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MAC 24: Investigate a Specialty Cut Flower Production System for Rural Maine – Field Trials at Bird Farm

Principle Investigator(s): Donglin Zhang, Matthew Williams, Lois Berg Stack

Background:

Specialty cut flowers (cut flowers other than roses, chrysanthemums and carnations) offer great potential for connecting rural Maine producers with urban consumers. Specialty cut flowers offer higher profits and rising sales potential compared to traditional field crops. Specialty cut flowers offer the potential for small farms to develop a valuable export commodity, thereby bringing money into the rural economy. This is especially critical for rural areas like Aroostook County, where a low population density restricts the potential for direct sales that support profitable small farm systems in other regions.

Horticulture, including floriculture, is the fastest growing sector of American agriculture. The US floriculture industry enjoyed a 6% increase in sales in 2000. While standard cut flower consumption (imported plus domestic) decreased in 2000, specialty cut flowers experienced high demand. Most specialty cut flowers are not shipped internationally, and are generally produced within trucking distance of their point of retail sale.

This study establishes a foundation for further development of the specialty cut flower industry in rural Maine. To better evaluate and understand the growth, development, and postharvest performance of these crops under Maine conditions, field trials must be established. The broad objectives of this project are to:

1. establish specialty cut flower field trials at Bird Farm;
2. assess the postharvest performance of specialty cut flowers grown at Bird Farm; and
3. estimate the potential economic impact of specialty cut flower production in rural Maine.

Research Description:

Seeds of snapdragon (Antirrhinum majus 'Chantilly Bronze'), loves-lies-bleeding (Amaranthus caudatus var. atropurpureus) and Plainview Farm daisy (Rudbeckia hirta 'Plainview Farm') will be sown in the University of Maine greenhouses in April. The resulting seedlings will be transplanted into the field trial beds in June at Bird Farm near Houlton. Woody and herbaceous perennial plants will be obtained from nurseries and planted directly in the Bird Farm trial beds. Specific perennial plants will be chosen from tatarian dogwood (Cornus alba 'Bloodgood'), winterberry (Ilex verticillata 'Scarlet O'Hara'), Japanese fantail willow (Salix sachalinensis 'Sekka'), false spirea (Astilbe spp.), painted daisy (Chrysanthemum coccineum), gladiolus (Gladiolus hortulanus), and peony (Paeonia spp.). The trial beds will be prepared with nutrients and black-plastic mulch, according to typical production procedures.

A randomized complete block design will be employed in planting. A total of four blocks (four replicates) will be set up for each taxum. Data will be taken every three weeks in summer 2002. The sampling parameters will be 1) plant growth (height); 2) days to first bloom and full bloom; 3) time to harvest cut stems; 4) total number of cut stems (yield); 5) vase life of cut stems; and 6) estimate of the value of cut stems. All data will be analyzed using the SAS program.

This study is designed to fully integrate research, extension and education. It is also designed to initiate assessment of the potential of specialty cut flowers in terms of both production and marketing. A combination of both traditional and innovative activities will translate the findings of the research into useable information that will be made available to potential specialty cut flower growers, and also to potential buyers of their products.

First, growers will have an opportunity to view the trials at Bird Farm through guided tours and presentations at a summer field day. Second, the results of this project will be developed into a Cooperative Extension brochure and web page for potential growers. Third, cut flowers from this project will be used at a design show sponsored by Maine State Florists' and Growers' Association in September 2002. This third activity will introduce Maine retail florists to the types of high-quality specialty cut flowers that can be produced locally, thereby initiating the process of connecting producers and retail vendors.

Projected Outcomes:

Specific research outcomes of this project are:

1. specialty cut flower field trials will be established at Bird Farm;
2. production and postharvest performance data will be collected for specialty cut flowers produced at Bird Farm; and
3. the economic impacts of specialty cut flower production will be estimated for rural Maine.

These outcomes will be shared by the following methods:

1. growers will learn from presentations and a production site tour during a field day;
2. printed and web-based Extension publications will be made available to growers; and
3. retail florists will become familiar with products of the study through a design show.

Industry Support:

The proposed project is one aspect of a larger effort that has already garnered broad support. The Southern Aroostook Soil and Water Conservation District has awarded 00 to the Bird Farm project. Four students will be employed at the farm, and will be available to contribute labor to this project during summer 2002. New England Grows, a regional trade show, has pledged 00 toward this project if fully funded, to support publication of extension materials. Plant materials have been donated for the annual cut flower research. A letter of support is forthcoming for this project, from Robert Bennett, a prominent floriculture industry member who buys cut flowers internationally, and wholesales them to Maine florists. He serves as the connection between growers and buyers, a critical link in this project.

Abstract:

Establish specialty cut flower field trials at Bird Farm: About one acre of cultivated land at the Bird Farm was planted with specialty cut flowers. A total of 18 planting rows with plastic mulch were prepared and planted with 36 taxa. Among them, herbaceous plants were Amaranthus (3 taxa), Antirrhinum (8), Dahlia (2), Helianthus (1), Helichrysum (1), Lathyrus (1), Physalis (1), Paeonia (seedlings), Rudbeckia (1), Zinnia (1) and woody plants were Cornus (2 taxa), Ilex (2), Salix (2), and Syringa (10). Some herbaceous plants, such as Amaranthus, grew much better when direct sown in the field. Others, such as Rudbeckia, survived 100% from transplanted seedlings. Helianthus, Lathyrus, and others could be grown both direct seeded and transplanted, with 90% or higher survival rates. All woody plants survived from 2002 planting to the 2003 growing season.

Assess the postharvest performance of specialty cut flowers grown at Bird Farm: All fresh flowers were harvested every three days during the months of July and August and marketed by a wholesale distributor. A total of 17 taxa were collected for postharvest performance assessment. Flowers were placed in vases with tap water, sugar water, and a commercial floral preservative. Amaranthus, Lathyrus, Zinnia, and others had only 5-7 days vase-life, regardless of the treatments. Antirrhinum, Helianthus, and others could be kept fresh for 8-12 days. The flower quality in the commercial preservative treatment was best. Rudbeckia showed the greatest response under the different treatments. Flowers in the commercial preservative treatment lasted for 27 to 35 days, but only 3-4 days in the sugar water treatment and 8-12 days in tap water.

Estimate the potential economic impact of specialty cut flower production in rural Maine: Harvested flowers were distributed through a wholesale broker and were welcomed by local retail florists. A small number of specialty cut flowers from our project were provided to a design show sponsored by the Maine State Florists' and Growers' Association. Survey results from the owners of the 80 retail florist shops revealed that 20 of the 21 respondents had previously purchased from local growers, and all 21 were interested in doing so in the future. They reported that their decision to buy Maine-grown cut flowers were high quality, direct delivery from farm to shop, availability of unusual flowers, and etc. Obviously, the specialty cut flowers produced in rural Maine communities have great market potential in Maine.

Methods Used to Evaluate Outcomes:

This information will be disseminated to growers. Further evaluation of impact will be based on how many farmers will grow specialty cut flowers and the success of marketing.

Integration of Research and Extension Activities:

Growers had an opportunity to view the trials at Bird Farm through guided tours and presentations at a summer field day. A small demonstration area was set up at Rogers Farm in Stillwater, in the Penobscot County Master Gardener Demonstration Garden. Cut flowers from this project were used at a design show sponsored by Maine State Florists' and Growers' Association in September 2002. This activity introduced Maine retail florists to the types of high-quality specialty cut flowers that could be produced locally, thereby initiating the process of connecting producers and retail vendors (see above). Data from this project were used to support an application for a USDA SARE grant. The final results of this project will be developed into a Cooperative Extension brochure and web page for potential growers.

Outputs:

The project was renewed and is in progress.

MAC 25: Improving Transplant Quality for Muskmelon Production in Maine*

Principle Investigator(s): David Handley, Mark Hutton

Background:

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. 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. Transplant size also effects sensitivity to shock, with larger, more mature plants tending to be more sensitive to this condition. To compensate for these issues, melon transplants are often started in large peat pots in the greenhouse, and set out after only two to three weeks of development. While this appears to reduce the incidence of transplant shock, it does not take full advantage of the benefits of starting plants in the greenhouse, and is a very costly method of producing transplants.

Developing alternative methods of muskmelon transplant production could lead to a more cost efficient technique of growing transplants, and the production of transplants that produce earlier ripening fruit and higher yields. The use of seedling plug trays for transplant production is common with many long-season vegetable crops, such as tomatoes, but has not been used for melons, despite its much higher efficiency, due the problems with root restriction and plant injury associated with small plug sizes. The peat pots now used are costly and not reusable, but smaller sizes are now available which can reduce overall cost. Testing different plug and peat pot sizes in combination with different lengths of growing time prior to transplanting could provide a means to produce better, inexpensive, vigorous melon transplants less susceptible to shock. Such information could play an important role in making muskmelon production a profitable venture for Maine farmers.

Research Description:

Muskmelon (cv. "Earliqueen") will be seeded in the greenhouse at Highmoor Farm, the Maine Agricultural Experiment Station in Monmouth, at two different dates, allowing transplanting to occur 20 days or 35 days after seeding. Four seedling containers will be tested, including a 72-plug seedling tray, a 24-plug seedling tray, two-inch peat pots and three-inch peat pots. 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.

Projected 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 2002 growing season. Results will also be presented to other agricultural research and extension staff at scientific meetings such as the American Society for Horticultural Science.

The Maine Vegetable and Small Fruit Growers Association and the New England Vegetable and Berry Growers association have contributed some funding to support this research in 2002. It is expected that these funds will be used to further support travel and costs associated with presenting results to these groups, and to help with the purchase of any special equipment needs.

Abstract:

Cucumbers and melons are popular items at farmers markets and retail stands, with demand often exceeding supply, especially early in the season. One of the important limiting factors for cucumber and muskmelon production in Maine is the short growing season. Most varieties require a long growing season and early-maturing varieties often lack adequate quality and yield to be viable for commercial sales. A previous study carried out at the Maine Agricultural Experiment Station (Handley et al, 1998, HortScience 33[3]: 474) demonstrated that using greenhouse-grown melon 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. To prevent transplant shock cucurbit transplants are often started in large peat pots in the greenhouse, and set out after only two to three weeks of development. While this appears to reduce shock, it does not take full advantage of the benefits of starting plants in the greenhouse, and is a costly means of producing transplants. The use of seedling plug trays for transplant production is common with many long-season vegetable crops, such as tomatoes, but has not been used for melons, despite its much higher efficiency, due the problems with root restriction and plant injury associated with small plug sizes. The peat pots now used are costly and not reusable, but smaller sizes are now available which can reduce overall cost.Testing different plug and peat pot sizes in combination with different lengths of growing time prior to transplanting could provide a means to produce better, inexpensive, vigorous melon transplants less susceptible to shock. Such information could play an important role in making cucumber and melon production a more profitable venture for Maine farmers.

