Maine Agricultural Center Integrated Research and Extension Projects: 2009–2010

MAC107: Improving the Potential for Off-season Strawberry Production with Day-Neutral Cultivars and Plastic Mulches

Investigator(s): David T. Handley, Mark Hutton, James F. Dill

Background:

Strawberries are a high value crop in Maine and throughout New England, with net profit potential of $6,000 to $10,000 per acre. U.S. Agricultural census data from 2007 shows that both the number of farms in Maine raising strawberries and the statewide acreage dedicated to this crop have increased substantially in recent years, fueled by increased demand for locally grown fresh fruit. Presently, nearly all strawberries in Maine are June-bearing varieties, grown in fields that are not harvested until the year after planting, and then only for a relatively short period of about four weeks during June and July. Extending the strawberry season beyond this small harvest window could significantly expand markets for Maine strawberry growers, and provide extended availability of local fruit to Maine consumers. Day-neutral strawberry varieties offer a promising means to produce fruit during beyond the typical season. These varieties can be planted in the spring and harvested in the same year during the late summer and fall. However, until recently few day-neutral varieties were available and only two were adapted to the New England climate, which bore small fruit and had relatively low yields. Suitable growing techniques for commercial production of day neutral types in New England were also lacking. The release of several new day-neutral cultivars from California, most notably 'Seascape', that adapt well to northern climates have generated much interest from New England growers. When planted densely into raised beds covered in plastic mulch, these plants can produce fairly high yields of good quality fruit during August and September, when they meet a high demand from both retail and wholesale markets. However, growers have experienced substantial problems with fruit quality that appear to be related to the type of plastic mulch on which they raise the plants. Black plastic is desirable in the spring and fall because it warms the soil encouraging plant growth and early harvests. However, the intense sunlight and high temperatures of summer days can result in the break down of fruit lying on the hot layer of plastic. White plastic mulch keeps the fruit cooler by reflecting the light and heat, but may slow plant growth, resulting in delayed harvest and reduced fruit size. New plastic mulches are now available that have black strips for plant rows and a reflective coating for the remainder of the bed. This type of mulch may fulfill the needs of day neutral strawberries from both plant growth and fruit quality perspectives. Applying reflective coatings, such as kaolin clay, to black plastic mulch when surface temperatures become too high may also reduce fruit decay with less expense than reflective mulches. We propose to evaluate several mulch alternatives, with the objective of determining the optimum mulching strategy to enhance yield and fruit quality and to advance the harvest date of day neutral strawberries.

Project Description:

Plots of the day-neutral variety 'Seascape' will be planted on beds covered with plastic mulches of black, white, reflective (silver), silver with black planting strips, or black to be coated with kaolin clay post-planting. Plantings will be made at Highmoor Farm in Monmouth, Doles Orchard in Limington, and Farm To You in Farmington. Temperature probes will be set up within the different treatments at the Highmoor Farm site to record temperatures at the root zone and on the mulch surface during the growing season. Plant growth rates will be measured at regular intervals. Data will be collected for first harvest date, peak harvest, marketable yield, fruit size, and percent cull, including losses to high temperature breakdown.

Expected Outcomes:

Many strawberry growers in Maine would like to expand the market for their fruit. A dependable, profitable production system for day neutral strawberries could allow growers to bring fruit to market well beyond the typical season when both demand and prices are high. Additionally, vegetable growers not presently growing strawberries may find that a day neutral production system fits well into their typical vegetable production practices, allowing them to add an additional high-value crop to their offerings. We anticipate that the results of this work could reach over 500 growers within two years. One farmer/cooperator site will host a grower meeting where the mulch treatments will be discussed and demonstrated. Results of this study will be presented to growers through presentations at meetings, including the Maine Vegetable and Small Fruit Growers Annual Meeting and the New

England Vegetable & Berry Growers Winter Meetings. The results will also be presented in a statewide Extension Vegetable & Berry Newsletter. The results will also be posted on the UMCE Highmoor Farm web site. Should the project determine a clear best mulching strategy, we expect to see a rapid adoption of the technology and a significant increase in day neutral strawberry production within one to two seasons. Results of this project will also be presented and published for other agricultural research and extension staff through scientific associations such as the American Society for Horticultural Science and the American Pomological Society.

MAC 108 Evaluation of Natural Plant Extracts to Prevent Colonialization by the Invasive European Fire Ant, Mymica Rubra

Investigator(s): Kerry W. Bernard, Eleanor Groden

Background of Issue Addressed and Project Objectives:

Myrmica rubra is an aggressive stinging ant native to Europe that has become a major pest for some Maine communities in recent years. Infested sites in Maine often become so saturated with this ant that nests may occur at densities of several per square meter. Nests reaching up to 10,000 individuals have been observed. This ant has been found in almost every habitat type in Maine and nests in or under almost anything that can hold moisture. Due to its painful sting and readiness to defend its nest, *M. rubra* can prevent residents from using their lawns and gardens throughout the spring and summer months and harass customers and employees of greenhouses and nurseries afflicted with infestation. In addition to harming people this ant has been known to alter arthropod communities of infested areas. Specifically, *M. rubra* feeds on the honeydew secreted by aphids and in exchange defends these aphids from natural enemies such as lady beetles. Protecting aphids from natural predators can result in growing pest aphid populations which may increase damage to horticultural and agricultural plants.

Fortunately, *M. rubra* populations can remain relatively isolated. Mating flights have not been observed in Maine and colonies are not well equipped to cross bodies of water or long stretches of pavement without human aid. Instead *M. rubra* spreads by budding, a process in which one of the colony's numerous queens leaves the nest with a contingent of worker ants to establish a new colony, often only a short distance away. Regrettably, these colonies frequently establish inside plant pots containing soil and in mulch, fill, hay bales, and other materials that can be transported across natural barriers and result in new infestations. It has been hypothesized that *M. rubra* was first introduced to the United States by importation of horticultural material from Europe to an arboretum. Since then at least one infestation in Maine can be attributed to transportation of horticultural plants and it is likely there are many such instances. Colonies of *M. rubra* have repeatedly been observed moving into plant pots containing moist soil. This is problematic for greenhouses and nurseries where these ants occur, not only is *M. rubra* a painful nuisance, but it can also affect business. Any potential customer whose property is not infested and is familiar with this ant is unlikely to buy from a greenhouse known to harbor it. Also people with high density infestations in their yards may give up trying to garden and landscape altogether rather than being constantly stung.

Attempts to control *M. rubra* using traditional insecticides have met limited success and eradication is nearly impossible once this ant becomes fully established at a new site. Preventing its spread is therefore very important, and one critical step in this is to develop methods for protecting potted plants from colonies in search of a nest site. This can be accomplished by using repellents and understanding *M. rubra* colony movement. Some plant extracts are known to have repellent and insecticidal properties, but low toxicity to mammals, making them ideal candidate materials for treating plant pots and other containers without endangering human health or the environment. Our research to date has suggested that the plant extracts: spearmint, peppermint, neem, and possibly d-limonene may be able to protect plant pots from colonization. We propose to continue this research with extended field trials and experiments designed to generate a more in-depth understanding of colony relocation and budding. Because education about this ant is a critical factor in deterring its spread, we also propose to continue outreach activities about these ants.

Our proposed research and extension objectives are:

1. To determine the efficacy of using plant extracts as repellents to protect greenhouse and nursery stock from *M. rubra* colony invasion.
2. To characterize colony movement of *M. rubra* to better understand how and when invasions are likely to occur.
3. To raise awareness of *M. rubra* and its nesting behavior among Maine horticulturists and to disseminate information garnered in the achievement of the previous two objectives.

Research Methodology:

Objective 1: One hundred one-gallon plastic plant pots filled with moist soil and deployed within two infestations in early May. These pots will be dipped in 10% spearmint, peppermint, neem, d-limonene, or water. Pots will be monitored for colonization by *M. rubra* through September and watered as needed to maintain moisture. The number of pots colonized will be compared between treatments to determine the effectiveness of the four potential repellents. Rainfall and soil moisture of the infestation sites will also be measured to determine if colonization of plant pots is related to drought events in the surrounding environment. If so, treatment of potted plants in or adjacent to infestations might only be necessary during periods of dry weather.

