn silage yield and moisture content at harvest as impacted by manure application method.

Treatment	Stand density at sidedress time	Corn silage yield (35% DM)	Moisture content at harvest
	plant/acre	tons/acre	%
	Farm A		
Surface	30,786 a	17.4 b	64.0 a
Chisel incorporation	31,308 a	19.4 a	62.4 a
Aerway incorporation	32,088 a	19.4 a	61.7 a
	Farm B		
Surface	30,856 a	20.7 a	59.4 a
Chisel incorporation	29,737 a	20.1 a	58.5 a
Aerway incorporation	29,916 a	21.1 a	55.7 a
	Farm C		
Surface	30,504 a	11.8 a	65.0 a
Chisel incorporation	30,735 a	12.9 a	64.3 a
Aerway incorporation	32,197 a	13.5 a	63.9 a
	Farm D (grain in bu/acre; damage due to late harvest)		
Surface	34,107 a	129.9 b	24.3 a
Chisel incorporation	34,843 a	164.9 a	25.0 a
Aerway incorporation	33,606 a	175.1 a	24.7 a

Table 2: Forage quality at harvest as impacted by manure application method.

Treatment	Crude Protein	Soluble Protein	NDF	dNDF	Lignin	Starch
	--------------------------------% of DM -------------------------					
	Farm A					
Surface	5.9 a	1.6 a	46.3 a	68.0 a	3.3 a	30.7 a
Chisel Incorporation	6.4 a	1.7 a	45.4 a	66.6 a	3.4 a	30.5 a
Aerway incorporation	6.4 a	1.6 a	45.1 a	67.0 a	3.4 a	31.1 a
	Farm B					
Surface	7.1 a	2.0 a	44.5 a	62.4 a	3.2 a	31.8 a
Chisel Incorporation	7.3 a	2.0 a	41.3 a	62.4 a	3.1 a	35.1 a
Aerway incorporation	7.3 a	1.9 a	42.7 a	62.2 a	3.2 a	33.6 a
	Farm C					
Surface	6.0 a	1.7 a	40.4 a	68.9 a	2.7 a	36.7 a
Chisel Incorporation	6.1 a	1.7 a	40.5 a	68.6 a	2.7 a	36.8 a
Aerway incorporation	5.9 a	1.6 a	38.9 a	67.5 a	2.6 a	39.1 a
	Farm D					
Surface	.	.	.	.	.	.
Chisel Incorporation	.	.	.	.	.	.
Aerway incorporation	.	.	.	.	.	.

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

Table 3: Estimated milk production as impacted by manure application method.

Treatment	Milk per acre	Milk per ton
	lbs per acre	lbs per ton of silage
	Farm A	
Surface	20937 b	3441 a
Chisel Incorporation	23247 a	3426 a
Aerway incorporation	23402 a	3439 a
	Farm B	
Surface	23928 a	3309 a
Chisel Incorporation	23917 a	3396 a
Aerway incorporation	24806 a	3346 a
	Farm C	
Surface	14914 a	3624 a
Chisel Incorporation	16284 a	3615 a
Aerway incorporation	17250 a	3643 a
	Farm D	
Surface	.	.
Chisel Incorporation	.	.
Aerway incorporation	.	.

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

Table 4: Soil nitrate level (0-8 inch depth) at four sampling times as impacted by manure application method.

Treatment	Baseline	Planting	Sidedress	Harvest
	------------------------------ lbs/acre ------------------------------			
	Farm A			
Surface	17.5 a	61.0 a	53.0 a	8.0 b
Chisel incorporation	14.8 a	72.8 a	60.8 a	18.5 a
Aerway incorporation	16.8 a	73.0 a	69.0 a	15.8 a
	Farm B			
Surface	33.8 a	68.8 b	92.0 a	37.3 a
Chisel incorporation	36.5 a	97.3 a	107.8 a	53.0 a
Aerway incorporation	33.3 a	85.8 ab	91.3 a	45.5 a
	Farm C			
Surface	29.5 a	42.5 a	35.8 a	20.3 a
Chisel incorporation	29.8 a	21.0 a	32.0 a	17.8 a
Aerway incorporation	28.5 a	39.0 a	28.0 a	22.0 a
	Farm D			
Surface	31.8 a	86.0 a	114.8 b	.
Chisel incorporation	32.3 a	103.0 a	145.3 a	.
Aerway incorporation	32.0 a	85.5 a	124.5 ab	.

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

Table 5: Illinois Soil Nitrogen Test (ISNT) (0-8 inch depth), Pre-Sidedress Nitrogen Test (PSNT) (0-12 inch depth), and Late Season Stalk Nitrate as impacted by manure application method.

	Sidedress		Harvest	
Treatment	ISNT	PSNT	Stalk N	
	---------------------------------- ppm ------------------------------			
	Farm A			
Surface	346 a	22.6 b	191 a	L
Chisel incorporation	354 a	28.0 ab	1,095 a	O
Aerway incorporation	383 a	32.8 a	840 a	O
	Farm B			
Surface	357a	49.5 a	8,171 a	E
Chisel incorporation	378a	48.0 a	9,845 a	E
Aerway incorporation	373a	42.5 a	8,134 a	E
	Farm C			
Surface	355 a	12.5 a	30 a	L
Chisel incorporation	351 a	12.8 a	9 a	L
Aerway incorporation	363 a	13.0 a	21 a	L
	Farm D			
Surface	466 a	57.9 a	2,535 a	E
Chisel incorporation	472 a	57.8 a	2,751 a	E
Aerway incorporation	471 a	57.9 a	1,795 a	O

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

Table 6: Soil compaction readings taken at three sampling times as impacted by manure application method with rating from (0-5).

Depth	Treatment	Baseline	Side-dress time	Harvest
		---------------------------rating------------------------		
		Farm A		
3”	Surface	0 a	0 a	0.0 a
	Chisel incorporation	0 a	0 a	0.3 a
	Aerway incorporation	0 a	0 a	0.0 a
6”	Surface	0 a	0 a	1.5 a
	Chisel incorporation	0 a	0 a	1.3 a
	Aerway incorporation	0 a	0 a	1.0 a
9”	Surface	0 a	0 a	2.8 a
	Chisel incorporation	0 a	0 a	2.8 a
	Aerway incorporation	0 a	0 a	2.8 a
12”	Surface	0 a	0 a	3.0 a
	Chisel incorporation	0 a	0 a	4.3 a
	Aerway incorporation	0 a	0 a	3.8 a

Depth	Treatment	Baseline	Side-dress time	Harvest
		---------------------------rating------------------------		
		Farm B		
3”	Surface	0 a	0 a	0 a
	Chisel incorporation	0 a	0 a	0 a
	Aerway incorporation	0 a	0 a	0 a
6”	Surface	0 a	0 a	0 b
	Chisel incorporation	0 a	0 a	0 b
	Aerway incorporation	0 a	0 a	0.8 a
9”	Surface	0 a	0 a	2.3 a
	Chisel incorporation	0 a	0 a	2.3 a
	Aerway incorporation	0 a	0 a	2.8 a
12”	Surface	0 a	1.3 a	4.3 a
	Chisel incorporation	0 a	0 a	3.8 a
	Aerway incorporation	0 a	0.3 a	4.5 a
		Farm C		
3”	Surface	0 a	0 a	0 a
	Chisel incorporation	0 a	0 a	0 a
	Aerway incorporation	0 a	0 a	0 a
6”	Surface	0 a	0 a	0.3 a
	Chisel incorporation	0 a	0 a	0 a
	Aerway incorporation	0 a	0 a	0.3 a
9”	Surface	0 a	0 a	2.3 a
	Chisel incorporation	0 a	0 a	1.0 a
	Aerway incorporation	0 a	0 a	2.3 a
12”	Surface	0 a	0.8 a	3.3 a
	Chisel incorporation	0 a	1.3 a	2.5 a
	Aerway incorporation	0 a	2.0 a	3.3 a
		Farm D		
3”	Surface	0 a	0 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0 a	.
6”	Surface	0 a	0 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0 a	.
9”	Surface	0 a	0 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0 a	.
12”	Surface	0 a	0.3 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0.3 a	.

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

Table 7: Soil moisture (%) at three sampling times as impacted by manure application.

Treatment	At planting	Side-dress time	Harvest
	---------------------------------- % ----------------------------------		
	Farm A		
Surface	20.3 a	21.4 a	19.8 a
Chisel incorporation	20.9 a	21.5 a	19.9 a
Aerway incorporation	21.5 a	21.8 a	20.0 a
	Farm B		
Surface	23.2 a	23.3 a	22.7 a
Chisel incorporation	22.4 a	23.0 a	22.1 a
Aerway incorporation	22.2 a	23.2 a	22.4 a
	Farm C		
Surface	22.2 a	24.1 a	22.4 a
Chisel incorporation	21.0 a	24.7 a	22.9 a
Aerway incorporation	21.7 a	23.7 a	22.6 a
	Farm D		
Surface	26.3 a	24.2 a	.
Chisel incorporation	26.3 a	23.9 a	.
Aerway incorporation	26.2 a	24.1 a	.

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

Table 8: Percent surface residue coverage before and after manure application method.

Treatment	Baseline	After Manure Treatment
	------------------------------------%---------------------------------	
	Farm A	
Surface	18.0 a	7.5 a
Chisel incorporation	16.1 a	5.3 a
Aerway incorporation	15.7 a	6.8 a
	Farm B	
Surface	22.3 a	14.1 a
Chisel incorporation	19.2 a	6.2 b
Aerway incorporation	23.0 a	8.3 b
	Farm C	
Surface	49.1 a	52.9 a
Chisel incorporation	46.2 a	7.6 c
Aerway incorporation	50.8 a	19.8 b
	Farm D	
Surface	70.0 a	34.4 a
Chisel incorporation	67.8 a	27.6 a
Aerway incorporation	68.3 a	32.6 a

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

Photos (Photos are encouraged where possible for press stories and fact sheets that might be developed from this report and previous work.) Submit photos in electronic format as attachments to this report. Photos should be at a resolution of 300 dpi in jpeg format. Include photographer's credit and suggestions for a caption, including the identity, affiliation and county.

# # #

Dan Chambers (left) and Peter Barney (right) during harvest of the field trials at Chamber's farm in St Lawrence County.

Harvest at Chamber's Farm


Getting ready for harvest at the Miner Institute.

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Precise Nitrogen Management for Corn Production**

Project Leader(s):

- **Jeff Melkonian.** Sr. Research Associate; Crop & Soil Sciences, Cornell University, Ithaca NY 14853; Tel: (607) 227-9172, E-mail: jjm11@cornell.edu
- **Harold van Es.** Professor and Chair**,** Crop & Soil Sciences, Cornell University; Tel: (607) 255-5459, E-mail: hmv1@cornell.edu
- **John Idowu.** Research Associate, Crop & Soil Sciences, Cornell University; Tel: (607) 255-1706, E-mail: oji2@cornell.edu
- **Robert Schindelbeck**. Extension Associate, Crop & Soil Sciences, Cornell University; Tel: (607) 255-1706, E-mail: rrs3@cornell.edu

Collaborator(s): **Michael Davis**: Manager, Cornell research farms at Willsboro and Chazy. **Anita Deming** (CCE Essex Co.), **Michael Hunter** (CCE Jefferson Co.), and **Carl Tillinghast** (CCE)

Background:

Deep placement of nitrogen (N) fertilizer for corn production. Successful new soil tillage management practices for corn production include the use of 'strips' or 'zones' that involve deep localized soil loosening with minimal surface disturbance. These methods maintain crop residue cover, conserve soil, and increase soil health and crop yields. With these, farmers may also apply N fertilizer through deep placement (10-12") at tillage prior to planting. A three year replicated on-farm study in western NY has demonstrated that the combination of zone tillage and the deep N placement boost corn yields and improve soil health, increasing average profit by $57/acre. In this study, UAN was applied at planting (deep N placement) and contained both a urease inhibitor (slows conversion of urea to ammonium for up to two weeks to reduce ammonia volatilization) and a nitrification inhibitor to slow the conversion of ammonium (less susceptible to leaching) to nitrate (more susceptible to leaching) for up to 6 – 8 weeks, approximately when corn begins rapid growth and N uptake. Both the deep N placement and nitrification inhibitor also may reduce denitrification losses on fine-textured soils as suggested in a Minnesota study. There have not been any controlled trials that evaluated the N dynamics associated with deep vs. shallow N placement on different soil types, nor determined the potential for reduced N rates with increased soil health. We established such a trial in 2007 and continued the trial in 2008.

Precision N application. Nitrogen management for both silage and grain corn production continues to be a challenge for economic, agronomic and environmental reasons. Year-to-year variability in weather can affect the optimum fertilizer rate to meet crop N needs without over-fertilizing. Off-farm N losses from crop (particularly corn) production are receiving increased attention. Improving crop N use efficiency is, therefore, important for maintaining or improving farm incomes, and can also reduce N losses to the environment. From past research, we quantified the effects of various fertilizer N and manure management practices on N losses associated with corn production (see Appendix 1). This research has shown a year-to-year variation in optimum N rates for corn of up to 80 lbs/acre that is due, in part, to variability in soil N as affected by early season weather. This range in optimum N rates represents an opportunity for more efficient use of N fertilizer. Based on this research, we have developed and calibrated a decision support tool (*Adapt-N*; url: http://adapt-n.eas.cornell.edu) that is based on the Precision Nitrogen Management (PNM) computer model. The *Adapt-N*/PNM model decision support tool accounts for the impact of early season weather on soil N to provide more precise sidedress N recommendations for corn production. Dairy farmers are especially interested in such predictions, as fields are often manured based on estimated N availability, but may still require costly additional sidedressing in wet years. Given the high N fertilizer prices and the increased regulatory pressure to reduce agricultural N losses, there is a need for improved N management for corn production in northern New York. This project seeks to encourage adoption of PNM-generated recommendations in the NNY region.

Estimating the N supplied by the soil is a critical component of the *Adapt-N* tool. The N supplied by the soil in a given year depends on the readily mineralizable portion of root zone soil organic matter (SOM) and on early season weather conditions. Tillage practices can potentially affect the amount of soil N supply for corn production by altering the amount of readily mineralizable SOM. For example, no till plots in a long-term tillage experiment at the E.V Baker Farm in Willsboro, NY have significantly higher SOM in the top soil layers compared to plow till plots. In early June 2007, we measured approximately 35 lbs/ac more available N in these no till plots compared to the plow till plots. Greater N mineralization from SOM combined with improved soil quality in the no till plots resulted in higher N use efficiency in those plots in 2007 (i.e., higher no till plot yields compared to the plow till plot yields for the same N application). Because of year-to-year variability in both temperature and precipitation, we continued collecting these data in 2008 to develop a more complete understanding of the tillage x SOM x N mineralization interaction. These data should help improve *Adapt-N*.

Methods:

Deep placement of N fertilizer for corn production. This study was conducted on sandy loam and clay loam plots at the Willsboro Farm. For each soil texture plot, there were subplots representing long-term continuous corn and corn after grass under plow till and no till. The crop was planted on 5/7/08 (Pioneer 39D80, 86 d RM at 37,500 seeds/acre; 6-24-24 starter (banded) at 250 lbs/acre; 8.7 lbs/acre Empower®[1] insecticide applied through the planter). On the no till plots, additional N (125 lbs N/acre of nitan) was applied (i) at planting through deep placement (10-12”) associated with deep tillage using a two row ripper with attached tubes behind the ripper shanks for deep N placement (Photo 1a,b) and (ii) conventional sidedress (6/16/08). On the plow till plots, additional N (125 lbs N/acre of nitan) was applied as (i) broadcast/incorporated at planting using the same two row ripper but with N applied on the surface and immediately incorporated (Photo 2), and (ii) conventional sidedress (6/16/08). A nitrification/urease inhibitor

[1] Helena Chemical Company

(Agrotain Plus®)[2] at the recommended rate was added to the deep N placement (no till) and broadcast/incorporated N (plow till) treatments. The same total N (140 lbs N/acre: 125 lbs N/acre (nitan) + 15 lbs N/acre through the planter) was applied in all treatments. We tracked N in the soil, crop and in subsurface drainage water from the subplots. Soil samples were collected for soil health measurements prior to planting and samples for soil N (0-12") were collected periodically from planting to sidedress. All subplots were harvested on 9/04/08 for silage yield and crop N uptake.

Precision N application. We established two studies at the long-term no till and plow till experimental site at the Willsboro farm. The first study was designed to track N mineralization from SOM in fallow plots (i.e., bare soil) in order to compare 'N supplying power' of the soils in the two tillage systems. Soil samples (0 – 12") for crop available N determination were collected from these plots over the growing season. In the second study, we established different sidedress N treatments in the no till and plow till plots at the long-term tillage site. The objectives were to determine if optimum sidedress N rate varied with tillage and to compare the measured optimum N rate with the optimum N rate predicted by the PNM model Soil samples were collected for crop available soil N (0-12") were collected over the growing season. All plots were planted on 5/7/08 as described above. Subplots were established with different levels of sidedress N (nitan) (0, 65, 95, 125, 155 and 185 lbs N/acre) (applied on 6/27/08) in each of the tillage plots. The 95 lbs N/acre treatment corresponded most closely to the PNM-model adjusted sidedress recommendation for this date, location and soil type. All subplots were harvested on 9/04/08 for silage yield and crop N uptake.

Results:

Deep placement of N fertilizer for corn production. <u>Sandy loam plots.</u> Preplant crop available soil N (0 – 12") was similar across all plots (30 - 35 lbs N/acre). Crop available soil N (0 – 12") increased 30 – 50 lbs N/acre between planting and sidedress due to SOM mineralization combined with low N losses (precipitation was below normal from May to mid-June at Willsboro). We measured higher crop available soil N at sidedress in the no till plots (approximately 80 lbs N/acre) compared to the plow till plots (approximately 60 lbs N/acre) consistent with the higher SOM levels measured in the no till compared to the plow till plots.

There were no significant differences in harvest populations or silage yield among the main treatments, or related to previous cropping history (continuous corn, corn after grass). Average silage yields (65% moisture) ranged from 22.6 tons/acre for the plow till/sidedress treatment to 25.2 tons/acre for the no till/sidedress treatment (Appendix 2, Fig. 1). As in 2007, May and June 2008 rainfall at the Willsboro research farm was below average. Since leaching is the main pathway for N loss in sandy loam soils, this indicates that, for a dry early season like in 2007 and 2008, N availability to the crop was similar regardless of the N management practice (deep N placement, broadcast/incorporation at planting, sidedress). Crop available soil N levels at harvest were higher (10 – 25 lbs N/acre) in the no till/deep tillage and N plots and the plow till/early broadcast N plots compared to the sidedress N plots for both tillage treatments.

[2] Agrotain International LLC

Clay loam plots. Preplant crop available soil N (0 – 12”) was similar across all plots (35 - 45 lbs N/acre) and was higher than in the sandy loam plots, consistent with the higher measured soil organic matter in the clay loam plots. As in the sandy loam plots, crop available soil N (0 – 12”) increased 35 – 40 lbs N/acre between planting and sidedress from SOM mineralization. We measured higher crop available soil N at sidedress in the no till plots (approximately 80 lbs N/acre) compared to the plow till plots (approximately 60 lbs N/acre).

There were no significant differences in final harvest population among the treatments, ranging from 28,000 to 30,000 plants/acre. Silage yields (65% moisture) were higher in the no till/sidedress (24.1 tons/acre) and no till/deep tillage and N (22.4 tons/acre) treatments compared to the plow till/early broadcast N (17.2 tons/acre) and plow till/sidedress N (19.6 tons/acre) (Appendix 2, Fig. 2) Crop N uptake was 60 – 70 lbs N/acre higher in the no till plots compared to the plow till plots. However, crop available soil N levels at harvest were similar among all plots (50 – 55 lbs N/acre in the top 12”). We will be using the PNM model to analyze our field data on N dynamics associated with N practice/tillage/soil type. This should help us better understand possible factors responsible for the reduction in yield associated with the plow till treatments.

We note that, in all treatments but one, lower stalk nitrate levels were optimal or close to optimal. The exception was the plow till sidedress N treatment in the clay loam plot which was suboptimal.

Precision N application. Crop available N from no till and plow till fallow plots: Soil N in the top 12” in fallow subplots located in the no till and plow till plots were approximately 25 lbs N/acre higher at pre-plant, and approximately 50 lbs N/acre higher at pre-sidedress in the no till plots compared to the plow till plots (Appendix 2, Fig. 3). The large accumulation in soil N under both tillage practices indicates the capacity of the soil to supply N when soil N losses are low due to lower than average rainfall. The higher soil N accumulation in the no till plots was correlated with higher soil organic matter (5.3%) in the top 6” of the soil under that tillage practice compared with plow till plots (4.3%).

Optimum N rate: Both the no till and plow till plots showed an N response to the different sidedress N rates (Appendix 2, Fig. 4). Silage yields were 4 – 8 tons/acre higher in the no till plots compared to the plow till plots across all treatments. The apparent yield maximum occurred at sidedress N rate of 95 lbs N/acre in the no till plots (95 lbs N/acre was the PNM model recommended rate for this location), and 65 lbs N/acre in the plow till plots. Silage yield did not increase with sidedress N rates above 65 lbs N/acre in the plow till plots. In the no till plots, silage yields were more variable above 95 lbs N/acre but no clear trend was apparent. As in 2007, yields were much higher (approximately 8 tons/acre) in the no till check (no sidedress N) plots compared to the plow till check plots. Some of this yield difference was likely due to the higher N supplying power of the no till plots compared to the plow till plots (Appendix 2, Fig. 3). However, even at the highest sidedress N rate, plow till silage yields did not increase to the level of the no till silage yields in the check treatment. This indicates an interaction between tillage and N that increases the yield potential of corn relative to the plow till plots. This interaction needs further study.

Conclusions/Outcomes/Impacts:

Deep placement of N fertilizer for corn production. In 2008, there was no significant yield advantage of deep tillage and N placement compared to sidedress N in the no till subplots. Deep tillage/urease and nitrification inhibitors would be expected to be an advantage in years with high early season precipitation since these practices are thought to reduce the likelihood of high N losses associated with precipitation. However, Willsboro experienced dry early season weather in both 2007 and 2008. Rainfall totals for May and June 2008 were low compared to the averages for these months so that soil N leaching losses were low. It is likely that early season N losses due to denitrification were also low (although this was not measured directly). We believe this resulted in no advantage or disadvantage of the deep tillage/deep N placement compared to the other treatments. We will continue this testing in 2009 as funding permits.

One suggested management practice from this study is that a cover crop should be considered in years where there was a dry early season and significant residual soil N after harvest. We measured 50 - 75 lbs N/acre in some of the subplots after harvesting. Past research has shown that most of this soil N is lost over the late fall-winter-early spring period when there is no crop cover and crop water uptake. Another suggested management guideline is to adjust sidedress N application rates for early season weather using tools like *Adapt-N*.

Precision N application. Tillage practice, if well established, affects both crop available N and corn silage yields. In both years of this study (2007, 2008), we measured higher crop available N and higher silage yields on the no till plots compared to the plow till plots. The data also indicates that the yield improvement is the result of an interaction between tillage and N, possibly related to the improved soil health measured on the no till plots.

Based on our results at the Willsboro research farm in both 2007 and 2008, we recommend that growers who typically apply sidedress N use the PNM model for more precise N management in corn production. The PNM model-recommended sidedress N rate of 95 lbs/acre was the optimum sidedress rate for the no till and was somewhat higher that the optimum sidedress rate for the plow till plots. In both tillage plots, however, the PNM rate was below the recommended rate for that location as a result of incorporating the effects of early season weather on soil N availability.

We will be conducting further analyses of results from both experiments using the PNM model. Results of these analyses related to N management for corn production will be made available to NNY extension staff and growers.

Outreach:

Deep placement of N fertilizer for corn production. Results of the 2007 research were presented at meetings in Canton (1/30/08), Plattsburgh (2/7/08) and Malone (2/8/08) in conjunction with presentations on the Soil Health NNYADP 2007 project (van Es et al.). Anita Deming (CCE Executive Director, Essex Co.) and John Idowu (Dept. of Crop and Soil Sciences, Cornell) were the main organizers for these meetings.

Precision N application. The *Adapt-N* tool for field or farm level N application recommendations for corn was offered for the first time in spring 2008. *Adapt-N* will continued to be offered for all New York State growers, including those in NNY, in 2009 and beyond. Training for CCE staff on the use of the interface will be held at a combined Soil Health/ PNM model workshop at Cornell University on Tuesday, March 16, 2009. Bob Schindelbeck, Jeff Melkonian and Larissa Smith (Dept. of Crop and Soil Sciences, Cornell) are the contact people for the workshop.

We also offered PNM model-generated sidedress N recommendations by climate region for 2008. These were provided twice a week from late May to early July, 2008. As in the past, the recommendations were sent out as part of an email extension bulletin to CCE staff, including those in NNY.

Next steps:

If we receive NNYADP funding in 2009, we will continue both projects ("Deep placement of N fertilizer for corn production" and "Precision N application") at the Willsboro research farm. This will allow us to more thoroughly test deep N placement and the PNM model as N management tools for NNY.

Acknowledgements:

We would like to acknowledge the NNY Agricultural Development Program for their generous support in 2008. We would also like to acknowledge Mr. John Altobelli (grower) and Chuck Bornt (CCE, Team Leader, Capital District Regional Vegetable Program) for their assistance with the deep ripper/deep N applicator. We would also like to acknowledge Mr. Harold Brecht (Agrotain International LLC) for kindly supplying the Agrotain Plus urease/nitrification inhibitor.

Reports:

Handouts on our 2008 NNYADP-funded research were provided by Bob Schindelbeck as part of the Field Crops Soil Management Update at the 2008 CCE Agricultural and Food Systems Inservice, 11/12/08, at the Ramada Inn in Ithaca.

Contacts:

Jeff Melkonian
Senior Research Associate
Department of Crop and Soil Sciences
Cornell University
Phone: (607) 227-9172
Email: jjm11@cornell.edu
FAX: (607) 255-2106

Photographs

Photo 1a. Two row ripper unit with nitrogen (UAN) delivery hoses. (Photo courtesy of Bob Schindelbeck).

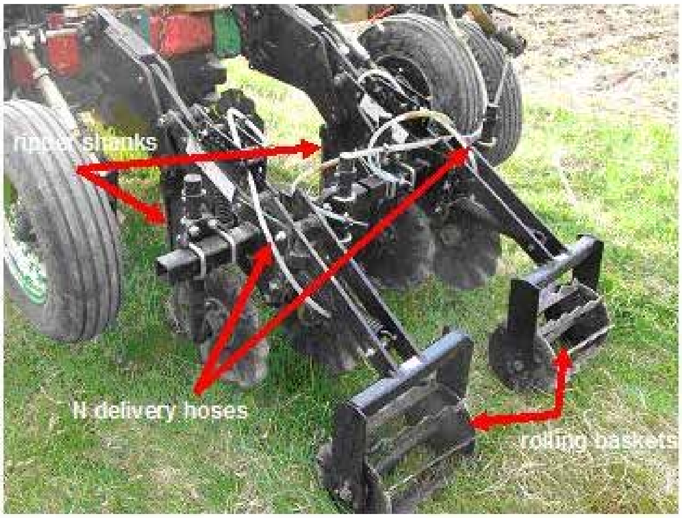


Photo 1b. Side view of ripper shank with deep N placement tube. (Photo courtesy of Bob Schindelbeck).

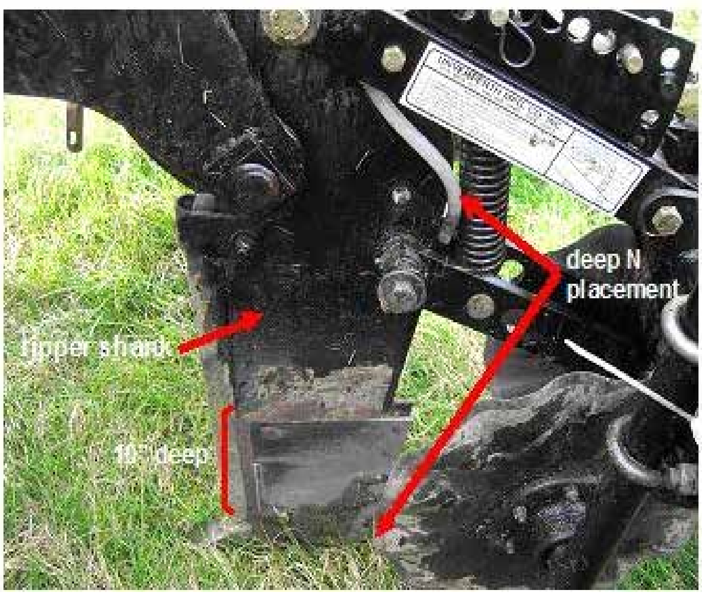
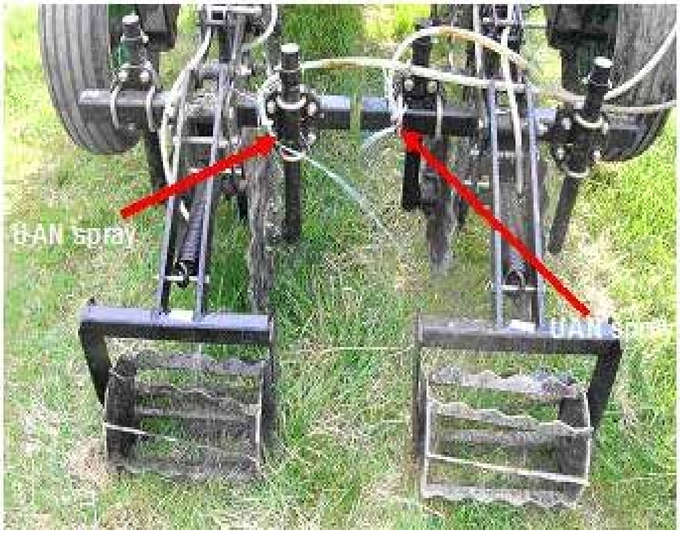


Photo 2. Broadcast N application at planting: UAN sprayed under rolling baskets (plow till subplots) . (Photo courtesy of Bob Schindelbeck).



Appendices:

Appendix 1

Nitrogen-related publications from research conducted in Northern NY

Poe, G., H.M van Es, T. vanderBerg, and R. Bishop. 1998. Do participants in well testing programs update their exposure and health risk perceptions? J. Soil and Water Cons. 53:320-325.

Sogbedji, J.M., H.M. van Es, J. Melkonian, and R.R. Schindelbeck. 2006. Evaluation of the PNM model for simulating drain flow nitrate-N concentrations under manure-fertilized maize. Plant and Soil 282: 343-360

Sogbedji, J.M., H.M. van Es, J.L. Hutson, and L.D. Geohring. 2001. Fate of N fertilizer and green manure in clay loam and loamy sand soils: I Calibration of the LEACHM model. Plant and Soil 229(1): 57-70.

Sogbedji, J.M., and H.M. van Es. 2001. Fate of N fertilizer and green manure in clay loam and loamy and soils: II Validation of the LEACHM model. Plant and Soil 229(1): 71-82

Sogbedji, J.M., H.M. van Es, S.D. Klausner, D.R. Bouldin, and W.J. Cox. 2001. Spatial and temporal processes affecting nitrogen availability at the landscape scale. Soil & Tillage. Research 58 (3-4) 233-244.

Sogbedji, J.M., H.M. van Es, C.L. Yang, L.D. Geohring, and F.R. Magdoff. 2000. Nitrate leaching and N budget as affected by maize N fertilizer rate and soil type. J. Environm. Qual. 29:1813-1820.

Tan, I.Y.S., H. M. van Es, J. M. Duxbury, J. J. Melkonian, R. R. Schindelbeck, L.D. Geohring, W.D. Hively, and B. N. Moebius. 2009. Nitrous oxide losses under maize production as affected by soil type, tillage, rotation, and fertilization. Soil&Tillage Research 102:19-26.

van Es, H.M., J.M. Sogbedji, and R.R. Schindelbeck. 2006. Effect of manure application timing, crop and soil type on nitrate leaching. J. Environmental Quality 35(2):670-679.

van Es, H.M., J.M. Sogbedji, and R.R. Schindelbeck. 2006. Nitrate leaching under maize and grass as affected by manure application timing and soil type. J. Environmental Quality 35:670-679.

van Es, H.M, C.L. Yang, and L.D. Geohring. 2005. Maize nitrogen response as affected by drainage variability and soil type. Precision Agriculture 6:281-295.

van Es, H.M, and J.E. Delgado. 2004. Nitrate Leaching Index. *In*: R. Lal (Ed.). Encyclopedia of Soil Science. Marcel Dekker.

van Es, H.M., K.J. Czymmek, and Q.M. Ketterings. 2002. Management Effects on N leaching and Guidelines for an N Leaching Index in New York. J. Soil Water Conserv. 57(6): 499-504.

Appendix 2.

Figure 1. Mean subplot silage yields in the sandy loam plots at the Willsboro research farm in 2008. NT_DeepN = no till deep tillage and N (125 lbs N/acre) placement at planting (5/07/08) and 15 lbs N/acre applied through the planter; NT_SidedressN = no till sidedress N (15 lbs N/acre) applied through the planter and 125 lbs N/acre applied as sidedress on 6/16/08); PT_BroadcastN = plow till, N (125 lbs N/acre) broadcast and incorporated at planting, and 15 lbs N/acre applied through the planter; PT_SidedressN = plow till sidedress N (15 lbs N/acre) applied through the planter and 125 lbs N/acre applied as sidedress on 6/16/08). Note that a nitrification/urease inhibitor was added to the deep N placement (no till) and broadcast/incorporated N (plow till) treatments. (Error bars: ± s.e.)

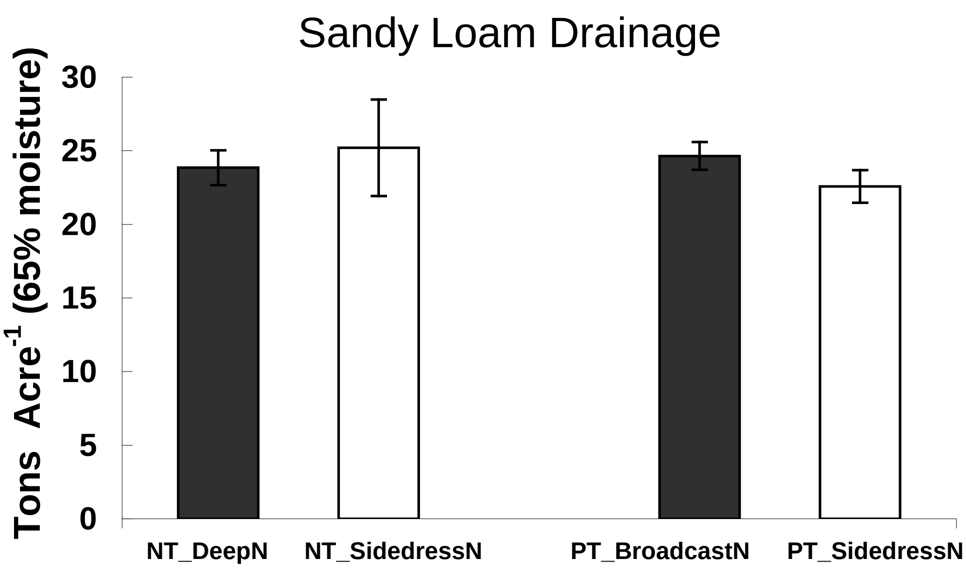
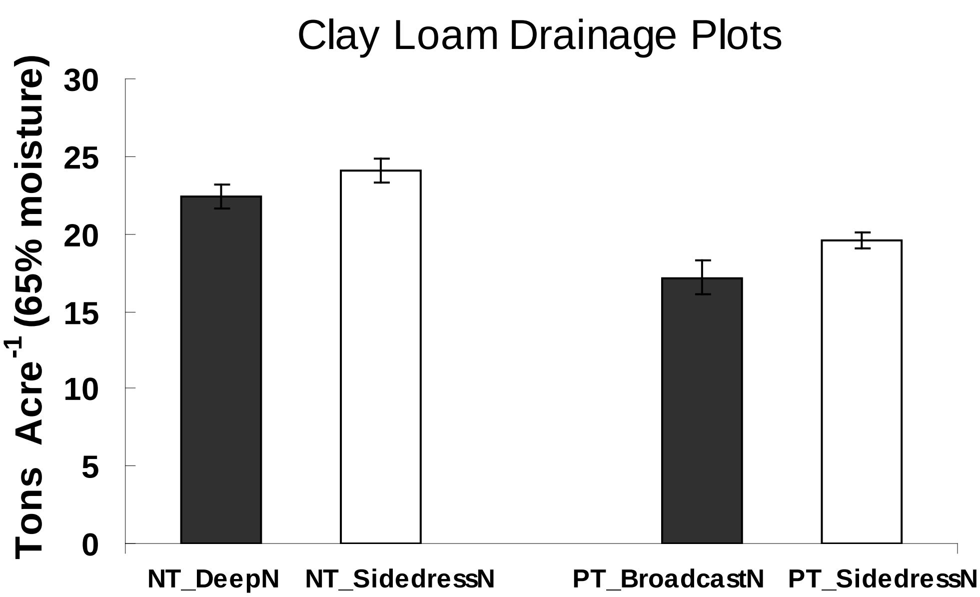


Figure 2. Mean subplot silage yields in the clay loam plots at the Willsboro research farm in 2008. NT_DeepN = no till deep tillage and N (125 lbs N/acre) placement at planting (5/07/08) and 15 lbs N/acre applied through the planter; NT_SidedressN = no till sidedress N (15 lbs N/acre) applied through the planter and 125 lbs N/acre applied as sidedress on 6/16/08); PT_BroadcastN = plow till, N (125 lbs N/acre) broadcast and incorporated at planting, and 15 lbs N/acre applied through the planter; PT_SidedressN = plow till sidedress N (15 lbs N/acre) applied through the planter and 125 lbs N/acre applied as sidedress on 6/16/08). Note that a nitrification/urease inhibitor was added to the deep N placement (no till) and broadcast/incorporated N (plow till) treatments. (Error bars: ± s.e.)