Cucumber seeds (cv. "Calypso") were seeded in the greenhouse at Highmoor Farm, the Maine Agricultural Experiment Station in Monmouth on 11 June and 26 June 2002 to allow transplanting to occur 15 days and 30 days after seeding. The seeds were started in four different transplant containers, including 7.6 cm (3 inch) diameter x 7.6 cm deep round peat pots, 5 cm (2 in) diameter x 5 cm deep round peat pots, 6 cm diameter x 5.9 cm deep round plugs (24 count), and 3.8 cm diameter x 5.9 cm deep round plugs (72 count). All containers were filled with a peat/vermiculite mix (Redi-Earth) and fertilized twice with liquid 16-32-16. Seedlings were hardened-off by being placed outdoors from 7 a.m. to 3:30 p.m. for three days prior to being transplanted into plots outdoors on 11 July, 2002. All plots were covered with black plastic mulch, and all transplants received liquid starter fertilizer (15-30-15) at planting.

Methods Used to Evaluate Outcomes:

It should be noted that this experiment was originally designed with the intent of using muskmelon (cv. "Earliqueen") as the test plant, as well as an earlier transplanting date (29 May). However, a prolonged period of cool wet weather killed more than 50% of the seedlings following transplanting, and the experiment was restarted using a shorter season cucumber variety ("Calypso"). It is interesting to note however, that in terms of survival during the early inclement weather, the older (34 day) melon plants in the large (7.6 cm) peat pots were far better than any of the other treatments. In that situation, it was clear that the largest plants were best able to deal with the stress of cold and soil saturation.

Seedlings started in the large (7.6 cm) peat containers had the largest plants at the time of transplanting for both the 18 and 34 day seeding dates (Table 1). These plants had significantly greater fresh weights, dry weights and more leaves than any of the other treatments. However, it is interesting to note that seedlings started in the large peat pots had noticeably slower germination than all of the other treatments, probably as a result of cooler media temperatures in these containers. Plants started in the 24 plug trays had the next largest plants by all parameters measured, followed by the small (5 cm) peat pots, which tended to dry out quickly in the greenhouse, making them more challenging to manage. The 72 plug trays showed the quickest germination, of all the treatments, but produced the smallest plants.

Table 1. Cucumber transplant characteristics at planting as a result of container size and days from seeding in the greenhouse, Monmouth, Maine, 2002.

Treatment	Sub Treat.	Plant Fresh Weights (g)	Plant Dry Weights (g)	Number of Leaves
3" Peat	18 days	5.79	0.39	3.0
3"Peat	34 days	14.63	1.06	5.4
2" Peat	18 days	2.98	0.20	2.0
2" Peat	34 days	4.20	0.35	3.4
24 Plug	18 days	4.15	0.28	2.6
24 Plug	34 days	7.82	0.73	4.0
72 Plug	18 days	2.70	0.16	1.8
72 Plug	34 days	2.86	0.30	2.6
LSD 0.05		0.976	0.08194	0.6478

All transplants established well and produced acceptable harvests of marketable fruit. There were no significant differences between seeding dates on early or total yield among any of the container types (Table 2). Therefore, in this experiment, allowing seedlings an additional 15 days of growth in the greenhouse did not significantly affect the number or weight of fruit the plants produced.

Table 2. Cucumber yield characteristics as a result of transplant container and size, Monmouth, Maine, 2002.

Treatment	Sub Treat.	Early Yield (kg)	Early No.	Total Yield (kg)	Total No.
3" Peat	18 days	12.27	74	22.72	151
3"Peat	34 days	14.96	81	30.90	195
2" Peat	18 days	12.94	81	32.66	208
2" Peat	34 days	11.65	76	29.03	196
24 Plug	18 days	16.83	101	35.18	229
24 Plug	34 days	17.11	105	37.25	237
72 Plug	18 days	10.95	68	33.89	233
72 Plug	34 days	11.74	74	28.98	200
LSD 0.05		3.47	23	11.42	73

Transplants from the 24 cell trays produced the greatest early yield and total yield, regardless of seeding date, although there were few significant differences across the container types. The small peat containers and the 72 plug trays had very similar yields, slightly less than the 24 plugs. The large peat pots had the lowest overall yield, but this may have been due in part to plot placement, which, although random, exposed this treatment to more weed competition than other treatments.

While container size did affect transplant size in this trial, these differences had little impact on yield once the plants became established in the field. This suggests that using small to medium size plug trays rather than large peat pots may provide a more efficient and economical way to produce cucumber seedlings, and that these seedlings require only a short growing period in the greenhouse prior to transplanting. However, earlier trials demonstrated that larger transplants are better able to survive under conditions of environmental stress, which are typical of the early growing season in the northeastern United States. Therefore, while smaller transplants may be suitable for mid to late season production, larger transplants may be a better option for early season production.

Integration of Research and Extension Activities:

Results of this study were presented to growers at 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. Growers and Master Gardeners had an opportunity to view the experiment first-hand and discuss the treatments during a field day to be held at Highmoor Farm during the 2002 growing season.

Results will also be presented to other agricultural research and extension staff at the annual meeting of the American Society for Horticultural Science in 2003.

*Please Note: This project was originally titled Improving Transplant Quality for Muskmelon Production in Maine, however, due to severe weather during the two weeks following planting, survival of the plots was very poor and the experiment had to be abandoned. It was necessary to replant using cucumber to permit the crop to mature by the end of the season.

MAC 26: An Early Warning System For Blueberry Spanworm

Principle Investigator(s): Francis A. Drummond

Background:

The blueberry spanworm, Itame argillacearia (Packard), is an important spring caterpillar pest which can defoliate lowbush blueberry. Many growers do not have great success in managing this pest, however, excellent control can be achieved by using environmentally safe biorational insecticides. The economic basis for making a decision depends on a complex coming together of weather, biology of blueberry spanworm egg hatch, and the scouting resources for a given blueberry farm. Traditionally, blueberry growers start scouting their fields in early to mid-April for the first sign of egg hatch or the first occurrence of caterpillars. However, the decision to treat a field must be made later when evidence of economic crop loss (economic threshold) is exceeded, thus continuous serial field scouting must be conducted. This economic threshold is 10 larvae per set of ten sweeps with an insect sweepnet in a bearing field. Therefore, there is a potential that some fields will not need to be treated and some will, but all will need to be scouted through the spring, an expensive and time consuming proposition. THIS proposal offers a means that growers can use knowledge of blueberry spanworm developmental biology and spring weather in the form of a predictive model which will enable a grower that monitors field soil temperatures to determine when blueberry spanworm has hatched enough that its population will be at a point that it is optimal for sampling and determining if the economic threshold has been exceeded. I believe that this "early warning" system should reduce the number of visits to a given field by 50-75% and at the same time result in better control.

Research Description:

Data has been collected over the past two years in the laboratory on the temperature-dependent hatch rate of overwintering blueberry spanworm eggs. This data was collected on individual eggs under five differing temperature regimes. The resulting data set will allow a statistical model to be developed that can be used to determine the proportion of eggs that have hatched in a field at an given point in time. A time-varying distributed delay mathematical algorithm will be used based upon a non-linear statistical model of the median temperature-dependent development rates and the distributional properties of the Erlang cumulative density function. This approach has already been successfully used in Maine for modeling the Mexican bean beetle larval development (Fan et al., 1992), Colorado potato beetle development (Zeigler et al., 2000), and the blueberry maggot fly (Drummond et. al, 2001). I have made a request to purchase MatLab® and its compiler so that a fast running, but compact program for Windows® desktop computers can be programmed and distributed to blueberry growers either through email or downloaded from the Maine Wild Blueberry web site maintained by Dr. David Yarborough (www.wildblueberries.maine.edu).

Some data collection is necessary before the model can be finalized and made available for distribution to growers. A validation of the predictor model has to be conducted. I propose setting out known packets of ovewintering eggs (currently held in refridgeration) in three different blueberry field sites this spring. At each site, one hundred eggs will be cleaned and placed in groups of 20 in a petri dish with a nylon window screening top cover. A similar petri dish with a Hobo temperature data logger in it will be deployed with the five egg containing petri dishes in the field. Dishes with eggs will be collected every 3-4 days after deployment and assessed for hatch. Temperature recorded at 15 minute intervals by the dataloggers will be downloaded and used to predict (from the model described above) the observed egg hatch rate seen in the deployed egg dishes. A chi-square comparison between predicted and observed egg hatch will be used to assess the effectiveness of the predictor model.

A blueberry school workshop will be taught in spring 2003 to teach growers how to use the blueberry spanworm egg hatch predictive model.

Projected Outcomes:

The outcomes are from this proposal, if funded, are two-fold. The first outcome is expected to be an increased efficiency for blueberry growers in managing blueberry spanworm. The second outcome is that I expect completion of an egg hatch model for spanworm will provide a strong basis for grant support to the U.S. EPA Pesticide Stewardship Program to develop a model of blueberry thrips emergence from the soil. The goal will then be to incorporate a

currently existing predictor model of the blueberry maggot fly, the blueberry spanworm egg hatch model described in this proposal, and a blueberry thrips model into a multi-faceted pest predictor for blueberry pest management.

Objectives Met:

1. Develop a forecasting model for blueberry spanworm egg hatch and incorporate the model into a user friendly computer application that growers can use to help time field scouting and insecticide applications.

Objectives Not Met:

- Successful automated measurement of surface soil temperature

Methods Used to Evaluate Outcomes:

Data was collected in the laboratory on the temperature-dependent hatch rate of overwintering blueberry spanworm eggs. This data was collected on individual eggs under five differing temperature regimes. The resulting data set was used to develop a statistical model for forecasting the proportion of eggs that have hatched in a field at any given point in time as long as daily soil surface temperatures are monitored. A time-varying distributed delay mathematical algorithm was developed, based upon a non-linear statistical model of the median temperature-dependent development rates and the distributional properties of the Erlang cumulative density function. MatLab was used to construct a grower application. A validation of the predictor model was conducted in the field in 2003 by setting out known packets of ovewintering eggs in three different blueberry field sites. At each site, one hundred eggs was cleaned and placed in groups of 20 in a petri dish with a nylon window screening top cover. A similar petri dish with a Hobo temperature data logger in it was deployed with the five egg containing petri dishes in the field. Dishes with eggs were collected every 3-4 days after deployment and assessed for hatch. Temperature recorded at 15 minute intervals by the dataloggers was downloaded and used to predict (from the model described above) the observed egg hatch rate seen in the deployed egg dishes

A chi-square comparison between predicted and observed egg hatch in the field in 2003 suggested that the predictor model forecasts lagged significantly behind the observed egg hatch rates. However, in the laboratory, the forecast predictions were not significantly different than the observed. I believe that this is due to the difficulty in automating and measuring soil temperature at the soil surface (0-5 mm below the soil surface). Since I have a successful forecast algorithm, at least when applied in the laboratory, I will continue to refine the measurement of the temperature that blueberry spanworm eggs receive under field conditions. This MAC project enabled me to collect important data which lead to the development of a grower friendly algorithm to predict blueberry spanworm egg hatch. I expect that over the next 2-3 growing seasons I will be able to use the forecast model to successfully predict egg hatch.

Integration of Research and Extension Activities:

At this point there are no scientific journal articles or extension materials which have been published. However, during my sabbatical in 2004 I plan to submit a manuscript on the temperature development of blueberry spanworm immature stages.