Objective 2: Sixty artificial nesting substrates (plywood boards or patio stones) that were previously set out in three infested sites at Acadia National Park will be monitored from May 1st through October 2009. These substrates will be checked for the presence of *M. rubra* colonies every week. Colony movement can be enumerated by looking at the number of substrates that were abandoned and newly colonized from week to week. Colony structure as well as multiple environmental factors will be quantified such as: ambient temperature, nest temperature, relative humidity, soil moisture, and percent canopy cover above each substrate. Together this data should be useful for determining what environmental conditions promote or deter colony movement and why some potential nest sites are utilized much more frequently than others. In addition, 20 new artificial nesting substrates will be deployed one meter apart in a 4 by 5 grid within an infestation and as many natural substrates will be removed from the area as possible. *M. rubra* colonies found in natural substrates will be transplanted to the artificial nesting substrates and queens from each colony will be marked with a unique color of paint. Each week the substrates will be checked for *M. rubra* colonies and the queens of any new colonies that move in will be painted as well. This will allow for identification of an individual colony and hopefully the tracking of its movement between substrates. It will also be possible to determine how often and when budding occurs as well as if colonies within the grid coalesce, as *M. rubra* colonies are thought to do. Painting worker ants has not proven to affect ant behavior under laboratory conditions, but a preliminary test will need to be done in the lab monitoring movement using colonies with painted queens and colonies without painted queens. It will also be necessary to make sure that paint does not rub off under field conditions; this can be accomplished by providing moist soil as nesting material in the laboratory and checking queens periodically for markings.

Objective 3: The results of objective 1 experiments and our previous research into repellents, will be summarized for a management section to add to the current *M. rubra* extension factsheet that was developed in 2005. Updated factsheets will be distributed to extension agents in counties affected by this ant and made available through our European fire ant website. In addition, a presentation on the use of repellents in *M. rubra* management will be given at the next Maine Agricultural Trade show, and an exhibit on pest ants and the use of repellents will be developed for the Maine Organic Farming and Gardening Association's Common Ground Fair.

Expected Outcomes:

One or more plant extracts will be proven to effectively protect plant pots from *M. rubra* colonization. We expect that both neem and spearmint oils will prove very effective, but all four extracts have shown potential.

Sufficient knowledge of *M. rubra* colony movement will be gained as to predict when and under what conditions plant pots and other materials are most vulnerable to invasion. This should lead to the development of more effective and economical approaches to management. We expect plant pots will be most vulnerable in the summer after multiple consecutive days without rain.

Awareness of *M. rubra* colony movement patterns and the potential benefit of using repellents will increase, possibly resulting in fewer new infestations.

Termination Report

Results:

1. Fewer plant pots treated with the potential repellents were colonized by *M. rubra* for eleven weeks. Only d-limonene treated pots met or exceeded colonization of water treated pots. D-limonene and neem were 100% effective for the first 3 week and the mint oil treated pots were colonized until week five. Seven water treated pots had been colonized by this time. Spearmint appears to have been the most effective repellent. Survival analysis revealed significant differences between treatments, further analysis is in progress to determine when each repellent failed to significantly repel colonies.
2. The greatest number of substrates occupied by *M. rubra* occurred in May with over 50% occupancy. The number of substrates occupied steadily declined through the rest of the season. The greatest amount of movement occurred in June and in general movement also declined over the summer. Emigrations were considerably more common than immigrations. Only in July did more immigrations occur. Modeling revealed that abiotic nest site conditions varied in importance throughout the season, but when these were significant occupied substrates were cooler, more moist, and more shaded than substrates which were not occupied. Temperature significantly impacted occupancy throughout the season. Soil moisture was important in all months tested except July. Shade had significant influence on occupancy in June, August, and September, and nearly did in May. Analysis of colony structure has yet to be completed. Marking colonies within a grid was mostly unsuccessful as they did not stay within the grid for long. However, 7 of 18 colonies taken from different nests were subsequently found intermixed. The greatest distance between nests found with ants of different colors was 2.9 meters. Assays determined that paint did not cause significant mortality or changes in behavior. Paint lasted from summer through overwintering to the following spring.

MAC 109 Managing Fertility to Produce High Quality Bread Wheat in Maine

Investigator(s): Ellen Mallory, Greg Porter, Rick Kersbergen, Eric Gallandt

Abstract:

Supplying the expanding market for locally grown organic and "natural" bread wheat represents a significant opportunity for Maine's farmers. Many who have begun growing bread wheat have found that their current fertility methods do not produce grain that meets baking standards for protein content. We will conduct a field trial to evaluate 3 different organic nitrogen sources at 2 application rates and 2 timings. We will also evaluate a wide-row cereal production system used in northern Europe for its potential to stimulate nitrogen (N) mineralization at grain filling. Related educational programs will improve growers' knowledge of fertility management and quality standards, and offer specific recommendations to ensure quality standards are reached.

Background

Growing demand for local food has inspired new efforts to revive a staple element of the New England food system—***bread*** (Russell, 2008). Millers and bakers, however, cannot find enough locally grown wheat (Jim Amaral, Borealis Breads, 2/28/09, pers. comm.). Supplying the current demand in Maine alone would require the equivalent of more than 3,000 acres of production (Russell Libby, Maine Organic Farmers and Gardeners Assoc. (MOFGA), 3/4/09, pers. comm.). This increasing demand has inspired great interest in growing bread wheat. A recent conference on the topic attracted over 120 farmers, millers, and bakers (Spring Growth 2009, MOFGA and UMaine Coop. Extension). Many organic dairy farmers see human-grade grains as an opportunity to stabilize their whole-farm profitability, recently threatened by volatile organic milk prices. Farmers in Aroostook County, where over 43,000 acres of small grains are currently produced (NASS, 2007), are increasingly interested in growing organic bread wheat as potato ground is idled. Additionally, Maine Potato Growers, Inc. has begun working with a Quebec mill to provide "natural" bread wheat, receiving no pesticides or synthetic fertilizers during the year of production.

Many Maine farmers have found that their current fertility practices are not adequate to meet the strict quality standards for bread wheat. Grain protein concentration, which influences gluten strength and loaf volume, is considered the most essential property of bread flour (Wall, 1979). Most commercial mills have a target protein content of 12-15%. The most critical factor controlling grain protein is the amount and timing of N availability (Wooding et al., 2000). Nitrogen accumulated during wheat's vegetative period increases primarily yield, whereas N applied after flowering increases grain protein (Jenner et al., 1991). For this reason, topdressing inorganic N at flowering is a recommended practice in conventional management to enhance bread wheat protein.

Assuring adequate available N for grain yield and protein is particularly difficult for organic winter wheat production. A practice currently used and recommended by Matt Williams, Aurora Mills and Farm, is the addition of Chilean nitrate (sodium nitrate) in early spring. While currently approved for organic production, Chilean nitrate is an inorganic N source whose use is limited to 20% of total N additions. Alternative N sources approved by the Organic Materials Review Institute (OMRI) have different N release rates and are equally or more expensive. There is a need to investigate different OMRI approved N sources, application rates, and timings, to identify cost effective strategies to produce adequate grain yield and grain protein.

There also may be reason for farmers to consider an alternative approach to cereal production that could enhance grain quality. Some northern European organic growers manage wheat as a "row crop" to allow inter-row hoeing. Recent work in Maine has shown that this wide-row hoeing system provides substantially greater weed control in organic barley than the standard practice (narrow rows, no hoeing) (Kolb and Gallandt, unpublished). Others have found a full percentage point higher grain protein for winter wheat grown in wide rows compared to narrow rows (Hiltbrunner et al., 2005). The inter-row hoeing, which stimulates mineralization of soil N, may be optimally timed to enhance N supplied at the critical grain filling stage (Thomsen and Sørensen, 2006).

Objectives

1. Evaluate the efficacy of different spring nitrogen application sources, rates, and timings to enhance winter wheat grain protein.
2. Assess the effects of wide-row planting and inter-row hoeing on grain protein.
3. Develop and distribute fertility recommendations to Maine's farmers and agricultural educators.

Methods

Objective 1:

We will conduct an on-farm study at the A.J. Qualey Farm, in Benedicta, Maine. Winter wheat was planted in the fall of 2008 after a clover sod plowdown. Three OMRI-approved N sources will be compared: Chilean nitrate, a dry organic fertilizer (Nature Safe 13-0-0), and liquid fish emulsion. The materials will be applied at two different rates (10 and 20 lbs of plant available N per acre) and two times (at tillering, Zadoks 25, and late boot, Zadoks 50). A control treatment with no N application will be included. Plots will be 10 feet by 20 feet and treatments will be replicated 4 times. Soil inorganic N availability and plant N uptake will be monitored. Soil samples will be taken to an 8 inch depth before N application and then at 10-14 day intervals thereafter, ending at wheat physiological maturity. Soils will be extracted with KCl for inorganic N determination. Above-ground wheat samples will be collected at similar intervals analyzed for total N concentration. Soil extracts and plant samples will be analyzed at the University of Maine Analytical Laboratory. Grain will be harvested with a plot combine, weighed, analyzed for test weight and moisture, and submitted to the Dairy One Laboratory for protein determination.

