Maine Agricultural Center Integrated Research & Extension Agricultural Projects: 2000–2001

Contents

MAC 1: Development of an Equine Semen Facility for Teaching, Research and Extension

Principle Investigator(s): Robert C. Causey

Background:

Artificial insemination and shipment of cooled or frozen semen are used heavily by the equine industry. Artificial insemination is safer than natural service, allows valuable stallions to breed increased numbers of mares, and lessens the likelihood of disease transmission between horses. Many breed associations permit the use of artificial insemination with either cooled semen transported across the country, or frozen semen. However, currently in Maine there is no center that teaches members of the equine industry how to perform semen collection, shipment, or artificial insemination. In addition, nowhere else in Maine is research being performed to improve methods of assisted reproduction in horses.

We seek to correct this imbalance by developing a facility for teaching and research on equine semen collection and handling at the University of Maine Witter Center. UMaine has the faculty knowledge (Jim Weber and Robert Causey) to put such a program into action. All that is lacking is additional equipment, modifications to existing facilities, and maintenance of horses dedicated to semen collection. Members of the Maine equine industry support this project.

Research Description:

Research projects involving horse semen are being planned at UMaine. These include improving methods of equine in vitro fertilization, analysis of semen extender components for their effect on motility, and adaptation of cell viability assays to assess semen quality. These research projects would be made possible using the proposed equine semen facility.

Extension activities include demonstrating to members of the horse community the current methods of semen collection, freezing, shipment and handling. To provide quality instruction it is necessary to have adequate facilities to ensure safety of participants, and to demonstrate correct technique. The proposed equine semen facility would allow us to safely and effectively teach equine semen collection and handling to students and the community.

Projected Outcomes:

Research findings from the facility will be made available in the scientific literature and at scientific meetings. The facility will be available to members of the Maine equine community for lectures and "hands-on" demonstrations, as part of our Certificate of Equine Studies.

Objectives Made:

1. Construction of a phantom. This objective was met in the summer of 2000. Most of the 00 awarded was spent on purchase and placing of a phantom. The phantom is a large padded cylinder, which a stallion can mount for the purpose of semen collection.
2. Equipment for a semen laboratory. Breeding supplies for the lab were purchased. This included equitainers, which can be used for shipment of cooled equine semen. A semen laboratory has been established using other sources of funds.
3. Maintenance of horses necessary for semen collection. No money was awarded directly for this objective. However, a generous increase in base funding to the Witter Center allowed us to meet this objective and support our research horses.

Methods Used to Evaluate Outcomes:

Outcomes have been evaluated by assessing our ability in the following areas. Since the phantom was constructed it has been used successfully for everything on this list.

1. Ability to use phantom and collect semen successfully
2. Ability to offer semen collection, evaluation, and artifical insemination to Maine horse owners
3. Ability to use phantom as a research tool
4. Ability to use phantom as an undergraduate teaching tool

5. Ability to use phantom as a graduate student teaching tool
6. Ability to offer breedings to our stallion Night Country for the Maine Sire Stakes program.

Integration of Research and Extension Activities:

Research projects were dovetailed with semen collection from client mares. Interested parties from the horse industry have visited when we were collecting semen and have been given instruction in semen collection and handling. We have participated in the Standardbred breeding industry by using Night Country as a breeding stallion in the Maine Sire Stakes program.

Outputs:

- Four undergraduate research projects (Brian MacAlistair, Leslie Hart, Joanne Curtis and Michael Miner)
- One graduate Master's project (Pam Small -Use of an MTT assay in equine semen evaluation)
- Income of 50 in breeding fees

MAC 2: An Economic Assessment of the Returns to Irrigation Investment for Lowbush Blueberries

Principle Investigator(s): Timothy J. Dalton, John Halloran, David Yarborough

Background:

Wild blueberry production is largely dependent upon water availability to protect against frost damage in the spring and to supplement natural rainfall during fruit set. While many large grower-processors have invested in irrigation infrastructure, less than one-sixth of the total blueberry growing areas are irrigated and few independent growers have invested in irrigation (Yarborough, 1999). Several factors may explain why producers have not invested in supplemental irrigation. These include limited understanding of the yield effect of irrigation, water delivery engineering, the permitting process, agronomics and the costs and benefits to irrigation.