MAC 27: Improving Equine Fertility by Determining the Impact of Intrauterine Medications on Endometrial Ciliary Beating

Principle Investigator(s): Robert Causey, Jim Weber

Background:

Mucociliary clearance is essential for resistance to infection. Dust, trapped bacteria, viruses, and fungal spores are expelled from many mucosal surfaces by flow of a mucus blanket propelled by rhythmic beating of cellular projections known as cilia (11). Disruption of mucociliary transport inevitably leads to increased susceptibility to infection, and subsequent economic loss in domestic livestock, including cattle (8), horses (10), sheep (9), and pigs (6). Recently we showed that mucociliary clearance can also contribute to defenses of the reproductive tract. Specifically, ciliated cells propelling a mucus blanket through the oviduct, endometrium and cervix appear to aid removal of particulate debris and pathogens from the uterus (2,3). If confirmed, this novel concept of mucociliary clearance operating in the reproductive tract would open new possibilities for treatment of uterine infections in the domestic livestock. Specifically, we wish to explore those factors which affect ciliary beat frequency in the equine reproductive tract. The equine industry contributes fifty million dollars to the Maine economy through harness racing alone. Improved equine fertility would therefore be an important boost to the equine breeding industry and the Maine economy.

Recent improvements in the video and computer technologies make high-speed digital video imaging the best approach to study ciliary activity (4,7). This method, records images with a high-speed video camera (60 frames per second or greater) on S-VHS videotape or directly into the computer (7). Ciliary beat frequency can be determined manually by replaying the images at slow speed and visually counting ciliary beats in a given time. Alternatively, ciliary beat frequency may be determined by image analysis wherein ciliary motion is detected by variations in light intensity (gray-scale). Beat frequency can then be measured using gray-scale difference vs. time. The resulting data are subjected to fast Fourier transformation (FFT) to yield ciliary beat frequency in Hz (5). This objective method is especially useful for detecting small differences in ciliary beat frequency.

Projected Outcomes:

We expect to generate useful information for the Maine equine industry with respect to uncovering the dangers of some intrauterine medications with respect to their deleterious effect on ciliary activity. Similarly, we should be able to show that other medications do not adversely affect ciliary activity. This information will be shared in pring, oral presentation, and web-based media.

Objectives Not Met:

Project was proposed at the request of William Yeung, graduate student. He was to help with this project and then was unable to pursue this project. Dr Causey was unable to proceed without his help. Award money returned.

MAC 28: Host Plant Volatile Augmentation of Trap Cropping for Management of Colorado Potato Beetles in Organic Potato Production

Principle Investigator(s): Randall Alford, John W. Martel

Background:

Colorado potato beetle, Leptinotarsa decemlineata (Say), is a major pest of crops in the family Solanaceae and is considered the most destructive insect pest of cultivated potato, Solanum tuberosum L., in the northeastern and north central United States (Casagrande, 1987). The reliance of conventional agriculture on broad-spectrum pesticides has sparked public concern regarding the long-term effects of these compounds on human and environmental health, and has contributed to an increased incidence of pest resistance (Shani, 1991; Smart et al., 1994). Known for its rapid development of resistance to all major classes of synthetic insecticides, the Colorado potato beetle may be more successfully managed through development and implementation of alternative strategies.

One possible alternative to the use of synthetic insecticides is exploitation of the wide array of chemicals insect herbivores utilize in host selection. Dickens (2000, 2001) recently developed a synthetic host volatile attractant blend derived from S. tuberosum (var. Kennebec). Preliminary greenhouse and field work conducted in 2000 and 2001 suggests that post-diapause, colonizing adult CPB are strongly attracted to this compound. We propose to use this volatile formulation to increase the attractiveness of trap crops to colonizing CPB, with the purpose being to aggregate this pest in an area where its population may be effectively managed and reduced.

The primary goal of the proposed work is the development of an environmentally-sound pest management tactic designed to provide commercial potato producers and home gardeners with viable alternatives to conventional CPB control methods. Although public concern regarding environmental and production system health are key factors driving sustainable pest management research initiatives, rapid growth of the organic food market also warrants the development and implementation of such strategies at the organic farm and home garden production scales (Peterson, 2001)

We propose to deploy the synthetic host volatile attractant blend developed by Dickens (2000, 2001) as a means of aggregating colonizing adult CPB in a trap crop pest management system. Trap crops are sacrificial plantings grown for the purpose of drawing insect pest populations away from economic regions of production systems. Weber and Ferro (1985) suggested that trap crops might serve to aggregate adult CPB during spring colonization. Hardee (1982) and Metcalf (1985) reported that the attractiveness of trap crop plantings might be further enhanced by application of attractive semiochemicals. Furthermore, by manipulating plant stands in space and/or time, invading pest populations may be concentrated in trap crop regions and reduced considerably with highly selective insecticide application (Hokkanen, 1991).

Kobayashi and Cosenza (1987) and Todd et al. (1994) demonstrated that a trap crop area sized approximately 10% of the main crop is sufficient to attract as much as 85% of a given pest population. Because CPB exhibits such strong attraction to host volatiles (McIndoo,1926; Shanz, 1953; DeWilde, 1976; Visser & Avé, 1978; Bolter et al., 1997; Dickens, 2001, 2001), it seems plausible that the synthetic host volatile blend could be used to augment the attractiveness of trap crops to colonizing adult CPB. As an alternative to conventional pest control programs, insecticide application would occur only in these specific locations when pest densities exceed an established management threshold (e.g. 30% egg hatch). If effective larval control is achieved in the first generation, damage from second-generation adults will be minimal (Wyman, 1995). By selectively applying insecticide only in trap crops, total spray area could be reduced by as much as 90% per application. Furthermore, the frequency of application and the total volume of insecticide applied over the course of a growing season could also decease considerably. Given that only a small proportion of a field would be sprayed at any one time, this strategy may also decrease the likelihood that CPB populations will develop insecticide resistance.

Research Description:

In order to evaluate and demonstrate synthetic host attractant-augmented trap cropping for CPB management in organic potato production, the proposed work will be conducted on-farm at MAFES Rogers Farm and in cooperation with several organic growers at three production levels.

Large Organic Production System

An early-planted potato trap crop system will be compared with a Rotenone-based CPB management system. Trap crops (10% of total field area) will be distributed evenly around main field perimeters and comprised of Russet Burbank variety planted 2-3 weeks prior to main field planting (ca. June 1). There will be two treatments replicated at least three times: 1) fields uniformly sprayed with Rotenone when insect densities exceed economic threshold, and 2) a trap-cropped system where the synthetic host volatile attractant is uniformly applied weekly in trap crops with Rotenone applied here when insect densities exceed economic threshold. CPB economic thresholds are as follows: Egg Mass (10-30% hatch), Small Larvae, 200/50 plants counted; Large Larvae, 75/50 plants counted; Adult, 25/50 plants counted. Insect density for all life stages will be sampled in both trap and main crop regions of all treatment plots on a bi-weekly basis. Treatment 1 sampling will occur in an area analogous in size to the main crop region in the trap crop system. A leaf area meter will be used to quantify percent defoliation in all analogous main crop field regions and will be conducted on four occasions (ca. June 15, 30 and July 15, 30). Total yield mass will be collected for main and trap crop field regions and extrapolated to mean cwt. Ha-1. Grading will be conducted using commercial criteria and quality will be expressed as percent US No.1 by treatment type for harvested potatoes.

Small Organic Production System

Trap crops (10% of total field area) will be distributed evenly around main field perimeters and comprised of eggplant (var. Rosa Bianca). There will be two treatments replicated at least three times: 1) fields uniformly sprayed with RotenoneÒ when insect densities exceed economic threshold, and 2) a trap-cropped system where the synthetic host volatile attractant is uniformly applied weekly in trap crops with RotenoneÒ applied here when insect densities exceed economic threshold. Economic thresholds and sampling methods will be the same as in the large organic production system. Grading will be conducted using commercial criteria and quality will be expressed as percent US No.1 by treatment type for harvested eggplant.

Home Gardener Production System

Trap crops (10% of total plot area) will be distributed evenly around main plot perimeters and comprised of potted eggplant (var. Rosa Bianca). There will be two treatments replicated at least three times: 1) plots uniformly sprayed with RotenoneÒ when insect densities exceed economic threshold and 2) a trap-cropped system where the synthetic host volatile attractant is uniformly applied weekly in trap crops with RotenoneÒ applied here when insect densities exceed economic threshold. Economic thresholds, sampling methods, and yield grading will be the same as in the small organic production system.

Projected Outcomes:

The primary goal of this insect management strategy is to reduce both the volume and area over which insecticides are applied while offering economically rational levels of insect control. Timely application of Rotenoneâ applied to a trap crop comprised of 10% total field area may reduce application costs by as much as 90% while considerably decreasing the amount of insecticide introduced into the production environment. General labor costs might also decrease because hand-removal and other mechanical efforts could be concentrated primarily in trap crop regions.

By using early-planted potatoes as a trap crop in space and time, large growers can maintain a single cash crop and employ the same production methods throughout the system. An eggplant trap crop is more appropriate for smaller producers that rely less on machinery as primary cultivation tools and are interested in production system crop and spatial diversification. The eggplant trap crop system can be easily modified to meet the needs of home gardeners by arranging potted eggplants around potato garden plots and spot treating as necessary with hand-removal, Rotenone , or *Bacillus thuriengensis* (var. *tenebrionis*). If trap crop infestation is particularly high, the plants can simply be removed from the area.

Demonstration of the experiment will be made at the annual UM Cooperative Extension Sustainable Agriculture Field Day at Rogers Farm during the summer of 2002.

Abstract:

The attractiveness of pitfall traps baited with a synthetic host volatile attractant to colonizing adult Colorado potato beetle, *Leptinotarsa decemlineata* (Say), and its application to a comprehensive trap crop pest management strategy

were evaluated in a field setting. There were significantly more colonizing adult L. decemlineata in baited than unbaited pitfall traps and significantly more colonizing adults, egg masses, and small larvae in attractant-treated trap crops than in untreated trap crops. There were no significant differences in egg mass and small larvae densities between plots bordered by attractant-treated trap crops and conventionally-managed plots, but there were significantly fewer large larvae and adult beetles in conventionally-managed plots than in plots bordered by untreated and attractant-treated trap crops. Relative canopy area of conventionally-managed plots was significantly higher than in plots bordered by either type of trap crop. Despite these differences, there was no significant difference in yield between conventionally-managed plots and plots bordered by attractant-treated trap crops. Furthermore, significantly less insecticide (44%) was applied to plots bordered by attractant-treated trap crops than conventionally-managed plots. The addition of the synthetic host attractant clearly augmented the efficacy of otherwise untreated trap crops, with specific regard to insect pest management and potato production.

MAC 29: Survey of Fungal Diseases of Pumpkin in Maine

Principle Investigator(s): Young-mee Ahn, Bruce Watt

Background:

In recent years Maine growers have become concerned with the control of diseases affecting cucurbit crops. Cucumber, squash, melon and pumpkin are the main cucurbit crops in Maine. Based on the 1997 Census of Agriculture, cucurbits are grown on over 1000 acres and 505 of these are allocated to pumpkins. Due to the lack of information on the cucurbit disease complex in Maine, it can be difficult for growers to develop appropriate control strategies. For effective control of these diseases, understanding of the basic biology of the pathogens is important. The first and inevitable step in the process would be determination of the most common fungal pathogens.