<u>Figure 3.</u> Crop available soil N (nitrate-N and ammonium-N; lbs N/acre) in the top 12" of the root zone of fallow subplots in the no till and plow till plots at the Willsboro research farm at pre-plant (5/05/08), pre-sidedress (6/05/08) and harvest (9/03/08).

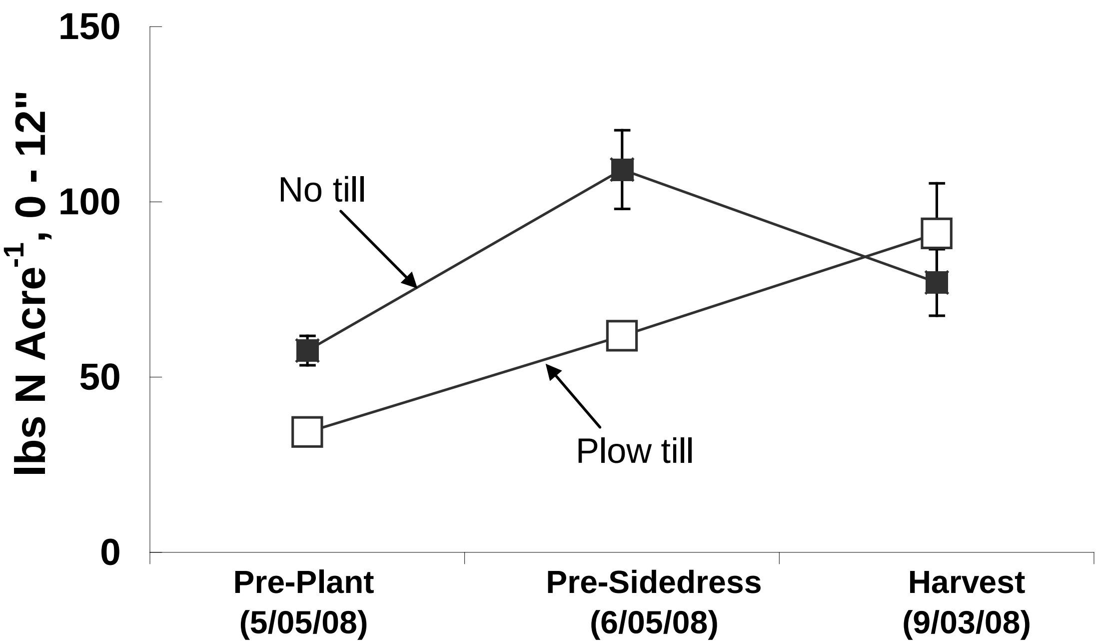
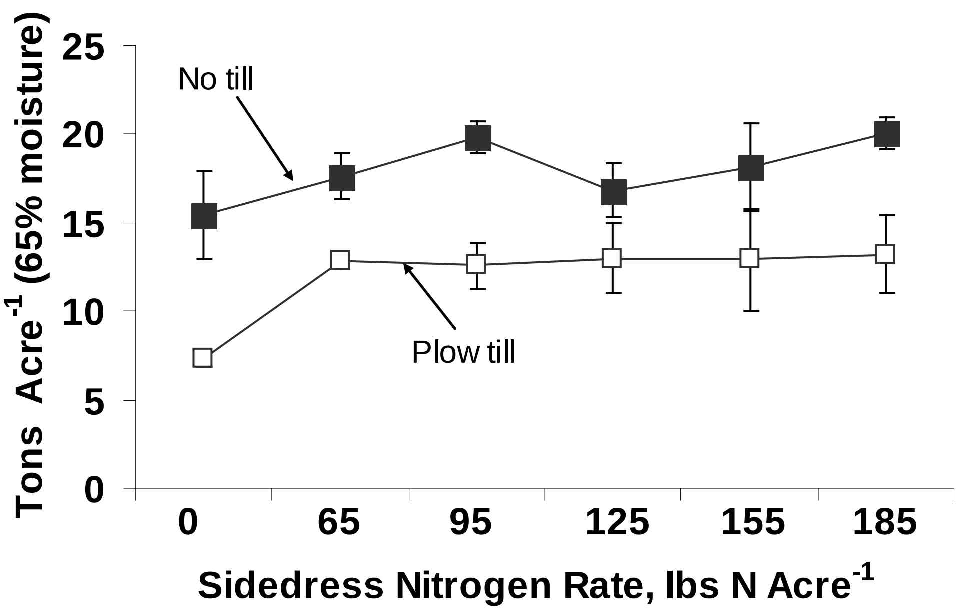


Figure 4. Mean sidedress N subplot silage yields (tons (65% moisture)/acre) in the no till plots and plow till plots at different sidedress N rates in 2008. The plots are part of a long-term tillage experiment at the Willsboro research farm. (Error bars: ± s.e.).



Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title; **Promoting Soil Health Management in Northern New York**

Project Leader(s):

- **Harold van Es.** Professor of Soil and Water Management, Crop & Soil Sciences, Cornell University; ph: 607-255-5629; email: hmv1@cornell.edu
- **George S. Abawi**. Professor of Plant Pathology, Cornell University
- **David Wolfe** Professor of Horticulture, Cornell University
- **Robert Schindelbeck**. Extension Associate, Crop and Soil Sciences, Cornell University
- **John Idowu**. Research Associate & Soil Health Project Coordinator, Cornell University

Collaborator(s):

- **Cornell University:** Michael Davis: Manager, Cornell research farms at Willsboro and Chazy.
- **Cornell Cooperative Extension**: Stephen Canner (St. Lawrence & Franklin), Michael Hunter (Jefferson), (Lewis), Anita Deming (Essex), Carl Tillinghast (Franklin) Joseph Lawrence (Lewis County) and Blake Putman (Clinton County)

Cooperating Producers:

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

Background: Soil degradation problems are evident on many NNY farms. With intensive crop production, significant numbers of farms are experiencing declining soil health due to 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 are seeking solution to address soil problems encountered on their farms. The recently developed Cornell Soil Health Test (CSHT), which integrates physical, biological and chemical soil measurements, is being demonstrated as a useful tool to identify and manage on-farm soil constraints. In the past year, we used the CSHT to assess some of the farms in NNY. We plan to continue to engage growers in discussions on soil health assessment and management, using the information provided on the Cornell soil health test report for their fields.

More educational information is needed to promote soil health management among NNY growers. Educational tools such as fact sheets and case studies can significantly impact the adoption of better soil health management practices. These educational materials can assist county educators in disseminating information to growers in their regions and can serve as foci for discussions during field meetings.

Outreach: Four county-based outreach events were conducted in NNY during 2008. The outreach activities generally addressed the utility of the Cornell Soil Health Test for improved soil management.

The outreach in Jefferson County took place on January 29, 2008 in La Fargeville, NY. The meeting focused on soil health improvement in both the conventional and organic systems. The meeting was attended by about 30 growers who asked question on various soil health management principles.

The outreach in St. Lawrence County took place in Canton, NY on January 30, 2008. The Canton meeting focused on the principles of soil health interpretation. About 10 growers attended this meeting.

The meeting in Plattsburg, NY took place on February 7, 2008. About 15 growers and SWCD staff attended from both Essex and Clinton Counties. The meeting focused on the importance of individual soil health indicators and how they relate to soil processes.

The last county-based outreach program held in Malone, NY on February 8, 2008 covered topics on soil health, reduced tillage and compaction management. The meeting was attended by about 15 farmers.

A soil health workshop held on March 18, 2008 in Ithaca, NY was attended by over 70 CCE staff, CCA, consultants and several farmers in NY. The workshop focused on how to use the Cornell Soil Health Test for practical farm management.

We also conducted a combined soil health training session for the NY CCE field and vegetable crops educators during the annual in-service training that was held in Ithaca, NY on November 12, 2008.

During all these outreach meetings, handouts were distributed to participants and copies of the Cornell Soil Health Manual were made available to those interested.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. We intend to produce case studies of growers who have successfully implemented soil health improvement practices to help the growers in the NNY region transition to better soil management strategies. However, we have not been able to compile all information needed to complete the studies. Part of the study involves interviewing selected growers to get information on their management practices. Growers could not participate in these interviews during the growing season of 2008. We plan to finish up with the interview during this winter and travel to visit the growers in the spring to take pictures of their equipment and farming practices. We will also use the spring visit to clarify any information that we obtain through the phone interviews.

The questionnaire that was designed for the case study is attached to this report.

Acknowledgments: We acknowledge the funding received from NNYADP, the NE-SARE and New York Farm Viability Institute to promote the soil health sampling and outreach in NY State and the other parts of the Northeast.

Reports and/or articles in which the results of this project have already been published. Two extension articles listed below were released in 2008:

1. The Link Between Soil Health and Reduced Tillage -- Bob Schindelbeck, John Idowu and Harold van Es. What's Cropping Up? Vol. 18, No. 3, 2008 May-Jun. http://css.cals.cornell.edu/cals/css/extension/upload/wcu_vol18no3_2008a5reducedtillage.pdf

2. How to Interpret and Use the Cornell Soil Health Test (CSHT) Report-- Robert Schindelbeck, John Idowu, Harold van Es, George Abawi, David Wolfe and Beth Gugino. What's Cropping Up? Vol. 18, No. 1, 2008 Jan-Feb. http://css.cals.cornell.edu/cals/css/extension/upload/Interpreting_the_CSHT_Report.pdf

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

For more information please contact:

John Idowu
Soil Health Project Coordinator
Department of Crop and Soil Sciences
1001 Bradfield Hall
Cornell University, Ithaca NY 14853
E-mail: johnidowu@cornell.edu
URL: http://soilhealth.cals.cornell.edu
Tel: (607) 255-1706

OR

Robert Schindelbeck
Extension Associate
Dept. of Crop and Soil Science
1003 Bradfield Hall
Cornell University
Ithaca, NY 14853
Tel: (607) 255-1706
Cell: (607) 227-6055

Photos

Plate 1. Winter soil health meeting in Canton, NY

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Management of Brown Root Rot of Alfalfa and Forage Grasses**

Project Leader(s):

Michael J. Wunsch, graduate research assistant
607-255-8393 (lab), 607-351-4234 (cell), mjw55@cornell.edu
Gary C. Bergstrom, professor
607-255-8393 (lab), 607-255-7849 (office), gcb3@cornell.edu
Department of Plant Pathology and Plant-Microbe Biology, Cornell University,
334 Plant Science, Ithaca, NY 14853.

Collaborator(s):

Peter Barney, private crop consultant, Canton, NY (Saint Lawrence County)
Anita Deming, Cornell Cooperative Extension of Essex County
Michael Hunter, Cornell Cooperative Extension of Jefferson County
Joe Lawrence, Cornell Cooperative Extension of Lewis County
Everett Thomas, W. H. Miner Institute, Chazy, NY
Carl Tillinghast, Cornell Cooperative Extension of Franklin County

Cooperating Producers:

Clinton County:	W.H. Miner Institute; Chazy, NY
Essex County:	Pat Bennett; Westport, NY
	Lee Garvey; Willsboro, NY
	Erik Leerkes; Ticonderoga, NY
Franklin County:	Rod and Doug Mallette; Chateaugay, NY
	Randy Ooms; Constable, NY
	Jim and Keith Woodworth; Constable, NY
Jefferson County:	Dan Reed, Reedhaven Farm; Adams Center, NY
Lewis County:	Glen Beller; Croghan, NY
	Kevin Sullivan; Denmark, NY
	Shawn Bender; Martinsburg, NY
St. Lawrence County:	Cornell Cooperative Extension of St. Lawrence County Learning Farm and Education Center; Canton, NY

Background: *Phoma sclerotioides*, causal agent of brown root rot (BRR), is a soil-borne fungus causing root and crown rot of alfalfa, other perennial legumes, and overwintering grasses. Primarily active during late winter and early spring (Cormack, 1934), it is associated with yield loss, winterkill, slow emergence from winter dormancy, and stand decline of alfalfa (Berkenkamp et al., 1991; Hollingsworth et al., 2003) and with winterkill of overwintering grasses (Larsen et al., 2007).

BRR was first detected in the eastern United States in 2003 in Clinton County, NY on alfalfa. The results of subsequent surveys of alfalfa production fields conducted in Clinton County in 2004 and in New York, Vermont and New Hampshire in 2005 suggest that BRR may be a serious factor impacting the health and persistence of alfalfa in the region. BRR was found on a high percentage of plants in many fields (Wunsch et al., 2007), and most of the lesions caused by the disease progressed into the cortical (internal) tissues of roots and crowns (Wunsch et al., 2006; Wunsch et al., 2007). The BRR incidence observed in New York, Vermont and New Hampshire is similar to that observed in Saskatchewan, Canada (Wunsch, unpublished), where the disease has long been recognized as a serious problem for alfalfa production.

BRR can have severe effects on alfalfa yields. In Saskatchewan fields with heavy BRR disease pressure, BRR-resistant alfalfa produces yields 40 to 65 percent higher than BRR-susceptible alfalfa (second and third production years, three cuts per year); alfalfa moderately resistant to BRR produces yields 23 to 43 percent higher than BRR-susceptible alfalfa (Berkenkamp et al., 1991).

No management tools currently exist for BRR in New York. Peace, the BRR-resistant alfalfa variety grown in Saskatchewan and Alberta, performs poorly in New York; it is highly susceptible to other alfalfa root rots common in New York, and preliminary results suggest that it is also highly susceptible to some New York strains of *P. sclerotioides.* Crop rotation is not an effective alternative; *P. sclerotioides* produces resting stuctures that can persist extended periods in the soil without a suitable substrate (Cormack, 1934), and *P. sclerotioides* can survive on organic matter in the soil (Davidson, 1990).

Significant differences in BRR resistance have been observed among alfalfa varieties grown in Saskatchewan and in Wyoming (Berkenkamp et al., 1991; Hollingsworth et al., 2005). If significant differences in BRR resistance are also observed among alfalfa varieties grown in New York, adoption of the most resistant varieties by growers in fields with high BRR pressure would be expected to increase forage yields. The most resistant varieties would also serve as sources of BRR resistance for alfalfa breeding.

P. sclerotioides is a recognized pathogen of certain overwintering grasses and cereals (Larsen et al., 2007; Smith, 1987), and it is frequently the predominant fungus isolated from diseased roots of perennial grasses in the early spring (Davidson, 1990). However, pathogenicity of *P. sclerotioides* to forage grasses has never been studied. If there are significant differences in susceptibility to *P. sclerotioides* among forage grass species, use of the most resistant grasses in mixed alfalfa-grass stands may reduce the inoculum density of *P. sclerotioides* within such stands, thereby minimizing losses of alfalfa to BRR in the stands.

Methods: Replicated field experiments were established at the W.H. Miner Institute in Chazy, NY and at the Cornell Baker Research Farm in Willsboro, NY to test the relative susceptibility of 11 alfalfa varieties to BRR. Nine alfalfa varieties commercially available in New York were tested: 54V46 (Pioneer), 361 HY (Preferred Seed), Guardsman II (Seedway), Mariner III (Allied Seed), ReGen (Seedway), Oneida Ultra (Seedway), Seedway 9558 (Seedway), Starbuck (Pickseed), and WL 347 LH (W-L Research). Two additional varieties, Peace (Richardson Seeds) and Vernal (University of Wisconsin), were included as resistant and susceptible checks. The field experiment in Chazy was seeded in May 2006 and inoculated in September 2006; the experiment in Willsboro, NY was seeded in May 2007 and inoculated at seeding. Each plot included five replicates. A third field experiment (not funded by NNYADP) was established in Bath, NY in May 2006 and inoculated in October 2006.

In April and May 2008, 125 plants of each variety were collected from each plot and assessed for BRR in the laboratory. A plant was only considered positive for BRR if *P. sclerotioides* was successfully isolated from a root or crown lesion. Incidence of BRR was recorded.

Susceptibility of perennial forage grasses to *P. sclerotioides* was assessed with a combination of surveys of production fields and replicated field experiments. Three production fields seeded to perennial forage grasses were sampled in each Clinton, Essex, Franklin, Jefferson, Lewis, and St. Lawrence Counties; 10 to 36 plants were sampled per field. Bromegrass, tall fescue, orchardgrass, reed canary, and timothy were collected, and all stands were at least two years old. The fields were randomly selected, and none had previously been evaluated for brown root rot of alfalfa. Replicated field experiments evaluating the susceptibility of bromegrass, tall fescue, orchardgrass, reed canary, perennial rye, and timothy to *P. sclerotioides* were established at the W.H. Miner Institute in Chazy, NY and at the Cornell Baker Research Farm in Willsboro, NY in August 2007. Uninoculated (plants exposed only to native *P. sclerotioides* populations) and inoculated (plants exposed to elevated *P. sclerotioides* populations) treatments were evaluated. In April 2008, 24 to 36 plants of each grass species were collected from each treatment (inoculated or uninoculated) and assessed for infection by *P. sclerotioides* in the laboratory. The roots were washed and visually assessed for root rot severity, and isolation of *P. sclerotioides* was attempted for each root. Incidence of infection by *P. sclerotioides* and incidence of winterkilled plants were recorded.

Results:

Alfalfa variety trial

Results of the replicated alfalfa variety trials differed by location. In Bath, Guardsman II, 361 HY, WL347 LH, 54V46, Oneida Ultra, Starbuck, and ReGen were significantly more resistant than Peace in 2007, but only Starbuck was significantly more resistant in 2008 (Table 1). In Willsboro, Peace was significantly more resistant than Starbuck, 361 HY, and Guardsman II, the opposite of what was observed in Bath (Table 1). In Chazy, ReGen was more resistant than WL347 LH and Peace in 2007, but no statistically significant difference was observed among these varieties in 2008 (Table 1).

The variable results from the variety trials were likely caused by genetic differences among isolates of *P. sclerotioides*. Research conducted in the last year indicates that *P. sclerotioides* is represented by at least four biotypes in New York. In Bath, only biotype 5 is present. In Chazy, biotypes 1, 2, 3, and 5 are present, and biotypes 1 and 5 predominate. In Willsboro, biotypes 1, 3, and 5 are present, and biotype 1 predominates. *P. sclerotioides* isolates of local origin were used to inoculate the plots; isolates of biotype 5 were used in Bath and Chazy, and an isolate of biotype 1 was used in Willsboro.

The variety trials suggest that resistance to BRR may differ by *P. sclerotioides* biotype. In previous research conducted in Wyoming with *P. sclerotioides* biotype 1, Peace was resistant to BRR. Likewise, in Willsboro, where *P. sclerotioides* biotype 1 predominates and an isolate of biotype 1 was used for inoculation, Peace was the most resistant. In Bath, however, where only *P. sclerotioides* biotype 5 is present and an isolate of biotype 5 was used for inoculation, Peace was consistently one of the most susceptible varieties. In Chazy, where both biotypes 1 and 5 are common and biotype 5 was used for inoculation, Peace was one of the most susceptible varieties the first year (when the laboratory-grown *P. sclerotioides* biotype 5 would have been most important) but not the second year (when the native *P. sclerotioides,* including biotype 1, would have been more important).

Susceptibility of perennial forage grasses to P. sclerotioides

The results indicate that perennial forage grasses can serve as an alternate host for *P. sclerotioides*. *P. sclerotioides* was isolated from roots of tall fescue, orchardgrass, reed canary, perennial rye, and timothy in both the Chazy and Willsboro field experiments, and it was isolated from roots of bromegrass in the Willsboro plot (Table 2). In surveys of northern New York forage production fields, *P. sclerotioides* was isolated from roots of bromegrass in one of two fields sampled, roots of orchardgrass in two of five fields sampled, roots of reed canary in one of six fields sampled, and roots of timothy in one of three fields sampled (Table 3).

P. sclerotioides does not, however, appear to be an economically important pathogen of perennial forage grasses. Incidence of infection by *P. sclerotioides* was low in the forage grasses sampled in northern New York production fields (Table 3). In the replicated field experiments conducted in Chazy and Willsboro, inoculation with *P. sclerotioides* (supplementing native *P. sclerotioides* populations with laboratory-grown *P. sclerotioides*) caused an increase in the incidence of infection by *P. sclerotioides* but not an increase in either winterkill losses or root necrosis (Table 2), suggesting that *P. sclerotioides* colonized the roots without causing much disease.

Conclusions/Outcomes/Impacts: Brown root rot (BRR) of alfalfa must be managed by host resistance. Crop rotation with perennial grasses is unlikely to be an effective technique for managing the disease. The results of the present study indicate that perennial forage grasses serve as an alternate host for *P. sclerotioides* and can act as reservoirs for the pathogen even when alfalfa is not grown in mixtures with the grasses.

In mixed seedings of alfalfa and perennial grasses, the severity of BRR of alfalfa is unlikely to be affected by the type of perennial grass planted. All of the perennial forage grasses commonly planted in northern New York appear to be moderately susceptible to *P. sclerotioides,* suggesting that each may have a similar effect on *P. sclerotioides* inoculum density and, consequently, the severity of alfalfa BRR.

It is unclear which alfalfa varieties are best suited for fields with high BRR disease pressure. Ranking of varieties for relative resistance to BRR was inconsistent among field trials at Bath, Chazy, and Willsboro, likely a reflection of biological variation in the pathogen at these locations. There are at least four genetically distinct biotypes of *P. sclerotioides* present in New York, and the relative resistance of alfalfa varieties to BRR appears to differ by *P. sclerotioides* biotype.

Outreach: Gary Bergstrom is presenting the results of this project at Crop Congresses in the northern New York communities of Watertown, Chazy, Madrid, and Carthage on February 2, 2009 and March 3, 4, and 5, 2009. An extension handout summarizing the results from this study was prepared for the meetings. Additional outreach on brown root rot was conducted for northern New York growers at Crop Congresses Carthage and Madrid in March 2008, and for Cornell Cooperative Extension field crop educators at in-service training sessions in March and November 2008.

Extension publications:

Bergstrom, G.C. and M.J. Wunsch. 2008. Assess alfalfa stands for brown root rot this spring. What's Cropping Up? (Cornell Cooperative Extension) Volume 18, No. 2:1. http://css.cals.cornell.edu/cals/css/extension/upload/WCUvol18no2mar-apr2008.pdf

Publications in the popular press:

Ohler, Amy. Brown root rot research underway. News 10 Now. May 13, 2008. Online: http://news10now.com/Default.aspx?ArID=116026

Reiner, Alvin. Getting to the root of rot. Plattsburgh Press Republican. June 21, 2008. Online: http://www.pressrepublican.com/archivesearch/local_story_173231620.html

Anonymous. Researchers Hunt Killer Fungus. Watertown Daily Times. May 15, 2008. Online: http://www.watertowndailytimes.com/section/archive

Peer reviewed journal articles:

Wunsch, M. J., Baker, A. H., Larsen, R. C., and Bergstrom, G. C. 2006. Distribution and prevalence of brown root rot of forage legumes in the northeastern United States. Phytopathology 96:S125.

Wunsch, M. J., Schindelbeck, R. R., van Es, H. M., and Bergstrom, G. C. 2007. Distribution, impact and soil environment of *Phoma sclerotioides* in northeastern U.S. alfalfa fields. Plant Dis. 91:1293-1304.

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

(1) The results from the variety trial in Willsboro suggest that Peace, as suggested by previous studies, is relatively resistant to *P. sclerotioides* biotype 1 and that Starbuck is relatively susceptible. A second year of data is needed to confirm this result. The additional data on the relative susceptibility of alfalfa varieties to *P. sclerotioides* biotype 1 will be valuable for breeding alfalfa resistant to BRR.

(2) Identification of alfalfa variety recommendations for fields with severe BRR disease pressure will require the establishment of a new field experiment. The plot will need to be inoculated with all four biotypes of *P. sclerotioides* common in New York. In order to provide more relevant data to growers, yield, not BRR incidence, should be recorded. If both inoculated and inoculated treatments are included, the experiment could also help clarify the economic impact of BRR to northern New York producers. The effect of BRR on alfalfa yields in northern New York is currently unclear.

Acknowledgments: In addition to NNYADP, partial funding support for this project was from Hatch project NYC153-433.

Person(s) to contact for more information:

Michael J. Wunsch, graduate research assistant
607-255-8393 (lab), 607-351-4234 (cell), mjw55@cornell.edu
Gary C. Bergstrom, professor
607-255-8393 (lab), 607-255-7849 (office), gcb3@cornell.edu
Department of Plant Pathology and Plant-Microbe Biology, Cornell University,
334 Plant Science, Ithaca, NY 14853.

Photos

Alfalfa with brown root rot collected from the field experiment in Willsboro. Note that the BRR lesions completely girdled the crowns of the two plants on the right.

Appendix

Table 1. Relative resistance of alfalfa varieties to brown root rot.

Bath, NY (Steuben County)

SPRING 2007		SPRING 2008	
variety (seed company)	**incidence**	**variety**	**incidence**
Guardsman II (Seedway)	45 a	Starbuck	14 a
361 HY (Preferred Seed)	46 ab	Mariner III	25 ab
WL347 LH (W-L Research)	51 ab	WL347 LH	28 ab
54V46 (Pioneer)	51 ab	Seedway 9558	32 b
Oneida Ultra (Seedway)	52 ab	Oneida Ultra	32 b
Starbuck (Pickseed)	55 ab	54V46	33 b
ReGen (Seedway)	56 ab	Guardsman II	34 b
Seedway 9558 (Seedway)	61 abc	361 HY	36 b
Mariner III (Allied Seed)	65 bc	Vernal	36 b
Vernal (Univ. of Wisconsin)	65 bc	Peace	37 b
Peace (Richardson Seeds)	76 c	ReGen	39 b
LSD=18 (α=0.05)		LSD=17 (α=0.05)	

Willsboro, NY (Essex County)

SPRING 2008	
variety (seed company)	**incidence**
Peace (Richardson Seeds)	5 a
WL347 LH (W-L Research)	8 ab
ReGen (Seedway)	9 ab
Oneida Ultra (Seedway)	12 ab
54V46 (Pioneer)	14 ab
Vernal (Univ. of Wisconsin)	14 ab
Mariner III (Allied Seed)	15 ab
Seedway 9558 (Seedway)	18 ab
Starbuck (Pickseed)	21 b
Guardsman II (Seedway)	22 b
361 HY (Preferred Seed)	22 b
LSD=15 (α=0.05)	

Chazy, NY (Clinton County)

SPRING 2007		SPRING 2008	
variety (seed company)	**incidence**	**variety**	**incidence**
ReGen (Seedway)	16 a	Oneida Ultra	26 a
Guardsman II (Seedway)	22 ab	Seedway 9558	29 ab
361 HY (Preferred Seed)	23 ab	WL347 LH	30 ab
Vernal (Univ. of Wisconsin)	23 ab	Peace	33 ab
Oneida Ultra (Seedway)	28 ab	361 HY	36 ab
Seedway 9558 (Seedway)	29 ab	54V46	37 ab
Starbuck (Pickseed)	29 ab	Mariner III	39 ab
Mariner III (Allied Seed)	32 ab	Guardsman II	40 ab
54V46 (Pioneer)	32 ab	Vernal	43 ab
WL347 LH (W-L Research)	37 b	ReGen	43 ab
Peace (Richardson Seeds)	37 b	Starbuck	48 b
LSD=18 (α=0.05)		LSD=19 (α=0.05)	

EXPLANATORY NOTES:

"**Incidence**": The percentage of plants infected with *P. sclerotioides*.

* Each spring, 125 plants of each variety were evaluated from each field experiment.
* Isolates of local origin were used to inoculate the plots, and different isolates were used at each site.
* The Chazy and Bath plots were seeded in spring 2006; the Willsboro plot, in spring 2007.

Note that NNYADP funds were not used for work conducted in Bath, NY.

Table 2. Susceptibility of perennial forage grasses to *P. sclerotioides* and effect of increased *P. sclerotioides* inoculum density on infection by *P. sclerotioides*, winterkill, and root necrosis.

Chazy, NY W.H. Miner Research Institute	*P. sclerotioides* [1]		winterkill [2]		root necrosis [3]	
	uninoculated*	inoculated*	uninoculated*	inoculated*	uninoculated*	inoculated*
Bromegrass (cv. Peak; Seedway)	0	0	2.8	0	8.53	7.97
Tall Fescue (cv. Enhance; Seedway)	2.8	5.6	11.1	2.8	6.08	3.25
Orchardgrass (cv. Intensiv; Barenbrug)	0	2.8	0	0	4.79	2.86
Reed Canary (cv. Bellevue; Pickseed)	0	3.2	4.2	3.2	2.63	1.84
Perennial Ryegrass (cv. Citadel; Seed Research of Oregon)	0	11.1	0	0	5.33	4.19
Timothy (cv. Climax; Agriculver)	2.8	0	0	0	2.03	1.83

Willsboro, NY Cornell Baker Research Farm	*P. sclerotioides* [1]		winterkill [2]		root necrosis [3]	
	uninoculated*	inoculated*	uninoculated*	inoculated*	uninoculated*	inoculated*
Bromegrass (cv. Peak; Seedway)	4.2	33.3	0	0	6.00	7.08
Tall Fescue (cv. Enhance; Seedway)	25.0	33.3	0	0	2.00	3.08
Orchardgrass (cv. Intensiv; Barenbrug)	50.0	54.2	0	0	2.00	2.17
Reed Canary Grass (cv. Bellevue; Pickseed)	37.5	20.8	0	0	1.08	0.88
Perennial Ryegrass (cv. Citadel; Seed Research of Oregon)	33.3	69.4	0	0	2.94	2.56
Timothy (cv. Climax; Agriculver)	12.5	37.5	0	0	1.50	1.42

EXPLANATORY NOTES:

Both plots were established in August 2007 and evaluated in April 2008. Five replicates were seeded, but because of problems with stand establishment, plants were only evaluated from two to three replicates. For each treatment (inoculated or uninoculated) at each site, 24 to 36 plants of each grass species were sampled.

[1] ***P. sclerotioides*** **:** The percentage of plants infected with *P. sclerotioides* .

[2] **Winterkill:** The percentage of plants that were dead after the first winter.

[3] **Root necrosis:** Average root necrosis. Root necrosis was rated on a 0 to 10 scale, where 0 = roots healthy and 10 = roots 100% necrotic.

* **Uninoculated:** only native *P. sclerotioides* * **Inoculated:** native *P. sclerotioides* supplemented with laboratory-grown *P. sclerotioides*

Table 3. Percentage of perennial forage grass plants infected by *P. sclerotioides* in northern New York production fields.

Orchardgrass

Field	County	*P. sclerotioides* [1]
1	Clinton County	7
2	Franklin County	0
3	Jefferson County	0
4	Lewis County	6
5	Saint Lawrence County	0

Timothy

Field	County	*P. sclerotioides* [1]
1	Essex County	0
2	Essex County	0
3	Franklin County	19

Reed Canary

Field	County	*P. sclerotioides* [1]
1	Clinton County	0
2	Essex County	0
3	Franklin County	7
4	Jefferson County	0
5	Lewis County	0
6	Saint Lawrence County	0

Tall Fescue

Field	County	*P. sclerotioides* [1]
1	Clinton County	0
2	Saint Lawrence County	0

Bromegrass

Field	County	*P. sclerotioides* [1]
1	Essex County	0
2	Lewis County	9

EXPLANATORY NOTES:

From each field, 10 to 35 plants were sampled. All stands were at least two years old.

[1] ***P. sclerotioides*** **:** The percentage of plants infected with *P. sclerotioides* .

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Biological Control of Alfalfa Snout Beetle: Developing a Farmer-Friendly Rearing and Application Method to Speed the Spread of the Biocontrol Nematodes.**

Project Leader(s): Elson Shields and Tony Testa, Dept. of Entomology, Cornell University.

Collaborator(s):

Mike Hunter, Jefferson Co. Cornell Cooperative Extension
Joe Lawrence, Lewis Co. Cornell Cooperative Extension
Steve Canner, St. Lawrence Co. Cooperative Extension
Carl Tillinghast, Franklin Co. Cooperative Extension
Pete Barney, Private Sector / Consulting

Cooperating Producers:

Jefferson Co.: David Haldeman, John Hansen, Michael Kiechle, Lynn Murray, John Peck, Doug Shelmidine

Lewis Co.: Jerome Demko, Bernie Golhert, Mark Karelus, Andrew Moser, Mervin Moser, Gary Sullivan, Merle Yancey, Roger Zehr

St. Lawrence Co.: Mark Akins, James Armstrong, Peter Braun, Scott Loomis, Steven McKnight, "Skip" Putney

Franklin Co.: Real Choiniere, Carolyn McNamara/ Dick Eakins, David Moore, Eugene Poirier, Peter Poupore

Background: Alfalfa snout beetle, within the infested counties, continues to be the single most contributing factor to alfalfa death and stand loss in NNY. Snout beetle related stand loss is often identified as winter kill because the majority of plant death occurs after the growing season during the fall and early winter. This insect was introduced into NNY at the port of Oswego between 1848 and 1896, when the first individual was collected and identified. Snout beetle became a major pest problem after alfalfa was introduced into NNY in the 1920s. Attempts were made to control this insect from the 1940s to 1972 with the widespread distribution of poison baits. During this time, snout beetle continued to spread. Widespread baiting ended in 1972, due to environmental concerns and the snout beetle population exploded in the early 1980s. Research focused on the use of biological control to suppress snout beetle was initiated in 1990 and has been supported in part by NNYADP since its initiation.

In 2002 and 2003, the snout beetle population on the Peck Farm (Great Bend, Jefferson Co.) crashed from about 1 million beetles per acre to an extremely low level.

Subsequent research has shown that the entomopathogenic (insect attacking) nematodes released on the farm in a series of small plots during 1993-98, have been moved throughout the farm by farming practices and caused the population crash of snout beetle. A small rebound of beetles was observed in a field bordering a neighbor's heavily infested farm in 2007 and 2008. John Peck's farm has progressed from having the alfalfa stands completely killed out during the first production year from snout beetle feeding to actually plowing alfalfa plants down at the end of an alfalfa stand's life (5 years). With the establishment of 6 different small test plots on the Peck farm, it required nearly 10 years for the nematodes to spread throughout the farm and control snout beetle.

The question is: "How can we move the biological control success on the Peck Farm to the rest of the infested farms in the NNY?"

Since the entomopathogenic nematodes used as the biological control for snout beetle are adapted to NNY, a farm or field only needs to be inoculated once for the establishment of the nematodes in the field. If only a single field per farm is inoculated, the farmer will move the nematodes around the farm with the movement of soil during normal farming operations, but it will take years for the nematodes to become established in all of the affected fields on the farm and control the population of snout beetle on the farm. However, if a farmer friendly method could be developed to rear the nematodes on the farm and a method of application be developed compatible with on-farm equipment to inoculate individual fields, then each farmer could more rapidly spread the biocontrol nematodes throughout their fields for faster control of snout beetle.

In 2007 and 2008, we shifted our research focus to address the problems associated with large-scale application of nematodes for area wide control of snout beetle. The focus and goal of the projects was shifted to develop the necessary components which would allow the ASB-Biocontrol nematodes to be inoculated into fields throughout the 9 county infested region by farmers themselves or by commercial applicators.

Methods & **Results:**

Nematode Field Application Techniques Compatible with Large-scale Agriculture.

In 2007, two field sites were established in southern Jefferson Co. on the Doug Shelmidine farm to test nematode field inoculation methods into established alfalfa fields compatible with current farming practices. At each site, four different soil inoculation techniques were tested. The inoculation methods tested were 1) nematode infected insect cadaver placed on the soil surface, 2) nematode infected insect cadavers placed four inches under the soil surface (a natural condition), 3) nematodes suspended in water and applied to the soil surface (a method used in experimental plots for more then 10 years) and 4) nematode infected soil placed on the surface.

Soil samples to bioassay for the presence of nematodes were collected five different times between June 2007 and October 2008 (22 days, 69 days, 109 days, 371 days & 420 days after inoculation). Soil samples were collected at 6 inch intervals from the initial inoculation site to document natural nematode spread from the single point of inoculation. The results indicated that the two best methods to inoculate fields with the biocontrol nematode were buried infected insect cadavers and nematodes suspended in water. Since the application of a water suspension of nematodes is more compatible with agricultural practices than burying insect cadavers, all subsequent research utilized the water suspension method to inoculate fields. During the 420 day duration of this study, nematodes persisted in both locations and movement as far as 9.5 ft from the point of initial inoculation was recorded. The detected movement of the nematodes in this study shows that nematodes are capable of moving away from the point of inoculation without the movement of soil during tillage.

Economical Mass-rearing of Biocontrol Nematodes (Farmer Friendly.) Traditionally, the high cost of rearing nematodes was a major obstacle to using nematodes in a wide-spread biological control effort. These high rearing costs were mainly a result of the high labor costs and specialized laboratory supplies required for nematode rearing. By tossing out all of the published rearing procedures and starting over with a clean sheet of paper, we have been able to slash rearing costs by 350% and eliminate specialized laboratory equipment. To produce 100 million nematodes for a single field release, the old rearing technique required 8 hours of labor and $65 of laboratory materials for a total cost of $175. In contrast, the new rearing technique required 2 hours of labor and cost $50 to produce 100 million nematodes for field release. This $50 cost is broken down into $20 materials (insect larvae to rear nematodes) and $30 labor. With the new technique, the insect larvae used to produce the nematodes arrive in plastic tubs filled with fine wood chips. The lids are opened and 5000 infective nematodes suspended in 10 mls of water are applied to the wood chips. The nematodes then search out the larvae buried through the wood chips, infect the larvae and reproduce. After inoculating the tub, the lid is replaced and the tub is placed at room temperature for 15 days. By 15 days, the new nematodes have emerged from the insect cadavers and are dispersed throughout the wood chips. The tubs filled with wood chips, nematodes and insect cadavers are transported to the field where the tubs are dumped onto a fine screen over a 5 gal bucket. The wood chip mass is washed with a high pressure water stream and the nematodes are flushed out of the wood chips and into the bucket. The bucket of nematodes is then dumped into a spray tank for application in a field.