Objective 2:

This experiment will take advantage of long-term plots in the Maine Potato Ecosystem Project at the Aroostook Farm in Presque Isle. Two contrasting soil treatments (Amended and Nonamended) represent the farms where bread wheat production will likely expand: organic dairy farms whose soils receive manure amendments and are high in organic matter; and potato farms with no access to manure whose soils have low organic matter. We will use these plots to test the potential of the wide-row inter-row hoeing system to enhance N availability and increase grain protein. Treatments will be: standard row spacing; wide-row spacing with no inter-row hoeing; wide-row spacing with one inter-row hoeing at 5 tillers (Zadoks 25); and wide-row spacing with an additional inter-row hoeing at booting (Zadoks 45). These treatments will be implemented on Amended and Nonamended plots, and replicated 4 times. Soil inorganic N, plant N uptake, grain yield, and grain protein will be monitored as described above.

Expected Outcomes and Outreach (Objective 3)

An article summarizing recommendations for organic farmers on the most effective fertility strategies to enhance yield and achieve grain protein levels required for the bread end-use market will be published in online and print newsletters and newspapers from the Northern Grain Growers Association (NGGA), the MOFGA, and the Northern Organic Dairy Producers Association. We will also present the project and its results at workshops and conferences, including the NGGA winter conference, the Maine Agricultural Trades Show, and Maine's KNEADING Conference.

Literature Cited

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Termination Report

Introduction

Organic bread wheat producers need effective strategies to produce grain that meets the protein standards required by millers and bakers for bread wheat flour (12%). This integrated research and extension project investigated two strategies to boost bread wheat grain protein: in-season nitrogen applications ("topdressing") of materials approved for organic production and wide-row plant spacing with inter-row hoeing.

Original Objectives and Significant Findings

Objective 1– Evaluate the efficacy of different sources, rates, and timings of in-season nitrogen applications ("topdressing") to enhance winter wheat grain yield and protein. (FULLY MET)

We evaluated 2 nitrogen (N) sources allowed under organic production (Chilean nitrate and dehydrated chicken manure) at 2 rates of application (20 and 40 lbs of total N acre^{-1}) and 2 application times (tillering and boot growth stages of wheat; May 15 and June 9, respectively) in an on-farm trial in Benedicta, Maine.

- Topdressing N increased grain protein levels when applied at the boot growth stage, but had no effect when applied earlier in the spring at the tillering stage. Therefore, mid-season topdressing may be an effective strategy for farmers to attain the 12% grain protein required for the high-value bread wheat market.
- Chilean nitrate was twice as effective as dehydrated poultry manure at increasing grain protein. The same increase in grain protein, from 11.8 to 12.4%, was observed with 20 lbs N acre^{-1} of Chilean nitrate as with 40 lbs N acre^{-1} of dehydrated chicken manure. Chilean nitrate applied at the 40 lbs N acre^{-1} rate increased grain protein to 13.1%.
- Only the highest rate of Chileannitrate significantly increased grain yield. High variation in the yield data due to uneven overwintering of the wheat stand contributed to the lack of other statistically significant treatment effects.

Objective 2- Assess the effects of wide-row planting and inter-row hoeingon grain protein. (PARTIALLY MET)

This experiment took advantage of long-term plots in the Maine Potato Ecosystem Project at the Aroostook Farm in Presque Isle. Two contrasting soil treatments (Amended and Nonamended) represent the farms where bread wheat production will likely expand: organic dairy farms whose soils receive manure amendments and are high in organic matter; and potato farms with no access to manure whose soils have low organic matter. We intended to use these plots to test the potential of the wide-row inter-row hoeing system to enhance N availability and increase grain protein. However, excessive wet weather prevented the hoeing treatments from being implemented. We were able to evaluate row spacing (standard 7" vs. wide-row 9") and soil management system (Amended vs. Nonamended).

- Row spacing had no significant effect on wheat grain yield or protein.
- The Amended, manure-based fertility treatment produced higher grain protein than the Nonamended, fertilizer-based treatment although total available nitrogen was the same. Higher soil quality and slower release of N may have con tributed to higher grain quality in the Amended system. Yields were similar between the treatments.

Objective 3– Develop and distribute fertility recommendations to Maine's farmers and agricultural educators. (PARTIALLY MET)

- The results from these trials were presented at 9 grower workshops and meeting from July 2009 to July 2010. (see list below)

- Fertility recommendations will be developed after two more years of field trials to assure they are robust, and will be published in a regional production guide in collaboration with Vermont as part of the new USDA-OREI grant (see below).

Project Outcomes

Grant funding:

- Inspired by this project, we developed a multi-state, multi-institution USDA Organic Agriculture Research and Extension Initiative (OREI) grant on organic bread wheat production that was funded at $1.3 million over 4 years. Mallory, E., H. Darby, E. Gallandt, R. Kersbergen, M. Camire, S. Bosworth, J. Halloran, S. Smith, A. Hazelrigg, and D. Lambert. Enhancing farmers' capacity to produce high quality organic bread wheat. USDA Organic Agriculture Research and Extension Initiative.

Video:

- PSE graduate student Lauren Kolb and technician Katie McPhee produced a video, "Weed Control in Organic Cereals", that highlights the wide-row planting and inter-row hoeing system.

Follow-up research:

- I am collaborating with Heather Darby, University of Vermont, to further evaluate topdressing strategies for improving grain quality. Results will be developed into fertility recommendations for bread wheat growers.
- I am collaborating with Mary Ellen Camire (Univ. Maine Dept. of Food Science and Human Nutrition) to investigate the influence of soil quality on bread wheat food quality. We will consider grain protein, flour performance and flour nutritional and nutriceutical components.

Integration of Research and Extension activities

Research results have been fully integrated into educational programming (talks and video) on bread wheat production. In addition, a major outcomefrom this project was the development of a successful integrated research and extension grant proposal (see USDA-OREI proposal listed above).

Presentations

- Growing Bread Wheat in Maine: Production Practices, Quality Standards, and Current Research. Growing Wheat in Washington County Conference. July 9-10, 2010. East Machias, Maine.
- Topdressing Nitrogen to Improve Organic Winter Wheat Yield and Quality. University of Maine Sustainable Agriculture Field Day. July 1, 2010. Stillwater, ME.
- Organic Bread Wheat: Quality Standards and Related Production Practices. Talk was given to three different groups: 1) Meeting of current and potentialFranklin County grain growers, February 4, 2010, Farmington, ME; 2) Aroostook County Organic Growers Seminar, February 13, 2010, Littleton, ME; 3) Meeting of current and potential Somerset County grain growers, February 23, 2010, Skowhegan, ME.
- Local Bread Wheat. New England Agricultural Service Providers In-Service Training. January 28, 2010. Portsmouth, New Hampshire.
- Reweaving Our Bread Basket: New Efforts in Bread Wheat Production in New England. Food for Thought, Time for Action: Sustainable Food, Farming, and Fisheries for the 21st Century. October 2-4, 2009. College of the Atlantic, Bar Harbor, Maine.
- Bread Wheat in Maine: Markets and Quality. 2009 Maine Farm Days. August 21, 2009. Barker Farm, Leeds, Maine. 10 attendees.
- Bread wheat research in Maine. Highmoor Farm Centennial Field Day. August 19, 2009. Monmouth, Maine.
- Local Bread Wheat Production. University of Maine Sustainable Agriculture Field Day. July 27, 2009. Stillwater, ME.

Video

- "Weed Control in Organic Cereals"- highlights the wide-row planting and inter-row hoeing system. Available on YouTube at http://www.youtube.com/watch?v=3kwNGKBICU

Nontechnical Summary

Organic bread wheat farmers need strategies to increase grain protein levels in order to meet the standards required by millers and bakers for bread wheat flour (12%) and take advantage of the expanding high-value market for locally grown wheat. Research conducted by Dr. Ellen Mallory at University of Maine in 2009 found that applying nitrogen to the growing crop ("topdressing") in late spring may be an effective strategy for organic production.