Because Maine growers do not have good information about the cucurbit disease complex in Maine, they may choose sub-optimal control strategies such as varieties that are resistant to the wrong disease or insufficient rotation schedules. In addition, the choice and timing of fungicide sprays may depend on which specific disease is present. Conventionally, growers spray on a 7-10 day schedule after disease appearance but significant losses may still occur. Organic disease control methods may be especially sensitive to the type of organism involved. Therefore, it is important that growers base disease management strategies on well-informed data. Knowledge of which cucurbit pathogens are most important in the state will help direct future research efforts.

Presently, growers get advice from Cooperative Extension?s plant disease diagnostic clinic or other crop specialist. Recommendations are commonly made according to the New England Vegetable Management Guide. However, sometimes fungi are encountered that are not listed or not considered as common pathogens, perhaps because the climate of Maine is unique or because the information in the guide is based on the other New England states. Little work has been done to date with the occurrence and distribution of cucurbit diseases in Maine.

Research Description:

Investigators will select pumpkin fields for the present study because pumpkins represent about half of the cucurbit acreage in Maine. Surveying the pathogenic fungi on pumpkins is a good starting place for research on cucurbit crops and manageable for a one year survey. We will collect samples from three different pumpkin fields on three separate dates throughout the growing season. Other growers will be contacted to submit additional samples of diseased plants. Samples will be examined microscopically and cultured when necessary. Symptoms will be characterized and associate with the pathogens involved. Photographs of symptoms will be recorded to aid in future diagnosis. A student worker will help with the preparation of samples and general laboratory work.

Projected Outcomes:

Investigators are expecting to determine which are the most important of the fungal pathogens of pumpkin in Maine. Our results will be the basis for the further research on cucurbit crops. Based on these results growers can make better-informed management decisions.

Objectives Met:

1. To determine the occurrence of fungal pathogens affecting leaves, stems and fruit of commercial pumpkins grown in Maine.
2. To increase the efficacy of cucurbit disease control programs.

Methods Used to Evaluate Outcomes:

To determine the diversity and incidence of fungi on pumpkin plants in Maine, samples were collected from several pumpkin varieties located in fields at Roger's Farm in Orono and at Johnnies Selected Seeds in Albion. Pumpkin leaves, flowers and fruits were collected from the fields and selected based on signs and symptoms of disease. Symptomless and symptomatic tissues were cultured on potato dextrose agar and water agar plates after surface sterilization. Cultures were incubated at room temperature and examined.

The results of our investigation into pumpkin diseases in Maine were significant because some possible fungal pathogens we found have not been considered or reported as problems in Maine.

The most abundant and commonly isolated fungus in this study was Alternaria alternata. The fungus was isolated from leaves, flowers and fruits. This fungus is often found as a secondary invader on many substrates. However; we isolated the fungus not only from the necrotic pumpkin tissues but also from apparently healthy tissues. This indicates the fungus may be a primary pathogen. In our study, the major leaf symptom was a leaf spot disease associated with A. alternata. According to the Compendium of Cucurbit Diseases (1996), the causal agent of leaf spot diseases in the pumpkin family is A. alternata f. sp. cucurbitae. Alternaria alternata f. sp. cucurbitae was isolated from melon not pumpkin and has been reported only from Crete in Europe and not in the U.S.A. Therefore, our finding of A. alternata associated leaf spot disease on pumpkin is new. As a side interest, we sterilized the surface of pumpkin leaves heavily infected by the obligate pathogen, powdery mildew (Sphaerotheca fuligineae). Alternaria alternata was isolated from the surface sterilized leaves. We did not find any literature indicating the coexistence of A. alternata and powdery mildew on pumpkin or any other crops. Besides A. alternata on the pumpkin leaves, Epicoccum nigrum was often isolated in the same plate as A. alternata.

The most common disease of the pumpkin fruit in this study was black rot. We isolated Didymella bryoniae from the diseased tissues. Often Alternaria alternata and Phoma sp. were also found with D. bryoniae. Fusarium sp. and Cladosporium sp. were isolated rarely along with D. bryoniae, A. alternata, and Phoma sp. The Compendium of Cucurbit Diseases (1996) mentions the teleomorph-anamorph connection of D. bryoniae with Phoma cucurbitacearum. We found fungi of both of these genera. However, further investigations are needed to clarify the connection between D. bryoniae and Phoma sp. found in this study. Although Fusarium sp. was found with other fungi on the tissue of black rot lesions, we did not find the fungus causing any significant damage, such as Fusarium rot, by itself in the study. Alternaria alternata was also cultured from apparently healthy blossom end tissues of the fruits.

Furthermore, fungi on pumpkin stamens, petals and sepals, peduncles and tendrils were investigated. Alternaria alternata was isolated from all these parts from healthy and necrotic tissues. Didymella bryoniae and E. nigrum were seldom found on the flower parts. Interestingly, a species of Zygomycetes was found on flower parts only from Johnnies Selected Seeds, not from Roger's Farm. All the fungi found on the pumpkin flower parts and tendrils mentioned above were not specific to either healthy looking or necrotic tissue. Because our findings on diseases of pumpkin flower parts are fairly new and limited research on pumpkin flower diseases has been reported, the implication of the existence of these fungi is uncorroborated.

The summer of 2002 was hotter and drier than usual. Because of the weather conditions, we think the diversity of fungi and the incidence of diseases on pumpkins from two fields in Maine were relatively low. Even though the weather conditions were not favorable to disease development, the fungi discussed above were consistently isolated from sick parts and/or symptomless parts of plants. However, it is difficult to conclude at this point that the fungi consistently isolated from healthy and diseased tissues are pathogens. Alternaria alternata, for example, has not previously been considered a problem pathogen on pumpkin. In this study we speculate that A. alternata may be causing primary damage to pumpkins and could be an important limiting factor in pumpkin production. Proof of pathogenicity will require the satisfaction of Koch’s postulates.

MAC 30: Evaluation of Calf Coat Use in Beef Cattle Operations

Principle Investigator(s): Dee Potter

Background:

A key component to the success of farming operations is an awareness of different management tools and how they can fit into a production scheme. Beef cattle operations are no exception. In a region of the country where cold climate can challenge production and feasibility on some operations, techniques available to help reduce adverse conditions are important.

The dairy industry has been using calf coats in raising replacement heifers for several years. The objective behind placing insulated coats on the young calves is to convert the calf's energy into growth rather than maintenance (keeping warm.) According to research reported in the Canadian Journal of Veterinary Research (1989; 53: 275-278) insulated coats worn by calves housed at -30° to -18° C provided a 52% increase in whole animal insulation. There may also be positive health implications due to decreased stress on young calves. From a physiological perspective the same principles should apply to beef calves. However, the environment in which dairy and beef calves are raised differs significantly. Dairy calves are raised in individual pens or hutches without their mothers. Beef calves are raised in large open areas with their mothers and the rest of the herd. The calf coat evaluation project was developed to determine if a physiological effect would be noticed on the beef calves as well as an assessment of the practicality of using the coats in beef operations given the difference in how beef calves are housed and raised.

Research Description:

- Evaluation of calf coat use in beef cattle operations.
- Determine weight gain response
- Monitor health conditions
- Assess practical application of calf coat use

Methodology:

The study is designed to have both a qualitative and a quantitative component. One half of the beef calf crop at the Witter Center (every other calf) will wear a calf coat. The coats will be put on a dry calf within 24 hours of birth and will remain on for 21 days. A project report sheet will be developed to collect data on both groups of calves (with and without calf coats). Specific data to be collected will include; individual weights (collected weekly), weather data (daily high and low and precipitation type and amount) and a health assessment on the calves. Also a scoring system will be developed to determine the practicality of using the coats in which the cow response to the coats, how well the coats stay on and their cleanliness will be evaluated. A training session on the project and data collection will be held with the students working at the Witter Center Farm. The students, using the Witter Center handling facilities and scales, will collect the data.

Project timeline:

The calf coat evaluation project will begin with the spring 2003 calving season at the Witter Center (late February through April). At this time, calf management and data collection will be the primary activities of the project. During late spring and into the summer, the data will be complied, reviewed, analyzed and reported. The project will be completed by August 1, 2003. Ideally this study would be repeated over several years since climate conditions vary greatly from year to year.

Project Benefits:

The calf coat evaluation project will provide practical information to livestock producers in Maine. The producers may have two schools of thought; calf coats will correct and compensate for marginal management practices and/or hesitation to use a new product that has not been tested. The information generated through this project will help producers realize the possible advantages and disadvantages of using calf coats in their operations.

Projected Outcomes:

The results of the calf coat evaluation project will be presented in the following ways:

- An article in the statewide producer newsletter Maine Beef
- An article in the regional weekly newspaper Country Folks
- A presentation at Maine's Annual Beef Conference
- A fact sheet on beef calf survival strategies, which will use the information, gathered in the calf coat evaluation study. The fact sheet will also be posted on the New England Livestock web site.

Industry Support:

Attached is a letter of support from the Maine Beef Producers Association (MBPA), the organization responsible for representing Maine's beef industry.

Objectives Met:

- Determine weight gain response–statistical analysis of weekly weights collected showed there was no significant difference in the early weight gains of calves wearing coats to calves not wearing coats. There was also no relationship between weight gain and air temperature or age of calf. The sample size was too small to compensate for environmental variation over the calving season and biological factors such as genetics, cow ages and different calf sires, all of which influence weight gain. As a follow-up to the trial, weaning weights were collected in the fall of 2003 on the calves and were evaluated to determine if there was a possible longer-term effect on weight gains of the calves from the two groups. There was no relationship between weaning weights and coat use in the young calves.
- Monitor health conditions–During the course of the trial no calves were treated for illness from either group, nor was there any death loss in the calves. Also, there were no unthrifty calves for which health conditions needed to be monitored. While calves wearing coats appeared to be more comfortable especially during the first week of life and during extremely cold and windy environmental conditions. There were no sick calves to indicate a health difference between the two groups of calves.
- Assess practical application of calf coat use–With farming in general, the level of management for any practice must be proportional to its return. The specific areas considered for this objective were; would the cows allow the coats to remain on the calves and would the coats remain relatively clean and not jeopardize the hygiene of the calves. The mother cows fully accepted the coats on their calves (22 cow-calf pairs). From time to time cows could be heard licking the coats as if it was the hide of the calf. The design of this particular calf coat (CRI Genex) with a thinsulate lining and gortex outer layer allowed it to stay clean. Coats were checked at calf weighing for moisture and wicking from the material to the calf's hair. None occurred. Observations to note were that coats needed to be adjusted periodically especially on calves over two weeks of age. Some calves out grew their coat adjustments resulting in minor chafing around the coat straps. Conversely, the coats did not stay on small calves. Additional insulation provided by the coats allowed calves to walk under the electric fence wire without being shocked, resulting in calves escaping from the yard.

All of the objectives were met for this project. The on-farm research based trial was conducted over a 10-week period from March 3, 2003 to May 13, 2003, the calving season on a commercial beef herd in Frenchville, ME. Twenty-two calves went through the trial (11 pairs, one with a coat, one without.) The coats were applied to the calves on an alternating basis, according to order of birth. The first calf born did not receive a coat; the second calf born did. Coats remained on the calves for four weeks. Weight data was collected at birth and weekly for approximately eight weeks per calf. For calves wearing coats this allowed for four weeks of weight data with coats and four weeks of weights without the coats. Calves not receiving coats were also weighed for 8 weeks. Temperature data used was collected at the National Weather Service station in Frenchville, Maine. The health and management objectives were met by observation of the calves and cows.