This new rearing technique was used to rear approximately 10 billion nematodes for field application during the 2008 growing season. Of the 10 billion nematodes produced 7.2 billion were applied to 36 fields distributed throughout the NNY snout beetle infected region. Below is the breakdown by species for the 2008 fields:

Heterorhabditis bacteriophora 'Oswego' – 2.8 Billion
Steinernema carpocapsae 'NY001' – 2.7 Billion
Steinernema feltiae 'Valko' – 1.7 Billion

Field Application of Nematodes. Nematodes were applied to alfalfa fields using a custom built 8 ft spray boom which fit into a trailer hitch receiver mounted on a 2-wheel drive pickup. There were two sets of nozzles on the spray boom. The first set of nozzles was located on the front side of the boom and used only the nozzle bodies with the nozzles (and screens) removed. Nematodes suspended in water were applied through these nozzles bodies as a dribble of water. A second set of nozzles were mounted on the back side of the boom and utilized high volume flat fan nozzles. The purpose of this set of nozzles was to wash any nematodes off of the alfalfa foliage and provide extra wetting of the soil surface to facilitate nematode entry into the soil. Two 50 gallon spray tanks were mounted in the truck bed with one tank used for nematode application and the second tank used for the “rain storm”. Pressure to the two set of nozzles by four 12 V pressure pumps rated at 5 gpa. Two pumps were hooked in parallel to each tank to provide pressure to each set of nozzles. The spray system was powered by the pickup electrical system and was controlled by a switch panel located in the cab of the truck.

Nematodes (100 million) were applied to the field in four strips across the grain of the field. In this manner, any tillage of the field would help to distribute the nematodes from the strips along the length of the field. Each application strip was approximately 24 ft wide (3 truck passes) x 200 ft long. The spray system was calibrated to apply 50 gallons of nematode laden water and 50 gallons of supplemental water over this area (ca. 12,000 sq ft of the field)

Field application of nematodes required the alfalfa to be relatively short to allow the nematode laden stream of water from the spray nozzle to easily reach the soil surface. The nematodes once applied to the soil surface, needed to penetrate the soil before dying from desiccation or UV exposure. The ideal alfalfa field for application was a field with about 6” of re-growth after cutting. The ideal time of day for nematode application was late afternoon-evening which reduced nematode mortality from UV exposure and desiccation. Field applications were focused on the time intervals following 1st and 2nd cuttings. Project leaders spent most of the month of May setting up the contacts, scouting the field locations and trying to estimate the harvest dates for individual fields so nematodes could be produced in a timely manner for application in the field.

Field applications focused on the 1st harvest were initiated during the first week of June and continued for the entire month. A total of 19 fields were inoculated during the 1st harvest interval with the field located in Jefferson and Lewis counties. Field applications targeting the 2nd harvest interval were initiated in early July and were located primarily in Franklin Co and St. Lawrence Co. A total of 17 fields were inoculated with nematodes during the 2nd harvest interval.

Table 1: Time Table of Field Applications

Lewis County	**Jefferson County**	**St. Lawrence County**	**Franklin County**
June 5 – 3 fields	June 12 – 1 field	July 30 – 6 fields	July 23 – 4 fields
June 11 – 4 fields	June 25 – 1 field	July 31 – 3 fields	July 24 – 4 fields
June 12 – 1 field	June 26 – 3 fields		
June 18 – 3 fields			
June 19 – 3 fields			
June 25 – 1 field			

Table 2: Breakdown of Producer Location and Number of Fields

Lewis County	**Jefferson County**	**St. Lawrence County**	**Franklin County**
15 fields	5 fields	9 fields	8 fields
7 Producers	5 Producers	4 Producers	5 Producers

Nematodes were successfully established in all fields in which they were applied. Experimental results from the Peck farm in past years, indicated that snout beetle could be effectively controlled using one of three different combinations of nematodes species. To test these results on a larger scale, different nematode combinations were selected for field sites in different counties. The three different nematode combinations were 1) *S. carpocapsae x H. bacteriophora,* 2) *S. carpocapsae x S. feltiae* and 3) *S. feltiae x H. bacteriophora.* In all cases, there were high levels of establishment of *S. carpocapsae* and *S. feltiae* regardless of the nematode combination and environmental conditions. In contrast, establishment of *H. bacteriophora* was variable across field sites and at a much lower level than desired. *H. bacteriophora* appears to be more sensitive to a wide array of environmental conditions during application in the field than the other two nematode species. Reasons for the variable establishment of *H. bacteriophora* is still being examined and analyzed.

Conclusions/Outcomes/Impacts. The opportunity to blend funds and research/demonstration efforts from both the NNYADP and NYSFVI program together during 2008 allowed us to make tremendous strides toward the development of a production/application system which is technological feasible for adoption by commercial applicators and farmers themselves. These advances will allow the rearing and application of nematodes to move from the university research setting into the “real world” where biocontrol nematodes can be applied to infested fields across the infested counties at an intensity desired by individual farmers.

Our goal in the next two years is to work closely with both interested commercial applicators and interested individual farmers to teach them nematode rearing, and nematode application techniques. We hope to work with all interested individuals. In any biological system, quality control is an important issue. During our transition toward farmer/industry nematode rearing and application, we plan to use our soil bioassay procedure to verify successful field applications of nematodes by each individual. Our efforts to apply nematodes to 17 commercial fields reinforced the importance of three factors: 1) Nematode applications need to be applied during the evening hours due to their sensitivity to UV. 2) The amount of alfalfa regrowth in a field is important. A greater level of regrowth provides an increased level of soil surface shading and provides a higher level of protection for the nematodes while they are penetrating the soil. 3) Chlorinated water needs to be avoided at farms when filling water tanks for nematode applications.

There are still many unanswered questions about the long-term persistence of these biocontrol nematodes under the widespread soil conditions and various crop rotation plans common across the nine snout beetle infested counties. These questions need to be addressed in the near future for the biological control of snout beetle with entomopathogenic nematodes to be successful on a large scale.

Outreach:

National-Regional News Coverage:

Due to the efforts of Kara Dunn, NNYADP publicist, the story of alfalfa snout beetle, its devastating impact on NNY alfalfa and promising research progress was brought to the attention of an AP reporter who wrote an article for the AP wire. This article about snout beetle was widely distributed and printed in papers throughout the Northeastern region of the US and was even published in papers in Florida. The long-term support of NNYADP was mentioned in the article.

Professional Popular Journals:

With the infested area of alfalfa snout beetle in North America limited to nine New York counties and a small area in the providence of Ontario, Canada, many government officials in USDA and other entomologists are unaware or poorly informed about this serious insect. In an effort to educate these important groups of professionals, an article was written about the history of snout beetle along with current research progress and submitted for publication in the American Entomologist. This article with color pictures has been accepted for publication. The American Entomologist is a general interest publication which is widely read by entomologists, including individuals in USDA and APIS.

Extension Outreach:

March 2008: Update on the Biological Control of Alfalfa Snout Beetle and the Effort to Develop Snout Beetle Resistant Alfalfa. Presented in Madras and Carthage.

October 2008: Talk segment about Alfalfa Snout Beetle Damage, Biological Control and Resistant Alfalfa Development. Agribusiness Dealer Meetings and presented in four locations across the state.

March 2009: Snout Beetle Updates planned for Miner Institute, Madras and Carthage.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. The next logical steps are to expand the program into Clinton and Essex counties and to begin the movement of the program into the private sector. With a new snout beetle infestation identified in east-central Clinton Co. and the continued spread of the insect throughout Essex county, nematode establishment within infested fields within each of the two counties need to be implemented. To focus on these two steps, we would like to begin two pilot programs in 2009 and 2010 focused on working with interested commercial applicators and individual producers on the production and application of the biological control nematodes. In addition, we would like to expand our "key field" nematode application program into the infested areas of Clinton and Essex counties.

One area of research which has been neglected due to funding levels and priorities set by NNYADP is the longer term questions regarding the persistence on the biocontrol nematodes across a corn rotation. Most of our experience with these nematodes as successful persistent biocontrol agents for snout beetle has been under continuous alfalfa production conditions. We have little understanding about the persistent of the biocontrol nematode across a rotation of other crops. Insects which feed on the roots of the grass within the alfalfa field serve as alternate host for the nematodes to maintain the nematode populations in the field. However, the soil population of alternate insects declines when the field site is rotated to crops such as corn. Questions arise whether the soil population of nematodes remain high enough during the corn portion of the rotation to rebound during the alfalfa portion of the rotation to a level where invading snout beetle are controlled. If not, nematodes may have to be reapplied to the field after the corn portion of the rotation.

Acknowledgments. This research has been supported in part by Northern New York Agricultural Development Program and the New York State Farm Viability Institute. Additional support has been provided by Cornell University College of Agriculture.

Reports and/or articles in which the results of this project have already been published. Since this project has been jointly funded by both NNYADP and NYSFVI, quarterly reports about the progress of this project has been filed with NYSFVI.

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

Mark Akins
296 Five Mile Rd
Lisbon, NY 13658
318.393.0813

Jim Armstrong
County Route 31
Lisbon, NY 13658
315.393.5468

Peter Braun
Woodcrest Dairy
Wood Road
Lisbon, NY 13658
315.323.0635

Real Choiniere
327 Goodman Road
Malone, NY 12953
518.483.7791

Jerome Demko
Demko Farms
6329 State Road 26
Lowville, NY 13367
315.523.2556

Dick Eakins
Carolyn McNamara
Malone Garden Apts.
75 Pleasant St.
Malone, NY 12953
518.483.0307

Bernie Gohlert
Hilltop Farm
6928 State Route 26
Lowville, NY 13367
315.486.4430

David Haldeman
3349 NYS Rt. 26
Carthage, NY 13619
315.493.2076

John Hansen
22000 Co. Rt. 47
Carthage, NY 13619
315.286.5052

Mark Karelus
7013 State Rt. 26
Lowville, NY 13367
315.376.6453

Michael Kiechle
34764 Garden of Eden Rd
Philadelphia, NY 13673
315.778.8110

Scott Loomis
Ridge Road
Waddington, NY 13694
315.212.1696

Steven McKnight
River Breeze Farm
54 McKnight Road
Chase Mills, NY 13621
315.322.4424

David Moore
3107 State Route 11
Malone, NY 12953
518.483.1079

Andrew Moser
Moserdale Farm
3755 Wilson Road
Copenhagen, NY 13626
315.783.5214

Mervin Moser
Village View Farm
4928 State Rt. 410
Castorland, NY 13620
315.783.9557

Lynn Murray
Muscrest Farms
31721 NYS Rt. 12
Copenhagen, NY 13626
315.771.2241

John Peck
24082 Co. Rd. 47
Carthage, NY 13619
315.493.3191

Eugene Poirier
159 Taylor Road
North Bangor, NY 12966
518.483.6696

Peter Poupore
385 White Road
Malone, NY 12966
315.296.5476

“Skip” Putney
382 Five Mile Line Rd.
Lisbon, NY 13658
315.393.5652

Douglas Shelmidine
Sheland Farms
12043 Co. Rt. 79
Adams, NY 13605
315.846.5640

Gary Sullivan
3769 Deer River Rd.
Carthage, NY 13619
315.921.4375

Merle Yancey
Yancey Farm
5456 Trinity Ave.
Lowville, NY 13367
315.783.1987

Roger Zehr
9616 East Road
Lowville, NY 13367
315.376.4284

Northern NY Agricultural Development Program
2008 Project Report

Project Title: **Breeding Alfalfa Snout Beetle Resistant Alfalfa Varieties**

Project Leader(s):

D.R. Viands, Professor, Department of Plant Breeding and Genetics; 523 Bradfield Hall; Cornell University; 607-255-3081; drv3@cornell.edu

E.J. Shields, Professor, Department of Entomology; 4144 Comstock Hall; Cornell University; 607-255-8428; es28@cornell.edu

J. Crawford, 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

J. Hansen, Sr. Research Associate, Department of Plant Breeding and Genetics; 101 Love Lab; 607-255-5043; jlh17@cornell.edu

E. Thomas, Research Support Specialist, Department of Plant Breeding and Genetics; 101 Love Lab; 607-255-5043; emt3@cornell.edu

Collaborator(s):
Chuck Burnett, Seed producer, Nampa, ID.
Mike Hunter, Extension Educator in Jefferson County, worked with growers to identify a field site for a new trial established in spring 2008.

Cooperating Producers: Alfalfa snout beetles were collected along the roads closest to farms owned by John Peck and Howard Keefer in Carthage, NY._The alfalfa trial was planted on land prepared and owned by Doug Shelmidine, Sheland Farms in Adams, 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 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. Until now, there have been no effective methods of controlling this destructive insect pest. We have been working on two strategies to reduce the insect populations and plant damage to manageable levels. These strategies are 1) breed alfalfa with resistance to the insect and 2) identify and establish in NNY biological control organisms from the native home of ASB. The success of the second strategy is described in another NNYADP report. This report addresses the first strategy.

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 selection breeding program 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 have been 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 was 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 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: During this past year, we completed the fifth or sixth cycle of selection for resistance in 16 alfalfa populations. 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 more than 130,000 plants have been evaluated for resistance to ASB. About 27,000 plants were evaluated in 2008.

From seed increases in Idaho of six alfalfa populations from the ASB breeding program, 12 plots of each population were seeded on April 21st at Adams NY (plot size 3.5 x 20 feet). The populations seeded were three unselected populations and three selected populations (four cycles of selection for resistance to ASB in the greenhouse), such that progress from selection could be evaluated under field conditions. Field conditions at the time of seeding were excellent, and the field area outside of the trial was seeded by the producer at the same time that we seeded our trial. Alfalfa snout beetle adults were just beginning to emerge when the trial was seeded. The trial was sprayed with pesticides to control weeds and potato leafhoppers on July 2nd and was mowed off on August 1st.

Results: The trial was surveyed on June 6th for seedling emergence. Many plots were noted to be very thin in plant stand (Table 1). It was determined that the seed germination was excellent as the ASB populations were seeded in other trials in Ithaca, and excellent stands were achieved. Some seedlings were found with circular bites in the first trifoliate leaflet, and so it may have been that small seedlings were eaten and thus killed by the ASB adults as they emerged. The producer's alfalfa stand in the same field also was thin in places.

Table 1: The average, minimum, maximum, and standard deviation in percent stand (visual estimate on September 17, 2008) of the alfalfa plots seeded in Adams NY (n=12).

Alfalfa Population	Average % Stand	Minimum % Stand	Maximum % Stand	Standard Deviation
CR - cycle 0	52	20	75	19
CR - cycle 4	48	20	75	22
Seedway 9558 - cycle 0	56	40	80	17
Seedway 9558 - cycle 4	57	30	75	18
9117 - cycle 0	64	50	85	12
9117 - cycle 4	52	20	80	19

Samples of plants from the edge of two plots per population were dug in the fall and roots examined. Only a few roots had any ASB feeding damage.

Conclusions/Outcomes/Impacts: As stated in previous reports, the significant progress from selection in the greenhouse provides the first real hope that we can develop alfalfa varieties with resistance to ASB. We anticipate that 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.

We do not yet know if the resistance levels achieved thus far are sufficient to protect the alfalfa crop in fields with ASB. Current and future field experiments will provide this information, but we are continuing selection to enhance the resistance levels.

Since the plant stand in the field trial is thin, this trial will not be useful for yield estimates; rather it will be used for root damage ratings of the alfalfa populations next year.

Outreach: Updated progress on this research was reported to extension educators and seed company representatives during a field day presentation last summer. During annual meetings with seed companies closely associated with our program, the seedsmen expressed very strong interest in a new alfalfa variety with resistance to alfalfa snout beetle.

Next steps if results suggest continued work is needed.

Selection: Although progress from selection already has been realized, we will try to increase the resistance levels by continuing selection in the plant populations under controlled conditions in Ithaca.

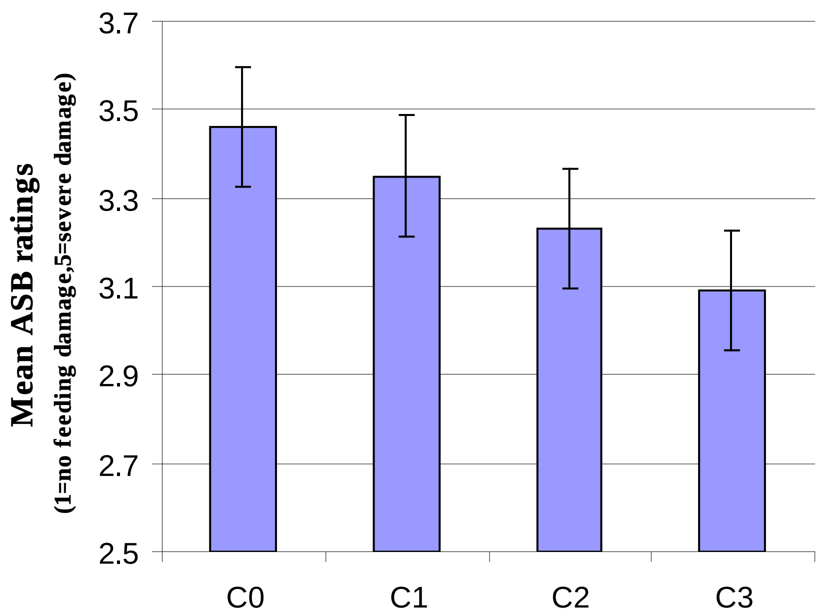
Field Experiment: During spring 2009, a second field experiment will be established with some of the same alfalfa populations as the first experiment and with more advanced populations selected for higher levels of resistance to ASB. This experiment will provide information to determine if resistance in the greenhouse translates to resistance in the field, and the level of resistance needed to adequately protect the alfalfa crop. The trial will be planted after the risk of adult ASB feeding so that the seedlings will become well established.

Acknowledgments: Funding support from Northern New York Agricultural Development Program and the Cornell University Agricultural Experiment Station (Hatch Multistate Project NE-1010)

Person(s) to contact for more information:

Donald R. Viands; Cornell University; Department of Plant Breeding and Genetics; 523 Bradfield Hall; Ithaca, NY 14853-1902. 607-255-3081; drv3@cornell.edu; http://plbrgen.cals.cornell.edu/people/profiles/viandsdonald.cfm

Base Population Cycle 1 Cycle 2 Cycle 3



Figures 1 and 2. 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 h

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Production and evaluation of perennial grasses for energy conversion in Northern NY**

Project Leader(s): D.R. Viands, Professor, Department of Plant Breeding and Genetics; 523 Bradfield Hall; Cornell University; 607-255-3081; drv3@cornell.edu

J. Hansen, Sr. Research Associate, Department of Plant Breeding and Genetics; 101 Love Lab; Cornell University; 607-255-5043; jlh17@cornell.edu

H. Mayton, Extension Associate, Department of Plant Breeding and Genetics; 101 Love Lab; Cornell University; 607-255-5043; hsm1@cornell.edu

Collaborator(s): Michael H. Davis, Research Associate, Department of Crop and Soil Sciences, Cornell University; and Farm Manager, Cornell Baker Research Farm, Willsboro, NY, 518-963-7492, mhd11@cornell.edu.
Mike Hunter (Jefferson Co. Extension) meh27@cornell.edu

Cooperating Producers: Miner Institute, Clinton County, NY; Belleville Central School District, Jefferson County, NY

Background: The close proximity of agricultural land in the Northeast to major population and transportation centers makes this region ideal for development of bioenergy crops and industrial bi-products from energy conversion processes. Corn grain is the most widely used bioenergy crop for ethanol production in the Midwest. Grasses and legumes, used as feedstock for biofuel, have the potential to be more economical and environmentally sustainable than corn-ethanol production. Perennial grasses reduce greenhouse gas emissions and soil erosion by sequestration of carbon from the atmosphere and through production of an extensive root system.

Switchgrass (*Panicum virgatum* L.) has been selected as a model biofuel feedstock crop by the United States Department of Energy (DOE) due to its native geographic distribution and high biomass production. However, the majority of research conducted on switchgrass for the DOE was done in the Midwest where management practices and environmental conditions differ from those in Northeast. Thus, data obtained in the Midwest trials may not reflect how the perennial grass will perform in New York. Since yield is highly influenced by environmental conditions, we feel it is important to evaluate these grasses in as many bioregions of New York as possible.

In 2007, our research group was funded by the Northern New York Agricultural Development Program (NNYADP) to evaluate perennial grasses as a feedstock for biofuel production. In addition to the funds from the NNYADP, our group also received funding for biofuel production trials by the New York Farm Viability Institute (NYFVI).

In the spring of 2007, a cultivar evaluation trial with six replicates of 20 monoculture and 4 mixed plots of warm season grass species was planted in Jefferson County. An additional 12 field trials (five strip trials, seven replicated small plot evaluation trials) consisting of both monoculture and mixed species stands of several switchgrass and big bluestem cultivars, and other warm and cool season species were established in 2007. The perennial grass trials were planted in five diverse regions of New York. Through funding from this project both warm and cool season perennial grass trials were planted in the eastern region of Northern NY to determine which species and cultivars will generate the maximum biomass production. The goals are to identify high yielding and adapted grass species and cultivars that can be harvested in an efficient and timely manner and used for conversion to liquid fuels, gases and combustible products. Identification of these grass species and cultivars in NNY will benefit current and potential producers in the region by providing information on which grasses to establish for dedicated bioenergy production.

Methods: Replicated warm and cool season perennial grass trials were established on the 9th of May at the Miner Institute in Clinton County, NY. Plots for both trials (3.5 ' X 15 ') each with six rows spaced six inches apart, were established in a randomized complete block design with six replications. Seed of the various trial entries (Table 1) were planted with a Carter (Carter Manufacturing Co., Brookston, ID) small plot seeder. For the warm season grass trial, 20 trial entries were planted in monoculture and four entries consisted of a mixture of two different grass species (Table 2). Seven trial entries of four cool season grass species (Tables 3 and 4) were established in the cool season grass trial. Both fields were plowed and fertilized (300 lb/A 10-20-20) before seeding. Data were collected on % stand and height for the warm season grasses. Yield data were collected from the cool season grasses harvested on a two-cut schedule (July 15 and September 2).

Results: A first year stand of 40% or more has been reported to indicate successful establishment of warm season grasses. By this criterion, all of the grass species/cultivars had acceptable stand establishment (Table 5). The eastern gamagrass cultivar Pete and big bluestem Goldmine had the lowest stands (50 % and 67 %, respectively). The overall average stand establishment for the warm season grasses in trial was 83%. This is significantly higher than the average percent stand (62%) observed in the trial located in Jefferson County planted in 2007. The switchgrass cultivars Blackwell, Shelter, and Forestburg, had the highest 1st year stands (Table 5). The rankings are consistent with data regarding stand establishment of other warm season grass trials planted at various locations in New York State in 2007. Big bluestem cultivars and other warm season grass species did not establish as well as the majority of switchgrass cultivars. In terms of overall growth measured by canopy height, the switchgrass cultivars Cave-in-rock, Blackwell and Pathfinder performed well. There was significant weed pressure in the warm season grass trial, but this did not appear to inhibit overall stand establishment. Cool season grasses were the most prevalent type of weed in the plots. Incidence of disease was less than 5% for all grass cultivars.

The two cool season perennial bromegrass cultivars Peak and York had the highest first harvest yields (Table 6), followed by the reed canarygrass and the two fescue cultivars. The lowest yielding entries were Jose and Largo wheatgrass (Table 6). The two tall fescue cultivars had the highest 2nd harvest yields (Table 6) and also the highest total yields at 2.9 and 2.9 dry tons/acre, respectively. Cool season grass stands did not have any significant weed pressure, presumably since weeds were controlled in the corn crop the previous year and the cool season grasses grew quickly enough to shade out many competing weed seedlings.

Conclusions/Outcomes/Impacts: Purchasing and planting good quality seed is critical to successful establishment of warm-season grasses. Also, producers should correct seeding rates for percent pure live seed, as each seed lot will vary in the amount of inert material in the seed bag. A quick germination test can be done to check seed quality. The protocol for this test can be downloaded from our project web-site (nybiofuels.info). Establishment of the warm season perennial grasses without the use of post-emergent herbicide applications resulted in plots with heavy weed pressure, yet good stands of the grasses were obtained in most cases. Competition with annual and perennial weeds is a common problem that has been reported in the literature in establishment years for warm season perennial grass field trials. Results from these trials will be compared with trials established in other regions of the state. A few of the warm season grass cultivars have been reported to have problems with winter survival. As a result, stand and yield data in 2009 may have different rankings from the trials in NNY than from other locations.

The mean dry tons/acre was lower from the cool season grass trial harvested at the Miner Institute (2.38) than the trial in Ithaca (5.0) in 2007. This difference was mostly due to the lack of nitrogen applied on grass regrowth at the Miner Institute.

Data from these trials already are providing information that is useful in establishing best practices for growers to obtain good stand establishment and higher biomass yields. Data to be collected in the next few years will provide even more useful information.

Outreach: Information and data from this research trial was reported to extension educators at the Agriculture-Food-In-Service meeting in Ithaca, NY, held during the second week of November 2008. A field day was held in St. Lawrence County on the farm owned and operated by Tom Lee August 12, 2008, where a strip trial of perennial warm season grasses was established in 2007. Through personal conversations with producers attending the field day in St. Lawrence County, it was understood that the information provided was helpful for their future plans in planting these types of grasses. Because the warm season grasses take three years to produce a mature stand, we did not schedule a field day at the Miner Institute in 2008, but we plan to do so in 2009.

Some information relating to these trials and others in NNY have been reported in newspaper articles and news stories (please see appendices for a list of articles, press releases and news coverage relating to the research in NNY on grass for use as bioenergy feedstock).

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. Research on seed quality, germination and dormancy in relation to successful stand establishment is necessary to make gains in production of these grasses. Analysis of biomass harvested from these trials for quality characteristics of economic significance such as quantity and type of cell wall sugars, theoretical ethanol yield, ash and mineral content, and total BTU's are currently underway. Yield data of the warm season grasses established in the 2008 trial at the Miner Institute should be collected in 2009.

Acknowledgments: This project was funded by the Northern New York Agricultural Development Program and the Cornell University Agriculture Experiment Station. Salaries for summer technicians working on the trials were also funded in-part by a grant from the New York Farm Viability Institute.

Reports and/or articles in which the results of this project have already been published. Data from these trials have been reported in the 2008 Forage Breeding Project Annual Databook produced by the Forage Breeding project at Cornell University.

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

Hilary Mayton hsm1@cornell.edu; Julie Hansen jlh17@cornell.edu; and Donald Viands drv3@cornell.edu; Cornell University; Department of Plant Breeding and Genetics; 523 Bradfield Hall; Ithaca, NY 14853-1902. 607-255-5043; http://plbrgen.cals.cornell.edu/people/profiles/viandsdonald.cfm; Mike Hunter Cornell Cooperative Extension meh27@cornell.edu; Michael H. Davis, Research Associate, Department of Crop and Soil Sciences, Cornell University; and Farm Manager, Cornell Baker Research Farm, Willsboro, NY, 518-963-7492, mhd11@cornell.edu.

Photos

Warm season perennial grass trial

Clinton County, Miner Institute 2008

Jefferson County News 10 Now interview
with Extension Associate Hilary Mayton

Appendices

Table 1. Common and scientific names of warm season perennial grasses established in small plot trials at the Miner Institute, Clinton County, NY.

Common name	**Species**
big bluestem	*Andropogon gerardii*
coastal panic grass	*Panicum amarulum*
eastern gamagrass	*Tripsacum dactyloides*
indiangrass	*Sorghastrum nutans*
switchgrass	*Panicum virgatum*

Table 2. Cultivar, common name, % pure live seed (PLS), seed tag label % quick germination, and seeding rate of perennial grass entries in cultivar evaluation trials.

Cultivar	Common name	% PLS*	% Seed tag quick germination	Seeding Rate lb PLS/A
Bonanza	big bluestem	72	80	12
Goldmine	big bluestem	56	68	12
Niagara	big bluestem	22	74	12
Pawnee	big bluestem	63	68	12
Atlantic	coastal panic grass	87	88	8
Pete	eastern gamagrass	84	30	10
Rumsey	indiangrass	86	78	10
Nebraska 54	indiangrass	92	67	10
Blackwell	switchgrass	86	31	10
Carthage	switchgrass	94	51	10
Cave-in-rock	switchgrass	95	71	10
Cave-in-rock***	switchgrass	95	37	10
Forestburg	switchgrass	77	21	10
Kanlow	switchgrass	93	86	10
Pathfinder	switchgrass	74	16	10
Shawnee	switchgrass	93	93	10
Shelter	switchgrass	86	22	10
Sunburst	switchgrass	98	98	10
Trailblazer	switchgrass	93	83	10
Nebraska 28	switchgrass	92	92	10
Cave-in-rock	Switchgrass	95 72	37	5
Bonanza	big bluestem		80	6
	Switchgrass	98 22	98	5
Sunburst Niagara	big bluestem		74	6
	Switchgrass	95 84	37	5
	eastern		30	5
Cave-in-rock Pete	gamagrass			
Niagara Pete	Big bluestem	22 84	74	6
	eastern gamagrass		30	5

* % Pure live seed (PLS)

** Actual seeding rate is corrected for quick germination rate.

*** Cave-in-rock seed for this entry was stratified before planting

Table 3. Common and scientific names of warm cool season perennial grasses established in small plot trials at the Miner Institute, Clinton County, NY.

Common name	Species
wheatgrass	*Thinopyrum ponticum*
tall fescue	*Festuca arundinacea*
Reed canarygrass	*Phalaris arundinacea*
Brome grass	*Bromus inersis*

Table 4. Cultivar, common name, % pure live seed (PLS), seed tag label % quick germination, and seeding rate of perennial grass entries in cultivar evaluation trials.

Cultivar	Common name	Seeding Rate lbs /Acre
Jose	wheatgrass	40
Largo	wheatgrass	40
Enhance tall fescue	tall fescue	20
Bull tall fescue	tall fescue	20
Bellevue	reed canarygrass	20
Peak	brome grass	20
York	brome grass	20

Table 5. Cultivar, common name, height of canopy (two dates), seed height and % stand of perennial warm season grasses established at the Miner Institute, Clinton County, May 8, 2008.

		9/3/2008	9/30/2008		6/30/2008
Cultivar	**Common name**	**Height**	**Canopy Height**	**Seed Head Height**	**% Stand**
		- - - - - - - - - - - -	**inches**	- - - - - - - - -	
Bonanza	big bluestem	30	29	54	81.67
Goldmine	big bluestem	15	30	66	66.67
Niagara	big bluestem	28	26	45	80.83
Atlantic	coastal panic grass	30	34	-	78.33
Pete	e.gamagrass	32	34	-	50.00
Blackwell	switchgrass	30	40	53	90.83
Carthage	switchgrass	35	39	44	81.67
Cave-in-rock	switchgrass	34	43	52	85.83
Cave-in-rock	switchgrass	32	43	56	89.17
Forestburg	switchgrass	25	34	49	90.83
Kanlow	switchgrass	46	34	34	85.83
Pathfinder	switchgrass	30	44	56	88.33
Shawnee	switchgrass	30	40	53	83.33
Shelter	switchgrass	30	40	52	90.00
Sunburst	switchgrass	26	37	48	87.17
Trailblazer	switchgrass	30	41	57	88.33
Nebraska 54	indiangrass	34	34	41	85.00
Nebraska 28	switchgrass	26	39	50	84.17
Rumsey	indiangrass	32	32	32	79.17
Pawnee	big bluestem	24	34	55	80.83
Mixtures-1a	Cave-in-Rock/Bonanza	35	40	54	85.83
Mixtures-2a	Sunburst/Niagara	30	35	54	83.33
Mixtures-3a	Cave-in-Rock/Pete	40	37	49	89.17
Mixtures-4a	Niagara/Pete	36	30	56	75.00
				Trial Mean	82.56
				F-entry	19.77**
				LSD (.05)	5.60
				CV (%)	5.9

** Significant at 0.01
% Stand based on visual rating

Table 6. Cultivar yield of perennial cool season grasses established at the Miner Institute in 2008, harvested in a two-cut system.

Cultivar	15-Jul	2-Sep	Total Season
	- - tons per acre dry matter - -		
Jose Wheatgrass	0.70	0.87	1.57
Largo Wheatgrass	0.91	1.00	1.91
Enhance Tall Fescue	1.22	1.57	2.79
Bull Tall Fescue	1.35	1.59	2.94
Bellevue R. Canarygrass	1.39	0.86	2.24
Peak Brome	1.72	0.86	2.58
York Brome	1.69	0.93	2.62
Trial Mean (T/A)	1.28	1.10	2.38
F-entries	21.11**	23.55**	24.58**
LSD (.05)	0.24	0.20	0.29
CV (%)	15.7	15.4	10.3

Note:
** Significant at 0.01

Media Hits and Public Outreach for Perennial Grass/Bioenergy Research in NNY

Media Hits

The following media outlets printed or aired stories on grass-based agriculture research in NNY – grass as a feedstock for animal agriculture and for bioenergy production.

10-01-08	Empire State Farmer: Belleville-Henderson trials
Sept 2008	Country Folks Grower
Sept 2008	American Agriculturist: Tom Lee
08/25/08	Country Folks
08/13/08	Watertown Times Online
08/13/08	TV 7 WWNY TV
August 08	North Country Public Radio: Switchgrass Field Day
07/29/08	Watertown Times: Switchgrass Field Day
07/27/08	Sunday Advance News (St Lawrence County): Switchgrass Field Day
07/27/08	Hay & Forage Grower: Switchgrass Field Day
06/27/08	News 10 Now
June 2008	Grassroots
05/21/08	Empire State Farmer
05/19/08	Country Folks
05/15/08	American Agriculturist
05/14/08	Hay & Forage Grower
09/17/07	Country Folks
09/17/07	renewablenergyaccess.com
09/05/07	Cornell Chronicle
08/31/07	Lowville Journal
August 07	Absolutely Business Magazine
07/02/07	Country Folks: Belleville-Henderson trials
July 2007	Cornell Cooperative Extension of Jefferson County Ag News
06/20/07	Empire State Farmer: St. Lawrence County trials
06/17/07	TV 7 WWNY TV 6 and 11 pm News: St. Lawrence County trials
06/15/07	Farmer's Friend
06/14/07	Watertown Times: St. Lawrence County trials
06/13/07	News 10 Now: St. Lawrence County trials
June 2007	Cornell Cooperative Extension News
06/11/07	Country Folks: St. Lawrence County trials
06/11/07	NY Farm Bureau requested info and photos
06/11/07	Jefferson County Ag News Flash
03/26/07	Watertown Times: Belleville-Henderson trials

Press Releases

The following press releases, issued by the Northern New York Agricultural Development Program and the NY Farm Viability Institute, put a spotlight on grass research in NNY.

May 10, 2008
Grass for Energy Research Expanded in NNY

February 15, 2008
NNY Agricultural Development Program Announces 22 Grant Projects for 2008

June 11, 2007
North Country Farmers Switching to Grass as Energy, Livestock Feed Crop

May 30, 2007
Evaluating Grasses as Bioenergy Crops: New Plantings at Belleville-Henderson School Among Those In & Planned for NNY

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Developing New Cropping System Options for Organic Grain Production in Northern New York**

Project Leader: Michael H. Davis (mhd11@cornell.edu), Cornell University Willsboro Research Farm

Collaborators:Jerry Cherney (jhc5@cornell.edu), Cornell University
Anita Deming (ald6@cornell.edu), Cornell Cooperative Extension of Essex County

Background: Organic grain production is one strategy that farmers can adopt to diversify their operations, and the amount of acreage committed to organic field crop production in northern New York has increased significantly in recent years. In 1993, six acres on the Cornell University Willsboro Research Farm were set aside for organic field crop production studies. The six acres were divided into ten equal blocks, and two five-year rotations were established on these blocks.

Wheat Rotation: The first rotation to be developed consisted of one year of spring wheat, one year of winter wheat, and three years of alfalfa/timothy hay. Spring and winter wheat were chosen as the grain components in the first rotation because Champlain Valley milling, a specialty organic flour mill located in Westport, NY, provided a regional market for organically grown bread wheat. Three years of alfalfa/timothy sod played a critical role in sustaining the soil health in the system as the alfalfa fixed nitrogen, and the fibrous timothy roots added organic matter and improved soil tilth. Given that many area farms were already producing hay, we believed that the incorporation of one or two years of small grains into the rotation would be a profitable way for farmers to diversify their operations. The wheat rotation has been maintained for the past fifteen years. In 2008, we coordinated with Susan Monihan, a graduate student working with Dr. Sid Bosworth at the University of Vermont (UVM), to establish an organic fertilizer and variety study on the winter wheat block of the rotation.

New Crop Rotation: The purpose of the 'New Crop' rotation was to develop and test organic production methods for alternative grain crops that could potentially be grown in northern New York. As with the organic wheat rotation, a two to three year period of alfalfa/timothy sod forms the heart of the rotation. Several alternative grain crops have been inserted into the 'New Crop' rotation including food-grade soybeans, sweet corn, sunflowers, dry beans, flax, and grain amaranth. Flax, grain amaranth, and food-grade soybeans were produced in 2008.

2008 Objectives

- Ø Advance the spring wheat-winter wheat-alfalfa/timothy rotation ahead one year
- Ø Repeat the flax variety/topdressing trial
- Ø Substitute grain amaranth for sunflowers in the second rotation, and develop an organic crop production system for grain amaranth
- Ø Replace the dry bean plots with an organic food-grade soybean variety trial

Results

***Organic Wheat Rotation*:** The organic wheat rotational sequence was maintained in 2008. Field activities in each of the five blocks are listed below.