Recent dry conditions in Maine have accelerated producer interest in blueberry irrigation. In addition, after viewing the impact of drought induced crop failure during the 1999 cropping season, Maine's governor convened a task force to draft a strategy for crop irrigation focusing on several crops including blueberries. However, there is little analysis regarding the financial costs and benefits of irrigation investment on blueberries. Leiby and Marra conducted a review of secondary information, but did not conduct partial budgeting or investment analysis. As they state, there are three potential benefits to crop irrigation: (1) the value of potential yield saved from frost damage; (2) the value of the yield gain from reducing water stress during fruit bearing and non-bearing years; (3) reducing interannual yield variability. Agronomic field trials will be established in 2000 and continued for several years in order to estimate actual crop water use and the impact of supplemental irrigation on crop yields.

Balancing against the potential yield gains from irrigation are the costs. There are several cost components of irrigation including initial investment costs and recurrent annual maintenance charges. Initial investment costs include not only the equipment purchase and site development but federal and state permitting and these need to be amortized over time. Owing to recent federal regulation, many farmers find the permitting process, and the potential costs associated with mitigating wetland impacts, the most uncertain cost element in the decision process. Recurrent costs take the form of annual maintenance of irrigation infrastructure, management of irrigation systems, system operational and ownership costs.

Research Description:

The objectives of this project are to assess the costs and benefits of irrigation investment in blueberry production. Attention will focus on developing decision tools to assist growers in calculating the costs and benefits to irrigation. In particular the project will

1. Evaluate the investment, recurrent and ownership cost of irrigation development;
2. Indicate the potential costs associated with the permitting and mitigation processes;
3. Derive the breakeven yield impact required for profitability;
4. Determine the minimum field size for profitable investment;
5. Develop decision tools for farmers to calculate individual farm profitability.

Actual yield impacts attributed to irrigation will be incorporated as the Seymour study evolves. This information will also be combined with other sources on yield effects, for example observed field level yields in years when moisture was not a limiting factor. The primary goal, however, is to develop a decision tool that growers can use to make their own decision on whether or not to invest in irrigation.

A second important result of the project will be to derive preliminary estimates of how irrigation will affect interannual yield variability and the riskiness of the production process. Irrigation has the potential to smooth production variability by reducing downside yield risk due to frost and seasonal water deficits. The overall impact upon the producer decision-making process is not only dependent upon yield variability but also on price variability. At an aggregate level, widespread adoption of irrigation will contribute to stabilizing annual output thereby providing

processors with a more steady stream of locally produced berries. A more steady and assured annual supply may increase the demand for Maine blueberries used in processing.

Projected Outcomes:

Outputs of this research project include:

1. MAFES research publication;
2. UMCE Wild Blueberry Fact Sheet;
3. UMCE decision tool, downloadable from the UMCE WWW site;
4. Refereed journal publication.

The research results will be presented at the 2001 Spring Wild Blueberry meetings. The researchers will also present the results at the annual Wild Blueberry Research and Extension Workers and the Wild Blueberry Association of North America meeting. A refereed journal publication will be developed from the study.

Objectives Made:

The original project objectives that were completed are listed below with a summary of their findings:

- Objective 1: Evaluate the investment, recurrent and ownership cost of irrigation development. Total system investment cost were calculated for three field sizes (25 acres, 50 acres, and 100 acres) for two types of irrigation systems (solid set and gun systems) by summing investment costs for each component of the irrigation system (pumping system, mainline delivery, lateral lines and water delivery system). Since well and impoundment costs are highly variable, the analysis indicated a range for this cost and has left it as a variable for end-users to input into the spreadsheet model. The investment costs were annualizing using the capital recovery method and presented on a per-acre and field level. Recurrent costs attributable to irrigation were also estimated. Set-up and take-down labor coefficients were derived from secondary data and other cost directly (e.g. fuel, interest) estimated based upon technical coefficients. Recurrent cost was combined with investment cost to provide an estimate of total annual ownership costs. Calculation methods and data are provided in the publication appendices for user review.
- Objective 3: Derive the breakeven yield impact required for profitability. Using the estimated ownership cost found in objective (1), the breakeven yield impact was derived on a per-acre basis under per pound price assumptions ranging from .30/lb to .65/lb. Since yield response functions for wild blueberries to water are not available, the breakeven incremental yield increase was derived under various equipment, labor and price scenarios. These are presented in graphical and tabular format.
- Objective 4: Determine the minimum field size for profitable investment. Rather than deriving the minimum field size for profitable investment, the project estimated costs and returns for three-field size and presented these results together in order to present the impact of field sizes on costs, net returns and payoff. Since irrigation investment is lumpy and very size specific, it was difficult to calculate a minimum field size. Alternatively, I used field data collected in 2000 Wild Blueberry Commission sponsored survey to select three field sizes representative of Maine conditions.
- Objective 5: Develop decision tools for farmers to calculate individual farm profitability. These calculations were conducted in an MS Excel spreadsheet. This spreadsheet will be made available to producers so that they may modify some of the assumptions of the base models and investigate their impact upon costs, net returns and payoffs. For example, well and impoundment costs are highly variable and are important to investment and ownership costs.

Additional results that developed but not included in original proposal:

- The spreadsheet models were modified so that cost-sharing assumptions could be included into the estimates. This element evolved in response to NRCS and Atlantic Salmon Commission programs.
- Net present value tools were applied to the data to derive the minimum number of years required to pay-off the investment at several price and yield assumptions. For example, for a small 25-acre field, assuming that irrigation would increase yield by 1000 lbs, it would take between 4 to 9 years to payoff the investment (ranging prices from .55/lb to .35/lb).

- Long-term daily precipitation data from the National Climate Data Center was summarized for Jonesboro, Ellsworth and Belfast in order to derive the probability of receiving 1, 3/4 and 1/2 inch of rainfall per week during the growing season. Data from 1959-1998 were used for Jonesboro and Ellsworth and 1959-1994 for Ellsworth. In addition, cumulative rainfall amounts for the same period were derived. This component of the project found that there are distinct intra-seasonal patterns of decreased rainfall beginning in mid-July and continuing through August. Across the blueberry growing region, this translates to high probability of not receiving one inch of rainfall during the critical fruiting stage, roughly a 50-50 chance of receiving 3/4 of an inch during this stage, and a high chance of receiving at least 1/2 of an inch of rainfall.

Objectives Not Made:

The original project objectives that were not met include the following:

- Objective 2: Indicate the potential costs associated with the permitting and mitigation processes. This objective was not pursued because the Central Aroostook Soil and Water Conservation District was preparing a similar publication.

Methods Used to Evaluate Outcomes:

The publications and decision tool have not been finalized and made available to the public so it is not possible to evaluate project outcomes. Counters will be used to track the number of times the decision tool is downloaded, and the number of times the publication requested.

Integration of Research and Extension Activities:

A presentation was given to growers at the WBC sponsored irrigation tour on 7/12/00. Discussion was held with growers at that time on their needs and interests in this research. I expect to present the research results and tools at the 2002 blueberry extension meetings.

Outputs:

This research is being finalized during September 2000. Information from irrigation input suppliers, namely price and cost information, has been slow and greater input is required to develop confidence that the costs are "representative." Once I have developed confidence in the accuracy of the cost estimate the following publications will be finalized. Proposed outputs of this research project include:

- Output 1 MAFES research publication. A draft publication of the investment report is being finalized. It is expected that this publication will be finalized by the end of 2001. Once published, a copy will be directed to MAC for inclusion in this file.
- Output 2 UMCE Wild Blueberry Fact Sheet. This fact sheet will be developed after the MAFES publication is finalized. It is expected that this publication will be finalized by the end of 2001. Once published, a copy will be directed to MAC for inclusion in this file.
- Output 3 UMCE decision tool, downloadable from the UMCE WWW site. The spreadsheet models will be the basis of this decision tool but it is not clear, at this point, whether this is the best format for the tool or whether a run-time program would be better. This tool should be in place in early 2002.
- Output 4 Refereed journal publication. This publication is not yet prepared but it is expected that an article will be submitted to the Journal of Production Agriculture or another appropriate source in late 2001.