The overall assessment of calf coat use in beef cattle operations is there are likely to be situations in extreme weather conditions where the calves would be made more comfortable with a coat. Also, given the response of healthy calves to wearing coats, using a coat on an unthrifty or sick calf may be a good management practice as part of treatment strategy. However, the small sample size did not prove any justification for purchasing and using calf coats solely to enhance calf performance and weight gain.

The results of this trial are printed in a brochure, which will be presented and circulated to beef producer groups across Maine. The first of which will be the 16th Annual Beef Conference in December of 2003.

MAC 31: Utilizing Food Processing Waste as a Soil Amendment for Growing Cover Crops in an Organic Vegetable Production System.

Principle Investigator(s): Mark Hutchinson, Mark Hutton, Richard Kersbergen,, Eric Sideman, Justin Jamison

Background:

The demand for organic produce is rapidly increasing throughout the United States. According to a USDA report, sales of organic food in the US reached billion dollars in the year 2000 and have grown at a rate of 24% per year for the last eight years. Therefore the need to produce high quality organic food economically continues to be an issue. An economical source of plant available nitrogen is one of the limiting factors in organic production. Animal manure has traditionally been applied directly to the soil to supply this crop nutrient. New national organic standards restrict the direct soil amendment of animal waste for crop production. Therefore, alternative sources or methods will have to be developed to supply the plant nitrogen required for proper growth.

Legume cover crops are one method of supplying nitrogen to subsequent crops. Legumes can supply from 90-200 lbs of N/acre under proper growing conditions from fixing atmospheric N (Managing Cover Crops Profitably 1998). Small grain cover crops can scavenge 25-100 percent of residual N in conventional and no-till corn fields (Jordan et.al An Economic Analysis of Cover Crop use in Georgia to Protect Groundwater Quality. Research Bulletin, 1994).

A second alternative for organic producers corresponds with the need for proper disposal or utilization of food processing waste. Food processing waste is a regulated waste material by the Department of Environmental Protection. Food processing waste from two Maine plants, Stinson Foods Inc. (Bath) and B&M Baked Beans (Portland), have potential to become nutrient sources for organic vegetable production. These facilities have a difficult time finding an environmentally sound means of disposing the waste product. Stinson is currently shipping their waste product to Canada for further processing into animal feed. B&M Baked Beans have several outlets; used as animal feed by local producers, commercial compost operations and landfills, but none are dependable.

Organic growers are interested in determining the agronomic viability of using these products as a nutrient source to feed cover crops to build soil health and conserve nutrients for the following growing season. The food waste industry is interested because it would create an environmentally sound method of utilizing their waste product. Both are interested in the economic viability of the relationship.

Objective:

To evaluate an underutilized nutrient source for organic vegetable production in terms of economics and agronomics.

Research Description:

A randomized complete block experiment in two locations with five replication and four treatments will be conducted utilizing food waste as a soil amendment. Locations will be at Highmoor Farm, Maine Agriculture Experimental Station at Monmouth and Goranson's farm in Dresden.

Small research plots will be used to determine the impact of fish processing waste (Stinson's) and bean processing waste (B&M Baked Beans) on cover crop biomass production and soil nitrogen availability for next season's crop. Preliminary soil test and Pre-side Dressed Nitrate Test (PSNT) will be collected on all plots. Soil amendment material will be applied at 0, 40,80,120 lbs. of N /acre. A cover crop of either Sorghum Sudan or Pearl Millet will be planted in early July 2002 followed by a cash vegetable crop the following spring of 2003.

Dry and wet weight biomass data of the cover crop will be collected in late fall. Plant tissue analysis will be conducted to determine the amount of nitrogen the plant was able to scavenge and conserve.

PSNT values will be collected biweekly to monitor the soil NO3- levels throughout the research period, except when the soil is frozen. Cost associated with the project will be evaluated to determine economic viability.

Projected Outcomes:

- A demonstration of the project will be set up at Maine Organic Farmers and Gardeners Association in Unity. It will be used as for educational programs during the Common Ground Fair and Small Farm Field Day. It will be established in conjunction with Eric Gallandt's SARE Project on cover crops.
- A presentation will be prepared for the Maine Farmer to Farmer Conference, Maine Agricultural Trade Show and New England Fruit and Vegetable Conference.
- The project will also be highlighted during Highmoor Farm Field days and Small Farm Field Day at the MOFGA site.
- Provide an in-service training using SARE professional development funds.
- Increased use of recyclable nutrients for supplying nutrients for vegetable production.
- Reduce the food waste materials currently being sent to landfills or other unfriendly environmental location from Stinson and B&M Baked Beans by 50%.
- Link two food processing facilities with organic farming community.
- Determine soil N carry from a cover crop that has been amendments with food processing waste.
- Reduce waste disposal cost to food processors.
- Develop a fact sheet for Maine Agricultural Center and University of Maine Cooperative Extension distribution.

Industry Support:

Cooperators: Robin Johanson; Eric Sideman of MOFGA and Rob Johanson a certified organic grower both are co investigators in the project. Stinson Foods Inc and B&M Baked Beans have made verbal commitments to the project.

Abstract:

The need to develop an alternative source of plant available nitrogen is important for the continued growth and development of the organic vegetable industry in Maine. The priority for this project was to evaluate food residual as a possible nitrogen source. The majority of food waste is available after most cash crops are planted in the spring.

Organic growers are interested in determining the agronomic viability of using this material as a nutrient source for summer cover crops to build soil health and to conserve the nutrients for the following growing season. The food waste industry is interested in an environmentally sound method of recycling their waste product. On Farm Research Trials

Field trials utilizing fish and bean residual in a randomized complete block design using four replications were established at Goranson Farm, Dresden and Highmoor Farm, Monmouth in the spring of 2002. Soil nitrate samples were collected from April through November of 2002 and continued from April through August 2003.

A Sorghum-Sudan cover crop was established in July 2002. The cover crop biomass was harvested in September of 2002. Total plant tissue nitrogen was also determined.

Methods Used to Evaluate Outcomes:

Plots amended with the highest rate (120 lbs. of total N) of bean residual at Goranson Farm were found to have significantly higher levels of total nitrogen in cover crop biomass. Plots at Highmoor Farm indicated no statistical significant difference in total plant nitrogen.

There were no significant differences among nitrogen application rates in soil nitrate levels or plant biomass yield in any plots through November 2002. Soil N data was collected from April 2003 through August 2003.The results of this data is incomplete.

This portion of the research created as many questions as answers, "What is the mineralization rate of food residual and food residual compost"? To try to answer this question a winter greenhouse mineralization study was conducted in collaboration with Tim Griffin at the USDA Agricultural Research Center in Orono.

This research showed that direct application of food residual resulted in the mineralization of plant available nitrogen before the majority of plant uptake occurred. Most of the plant available nitrogen was leached below the plant root

zone. In contrast, preliminary composted food residual provided plant available N at the time most required by the plant. A follow up field study was conducted in 2003; the results are not yet available. This project was funded through USDA and UMCE. The results of this study will be presented at the New England Small Fruits and Vegetables meeting in December 2003.

Second year cash crop data is still being collected and analyzed; therefore, this portion of the project is incomplete. However, this portion of the project is funded through a Northeast SARE Partnership grant and will be completed by December 2003.

A second objective was to determine the economics of utilizing the food residual as a nitrogen source for cash crop production. The scale of operation made determining financial figures difficult. Long trips for small quantities of materials created disproportionate transportation cost. It is clear that the transportation and on-farm handling of the material were very inefficient. A more efficient method of unloading, applying and incorporating the materials needs to be developed in order for farmers to successfully utilize these products. This portion of the project is being further explored with a Farmer to Grower SARE grant to be completed by December 2003.

Food- processors developed a good working relationship with an organic vegetable grower. Both are willing to continue to explore how their material can be used as a soil amendment. Additional funding was secured through a Northeast SARE Partnership grant of ,988.00 to continue working on these goals during the 2003 crop season and to evaluate the production of a cash crop following this cover crop.

Integration of Research and Extension Activities:

A demonstration plot was developed at Maine Common Ground Fair in 2002 for Small Farm Field Days. Approximately, one hundred and fifty people had the opportunity to see cover crops growing with food residual as a soil amendment.

Presentations were made to the following audiences on the utilization of food residuals in cover crop production for organic vegetable production.

- Field Day at Highmoor Farm, August 2002
- Maine Organic Farmers and Gardeners Association meeting during the Maine Agricultural Trade Show, 85 Growers and Service providers, January 2003
- 1st Annual Winter Vegetable Meetings held in Alfred and Augusta, 58 growers and service providers, March 2003
- Soil Health Workshop at Goranson farm in July of 2003, thirty-three people attended the workshop. Three people have made additional inquires about utilizing these products for organic production.
- American Society for Horticultural Science Centennial Conference in Providence, Rhode Island, A poster session will be presented on this research, over 1200 participants anticipated, October 3-6, 2003.

MAC 32: Evaluation of Vegetable Varieties for Maine Vegetable Farmers

Principle Investigator(s): Mark G. Hutton, David T. Handley, James F. Dill,, Gleason Gray

Background:

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 (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.

Research Description:

Tomato Trial

Twelve varieties of tomatoes will be grown in randomized complete blocks using four replications at both Highmoor Farm and Rogers Farm. Transplants will be started in late April and transplanted into plastic covered raised beds in late May/early June. The trial will focus on disease resistant varieties requiring short growing seasons with medium to large size high quality fruit. The tomato varieties will be evaluated for harvest date, fruit characteristics, yield, disease resistance and fruit quality.

Melon Trial

There have been several new introductions in the past few years and there have been several requests from growers for this information. Ten eastern cantaloupe varieties and five specialty melons will be evaluated for ripening date, fruit characteristics, yield, disease resistance and quality. Transplants will be started in late May and transplanted into raised beds covered with black plastic mulch. Each variety will be planted in plots of 12 plants with four replications.

Onion Trial

In 2000, a storage onion trial was conducted at Highmoor farm. This year we are proposing to conduct an evaluation trial of red onion varieties. Six red onion varieties will be evaluated for maturity, yield, color, sweetness/pungency, and storage ability. Double row plots of five feet will be planted using transplants. Each variety will be replicated four times. Transplants will be seeded in April with bulb harvest expected to begin in late September.

Projected 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 will also be presented in the statewide Extension Vegetable Newsletter and posted on the UMCE Pest Management 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.

Results

Tomato Trial:

Twelve varieties of tomatoes were grown in randomized complete blocks using four replications at both Highmoor Farm and Rogers Farm. Transplants were started April 23. 2002 and transplanted into plastic covered raised beds on

June 5, 2002. The tomato varieties were evaluated for harvest date, fruit characteristics, yield, disease resistance and fruit quality.

Melon Trial:

Ten eastern cantaloupe varieties and five specialty melons will be evaluated for ripening date, fruit characteristics, yield, disease resistance and quality. Transplants were started May 16, 2002 and transplanted into raised beds covered with black plastic mulch on June 10, 2002. Each variety will be planted in plots of 12 plants with four replications. *Red Onion Trial:* Due to the lack of seed this trial was not conducted.