Field block	Date	Activity
12-O-1	7/3/08	Chopped off hay
	8/21/08	Chopped off hay
	8/30/08	Plowed down alfalfa/timothy sod -- Start fall fallow period in preparation for seeding wheat in spring 2009
12-O-2	7/3/08	Chopped off hay
	8/21/08	Chopped off hay
12-O-3	4/25/08	Planted alfalfa (12#/a) + timothy (6#/a)
	8/21/08	Chopped off weeds
12-O-4	8/21/08	Combined winter wheat experiment
	8/25/08	Chopped straw
	8/30/08	Moldboard plowed in preparation for seeding alfalfa/timothy spring 2009
12-O-5	4/17/08	Planted *Profit* hard red spring wheat @ 150lbs/a rate
	8/18/08	Combined spring wheat
	8/25/08	Chopped straw
	8/30/08	Moldboard plowed
	9/10/08	Disced and dragged in preparation for seeding winter wheat trial
	9/19/08	Planted winter wheat experiment

University of Vermont researchers established a winter wheat variety/fertilizer experiment in the winter wheat block (12-O-4) in 2008. Three hard red winter wheat varieties (*Zorro*, *Harvard*, and *Maxine)* were evaluated. Organically acceptable fertilizer treatments included 12 ton/acre UVM compost, 10.4 tons/acre cow manure, 3.2 tons/acre Giroux Poulty chicken manure compost, Chilean Nitrate -- split application with 156 lbs/acre applied prior to planting and 156 lbs/acre applied pre anthesis in the spring, Chilean Nitrate – split application with 156 lbs/acre applied prior to planting and 156 lb/acre applied post anthesis, and a control. The trial will be repeated in field block 12-O-5 in 2009.

Organic Flax Production: Flax trials were conducted on *New Crop* rotation blocks 12-O-6 in 2006, 12-O-9 in 2007, and 12-O-10 in 2008. All fields had a Rhinebeck clay loam soil with subsurface drainage.

2006: Untreated seed for five flax varieties was obtained from the Flax Institute at North Dakota State University. The variety trial employed a randomized complete block design with six replications. Plots were 10' wide, 20' long, and planted at a 7" row spacing. Target seeding depth was 1", and the seeding rate was 56 lbs/acre (1 bu/acre). Three tons per acre composted chicken manure and 500 lbs/acre granulated organic fertilizer (North Country Organics 5-3-4) were applied to the field in 2005. No additional fertilizer was applied. The 2006 trial was planted May 8 and harvested October 10.

2007: Six flax varieties were included in the 2007 trial, which followed a plowed down alfalfa/timothy sod in the rotation. Additionally, a topdress fertilizer treatment was incorporated into the study. Fertilized plots received a 500 lb/acre broadcast application of OMRI approved *Northcountry Organics 5-3-4 Pro Gro* granulated fertilizer ten days after crop emergence. A split plot experimental design with four replications was used with the topdress application as the whole plot treatment, and variety as the split plot treatment. Plot size, seeding rate, row spacing, and target planting depth were the same as in 2006. The 2007 trial was seeded May 25 and harvested October 5.

2008: The 2008 trial was a repeat of the 2007 experiment. The plots followed a plowed down alfalfa/timothy sod in the rotation. Six flax varieties were evaluated with and without a topdress fertilizer treatment in the spring. Fertilized plots received a broadcast application of OMRI approved *Northcountry Organics 5-3-4 Pro Gro* granulated fertilizer sixteen days after planting. A split plot experimental design with four replications was employed. The topdress application was the whole plot treatment, and variety was the split plot treatment. Plots were 10' wide, 30' long, and planted at a 7" row spacing. Target seeding depth was 1", and the seeding rate was 56 lbs/acre (1 bu/acre). The 2008 trial was seeded May 29 and harvested October 8.

The **2008** flax trial had extensive weed populations that greatly reduced flax yields and made it impossible to test for treatment effects. The overall trial mean yield for those plots that were harvested was 442.9 lbs/acre, markedly less than either the 2006 or 2007 organic flax trials (Table 1). Weed problems in the 2008 trial may have been largely a function of the weather patterns during the season. Weed control for the flax trials depend on a late season summer fallow period the previous year, and a stale seedbed in the spring. May, 2008 was dry with a monthly rainfall total of only 0.28" (Table 3). As a result of the dry weather, the spring stale seedbed failed to flush out significant numbers of annual weeds. Rainy weather arrived just after the flax trial was planted at the end of May, and large numbers of weeds germinated along with the crop. Once the crop has emerged, there are no proven organic weed control options for flax. Flax is a very poor competitor with weeds, and many of the plots were a total loss. In retrospect, once it was clear that the weed populations had taken hold, the whole field block should have been plowed under to eliminate the potential for weed seed development and dispersal.

Organic Grain Amaranth Production

Amaranth is a broadleaf, warm season crop that has good drought tolerance. It is often characterized as a 'pseudo-cereal' because it is dicotyledonous. The grain is high in the amino acid lysine, and there is significant demand for amaranth in certain specialty markets. Acreage devoted to grain amaranth has actually decreased in recent years as the high prices paid for corn, soybeans, and small grains have prompted many growers to move away from alternative grain crops. 2008 was our first year growing grain amaranth organically, and the effort can best be categorized as a learning experience.

Grain amaranth (*Amaranthus cuentus*) replaced sunflowers in the *New Crop* rotation in 2008. The soil type was a Rhinebeck clay loam that was plowed the previous fall. Amaranth followed dry beans in the rotation. Organic seed was purchased from *Albert Lea Seeds* in Minnesota, and planted at 30" row spacings on May 30, 2008. A hand-pushed single row *Nibex* precision vegetable seeder was used, and the target seed depth was 0.5 inches.

Amaranth seed is very small (0.7-0.9 grams per 1000 seeds) and a fine, friable seedbed with good drainage and no compaction is desirable for good stand establishment. Amaranth grows poorly on wet, compacted soils. Weed control is also critical to obtaining a good crop. Nitrogen requirements are moderate, and researchers at the Rodale Institute recommend that available nitrogen levels (soil credits plus added fertilizer) not exceed 90lbs/acre. Nitrogen levels higher than 90 lbs/acre often create lodging problems. Soil temperatures between 65 degrees F and 75 degrees F are required for seed germination. Target planting depth is 0.5 inches or less, and the recommended seeding rate is 1 – 2 pounds per acre. On heavy soils, surface crusting can greatly reduce crop emergence. If surface crusting is observed, a rotary hoe can be used pre-emergence to break up the crust.

Amaranth stand establishment and weed control were poor in 2008. The seedbed was dry and cloddy at planting, and as a result it was difficult to maintain accurate seed depth placement. The cloddy nature of the soil conditions also made it difficult to ensure good soil-seed contact. The weather turned wet after planting at the end of May as the plots experienced 16 days of rain in June. While the rainy weather was presumably a positive factor for amaranth germination, it also germinated a major flush of weeds, and the perpetually wet soil conditions made it impossible to conduct mechanical weed control operations. Amaranth plants that did manage to survive among the weeds grew poorly. As a result of the poor stands, meaningful yield data could not be obtained. Mature grain heads were cut and harvested by hand on October 8 (following a killing frost), and then run through the combine in order to identify optimal combine settings for the crop.

The take home message from the 2008 trial is that a fine, friable seedbed is essential for good stand establishment, and weed control is critical. Ideally, weed pressure should be reduced prior to seeding the crop, but in situations where significant weed populations become established, the 30" row spacing should allow for additional cultivation options (weather permitting).

Organic Food-Grade Soybean Variety Trial: An organic food-grade soybean variety trial was conducted in field block 12-O-9 in 2008. Soybeans replaced dry beans in the rotation, and the results are presented in a separate 2008 NNYADP report titled *Forage Soybean Advanced Breeding Line Evaluations & Food-Grade Soybean Variety Trials.*

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. Two workshops on organic crop production were presented at the NOFA-NY winter conference in Rochester NY, January 23-25, 2008.

Acknowledgments: Organic cropping systems research was funded by a grant from the Northern New York Agricultural Development Program.

Person to contact for more information:

Michael H. Davis, Cornell E.V. Baker Willsboro Research Farm, 48 Sayward Lane, Willsboro, NY 12996. (518) 963-7492. email <mhd11@cornell.edu>

Table 1. Mean yields for flax varieties in 2006, 2007, and 2008.

Variety	2006 Mean Yields (lbs/acre)	2007 Mean Yields (lbs/acre)	2008 Mean Yields (lbs/acre)
Rahab94	654 a	1200 a	506
York	656 a	1195 a	435
Omega	739 a	1187 a	553
Nekoma	676 a	1100 a	451
Carter		1094 ab	362
Pembina	636 a	896 b	352
	LSD 0.05 = 134	LSD 0.05 = 204	

Table 2. Seed color and mean plant heights for flax varieties in the 2006, 2007, and 2008 trials.

Variety	Seed Color	2006 Mean Plant Heights (cm)	2007 Mean Plant Heights (cm)	2008 Mean Plant Heights (cm)
Nekoma	Brown	52.0 ab	73.4 a	56.9
Pembina	Brown	52.0 ab	72.0 a	62.3
Rahab94	Brown	50.2 b	66.1 b	50.8
Carter	Yellow		64.6 b	52.5
York	Brown	48.0 b	63.8 b	54.5
Omega	Yellow	54.8 a	59.0 c	52.0
		LSD 0.05 = 4.4	LSD 0.05 = 3.3	

Table 3. Monthly rainfall totals during the 2006, 2007, and 2008 field seasons.

	Monthly Rainfall Totals on the Cornell Willsboro Farm (inches)			
Year	May	June	July	August
2006	4.08	4.81	2.73	1.83
2007	1.53	1.81	4.72	0.34
2008	0.28	3.78	6.6	5.77

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Corn Hybrids for Grain and Ethanol Production in Northern New York**

Project Leader: Margaret E. Smith, Dept. Plant Breeding and Genetics, Cornell University

Collaborator(s):

Mike Davis, Research Associate, Dept. Crop and Soil Sciences
Laraine Ericson, Research Support Specialist, Dept. Plant Breeding and Genetics
Sherrie Norman, Research Support Specialist, Dept. Plant Breeding and Genetics
Judy Singer, Extension Support Specialist, Dept. Plant Breeding and Genetics

Cooperating Producers:

Jon Greenwood, St. Lawrence County
Ron Robbins, Jefferson County

Background: Corn is the primary row crop grown in northern New York (NNY), harvested from about 120,300 acres (24% of NY's total corn acreage) and providing essential feed for the dairy industry. Roughly 45,000 acres of this total were harvested as grain in 2007 – up 10,000 acres from the 2006 total and representing 37% of NNY's total corn acreage last year. With ethanol production facilities in NY now on-line, there are new grain production and marketing opportunities for NNY farmers and increased interest in corn production for grain in this region. The grain produced by corn hybrids also is a major 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 at all in the region. 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. Starch content analysis of commercial hybrids, together with information about their grain yield, provides comparative information regarding ethanol production potential that will be of use in choosing hybrids for this new corn market.

Methods: During 2008, we summarized the results of early and medium-early maturity corn grain testing done in 2007 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 12 early maturing hybrids from seed companies (1400-1900 growing degree days, 70-90 days relative maturity) and three Cornell-developed experimental hybrids in this same maturity range 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 30 medium-early maturing seed company 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). In addition, a grain sample was taken from each replication of each hybrid and analyzed for starch content, as an indicator of ethanol yield potential per unit of grain.

Results of 2007 testing were published in the 2007 Hybrid Corn Grain Performance Trials report (Plant Breeding Mimeo 2008-1) and were incorporated into the tables of recommended hybrids in the 2009 Cornell Guide for Integrated Field Crop Management (Cornell University, 2008). 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 2007 trials, which were harvested during October and November, will soon be available in the 2007 Hybrid Corn Grain Performance Trials Report (Plant Breeding Mimeo 2008-1) and will be incorporated into the tables of recommended hybrids in the 2009 Cornell Guide for Integrated Field Crop Management (to be published by Cornell University in fall 2008). Results of 2008 testing are currently in preparation for publication in the 2008 Hybrid Corn Grain Performance Trials report and are presented below.

Results: The 2008 planting season in northern New York had average or cool temperatures and was average to dry in moisture, with our corn evaluation plots planted in a timely manner between May 4 and 6. There was some early cutworm damage at Madrid. The summer months of the growing season (June through September) tended to be warmer than long-term averages at all three sites, except for slightly cooler temperatures in August at Sackets Harbor. Precipitation during this time was close to normal or a bit below, except for a period of wet weather at each location. In Chazy, this was during June and July; at Madrid the wet month was August; and at Sackets Harbor it was wet in July and August. On 18 July at Chazy, a devastating rain and wind storm with winds up to 60 mph passed through the area. Hundreds of trees (some over 4 feet in diameter) were snapped off or uprooted. The storm was highly localized and included our corn trial, resulting in shredded leaves, a lot of early root lodging, and some lost plots where trees fell on the corn. Consequently, we were unable to collect enough replications of data on four varieties in the Chazy plot to publish results for them. In general, however, all three plots looked good in September.

In October, temperatures were close to normal but precipitation was well above normal in Madrid and Sackets Harbor due in part to Hurricane Ike, which came through the area early in the month. It laid down most of the corn at Sackets Harbor, but did not cause this degree of lodging in Madrid. The 12" of snow that fell in this region in late October caused significant losses in Sackets Harbor, where many plants were already lodged. As a result, we were unable to collect enough replications of data on six varieties in the Sackets Harbor plot to publish results for them. Informal reports are that the combination of Hurricane Ike and this snowstorm caused major production losses of corn for many fields in the Sackets Harbor area, and significantly slowed harvest operations due to the extensive lodging. These two events contributed to the 25 inches of precipitation in Sackets Harbor in October (as compared to a long-term average of 18 inches).

Despite delayed harvest in many areas of the state due to slow maturity and drydown combined with difficult weather conditions during harvest season, state average yields of 144 bu/acre were reported – well above the previous state record (129 bu/acre). This was the sixth year in a row that NY corn yields have topped 100 bu/acre. At our NNY locations, average yields for our hybrid tests were excellent and ranged from 192 bu/acre to 221 bu/acre.

Results from the three hybrid evaluation trials are shown in Table 1 (Chazy), Table 2 (Madrid), and Table 3 (Sackets Harbor). The quality of our testing data this year was excellent, as reflected in the low coefficients of variation (CVs) for yield in the trials (9% at Chazy, 7% at Madrid, and 10% 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. Generally, a yield CV below 15% is considered evidence of high quality data, and ours were considerably better than that.

Hybrids showed highly significant variation for all traits except starch content at Madrid and Sackets Harbor, and for all traits except yield, stalk lodging, and starch content at Chazy. Although starch content variation was not significant, at all three locations some of the highest yielding hybrids also had the higher starch content values, suggesting that they would be higher overall in ethanol yield per acre due to the combination of these two traits. High stalk lodging pressure at all three trial locations revealed some notable differences in standability among the hybrids evaluated, which should be an important consideration for choosing hybrids specifically adapted to NNY. Lastly, the three Cornell experimental hybrids evaluated all showed some promise for NNY. The lowest yielding of the three was the double cross, but seed of this hybrid also could be produced at considerably lower cost than seed of the other hybrids tested, which are single crosses. So even at this lower yield, the double cross may have an economic advantage.

The results in the tables provide information on a broad array of commercially available hybrids, allowing farmers and seedsmen to compare productivity and adaptation of hybrids from various seed companies. Information about the three experimental Cornell hybrids will help seed growers who have just begun producing seed of these hybrids to decide whether they are worthy of marketing in NNY.

Conclusions/Outcomes/Impacts: Data in the hybrid production tables in this report shows a number of hybrids that had excellent performance in NNY in 2008. 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 2007 testing were published in the 2007 Hybrid Corn Grain Performance Trials report (Plant Breeding Mimeo 2008-1) and were incorporated into the tables of recommended hybrids in the 2009 Cornell Guide for Integrated Field Crop Management (Cornell University, 2008). 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 2008 trials, which were harvested during October and November, will soon be available in the 2008 Hybrid Corn Grain Performance Trials report (Plant Breeding Mimeo 2009-1) and will be incorporated into the tables of recommended hybrids in the 2010 Cornell Guide for Integrated Field Crop Management (to be published by Cornell University in fall 2009).

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. 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. We will continue to monitor starch content of different hybrids grown in these trials to assess the potential ethanol yield from each hybrid.

Acknowledgments: Funding by the Northern New York Agricultural Development Program and by the participating seed companies is gratefully acknowledged. We also acknowledge some general support for corn breeding and testing from Cornell University Agricultural Experiment Station through Hatch Project NYC149466, "Breeding Pest Resistant and Stress Tolerant Corn for more Environmentally Sound Production Systems." Collaborating farmers are thanked for their in-kind contributions of land, labor, management expertise, and ideas. They are Jon Greenwood, Madrid, St. Lawrence County and Ron Robbins, Sackets Harbor, Jefferson County. We acknowledge the assistance of Dr. Mike Davis with planting, general management, and harvest of the trial at the Miner Institute in Chazy, and the Miner Institute for use of field space.

Reports and/or articles in which the results of this project have already been published. Smith, M.E. 2008. 2007 New York Hybrid Corn Grain Performance Trials. Cornell University, Cornell Cooperative Extension, Plant Breeding and Genetics 2008-1. 14 pp.

Cox, W. and L. Smith (eds). 2008. 2009 Cornell Guide for Integrated Field Crop Management. Cornell University Cooperative Extension. 155 pp.

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

Margaret E. Smith or Judy Singer
Dept. of Plant Breeding and Genetics, Cornell University
G42 Emerson Hall
Ithaca NY 14853
Tel. 607-255-1654 (Smith), 607-255-5461 (Singer)
FAX 607-255-6683
e-mail mes25@cornell.edu (Smith), jls10@cornell.edu (Singer)

Jon Greenwood
1087 State Highway 310
Canton, NY 13617
Tel. 315-386-3231

Ron Robbins
14471 County Route 145
Sackets Harbor, NY 13685
Tel. 315-583-5737

Brand	Hybrid	Yield, bu/acre	% Grain Mois-ture	Yield: Moist. Ratio	% Stalk Lodging	Early Vigor Rating, 1-6 scale*	Plant Height, 1-6 scale*	Starch, % of dry matter
Hyland	HLCVR48	206	25.6	8.0	4	4.7	5.3	66.2
Hyland	HLR230	235	25.7	9.1	2	4.2	4.0	68.6
Hyland	HLB263RR	187	25.8	7.2	6	5.0	6.0	68.1
T A Seeds	TA290-19	232	26.1	8.9	13	5.0	3.7	66.7
Hyland	HLCVR44	217	26.2	8.3	1	4.7	3.0	64.9
T A Seeds	TA370-00	235	26.8	8.8	3	4.0	4.5	69.1
Growmark FS	3968VT3	213	26.8	7.9	2	4.7	5.0	65.5
Dekalb	DKC38-89(VT3)	230	29.0	7.9	1	5.0	3.7	67.1
Growmark FS	3989VT3	233	30.4	7.7	6	4.0	4.3	66.6
Cornell Exp.	Double Cross	224	30.6	7.3	10	4.7	4.0	64.0
	Mean	221	27.3	8.1	5	4.6	4.4	66.7
	CV, %	9	3.4		105	8.2	16	3.2
	LSD	34	1.6		9	0.6	1.2	3.7
	SD	20	0.9		5	0.4	0.7	2.1

Table 1. 2008 Early Maturity Hybrids, Chazy, Clinton County.
*Ratings for early vigor and plant height are on a scale where 6=big vigorous or tall plants and 1=small weak or short plants.

Table 2. 2008 Early Maturity Hybrids, Madrid, St. Lawrence County.

Brand	Hybrid	Yield, bu/acre	% Grain Mois-ture	Yield: Moist. Ratio	% Stalk Lodging	% Root Lodging	Early Vigor Rating, 1-6 scale*	Plant Height, 1-6 scale*	Starch, % of dry matter
Cornell Exp.	EX8102	173	23.1	7.5	11	1	3.3	4.5	66.8
Cornell Exp.	07-5:67x54	216	23.6	9.2	3	2	4.7	6.0	65.4
Hyland	HLCVR44	199	23.6	8.4	2	1	4.8	3.0	68.3
T A Seeds	TA370-00	228	24.0	9.5	13	3	3.5	5.7	69.6
Doebler's	372XRR	207	24.0	8.6	1	0	4.7	5.3	67.9
Hytest	HT7220Bt/RR	216	24.2	8.9	1	1	3.2	6.0	67.0
Hyland	HLCVR48	202	24.2	8.3	0	0	3.8	5.3	65.7
Growmark FS	3968VT3	193	24.5	7.9	3	0	4.2	5.3	66.9
Growmark FS	4282VT3	207	24.7	8.4	9	1	4.0	5.3	67.6
T A Seeds	TA290-19	188	24.7	7.6	10	0	4.5	4.0	66.2
Cornell Exp.	Double Cross	156	25.1	6.2	18	1	3.8	4.2	68.1
Growmark FS	3989VT3	199	25.4	7.8	1	0	5.2	5.3	67.4
Dekalb	DKC38-89(VT3)	197	25.5	7.7	0	1	4.8	4.3	67.6
Hyland	HLR230	189	25.7	7.4	0	0	4.2	4.3	68.6
Hyland	HLB263RR	176	26.3	6.7	1	0	5.3	5.7	66.2
	Mean	196	24.6	8.0	5	1	4.3	5.0	67.3
	CV, %	7	4.0		108	135	13.2	12.8	3.7
	LSD	21	1.6		8	2	0.9	1.0	4.1
	SD	13	1.0		6	1	0.6	0.6	2.5

*Ratings for early vigor and plant height are on a scale where 6=big vigorous or tall plants and 1=small weak or short plants.

Table 3. 2008 Medium-early Maturity Hybrids, Sackets Harbor, Jefferson County.

Brand	Hybrid	Yield, bu/acre	% Grain Mois-ture	Yield: Moist. Ratio	% Stalk Lodging	% Root Lodging	Early Vigor Rating, 1-6 scale*	Starch, % of dry matter
Hyland	HLCVR54	196	21.0	9.3	35	1	4.2	66.7
T A Seeds	TA451-11	168	21.7	7.7	63	3	4.0	72.1
Dekalb	DKC43-27(VT3	207	21.8	9.5	10	1	3.9	71.9
N K	N27B-CB/LL/RW	182	21.8	8.3	32	2	4.8	65.7
Growmark FS	4465VT3	204	22.3	9.1	19	0	4.7	71.3
Dyna-Gro	CX08097	201	22.3	9.0	16	3	3.7	67.6
Hyland	HLCVR64	228	22.5	10.1	10	4	4.9	67.0
Growmark FS	4373VT3(4373XRR)	203	23.0	8.8	12	5	5.2	67.7
Dekalb	DKC46-60(VT3	174	23.0	7.6	14	2	3.8	69.8
Dyna-Gro	55V18	221	23.2	9.5	10	2	4.8	68.8
Dekalb	DKC50-44(VT3	225	23.3	9.7	31	5	4.7	71.5
BGI	VPC847	106	23.4	4.5	58	5	3.3	64.0
Hytest	HT7428	207	23.5	8.8	22	4	4.3	68.1
Hytest	HT7398TS	184	23.6	7.8	46	2	4.3	66.8
Growmark FS	4819XRR	173	23.7	7.3	7	35	5.3	66.6
T A Seeds	TA497-11	212	23.8	8.9	28	0	3.8	70.6
Growmark FS	4861VT3	207	24.1	8.6	20	3	5.0	69.0
Hyland	HLCVR72	198	24.2	8.2	28	2	4.0	67.6
LICA	1898CB/LL	222	24.4	9.1	60	6	5.0	71.0
LICA	9707BT/LL	166	24.6	6.7	42	1	3.3	70.0
Hyland	HLCVR74	214	24.8	8.6	9	11	5.0	68.9
Hyland	HLB49R	221	25.1	8.8	19	4	4.5	68.0
T A Seeds	TA500-16	209	25.3	8.3	10	5	4.0	69.2
Growmark FS	5484VT3	215	26.1	8.2	9	17	3.2	69.1
	Mean	198	23.4	8.4	25	5	4.3	68.7
	CV, %	10	3.6		59	79	104	4.0
	LSD	32	1.4		24	7	0.7	4.5
	SD	20	0.9		15	5	0.4	2.8

*Ratings for early vigor are on a scale where 6=big vigorous plants and 1=small weak plants.

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Can sulfur addition increase alfalfa yield and quality in Northern New York?**

Project Leader(s):

Quirine M. Ketterings, Associate Professor, Nutrient Management Spear Program (NMSP), Dept. of Animal Science, Cornell University

Collaborator(s):

- Cornell University:
  - Kevin Dietzel, Chie Miyamoto and Greg Godwin, NMSP staff
  - Mike Davis, E.V. Baker Research Farm, Willsboro NY
  - Jerry Cherney, E.V. Baker Professor, Dept. of Crop and Soil Sciences
  - Debbie Cherney, Associate Professor, Dept. of Animal Science
  - Renuka Rao, Director, Cornell Nutrient Analysis Laboratory
  - Karl Czymmek, PRODAIRY, Dept. of Animal Science
- Cornell Cooperative Extension:
  - Joe Lawrence (CCE of Lewis County)
- Consultants:
  - Peter Barney, Barney Agronomic Services

Cooperating Producers:

- Bob Hanno (Lewis County)
- Tony Gilbert, Adon Farms (St. Lawrence County)

Background: Alfalfa is an important forage crop in Northern New York (perennial, high protein levels, ability to fix N from the air, deep rooting system that allows continued biomass production in dry periods and reduces risk of leaching losses). Over the past decades, S deposition has decreased substantially from 20-25 lbs S/acre in 1984 to currently as low as 5-6 lbs S/acre in some regions, raising questions about the S status of all field crops but especially alfalfa, a crop with high DM yields and S content. Assuming an average tissue S content of 0.25%, a 4 ton/acre harvest (85% DM) removes about 17 lbs S/acre. If we assume 6 lbs S/acre deposition, 11 lbs S/acre is needed from other sources to match crop removal on an annual basis. Soil organic matter (OM) is a source of additional S but on sandy low OM soils, this S supply might not be sufficient. Manure addition could alleviate a potential S deficiency (about 1 lbs S/1,000 gallons) but applications above 4,000 gallons/acre could pose phosphorus (P) accumulation problems and other management challenges including burn and smothering upon heavier manure applications (http://nmsp.css.cornell.edu/publications/factsheets/factsheet16.pdf).

Sulfur deficiency can impact not only yields but also protein quality of alfalfa as S is closely associated with nitrogen in the process of protein and enzyme synthesis, and a constituent of aminoacids and vitamins. Deficiencies in these aminoacids and vitamins can greatly impact milk production, increase the need for imported feed and hence negatively impact farm N, P, and K balances and increase environmental loss.

Coarse-textured soils that are low in OM are most likely to cause S deficiency in high S consuming crops such as alfalfa. A survey S status of alfalfa fields New York was done in 2007 by sampling 2nd year alfalfa fields (top 15 cm of the alfalfa stand at the bud to early bloom stage). This included 10 NNY sites several of which showed low S levels (less than 0.25%).Within the Northern

New York region, St Lawrence, Lewis and Essex counties have a substantial acreage on such soils. The current S status of alfalfa in Northern NY is, however, unknown most importantly because we lack calibrated tools for determining deficiencies in advance of a yield or quality decline. Our objectives were to: (1) evaluate six soil test methods for their ability to determine soil S increase upon S addition; and (2) determine S responsiveness of four NNY sites. The proposed work includes more detailed soil and crop response testing for four sites with low tissue S.

Methods:

Soil incubation study:

Our goal was to identify a soil test that can be used to determine S deficiency prior to occurrence of deficiency symptoms or yield decline. Four soils (three NNY soils and one eastern NY site) were incubated with 6 rates of S (0, 25, 50, 75, 100 and 150 lbs S/acre applied as gypsum). Soil samples were analyzed with six different extraction chemistries and two detection methods (ICP versus spectrophotometer). The chemical extraction methods were:

1. Potassium phosphate (KH_2PO_4)
2. Monocalcium phosphate ($Ca(H_2PO_4)_2$)
3. 1.0 N neutral (pH 7) ammonium acetate (NH_4OAc)
4. Calcium chloride ($CaCl_2$)
5. Morgan solution
6. Mehlich 3 solution

On-farm S response studies:

On-farm S response trials were conducted on four NNY sites including two farm sites in St Lawrence County, one farm location in Lewis County and one in Essex County (Willsboro Research Farm). The treatments (four replications) include a no-S control and two S sources ($CaSO_4$ and $K_2SO_4.MgSO_4$) both added at a rate of 150 lbs S/acre. These treatments are consistent with work in 1981-1983 conducted by Klausner et al. (1984) allowing for direct comparison with this earlier study. These treatments were applied at each site after 1st cutting, and soil samples from all spots were taken at this time. Forage quality samples and yield measurements will be taken at 2nd and 3rd cuttings. Soil samples were taken again after 3rd cutting.

Results:

Soil Incubation:

Of the six methods tested, the $CaCl_2$ extraction method was the best method (limited variability in response to S addition due to detection method or soil to soil differences and a linear response to addition of S with a relatively large slope of the linear equation (Figure 1).

On-farm sulfur trials:

Two sites that tested below 0.25 ppm tissue S (Willsboro site and one of the two St Lawrence sites) showed a significant yield response to sulfur addition. The other two sides were non-responsive to additional S. Thus, the current interpretations for tissue testing (<0.25 ppm indicates a deficiency) seems correct, based on the four sites in the study. We had 4 additional sites in this co-funded study (non-NNY) and results from these sites are still being summarized. All soils need to be analyzed for $CaCl_2$ extractable S to determine critical soil test levels.

Conclusions/Outcomes/Impacts: The results of the soil incubation study are very promising. The best test for sulfur detection is the $CaCl_2$ test. We will be analyzing the soil of the field trials (2008 and 2009) for this new soil S test and, if funds become available, invite farmers to submit samples to the laboratory so we can do a larger assessment of the S status of NNY soils.

Outreach: The project was discussed at winter meetings and field crop retreats. However, as the results of the field trials and the incubation were not known until mid-December, additional extension activities will need to take place in 2009. We are currently working on a journal article on the soil testing component of the project, to be submitted in early 2009. We will generate an extension article on the work once the journal article has passed peer review. We plan to develop an Agronomy Fact Sheet on the findings of the soil testing component as well and we will include discussions of sulfur needs for alfalfa in our nutrient management workshops.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. The field trials will need to be continued for a second year before we can conclude on the effectiveness of the soil test identified as most promising in the incubation study ($CaCl_2$ extraction) and the need for S across NNY farms. Forage samples also need to be analyzed for forage quality (awaiting the results of samples that were submitted). We propose to do an assessment of soil S levels once the soil testing component is completed (in 2009) and to complete the second year of field trials for this project in 2009 as well. Once results are compiled, extension talks and documents will be developed and the soil test (assuming field work confirms it use as S test) will be released for general use for farmers and their advisors.

Acknowledgments: The project was funded through NNYADP (4 NNY field sites and soil test comparison study) and federal formula funds (additional sites, staff time, greenhouse experiment).

Reports and/or articles in which the results of this project have already been published. The initial results of the soil testing component were presented at the Northeastern Branch of ASA/SSSA/CSSA meeting this year. They were shared with the extension educators but no formal extension articles could be written yet as we are still analyzing the remaining samples.

Person(s) to contact for more information (including farmers who have participated: The four field trials were conducted at the Willsboro Farm, two St Lawrence locations (Peter Barney, Consultant) and one Lewis County location (leadership by Joe Lawrence, CCE of Lewis County). For more information, contact Quirine Ketterings, Nutrient Management Spear Program, 323 Morrison Hall, Department of Animal Science, Cornell University (qmk2@cornell.edu or 607 255 3061).

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title; **Corn Silage Hybrid Trials in Northern NY**

Project Leader: William J. Cox, Cornell University, 607-255-1758, wjc3@cornell.edu

Collaborators:

Jerry Cherney, Cornell University, 607-255-0945, jhc5@cornell.edu
Mike Davis, 518-846-7400. mhd11@cornell.edu

Farmer Participants:

John Greenwood, Madrid, St. Lawrence Co.
Ron Robbins, Sackets Harbor, Jefferson Co.

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.

Materials and Methods. We planted all hybrids with a 2-row plot planter at three sites in Northern NY at about 36,000 plants/acre to achieve harvest populations of 32,000-34,000 plants/acre. The Sackets Harbor site was planted on 6 May, the Madrid site on 7 May, and the Chazy site on 8 May. All hybrids were grouped within a 5-day Relative Maturity (RM, i.e. 91-95 day, 96-100, etc.) group, 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 Chazy site received about 140 lbs N/acre of sidedressed N at the 4 to 5-leaf (V4 to V5) stage. The Sackets Harbor and Madrid sites were well-manured dairy sites so they received no sidedressed 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 and only a very few of the hybrids were outside that range at Madrid and Chazy. All hybrids were harvested at Sackets Harbor on 11 September and at Madrid on 19 September the morning of the first fall frost in Madrid. Unfortunately, we were unable to harvest the Chazy site because of severe wind damage in July and again in mid-September. The plots were so entangled and many plants had been snapped in half, which made harvest by a chopper impossible. Consequently, we decided not to harvest the Chazy site because any data from that trial would have been suspect.

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 sub- sample was then weighed with a gram-scale in the field 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). Crude protein (CP), starch, ether extract, and ash were determined using NIRS. Milk per ton and milk per acre were then calculated using the Milk2006 spreadsheet program.

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 101% or more of the mean value within their RM group.

Results and Discussion. The 2008 growing season in Northern NY was mostly similar to that in central/western NY (Table 1). Conditions were moderately dry at both sites from late April until mid-June and then turned exceedingly wet. June and July were exceptionally wet at Madrid and July and August were exceptionally wet at Sackets Harbor. September was moderately dry at both sites, which facilitated harvest. Frost did not occur until early October at Sackets Harbor but a light frost occurred the morning of September 19 at Madrid, the day of harvest. As in central/western NY, silage yields were high because of stress-free conditions and the 80-89 day RM group averaged 24.0 at Sackets Harbor and 25.0 tons/acre at Madrid, the 90-95 day RM group averaged 26.1 and 26.0, and the 96-100 day RM group averaged 27.2 and 26.4 tons/acre, respectively.

Three hybrids at Sackets Harbor and four hybrids at Madrid had above-average calculated milk yields in the 80-89 day RM group (Tables 2 and 3). The hybrids, TA290-19 and TA240-00 from T.A.

Seeds, and HL SR35 from Hyland had above-average milk yields at both sites. The hybrid, DKC38-89, a DK brand, also had above-average milk yields at Madrid. The hybrid F2F29/F27311 from Mycogen had a much above-average milk/ton value at both sites. Other hybrids with above-average milk/ton values include DKC38-39 and TA240-00. When averaged across sites, TA290-19, HL R35, and TA240-00 had much above-average silage yields.

Twelve hybrids at Sackets Harbor and 11 hybrids at Madrid had above-average milk yields in the 90-95 day RM group (Tables 2 and 3). The hybrids, HL B294 from Hyland, 946 LRR and 1900F/RR/HX from LICA, TMF2L416 and TMF2N422 from Mycogen, 99 S7 from LICA, and HL S047 from Hyland had above-average milk yields at both sites. The hybrids DKC45-79, a DEKALB brand, UFO 105B6 from LICA, 4282VT3 from GROWMARK FS, 88H48GT from Garst, and TNT-92RR from HYTEST SEEDS, had above-average milk yields at Sackets Harbor. The hybrids, 38H08 and 38N47 from Pioneer, 467BVR from Doebler's, and HL SR42 from Hyland, had above-average milk yields at Madrid. The hybrid UFO 105B6 had a much-above milk/ton value in the 90-95 day RM group. Other hybrids with above-average milk/ton values include HL SR42, TMF2L416, TMF2N422, and HL B294. When averaged across sites, HL B294, 1900F/RR/HX, 946 LRR, 99 S7, TMF2L416, and TMF2N422, had much above-average silage yields in the 90-95 day RM group.

Three hybrids at Sackets Harbor and three hybrids at Madrid had above-average calculated milk yields in the 96-100 day RM group (Tables 2 and 3). The hybrid 36Y26 from Pioneer had above-average milk yields at both sites. The hybrids, DKC50-44, a DEKALB brand, and TA489-00F from T.A. Seeds, had above-average milk yields at Sackets Harbor. The hybrids TA476-11 from T.A. Seeds and NG6520 from Fielder's Choice had above-average milk yields at Madrid. When averaged across sites, 38H72 from Pioneer had an above-average milk/ton value, as did 36Y26 and DKC50-44. When averaged across sites, TA476-11, DKC50-44, and TA489-00F had above-average silage yields.

Conclusions: The 2008 growing season in Northern New York was almost ideal for corn. May was dry, which allowed for timely planting, conditions stayed dry until mid-June, which allowed corn to maintain uniform growth in all parts of the field, including the somewhat poorly-drained areas. June was warm, which allowed for excellent vegetative growth, July and August were wet, which allowed for excellent kernel set, and August was cool, which allowed for excellent grain-filling. Finally, September was dry and a killing frost did not occur until the first week of October in most regions, except for light frosts around 20 September in isolated regions. The results from this study reflect well the yield and quality of corn silage in Northern New York in 2008, except those regions that suffered from hail damage in June or July or wind damage in September.