MAC 3: Evaluation and Design of a Packaging System for Chocolate-covered Maine Wild Blueberries

Principle Investigator(s): Darrell W. Donahue, Alfred A. Bushway

Collaborator: Thomas Wilbur, Wilbur's of Maine, Maine Specialty and Gourmet Foods Association.

Background:

This project will be able to keep and enhance value-added processing in Maine. It will provide an opportunity to bring new packaging technologies to this industry sector in Maine and will assist the university and industry in better understanding their packaging needs. It will provide a mechanism for the expansion of a current business opportunity for a specialty food processor.

Research Description:

In 1999, the PI assisted Tom Wilbur with some processing issues at his confections plant. During these discussions a new product was discussed, chocolate covered Maine wild blueberries. At that time, Mr. Wilbur was contracting to have the product made out of state, shipped back, and then repackaging it for sale locally. The PI assisted Mr. Wilbur with contacts within Maine and these contacts resulted in the product being completely made and packaged in Maine. The product demand has created a need for a low-cost method to automatically fill bags with chocolate covered blueberries. The project we are proposing is to assist with the evaluation and selection of appropriate packaging materials and to assist in the design specifications for a low-cost automatic packaging system. The deliverables from the project will be recommendations on packaging materials types and a design (computer generated drawing) that can be used to obtain bids for fabrication of the packaging system. The recommendations will present a set of alternatives and the selection of the best alternative based on project team evaluation.

Currently, Wilbur's Chocolate Confections manually bags all the chocolate-covered Maine wild blueberries. There are several sizes of packages used, however, the primary package type is an 8-ounce cellophane package. We will investigate different types of packaging materials that achieve the same results (visible product and product aroma) as the current material (cellophane), but also have properties which are adaptable to automatic filling equipment. Other concerns for packaging materials are shelf-life stability, future packaging needs and/or changes, and enhanced marketing opportunities. The project team will work together with Mr. Wilbur to identify his future needs relative to packaging and consider those in our recommendations.

There are several different machines and capabilities for automatically packaging of products similar to chocolate-covered Maine wild blueberries. Once the packaging material and type is selected, the project team will begin by evaluating several different concepts to accomplish the automatically weighing, filling, sealing, and labeling of packages of chocolate-covered Maine wild blueberries. The project team has industry contacts with Mars, Inc. (makers of M&Msâ) and Hersey's, Inc. (makers of Hersey's KissesÔ) and will make use of those when evaluating low-volume machinery and methods for packaging candies. It is expected that the resulting design will be selected on the basis of efficiency and also allowance for growth in product demand and expansion to new product lines (other chocolate covered fruits). However, all alternatives will be delivered to Mr. Wilbur with a selected recommendation from the project team. The project provides an educational and real world design opportunity for the students involved as well as capitalizing on the expertise of the UM faculty to solve the problem. The PIs feel that there are two strong elements of the project; assisting a specialty food processor and the educational component for the students. As mentioned previously, the deliverables for the project are: 1) recommendations on packaging materials types and 2) a design (computer generated drawing) that can be used to obtain bids for fabrication of the packaging system.

Projected Outcomes:

The project deliverables will be shared with Mr. Tom Wilbur and the UMaine-MAC in written format.

Objectives Not Made:

Due to a lack of funding this project never occurred.

MAC 4: Evaluating Pollen Transport from Genetically Engineered Corn

Principle Investigator(s): John Jemison, Michael Vayda

Background:

Genetic engineering provides great opportunities including the possibility of 1) reducing the amount of pesticides used in crop production; 2) improving the nutritional value of food; and 3) providing producers with greater flexibility with production methods. At the same time, some growers, producers and consumers do not want to use genetically modified crops. For example, Organic growers will lose certification if their crops are cross-pollinated by GMO crops. More research and extension activities are needed to understand the risks and benefits of this technology. The proposed work will examine whether potential benefits of GMOs are realized, evaluate the risk of cross-pollination, and assess a method to mitigate pollen spread to ensure organic certification standards.