Romaine Trial:

A Romaine trial was substituted for the onion trial. The 11 varieties selected ranged in maturity from 46 to 60 days and represented red and green leaf types. Four plots of each variety were planted in a randomized design and data from the plots combined for statistical analysis. Seeds were sown on May 15, 2002 in trays filled with a peat/vermiculite mixture and seedlings grown in a greenhouse. The transplants were hardened in a cold frame one-week prior to setting in the field on June 16, 2002 the plants were spaced one foot apart within triple rows spaced one foot apart. The triple rows were spaced two feet apart. The center 10 plants of each plot were harvested on July 25. Harvest was delayed until after the Highmoor farm field day (approximately seven days). The heads harvested from each plot were weighed, measured and rated for attractiveness, tip burn, bolting, leaf texture, and taste.

Methods Used to Evaluate Outcomes:

Tomato Variety Trial:

The tomatoes performed well in 2002 having good yields for most varieties. Royal Mountie, Sun Chief and Sunbrite had the greatest early yields and were also top performers for total yield. Royal Mountie in particular is a good choice for a first early field tomato, however, the fruit size is small (174g) and the plant succumbs to disease early in the season. Sun Chief was not only early but had the largest average fruit size in the trial (208g). Sunbrite had the greatest total yield, excellent flavor and large fruit. Sunsation, Moreton hybrid Red Sun and Sun Guard all exhibited acceptable uniformity and yields. Fruit size of Moreton Hybrid was small relative to the other varieties however the flavor was rated the best of all the varieties evaluated. BHN 555, BHN 543, STO 6212, JTO 99203 and JTO 99197 all were too variable, and had too much cat-facing and blossom end rot.

Melon Variety Trial:

Most of the melon varieties performed well under very hot and dry conditions that characterized the 2002, growing season in Maine. The one exception was Minerva, which had very low yields and may be too late for the short growing season in Maine. Earliqueen and Fastbreak were the earliest of the varieties evaluated and share many of the same characteristics: small sizes, deep suture, fairly course net and good flavor. Perhaps the greatest drawback of these two varieties is the relative speed with which they pick-out. These are truly, first-early melons and need to be sequentially planted or followed with a main season variety. Starfire was the next earliest melon in our trial and was in the middle of the range for total yield. The fruit quality was very good with a pleasant musky sent and good flavor. Starship was similar to Starfire. Starsweet was one of the most attractive melons in this trial. It had good fruit size and the greatest yield in the trial. However, the flesh was soft and the flavor bland. Athena, Minerva, Eclipse and RML 8793 are best classified as Eastern shipper type melons and, in general, lack the suture or musky aroma of a true muskmelon. Athena was uniform with high yields and good fruit quality. RML 8793 had the largest fruit size of any variety in our trial. In fact, RML 8793 may be too large for many roadside markets. Eclipse was the most variable variety in this trial. There was a vast range in the degree of netting on the fruits of this variety. The flesh color was a deep orange flesh however; the flavor in this trial was poor. Sugar Bowl was judged to have the best overall fruit quality but, the fruit size was small and total yields were average. Based on this study, Earliqueen and Fastbreak are good choices for the early market while the Star series and Sugar Bowl are excellent choices as main season varieties.

Romaine Variety Trial

All the Romaine varieties performed well in this trial although each variety exhibited a high percentage of bolting (due to the delayed harvest). Green Towers, Green Forest, and Medallion, were the largest of the green romaine. Green Towers was the most attractive and darkest green. Claremont and Winter Density were the smallest of the green

romaine. Winter Density had several plants that were yellow and stunted. Claremont was a bright glossy green more closely resembling a bibb type lettuce than a romaine. Outrageous, Eruption and Integrata Red were a very dark deep red color, with Eruption having the darkest color. In general, the red leaf types were rated to be less crisp than the green leaf varieties and showed less tip burn. Cimmaron and Rosalita are green leaf types with red leaf margins and Freckles has a green leaf with red spots. These three varieties are probably best suited for use as baby leaf types in salad mixes.

Integration of Research and Extension Activities:

The results of these studies have been presented at the Maine Vegetable and Small Fruit Growers Annual Meeting and the New England Vegetable and Berry Growers Winter meeting. The melon experiment was also presented at the Mid-Atlantic Fruit and Vegetable Conference and at the New York State Vegetable Conference. The results were also presented in a statewide Vegetable newsletter. The Melon experiment was also presented in the March issue of The Vegetable Grower News. Growers and Master Gardeners were able to view the experiments at two field days held at Highmoor Farm during the 2002 growing season.

MAC 33: Floral Markers for Tarnished Plant Bug Resistance in Strawberries

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

Background:

Strawberries are the most important cultivated small fruit crop grown in Maine. Currently, about 150 farms produce nearly 3.2 million pounds of fruit, valued at .5 million. One of the most important limiting factors in strawberry production is the tarnished plant bug, Lygus Lineolaris, which feeds on flowers and developing fruit causing a severe malformation of the berries. As a result, this insect accounts for between 25% to 75% of insecticide use in strawberry fields. Previous research (Handley et al. 1991, Fruit Varieties Journal 45(3): 166-169) has demonstrated that different strawberry varieties grown in Maine differ in their susceptibility to tarnished plant bug injury, and that this may be used to influence pesticide use (Handley et al. 1993, Fruit Varieties Journal 47[3]: 133-137). However, characteristics that contribute to tarnished plant bug resistance have not been determined. If the mechanisms that lead to susceptibility or resistance to tarnished plant bug in strawberry can be determined, developing resistant varieties will become practical. In addition, identifying resistance within currently grown varieties may allow growers to reduce insecticide applications on those resistant to tarnished plant bug, and allow organic growers to select varieties based on their level of resistance. Results of a study carried out at the Maine Agricultural Experiment Station in 2001 found that varieties that produced high levels of pollen were more likely to have tarnished plant bug injury than varieties that produce low amounts of pollen. This is this first time such a correlation has been reported, and it occurred despite very low levels of tarnished plant observed during the 2001 season. It is important to verify these results through another season and under higher feeding pressure and expand on these observations with a wider selection of varieties.

Research Description:

Four varieties of strawberries were established in large plots at Rogers Farm, the Maine Agricultural Experiment Station in Stillwater during 2001. Selected plant populations within these plots will be closely monitored for tarnished plant bug and feeding injury levels. In order to evaluate levels of resistance under high feeding pressure, four varieties varying in susceptibility to tarnished plant bug injury will also be grown in pots and placed in fields likely to support high populations of tarnished plant bugs during flowering (e.g. alfalfa). Plant characteristics that may be associated with feeding will be measured for each variety, including: time of flowering, length of bloom period, flower number and size, pedicel length, stamen number and length, style number and length, pollen production and canopy size. These characteristics will be correlated with the levels of tarnished plant bugs and fruit injury recorded for each variety. The correlation values should suggest which plant characteristics are most closely associated with tarnished plant bug resistance and may indicate the mechanisms that impart resistance.

Projected Outcomes:

Results of this study will be presented to growers through presentations at meetings, such as 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, and the regional trade e-journal the Yankee Grower. The results will also be posted on the UMCE Pest Management web site. Growers will have an opportunity to view the experiment first-hand and discuss the treatments during the summer field day at Rogers Farm. Results 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. Results of the 2001 project have been accepted for presentation at the International Horticultural Congress to be held in Toronto in August of 2002.

Project Description:

The study was carried out in 2001 within a replicated strawberry variety trail established at the Maine Agricultural and Forestry Experiment Station in Monmouth, Maine. The 6 m long plots were maintained as perennial narrow matted rows 0.5 m wide and 1.2 m apart. Six cultivars (‘Cabot’, ‘Jewel’, ‘Mesabi’, ‘Mira’, ‘Northeaster’ and ‘Sable’) were included in the study. Each cultivar was replicated four times in a randomized complete block design. To measure floral and leaf parameters, three inflorescences and one leaf were harvested from each plot when the primary and secondary blossoms had opened. Measurements included number of blossoms per inflorescence, pedicel

length, peduncle length, diameter of primary blossoms, diameter of secondary blossoms, dry weight of secondary blossoms, a 1 to 5 rating for pollen abundance and petiole length. Tarnished plant bug nymphs were monitored weekly by tapping three flower clusters in each plot over a white plate and counting nymphs. Fruit was harvested from each plot, graded, counted and weighed.

Methods Used to Evaluate Outcomes:

Due to drought conditions during the summer of 2001, plot yields and fruit sizes were low and variability within cultivars was high (Table 1). Further, tarnished plant bug populations were very low and thus blossoms were not exposed to high feeding pressure. As a result, injury was very low among all of the cultivars. The high variation in the distribution of the few nymphs present provided only a weak, positive, and insignificant correlation between the insect density and the amount of damage observed. However, levels were significantly different between cultivars when measured as a percentage of yields by weight. 'Mira' had the highest level of tarnished plant bug followed by 'Northeaster', 'Cabot', 'Mesabi', 'Jewel' and 'Sable'. Among all the parameters measured, tarnished plant bug injury was most highly correlated with pollen rating, i.e. cultivars with more pollen tended to have higher levels of injury (Table2). Injury was also positively correlated, although weakly, with secondary flower diameter, pedicel length, number of blossoms per inflorescence and petiole length. No correlation was found for other characteristics such as primary flower diameter, peduncle length, or blossom dry weight.

The significant differences in injury observed between cultivars supports previous research suggesting that cultivar characteristics affect susceptibility to tarnished plant bug. Among the parameters measured, tarnished plant bug injury was most highly correlated with pollen levels. It is possible that adults may prefer to lay eggs on plants with higher pollen levels, using it as a marker for host fitness, or simply preferring to feed on such flowers. However, given the subjective nature of the pollen rating and the low level of injury, this relatively strong correlation requires further study before being recommended as a screening characteristic for tarnished plant bug. The other parameters that showed weaker positive correlation with tarnished plant bug injury included plant characteristics that could be associated with adult feeding and oviposition preferences. Larger secondary blossoms, and higher numbers of blossoms per inflorescence, along with plentiful pollen, could act as a signal for a more desirable host plant. Longer pedicels and petioles might also be more attractive as these are the primary oviposition sites for tarnished plant bug on strawberry. These parameters should receive further study as characteristics that may impart susceptibility to tarnished plant bug injury. Because its wide host range and adaptation, the development of resistance to tarnished plant bug in a highly susceptible and preferred host such as strawberry will be a difficult and long-term project. However, this study provides further evidence that susceptibility is, to some degree, a function of genotype, and that certain plant characteristics likely play a role in this susceptibility. Further study may clearly identify characteristics that are key for resistance to tarnished plant bug.

Integration of Research and Extension Activities:

Results of this study were presented to the 2002 International Horticulture Congress Symposium: Berry Crops, Breeding Production & Utilization into the 21st Century. They will be published as a paper in Acta Horticulturae in 2003. In combination with further research carried out in 2003, this study will also be presented to the Maine Vegetable and Small Fruit Growers Annual Meeting in 2003 and the New England Vegetable and Berry Growers Conference in 2003. A summary article will also be submitted to Advances in Strawberry Research for publication in 2003. The results will also be presented in a statewide Extension Vegetable & Berry Newsletter and posted on the UMCE Pest Management web site. Approximately 40 growers had an opportunity to view the experiment first-hand and discuss the treatments at twilight meeting held at Highmoor Farm during the 2001 growing season.