The research compared topdressing times (early spring vs. late spring), nitrogen sources (Chilean nitrate vs. dehydrated chicken manure, both approved for organic production), and rates of application (20 vs. 40 lbs of total N per acre). Topdressing in late spring at the wheat "boot" growth stage (May 15) increased wheat grain protein whereas topdressing earlier at wheat tillering (June 9) did not. The same increase in grain protein, from 11.8 to 12.4%, was observed with 20 lbs N $acre^{-1}$ of Chilean nitrate as with 40 lbs N $acre^{-1}$ of dehydrated chicken manure. Chilean nitrate applied at the 40 lbs N $acre^{-1}$ rate increased grain protein to 13.1%.

Dr. Mallory is collaborating with colleagues in Vermont to further investigate the topdressing strategy as part of a $1.3 million, multi-state, multi-institution USDA Organic Agriculture Research and Extension Initiative grant. Gaining results over multiple years and sites will allow the researchers to develop reliable fertility recommendations for farmers to produce high-quality, organic bread wheat in Northern New England.

MAC 110 Evaluating Bt Field and Sweet Corn for Yield and Insect Damage

Investigator(s): John M. Jemison

Introduction

In 2007, the Maine Board of Pesticides Control approved the use of three field corn plant incorporated protectants (PIPs). In 2009, Syngenta submitted a request for the Board to approve Bt sweet corn using one of the same events (Bt-11) approved in field corn.

In 2006, the Maine Ag Center funded the first year of a trial comparing several lines of Bt corn to their non-Bt isoline. Since this time, with the help of Miah and Lauchlin Titus, we have continued this work using industry supplied seed, and industry funding for forage quality and mycotoxin analysis. Last year, Monsanto provided analytical funding for the forage quality work from both locations and mycotoxin analysis for one site. I have completed five site years of this work (five locations over three years). We lost two trials: one to crows and one to weeds. Monsanto and Mycogen have agreed to supply seed for a trial we hope to conduct this year, and I hope to get seed from Pioneer as well.

It is said, one can't control the weather; neither can one control insect populations. Over the three years that we have conducted the trials, there has been, at best, moderate populations of corn borer and only light pressure from cutworms and rootworms. We have documented significantly reduced numbers of feeding holes in the leaves and the stalks, but we have not been able to document yield or quality differences. However, there has been a general slight (non-statistically significant) improvement in forage quality components such as acid detergent fiber, neutral detergent fiber and non-functional carbohydrates. I propose to establish three field corn trials on farmers fields in Maine. I may try to establish four trials to protect against a lost trial if I can find a fourth willing farmer. With 8 site-years of research, I am confident we will have sufficient work to provide farmers with scientifically valid information on the cost/benefit of this technology, and I should be able to get this work published in a peer-reviewed journal.

The second set of experiments that I propose to do this summer are related to sweet corn. The major advantage of Bt sweet corn is that growers would not be exposed to harmful insecticides like Lannate which is labeled as danger with skull and crossbones. Other options like the carbamates are very hazardous as well. Bt sweet corn has never been trialed in Maine. When I presented at the Ag Trades Show in January, several growers expressed interest in my working with them to trial this corn. I would measure early development, insect activity at silking, yield, and number of insects in corn ears and holes in stalks. This information will be made available to growers through programs at the Ag Trades Show, dairy farmer meetings, and on the web through Adobe Connect.

Goals and Objectives

Goal 1. Complete a 4-year, 8-location study on Bt field corn.

- Objective 1a. Determine yield of three Bt corn hybrids and their non-GE near isolines in fields which have been in continuous corn in at least three locations in Maine.
- Objective 1b. Evaluate insect damage on Bt hybrids and non-GE near isolines at three stages of development: at the second leaf stage to assess cutworm impact, at silking for leaf and stalk ECB holes, and prior to harvest to assess late season ECB impact.
- Objective 1c. Test Bt lines and non-GE near isoline silage for the presence of mycotoxins.

Goal 2. To help guide future BPC decision-making, provide the BPC useful information about effectiveness of Bt sweet corn for Maine growers.

- Objective 2a. Determine yield of Bt sweet corn compared to its near non-Bt isoline.
- Objective 2b. Evaluate insect damage on Bt sweet corn hybrids and non-GE isolines at two stages of development: at or before silking and at harvest to assess impact on ECB.

Goal 3. Growers will understand the financial cost and benefit of Bt corn systems.

- Objective 3. Perform a simple cost-benefit analysis on the Bt corn hybrids and their non-GE isolines for the four-year evaluation.
- Objective 3b. Compare costs to simple silage blends.

Goal 4. Growers will learn about the results of this study through standard Cooperative Extension training opportunities.

- Objective 4a. Results of both trials will be presented at the Agricultural Trades Show, and to at least one regular corn growers meeting.
- Objective 4b. A report will be prepared and presented to the BPC at a regular monthly meeting.

Termination Report

Project Summary:

Bt sweet corn is a new crop production option for vegetable growers. These lines are altered with a protein (Bt11) that is toxic to corn earworm and to a limited extent fall armyworm and European corn borer. We conducted two trials to evaluate the effectiveness of these lines. We found that Bt11 was highly effective on corn earworm. However, it was less effective on fall armyworm. If fall armyworm pressure is high, additional materials will be needed to control them. Also, we found that growers assumed that if they used Bt11 corn that they would get cutworm control as well. This is not the case, and in our subsequent educational efforts made around the state, we strongly focused on this issue. A new line of Bt sweet corn has been approved by the state BPC that may provide better control over cutworm and fall armyworm.

Introduction

During the spring of 2009, the Maine Board of Pesticides Control (BPC) approved the use of transgenic sweet corn. There was interest among members of the BPC staff and board to see how effective these materials were at controlling common sweet corn pests such as corn ear worm (*Helicoverpa zea)*, fall army worm (*Spodoptera frugiperda)*, and European corn borer (*Ostrinia nubilalis*). There are currently no sweet corn varieties that control black cut worm (*Agrotis ipsilon).*

During the summer of 2009, we were provided funding by the Maine Ag Center to evaluate Bt sweet corn. We initially planned to have four formal replicated trials over four different soil types and three environments. I present our findings from one replicated trial at the Thomas farm in Garland Maine. I will also present some findings from an unreplicated trial at Highmoor Farm where we took six random replicate samples from two varieties: one Bt and the other unsprayed Kristine sweet corn. The third sweet corn trial planted at Rogers Farm in Stillwater was planted, but it was inundated by flood waters and never recovered. The first trial planted at the Thomas farm came up well, but was decimated by black cutworm. The Thomas family planted that trial in a field far from the work center. The rains kept them from getting back to spray that field. When the rains slowed enough to scout, the field was essentially destroyed. We didn't have a stand remaining to work with.

But at the Thomas farm, we were successful at completing a replicated trial. We compared the later maturing corn Providence against two Bt sweet corn lines (BC-0805 and GH-0851). The sprayed comparison came from a strip of conventionally sprayed Providence located next to the replicated corn trial. We also took six samples from a field at Highmoor planted to Kristine and BSS-0982. These studies will be useful to document important findings and trends.

Experimental Details

The Thomas Farm trials were planted on 2 June 2009. We planted corn on 8 inch spacing at approximately 22,000 seeds to the acre. The Highmoor farm trial was planted by David Handley and the farm manager. Slightly higher seeding rates were used there.

The Thomas study was harvested on 10 September 2009. The Highmoor corn trial was harvested on 21 September 2009. In each study, we took six samples from 20 linear feet of corn for yield. We measured all ears making

marketable length. Each ear was opened and we determined number of samples that would have been marketable to consumers expecting the ear to be free of ear worm, fall army worm or European corn borers.

Results – Thomas Farm

Table 1. Yield and Quality Data from Thomas Farm Experiment

Variety	Population harvested	Marketable Ears **	Corn Ear Worm	Fall Army Worm	European Corn Borer
	****** numbers ac-1 ******				
Providence (no spray)	18513	7865 b	7260 a	5082 a	605 a
BC-0805	18392	10769 ab	605 b	2057 b	242 ab
GH-0851	17303	9559 ab	484 b	1089 b	121 b
Providence (sprayed)	18634	14157 a*	1815 b	605 b	121 b
Pr>F	-	0.08	0.006**	0.01**	0.06
LSD (0.05)	NS	4842	3836	2474	396

** Marketable ears were a combination of those reaching appropriate size and meeting insect free criteria.
* Note that the yield of sprayed providence came from a field adjacent to the replicated study and more of these ears met the size criteria possibly because of better growing conditions.