Outreach: The results of the two sites (Madrid and Chazy) were used to recommend corn silage hybrids in Northern NY for the 2009 growing season in our **What's Cropping Up?** newsletter that was published in December of 2008 (Vol.18, No.5, p.1-3, on our web site at : www.fieldcrops.org.). Furthermore, the results will be incorporated into the recommended corn silage tables in our **2009 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. 86-90, 91-95 day RM, etc.). We also list the relative silage yields and milk/ton values for the recommended hybrids. We also presented the results of the study at our Field Crop Dealer Meetings in late October, In-Service for our field crop educators in November, and at the advanced session of our Certified Crop Advisors Training Session in December.

Acknowledgments: We acknowledge the support of Cornell Cooperative Experiment Station for providing technical support for the corn silage program. The technical support individual transports equipment, plants, and harvest all the studies. We also acknowledge the technical support that the Cornell Cooperative Experiment Station provides for the work at the Miner Institute at Chazy. We acknowledge and thank Miner Institute for the use of the land.

	PRECIPTATION		GDD	
Month	Madrid	Sackets	Madrid	Sackets
May	2.62	2.74	229	222
June	5.66	3.00	513	495
July	4.28	4.39	599	571
August	2.67	4.68	490	497
Total	**15.23**	**15.77**	**1831**	**1785**

Table 2. Results at Ron Robbins's farm in Sackets Harbor, NY in 2008.

Brand/ Company	Hybrid	Silage Yield	Moisture	NDF	30 hour NDFD	CP	Starch	Milk2006 Milk/ton	Milk2006 Milk Yield
		Tons-65%	%	%DM	%	%DM	%DM	lbs/ton	lbs/acre
				80 to 89-d RM					
Hyland	HL SR35	27.4	66.0	43.2	55.3	7.3	31.7	3186	30553
T.A. Seeds	TA240-00	26.1	60.8	40.2	55.4	7.0	36.2	3292	30086
T.A. Seeds	TA290-19	25.9	60.6	39.6	53.8	7.1	37.0	3293	29939
DEKALB	DKC38-89	25.1	65.0	38.9	56.9	7.2	36.4	3344	29404
Hyland	HL SR22	25.4	63.3	41.5	55.7	8.0	31.8	3248	28881
Mycogen	F2F297/F27311	22.2	64.2	39.0	68.4	7.3	35.8	3608	28054
Dairyland Seed	HiD.F.-3085-6	24.4	65.2	39.8	54.6	7.5	34.4	3274	27976
Fielder's Choice	NG6321	23.8	66.2	40.1	53.1	7.8	31.7	3144	26174
				90 to 95-d RM					
Hyland	HL B294	31.5	69.1	41.6	59.2	7.1	33.2	3312	36551
LICA	99 S7	28.6	67.6	42.4	56.3	7.2	31.7	3252	32524
Mycogen	TMF2L416	27.8	66.3	40.8	58.6	7.6	33.2	3336	32479
Mycogen	TMF2N422	28.2	65.2	42.8	56.4	7.1	32.7	3241	31940
Pioneer	38H08	27.8	64.1	40.5	55.2	6.6	35.8	3254	31679
LICA	1900F/RR/HX	28.8	70.0	42.9	54.4	6.8	31.8	3143	31656
LICA	946 LRR	27.3	65.9	43.4	57.3	6.9	32.5	3245	31011
Doebler's	467BVR	27.5	68.9	43.5	54.9	6.9	31.9	3182	30687
Hyland	HL SR42	25.5	67.0	40.6	61.0	7.5	33.9	3399	30313
Pioneer	38N87	26.0	66.1	39.3	55.0	7.5	35.2	3305	30099
Hyland	HL S047	26.2	65.6	42.1	57.1	7.4	32.8	3272	29963
HYTEST SEEDS	TNT-92RR	26.0	67.5	43.1	57.9	7.3	31.7	3253	29616
Dyna-Gro Seed	53K69	25.5	68.1	40.4	57.1	6.8	36.1	3309	29557
DEKALB	DKC41-60	25.6	67.5	40.4	55.9	7.1	35.2	3274	29361
Garst	88H48GT	26.0	66.5	41.4	52.7	6.7	34.5	3188	29054
GROWMARK FS	4282VT3	24.9	69.1	41.4	57.2	6.7	34.7	3282	28578
NK Seeds	N27B-CB/LL/RW	24.6	65.1	39.6	55.4	7.5	35.4	3316	28504
DEKALB	DKC45-79	25.0	67.9	41.7	56.1	7.1	33.3	3227	28242
Doebler's	377BVR	24.0	66.7	40.2	56.9	7.3	35.3	3305	27732
T.A. Seeds	TA370-00	24.2	65.6	39.7	54.7	7.2	36.1	3276	27727
HYTEST SEEDS	HT7220 BT/RR	24.6	67.5	41.1	52.4	7.4	33.9	3199	27566
LICA	UFO 105B6	22.4	72.1	42.2	69.0	7.4	30.4	3447	27036
T.A. Seeds	TA310-00F	23.8	65.0	43.2	56.8	7.2	32.2	3226	26876
LICA	9707 BT/LL	23.5	66.4	41.0	55.5	7.3	33.9	3255	26830
				96 to 100-d RM					
T.A. Seeds	TA476-11	28.1	66.8	41.5	52.8	7.1	34.1	3200	31487
Fielder's Choice	NG6520	27.1	68.5	40.6	54.7	7.2	34.7	3254	30816
Pioneer	36Y26	26.7	69.0	41.1	55.0	7.6	33.2	3234	30173
T.A. Seeds	TA489-00F	26.2	67.0	42.7	57.9	7.2	32.5	3276	29985
Pioneer	38H72	25.1	67.2	39.1	55.9	7.3	35.4	3320	29230
DEKALB	DKC50-44	25.2	70.0	42.0	55.0	7.0	33.4	3208	28306
	LSD 0.10	**2.25**	**1.00**	**1.37**	**1.36**	**0.23**	**1.59**	**68**	**2820**

Overall Mean	25.9	66.6	41.2	56.5	7.2	33.8	3273	29648

Table 3. Results at John Greenwood's farm in Madrid, NY in 2008.

Brand/ Company	Hybrid	Silage Yield	Moisture	NDF	30 hour NDFD	CP	Starch	Milk2006 Milk/ton	Milk2006 Milk Yield
		Tons-65%	%	%DM	%	%DM	%DM	lbs/ton	lbs/acre
80 to 89-d RM									
T.A. Seeds	TA290-19	28.6	62.7	37.9	53.9	7.8	36.8	3328	33286
T.A. Seeds	TA240-00	27.6	62.1	37.9	52.9	7.7	37.0	3308	31970
Hyland	HL SR35	27.0	65.1	40.2	55.4	7.9	33.5	3260	30749
DEKALB	DKC38-89	24.3	64.5	38.3	53.1	7.7	35.7	3260	27696
Mycogen	F2F297/F27311	21.6	64.5	37.2	67.4	8.0	35.5	3584	27083
Hyland	HL SR22	24.6	62.7	41.5	53.0	8.6	29.7	3127	26921
Dairyland Seed	HiD.F.-3085-6	23.6	63.3	38.9	52.7	8.1	34.1	3217	26544
Fielder's Choice	NG6321	22.0	63.8	41.1	49.4	8.6	28.8	2942	22675
90 to 95-d RM									
Hyland	HL B294	31.0	67.9	40.0	55.3	7.4	34.7	3261	35505
LICA	946 LRR	30.7	66.0	40.3	56.7	7.6	33.7	3286	35304
LICA	1900F/RR/HX	30.0	67.6	39.3	55.6	7.1	35.6	3268	34347
Mycogen	TMF2L416	28.2	66.2	39.7	56.7	8.1	33.2	3304	32662
Mycogen	TMF2N422	27.2	66.2	39.4	58.4	7.8	34.6	3367	32033
DEKALB	DKC45-79	28.3	66.9	39.2	53.2	7.5	34.9	3219	31915
LICA	99 S7	27.9	67.5	39.5	53.6	7.7	34.1	3246	31688
Hyland	HL S047	27.4	66.1	40.4	57.3	8.0	33.1	3285	31494
LICA	UFO 105B6	25.0	69.4	39.8	69.0	7.7	32.6	3525	30785
GROWMARK FS	4282VT3	26.4	66.9	39.0	56.5	7.3	35.8	3316	30637
Garst	88H48GT	26.3	64.9	38.4	54.8	7.3	36.7	3308	30452
HYTEST SEEDS	TNT-92RR	25.7	67.3	39.8	57.4	7.7	34.8	3336	29956
T.A. Seeds	TA370-00	26.0	65.7	37.3	51.5	7.7	37.6	3263	29737
NK Seeds	N27B-CB/LL/RW	26.2	64.9	39.6	52.8	7.9	34.0	3229	29597
Doebler's	467BVR	26.0	67.8	41.3	52.9	7.6	33.0	3172	28859
HYTEST SEEDS	HT7220 BT/RR	25.0	65.4	39.5	53.0	7.9	34.6	3253	28471
T.A. Seeds	TA310-00F	24.5	65.6	40.9	56.7	8.2	32.3	3267	27970
Hyland	HL SR42	24.0	67.7	39.1	57.9	8.1	33.6	3317	27894
Dyna-Gro Seed	53K69	24.7	68.1	40.5	52.7	7.5	33.7	3159	27393
Pioneer	38H08	24.9	63.0	41.2	52.1	7.8	31.7	3112	27158
Doebler's	377BVR	23.5	66.3	39.2	54.3	8.1	33.8	3240	26654
LICA	9707 BT/LL	22.6	64.2	36.5	55.1	7.9	38.0	3362	26508
DEKALB	DKC41-60	23.2	66.4	41.4	52.8	8.0	31.3	3130	25355
Pioneer	38N87	22.8	64.6	38.8	51.8	8.7	32.1	3162	25213
96 to 100-d RM									
DEKALB	DKC50-44	29.7	67.3	38.4	56.9	7.4	36.4	3350	34851
T.A. Seeds	TA489-00F	28.8	66.6	41.4	55.9	7.9	32.4	3234	32697
Fielder's Choice	NG6520	27.0	67.7	39.1	53.6	7.8	35.1	3235	30561
T.A. Seeds	TA476-11	27.6	65.0	41.4	51.4	7.5	33.6	3140	30286
Pioneer	38H72	23.0	65.7	37.6	54.1	8.1	35.7	3306	26640
	LSD 0.10	**3.47**	**1.10**	**1.58**	**1.66**	**0.28**	**2.16**	**85**	**4132**
	Overall Mean	26.0	65.8	39.4	55.1	7.8	34.2	3264	29758

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Cereal Variety Trials for Grain and Straw Production**

Project Leaders

Michael H. Davis (mhd11@cornell.edu), Cornell University E.V. Baker Research Farm
Michael Hunter (meh27@cornell.edu), Cornell Cooperative Extension of Jefferson County

Collaborators

Jerry Cherney (jhc5@cornell.edu), Cornell University
Anita Deming (ald6@cornell.edu), Cornell Cooperative Extension of Essex County

Background

***Grain Production Trials**:* Small grain variety trials at the Cornell E.V.Baker Research Farm have provided NNY producers with variety evaluations since the 1980's. These trials test the performance of established varieties from regional seed companies such as W.G. Thompson, JGL Inc., Seedway, and Agriculver, in addition to advanced lines and recently released varieties from Dr. Mark Sorrell's breeding program at Cornell. Promising varieties from the hard red spring wheat breeding program at North Dakota State University have also been included in recent years.

2007-2008 trials included 19 spring wheat varieties, 25 winter wheat varieties, 5 winter triticale varieties, 8 oat varieties, and 5 spring barley varieties. New additions in the 2007-2008 trials include *Jensen* a recently released winter wheat variety from Dr. Mark Sorrells that reportedly has excellent sprouting and disease resistance, and a soon to be released upgrade of the variety *Caledonia* (also from Dr. Mark Sorrells breeding program) with improved sprouting resistance.

Winter Cereal Straw Production Trials (Year 2):
The premium prices paid for clean straw in the Northeast have led to increasing farmer interest in growing small grains solely for the straw. "Pre-cut straw" – straw that is harvested after the crop has headed out, but before the grains have filled, could be a profitable crop for NNY farmers. Properly harvested pre-cut straw that has been bleached to a yellow or off white color before baling is generally longer, cleaner, and brighter than wheat straw baled after combining, and as a result, commands a higher price. The relatively tall winter triticale and rye varieties are particularly promising as they have high straw yields and fewer lodging problems when harvested before grain filling.

In 2007-2008, one winter rye and three winter triticale varieties were evaluated for pre-cut straw production on the Cornell E.V. Baker Research Farm in Willsboro, NY. The Jefferson County 2007-2008 trial tested the straw yield response of one winter rye and two winter triticale varieties to five different nitrogen treatments.

Objectives:

- To test the agronomic performance of regionally available varieties of spring and winter wheat, winter triticale, spring barley, and oats when produced under northern New York growing conditions.
- To evaluate winter hardiness and straw production potential for winter triticale and rye varieties grown on NNY farms.

Methods

***Grain Production Trials**:*

Variety trials for spring wheat, spring barley, oats, winter wheat, winter triticale, and winter barley 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 clay loam soil with subsurface tile drainage. 200 lb/acre 6-24-24 was broadcast applied and incorporated with a spring-tooth harrow prior to planting each trial. Additionally, the winter wheat, winter triticale, and winter barley plots all received a topdress application of ammonium nitrate (33-0-0) at a rate of 75 lbs nitrogen per acre on April 24, 2008. On May 1, 2008, winter grain trial plots were sprayed with 1 pint per acre 2,4 D herbicide for broadleaf weed control. Plant heights, lodging scores, disease incidence, and bird damage data were collected prior to grain harvests. Grain samples from each plot were cleaned, and then tested for moisture content and bushel weight. 2008 spring barley and oat trials were not harvested due to extensive bird damage and lodging problems.

Winter Cereal Straw Production:

Winter triticale and winter rye plots for pre-cut straw production evaluations were planted on the Cornell E.V. Baker Research Farm on September 25, 2007. Plots were located on a Rhinebeck clay loam soil with subsurface tile drainage, and seeded at a rate of 115 lbs/acre. 200 lb/acre 6-24-24 was broadcast applied and incorporated with a spring-tooth harrow prior to planting. A randomized complete block design with four replications was employed. All plots received a topdress application of 75 lbs nitrogen per acre in the form of ammonium nitrate (33-0-0) on April 24, 2008. 2,4 D herbicide (1 pint/acre application rate) was applied to all plots on May 1, 2008 for broadleaf weed control. Height and lodging scores were recorded for all plots prior to harvest on June 25, 2008.

A pre-cut straw production/nitrogen rate study was planted on a farm in northern Jefferson County on September 26, 2007. A randomized complete block experimental design with four replications was utilized. *Trical 336*, *Trical 815*, and winter rye plots were seeded at a rate of 115 lbs/acre. Four nitrogen rate treatments (0, 50, 75, 100 lbs/acre) were surface applied on April 15, 2008, and plots were harvested for straw on June 25, 2008 (after pollination but prior to grain fill).

Results

Table 1. Northern New York 2008 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	0-10
		Trial Mean	79.4	53.1	12.9	34.3	0
		LSD	8.0	1.9	0.7	1.8	
		LSD P >	0.05	0.05	0.05	0.05	
		CV	6.2	2.2	3.4	3.3	
		F Test	0.0001	0.0001	0.0001	0.0001	
Agriculver	7730R	SRW	89.3	57.2	13.9	28.3	0
Cornell	Freedom	SRW	84.6	53.8	13.0	32.5	0
Agriculver	Ashlund	SRW	77.2	54.2	13.0	34.4	0
JGL Inc.	HR45-104J	HRW	56.3	47.4	13.5	28.7	0
JGL Inc.	Gryphon	HRW	86.0	56.2	13.0	36.4	0
Cornell	NY 88024	SW	77.1	49.5	12.2	36.9	0
JGL Inc.	HR45-063J	HRW	80.9	55.3	13.0	31.2	0
JGL Inc.	Harvard	HRW	84.3	57.8	13.4	37.0	0
JGL Inc.	Kristy	SRW	88.9	56.0	13.7	32.4	0
Pioneer	Piovar25W33	SW	80.2	50.5	12.4	37.1	0
Cornell	99-53	SRW	88.8	55.0	12.8	35.7	0
JGL Inc.	CM98091	HRW	81.0	56.2	13.3	35.2	0
Agriculver	Harus	SW	82.3	52.5	12.5	35.7	0
Agriculver	Genesis	SRW	83.0	54.5	12.9	33.1	0
Agriculver	Richland	SW	74.8	46.7	12.0	36.6	0
Cornell	NY Batavia	SW	71.1	49.5	12.6	36.0	0
Cornell	Geneva	SW	73.7	50.7	12.4	36.6	0
JGL Inc.	Maxine	HRW	76.6	56.2	13.0	33.3	0
JGL Inc.	HR45014J	HRW	69.9	54.3	13.8	31.8	0
Cornell	Lindon	HRW	80.0	57.5	13.1	35.4	0
Agriculver	Caledonia	SW	70.6	45.0	12.5	30.4	0
Agriculver	AC Morley	HRW	87.0	57.8	13.4	37.1	0
Cornell	Cayuga	SW	82.5	53.0	13.1	39.4	0
Cornell	Jensen	SW	81.6	51.3	12.2	32.5	0
Cornell	Caledonia reselect-L	SW	82.5	45.5	12.0	33.1	0

Winter Wheat Trial: The 2008 winter wheat trial consisted of ten soft white (SW), six soft red winter (SRW), and nine hard red winter (HRW) varieties (Table 1). Plots were planted at a 2 bu/acre seeding rate on September 25, 2007, and harvested July 30, 2008. Grain yields ranged from 71.1 bu/acre to 89.3 bu/acre with a trial mean of 79.4 bu/acre. There was no lodging in the 2008 winter wheat trial. The top 12 yielding varieties (*7730R*, *Freedom*, *Gryphon*, *Harvard*, *Kristy*, *99-53*, *Harus*, *Genesis*, *AC Morley*, *Cayuga*, *Jensen*, and *Caledonia reselect-L*) did not differ significantly at the 0.05 level, and included soft red winter, soft white winter, and hard red winter entries (Table 1). A soft red winter variety, *7730R*, had the highest mean yield in the test for the second year in a row. It is interesting that the two new entries with improved sprouting resistance, *Jensen*, and *Caledonia reselect-L*, had the lowest grain moisture levels in the trial at harvest. Winter grain trial test weights averaged 53.1 lb/bu, and moisture levels at harvest averaged 12.9%.

Table 2. Northern New York 2007 Spring Wheat Variety Trial Results

Source	Hybrid/Variety Name	Market Class	Yield	Test weight	Moisture	Plant height
			bu/a	lb/bu	%	inches
		Trial Mean	43.1	49.1	17.1	33.2
		LSD	8.8	1.5		2.7
		LSD P >	0.05	0.05		0.05
		CV	12.3	1.9	4.5	4.9
		F Test	0.0001	0.0001	0.3075	0.0001
JGL Inc.	HRS6002J	HRS	49.1	50.7	16.7	40.8
Cornell	Stoa	HRS	41.5	48.0	16.4	29.4
NDSU	2375	HRS	36.4	48.3	17.7	29.1
Champlain Valley Milling	Russ	HRS	50.1	49.0	16.7	34.5
JGL Inc.	HRS45-025J	HRS	52.6	50.7	17.3	35.7
JGL Inc.	HRS45-035J	HRS	52.4	50.7	16.9	30.4
JGL Inc.	Profit	HRS	35.3	48.3	17.4	26.4
Champlain Valley Milling	Freyr	HRS	50.3	51.3	16.6	32.2
Champlain Valley Milling	Hannah	HRS	46.1	51.0	17.1	35.6
NDSU	Alsen	HRS	45.8	51.0	17.5	29.0
JGL Inc.	HRS6001J	HRS	41.9	49.7	17.4	34.9
NDSU	Butte 86	HRS	43.4	48.3	17.6	35.4
Champlain Valley Milling	Knudson	HRS	46.0	50.0	17.3	28.2
NDSU	Parshall	HRS	51.7	52.3	16.8	34.5
JGL Inc.	CM606	HRS	46.9	51.3	17.5	31.6
Champlain Valley Milling	Gunner	HRS	42.7	50.3	16.4	33.3
Champlain Valley Milling	Coteau	HRS	30.7	45.7	17.3	38.3
NDSU	Dapps	HRS	27.9	46.7	16.6	40.7
JGL Inc.	SD45-015J	HRS	28.1	39.7	18.2	30.8

Spring Wheat Trial: Spring grain trial plots were planted April 18, 2008 and harvested August 22, 2008. The seeding rate was 2.5 bu/acre. No lodging was observed in any of the plots. Yields were relatively low compared to the past two years, and ranged from 27.9 bu/acre to 52.6 bu/acre with an overall trial mean of 43.1 bu/acre (Table 2). Trial test weights averaged 49.1 lbs/bu, and moisture levels at harvest were on the high side with a mean of 17.1%. The top ten yielding varieties did not differ significantly at the 0.05 level, and included *HRS45-025J*, *HRS45-035J*, *Parshall*, *Freyr*, *Russ*, *HRS6002J*, *CM606*, *Hannah*, *Knudson*, and *Alsen*. *HRS6002J*, a line from JGL Inc.'s breeding program that yielded exceptionally well in 2006 and 2007, was once again among the top producers. Two other JGL Inc. lines, *HRS45-025J* and *HRS45-035J*, had the two highest mean yields in the 2008 trial.

The three lowest yielding entries were *Dapps*, *SD45-015J*, and *Coteau*. *SD45-015J*, and *Coteau* have been at the bottom of the hard red spring wheat yield rankings for the past three years, while *Dapps* has yielded at or near the bottom for the past two years. *Dapps* yielded in the middle of the trial in 2006. *Dapps* is a high protein variety that was bred for North Dakota growing conditions; low yields in the Baker Farm trials may indicate that an inherent trade-off exists between protein content and grain yield, and/or the variety is not well adapted to northern New York growing conditions.

Table 3. Northern New York 2008 Winter Triticale Variety Trial Results

Source	Hybrid/Variety Name	Yield	Test weight	Moisture	Plant height	Lodging
		lbs/a	lb/bu	%	inches	Scale 0-10
	Trial Mean	4345	45.9	12.3	45.5	2.3
	LSD	1440	2.1		4.3	1.3
	LSD P>	0.05	0.05		0.05	0.05
	CV	17.6	2.5	4.1	5.0	29.5
	F Test	0.0228	0.0001	0.4317	0.0001	0.0001
Agriculver seeds	Trical 102 lot# T521	2976	41.7	12.6	56.4	7.3
Agriculver seeds	Trical 103BB T412B	3603	39.7	12.2	51.0	4.3
Agriculver seeds	Trical 336	4738	50.7	12.4	39.5	0.0
Agriculver seeds	Alzo	5086	48.8	11.9	38.6	0.0
Agriculver seeds	Trical 815	5322	48.9	12.5	42.0	0.0
Winter barley entry	McGregor	3836	40.0	13.6	67.3	2.7

Winter Triticale (and Barley) Trial: Five winter triticale varieties and one winter barley variety were included in the 2008 test. Plots were seeded September 25, 2007 and harvested July 30, 2008. The planting rate was 115 lbs/acre for triticale, and 2 bu/acre for barley. The 2007-2008 winter was relatively mild with good snow cover through mid-March, and no winterkill problems were observed in the plots. 2008 results were consistent with those observed in 2006 and 2007. *Trical 336*, *Alzo*, and *Trical 815* were markedly shorter, had less lodging problems, much higher yields, and higher test weights than *Trical 102 lot #T521* or *Trical 103BB T412B* (Table 3). *McGregor*, the lone winter barley entry, had a mean yield of 3838 lbs/acre.

Table 4. 2008 Winter Triticale and Rye for Straw Trial

Source	Hybrid/Variety Name	Straw Yield	Moisture At Harvest	Plant height
		Dry Matter Per acre (lbs)	%	inches
	Trial Mean	5.01	64.6	50.1
	LSD	0.6	1.9	1.5
	LSD P>	0.05	0.05	0.05
	CV	7.7	1.8	1.9
	F Test	0.0112	0.0001	0.0001
Agriculver	Alzo	4.38	68.0	42.3
Agriculver	Trical 336	5.12	64.9	46.1
Agriculver	Trical 815	4.91	67.3	47.2
Agriculver	Winter rye	5.59	58.4	64.7

Winter Triticale and Rye for Straw Trial:

The 2008 triticale and rye straw production plots in Willsboro did not exhibit any signs of winter injury. 2008 dry matter straw yields ranged from 4.38 tons/acre to 5.59 tons/acre with a trial mean of 5.01 tons/acre (Table 4). Yield comparisons among the entries are consistent with the 2007 results as winter rye and *Trical 336* produced the highest straw yields, while *Alzo* produced the lowest. *Trical 815* was intermediate and did not differ significantly in yield from the other triticale varieties, but did yield significantly lower than the winter rye entry. There was no lodging in the 2008 trial. The winter rye entry was markedly taller than all the triticale entries. Among the triticale varieties, *Alzo* was significantly shorter than either *Trical 336* or *Trical 815*. The winter rye entry also had significantly lower moisture contents at harvest relative to the three triticale varieties. A lower moisture level in the winter rye suggests that the rye was at a more advanced developmental stage at harvest than the triticale varieties.

Table 5. Effect of nitrogen rate on yield in Jefferson Co.

Treatment	Trical 336	815 triticale	Rye
Nitrogen Rate (lb/acre)	DM Yield (ton/acre)	DM Yield (ton/acre)	DM Yield (ton/acre)
0	3.46c	2.81c	3.07b
50	4.69bc	4.09b	4.32ab
100	5.47ab	4.90ab	4.94a
150	5.65ab	5.43a	5.17a
200	6.68a	5.62a	5.36a

Means within a column followed by different letters are different by LSD $_{(0.05)}$

Jefferson County Nitrogen Rates for Straw Production Trial:

Results from the 2008 study on the influence of nitrogen rates on pre-cut winter cereal straw production was consistent with previous trials conducted in Jefferson County. All entries exhibited a consistent trend of increased straw yields with increased nitrogen fertilization rates, but the two triticale varieties were more responsive to higher N application rates than the winter rye entry (Table 5). In the 2008 trial, an application of 50 lbs N/acre at spring green up appeared to be sufficient for rye straw production, while an application of 100 lbs N/acre was sufficient for *Trical 336* and *Trical 815*.

Results from the 2008 trials provide further evidence that winter triticale straw yields can be comparable to winter rye, and in regions where triticale can reliably survive the winter, winter triticale offers a viable alternative to rye for straw production. Trical 336 has consistently performed well in both Jefferson County and Essex County (Baker Farm) trials, and appears to be well adapted to northern New York growing conditions.

It should be noted that winter triticale survival in Willsboro Farm trials has been inconsistent. The past three winters (2005-2007) were relatively mild and winter triticale survival was excellent in all years. However, winter triticale plots all winterkilled in both 2003-2004 and 2004-2005. Given the uncertainty of winter triticale survival, winter rye would generally be considered a safer bet for straw production from a winter grain. An additional advantage of winter rye is that it can be successfully planted later in the fall than winter triticale.

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.

Person(s) to contact for more information. Michael H. Davis, Cornell E.V. Baker Willsboro Research Farm, 48 Sayward Lane, Willsboro, NY 12996. (518) 963-7492. email <mhd11@cornell.edu

Photo

Small Grain Variety Trial Plots at the Cornell E.V. Baker Farm (photo by Michael H. Davis)

Northern NY Agricultural Development Program
2008 Project Report

Project Title: **Forage Soybean Advanced Breeding Line Evaluations & Food Grade Soybean Variety Trials**

Project Leaders
Michael H. Davis (mhd11@cornell.edu), Cornell University E.V. Baker Research Farm
Michael Hunter (meh27@cornell.edu), Cornell Cooperative Ext. of Jefferson County

Collaborators

Thomas Devine, (Thomas.Devine@ARS.USDA.GOV), USDA Sustainable Agriculture Systems Lab, Beltsville, MD
Jerry Cherney (jhc5@cornell.edu), Cornell University

Forage Soybean Advanced Breeding Line Trial:

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 experimented with harvesting grain-type soybeans for forage, but 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.

Dr. Thomas Devine, a USDA 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 entries 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 required to hold the plants up resulted in 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.

Objective. The 2008 trial evaluated the agronomic performance of the most promising advanced breeding lines from Dr. Devine's forage soybean breeding program.

Methods. Eleven advanced breeding lines were included in the 2008 trial. Entries ranged from maturity group (MG) II to MG VI. Six of the entries were repeats from the 2007 trial, while five lines were being tested for the first time.

Field trials were established at two sites in Northern New York: the Cornell research plots at the W.H. Miner Institute in Chazy, and on a farm field in northern Jefferson County. Extensive deer damage destroyed the Jefferson County trial; the Chazy methodology and results are reported below.

A randomized complete block experimental design with four replications was employed. Plots were located on a Roundabout silt loam soil with tile drainage (Field range 2). 200 lbs/acre 6-24-24 was broadcast applied and incorporated with a spring-tooth harrow prior to planting. Two-row plots were planted with 30” row spacings on May 24, 2008. All seed was inoculated prior to planting. A mixture of *Python* and *Dual* herbicides was applied prior to soybean emergence. Plots were harvested on September 16, 2008. Entries were scored for plant height, maturity, and lodging. In each plot two 20’ long rows were chopped with a Carter harvester, weighed, and oven dried for yield and dry matter determinations. An additional five plants per plot were sampled for quality analysis. Quality sample plants were run through a chopper and immediately dried in ovens at 60^{o} C.

Results. 2008 results are tabulated in Tables 1& 2, and 2007 results are presented in Tables 3 & 4.

2008 Entry Notes:

97NYCZ26-1 (Pedigree: PA5-2-1 x IA2008B) – Produced the highest yields in the 2008 trial (Table 1). While listed as a MGII line, *97NYCZ26-1*’s development in the Chazy trials has been consistent with the later maturing MGIII entries. This line exhibited very little seed filling and had only reached the R5 stage of development by the September 16 harvest in 2008 (Table 2). Crude protein levels averaged 17.6%, which was very close to the trial mean of 17.8%. *97NYCZ26-1* was intermediate in height, had good lodging resistance, and had relatively low NDF levels (39.9%).

XB17 (Pedigree: (OR 22-14-1 x Hutch) x Surge) – An interesting MGIII line that was in the top yield group in the 2008 trial (Table 1). Crude protein levels (18.1%) were close to the overall trial mean, and were consistent with what would be expected in a plant harvested at the R5 development stage. NDF levels (40.1%) were slightly below the trial average. *XB17* had intermediate height, and good lodging resistance.

F5#15 (Pedigree: Marathon x OR5-12-1T) – A MGIII line that yielded poorly in both the 2007 (Table 3) and 2008 (Table 1) trials. While yields have consistently been on the low side, quality measures have been decent. Crude protein levels averaged 19.1% and 19.3% in 2007 and 2008, respectively. Fiber levels were average in 2008 with an NDF of 40.8%, but were below average in 2007 with an NDF of 37.8%. *F5#15* is intermediate in height and has good lodging resistance.

F5-55-1#5 (Pedigree: (PA7-1-1 x Spry) x (OR5-12-1T x Braxton)) – The tallest and latest maturing line (MGVI) in the 2008 trial. *F5-55-1#5* had the third highest mean yield (3.0 tons/acre dry matter) in 2008, but quality measures were poor. Crude protein averaged 15.7%, the lowest in the trial, and fiber levels were high with an NDF of 44.5%. High fiber levels are consistent with tall sturdy plants that have good lodging resistance, and low crude protein levels typically are typical of late maturing lines that only reach the R2 stage of development by harvest. 2008 was the first year *F5-55-1#5* was tested in Chazy.

F5#12 (Pedigree: Marathon x OR5-12-1T) -- Topped the yield ranking (along with *97NYCZ26-1*) in the 2008 trial (Table 1). 2008 was the first time *F5#12* was trialed in Chazy. The line is listed as a maturity group IV, but its 2008 development was more characteristic of a group V or early group VI line. *F5#12* reached the R2-R3 development stage by harvest. Late maturity, tall stature, and good lodging resistance were accompanied by high fiber levels (mean NDF=43.4%). Crude protein levels were around the trial average (17.0%), which is higher than the maturity group and R development stage at harvest would typically predict.

1GH12-1-1 (Pedigree: L94-5886 x 7P116) – A maturity group V entry that reached the R3 stage of development by harvest. *1GH12-1-1* was the second tallest line in the 2008 trial, and had the highest fiber levels (mean NDF=45.3), and the second lowest mean crude protein level (16.5%) (Table 2). It is interesting that the large, sturdy plant size did not translate into a more impressive yield in 2008 (Table 1), as this line ranked in the middle of the pack with respect to dry matter production per acre. *1GH12-1-1* was among the top yielders in the 2007 trial (Table 3), so there may be some consistency issues with this line.

97NYCZ22 (Pedigree: PA5-2-1 x IA2008BC) – 2008 was the first year *97NYCZ22* was tested in Chazy. The group IV line reached the R5 stage of development at harvest, and was an intermediate performer with respect to quality (Table 2) and yield (Table 1). It was interesting that *97NYCZ22* had the highest percent moisture content at harvest.

F5#16 (Pedigree: Marathon x OR5-12-1T) – Listed as a MGIV line, but has consistently looked more like a group III entry in Chazy trials. *F5#16* is relatively low yielding, but has high quality measures. In 2008, it had the highest mean crude protein level (20.0%), and the lowest fiber content (mean NDF=37.4). The plant is relatively short and has excellent lodging resistance.

F5,4-1#3 (Pedigree: Marathon x Tara) – This entry is listed as a maturity group III line, but it has managed to fill some seed pods prior to harvest in each of the past two trials, and should probably be listed as a maturity group II line. *F5,4-1#3* was the shortest and lowest yielding entry in the 2008 trial. Quality measures were predictably favorable with an average crude protein level of 19.4% and an NDF of 39.0% (Table 2).

F5#3 (Pedigree: Marathon x Tara) – This entry is listed as a maturity group IV line, but develops like a maturity group II line in Chazy. 2008 was the first year it was tested. *F5#3* reached the R6 development stage by harvest, and was the earliest maturing entry in the trial. The line is short and has lower than average fiber levels (mean NDF=39.5). Crude protein levels, at 17.4%, were much lower than would be expected given that there was significant seed fill in the pods. The more advanced maturity of *F5#3* was accompanied by lower plant moisture levels at harvest.

F5#22 (Pedigree: SG13#53 x 97NYCZ29-1) – 2008 was the first year *F5#22* was tested. This line is on the tall side with good lodging resistance. NDF levels were surprisingly low (40.5%) for such a tall, sturdy plant. Yield and crude protein levels were around the trial average.

Forage Soybean Trial Discussion

The 2008 forge soybean trial had a lower overall mean dry matter yield (2.8 tons/acre) than either the 2007 trial (3.2 tons/acre) or the 2006 trial (3.9 tons/acre). A general trend toward decreasing yields over time is, at least partly, a function of the breeding program's selection emphasis on shorter, earlier maturing lines that yield less, but have desirable forage quality features. There is an unavoidable trade-off between plant size and sturdiness, which translates into shoot biomass yield, and crude protein and fiber content, which characterize forage quality. Large, sturdy plants that stand up well and produce a lot of biomass inherently have a high fiber content (high NDF) and therefore reduced forage quality. Additionally, tall, late maturing plants fail to produce much seed when grown in northern New York, so crude protein levels tend to be relatively low. The trick in this selection process will be to identify lines that optimize the balance between yield, lodging resistance, and quality when grown in northern NY. No lodging problems were observed in any of the 2008 trial plots. Four lines that appeared to provide a favorable balance between quality and yield in 2008 are *XB17, F5#16, F5#3*, and *F5#22*.

Food Grade Soybean Trials:

Background. Demand for high quality food grade soybeans continues to grow. Northern New York farmers have considerable experience growing grain-type soybeans, and could enhance their profit potential by incorporating food grade soybeans into their field crop rotations. If growers are going to be successful with food grade soybean production, it is essential that we identify food grade soybean varieties that are well adapted to Northern New York growing conditions, and meet the quality specifications and requirements of regional processors.

Objective. To test the agronomic performance of available varieties of food grade soybeans when grown organically under northern New York growing conditions.

Methods. Twelve commercially available food grade soybean varieties were included in the 2008 trial. A randomized complete block experimental design with four replications was employed. Food grade soybeans were grown on tile drained, certified organic fields with a Rhinebeck clay loam soil at the Cornell University Willsboro Research Farm. Trial plots were 10' wide and 20' long, and consisted of four rows with a 30" spacing between the rows. Target planting depth was 1" and all seed was inoculated with the appropriate *Rhizobium* sp. prior to planting. Plots were seeded May 28. 2008 and harvested October 15, 2007. Weed control measures included cultivation with a rotary hoe (two passes in opposite directions) when the plants were approximately 4" tall and had their first set of true leaves, and an additional between row cultivation with sweeps in mid summer (sweeps were mounted on an Allis Chalmers G tractor).

Food Grade Soybean Trial Results. 2008 was the second year for the organic food grade soybean variety trial. Results for 2007 and 2008 are presented in Tables 5 & 6, respectively. No disease or lodging problems were observed in the trial. The overall mean soybean yield was significantly higher in the 2008 trial (48.0 bu/acre) than in the 2007 trial (41.4 bu/acre). The high-low yield ranking order also differed considerably between trial years. For example, *Boyd*, the top yielding variety in 2008, was among the lowest yielding entries in 2007. Conversely, *1F61* was the high yielder in 2007, but ranked near the bottom in 2008. *OAC Prudence* exhibited some consistency as it ranked at or near the bottom of the list in both 2007 and 2008. While an additional one or two years of testing is required to sort out the relative yield potential of the different entries, most of the varieties appear to be well adapted to northern NY growing conditions.