Herbicide tolerant crops (HTCs) 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 genetically engineered (GE) proteins are permitted in organic food or feed materials. If corn pollen transfers from GE corn to standard forage or sweet corn, an organic producer could lose his or her certification. We need to learn more about corn pollen transport. When working with risk management issues such as this, we need information to reliably assess the potential risk. Growers need information on potential management measures to reduce this risk. Finally, since these crops 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. While industry support could be available to help fund this work, last year I was publicly criticized in the Bangor Daily News for accepting a bag of seed corn. Maine Ag Center support is critical to lend credibility to the impartiality of this work. This work meets the needs of both the organic and traditional production community by providing information on pollen transport and evaluating possible means to mitigate pollen spread to ensure organic certification standards. We will also provide growers with recommendations on how to use the new crops in the safest and most effective means possible.

Research Description:

During the summer of 2000, we intend to initiate two experiments to evaluate pollen transport in the field. One study will repeat the work conducted in 1999. That work evaluated pollen transport with no management measures taken to reduce the risk. A one acre block of corn was planted to Roundup-ready (RR) corn in middle May. Standard forage corn varieties of similar maturity were planted 100 feet away directly down wind of the plot, and another plot of corn was planted 1000 feet away against the prevailing wind direction. Corn was harvested from those experiments, dried, and replanted in the greenhouse. At the V2 stage of development, the corn was sprayed with glyphosate. Plants that survived were genetically resistant to glyphosate and thus cross pollinated in the field. We intend to repeat this experiment in 2000. We will follow a similar experimental protocol. We intend to plant the other plot closer than 1000 feet away, likely within 500 feet but still not in the direction of the prevailing winds.

Last year, we collected no weather data at the farm. This put all of us at the farm at a distinct disadvantage, particularly since the Old Town airport no longer collects weather. Getting wind speed, direction and rainfall data through the summer is critical. In this proposal we will request funds from the Maine Agricultural Center to ensure that the weather station is made operational again.

In the other experiment, we intend to evaluate potential management measures to reduce the potential for pollen transport. We intend to grow RR corn in a separate part of the Roger's farm. We will plant this field two weeks after the other corn to avoid unintended cross-pollination from the other study. We will assess the effectiveness of border rows around the corn by planting a very long season corn variety around the outside of the plot. We will plant a standard corn variety at the other end of the field and follow the same protocol as in the previous trial.

Within each of these corn experiments, we will evaluate glyphosate rates and timing of application compared to standard pre and postemergence control options. In the first experiment, there is heavy annual grass and broadleaf weed pressure. We will be using manure as well which will further increase the potential weed seed bank. In the second experiment, the field has heavy nutsedge and quackgrass weed pressure. Growers have expressed interest in

knowing how well glyphosate can effectively control these perennial weeds. We will again evaluate rates and timing of glyphosate compared to conventional control measures within the framework of the corn pollen transport experiment.

Projected Outcomes:

Information generated will be shared with growers at a number of proposed venues. Every year, I present information at the Maine Agricultural Trades Show. I would like to use this venue to present the findings of the work. I plan to hold the Roger's Farm Field Day in June or July 2000. We will discuss the findings of this work at that meeting. I am also on the Master Gardener Field Day at Rogers' farm in August discussing GE crops.

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 two-year project will be submitted for publication to the Agronomy Journal, likely as a note. Lastly, I would like to present this information at two professional meetings. One will be the Northeast Weed Science Society meeting in Boston, (January 2001) and for the other, I have been invited to present at the American Society of Agronomy meeting in Minneapolis in October, 2000.

Background:

During the summer of 2000, we accomplished most of the goals set out in our proposal, and in the process we initiated other areas of work that spun off from the original work. We participated in a 7-state study to look at weed control in forage corn using Roundup Ready crops. We evaluated timing of application and the need for pre-emergence herbicides as compared to standard herbicide approaches. This data was collected and sent to Dr. Bill Curran who summarized the work and presented the data at the Northeast Weed Science Society meeting in Boston. This work was repeated in the summer of 2001.

We also conducted our pollen transport study that we proposed. That work was a repeat of what we evaluated in 1999. We planted three plots of corn on May 17, 2000. One plot was the weed control study mentioned above. The other two plots were located at a distance of 30-m east and 100 m south of the weed control study. We monitored growth and development of each of these plots of corn. One plot (100-m south) developed more slowly than the others due to differences in soil temperature and moisture. So, once the plants started the reproduction process, there was a delay in silking in the plants 100-m south. We expected little or no cross-pollination.