Much of the impact of this study will be long term in its effect. The level of exposure given this work should stimulate interest among plant breeders to initiate screening for tarnished plant bug resistance in their breeding selections. Three breeding programs, USDA-ARS in Maryland, University of Wisconsin, and Ag Canada have expressed interest in this work and two are presently developing collaborative projects based on this study. If the selection criteria are simplified, through studies like this and ongoing projects, tarnished plant bug resistance could be an important factor in reducing pesticide use in strawberries in the near future.

MAC 34: Genetic Resistance to Internal Parasites in Sheep: The development of an on-farm testing guide and research of the biology of parasite resistance.

Principle Investigator(s): Richard Brzozowski, Thomas Settlemire

Background:

The number one health problem in the sheep industry nationwide as determined by a survey conducted by USDA/APHIS is internal parasite infections (see Appendix I), specifically the round worm Haemonchus contortus. Livestock producers depend upon the use of anthelmintic agents (dewormers) as a primary tool in the control of these infections. There are three families of chemicals from which all antihelmintic agents are formulated including : (1) the benzimidazoles, (2) levamisole and morantel, and (3) ivermectin. The effectiveness of these compounds has been reduced as resistance develops in the parasites. Resistance has now been reported against all three chemical families and needless to say this issue is a serious concern for the sheep industry in the United States and the world.

As part of a current research project under our direction supported by USDA-SARE, the Northeast Katahdin Hair Sheep Project, we have begun the process of identifying animals that are genetically resistant to internal parasite infections. Using animals we have obtained from high parasite environments such as the Gulf Coast states of Florida, Mississippi and Louisiana, we have identified animals resistant to Haemonchus contortus infections. These animals came from flocks in those states that had not used worming agents in over 25 years. As a surprise to us, we also found animals from our Maine breeding stock that were parasite resistant but not with the frequency found in the animals from the Gulf Coast.

Using lambs born in 2001 at the our project site in Buxton, Maine, we have developed an on-farm testing procedure that will identify lambs that are genetically resistant to round worm infection. Use of this procedure by farmers in Maine could provide a very valuable tool in the control of intestinal parasite infections and thus a tool for better flock health. The use of this procedure could provide an important marketing tool for those selling breeding stock or meat animals. Natural / genetic resistance to parasite infections could be an important tool as producers work toward producing "all-natural" or "organic" meat since it would eliminate or greatly reduce chemicals now given to animals for the control of internal parasites.

Support from the Maine Agricultural Center is requested for two aspects of the hair sheep work not supported by the current USDA-SARE grant.

This grant would allow us to develop an illustrated, step-by-step printed guide that producers could use to determine if they have parasite resistant animals within their flock. They would use this information to build a parasite resistant flock. The fortunate aspect of the procedure is that it does not require highly trained technical input and can be done by a producer with the right information and a microscope. The brochure would provide the producer with the needed steps including how to collect fecal samples, how to prepare fecal material for analysis, pictures of what they are looking for in the microscope (Haemonchus eggs) and directions on how to calculate infection levels. This information can then be applied by the farmer to test and select weaned lambs for the phenotypic expression of parasite resistance. The details of the selection process will be included in the brochure. In addition to a practical brochure, the information will be in a form that could easily be placed on UMCE's webpage.

In cooperation with the Maine Sheep Breeders Association, a hands-on workshop will be conducted to demonstrate the procedures for testing and the process for selecting genetically resistant animals.

Funds are also requested for a research component that would investigate the biology of parasite resistance. Work would be conducted with the cooperation of Professor Tom Settlemire, Biology and Biochemistry, Bowdoin College. Professor Settlemire is co-director of the USDA-SARE grant given to support the Northeast Katahdin Hair Sheep Project. The work proposed would examine the biology of the immune response in resistant and non resistant sheep and the biology of the eosinophil, an important white blood cell thought to be involved in protection against parasite infections.

Research Description:

Preparations of parasite outer coat protein will be used to determine if resistant sheep produce greater amounts of antibodies against unique antigens on the parasite. The initial screening will be done using ELISA (enzyme-linked-immunosorbant- assay) techniques and examine both IgG and IgA in resistant and non resistant sheep. If initial screening indicates antibodies against preparations via the ELISA procedure, electrophoresis techniques will be used to determine if there are differences in the antigen recognized by resistant and non-resistant sheep.

It is also possible that the genetic difference is the result of more or different eosinophils, which play a key role in fighting a range of infection in the intestinal tract. If there were differences in eosinophil biology between resistant and non-resistant sheep, a logical candidate would be in the levels of EDN produced by eosinophils. EDN is a key compound produced by eosinophils, stored in granules and used to eliminate invaders of the intestinal tract. Preliminary work would be done to determine if EDN levels in eosinophils from resistant and non-resistant sheep is different in amount or chemistry. This project will address the number one sheep health problem in the United States, internal parasite infections by Haemonchus contortus.

Projected Outcomes:

This project will create a useful printed guide for on-farm parasite testing and genetic selection of breeding ewes and rams that are resistant to parasite infection. The materials generated (printed guide, computer presentations) will be available to individual farmers and for workshops and web site use. A pilot group of Maine sheep farmers will be invited to participate in the project to test the usefulness and importance of methods and procedures as developed. Research will be conducted to further understand the biology of genetic resistance to parasite infections. We have the unique opportunity to do this research because we have at our hair sheep research site in Buxton, both genetically resistant and non-parasite sheep.

Industry Support:

A letter of support from a representative of the Maine Sheep Breeders Association has been directly sent to the MAC office. This project will provide the preliminary work needed to apply for funds from such sources as USDA and other granting agencies for continuing the research on the biology of parasite resistance in sheep.

Objectives Met:

This project addressed what is considered to be the current number one health problem for the sheep industry in the United States, namely internal parasites. The problem has become such a priority because the parasites have developed resistance to all forms of anthelmitics (dewormers). We are currently funded in a five-year USDA SARE project to genetically select for and develop a flock of Katahdin Hair Sheep that will be naturally resistant to Haemonchus contortus (round worm or barber pole worm). The funding for this project from the Maine Agricultural Center helped us to begin to investigate and extend the work supported by the USDA SARE grant into the biology and immunology of parasite resistance in sheep.

Objectives Not Met:

We have committed ourselves for the development of a producer handbook on monitoring and controlling parasites in sheep. The handbook is drafted but not yet completed. The draft version of the handbook will be reviewed by a veterinarian and a sampling of sheep producers before a final version is made available for distribution in Maine. We are behind schedule on this aspect of the project as a new technique to monitor internal parasite infestation of sheep was recently introduced in the United States. This technique, known as FAMACHA, was made available in the summer of 2003. We were the first research team in the northeast to learn of and use this effective and low cost technique. We thought it important enough to include this new information in the guide. We have been delayed in part because we want to include pictures and information about this very important technique.

Methods Used to Evaluate Outcomes:

The outcomes of this research were evaluated by surveying sheep producers and scientists who participated in workshops and activities. An end-of-conference survey was conducted following the 2003 Katahdin Hair Sheep International Gathering in October. Immediate feedback from participants helped us to verify the practicality of the techniques as well as to refine the descriptions and explanations for implementing the techniques. Our goal is to

produce practical tools for the sheep producer in monitoring and managing parasites for their respective sheep operations. A list of cultural practices in parasite management has been assembled as a part of the handbook to complement the monitoring techniques.

Integration of Research and Extension Activities:

Samples and physical observations were collected from the Katahdin Hair Sheep research flock in the form of blood and fecal matter; Laboratory work was conducted using the samples to investigate the biology of how sheep are resistant to parasites; The studies were conducted to detect the presence of specific antibodies and antibody reaction to specific proteins on the surface of parasites; We networked with a research team at the University of Georgia to implement a new technique in monitoring internal parasite infection levels; Photos were taken of sheep, parasites and steps; Steps were recorded for use by others; The feasibility of each process was evaluated; Recommendations were made; Presentations of the processes were given to sheep producers and scientists; Interactive workshops were presented with sheep producers.

Outputs:

The following presentations were made (Powerpoint presentations):

- “Monitoring Parasites in Sheep” – New Hampshire Sheep & Wool Festival, Hopkington, New Hampshire May 2003
- “Resistance to infection by Haemonchus contortus: What is the role of antibodies?”, University of Georgia, June 2003
- “The FAMACHA Technique” – 2003 Katahdin Hair Sheep International Annual Gathering, Pineland Farms, New Gloucester, Maine October 2003
- “Natural Resistance to Internal Parasites” - 2003 Katahdin Hair Sheep International Annual Gathering, Pineland Farms, New Gloucester, Maine October 2003
- “Controlling Internal Parasite Infections in Sheep – The Use of Genetics”, invited speaker. Ocala, Florida November 2003
- “Using Eye Blood Vascular Color to Monitor Parasite Populations in Goats” – Maine Agricultural Trades Show, Augusta, Maine, January 2004
- Information from this MAC funding helped us apply for and obtain a two year extension to the USDAS SARE grant (6,000.00) May 2003
- Reprint of publications from this integrated project
- Powerpoint presentations are available upon request: Richard Brzozowski 207-780-4205 or 800-287-1471 (in Maine), rbrz@umext.maine.edu

MAC 35: Investigation of Mycoplasma Presence in Bulk Tank Milk on Maine Dairy Farms

Principle Investigator(s): Gary Anderson, Michael Opitz

Background:

Mastitis (infection of the mammary gland) is the most costly disease affecting dairy farms in the U.S. It is estimated that the actual cost of mastitis to farms is over 2 Billion dollars per year. These costs are in lost milk sales, veterinary costs, drug costs, labor to treat, etc. Costs are estimated to average per case. The importance of mastitis to the dairy industry has recently been affirmed by the Maine Dairy Industry Association (MDIA) who recently voted that mastitis was their number one health concern. MDIA has recently received ,000 to implement a bulk tank milk culture program for Maine dairy farms. This program will be in conjunction with the Maine Veterinary Diagnostic Lab.

Mastitis is either caused by organisms that are contagious (spread from one cow to another) or environmental (arising from the environment in which the cow is housed). Historically, Streptococcus agalactiae was a cause of many mastitis cases. By understanding the physiology of the organism and its' susceptibility to antibiotics, a herd infected with this organism can follow best management practices to eliminate it from a herd.

There are many types of organisms that can result in mastitis. The most common of these organisms are bacteria, but others such as fungi and mycoplasma can also cause mastitis. This proposal deals with infections caused by mycoplasma. Mycoplasma is a common resident of the respiratory system and may cause respiratory problems. It also may be bound in the urinary and reproductive tracts. Mycoplasma can also cause a very problematic mastitis. Mycoplasma mastitis is resistant to antibiotics and once infected, a cow may remain infected for her life serving as a source of infection to other cows in the herd. With rapid expansion of the dairy industry (relative to increased numbers of cows per farm), there is increased chance of introducing infected cows into herds as expanding herds scour the country for replacements and additional animals to increase milking strings.

Mycoplasma bovis is the most common pathogenic mycoplasma to cows. The presence of mycoplasma often goes unnoticed and can only be detected by special diagnostic techniques. Routinely, milk samples submitted for diagnostic procedures are grown on blood agar for determination of bacterial types and then transferred to other specific media for identification as well as blood agar and Mueller-Hinton agar for determination of antibiotic sensitivity. Mycoplasma does not grow on blood agar, requiring a special media that is grown in a CO2 environment. Culture of milk for common mastitis causing bacteria takes 24 to 48 hours while mycoplasma culture takes up to a week for growth. In our current system, milk submitted for analysis and grown on blood agar would not detect mycoplasma. In those cases where mycoplasma is suspected, samples are submitted to the Cornell University Diagnostic Laboratory for diagnosis.