Discussion – Thomas Farm

The Bt varieties were very effective on corn ear worm. We found over 90% reduction in corn ear worm (CEW) compared to the untreated corn. Where occasionally found, the larvae were for the most part very small and isolated to the silk; but in about 5% of those cases, we found large (CEW) larvae. This was not likely failure of the toxin to kill the insect, but was more likely untraited seed. One should likely not expect 100% pure Bt sweet corn in a bag. Likewise the higher levels of earworms found in the sprayed Providence reflect that most insecticidal applications are not 100% effective either.

The other interesting finding is that Fall army worm (FAW) is not as effectively controlled in Bt sweet corn lines as CEW. Instead of 90% control compared to the check, we found between 60 – 80% efficacy. From this, we will recommend that growers continue to monitor insect pressure in their sweet corn. Additional sprays may be needed if FAW larvae are present in high numbers.

Results – Highmoor Farm

Table 2. Yield and Quality Data from Highmoor Farm Experiment

Variety	Population harvested	Marketable Ears **	Corn Ear Worm	Fall Army Worm	European Corn Borer
	****** number ac^{-1} ******				
Kristine (no spray)	24805 a	1331 a	23474 a	1815	242
BSS-0982	17660 b	14520 b	242 b	2541	121
Pr>F	0.01	0.0001	0.0001	NS	NS
LSD (0.05)	2658	2786	3573	----	---

Discussion – Highmoor Farm

We found similar trends in these data to what we found at the Thomas farm with the exception that the FAW numbers were lower and CEW numbers were extremely high. Almost every ear harvested from the Kristine had a worm in the ear tip or side. We found 99% control effectiveness in the Bt corn compared to the unsprayed Kristine. We found about 10% of the ears had some FAW larvae in the tip or side indicating again the need to scout for this pest and spray if levels exceed threshold levels.

Overall Conclusions

Overall the largest differences found between the two locations was the higher Fall Army Worm pressure at the Thomas farm and higher corn ear worm pressure found at Highmoor farm. Bt corn effectively controlled CEW at both locations to acceptable levels. Likely from 1 to 5% of the Bt corn seed will not carry the trait, but it should meet market acceptability for CEW. Farmers will want to continue to monitor for FAW based on our results, and spray if levels exceed thresholds. Lastly, growers should also know/remember to scout field for black cut worm as currently available Bt sweet corn lines have/show no control over this sweet corn pest.

MAC 111 Leachate Quantity and Quality Generated by Carcass Mortality Compost Piles

Investigator(s): Mark King, Mark Hutchinson

Background:

Carcass disposal continues to be an issue for Maine farmers. In 2006, Maine developed an Emergency Carcass Disposal plan which identified composting as a Best Management Practice for carcass disposal. (Note: Part of this research was supported by Mac funds in 2004. Additional funding in 2005 and 2006 was provided by the Maine Departments of Agriculture and Environmental Protection.) Since 2006, many farms and slaughterhouse facilities have used composting as their primary disposal method. Composting is considered to be an economical and environmentally sustainable practice. However, the plan does not address industry concerns specifically related to leachate and groundwater issues.

Leachate and groundwater contamination from manure storage and usage is well documented in the scientific literature. There is very little scientific literature on leachate and groundwater contamination from compost and specifically, carcass compost.

Dr. Tom Glanville, Iowa State University, has done preliminary leachate work on swine carcass compost piles with no conclusive results. Cornell Waste Management developed a leachate study for roadkill carcass compost in 2007; results have not been published. According to the Principal Investigators, neither study indicated a reason for concern when compost piles were constructed properly (personnel communication). However, neither study used hot-sludge derived compost as a feedstock. Hot-sludge compost has significantly more potential nutrients available for leaching than farm feedstocks. Hydrogeologists from the Maine Department of Environmental Protection, Division of Technical Services, have voiced concerns over the Emergency Carcass Disposal Plan, especially regarding the potential for placement of large quantities of nutrient laden materials (compost) on native soils without provisions for leachate collection and treatment. This concern, coupled with increasing public intolerance of traditional agricultural spreading practices, leaves little room for error.

This project is supported by the large poultry and dairy operations that would be required to use this emergency plan for large mortality losses.

The objective of this study is to assess the quality and quantity of leachate generated by mortality compost piles following the methodology outlined in Maine's Emergency Carcass Disposal Plan.

Research:

Between August 1, 2009 and September 30, 2009, replicated leachate trials will be conducted at the Highmoor Farm Compost Research & Educational Facility located in Monmouth, Maine. Three leachate collection platforms will be placed on the facility's existing asphalt composting pad (2% slope). Static piles (measuring 3 m^3 in volume) will be formed from hot sludge-derived compost on each platform. In addition to the compost, approximately 100-200 poultry mortalities will be placed in the middle of the piles. The poultry mortalities will be gathered from Dorothy Egg in Winthrop as part of their routine mortality losses.

During the eight-week study period, each pile will experience 6 simulated precipitation (trial) events of 30 minutes in duration. A National Phosphorus Research Project designed Rainfall Simulator (Sharpley and Kleinman, 2003), measuring 3 m inside diameter will be placed over each of the constructed piles and allowed to discharge for 30 minutes, equaling approximately 75 mm h^{-1} of accumulated precipitation. The rain fall simulator is currently on loan from the USDA Plant and Soils lab in Orono and is available for this project. Piles will be covered between precipitation events.

Leachate will be collected at the down slope end of each collection platform. A fabricated leachate collection device attached to a 284 L capacity container will be installed to capture all leachate that is generated during the simulated rain event. Leachate was successfully captured using this methodology during trials in 2008 with four different

feedstocks. All generated leachate will be collected and total volumes calculated (L). Additionally three subsamples will be collected per simulated rain event (10 minutes following the initiation of flow, 20 minutes following the first sample, and a final sample at the end of the flow or when flow becomes interrupted). These subsamples will be used to determine the quality of the leachate. Subsamples will be sent to the University of Maine Soil Testing Laboratory and tested for the following parameters: Total Nitrogen (N), Nitrate-nitrogen ($N0_3$-N), Ammonia nitrogen (NH_4-N), Phosphorus (P), Potassium (K), Aluminum (Al), Boron (B), Calcium (Ca), Copper (Cu), Iron (Fe), Sodium (Na), Magnesium (Mg), Manganese (Mn), Sulfur (S), Zinc (Z), pH, and Conductivity. A statistical analysis of the results will allow us to share specific results with industry representatives to assist them in making better disposal decisions. The information will also be used to generate additional funding through SARE or other appropriate external sources.

Expected Outcomes:

50 Agricultural Service providers, Industry representatives and producers will receive further information on carcass compost leachate by 2010. Information will be:

- Presented at regional trainings and international symposia, industry meetings and the Maine Agricultural tradeshow.
- Included in the Best Management Practices tool kit for carcass disposal used by Agricultural Service Providers.
- A part of Highmoor Farm's 100th celebration field trip.

Literature Cited:

- Sharpley, A. and P. Kleinman. 2003. Effect of rainfall simulator and plot scale on overland flow and phosphorus transport. J. Environ. Qual. 32:2172-2179.

Termination Report

Abstract:

Carcass management is an essential part of any livestock operation. Compost is an environmentally and economically sustainable practice, now considered a "Best Management Practice" for carcass management in Maine. However, there are still concerns about nutrient leachate from these compost piles. This project attempted to determine the character and quantity of leachate from carcass compost piles on an impervious surface. As expected, leachate occurred from the carcass compost piles over a period of 3 months. When the piles were cross-sectioned, it was discovered that very little water moved vertically through the piles. Water was shed by the pile and moved horizontally along the impervious surface. We suspect that soluble nutrients were picked up as it moved under the pile, but few nutrients moved vertically through the pile. This resulted in very little nitrogen released from the carcass being present in the leachate.

Original project objectives that were met:

Objective: Collect leachate effluent to determine quantity and character from static carcass compost piles using rainfall simulator and leachate collection platforms. This objective was partially met.

The Maine Compost Team conducted compost trials in the summer of 2009 and 2010 in order to measure the quantity and character of leachate that resulted from composting large animal carcasses. The original experimental design was to use poultry mortalities and hot municipal biosolids as the compost feedstock. However, circumstances did not allow us to procure sufficient poultry mortalities numbers for the project. Instead, dairy cows and on-farm feed stocks (horse bedding and waste feed in a 4:1 ratio) were used. All cows used in the project died of natural causes or birthing issues.