When we conducted the greenhouse study, we found much higher cross-pollination than we expected. Unfortunately, we found that the original seed source was contaminated with RR seed directly from the bag. This has information has been summarized in an article for Ag Bio Forum, a peer reviewed internet journal. It will be included in this report. As a result of this contamination, we screened an additional 12 hybrids in the greenhouse and found that 5 had low-level contamination. This work was continued in the field this summer.

The only work that was not completed was our effort to assess the impact of border rows to protect pollen from moving out of a field. This corn which had to be planted at a later date so as to avoid pollinating at the same time never reached maturity due to the cold growing season. As a result, we have no information on this to report.

We accomplished all the goals that were mentioned for educational outreach. The information on the weed control measures study was presented at the Maine agricultural trades show and at the Northeast Weed Science Society meeting.

MAC 5: The Integration of Maine's Potato and Dairy Industries: Profiles of Systems in Operation

Principle Investigator(s): Stewart N. Smith

Background:

Based on actual operating farms with various characteristics, this project develops a protocol Maine farmers can use to integrate cropping and livestock enterprises. Characteristics of operating Maine farms that have integrated cropping and livestock enterprises will be determined. Barriers to, and opportunities for, integration will be identified. Costs and returns from integrated systems will be estimated. The end product provides farmers a model to follow when integrating cropping and livestock enterprises.

The integration of farming operations has become a focus point of a number of agricultural groups within the State of Maine. The Agricultural Council of Maine (AGCOM) in their well-publicized Strategic Plan acknowledges the need to "integrate cropping systems, join livestock and cropping operations increase the use of locally produced inputs" and develop "economically sustainable and environmentally sound production systems." The University of Maine's Chancellor's Task Force has called for "more attention to integrated systems". And the Maine Potato Board, in its response to the University of Maine Board of Agriculture's survey, indicated a need for the "development of profitable rotation crops" and "improved soil quality and management practices to reduce plant stress and increase yields – results which can be achieved through system integration. The Maine Sustainable Agriculture Society (MESAS), with a mission to "explore, develop, and promote agricultural systems", has endorsed this proposal. In addition, all eight farmers listed below support the project and have agreed to participate.

Recent research at the University of Maine supports the advantages of these practices and systems. For example, Gallandt et al. (1998) and Porter et al. (1999) indicate that amended plots of potatoes, similar to that achieved with an integrated system, improve soil quality leading to late-season crop vigor, increased yields, and more stable yields in dry years. Files (1999) demonstrates that spatially integrated dairy/potato production systems perform better than spatially segregated dairy/potato production systems with respect to returns to the farmer as well as to the farming sector.

While the above research is significant and insightful, it is based on small research plots and simulated systems and does not reflect constraints inherent in actual operations or potential impacts of scale economies. Little is publicly known about the economics of existing integrated dairy/potato operations. In addition, the risk and uncertainty faced by farmers interested in integrating their operations are substantial deterrents to the adoption of integrated systems. This proposed research would provide farmers with protocols and information to guide their evaluation and subsequent adoption of integrated systems.

Research Description:

Research: The primary activity in this project is to produce profiles of selected integrated systems, including farm budgets using actual farm-level data. This work would be accomplished by the P.I. and Assistant Scientist (Andrew Files) and requires collecting data from six cooperating farmers (three dairy/potato systems) during on-farm and telephone visits. The six cooperating farmers, all of whom have agreed to participate, are

- Bob Fogler, Dairy, and John Dorman, Potato
- Mary Thomas, Dairy, and Frank Thomas, Potato
- Perry Lilley, Dairy, and Jim Hogan, Potato

The researcher would also be responsible for preparing a Maine Agricultural and Forest Experiment Station (MAFES) publication as well as for developing a one-page, two-sided profile of each integrated dairy/potato system studied.