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 and Food Grade Soybean 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:

Peter Barney (pmb10@cornell.edu), Senior Extension Resource Educator, CCE of St. Lawrence County
Michael H. Davis (mhd11@cornell.edu), Research Associate, Dept. of Crop and Soil Sciences, Cornell University E.V. Baker Research Farm
Michael Hunter (meh27@cornell.edu), Cornell Cooperative Extension of Jefferson County

Table 1. Northern New York 2008 Forage Soybean Trial Results

Variety/Selection Line	Maturity Group	Dry Matter Yield	Moisture at Harvest	Plant Height	Lodging
		tons/a	%	inches	Scale 0-10
	Trial Mean	2.8	77.2	48.1	0
	LSD	0.4	1.7	6.9	
	LSD P>	0.05	0.05	0.05	
	CV	9.8	1.6	10.0	
	F Test	0.0023	0.0011	0.0001	
97NYCZ26-1	II	3.2	76.1	44.7	0
XB17	III	2.9	76.4	48.9	0
F5#15	III	2.5	77.1	45.1	0
F5-55-1#5	VI	3.0	76.9	59.5	0
F5#12	IV	3.2	77.7	53.3	0
1GH12-1-1	V	2.8	78.6	55.0	0
97NYCZ22	IV	2.8	80.0	46.3	0
F5#16	IV	2.6	77.2	42.0	0
F5,4-1#3	III	2.4	76.2	41.6	0
F5#3	IV	2.7	75.7	42.4	0
F5#22	V	2.7	77.8	50.0	0

Table 2. 2008 Forage Soybean Trial Forage Quality Results

Variety/Selection Line	Maturity Group	R-Stage At Harvest	Crude Protein	NDF	NDFD30
		R-stage	%	%	%
	Trial Mean	4.4	17.8	41.2	36.5
	LSD	0.3	1.2	2.1	
	LSD P>	0.05	0.05	0.05	
	CV	4.2	4.5	3.6	10.0
	F Test	0.0001	0.0001	0.0001	0.112
97NYCZ26-1	II	5.0	17.6	39.9	34.3
XB17	III	5.0	18.1	40.1	34.0
F5#15	III	5.0	19.3	40.8	37.0
F5-55-1#5	VI	2.5	15.7	44.5	36.3
F5#12	IV	2.0	17.0	43.4	35.0
1GH12-1-1	V	3.0	16.5	45.3	39.0
97NYCZ22	IV	5.0	16.8	42.7	36.0
F5#16	IV	5.0	20.0	37.4	40.0
F5,4-1#3	III	5.4	19.4	39.0	40.5
F5#3	IV	6.0	17.4	39.5	35.8
F5#22	V	5.0	18.0	40.5	33.5

Table 3. Northern New York 2007 Forage Soybean Trial Results

Variety/Selection Line	Maturity Group	Dry Matter Yield	Moisture at Harvest	Plant Height	Lodging
		tons/a	%	CM	Scale 0-10
	Trial Mean	3.2	73.6	136.3	0.9
	LSD	0.5	1.42	12.7	0.8
	LSD P>	0.1	0.1	0.1	0.1
	CV	14.5	1.6	7.8	68.8
	F Test	0.1605	0.0231	0.0001	0.0001
97NYCZ26-1	II	2.9	73.1	128.8	0
IA2068	II	3.1	72.8	90.0	0
IA3023	III	2.9	74.4	96.3	0
XB17	III	3.1	73.6	139.8	1.0
97NYCZ33-1	III	3.1	74.7	134.0	0.3
4-1#3	III	3.1	72.8	129.5	0.3
F5#15	III	2.9	73.5	126.0	0
F5#16	IV	3.0	72.6	126.5	0
Tara	V	3.5	73.1	145.3	0.3
Donegal	V	3.7	74.9	167.3	8.0
AWS#4	VI	3.5	73.1	179.8	2.0
1GH12-1-1	VI	3.5	72.3	161.0	0.8
SG13#53	VI	3.1	74.4	142.0	0.3
F558	VI	2.9	75.2	146.0	0.5

Table 4. 2007 Forage Soybean Trial Forage Quality Results

Variety/Selection Line	Maturity Group	R-Stage At Harvest	Crude Protein	NDF	NDFD
		R-stage	%	%	%
	Trial Mean	4.5	17.4	40.9	45.2
	LSD	0.2	1.6	3.5	4.9
	LSD P>	0.1	0.1	0.1	0.1
	CV	4.3	7.5	7.3	9.1
	F Test	0.0001	0.0001	0.0011	0.0009
97NYCZ26-1	II	5.5	18.1	40.7	47.5
IA2068	II	6.0	20.3	37.1	44.0
IA3023	III	5.9	21.0	38.5	51.8
XB17	III	5.0	17.1	42.2	42.8
97NYCZ33-1	III	4.9	15.9	41.1	48.3
4-1#3	III	6.0	18.7	37.6	49.5
F5#15	III	5.4	19.1	37.8	43.8
F5#16	IV	5.1	19.4	37.9	49.0
Tara	V	5.2	16.3	42.3	46.3
Donegal	V	5.0	16.7	40.5	48.0
AWS#4	VI	2.4	15.0	45.3	40.8
1GH12-1-1	VI	3.0	16.0	43.7	41.0
SG13#53	VI	2.3	14.6	45.1	39.5
F558	VI	2.0	16.2	42.4	40.8

Table 5. 2007 Food Grade Soybean Trial Results

Variety	Yield	Moisture	Plant Height	Lodging
	Bu/acre	%	inches	0-10 scale
Trial Mean	41.5	12.8	33.3	0
LSD	3.9		2.0	
LSD P>	0.1		0.1	
CV	7.8	9.2	8.9	
F Test	0.0018	0.3051	0.0001	
1F61	45.9	13.2	28.2	0
21YP7	45.6	12.9	35.5	0
OAC Oxford	42.8	11.7	35.7	0
2F11	42.6	13.3	27.2	0
CFO703	42.3	13.4	36.4	0
IA24	42.0	12.9	27.9	0
OAC Champion	41.8	13.0	32.0	0
SO8-80	41.6	13.6	32.9	0
SO3W4	40.4	12.5	33.4	0
1F44	40.2	11.5	34.4	0
Boyd	39.1	13.2	43.9	0
OAC Prudence	34.0	12.4	31.9	0

Table 6. 2008 Food Grade Soybean Trial Results

Variety	Yield	Moisture	Plant Height	Lodging
	Bu/acre	%	inches	0-10 scale
Trial Mean	48.0	12.9	35.2	0
LSD				
LSD P>				
CV	14.0	5.3	13.3	
F Test	0.1866	0.2436	0.0612	
Boyd	52.7	13.3	34.0	0
SO8-80	52.7	13.6	35.4	0
1F44	52.2	13.3	42.7	0
2F11	50.8	12.7	37.3	0
SO3W4	49.6	12.8	34.6	0
IA24	49.4	12.2	37.0	0
21YP7	49.3	12.5	37.4	0
CFO703	46.4	12.9	35.1	0
OAC Oxford	44.9	12.5	33.8	0
1F61	44.7	12.8	30.4	0
OAC Prudence	42.6	13.0	31.0	0
OAC Champion	40.4	13.2	33.0	0

Photo:

Harvesting forage soybean test plots at the Cornell Research Plots in Chazy, NY.

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Determination of infectivity of *Fascioloides magna* in northern New York cattle herds**

Project Leader(s): Michael J. Baker, PhD. Sr. Extension Associate, Department of Animal Science, Cornell University.

Collaborator(s):

Dr. Laura Raymond, DVM Watertown Animal Hospital

John Campany, Croghan Meat Company, Croghan

Brent Buchanan, CCE St. Lawrence County

Ron Kuck, CCE Jefferson County

Michele Ledoux, CCE Lewis County

Cooperating Producers: Don Holman, Jefferson County

Background: There is growing interest in increasing the use of grasslands to improve animal performance and profitability. Grasslands can be used to improve the profitability of products for the commodity market such as stocker cattle or specialty markets, like the grass finished market. Additionally, the dairy industry utilizes pasture to supply a portion of the nutrients required by their cattle. Much of the pasture land in NNY is land not suitable for crop production due to low fertility, slope and drainage. Wet areas are often part of the pasture system and are breeding grounds for several internal parasites. The large liver fluke (*Fascioloides magna*) also known as the deer fluke has been found in the livers of slaughter cattle in two NNY plants. According to USDA regulations when a fluke is found in the liver it is condemned. While the value of liver is not a large part of income to the producer, heavy infestations can result in impaired animal performance. This affects growth rate in younger cattle and may impede reproductive efficiency in the cow herd. Deer flukes are common in other regions of the US, however the presence in our region has not before been documented. Unlike internal parasites common to this region, detection is not possible with fecal egg counts. Examination of the liver at slaughter is the best means to confirm the deer fluke infestation. The commonly used anthelmintics used in control of internal parasites have been shown to have limited effectiveness in controlling the deer fluke. Timing of treatment and changes in pasture management are the only known control. Therefore if grasslands are to be used more intensively in NNY especially those in wet areas, knowledge of the presence of liver flukes and resulting control measures need to be known.

Methods: Cooperative Extension Educators in each of the 6 NNY counties identified packing plants, both custom and USDA facilities and contacted them regarding their interest in participating in the study. A data entry sheet was developed to inventory and describe the cattle slaughtered and the number of livers condemned. Digital cameras were provided to each of the participating plants. Participating plants were to record the number of condemned livers and if fluke infection was suspected, then samples of the liver were to be collected. Dr. Laura Raymond, DVM was hired to teach plant personnel how fill out the data entry sheet, look for flukes, collect and preserve liver samples if flukes were suspected and photograph the specimen. Data and specimen collection occurred from April

2008 through December 2008. Specimens were sent to the Cornell Diagnostic Lab for confirmation of presences of *Fascioloides magna (F. magna).*

Results: Data collected at the five plants are shown in Table 1, Appendix 1. Sample collection occurred from April through December 2008. The plants were located in Lewis, Jefferson and St. Lawrence Counties; two were USDA inspected and three were custom plants. Of the 16 cattle sampled 4 were female and 12 were male. The average age of the cattle sampled was 3.2 years; five head were 2 years of age or less. As the population of cattle in the region is predominantly of dairy breeding, it follows that 69% of the cattle sampled were Holstein or Ayshire. The body condition score of the cattle averaged 3.6 indicating that the majority of the cattle were in good condition.

Plants A & B cited USDA log books for number of cattle slaughtered. Plant B also used a USDA log book to determine the number of livers condemned for fluke infestation. All other data from the plants was estimated by the plant owner and/or USDA inspector. The total number of cattle slaughtered during the collection period was approximately 1425 (Table 2, Appendix 1). The protocol stated that samples would be collected from all condemned livers. Plant A only collected 4 samples from approximately 35% of the livers condemned for flukes. Of these four samples one was positive for *F. magna*; the remaining three samples contained black pigment which according to the Diagnostic Lab, is indicative of the presence of *F. magna*. Plant B collected samples on 6 of the 11 condemned livers. All six were positive for *F. magna*. Of the 200 cattle slaughtered by Plant C, only one liver contained a fluke which was positively identified as *F. magna*. The last two plants reported no flukes in livers during the sampling period.

If only the confirmed cases of *F. magna* were used, the rate of infection was just under 1% of the cattle slaughtered in the five plants. While there are several species of liver flukes, only *F. magna* was positively identified. According to the literature, the other two species of flukes do not have a range in habitat that includes northern New York. Therefore it is probably a reasonable assumption that if a liver is condemned for flukes, it is most likely due to *F. magna*. Based on this assumption, average infectivity rate was 25%, with a range of 0% - 35%.

Conclusions/Outcomes/Impacts: The cattle that were infected with *F. magna* were generally older than two years of age and in relatively good body condition. Most authors feel that cattle can withstand up to moderate levels of infection with little impact on animal performance, yet the data found in the literature is inconclusive. The data from this survey would indicate that based on body condition score, cattle were not being adversely affected by fluke infestation. Most of the cattle in this survey were young dairy bulls (< 4 years old), which is probably more a function of the type of cattle slaughtered in Plant B than a description of the cattle most susceptible to infection. However, many of these bulls came from a dairy heifer raising operation which included a significant period of time grazing in swampy areas. With the allegedly high level of infection in Plant A, a more thorough characterization of the cattle in this plant might be more enlightening.

Based on the literature control of *F. magna* involves removing the intermediate host (snail) or definitive host (white-tailed deer) or reducing cattle exposure to these hosts. Given that most pastures consist of swampy areas in ideal deer habitat, these controls may not be practical. Limited success with anthelmintics has been reported in the literature; however the products are not labeled for control of *F. magna* in cattle. The products are albendazole (Valbazen® Suspension) and clorsulon (CURATREM®). Producers suspicious of fluke infection should work with their herd veterinarian to determine management options for prevention and control.

Outreach: A Power Point presentation was given Essex, Clinton, Franklin and St. Lawrence Counties in July, 2008 and Essex, St. Lawrence and Jefferson Counties in November, 2008. The presentation reviewed the project, results and discussed prevention and treatment options for the large liver fluke.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. What need to be better understood is why the one plant had such a high degree of condemned livers due to flukes. The USDA inspector in that plant was interested in this study and perhaps a more controlled data collection system could be designed. This may locate a geographical area or type of cattle that are particularly prone to *F. magna* infestation.

Reports and/or articles in which the results of this project have already been published.

"Deer parasite found in North Country beef cattle" Watertown Daily Times. January 14, 2009. http://www.watertowndailytimes.com/article/20090114/NEWS03/301149970

"Beef-cattle parasite found in local area" The Press Republican. January 18, 2009. http://www.pressrepublican.com/archivesearch/local_story_018001706.html

"Beef cattle parasite found in Northern New York. The Post Standard. January 13, 2009. http://blog.syracuse.com/farms/2009/01/beef_cattle_parasite_found_in.html

Person(s) to contact for more information (including farmers who have participated:
Michael J. Baker, Cornell Extension Specialist, 114 Morrison Hall, Cornell University, Ithaca, NY 14853. 607-255-5923. mjb28@cornell.edu

Don Holman, Holmdale Farms. 15107 State Route 178, Adams, NY 13603. 315-232-4185.

Appendix 1.

Table 1. Data collected for survey of *Fascoilodes magna* in Northern New York, April – December 2008

Plant name	Sex	Age, yr	Breed	BCS[1]	County	Liver Sample	Result
A	m	1.5	Holstein	3	St. Lawrence	y	positive
A	m	2	Angus	3	St. Lawrence	y	negative[2]
A	f	6	Hereford	5	-	y	negative[2]
A	f	3	Holstein	3	St. Lawrence	y	negative[2]
B	m	4	Angus	3	St. Lawrence sale barn	y	positive
B	m	-	Holstein	-	Lewis	y	positive
B	f	4	Holstein	3	-	n	
B	m	2	Holstein	3	Lewis	y	positive
B	m	4	Red Angus	1	Lewis	y	positive
B	m	4.5	Holstein	3	St. Lawrence sale barn	y	positive
B	m	3	Holstein	5	Lewis	y	positive
B	m	4	Ayshire	3	St. Lawrence	n	
B	m	2	Holstein	5	-	n	

B	m	3	Holstein	5	Lewis	n	
B	m	3	Holstein	5	Lewis	n	
C	f	2	Angus cross	4	Jefferson	y	positive
D	No flukes found						
E	No flukes found						

[1]Body Condition Score (1=lean 5=fat)
[2]No fluke found but black pigment which is associated with *Fascioloides magna*

Table 2. Cattle slaughtered and flukes identified April – December, 2008

Plant	No. slaughtered	No. flukes[1]	%
A	994	348 (4)	35
B	101	11 (6)	11
C	200	1 (1)	1
D	40	0	0
E	90	0	0

[1]Value in parenthesis is number of *Fascioloides magna* confirmed by Cornell Diagnostic laboratory

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: Improving Beef Carcass Quality/Consistency Using Ultrasound

Project Leader: Jessica Prosper, CCE Franklin; jlr15@cornell.edu

Collaborators:

Bernadette Logozar, Franklin County bel7@cornell.edu
Michele Ledoux, Lewis County mel14@cornell.edu
Anita Deming , Essex County ald6@cornell.edu
Blake Putman, Clinton County blp26@cornell.edu
Brent Buchanan, St. Lawrence County bab22@cornell.edu
Ron Kuck, Jefferson County rak76@cornell.edu
Mike Baker, Beef Cattle Extension Specialist mjb28@cornell.edu
Heather Birdsall, CCE Cortland County, hhb6@cornell.edu

Cooperating Producers:

Clinton County: Penny Pombrio, Corbiau Creek Angus Farm, Altona, NY
Franklin County: Hugh and Ginette Stark, Double T Ranch, Malone, NY
Jefferson County: Lloyd Garnsey, Clayton, NY

Background: According to the New York Agricultural Statistics 2006-2007 Annual Bulletin, there are currently 13,200 Beef Cattle being raised on farms in the six northern NY counties. Many of these are small, part-time operations where farmers often lack important knowledge in regards to grading their animals and carcass composition. Such information is essential for the efficient production of lean, consistent beef that consumers demand in today's market.

There has been an expressed need by farmers and producers in the region to work toward raising animals of more consistent quality, both for local and conventional markets.

Farmers who can accurately grade their animals on the farm because of their knowledge and understanding of carcass composition will be able to more effectively market their animals in a variety of market channels resulting in a more profitable business.

Methods: Beef animals in three central locations in counties across the region were analyzed through the use of ultrasound to measure the percentage of fat and the amount of marbling in the animals. This provided a reliable estimate of live animal composition, which showed the participants how animals differed according to their breeds, ages, and management practices. Knowing this information will assist farmers in gauging when their animals have reached their "optimal" sale weight and carcass composition.

The second portion of the program was more academic and involved a presentation on meat quality. This included such things as meat quality factors, factors that affect meat quality, and how the USDA grading system works.

Conclusions/Outcomes/Impacts: The outcome/impact of this project was that the participants were able to gain a better understanding of meat quality and how it is impacted by both environmental and genetic factors. Participants were also educated on the use of ultrasound on beef operations. This was the first time that most of the participants had seen ultrasound used in this manner. Upon reviewing the evaluations, most of the participants learned a lot from the demonstration and the presentation. Most left with better understanding of how the information could be used to improve some of the practices on their farms, including choosing better replacement animals, grading, and finishing their animals.

Outreach: Farmers were informed of the project prior to the workshops through several avenues. These included articles and notices in county Cooperative Extension Ag news publications and by Kara Dunn in various agricultural publications. Following the workshops, articles were published in county publications as well as an article in the Watertown Daily Times that can be found at: http://www.watertowndailytimes.com/article/20080917/NEWS03/309179943.

Participants in the workshop were also able to bring information away from the program in the form of a folder of information that was compiled to reinforce what was learned while attending the workshop.

The information that was included in the folder is attached.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. Because this was the first time many of the beef producers in the area were introduced to ultrasound, we feel that the next step in this educational process should be to give beef producers the opportunity to actually have their own animals ultrasounded and have the images analyzed and interpreted by an Ultrasound Processing Lab. After the results are received, we would then follow up with how the results are applied and used in regards to culling animals and bull selection in order to result in shifting the herd to producing a more consistent product.

Acknowledgments: Funded solely by NNYADP

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

Mike Baker
Cornell Beef Cattle Extension Specialist
Cornell University
114 Morrison Hall
Ithaca, NY 14853

Jessica Prosper
Franklin County Cooperative Extension
355 West Main Street
Malone, NY 12953

Northern NY Agricultural Development Program
2007-2008 Project Report

Project Title: **Cold Hardy Willsboro Wine Grape Cultivar Trial - Stage Three.**

Project Leader: Kevin Iungerman, CCE Northeast NY Commercial Fruit Program.

Collaborator(s): Grape Growers and Extension Associations of CCE's NENY Commercial Fruit Program (Albany, Clinton, Essex, Saratoga, Washington Counties). The Lake Champlain Grape Growers Association. The Cornell Willsboro Baker Farm. Steven Lerch, Cornell Grape Program, Geneva. Chris Gerling, Cornell Wine Analytical Lab, Geneva.

Cooperating Producers: (Include a list of producers who participated in the project. List producers by county.)

County	Producer	Farm/Vineyard	City/Town	State
Clinton	Phil Favreau	Stone House Vineyard	Mooers	NY
Clinton	Richard Lamoy	Lamoy Vineyard	Morrisonville	NY
Clinton	Rob McDowell	Purple Gate Vineyard	Plattsburgh	NY
Essex	William & Kathryn Reinhardt	Blue Stone Vineyards	Willsboro	NY
Essex	Peter Rowley	Edgewater Farm	Willsboro	NY
Essex	Libby Treadwell	Bessboro Farm	Westport	NY
Orange	Ed Lincoln	Maple Gate Farm	Randolph	VT
Windsor	Robert Stevens	BowVineyard	Weathersfield	VT

Background: The Willsboro Wine Grape Trial was planted as a unique, 300-vine vineyard comparative performance trial of 25 cold-hardy-wine-grape-cultivars in 2005 with the help of private and land-grant collaborators and also the NYFVI and NNADP funding assistance.

Performance differences were extensive in the first year because of initial vine quality variability owing to procurement issues: the uniqueness of the vines; the many varied nurseries providing the vines; the different planting forms available (bare root, softwood cuttings, grafts, plugs) and their requisite multiple planting dates; and delayed order placement arising from funding uncertainty and the rather extensive consultative process of establishing the trial. And so, 2005 performance variability was not due to site or climate factors.

In 2006, growth performance and vine pruning and training practices largely leveled the initial differences previously cited. An exception was the nearly 33% mortality with Petite Amie vines which had been received as soft wood cuttings, which were of marginal quality. Hardened canes were taken from healthy plants and these cuttings were propagated at the NYSAES, Geneva for replacement plantings. Plantings were made in early summer 2006.

Very small crop amounts were carried on healthy vines in 2006 to ensure that fall vine acclimation would not be compromised going into the 2006-2007 winter dormant period. Retained crop was utilized more for purposes of identification and for grower education and tasting. What crop there was, was divided up among our volunteers. Overall, vines were in very good condition in late fall of 2006.

The focus for the 2007 growing season was to allow the vines to become more fully established. Vines were minimally maintained, with minimal summer pruning and crop protectant spray applications. Beginning in mid-August, weekly tasting and brix readings were initiated, and periodic juice samples were taken for evaluations. These practices helped to establish a relative maturity sequence, which sets the stage for full cropping and finished wine making in 2008. Differences in crop load and quality were noted.

We confirmed that one grape cultivar was miss-identified. Early clusters of Ravat in 2006 suggested a larger problem, as they bore black fruit rather than the expected white. Fuller cropping in 2007 confirmed we had not received Ravat at planting. Fortunately, this is an inconvenience not a major setback; other grapes, such as Niagara can serve the regional comparison purpose that had been Ravat's role. (We have been unable to identify these "Not-Ravat" grapes to date.") Bird netting was applied in mid-August. The harvest, over September and October, was weighed by cultivar (not by vine) and again distributed among our winemaking volunteers.

The fall 2007 acclimation period was outstanding, superior to 2006, and indeed this was the case across all of NY. Unfortunately, the 2007 - 2008 winter was again mild, as they have been since the vines were planted. These mild winters are undermining a major purpose of this trial, namely establishing the relative cold hardiness merits of the different vines being evaluated. Contrary to expectations, virtually all of the grapes in the trial have done quite well to date and virtually all of the cultivars (except the replacements) produced fruit.

Methods: Growing season data collection was enhanced in 2008 because of the 0.25 time seasonal assistant being on site. Richard Lamoy noted dates of bud break, cane growth stages, bloom, capfall, berry set, and veraision for each of the wine grape cultivars by individual vine. Lamoy monitored for insect and disease issues and applied pesticides in accordance with the NY-PA Pest Management Guidelines for Grapes and in consultation with Kevin Iungerman. Lamoy also prepared juice samples and these were sent to Tim Martinson, of Cornell's Statewide Viticulture Program.

Over the course of the growing season, the tasks of vine tying, pruning, and training were largely carried out with Willsboro volunteer assistance in our "working seminars". Lamoy also monitored maturity weekly from mid-August through the September and October harvests. Lamoy and Iungerman coordinated the organization of volunteers for our harvests on September 24, 26, and October 1, 4, 2008. All grapes were picked and weighed by individual vine, and transported the same or the next day to the Cornell Wine Lab.

Results: The 2008 growing season was both cooler and wetter than the 2007 season, but vine condition was very good and late summer conditions were very favorable for berry maturation. Stepped-up attention to canopy care with greater shoot positioning and light cane removal better positioned grapes for both sun exposure and better air circulation. Overall, these and other IPM practices prevented any significant disease or insect injury.

Rain twice caused harvest date change as wetness greatly complicates weighing (and volunteers drop off too). On each harvest date, Steven Lerch of the Geneva Grape Program transported grapes intended for the Cornell Wine Lab to Geneva.

The 2008 harvest marked the first time that harvests of the more promising of the Willsboro wine grapes were selected, harvested, and transported to the Cornell Wine Lab at the Geneva, to be made into uniformly finished wines in a controlled environment. Extension enologist Chris Gerling and his staff handled the wine making part of this research. Wines have been made from five red grape cultivars (Marquette, MN 1200, Sabrevois, St. Croix, and Frontenac) and six whites (ES 6-16-30, LaCrescent, Petite Amie, NY 76.844.24, Prairie Star, and St. Pepin). Chris reports that the fully finished wines will be available in late spring to early summer, 2009.

Iungerman and Gerling will conduct one or more wine reviews of these "Cornell-" and "volunteer-" Willsboro wines at educational outreach sessions in 2009. Willsboro, NENYF, and stakeholder representatives will be alerted to these events.

Conclusions/Outcomes/Impacts: Four small wineries now exist in the NENYF program's 5 county area. Collectively, most of their raw product is sourced out-of-area, or where locally grown, the grapes and even the wine, are often lacking in quality. Shifting to hardier wine grapes capable of fully ripening in our short season, and improving local winemaking expertise with these hardier grapes are the two underlying goals of this project. I fully expect that this Willsboro work will aid several "pre-commercial" persons who are now cooperating with the NENYF program to assertively move their own vineyard and winery ventures to a commercial level. Our results should also boost "native" output of our existing wineries. Together, these outcomes should double the NENYF program area wineries in the next several years.

Outreach:

- In 2008, Iungerman organized "working seminar" sessions with volunteers, assisted by Richard Lamoy (seasonal horticulture field assistant) and several members of the Lake Champlain Grapes Growers Association. The working sessions covered dormant pruning, vine training and tying, overviews of vine health (disease and insect issues), bird netting, and finally, maturity and the four harvest events. Participants were contacted via postings to the NENYF program cce-cold-country-viticulture-L site and via the Lake Champlain Grape Growers email list.

- Iungerman and Lerch also participated in a dormant pruning session with approximately 20 attendees at Phil Favreau's Stonehouse Vineyard & Winery, at Mooers, NY on April 5, 2008.

- Iungerman and Tim Martinson organized the "Cold Climate Viticulture: Wines & Vines in the North Country." meeting at Willsboro's Noblewood Park on June 4, 2008. The workshop dealt with vineyard establishment issues, IPM, and also the Willsboro Trial and the wine grapes of the trial, and wine types that can be made. Speakers were Iungerman, Martinson, Chris Gerling, and Grape IPM Coordinator Tim Weigle. The Willsboro planting was visited as part of the day's program, and was followed by a wine tasting at the vineyard. The wines were obtained from Chris Granstrom of Lincoln Peak Winery in VT because they were blends of several of the wine grapes growing in the trial, most notably the Marquette grape. Seventy-five persons were in attendance. On June 5, the program was repeated at the Jefferson County CCE office in Watertown and a visit to the Yellow Barn Winery.

- Iungerman organized the "Cornell Tree Fruit & Berry Program Work Team Tour of the Champlain Fruit Production Region." over June 17 - 19. The Cornell Baker Farm, and the Willsboro Grape Trial were among the stops in the region that Iungerman arranged.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. Work remains to further develop optimal cropping techniques and increased production performance. The next logical step is to consider approaches to managing vigor and how such measures might impact the different cultivars and especially their wines. Such work will support extension educational practices for new and experienced grape growers alike via demonstrable practices. Cropping practices will be geared to enhancing grape sugar and acid formation as much as possible within the available light and temperature parameters of our northern latitude location. Additionally, we would need to illustrate how differences of practice can impact wood maturity for these various wine grape cultivars, a growth stage that is critical to the vines winter acclimation potential.

Acknowledgements: Thanks to Steve Lerch, Cornell Grape Program, Geneva; Richard Lamoy who was an exceptional seasonal employee; Mike Davis and the Cornell Willsboro Baker Farm Staff; the Lake Champlain Grape Growers Association; Willsboro volunteers Rob McDowell, Phil Favreau, and a number of others; -- all of whom have assisted me in carrying out this year's work at the Willsboro Trial. Thanks too, to the Growers and CCE Extension Associations of CCE’s NENY Commercial Fruit Program; CCE; and the Northern New York Agricultural Development Program, who provided the funding support for the technical and seasonal assistance and the wine making effort at Cornell.

Reports and/or articles in which the results of this project have already been published.

* *Standard And Hardier Cultivars Being Evaluated For Suitability, Willsboro NY ColdHardy Wine Grape Trial: A Subset Of Hardier Vines.* Cold Climate Viticulture: Wines and a Vines in the Northe Country, Willsboro and Watertown, NY, June 4, and 5, 2008.

* 2008 CCE Northeast NY Commercial Fruit Program Annual Report Success Stories: **"**Professional Outreach and Education for Commercial Fruit Producers", "Developing Volunteer Skills at the Willsboro Cold-Hardy Wine-Grape Tria", and "Willsboro Cold-Hardy Wine-Grape Trial Promising Wines".

Person(s) to contact for more information (including farmers who have participated: (Include US postal addresses, phone numbers email addresses and/or web sites if applicable.)

Richard Lamoy	Lamoy Vineyard	Morrisonville, NY	richl@charter.net
Rob McDowell	Purple Gate Vineyard	Plattsburgh,NY	redwine@charter.net
William & Kathryn Reinhardt	Blue Stone Vineyards	Willsboro, NY	willkath@willex.com
Libby Treadwell	Bessboro Farm	Westport, NY	Momandabe@aol.com
Ed Lincoln	Maple Gate Farm	Randolph, VT	hvacr@sover.net
Robert Stevens	BowVineyard	Weathersfield, VT	rasteve@comcast.net
Peter Rowley	Edgewater Farm	Willsboro, NY	ewfarm38@airmail.net

Willsboro Wine Grape Trial - Vine Development 2008							
Location (row.vine)	**Variety**	**Budburst**	**Shoots 10cm**	**Flowering**	**50% Capfall**	**Berry Set**	**Veraison**

1.1	Marquette	5/10/08	5/25/08	6/17/08	6/20/08	6/24/08	8/7/08
1.2	Frontenac	5/10/08	5/27/08	6/12/08	6/20/08	6/24/08	8/14/08
1.3	Foch	5/10/08	5/20/08	6/17/08	6/20/08	6/24/08	8/7/08
1.4	Louise Swenson	5/10/08	5/27/08	6/17/08	6/25/08	7/1/08	8/14/08
1.5	Petite Amie	5/10/08	5/27/08	6/17/08	6/24/08	7/1/08	8/19/08
1.6	Vignoles	5/13/08	6/8/08	6/24/08	7/1/08	7/8/08	8/19/08
1.7	Frontenac Gris	5/10/08	5/27/08	6/12/08	6/20/08	6/24/08	8/14/08
1.8	Sabrevois	5/10/08	5/27/08	6/17/08	6/20/08	6/24/08	8/14/08
1.9	St. Croix	5/10/08	5/20/08	6/17/08	6/25/08	7/1/08	8/14/08
1.10	St. Pepin	5/13/08	5/27/08	6/24/08	6/25/08	7/1/08	8/14/08
2.1	Noiret	5/13/08	6/8/08	6/22/08	7/1/08	7/8/08	8/19/08
2.2	Edelweiss	5/10/08	6/8/08	6/17/08	6/25/08	7/1/08	8/19/08
2.3	ES 6-16-30	5/16/08	5/27/08	6/24/08	6/29/08	7/8/08	8/19/08
2.4	Baco	5/8/08	5/20/08	6/12/08	6/17/08	6/24/08	8/14/08
2.5	Landot	5/21/08	6/12/08	6/25/08	7/1/08	7/8/08	8/19/08
2.6	Leon Millot	5/10/08	5/27/08	6/12/08	6/20/08	6/24/08	8/7/08
2.7	Mn 1200	5/10/08	5/27/08	6/12/08	6/20/08	6/24/08	8/7/08
2.8	Niagara	5/10/08	5/20/08	6/17/08	6/27/08	7/1/08	8/19/08
2.9	Cayuga White	5/15/08	6/8/08	6/24/08	6/29/08	7/2/08	8/14/08
2.10	Prairie Star	5/10/08	6/3/08	6/17/08	6/24/08	7/1/08	8/14/08
3.1	Ravat 34	5/10/08	5/27/08	6/20/08	6/25/08	7/1/08	8/14/08
3.2	GR7	5/8/08	5/20/08	6/12/08	6/20/08	6/24/08	8/14/08
3.3	Lacrosse	5/10/08	5/27/08	6/17/08	6/25/08	7/2/08	8/14/08
3.4	LaCrescent	5/10/08	5/27/08	6/12/08	6/20/08	6/29/08	8/14/08
3.5	NY 76.844.24	5/13/08	5/27/08	6/24/08	6/29/08	7/8/08	
3.6	Sabrevois	5/10/08	5/27/08	6/17/08	6/20/08	6/24/08	8/14/08
3.7	GR7	5/10/08	5/20/08	6/12/08	6/20/08	6/24/08	8/14/08
3.8	LaCrescent	5/10/08	5/27/08	6/17/08	6/24/08	6/29/08	8/14/08
3.9	Baco	5/8/08	5/20/08	6/12/08	6/17/08	6/24/08	8/14/08
3.10	Edelweiss	5/16/08	5/27/08	6/17/08	6/24/08	6/29/08	
4.1	NY 76.844.24	5/13/08	5/27/08	6/24/08	6/29/08	7/8/08	8/19/08
4.2	Marquette	5/10/08	5/20/08	6/17/08	6/24/08	6/29/08	8/7/08
4.3	Leon Millot	5/10/08	5/27/08	6/12/08	6/24/08	6/29/08	8/7/08
4.4	St. Pepin	5/10/08	6/8/08	6/24/08	6/29/08	7/1/08	8/14/08
4.5	Foch	5/8/08	5/27/08	6/17/08	6/24/08	6/29/08	8/14/08
4.6	ES 6-16-30	5/16/08	6/8/08	6/24/08	6/29/08	7/2/08	8/19/08
4.7	Cayuga White	5/10/08	6/3/08	6/24/08	6/29/08	7/8/08	8/14/08
4.8	Lacrosse	5/10/08	5/27/08	6/17/08	6/27/08	7/1/08	8/14/08
4.9	St. Croix	5/13/08	5/27/08	6/17/08	6/25/08	6/29/08	8/14/08
4.10	MN 1200	5/10/08	5/27/08	6/12/08	6/17/08	6/24/08	8/7/08
5.1	Vignoles	5/13/08	6/8/08	6/24/08	6/29/08	7/2/08	8/19/08
5.2	Landot	5/21/08	6/12/08	6/24/08	6/29/08	7/2/08	8/19/08
5.3	Ravat 34	5/10/08	6/8/08	6/17/08	6/25/08	6/29/08	8/14/08

5.4	Frontenac	5/10/08	5/27/08	6/17/08	6/20/08	6/24/08	8/14/08
5.5	Petite Amie	5/10/08	5/27/08	6/17/08	6/24/08	6/29/08	8/19/08
5.6	Louise Swenson	5/10/08	5/27/08	6/17/08	6/25/08	7/1/08	8/19/08
5.7	Niagara	5/8/08	5/20/08	6/17/08	6/24/08	6/29/08	8/19/08
5.8	Prairie Star	5/13/08	5/27/08	6/17/08	6/24/08	7/1/08	8/14/08
5.9	Noiret	5/13/08	5/27/08	6/24/08	6/29/08	7/2/08	8/19/08
5.10	Frontenac Gris	5/10/08	5/27/08	6/12/08	6/17/08	6/24/08	8/14/08
6.1	Foch	5/10/08	5/27/08	6/14/08	6/17/08	6/24/08	8/7/08
6.2	Edelweiss	5/10/08	6/3/08	6/17/08	6/25/08	6/29/08	8/19/08
6.3	Vignoles	5/16/08	6/12/08	6/24/08	6/29/08	7/2/08	8/19/08
6.4	Landot	5/20/08	6/12/08	6/24/08	6/29/08	7/8/08	8/19/08
6.5	Ravat 34	5/10/08	5/27/08	6/17/08	6/24/08	6/29/08	8/14/08
6.6	Noiret	5/10/08	5/27/08	6/24/08	6/29/08	7/2/08	8/19/08
6.7	Cayuga White	5/16/08	6/8/08	6/24/08	6/25/08	7/1/08	8/19/08
6.8	Leon Millot	5/10/08	5/27/08	6/12/08	6/17/08	6/24/08	8/7/08
6.9	Louise Swenson	5/10/08	5/27/08	6/17/08	6/25/08	6/29/08	8/19/08
6.10	Niagara	5/10/08	5/20/08	6/17/08	6/25/08	6/29/08	8/19/08
7.1	St. Pepin	5/16/08	6/8/08	6/17/08	6/29/08	7/2/08	8/14/08
7.2	Petiete Amie	5/13/08	6/8/08	6/17/08	6/24/08	6/29/08	8/19/08
7.3	Mn1200	5/10/08	5/27/08	6/12/08	6/17/08	6/24/08	8/7/08
7.4	ES 6-16-30	5/13/08	6/8/08	6/17/08	6/25/08	7/1/08	8/19/08
7.5	Lacrosse	5/13/08	5/27/08	6/17/08	6/29/08	7/1/08	8/14/08
7.6	Sabrevois	5/13/08	5/27/08	6/17/08	6/24/08	6/29/08	8/14/08
7.7	Marquette	5/10/08	5/20/08	6/17/08	6/20/08	6/24/08	8/7/08
7.8	Frontenac Gris	5/10/08	5/27/08	6/12/08	6/17/05	6/24/08	8/14/08
7.9	Frontenac	5/10/08	5/27/08	6/14/08	6/17/08	6/25/08	8/14/08
7.10	GR7	5/8/08	5/16/08	6/12/08	6/17/08	6/24/08	8/14/08
8.1	LaCrescent	5/10/08	5/20/08	6/12/08	6/24/08	6/29/08	8/14/08
8.2	St. Croix	5/13/08	5/27/08	6/17/08	6/25/08	6/29/08	8/14/08
8.3	Baco	5/8/08	6/8/08	6/12/08	6/24/08	6/29/08	8/14/08
8.4	Prairie Star	5/10/08	6/3/08	6/17/08	6/25/08	6/29/08	8/14/08
8.5	NY 76.844.24	5/10/08	6/3/08	6/24/08	6/29/08	7/2/08	8/19/08
8.6	Niagara	5/10/08	5/20/08	6/17/08	6/25/08	6/29/08	8/19/08
8.7	Cayuga White	5/16/08	5/27/08	6/24/08	6/29/08	7/2/08	8/19/08
8.8	Edelweiss	5/13/08	5/27/08	6/24/08	6/25/08	6/29/08	8/19/08
8.9	Vignoles	5/13/08	6/8/08	6/24/08	6/29/08	7/2/08	8/19/08
8.10	Leon Millot	5/10/08	5/27/08	6/12/08	6/17/08	6/24/08	8/7/08
9.1	Loiuse Swenson	5/13/08	6/3/08	6/17/08	6/25/08	6/29/08	8/14/08
9.2	ES 6-16-30	5/16/08	6/8/08	6/17/08	6/25/08	6/29/08	8/14/08
9.3	Landot	5/20/08	6/12/08	6/24/08	6/29/08	7/8/08	8/14/08