Three control and experimental platforms were assembled in July 2009. The leachate platform size was chosen to fit the dimensions of the rainfall simulator (10' x12'). The control platforms received approximately 12 yd^3 of the feedstock material. The experimental piles also received 12 yd^3 of feedstock material plus a dairy cow. The experimental piles were constructed using a layering technique previously developed by the Maine Compost Team.

After several unsuccessful attempts of using the rainfall simulator, the project was suspended until the summer of 2010. Issues with the rainfall simulator were providing consistent rainfall over the entire pile and collection of the leachate effluent.

In 2010, platforms were expanded to 10' x 14' and natural rainfall was used in place of the rainfall simulator. This created a more realistic "on-farm" scenario.

Leachate character and quantity data was collected after seven rain events between July 22nd and September 24th 2010. The largest nutrient release occurred within the first two weeks of pile construction. During this period the exterior integrity of the carcass was broken, releasing body fluids and nutrients. Nutrients continued to be released during the entire compost process but were not deemed significant. A mass balance of total nitrogen determined that less than 0.1% of the total nitrogen in a carcass was lost in the leachate.

Pile excavation showed that water moved under the piles rather than through the piles. The areas directly above and under the carcass were relatively dry. Soluble nutrients did not have a way to move out of the pile. This information helps explain why there was little total nitrogen in the leachate from the carcass.

The Maine Compost Team continues to seek funding to support further research on carcass management.

Project Outcomes:

Carcass compost leachate information was shared with over 150 Agricultural Service providers and producers throughout Maine, other New England states, New York, Pennsylvania and the Maritimes Provinces. New Hampshire and the Province of New Brunswick are in the process of changing regulations in relation to carcass management because of the research results in these projects.

The project was one of the tour stops for the Highmoor Farm 100th Celebration in 2009 where this information was shared with a diverse audience.

Cooperative Extension Publication:

- http://www-dev.umaine.edu/publications/carcass-management/

Professional Presentations

- University of New Hampshire Cooperative Extension program: "Emergency Carcass Management" Durham, NH September 2009.
- New England Agricultural Service Providers: "Impact of Carcass Management on Water Quality" Portsmouth, NH. January 2010.
- New Brunswick Provincial Department of Agriculture: Fredericton, New Brunswick, Canada. "Management Options for Carcass Mortalities and Slaughterhouse Offal". February 2010.
- Highfields Compost Workshop: Carcass Management on Vermont Dairy Farms a Look at the Environmental Impacts of Burial and Compost" Putney and St. Albans, Vermont. September 2010.
- Maine Agricultural Trade Show: Impact on Leachate from Carcass Composting Augusta, Maine. January 2011

MAC 112 Improving Transplant Quality and Survivorship for Muskmelon Production in Maine and New Hampshire

Investigator(s): Mark G. Hutton, David T. Handley, Becky Grube

Issue/Priority:

Muskmelons (*Cucumis melo*) have the potential to become an important crop for Maine vegetable farmers. Melons are a popular item at farmers markets and retail stands, with demand typically exceeding supply. Fresh cut melons offer further potential as a value-added product. The major limiting factor for muskmelon production in Maine is the short growing season. Most muskmelon varieties presently available require too long a growing season to ripen in Maine, and the few early-maturing varieties available often lack adequate quality and yield to be viable for commercial sales (Hutton and Handley, 2003). Additionally, due to cool wet soils early in the spring many muskmelon varieties die from attack by soil borne pathogens. A previous study carried out at the Maine Agricultural Experiment Station (Handley *et al*, 1998, HortScience 33[3]: 474) demonstrated that using greenhouse-grown transplants, as opposed to direct seeding, could significantly improve earliness and yield of muskmelons; more so than other types of season extenders, including plastic mulch and rowcovers. However, muskmelons and other cucurbit crops are known to be highly sensitive to transplant shock, a condition that causes young plants to grow poorly or die shortly after transplanting due to the dramatic change in environmental conditions from the greenhouse to the field. Roots are especially sensitive to transplanting injury leading to transplant shock and subsequent disease infestation. Recently a new product a beneficial microbe, *Trichoderma harzianum* (T-22) has been shown to reduce losses due to root rots improving plant growth and yield. The T-22 microbes colonize plant roots and soil surrounding the roots producing a protective barrier to defend the plant roots from root rotting fungi. This is the third and final year of this project. In the two previous growing seasons (2007, 2008) results of T-22 application were mixed with apparent interactions with melon genotype.

Project Description:

A split-plot experiment will be replicated at two sites, Highmoor Farm, the Maine Agricultural Experiment Station in Monmouth, and The University of New Hampshire Woodman Farm, Durham, NH. The main plots will be presence or absence of T-22; melon cultivars will be the sub-plots. Twelve muskmelon cultivars will be seeded in the greenhouse at into Speedling trays, four trays per cultivar. Two trays per cultivar will receive application of T-22 at the manufacture's labeled rate. Seedling growth will be measured for each treatment prior to planting. Transplants will be established in treatment plots outdoors during the last week of May. All plots will be covered with black plastic mulch, and all transplants will receive liquid starter fertilizer (15-30-15) at planting. As the season progresses, each plot will be rated for plant survival, growth and flowering date. At harvest, fruit maturity date, total yield, fruit size, fruit number and quality measurements will be taken. Data from the trial will be statistically analyzed and summarized for publication.

Sharing Outcomes:

Results of this study will be presented to growers through presentations at meetings, including the Maine Vegetable and Small Fruit Growers Annual Meeting and the New England Vegetable & Berry Growers Winter Meetings. The results will also be presented in the statewide Extension vegetable newsletter and regional trade journals such as the Yankee Grower. The results will also be posted on the UMCE Pest Management web site. Growers and Master Gardeners will have an opportunity to view the experiment first-hand and discuss the treatments during a field day to be held at Highmoor Farm during the 2009 growing season. Results of the first year of this experiment were presented at the 2007 New England Vegetable and Berry Conference and at the 2008 Annual meeting of the American Society for Horticultural Science. This third and final year of the project will provide additional data needed for peer reviewed publication.

Termination Report

Abstract:

Muskmelons are a popular item at farmers markets and retail stands, with demand typically exceeding supply. The major limiting factor for muskmelon production in Maine is the short growing season. Most muskmelon varieties presently available require too long a growing season to ripen in Maine, and the few early-maturing varieties available often lack adequate quality and yield to be viable for commercial sales. Eleven muskmelon cultivars ('Aphrodite', 'Athena', 'Diva', 'Earlichamp', 'Eclipse', 'Goddess', 'Halona', 'Maverick', 'Sarah's Choice', 'Strike', and 'Wrangler') were grown in replicated experiments during the 2009 growing season. Muskmelon yield ranged from an average of less than a single marketable fruit per plant for 'Diva' and 'Aphrodite' up to three fruit per plant harvested from 'Maverick'. 'Earlichamp', 'Halona', 'Sarah's Choice', and 'Wrangler' ranked below 'Maverick' in that order and all produced acceptable marketable yields (> 1.5 fruit per plant). 'Athena', a commonly grown commercial cultivar, had an average plant yield of 1.3 fruit per plant was at the lower end of the range. 'Wrangler' was on average the sweetest melon and very flavorful. However, 'Sarah's Choice' was rated as the best tasting melon in the experiment followed by 'Wrangler', 'Maverick' and 'Halona'.

Project Objectives that Were Met

The objective of this experiment was to evaluate eleven muskmelon cultivars for fruit yield and quality at locations in New Hampshire and Maine. Muskmelon cultivars evaluated in this experiment were: 'Aphrodite', 'Athena', 'Diva', 'Earlichamp', 'Eclipse', 'Goddess', 'Halona', 'Maverick', 'Sarah's choice', 'Strike', and 'Wrangler'. Conditions for muskmelon production were less than ideal in 2009 with lower than normal temperatures and greater than normal precipitation. Muskmelon yields for the 2009 experiment were somewhat reduced compared to yields obtained in 2007 and 2008. However, significant differences were observed among the muskmelon cultivars grown in both locations and generally reflected results seen in earlier experiments. Muskmelon yield ranged from an average of less than a single marketable fruit per plant for 'Diva' and 'Aphrodite' up to three fruit per plant harvested from 'Maverick'. The cultivars 'Earlichamp' and 'Halona' each yielded greater than 2 fruit per plant. 'Athena', a commonly grown commercial cultivar, had an average plant yield of 1.3 fruit per plant was at the lower end of the range.