Control measures are to sample new incoming cattle for all mastitis causing bacteria and mycoplasma. When buying entire herds, one of the first steps is to submit a sample of bulk tank milk for culture to increase the amount of information to the buyer. Control of mycoplasma is an ongoing process that is initiated with regular bulk tank milk cultures, culture of all new milking animals and culture of animals with longterm mastitis (including long term high somatic cell counts which are an indicator of mastitis).

Research Description:

We do not currently have the laboratory equipment nor the operating procedures in place to confidently diagnose mycoplasma mastitis. The media is expensive and does not have a long shelflife. With the number of samples requesting mycoplasma being low (in part because several farms submit samples directly to Cornell), these procedures have not been implemented into the standard analysis of milk samples. To date, the Maine milk quality program has been a program directed at individual cow samples. We now are expanding the milk quality program to increase the information to producers with which to make decisions. Knowledge is power and improved knowledge can help Maine dairy farms be competitive in a rapidly moving business.

We plan to develop the testing protocols in the Maine Veterinary Diagnostic Laboratory for mycoplasma. This important step will prepare us for the statewide program in bulk tank milk culture to start this Fall. We plan to work

with the Cornell Diagnostic Laboratory to learn the procedures that they use for mycoplasma culture. We plan to utilize these procedures to field test the bulk tank milk culture system and develop the targetted informational system that will be implemented with the statewide program by piloting the program with 25 herds. The benefits are threefold. First, the capabilities of our diagnostic lab staff will be enhanced so that additional diagnostics can be offered to Maine producers. Second, Maine producers will learn more about a silent threat to their dairy business and gain information on the presence of mycoplasma and best management practices to reduce its' incidence and impact and third, students will gain information on mycoplasma mastitis as they go on to employment in a variety of fields.

Projected Outcomes:

We will have targetted mailings to every dairy farm shipping milk for sale in Maine to improve the understanding of mastitis organisms, the potential impact on their farm and the availability of the new diagnostic capabilities. Once data is collected, we will have informational meetings to share the results of milk cultures statewide. We have talked with milk marketing organizations and have the support of all the companies for this program. The MDIA has written a letter of support for the program as has Dr. Don Hoenig, state veterinarian, who runs the state milk quality program. In the past, our Johnes work has been seen as very proactive, with every other state in New England asking questions about how we implemented the program, the results of our program and how we might work together collaboratively. The results of the work proposed here will become an integral portion of the mastitis module for the Maine Cattle Health Assurance Program.

Objectives Met:

Funding of this project allowed us to develop Mycoplasma culture procedures for the University of Maine Animal Disease Diagnostic Laboratory. Originally, we planned to utilize mycoplasma culture procedures to field test the bulk tank milk culture system and develop the targetted informational system that will be implemented with the statewide program by piloting the program with 25 herds. The benefits of this project were threefold. First, the capabilities of our diagnostic lab staff were enhanced so that additional diagnostics can be offered to Maine producers. Second, Maine producers have learned more about a silent threat to their dairy business and have gained information on the presence of mycoplasma and best management practices to reduce its' incidence and impact and third, students have gained information on mycoplasma mastitis as they go on to employment in a variety of fields.

Methods Used to Evaluate Outcomes:

With the help of other laboratories that currently culture mycoplasma, we have validated the procedures for the Maine Animal Disease Diagnostic Laboratory. We are now in a position to routinely offer the culture of mycoplasma in milk. We run positive controls with each group of unknowns submitted for mycoplasma culture. The upgrade in laboratory facilities has made the culture of other organisms requiring a CO2 environment easier to accomplish. While we initially planned to pilot mycoplasma milk culture of milk on 25 Maine dairy farms, we have completed mycoplasma culture on 115 Maine dairy farms. We have developed targetted informational factsheets that are included with the results of the mycoplasma culture on next steps for control. Out of the 115 dairy farm cultures done, two were positive for mycoplasma. We are encouraged by this low rate of mycoplasma infection as it is much lower than has been reported in other states. We are continuing to culture bulk tank milk from Maine dairy farms and have developed a comprehensive culture system so that we can report contagious and environmental organisms along with management information back to Maine dairy producers.. These data give producers information with which to make management decisions.

MAC 36: Evaluating Pollen Transport from Genetically Engineered Corn

Principle Investigator(s): John Jemison, Michael Vayda

Background:

Genetically engineered (GE) crops provide great opportunities including the possibility of 1) reducing the amount of pesticides used in crop production; and 2) providing producers with greater flexibility with production methods. However, some growers, producers and consumers do not want to use GE crops. For example, organic growers have a ban on growing GE crops, and these producers stand to lose their organic certification if their crops are cross-pollinated by GE crops. More research and extension activities are needed to understand the risks and benefits of this technology for Maine farmers. The proposed work will complete our evaluation of glyphosate timing and rate on Roundup-ready corn; and complete our work evaluating how long an introduction of GE pollen into open pollinated corn will be detectable.

Herbicide tolerant crops like Roundup-ready corn and soybeans offer growers weed control strategies that are potentially safer for the environment and have increased flexibility in terms of application timing. However, due to current organic production standards, no GE proteins are permitted in organic food or feed materials. In fact, legislation is now in place in Maine requiring companies selling GE seed to provide growers with setback standards to prevent cross contamination. All people growing these crops are required to follow these guidelines, including researchers doing small plot evaluations. As with many biological processes, 100% confidence in the standard of zero cross contamination is not likely. Thus, the need to learn more about corn pollen transport from large and research plot scales is important. We initiated work to evaluate pollen transport in 1999 and continued this work in 2000 and 2001. We now have some initial estimates of corn pollen transport. In 2001, we initiated another study introducing GE pollen into open pollinated corn, and we have found that the level of GE contamination does not increase, but actually decreases somewhat over time. We need to grow the seed harvested from last year and see how much the contamination will decrease in 2002.

Since Roundup-ready corn and soybeans are available in Maine, growers using these crops need information on how to use these materials effectively in the field. They need information on timing, rate, and tank-mix partner combinations. We intend to continue our work looking at timing, rate, and tank-mix partners with Glyphosate in Roundup-Ready corn production.

This work meets the needs of both the organic and traditional production communities by providing information on pollen transport to ensure organic certification standards. However, Maine Ag Center support is critical to lend credibility to this work because of the Center's impartiality to the issue. We will deliver recommendations on how to grow these crops most effectively while minimizing the potential for cross contamination.

Research Description:

During the summer of 2002, we propose to conduct two experiments: 1) continue an experiment to determine how long a single introduction of GE corn pollen will continue to express itself in a field of open pollinated corn; and 2) continue our work to determine the most efficacious means of using glyphosate in a Roundup-ready corn system. Each of these studies will repeat the work conducted in 2001. For the first study, open-pollinated corn harvested from the 2001 season will be replanted in an isolated field. We will hand-harvest 100 random ears from the experiment, dried the corn, and replant the corn offspring in the greenhouse. At the V2 development stage, the corn will be sprayed with glyphosate. Plants that survive are genetically resistant to glyphosate and thus cross-pollinated in the field. We will then be able to determine if the amount of GE corn in the population of open pollinated corn is increasing, staying the same or further decreasing over time.

Within the RR corn trial, we will evaluate glyphosate rates and timing of application compared to standard pre and postemergence control options. This is part of a 5-state regional study to provide growers with the best information needed to use these crops most effectively. The best treatments from the 2000 and 2001 season will be included in this year's trial along with some additional possible tankmix combinations that I have learned about from attending the winter Northeast Weed Science Society meetings.

Projected Outcomes:

Information generated will be shared with growers at a number of venues. Jemison will present weed control information at the Maine Agricultural Trades Show because it is an excellent venue to reach Maine growers. The Roger's Farm Field Day in June or July 2002 will continue to be an effective means to share this information with producers. Reports will also be developed into newsletter articles for dairy producers and MOFGA.

For both in-state and out-of-state information exchanges, we propose several possible avenues. As we have done with the first year's work, research results will be made available on our website: http://www.umaine.edu/waterquality. The three-year pollen transport project will be submitted for publication to the Agronomy Journal, likely as a note. Lastly, we would like to present this information at a couple of professional meetings. One will be the Northeast Weed Science Society meeting in Baltimore, (January 2003) and another would be the American Society of Agronomy meeting in Morgantown West Virginia in July, 2002. The corn pollen transport information should also be presented at a risk management meeting.

Objectives Met:

1. Determine if the extent of corn pollen transport would be similar in 2001 as they were in 1999
2. Determine optimum timing and need for tank mix partners when using Roundup over corn
3. Determine if Roundup resistance gene introduced into a pure stand of open-pollinated (OP) corn would increase or decrease over time.
4. Present this information to farmers in as many venues as feasible

Methods Used to Evaluate Outcomes:

- Objective 1. The results of the corn pollination work were remarkably similar to the results found in 1999. In 1999, we found approximately 1% of the corn pollen tested had cross pollinated from 30 m away. The corn at approximately 35 m dropped to 0.1% and the corn at 40 m was found to have 0.03% cross pollination. In 2001, we found very similar results. We found very similar results: (0.14% at 30m, 0.08% at 35m, and 0.04% at 40m). With this we were able to present these results to growers at trainings to show them the amount of close-proximity cross pollination one can expect if a grower were growing GE corn and an organic producer was growing corn in a near-by situation.
- Objective 2. We found over the two years of the glyphosate timing and placement studies very consistent results: Glyphosate applied over the top of corn at the 2nd-leaf stage was ineffective at controlling weeds if used alone. Mixed with atrazine or another chemical offering residual control, this timing was effective but more expensive. At the 4th-leaf stage, we found that glyphosate could be used effectively to control most all weed types effectively without a tank-mix partner. At the 6th-leaf stage, weeds had primarily done their damage, and yields suffered. This information has helped growers understand the limitations of the new technology, and if this technology is used at the most favorable timing, growers can reduce the amount of herbicides used in their operations.
- Objective 3. We found in 2000 that the standard corn hybrid that we had used as our trap crop for our experiment had a low level (0.16%) of contaminated seed. We were curious to find out if this level would increase or decrease if it blew into a field of OP corn. We planted a small field of OP corn and seeded into this corn a small amount of GE corn approximating the amount found in our standard hybrid in 2000. We harvested this corn and determined the amount of cross-pollination in the greenhouse in the winter of 2001. We found that the pollination dropped from 0.16% to 0.04% in that season. When this corn was planted in 2002, we found that the levels remained at about the same percentage (0.04%). What this told us is that if GE corn flies into a grower's field and gets into his/her OP corn, the contamination may drop over time, but it will likely take many years to completely drop out of the populations.
- Objective 4. The objective to get this information out to farmers was accomplished through demonstrations, field days, grower meetings, and also professional meetings. I presented at the Maine Agricultural Trades Show, a meeting with large dairy herd producers, New England Crops and Soils meetings in Portsmouth, NH, an international conference on agricultural biotechnology, northeast weed science society meetings, northeast agronomy conference, and a diffuse pollution conference in the Netherlands.