9.4	LaCrescent	5/8/08	5/27/08	6/12/08	6/17/08	6/24/08	8/14/08
9.5	Marquette	5/10/08	5/27/08	6/12/08	6/24/08	6/29/08	8/7/08
9.6	Noiret	5/13/08	5/27/08	6/20/08	6/29/08	7/2/08	8/19/08
9.7	Frontenac Gris	5/10/08	5/27/08	6/12/08	6/17/08	6/24/08	8/14/08
9.8	St. Croix	5/10/08	5/27/08	6/17/08	6/25/08	6/29/08	8/14/08
9.9	Sabrevois	5/10/08	5/27/08	6/17/08	6/24/08	6/29/08	8/14/08
9.10	Frontenac	5/10/08	5/27/08	6/12/08	6/20/08	6/24/08	8/14/08
10.1	St. Pepin	5/16/08	6/8/08	6/17/08	6/25/08	7/1/08	8/14/08
10.2	Lacrosse	5/13/08	5/27/08	6/17/08	6/25/08	7/1/08	8/14/08
10.3	Foch	5/10/08	5/27/08	6/14/08	6/17/08	6/24/08	8/14/08
10.4	Petite Amie	5/10/08	5/27/08	6/17/08	6/24/08	6/29/08	8/19/08
10.5	Ravat 34	5/10/08	5/27/08	6/17/08	6/25/08	6/29/08	8/14/08
10.6	NY 76.844.24	5/10/08	5/27/08	6/20/08	6/24/08	7/8/08	8/19/08
10.7	GR7	5/8/08	5/27/08	6/12/08	6/17/08	6/24/08	8/14/08
10.8	Baco	5/8/08	5/17/08	6/12/08	6/17/08	6/24/08	8/14/08
10.9	Prairie Star	5/10/08	5/27/08	6/17/08	6/24/08	6/29/08	8/14/08
10.10	MN 1200	5/10/08	6/3/08	6/12/08	6/17/08	6/24/08	8/7/08

NORTHERN NY AGRICULTURAL DEVELOPMENT PROGRAM
2007-2008 Project Report

Project Title: Extending the Season of Horticultural Production in Northern New York With High Tunnels

Project leaders:

- H. C. Wien, Professor, Department of Horticulture, Cornell University hcw2@cornell.edu
- Amy Ivy, Executive Director, CCE Clinton County adi2@cornell.edu

Collaborators:

- Anne Lenox Barlow, CCE Clinton County
- Mike Davis, E. V. Baker Research Farm, Essex County
- Emily Selleck, CCE, Essex County
- Richard Gast, CCE Franklin County
- Sue Gwise, CCE Jefferson County
- Joe Lawrence, CCE Lewis County
- Steve Vandermark CCE St. Lawrence County

Cooperating Farmers:

- Dan Kent, Heuvelton, St. Lawrence County
- Almeda Grandjean, Adams Center, Jefferson County
- Delores Desalvo, New Bremen, Lewis County
- Bruce Bonesteel, Malone, Franklin County
- Christine McCauliffe, Willsboro, Essex County
- Rob Hastings, Keene, Essex County
- Ken Campbell, Saranac, Clinton County
- Beth Spaugh, Peru, Clinton County

Background: The short growing season in Northern New York makes production of high quality horticultural crops over a long marketing season a tremendous challenge. Methods of season extension have been listed as a major important research and extension need for Northern New York for 2008. The Adirondack Harvest project in eight Northern NY counties identified season extension as a high priority for direct market farmers, and the cooperating restaurants have specifically requested more fruits and vegetables from the region for their local meals. In recent years, use of high tunnels (unheated greenhouse structures covered with a single layer of clear polyethylene plastic) have become popular as a season-extension technique in many parts of the world, but are so far little used in New York. Such a tunnel was erected at the Willsboro Farm in 2007 with financial support from Cornell's Department of Horticulture. That project was established to demonstrate the utility of high tunnels to grow small fruits, vegetables and cut flowers in Northern New York and provide information for growers in the region.

Methods:

1. **Testing automatic tunnel side openers:** Ventilation is critical for high tunnel performance and it is mostly accomplished through roll-up sides. The long sides can provide much better ventilation as the air flows more uniformly across the crops than it would if only the ends were open. Opening and closing of the sides is so far a chore accomplished manually, requiring

constant attention by the operator, because changes in sun exposure can quickly alter tunnel temperature. Automating the ventilation and controlling it by a thermostat is an innovation offered by a grower building and operating his own high tunnels, and we decided to test this mechanism on 4 high tunnels in three counties in NNY. Installation was carried out by each grower/cooperator under the guidance of Nelson Hoover, the son of the inventor, along with Judson Reid, CCE Yates Countyand Chris Wien. In August, this team consulted the growers to gather opinions on how well the side openers operated, and suggestions on design improvements.

2. **New tunnel cover materials:** Research at Penn State University and in Yates County has shown that conventional greenhouse plastic cover lets the heat escape from the tunnel at night. We tested a new cover material that reduces night-time heat loss on two growers' high tunnels. Recording thermometers with two sensors were given to the growers to allow monitoring of air temperatures in the tunnel from late August on. The collaborating growers provided the daily maximum and minimum temperatures inside and outside the high tunnels on a weekly basis.
3. **Test tender small fruit crops:** Almeda Grandjean in Jefferson Cty. planted two varieties of fall-bearing raspberries in ground that was to be covered by a 20 x 96 ft. high tunnel in early summer 2008. A comparison of productivity, earliness and fruit quality of fall-bearing raspberries, blackberries and black raspberries was planted in the Willsboro high tunnel and in an adjacent field in 2006, and this trial was harvested for the first time in 2007 and continued in 2008.
4. **Test varieties of cut flowers in high tunnels:** Flower species that have been found to be attractive and valuable as cut flowers in Ithaca tests were tested in the high tunnel at the Willsboro Farm, and were slated to be tested in one grower's tunnel in St. Lawrence Cty. At Willsboro, four varieties of cut flower sunflowers, and four varieties of lisianthus were transplanted into the high tunnel and outdoors, and their performances compared.

Results:

Automatic tunnel side openers: Installing the openers took a bit of creative mechanics and each of our cooperators came up with ways to customize the installation to suit their situation. Some of the modifications our growers suggested included:

- Anchoring the pole in the ground with a concrete footing or a crossbar welded to the base
- Enlarging the contact area for the switch sensor to strike
- Using a heavier duty switch sensor
- The vertical pole needs to be generously lubricated to allow smooth operation of the mechanism
- Allowing for swivel movement in the vertical pole to accommodate houses with slightly curved sides
- The cable to hold the weight of the motor was deemed unnecessary
- Consider how the baseboard lines up with the plastic; sometimes the roll of plastic gets hung up on the baseboard and the motor keeps running.

2. **New tunnel cover materials:** Growth in the high tunnels/greenhouses covered with the new IR-blocking polyethylene was good. In one case (Ken Campbell, Clinton Cty.), temperatures inside the house from mid-September to late October averaged 7 C higher during the day inside (23 C vs. 16 C outside), while night temperatures were 5 C higher inside (7 C inside vs. 2 C inside). More significantly, minimum temperatures outside dropped below freezing on 9 out of 31 nights, compared to none in the tunnel.

3. **Berry and cut flower production:** Production of strawberries, cane fruit and cut flowers was monitored at the Cornell Willsboro Research Farm in 2008. In general, strawberry earliness, yield and fruit quality was improved in the high tunnel compared to outside (Appendix Table 1). Raspberry performance showed similar trends. There were two harvest seasons, mid-summer and fall; these have been totaled in Table 2. Both sunflowers and lisianthus were taller and more productive in the tunnels compared to outside. In both locations, the plants could have used supports to prevent lodging. In general, for all the crops grown in the high tunnel at Willsboro, productivity was increased, and quality of the harvested products was improved.

Outreach:

2008 High Tunnel conference: The latest information on high tunnel construction, production and marketing was shared in a 2-day conference at Saranac Lake (March 27-28), attended by 7 CCE staff (for training), 7 cooperating growers, 6 speakers and 44 in the audience. Attendees came from all NNY counties, the Capital District, Western NY and the province of Quebec. Lively discussions among participants maximized the sharing of information. A survey of participants indicated that 10 attendees have been producing crops in tunnels for at least a year, and 17 were in their first year of production, or seriously considering acquisition of a high tunnel.

Lewis County Cooperator – Dolores DeSalvo
Having grown vegetables for years, Dolores planned to put up her first high tunnel this year but weather and other factors prevented her from doing this. She owns the tunnel and plans to erect it in April 2009.

Jefferson County Cooperator – Almeda Grandjean
Almeda already has 2 50' high tunnels in which she grows tomatoes, peppers, cucumbers and a variety of minor crops. For our project she planted fall-bearing raspberries and planned to erect a high tunnel over the planting in August/September. She planted 2 varieties, 'Caroline' and 'Autumn Britten' on June 6 and the next 2 months had near record levels of rainfall. The soil is well drained and the Autumn Britten thrived with the rain but Caroline barely grew and by the end of July most of those plants were dead. Once we were confident the soil was not infested with disease, Almeda erected the high tunnel structure over the planting area but did not cover it with plastic. She will plant the replacement plants in spring of 2009 and cover the tunnel in August for her first fall crop of berries.

Almeda's open house was August 20 with 26 people attending. Chris Wien and Judson Reid were the guest speakers.

St. Lawrence County Cooperator – Dan Kent
We began this project with a different cooperator who withdrew from participation due to serious health issues. In late July we met Dan Kent and although it was too late to start a project we did consult with him on fertility issues with his tomatoes and he hosted a very well attended open house in September. Dan has a 200' single bay Haygrove tunnel and wants to use organic methods. To reduce disease pressure he has been replacing the plastic every year. IPM Specialist, Betsy Lamb suggested he save money by using the plastic for a few years before changing.

Dan's open house was September 15 with 28 people attending. Betsy Lamb was the guest speaker, Amy Ivy facilitated.

Franklin County Cooperator – Bruce Bonesteel

Bruce has had a garden center and retail produce stand for years and has recently become interested in growing some of his own produce. For this project he tried out the Hoover automatic tunnel opener on his 96' tunnel. Bruce was extremely pleased once the system was fine tuned especially because of the freedom it gave him from having to check on the tunnel continually. "It took a fair bit of adjusting but once I got the bugs worked out of it, it opened and closed reliably, without issue," Bruce said.

Bruce's open house was September 21 with 4 people attending. Chris Wien was the guest speaker, Amy Ivy facilitated.

Clinton County Cooperators: Beth Spaugh and Ken Campbell

Beth Spaugh worked with the Hoover automatic tunnel opener on her 96' Ledgewood high tunnel. She has been rolling up the sides by hand for the previous 2 growing seasons and greatly appreciated the freedom the automatic opener provided. It took some adjusting to set up and it still needed to be checked on daily but the thermostat control gave her freedom from constant checking.

Beth's open house was September 21 with 12 people attending. Chris Wien was the guest speaker, Amy Ivy facilitated.

Ken Campbell installed the IR-40 plastic on his hoop house on April 18. He started with bedding plants, followed by squash and beans in the ground until mid July. Then he built raised beds for lettuce, greens and green onions. The plastic was removed October 28.

Ken's open house was on September with 10 people attending. Chris Wien was the guest speaker, Amy Ivy facilitated. We also demonstrated the ag plastics baler using greenhouse plastic and black plastic mulch.

Essex County Cooperators: Christine McAuliffe and Rob Hastings

Christine McAuliffe worked with the Hoover automatic opener on her 96' Ledgewood high tunnel. She also reported having to adjust the opener to work properly on her house but once installed it was a significant time saver. Her garden center is spread out with limited staff so the opener allowed the staff freedom to keep working, confident the opener would take care of temperature fluctuations during the day. Christine said the opener "caused less stress on our employees and most importantly on the plants. We also noticed that we were using less water when the auto-opener was working correctly."

Christine's open house was August 27 with 9 people attending. Judson Reid, Nelson Hoover and Chris Wien were guest speakers, Amy Ivy facilitated.

Rob Hastings has 4 multi-bay Haygrove-type tunnels in which he grows tomatoes, cut flowers and fall raspberries. For our project he tried out the Luminance plastic from Haygrove on the raspberry tunnel and compared it with regular plastic over his other tunnels. He noticed a significant difference in the way light is diffused through the Luminance. Although the intensity was less, Rob feels his plants did better under it than under regular plastic.

Rob's open house was August 27 with 12 people attending. Judson Reid, Nelson Hoover and Chris Wien were guest speakers, Amy Ivy facilitated.

Conclusions/ Outcomes/Impacts: Overall the growers liked the freedom the automatic openers gave them. But since some kinks were still being worked out the openers were not completely trouble free. The cold climate of NNY makes timely opening and closing a real benefit, especially in spring and fall the mornings start out cold. Growers rushing off to market benefit from knowing the tunnels will open at the optimum time for the crop instead of when the grower can finally get over to do it manually. If tunnels are left closed up on a chilly morning in May the temperatures can rise rapidly by late morning if the sun comes out. The automatic opener lets the grower work off-site. The suggestions made by growers who used the device will be incorporated into manufacture of an improved, more robust model that should again be tested in NNY.

Performance of the new high tunnel cover film on two growers' tunnels proved satisfactory and substantiated that the covers improved tunnel growing conditions.

The comparisons of the product quality and yield of strawberries, raspberries and cut flowers in the Willsboro tunnels illustrated why interest is so high for high tunnels among growers. The results endorsed the gratifyingly high attendance at the high tunnel conference in Saranac Lake in March, and the keen interest in high tunnels at the open houses held on growers' farms in the summer. Public support for locally produced foods can only augment this trend.

EXTENDING THE SEASON OF HORTICULTURAL PRODUCTION IN NORTHERN NEW YORK WITH HIGH TUNNELS

Appendix

Willsboro high tunnel yields:

Table 1. Strawberry yields inside and outside the high tunnel at the E V Baker Farm, Willsboro, NY in 2008.

Variety	Inside tunnel		Outdoors	
	First harvest date	Yield, lbs/100ft^2	First harvest date	Yield, lbs/100ft^2
Earliglo	6/10	63	6/14	46
Evangeline	6/10	43	6/12	46
Jewel	6/15	76	6/17	53
Everest	6/10	29	6/15	23

Table 2. Yields of raspberry and blackberry inside and outside the high tunnel at Willsboro, totaled over the summer and fall harvest seasons in 2008.

Variety	Yield, lbs/100ft^2	
	Inside tunnel	Outdoors
Encore	2.7	1.2
Jewel	10.8	1.5
Kiwi Gold	19.2	1.3
Heritage	27.4	4.8
Prelude	11.1	1.9
Prime Jean	0.1	0

Northern New York Agricultural Development Program
2007-2008 Project Report

Title of project. **Improved Apple Orchard Management Systems and Rootstocks for NNY**

Project Leader. Terence Robinson, Dept. of Hort. Sciences, Cornell University, Geneva, NY

Collaborators. Kevin Iungerman, Northeast NY Fruit Program.

Grower Cooperators: Tom Everett, Everett Orchards, Peru NY; Donald Green III, Chazy Orchards, Chazy, NY; Seth Forrence, Forrence Orchards, Peru, NY; Mac Forrence, Forrence Orchards, Peru, NY

Introduction. The Northern New York (NNY) apple industry is large (5,000 acres and a farm gate value of $16 million) and is an important segment of Northern New York agriculture. The industry has knowledgeable and progressive growers, an extensive infrastructure, and proximity to markets. However, to remain competitive in the world apple market NNY apple growers need to continue to modernize their orchards to improve orchard production efficiency and fruit quality. Modern high-density orchard planting systems, will help improve efficiency, yield and fruit quality and will offer growers the opportunity to plant profitable new varieties. Replanting older orchards to new high-density orchards with popular new varieties will help the long-term viability of the Northern New York apple industry.

The goal of this project was to develop and extend to growers information on modern, competitive orchard systems that incorporate new high priced varieties, disease resistant rootstocks, high planting densities for early production and partial labor mechanization to reduce costs. Research results on high density orchards and new rootstocks conducted in other parts of NY state is not directly transferable to the colder climate of NNY. Thus this project evaluated new rootstocks and orchard systems in Clinton County utilizing on-farm orchard systems and rootstock experiments that the project leaders have already established in NNY. In addition new on-farm experiments were conducted in 2008 on improved chemical thinning and drop control strategies with Honeycrisp and McIntosh. The project involved the apple growers in NNY through field days, workshops and winter fruit grower meetings.

Materials and Methods. We had previously established 4 on-farm trials in Clinton County that were used in this research project.

1. Champlain Valley 2002 Orchard Systems Trial. This replicated field plot was established at Everett Fruit Farm in Peru, NY and it compares 5 orchard system (Central Leader on MM.111, Slender Pyramid on M.26 and G.30, Vertical Axis on M.9, B.9 and G.16, Solaxe on M.9, B.9 and G.16 and Tall Spindle on M.9, B.9 and G.16). The objective of the trial was to develop realistic performance and cost data for the colder part of NY state to provide growers with practical examples of different orchard system performance and economics. Densities range from 218 trees/acre to 1307 trees/acre. Varieties include McIntosh and Honeycrisp. The experimental design is a randomized complete block split plot with 3 replications and 30 trees per experimental unit. We measured yield, fruit quality, light interception and labor input requirements for each of the various tree forms and planting densities. We will perform an economic analyses of the trial utilizing the actual packout and labor costs in 3 more years when the trial is 10 years old.

2) Everett Orchards 1999 Rootstock Trial: This replicated field plot compares 4 new rootstocks from Germany (Supporter series stocks) for survival, productivity and adaptability to the cold climate of

NNY. The experimental design is a randomized complete block 8 replications and 1 tree per experimental unit. We measured yield, fruit size and survival for each of the rootstocks.

3) Chazy Orchards 2001 Semi-commercial Rootstock Trial. This replicated field plot compares 16 rootstocks (G.16, G.30, B.9, B.118, O.3, Vineland 1, Vineland 3, Supporter 4, Mark, M.9T337, M.9Nic29, M.9/MM.111, M.26, M.7, MM.106, and MM.111) for survival, productivity and adaptability to the cold climate of NNY with Honeycrisp and McIntosh as the scion varieties. The experimental design is a randomized complete block 8 replications and 10 trees per experimental unit. We measured yield, fruit size and survival for each of the rootstocks.

4) Forrence Orchards 2002 CG Rootstock Trial: This replicated field plot compares 17 new rootstocks from the Geneva apple rootstock breeding program and 8 Malling stocks from England, 2 clones of B.9 from Russia, Ott.3 from Canada, P.22 from Poland and Supporter 4 from Germany with Honeycrisp as the scion. This trial is a comparison of many of the new disease resistant rootstocks from Cornell which have substantial potential in NNY. The experimental design is a randomized complete block 10 replications and 1 tree per experimental unit. We measured yield, fruit size and survival for each of the rootstocks.

In addition, we established 3 one year thinning, return bloom management trials with Honeycrisp and a pre-harvest drop control trials with McIntosh apple in 2008.

1) Thinning of Honeycrisp (Chazy): In 2008 we conducted a 1 year replicated field study at Chazy orchards of timing and concentration of chemical thinners to managed cropload on the new highly priced apple variety, Honeycrisp. This variety is proving to be difficult to manage and improved thinning strategies are essential to the long-term success of this variety. This study evaluated single vs. multiple sprays of NAA, NAA/Sevin and BA/Sevin on thinning efficacy of Honeycrisp. The experimental design was a randomized complete block with 4 replications and 2 trees per experimental unit.

2) Thinning and Return Bloom of Honeycrisp (Chazy): This study was begun in 2007 where a multi-factor field study of timing of chemical thinner application was laid out to evaluate return bloom in 2008. The experiment had 15 treatments of various rates and combinations of NAA, Carbaryl, and Benzyl Adenine. The experimental design was a randomized complete block with 4 replications and 2 trees per experimental unit.

3) Control of pre-harvest drop with McIntosh (Chazy): We conducted a replicated field trial where we evaluated Harvista, ReTain, and NAA in 2008 to reduce pre-harvest drop of McIntosh. The trial was conducted at Chazy Orchards in cooperation with Tre Green. The objective was to determine the effect of Retain, or Retain combined with NAA, Harvista, or Harvista combined with NAA, on preharvest drop of McIntosh apples in the Champlain Valley.

The treatments were:

1. Untreated Control
2. Retain 333 g/acre @ 3 weeks before harvest (Aug. 22)
3. Retain 333 g/acre @ 2 weeks before harvest (Aug. 29)
4. Retain 333 g/acre @ 2 weeks before harvest (Aug.29) + NAA 20ppm @2 week before harvest (Aug.29)
5. Retain 166.4 g/acre @ 2 weeks before harvest (Aug.29) + NAA 20ppm @2 week before harvest (Aug.29)
6. NAA 20ppm @1 week before harvest (Sept. 7)
7. Harvista 120g ai/acre @ 1 week before harvest (Sept. 7)
8. Harvista 120g ai/acre @ 1 week before harvest (Sept. 7) + NAA 20ppm @1 week before harvest (Sept. 7)
9. Harvista 60g ai/acre @ 1 week before harvest (Sept. 7) + NAA 20ppm @1 week before harvest (Sept. 7)

Results.

Orchard Systems Study (Table 1, Figures 1-8):

Our comparison of 5 orchard production systems has shown that the high density Tall Spindle system has been the most productive in the Champlain Valley. The Tall Spindle had the earliest production with a small crop in the second year. The M.9 trees had more yield than either B.9 or G.16. M.26, G.30 and MM.111 had no crop in the second year. In the third and fourth years there was a linear relationship of density and yield with the M.9 rootstock having greater yield than any of the other stocks. In the fifth year (2006) frost and poor pollination reduced crop significantly with McIntosh but not with Honeycrisp. However, Honeycrisp suffered from biennial bearing and had less than a full crop. B.9 rootstock was the most productive rootstock with Honeycrisp in 2006 but M.9 and G.16 were the most productive with McIntosh. In 2007 and 2008 there was a large crop with both varieties. The tall spindle system had the highest yield and with McIntosh/M.9 trees reached 1500 bushels/acre. With Honeycrisp the most productive combination was the Tall Spindle on G.16 rootstock which had a yield of 750 bushels/acre.

At the end of 7 years, there was a strong linear effect of tree planting density on cumulative yield (Table 1). As expected the trees the CL/M.111 trees had the lowest yield, followed by the Slender pyramid, Vertical Axis, SolAxe and Tall Spindle. Among rootstocks M.9 had the highest yield with McIntosh followed by B.9, G.16, G.30, M.26 and MM.111. With Honeycrisp, B.9 had the greatest yield followed by M.9, G.16, G.30, M.26 and MM.111.

Crop value was greatest with the tall spindle system in each year except 2006 when frost damage reduced crop value with the Tall Spindle more than any other system. Nevertheless, in 2007 and 2008 the tall spindle again had the greatest crop value. The Tall Spindle had the greatest cumulative crop value followed by the Vertical Axis and SolAxe which did not differ significantly, then the Slender Pyramid and lastly the Central Leader. The Tall Spindle exceeded the cumulative crop value of the Central Leader by 7.7 fold with McIntosh and 10 fold with Honeycrisp.

Honeycrisp had 2/3 the yield of McIntosh but 3.5 times the cumulative crop value as McIntosh due to higher fruit price. By the end of the 7th year the best Honeycrisp system had accumulated $53,000 in cumulative crop value compared to only $14,000 for McIntosh. This level of returns would essentially pay for the establishment cost of the Honeycrisp block by the end of the 5th year. It is likely to take 10 years with McIntosh.

This trial shows that much higher yields than previously achieved are possible with the Tall Spindle system at a relatively young orchard age. This dramatically changes the orchard profitability potential for new orchards in NNY State.

McIntosh Rootstock study (Table 2):

The plot has completed 10 years and had a large crop in 2008. Among dwarf rootstocks the smallest trees were on M.9T337 followed in order by, Supporter 2 Supporter 1, Supporter 3, and M.26EMLA. All of the stocks had 100% survival. The stocks with the greatest yield efficiency were M.9T337, Supporter 2, Supporter 3 and Supporter 1. This group had significantly higher yield efficiency than M.26EMLA. M.9T337 had the largest size followed by Supporter 2, M.26, Supporter 1 and Supporter 3. The later 2 rootstocks had significantly smaller fruit size then M.9. Of this group none of the new dwarfing stocks exceeded the performance of M.9. However, Supporter 2 was almost as good as M.9. Our trial did not show different winter hardiness. Only if Supporter 2 had greater winter hardiness would it be a superior rootstock to M.9.

Among semi-dwarfing rootstocks, trees on M.26EMLA were the smallest and trees on M.7EMLA and were the largest with Supporter 4 trees intermediate in size. The most efficient rootstock in the semi-dwarf plot was Supporter 4 followed by M.26 and lastly M.7. Root suckers were greatest with M.7 and lowest with M.26 and Supporter 4. This trial showed that Supporter 4 is a superior semi-dwarfing rootstock and much better than M.7. Our trial did not show different winter hardiness. However, if Supporter 4 is winter hardy it would it be a much superior rootstock to M.7.

Predicting Chemical Thinning study (Figures 9):

Carbohydrate Model Results for the Champlain Valley

We used a computer model and weather data from the weather station owned by Adam Sullivan of Sullivan Orchards in Clinton County to calculate in real time the carbohydrate status of trees in the Champlain Valley during the thinning period in late May and early June. This estimate of carbohydrate status was used to predict thinning response of apple trees in Clinton County. We presented the data in Figure 9 at the thinning meeting on Thursday May 29. After the thinning meeting there were 5 days with cloudy weather and a severe carbohydrate deficit. Saturday May 31 had a severe deficit due to very cloudy weather. Sunday and Monday June1-2 have had a mild carbohydrate deficit. From Tuesday June3-Sunday June 8 there was period of severe carbohydrate deficits due to high daytime temperatures, high night temperatures and somewhat overcast weather resulting in moderate to low sunlight levels. The carbohydrate status was very negative due to temperatures in the mid 80's.

We interpreted the 2008 data as follows:

1. The positive carbohydrate status on Wednesday May 28 was followed by a period of mild deficits and severe deficit days which resulted in a significant response for thinners applied that week.

2. The period from Tuesday June 3- Sunday June had a severe carbohydrate deficit with high daytime temperature and high night temperatures. The sustained period of night-time temperatures above 60°F resulted in excessive thinning if full rates of chemicals were used. The model suggested reduced rates for this period

We recommended that growers use caution in thinning in 2008 and to use lower rates to avoid over-thinning.

Return Bloom of Honeycrisp study (Figure 10):

In 2007 we applied 13 chemical thinning treatments to heavy blooming Honeycrisp trees at either petal fall or at 10mm fruit size. The treatments at petal fall did too little thinning except at the highest rate of 10ppm NAA + Carbaryl. Treatments at 10mm fruit size also did too little thinning. We did not apply the high rate of 10ppm + Carbaryl at the 10mm stage for fear of removing all of the fruitlets. The next spring (2008) none of the treatments resulted in any amount of return bloom except the high rate of NAA+Carbaryl applied at Petal Fall. This result combined with other work at Geneva, lead us to conclude that Honeycrisp requires very early thinning (during bloom or at petal fall) to have sufficient return bloom the next year. In this respect it is very similar to the variety Macoun which also must be thinned early with high doses of NAA+Carbaryl.

This information was not needed in the spring of 2008 since almost all Honeycrisp orchards had a light bloom following the heavy crop in 2007. However, we expect a heavy bloom in 2009 which will require growers to thin aggressively at petal fall to avoid another biennial bearing cycle in 2010. We are scheduled to make a presentation at the Hort Expo in Syracuse to discuss this important finding with NY Honeycrisp growers.

Control of pre-harvest drop study (Table 3, Figures 11-13):

In 2008, temperatures in August and September were close to normal. As a consequence fruit drop was low in the Champlain Valley until late in the harvest season.

At Chazy orchards in the Champlain valley pre-harvest fruit drop from untreated control trees remained low until winds from Hurricane Ike in late Sept. caused significant drop. In our plot drop exceeded 20% by Sep 21 and by the end of Sept had reached 60% drop. NAA applied on Sep 8 did not statistically reduce drop at any date although there was a small numeric decrease in drop from NAA. The full rate of Harvista applied on Sept 8 (1 week before harvest) provided excellent drop control in the Champlain Valley study. The addition of NAA to Harvista did not improve its effectiveness. The half rate of Harvista combined with NAA gave similar but slightly inferior drop control as the full rate of Harvista in the Champlain Valley study. Retain reduced fruit drop whether applied on Aug 25, (3 weeks before harvest) or Sep 2 (2 weeks before harvest) however the efficacy was much better when applied 2 weeks before harvest than 3 weeks before harvest. The addition of 20ppm NAA to the Retain sprays on Sep 2 did not statistically improve the performance of Retain but there was a small numeric improvement in drop control. When a reduced rate of Retain (166g/acre) was used with NAA the efficacy in reducing drop was reduced compared to the full rate of Retain applied on the same day; however the low rate of Retain plus NAA had similar efficacy to the full rate of Retain applied on Aug 22. It appears that in the Champlain valley if Retain is applied too early its effects wear off by the time massive drop begins in late September. The best Retain (Sept 2) or Retain+NAA treatment gave similar drop control as Harvista. However, Retain alone applied Aug 25 was less effective in controlling preharvest drop. The impact of the NAA in the spray mixtures on fruit quality after storage has not yet been determined.

The results of this study indicate that Harvista applied as a dilute spray with Silwett (0.25%) using commercial airblast spray machines can provide very effective drop control of McIntosh which is perhaps the most sensitive apple variety to pre-harvest drop. However, the 2008 season was not a heavy drop year with high heat before harvest. This study needs to be continued until we experience the high drop years to fully evaluate the potential of Harvista as a control measure to prevent pre-harvest drop.

The fruit quality effects of Harvista and Retain is currently being evaluated and a final report will be prepared in Mid January.

Education and Outreach Efforts.

We conducted a vigorous extension and outreach program with this project. In March 2008 we conducted a winter pruning workshop in the orchard systems plot on Everett Fruit Farm to teach tree pruning and training for high density orchards. In May 2008 we conducted a chemical thinning workshop at Bob Harts fruit farm. In June 2008 we conducted a summer field day where the orchard systems and rootstock plots were featured. We published several articles in the NY Fruit Quarterly magazine which were sent to all tree fruit growers in the state. In Dec. 2008, we made 2 presentations to fruit growers in Quebec which were available to Champlain valley apple growers. We will make a presentation in Feb 2009 at the Statewide Hort Expo in Syracuse and later in Feb. 2009 at the Northern NY winter fruit schools on orchard modernization.

Publications in 2008 for growers from this project:

Fazio, G. and T. Robinson. 2008. Modification of nursery tree architecture by apple rootstocks – a breeding perspective. *NY Fruit Quarterly* 16(1): 13-16.

Robinson, T.L. 2008. Crop load management of new high-density apple orchards. *NY Fruit Quarterly* 16(2): 3-7.

Robinson, T.L. and A.N. Lakso. 2008. Predicting and understanding chemical thinner response in real time. *Proceedings Great Lakes Fruit Workers Annual Meeting* 2008:15-18.

Robinson, T.L. and A.N. Lakso. 2009. Predicting and understanding chemical thinner response in real time. *Proc. of the 2009 Empire State Fruit and Veg. Expo.* p. 20-25.

Robinson, T.L. and A.N. Lakso. 2008. Predicting and understanding chemical thinner response in real time. *Journée Pomicole Provinciale* 2008:34-41.

Robinson, T.L. and S.A. Hoying. 2008. Successful high density apple orchards. *Journée Pomicole Provinciale* 2008:23-31.

Robinson, T.L. and S.A. Hoying. 2009. Fine points to consider when making planting system decisions. *Proc. of the 2009 Empire State Fruit and Veg. Expo.* p. 5-9.

Robinson, T.L. and S. Lopez. 2009. Cropload management for consistent Honeycrisp apples. *Proc. of the 2009 Empire State Fruit and Veg. Expo.* p. 16-20

Robinson, T., G. Fazio and S. Hoying. 2008. Intermediate stage evaluation of Cornell-Geneva and other promising rootstocks: Progress Report. *Compact Fruit Tree* 41:27-32.

Robinson. T.L., S.A. Hoying, A.M. DeMarree, K.I. Iungerman and M.J. Fargione. 2007. The evolution towards more competitive apple orchard systems in New York. *NY Fruit Quarterly* 15(1):3-7.

Table 1. Performance of McIntosh and Honeycrisp apple trees on 6 rootstocks trained to 5 orchard systems in the Champlain Valley.

Variety	System	Stock	Tree Density/ Acre	Cum Yield/ Acre	Av Fruit Size	Cum Crop Value/ acre
Honeycrisp	Central Leader	MM.111	218	221	227	4564
	Slender Pyramid	G.30	444	1383	239	29617
	Slender Pyramid	M.26	444	939	217	19625
	SolAxe	B.9	726	1633	230	36123
	SolAxe	G.16	726	1586	231	34733
	SolAxe	M.9	726	1495	221	32246
	Vertical Axis	B.9	726	1821	227	39508
	Vertical Axis	G.16	726	1584	217	32838
	Vertical Axis	M.9	726	1865	223	39398
	Tall Spindle	B.9	1307	2465	222	53107
	Tall Spindle	G.16	1307	1857	217	37371
	Tall Spindle	M.9	1307	2012	210	39720
McIntosh	Central Leader	MM.111	218	329	164	2140
	Slender Pyramid	G.30	444	1542	148	7005
	Slender Pyramid	M.26	444	972	151	4117
	SolAxe	B.9	726	1806	147	8645
	SolAxe	G.16	726	1855	142	7584
	SolAxe	M.9	726	2475	150	12418
	Vertical Axis	B.9	726	1851	145	7882
	Vertical Axis	G.16	726	1858	147	8105
	Vertical Axis	M.9	726	2804	145	11095
	Tall Spindle	B.9	1307	3190	143	13596
	Tall Spindle	G.16	1307	2690	141	11457
	Tall Spindle	M.9	1307	3841	143	14878
		LSD P≤0.05		**393**	**10**	**6686**

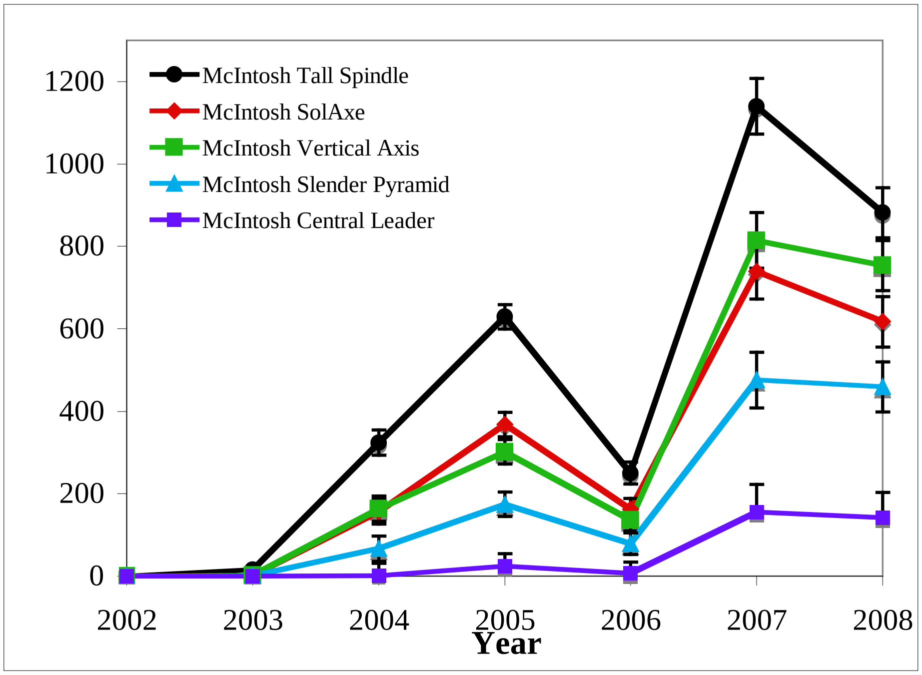


Figure 1. Annual yields of McIntosh apple trees trained to 5 orchards systems over the first 7 years in the Champlain Valley

.