Fruit size was significantly different among the cultivars. 'Aphrodite', eastern shipper type melon grown for its large size, had an average fruit size of 4.7 pounds and was significantly larger than the other cultivars. Most cultivars ranged between 2.5 to 3.5 pounds. 'Halona' (2.38 pounds) was significantly smaller than all but 'Wrangler' (2.54 pounds).

Brix readings were made on all harvested fruit and then averaged for each cultivar. Values ranged from 3 up to 15.2°Bx among fruit harvested from a single cultivar. 'Earlichamp' had an average of 6.93°Bx which was significantly lower than all other cultivars. 'Diva' and 'Goddess' also had unacceptable average values of 8.96 and 8.89°Bx respectively. 'Wrangler' a unique 'Tuscan' type had an average reading of 12.38°Bx and a range of 6-14.2. Brix is not the sole determination of flavor. 'Wrangler' was on average the sweetest melon and very flavorful. However, 'Sarah's Choice' (10.27°Bx) was rated consistently as the best tasting melon in the experiment.

Project Objectives that Were not Met

The original project we proposed to evaluate the effect of PlantShield® on muskmelon plant health, fruit yield and quality. After a detailed review of the 2007 and 2008 data it was apparent that PlantShield® treatment had no significant impact on muskmelons. The treatment was eliminated and the experiment focused on cultivar performance.

Methods Used to Evaluate Outcomes

This experiment provided supporting documentation used in creating a recommended muskmelon cultivar list published as part of the New England Vegetable Management Guide 2010/2011 edition which is distributed to more than 3000 growers throughout the New England region.

Integration of Research and Extension Activities

This research provides immediate direct support to extension educational programming for mixed vegetable farm operators to make decisions regarding cultivar selection. Muskmelons are an important part of many direct market farms crop mix. The results obtained from this research were presented to Maine vegetable growers in formal educational meetings and informal individual and small group settings.

Outputs:

1. These research plots were featured in presented to approximately 40 mixed vegetable growers at the Highmoor Farm centennial celebration, and an additional 25 growers who visited the trial during the growing season.
2. Results of this research were presented to 125 growers of the Maine Vegetable and Small fruit Growers Association annual meeting at the Ag Trade Show January 2010.
3. Results from this experiment were used to update the list of recommended muskmelon cultivars in the New England Vegetable Management Guide 2010/2011 edition
4. Manuscript in preparation for American Society for Hortechnology.

MAC 113 Searching for Profitable Vegetable Varieties for Maine Farmers

Investigator(s): Mark G. Hutton, David T. Handley

Issue/Priority:

Maine has a relatively large and diverse group of vegetable growers that farm in excess of 11,000 acres and are responsible for over 20 million dollars in gross revenue. Maine vegetable growers face several difficult challenges to economically viable vegetable production, not least of which, is Maine's short growing season. Vegetable growers are also confronted with declining numbers of vegetable varieties developed for short cool growing seasons. Surveys in 1999 (Handley) and 2001, 2007 (Hutton) indicated that the members of the Maine Vegetable and Small Fruit Growers Association rank varietal evaluation as one of their highest research priorities.

The number of vegetable seed companies with active research and breeding programs has declined. For economic reasons, the focus of the remaining breeding programs is varietal development for the primary vegetable production areas of the world. Unfortunately, Maine and other regions in northern latitudes are not part of the major vegetable production areas. Consequently, the selection of varieties available to Maine growers is shrinking and those that are available are not necessarily well adapted to northern environments. Identification of varieties that are locally adapted as well as have acceptable horticultural quality will become increasingly challenging and will require extensive testing.

Project Description:

Hoop House Tomato Evaluation

Five determinate and five indeterminate varieties of tomatoes will be grown in randomized complete blocks using three replications in the hoop house at Highmoor Farm. Transplants will be started in mid- April and transplanted into plastic covered raised beds in late May. The indeterminate tomatoes will be trellised on string and pruned to a single stem. The determinate varieties will be grown using a basket weave system. This experiment will provide information useful for deciding which varieties will perform best using two common management practices. Additionally, the experiment will allow use to compare the productivity of indeterminate and determinate varieties within a hoop house.

Hoop House Sweet Pepper Evaluation

There have been several new introductions in the past few years specifically for protected culture. There receive many requests from growers for information about other crops for hoop house production. In 2008, we evaluated 24 new pepper cultivars for their adaptation to hoop house production in single plots. Twelve pepper cultivars selected, based on the 2008 planting, will be evaluated for ripening date, fruit characteristics, yield, disease resistance and quality. Transplants will be started in late April and transplanted into raised beds covered with black plastic mulch. Each variety will be planted in plots of 8 plants with three replications.

Pumpkin Evaluation

Pumpkins are one of the most important vegetable crops to Maine vegetable farmers. Thirty pumpkin varieties in the 15 to 30 pound size class will be evaluated for maturity yield potential, fruit and handle characteristics, and disease tolerance. Pumpkins will be direct seeded during the first week of June into raised plastic covered beds located at the Highmoor Farm. The experiment will be conducted in randomized complete blocks using three replications of ten plants.

Sweet Corn Evaluation

Sweet corn is grown on approximately 2,000 acres in the state of Maine. In the last ten years development of synergistic and augmented sweet corn genetics has resulted in many new sweet corn varieties available to Maine growers. Plant and ear characteristics of these new varieties need to be evaluated under Maine growing conditions.

Approximately 12 synergistic and 12 augmented sweet corn varieties will be grown in a randomized complete blocks with three replicated of 36 plants each.

Sharing Outcomes:

Results of these vegetable variety trials will be statistically analyzed and summarized for presentation to growers at meeting such as the Maine Vegetable and Small Fruit Growers Association Meeting and the New England Vegetable and Berry Growers Winter Meeting. The results of the vegetable variety evaluations are the basis for making the variety recommendations in the New England Vegetable Management Guide a publication distributed to more than 1500 vegetable growers throughout New England. The results will also be presented in the statewide Extension Vegetable Newsletter and posted on the Highmoor Farm web site. Growers and Master Gardeners will have the opportunity to view the experiments first-hand and discuss the varieties during the summer field day.

Termination Report

Abstract:

In 2009 replicated vegetable cultivar trials were conducted at Highmoor Farm. Based on the trial results the following cucumber, pickle and small pumpkin cultivars can be recommended. Slicing cucumber: 'Rockingham', 'Talladega' and 'Cobra'. Pickling cucumber: 'Eureka', Fancipak', Alibi'. Small Pie Pumpkin: 'Baby Pam', 'Winter Luxury' and 'Mystic Plus'.

Project Objectives that Were Met

Slicing Cucumbers

Ten slicing cucumber cultivars were evaluated in a randomized complete block trial with three replications. The cultivars 'Rockingham', 'Talladega' and 'Cobra' were the top yielding cultivars producing high yields and few culls. These gynoecious cultivars produced highly acceptable 7-9" long, dark green fruit. 'Rockingham', 'Talladega' and 'Cobra' produced yields greater than the recognized standards 'Speedway' and 'Raider'. 'Diva' a Biet Alpha type cucumber had the lowest yields compared to the American slicer types. However, growers should consider trialing this cultivar because of its superior flavor and market acceptance.

Pickling Cucumbers

Five slicing cucumber cultivars were evaluated in a randomized complete block trial with three replications. 'Eureka', Fancipak', Alibi' produced high yields of market acceptable fruit. The cultivars 'Sassy' and 'Northern Pickler' had unacceptably low yields and poor quality fruit.

Small Fruited Pie Pumpkins

Seven small pie pumpkin cultivars ("Chucky', 'Small Sugar', 'Field Trip', 'Mystic Plus', 'Fall Splender', 'Baby Pam', 'Winter Luxury') were evaluated in a randomized complete block trial with three replications. These cultivars range in size from 4 to 10 pounds and are suitable for table decorations, face painting, and culinary use. 'Chucky' produced the greatest yields with an average of 4 fruit per plant. 'Small Sugar', 'Field Trip', 'Mystic Plus' produce between 2-3 fruit per plant and 'Fall Splender', 'Baby Pam', 'Winter Luxury' had 1-2 fruit per plant. All the cultivars produce market acceptable yields. Culinary use was evaluated for these cultivars cooked as both plain and as pie filling. 'Baby Pam', 'Winter Luxury' and 'Mystic Plus' had the best eating quality.

Project Objectives that Were not Met

The original project we proposed to evaluate several hoophouse tomatoes and peppers along with field production on sweet corn and pumpkins for adaptation to Maine growing conditions. Based on requests we made changes in the crops we evaluated.

Methods Used to Evaluate Outcomes

This experiment provided supporting documentation used in creating a recommended cultivar list published as part of the New England Vegetable Management Guide 2010/2011 edition which is distributed to more than 3000 growers throughout the New England region.

Integration of Research and Extension Activities

This research provides immediate direct support to extension educational programming for mixed vegetable farm operators to make decisions regarding cultivar selection. The results obtained from this research were presented to Maine vegetable growers in formal educational meetings and informal individual and small group settings.

Outputs

1. These research plots were featured in presented to approximately 40 mixed vegetable growers at the Highmoor Farm centennial celebration, and an additional 25 growers who visited the trial during the growing season.
2. Results of this research were presented to 125 growers of the Maine Vegetable and Small fruit Growers Association annual meeting at the Ag Trade Show January 2010.
3. Results from this experiment were used to update the list of recommended muskmelon cultivars in the New England Vegetable Management Guide 2010/2011 edition

1=Small Sugar
2=Baby Pam
3=Mystic Plus
4=Field Trip
5=Chucky
6=Fall Splendor
7=Winter Luxury

MAC 114 Evaluation of n-acetylcysteine for Reduction of Post-breeding Inflammation in Mares

Investigator(s): **Robert C. Causey**

Background

In recent years, workers at UMaine have been investigating the impact of uterine mucus on equine fertility. Through their work, in collaboration with colleagues in Kentucky and the University of Florida, mucus has been identified as an important defense mechanism of the equine uterus, but also a contributor to disease. If mucus production is altered, bacteria may have opportunities to evade host defenses. For example, organisms such as Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli and yeasts may increase the viscosity of uterine mucus by the production of biofilm, and thereby establish persistent infections. Such infections have a major impact on fertility.

To combat these viscid uterine secretions, collaborators in Kentucky equine practice have begun using the mucus–dissolving (mucolytic) drug n-acetylcysteine (NAC) as a uterine irrigation to break up uterine exudate, biofilm, and mucus. In an initial clinical trial, NAC treatment was accompanied by the unusually high pregnancy rates of 8/11 in infertile mares (73%), and 9/9 in fertile mares (100%). In addition, study of uterine tissue (endometrial biopsy), including data from a previously funded Maine Agricultural Center project, indicated that NAC exerts anti–inflammatory properties, most likely mediated through its documented ability to scavenge free-radicals. The anti–inflammatory properties of NAC were not expected, but in retrospect come as no surprise through its carrying an organic sulfhydryl group, and through a review of the NAC literature. However, the importance of the anti–inflammatory properties of NAC may outweigh its mucolytic properties, since persistent uterine inflammation following insemination is the single most important contributor to infertility in mares.

While these reports of improved pregnancy rates and anti–inflammatory properties must be viewed as preliminary, it is worth pursuing NAC's potential value to equine clinicians, especially in Maine, which has a large breeding Standardbred population. For this reason we wish to study the ability of NAC to reduce inflammation post–insemination in Maine Standardbreds.

Research and Extension Activities

The procedures are listed for each objective as follows:

1. Investigate effect of n-acetylcysteine in reducing post–breeding uterine inflammation in mares – Fourteen reproductively healthy Standardbred mares will be divided into a NAC treatment group (n=7) and a saline control group (n=7). Mares in the treatment group will receive a 180 mL intrauterine infusion of a 3.3% solution of NAC in saline, while the control group will receive 180 mL of saline only. Infusions will be performed in estrus in the presence of a 30 mm or greater follicle. Twenty four hours later mares will then be inseminated with 1 billion normal, motile, spermatozoa in an insemination volume of 120 ml, the volume adjusted with skim–milk semen extender. Three days post–insemination uterine tissue will be obtained from each mare for histopathologic examination (uterine biopsy) and a statistical comparison of epithelial height (index of uterine inflammation) made between the two groups.
2. Host a continuing education conference for equine veterinarians the topic of which will be management of equine uterine infections – In collaboration with Cooperative Extension and in coordination with Maine's equine veterinary and equine industry groups we will host a one–day continuing education conference for veterinarians. The topic will be an in–depth review of pathogenesis and management of uterine infections including presentation of the research findings of the proposed study. In addition to presentations by UMaine faculty, Dr Michelle LeBlanc, an internationally–known speaker and collaborator on this study, will be invited to present.
3. Publish results of the proposed study and literature review of n-acetylcysteine – The proposed work will generate two peer-reviewed publications: first, a scientific report on the results of the proposed study;

second, an in–depth review of NAC focusing on its mode of action, pharmacology, and range of uses in human an animal medicine.

4. Submit extra-mural grant to obtain funding for a clinical trial to evaluate NAC's efficacy – This study will contribute to preliminary data to support funding of a multi-state, randomized, double blind, controlled clinical trial documenting the efficacy of NAC in improving pregnancy rates in a large number of infertile mares.

Outcomes

1. New information concerning efficacy of NAC in horses
2. Improved equine fertility through transfer of findings to Maine Veterinarians
3. Dissemination of knowledge through experimental and review publications
4. Strengthened research capability at UMaine through extra-mural funding

Termination Report

Objectives that Were Met and Significant Findings

The following objective was met:

1. Investigate effect of n-acetylcysteine in reducing post–breeding uterine inflammation in mares – Ten reproductively healthy Standardbred mares were divided into a NAC treatment group (n=5) and a saline control group (n=5). Mares in the treatment group received a 180 mL intrauterine infusion of a 3.3% solution of N–acetylcysteine (NAC) in saline, while the control group received 180 mL of saline only. Infusions were performed in estrus in the presence of a 30 mm or greater follicle. Twenty four hours later mares were inseminated with 1 billion normal, motile, spermatozoa in an insemination volume of 120 ml, the volume adjusted with skim–milk semen extender. Three days post–insemination uterine tissue was obtained from each mare for histopathologic examination (uterine biopsy) and a statistical comparison of indices of uterine inflammation (cell height) made between the two groups.

No significant differences were detected between NAC and saline groups. However, cell height increased in 4/5 saline treated horses, but only 1/5 NAC treated horses. Sample size was reduced from the 7 per group originally proposed due to factors beyond our control.

Objectives that Were Not Met

2. Host a continuing education conference for equine veterinarians the topic of which will be management of equine uterine infections – In the original proposal $1000 was requested to prepare for a conference. However, the award size was $1000 less than that proposed. Consequently we were not able to host the conference as intended.
3. Publish results of the proposed study and literature review of n-acetylcysteine – Because results did not achieve statistical significance they have not yet been published in peer–reviewed journal. However, this work has been published as an Honors Thesis (Nile McGhie 2010) and was awarded Highest Honors.
4. Submit extra-mural grant to obtain funding for a clinical trial to evaluate NAC's efficacy – Although a clinical study assessing NAC's efficacy has not been submitted the following related projects have been proposed. A $500,000 submission to the Maine Technology Asset Fund has been submitted and advanced to the interview stage. Related to this submission is a proposed study to evaluate the efficacy of a preparation combining NAC and a streptococcal phage lysin for reduction of streptococcal infections in horses in collaboration with New Horizons Diagnostic Corporation.

Methods used to evaluate outcomes

Achievement of statistically significant results; numbers of peer-reviewed publications; dollar value of extramural grants submitted.

Integration of research and extension activities

As stated above, the intended conference was not held due to the reduced level of the award. However, the related proposed MTAF submission, indicated above, focuses on improving the Witter Center as a center for technology transfer and collaboration with the equine industry.

Publications, presentations and other outputs

- McGhie, N. The evaluation of N–acetyl cysteine for reduction of post–breeding inflammation in mares. (2010). Honors Thesis. Highest Honors

Non technical summary

Fertility in the mare is highly dependent on the animals ability to clear inflammation in the uterus after breeding. This study examined the ability of N-acetylcysteine (NAC) as an intrauterine wash to aid in the reduction of uterine inflammation post-breeding in the persistently inflamed mare. The primary inflammatory indicator examined (epithelial cell height) did not demonstrate a significant difference between mares treated with sterile saline and those treated with NAC. However, 4/5 saline treated mares, and only 1/5 NAC treated mares displayed increased cellular height, indicating that we might have been able to demonstrate a statistical effect with a larger sample size. This study supported an Undergradate Thesis which awarded HIghest Honors, and is related to a $500,000 grant submitted to the Maine Technology Asset Fund.