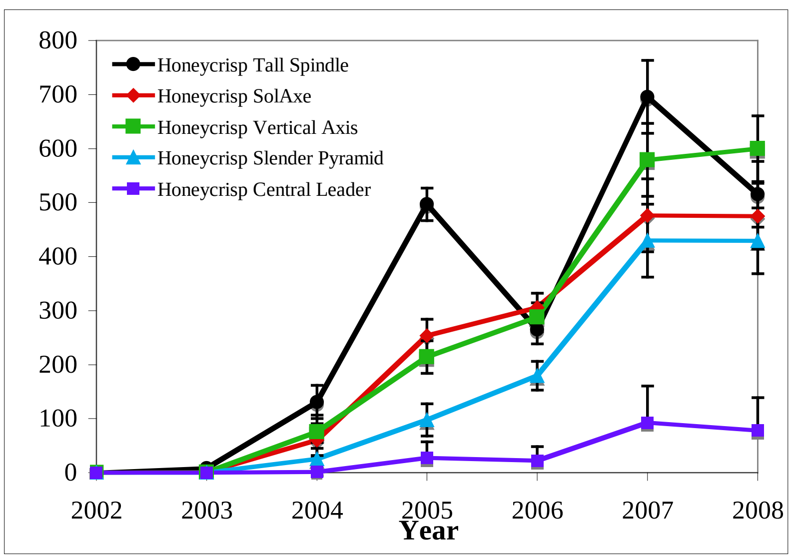


Figure 2. Annual yields of Honeycrisp apple trees trained to 5 orchards systems over the first 7 years in the Champlain Valley.

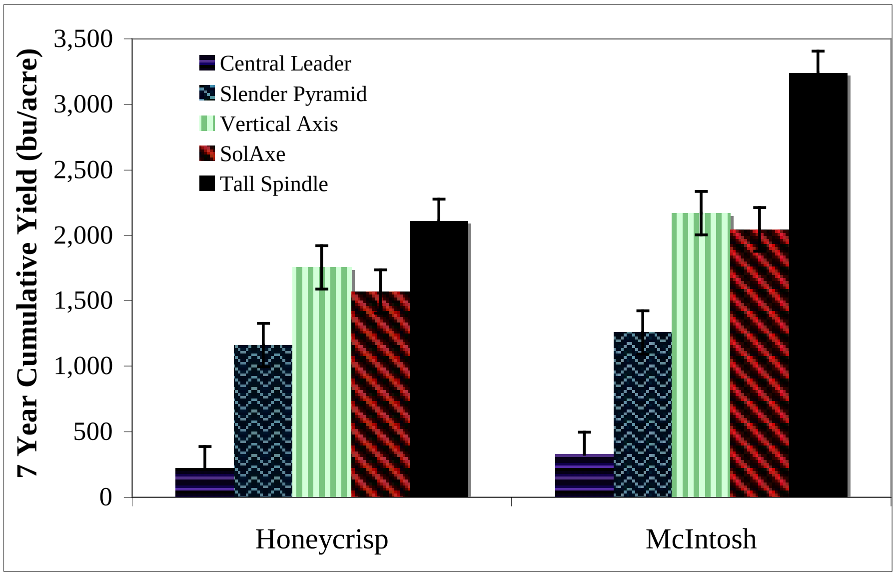


Figure 3. Cumulative yields of Honeycrisp and McIntosh apple trees trained to 5 orchards systems over the first 7 years in the Champlain Valley orchards.

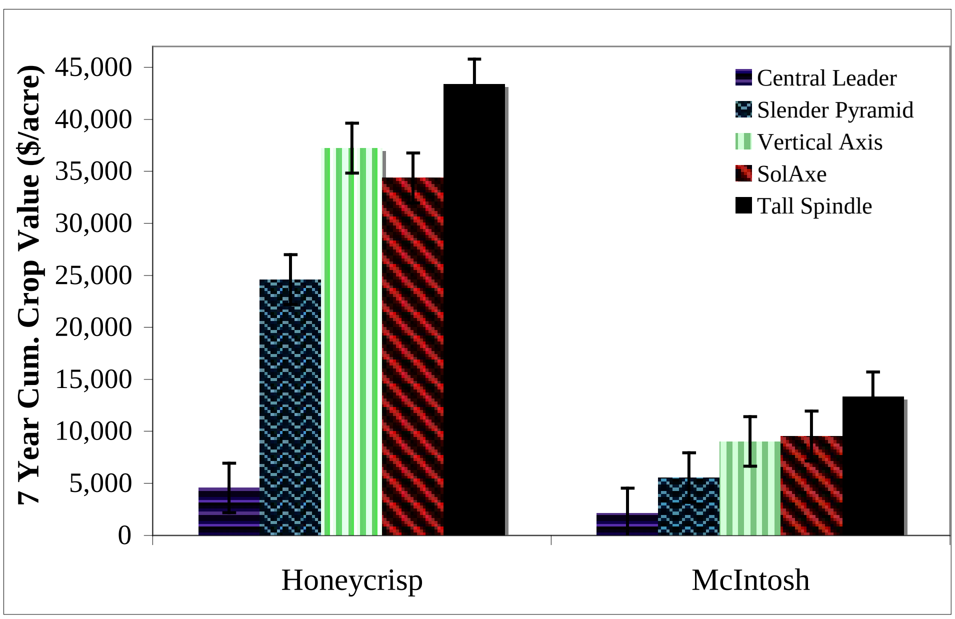


Figure 4. Cumulative crop value of Honeycrisp and McIntosh apple trees trained to 5 systems over the first 7 years in the Champlain Valley.

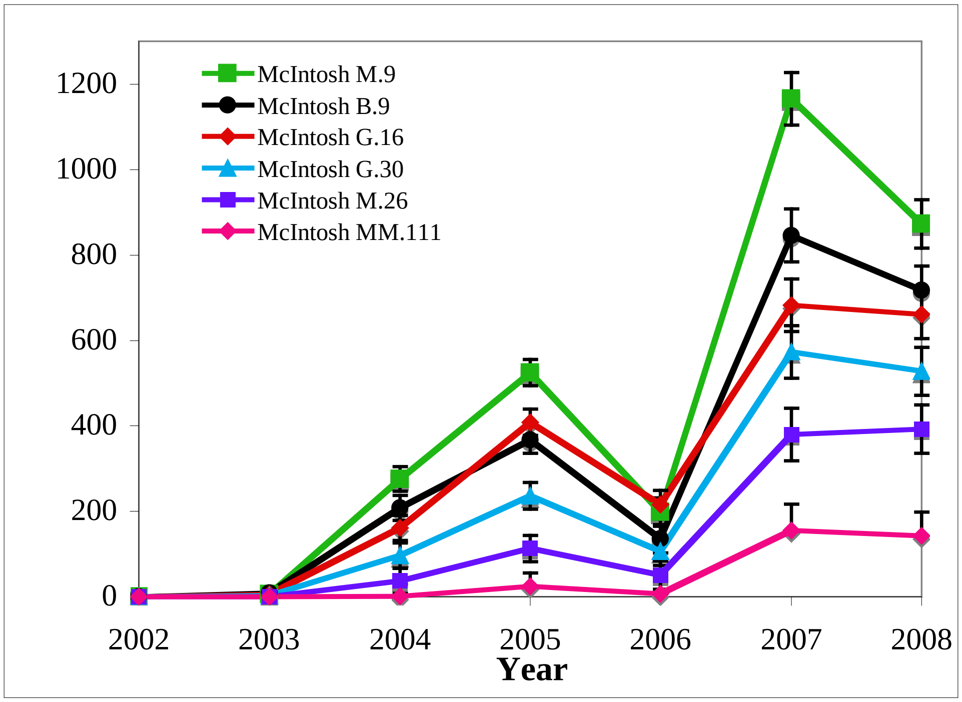


Figure 5. Annual yields of McIntosh apple trees grown on 6 rootstocks over the first 7 years in the Champlain Valley.

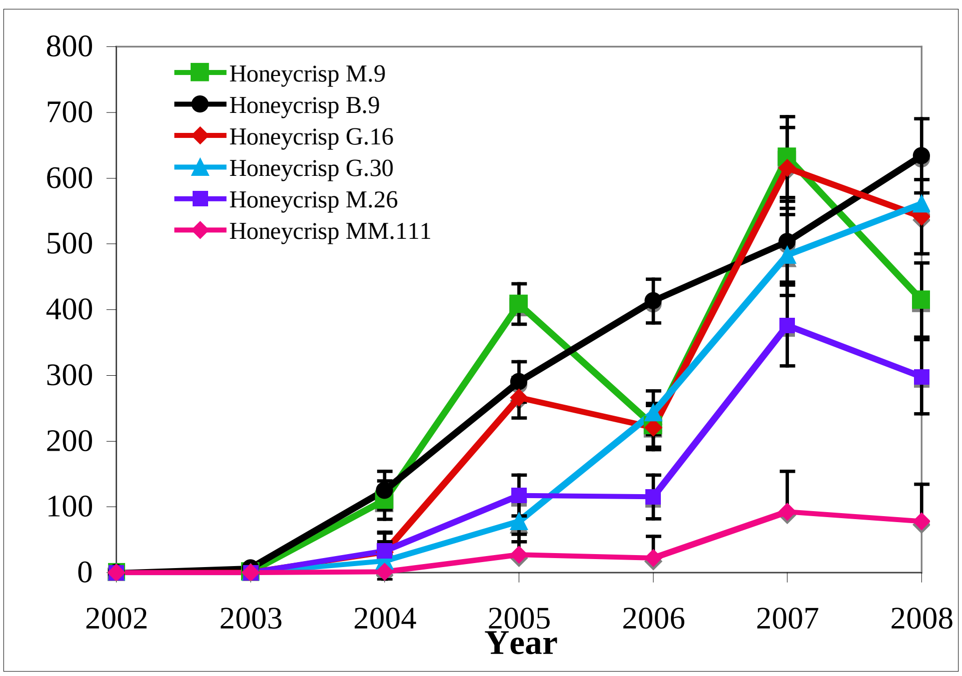


Figure 6. Annual yields of Honeycrisp apple trees grown on 6 rootstocks over the first 7 years in the Champlain Valley.

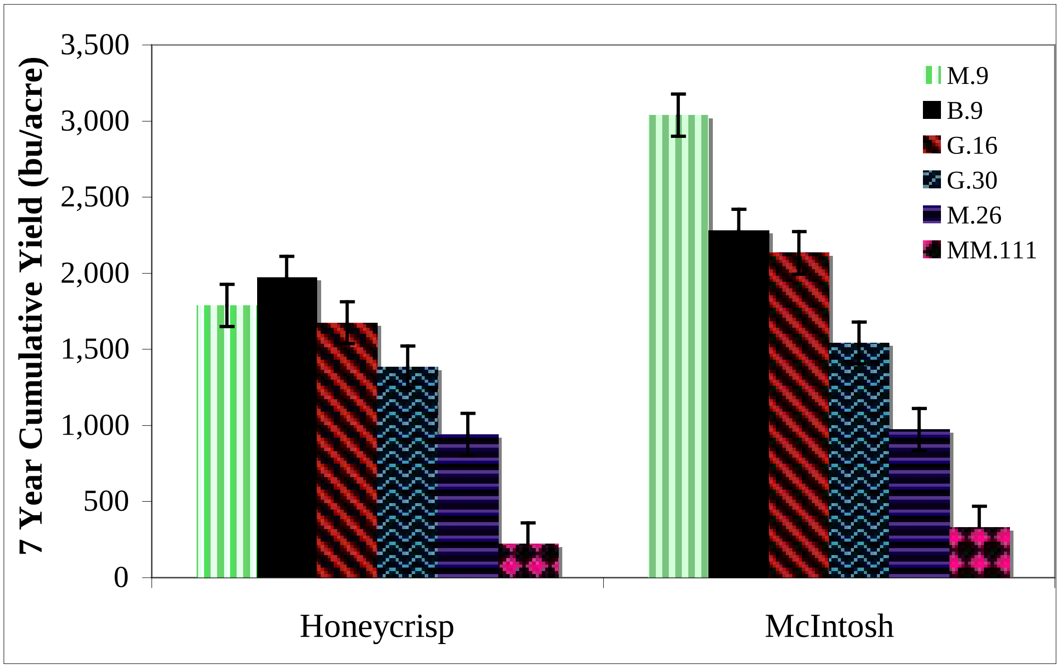


Figure 7. Cumulative yields of Honeycrisp and McIntosh apple trees grown on 6 rootstocks over the first 7 years in the Champlain Valley.

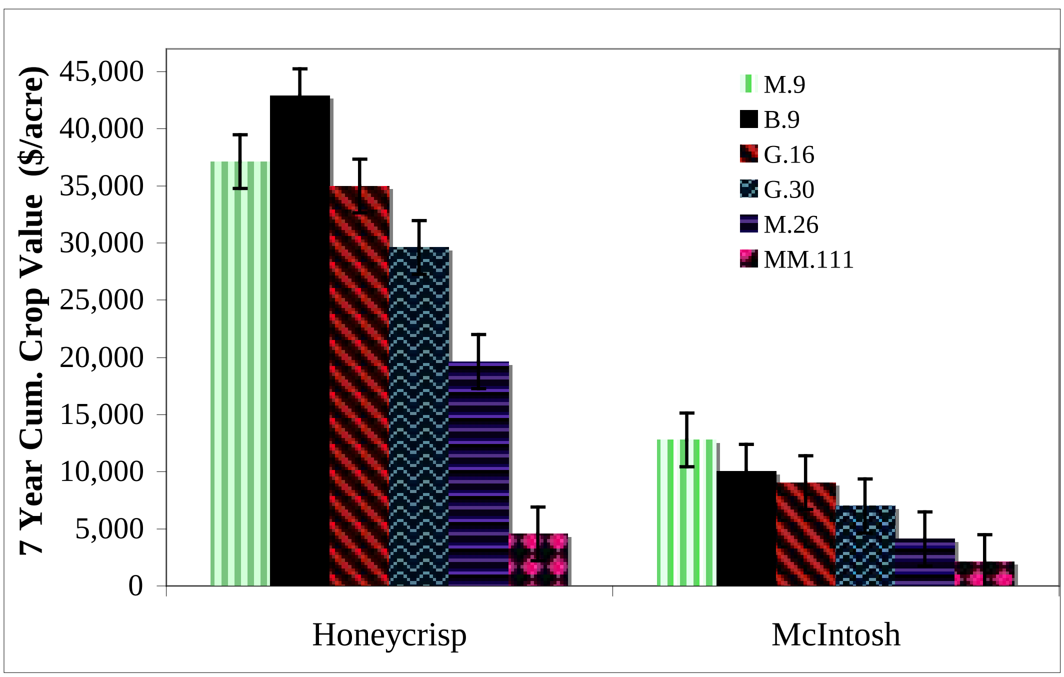


Figure 8. Cumulative crop value of Honeycrisp and McIntosh apple trees grown on 6 rootstocks over the first 7 years in the Champlain Valley

Table 2. Performance of Supporter Rootstocks in the 1999 NC-140 McIntosh Rootstock Trial

Plot	Stock*	TCSA Nov. 2007 (cm2)	Fruit No. 2008	Yield 2008 (kg)	Fruit Size 2008 (g)	Yield Eff. 2008 (kg/cm ^{2} TCSA)	Cum. Fruit Number	Cum. Yield (g)	Cum. Yield Eff. (kg/cm ^{2} TCSA)	Av. Fruit Size (g)	Cum Number of Root Suckers	Tree Survival (%)
Dwarf	M.9T337	23.1 c	175 a	24.1 a	137.7	1.08	850	121	5.47	156.4	2.7	100
Dwarf	Sup2	28.9 bc	185 a	25.1 a	136.4	0.88	1055	144	5.05	150.4	0.5	100
Dwarf	Sup1	34.9 ab	214 a	28.9 a	136.7	0.85	1160	162	4.72	147.4	0	100
Dwarf	Sup3	34.9 ab	188 a	25.9 a	139.5	0.73	1200	159	4.54	140	0.8	100
Dwarf	M.26EMLA	42.9 a	185 a	27.5 a	148.8	0.67	817	117	2.81	148.6	0.3	100
	LSD $p \leq 0.05$	**8.7**	**56**	**7.5**	**7.8**	**0**	**223**	**29**	**1.0**	**8.60**	**2**	
Semidwarf	M.26EMLA	48.4 c	177 c	25.4	144.4	0.52	792	114	2.35	151.7	0	100
Semidwarf	Sup4	77.4 b	304 a	45.3	148.9	0.59	1248	205	2.66	171.7	1.3	100
Semidwarf	M.7	105.0 a	275 b	43.7	159.3	0.42	1065	180	1.73	171.7	17.7	100
	LSD $p \leq 0.05$	**14.4**	**73**	**9.7**	**12.7**	**0**	**381**	**52**	**0.9**	**12.70**	**8**	

*Rootstocks ranked by cross-sectional area.

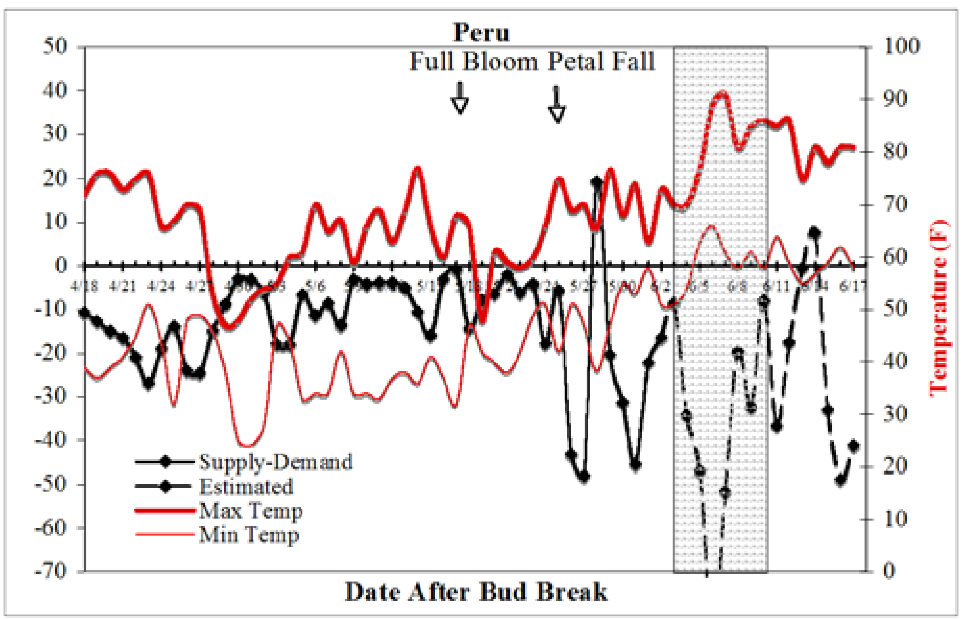


Figure 9. Carbohydrate balance and maximum and minimum temperatures at Peru, NY in the Champlain Valley during the chemical thinning period. The Gray box is the period when most commercial growers sprayed chemical thinners.

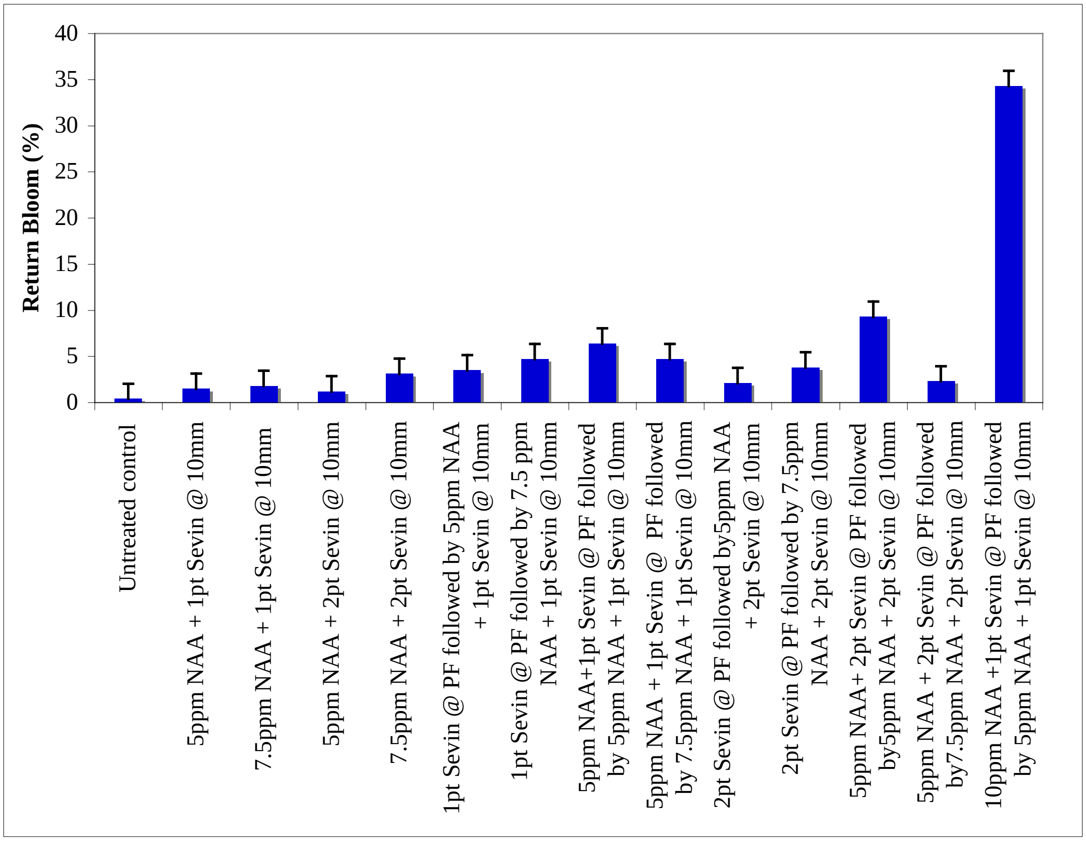


Figure 10 Return bloom in 2008 of Honeycrisp/M.9 trees at Chazy Orchards following various chemical thinning treatments in 2007.

Table 3. Effect of Retain, NAA and Harvista on preharvest fruit drop of McIntosh/M.26 apple trees (2008- Champlain Valley)

Treatment	Cumulative Drop 9/16/2008	Cumulative Drop 9/23/2008	Cumulative Drop 9/30/2008	Cumulative Drop 10/7/2008
Untreated Control	5.9	11.4	61.7	85.5
333g Retain/acre 8/25/08	5.3	6.9	25.3	43.0
333g Retain/acre 9/2/08	3.5	4.2	12.1	22.0
333g Retain/acre 9/2/08 +20ppm NAA 9/8/08	1.4	2.8	9.8	19.0
166g Retain/acre 9/2/08 +20ppm NAA 9/8/08	4.0	5.0	27.2	43.6
20ppm NAA 9/8/08	5.1	8.5	51.6	71.0
120g Harvista 9/8/08	4.6	5.6	8.25	16.2
120g Harvista+20ppm NAA 9/8/08	2.8	3.1	5.8	13.9
60g Harvista +20ppm NAA 9/8/08	3.4	4.2	14.3	22.9

LSD P≤0.05	2.6	3.9	14	16

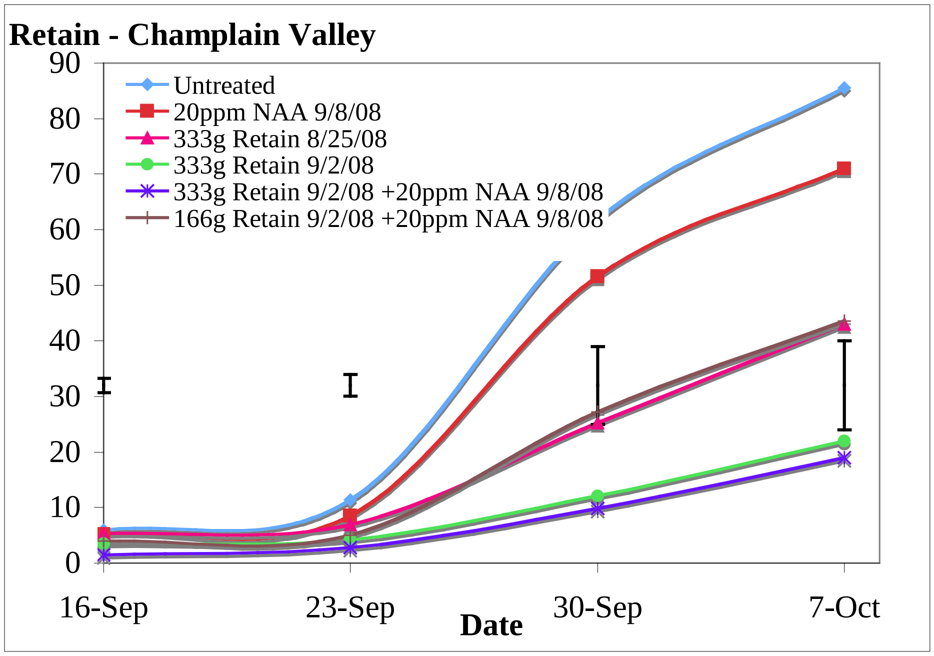


Figure 11. Effect of Retain, NAA and Retain+NAA on fruit drop of McIntosh/M.26 apple trees in the Champlain Valley, NY (2008).

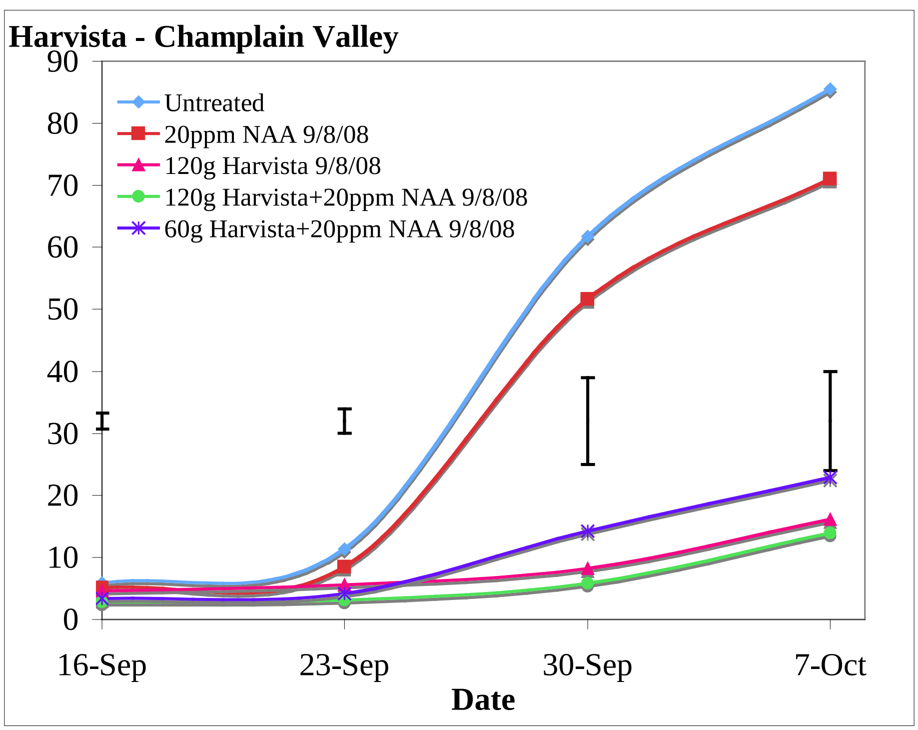


Figure 12. Effect of Harvista, NAA or Harvista+NAA on fruit drop of McIntosh/M.26 apple trees in Champlain Valley(2008).

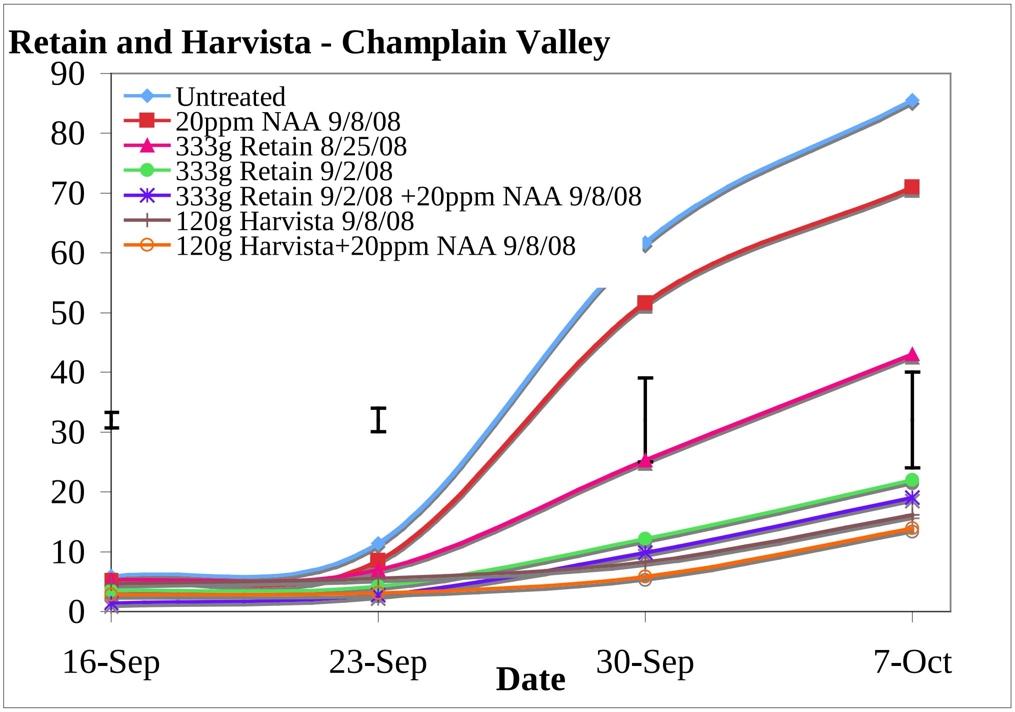


Figure 13. Effect of Retain, Harvista, NAA, Retain+NAA or Harvista+NAA on fruit drop of McIntosh/M.26 apple trees in Champlain Valley. (2008).

Northern NY Agricultural Development Program
2008 Project Report

Project Title: Adapting to climate change in Northern NY Maple Production

Project Leader(s):

Brian Chabot, Professor, Cornell University, Little Rice Hall, Ithaca, NY 14850
bfc1@cornell.edu (607) 254 4234

Michael Farrell, Northern NY Maple Specialist and Director of Uihlein Forest, 157 Bear Cub Lane, Lake Placid, NY 12946 mlf36@cornell.edu (518) 523 9337

Collaborator(s):

Michele Ledoux, CCE Lewis County
Richard Gast, CCE Franklin County

Cooperating Producers:

Rolland Thomas, Franklin County
Northwood School/Heaven Hill Farm, Essex County
Cornell Cooperative Extension Learning Farm, St Lawrence County
Steven Rider, Jefferson County
Champlain Valley Technical Education Center, Clinton County
Lewis/Jefferson BOCES, Lewis County

Background: The Northern NY Maple Advisory Committee gave their highest priority to research on the value and consequences of tapping earlier than traditionally happens. This comes from legitimate concern about how maple producers should adapt to the climate warming that has been well documented globally and in New York. Long-term sap collection records at the Uihlein Forest show that both the start and end of the sap season has moved about a week earlier in the past 30 years. This is consistent with data from other maple-producing states that also suggests the season is moving earlier and getting shorter.

Maple sap yields depend on having enough days with freeze/thaw cycles in the roughly eight-week period following tapping. Choosing when to start is a critical decision in having economically viable yields. If one taps too early, the tapholes may dry up prematurely, thereby missing out on late season runs. However, delaying tapping until the traditional time of late February/early March could result in a producer missing out on early season runs. This project collaborates with NNY maple producers to determine the advantages/disadvantages of tapping earlier and of staggering tapping as a risk-spreading strategy.

Methods: We collaborated with one maple producer in each of the 6 counties to test the effect of starting tapping on different dates in the winter. In December and January, we installed plastic spouts and tubing to connect a set of 4 trees to a 6-gallon bucket. We installed 9 tubing systems at each location. Three of these tubing systems (using 12 trees) were tapped in January, another 3 in February, and the final 3 in March. Every time the sap flowed, before the 6 gallon bucket was emptied into a larger tank, the cooperators measured the total volume and sap sugar content in the buckets. These data were then sent to Michael Farrell at the end of the season to conduct the analysis. Total syrup production was estimated by using the Rule of 86, which calculates the number of gallons of sap needed to produce a gallon of syrup by dividing 86 by the sugar content % of the sap. For instance, 43 gallons of 2% sugar sap are needed to produce 1 gallon of maple syrup.

Results: In most locations, early tapping did not significantly increase sap production. It did in one location. The reason seems to be that the largest amount of sap is obtained in March and April. A location in Clinton County had significant February sap flows, but mostly monthly sap yields in January and February are around 10% of the total. Our Clinton cooperator was the one location where early tapping increased overall yield. There is no evidence in these first year data that early tapping reduces yields during the peak months. Sap production varied 3x between the locations, something we need to understand more about.

Conclusions/Outcomes/Impacts: One year of data is not sufficient to make generalized recommendations. We are planning on continuing this project for several years and have already tapped trees for January to repeat the research in 2009. However, if we had to make recommendations with imperfect information based on only 1 year worth of data, we would offer the following advice:

For producers at low elevations and in warmer climates of NNY, we would recommend tapping in January as soon as the long range forecast indicates that there will be at least 2-3 days of sap flow. It wouldn't make sense to tap early if a producer only expected a short period of sap flow, but once the weather conditions start looking favorable for sap flow weather in January, a producer could likely increase their overall yield by tapping early.

For producers at higher elevations and in colder areas of NNY, we would recommend waiting until late February or March before starting to tap. Even though there may be some sap flow in January and February, a great deal of sap flow will occur well into April at these locations. Therefore, it makes sense to wait just before the first flows of March to start tapping to ensure that the tapholes will be as fresh as possible for the major sap flows in April.

Outreach: There has been a tremendous amount of media interest surrounding this project. Beginning in Fall of 2007, we started writing articles in Cornell Cooperative Extension newsletters and the Pipeline (quarterly publication of the NYS Maple Producers Association) to start promoting the project and soliciting volunteer cooperators. In January 2008, once all of the cooperators were selected and we had already tapped the first set of trees at each location, Michael Farrell wrote an article for the Maple News entitled "Timing of Tapping Project underway in NNY". There was good press coverage from the outset of the project, including featured news stories on News10 Now out of Watertown and NewsChannel 5 out of Plattsburgh.

The bulk of the media coverage came about from a press release we put together with Kara Dunn leading up to Maple Weekend in late March 2008. This generated an abundance of stories about the project and the impact of climate change on maple syrup production- included below is a partial list of media articles based on the press release:
Cornell Chronicle
http://www.news.cornell.edu/stories/March08/Maple.in.Jan.kd.html

American Agriculturist online:
http://americanagriculturist.com/index.aspx?ascxid=fpStory&fpsid=32884&fpstid=2

Schenectady Gazette:
http://cms.dailygazette.com/news/2008/mar/23/0323_mapleseason/

Sunday March 23 Ogdensburg Advance News
March 22 Watertown Times
News 10 Now
1000 Islands Sun
Physorg.com
Watertown Times
WWNY TV 7 Watertown
Poughkeepsie Journal
Observer-Dispatch
Olean Times Herald
Adirondack Daily Enterprise
Lake Placid News

We also worked with Kara Dunn to write an article for Farming: The Journal of Northeast Agriculture in Fall 2008 to document the results of the study. Michael Farrell presented the results at the Stone Barns Center for Food & Agriculture in New York in September. He has also shared the results with producers at the Upper Hudson Maple School in Warrensburg on January 2, 2009 and the NYS Maple Conference in Verona on January 10, 2009. He is scheduled to also talk about the results at the Lewis County Maple School on January 24th, the Clinton County Maple School at the Miner Institute on January 30th, and the St. Lawrence County Maple Expo on January 31st.

Next steps if results suggest continued work is needed in the areas of research, demonstration and/or education. This project will continue for several years. Results in future years will depend on the weather patterns for that year and the effect of tubing becoming more contaminated with bacteria and yeast over time. Previous research has shown that new tubing will produced increased yields throughout the sugaring season, as new tubing and spouts continue to produce later in the season whereas old dirty tubing will cause tapholes to “dry up” prematurely. Thus, even though some of the locations were able to produce increased yields by capitalizing on early runs while still obtaining the majority of late season runs, in the future, once the tubing has been impregnated with bacteria colonies, it may dry up much sooner, resulting in lower yields from January placed taps. By conducting this research in future years, we will be able to measure and document the extent to which this happens.

Acknowledgments: Cornell University is supporting this project in 2009 through a $5,000 Keickhefer Fellowship awarded to Michael Farrell.

Reports and/or articles in which the results of this project have already been published:

Dunn, K. Timing of Tapping. Farming: The Journal of Northeast Agriculture. October 2008.

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

Michael Farrell, 157 Bear Cub Lane, Lake Placid, NY 12946 (518) 523 9337 mlf36@cornell.edu

Steven Rider (315) 771-7187 sugarwoodhill@yahoo.com

Kevin O’Neil (315) 778-8076 koneill@mail.boces.com

Jennifer Parker (518) 420-4498 JCEISPARK@aol.com

Perry Babcock (518) 524-3358 babcockp@northwoodschool.com

Alex Barrett (413) 717- 0210 barretta@northwoodschool.com

Rolland Thomas (518) 529-7181

Steve Vandermark (315) 379-9586 sfv1@cornell.edu