Extension: Extension personnel (Tim Griffin and Matt Williams) are involved in three tasks. The first is participating in on-farm visits and related information collection. The second is assisting in the preparation of the written profiles of each system. And the third is disseminating the results of the research to farmers, policy makers and interested

members of the public. This will be accomplished by speaking to interested groups, by presenting at Extension-sponsored programs, and by distributing the profile of each integrated system to interested individuals or groups.

Projected Outcomes:

The information dissemination strategy contains three components.

- First, a MAFES publication will profile and compare the four systems, and provide a protocol for the general integration of potato and dairy enterprises.
- Second, the Extension Specialist/Extension Educator will share the outcome of the project by speaking to interested audiences and by presenting at Extension-sponsored programs.
- Third, a one-sheet, two-sided profile of each integrated dairy/potato system will be distributed to interested individuals and groups. This would be the responsibility of both the researcher and the Extension personnel.

Both the MAFES publication and the profile sheets will be available to MAFES and the Maine Agricultural Center for normal distribution.

Objectives Made:

- Protocol: Based on the interviews from this project, a protocol for Maine farmers was developed enabling them to evaluate crop/livestock integration as it applies to their operation. There are three aspects to this protocol: 1) It requires cropland and livestock production to be within close proximity to one another; 2) It requires a minimum level of trust between partners; and 3) It provides farmers the opportunity to increase integration activities as trust increases.
- Characteristics: Based on the interviews from this project, three characteristics of integrated crop/livestock systems were identified. First, each partner has a specific knowledge and resource base. Farmers are not integrating similar operations in order to achieve economies of scale, but rather are integrating dissimilar operations in order to achieve economies of scope. Second, perceived benefits of the integration are significant with the primary benefits being decreased input costs (i.e., plant nutrients for cropland and animal feed for livestock) and improved soil quality leading to increased crop yields and increased product quality. And third, trust is the key ingredient to making these integrations work. The integration partners in this study were not interested in tracking dollars and cents, but rather trusted their partner and the process, in general.
- Barriers and Opportunities: Based on the interviews from this project, a group of barriers and opportunities to crop/livestock integration were identified. First, partners in close proximity to one another and with different resource bases are required. The maximum distance apart in this study is fifteen miles. In addition, the partners must have complementary resource bases in order to satisfy the crop/livestock integration. Second, the partners must have trust in each other and in the process. Trust is considered a key condition of success. Third, location of interested partners will determine the type and likelihood of integration. With current livestock concentrations in central Maine and current crop concentrations in Aroostook County, crop/livestock integration will be limited unless farmers are willing to relocate in order to be in closer proximity to an integration partner. And lastly, there may be opportunities for a new type of farm ? one where the farm is integrated within itself, but where enterprise management is split among different individuals.
- Profiles of selected integrated systems The interviews of the farmers in this study led to the writing of a one-page, two-sided profile of each crop/livestock integration pair. The significant findings from these interviews consist of an increase in soil quality from integration leading to increased crop quality and crop yield and the fact that there were no written contracts involved with these integrations. All partnerships functioned on a handshake. In addition, in some cases the integration also consisted of sharing equipment and labor in addition to the land.
- A University publication As proposed, this project will publish and distribute (report is currently in print) a report outlining the key findings of this project. The report will be distributed to all UMCE offices as well as mailed to selected potato and dairy farmers. In addition, extra copies will be sent to Extension Educator Matt Williams for his distribution.
- One-page, two-sided profile of each integrated system As proposed, this project will publish and distribute (profiles are currently in print) one-page, two-sided profiles of each integrated system. Although important to

the project, it was realized that such profiles, as stand-alone publications, would be lacking in relevance to readers. As a result, the profiles are incorporated into the above University publication.

Objectives Not Made:

- Costs and returns (farm budgets) estimated for integrated systems Farm budgets relating to the integration of crop/livestock operations were not performed since the participating farmers did not track the values of exchanged goods and services and indicated little interest in doing so. Additionally, since the participating operations appear to be somewhat unique, the value of budgets based on these opera

Methods Used to Evaluate Outcomes:

Personal interviews with the participating farmers were conducted to obtain the information included in the summary report and producer profiles. The analysis used a qualitative review of interview transcripts. The focus of the qualitative review was on the commonalities of the different integration partnerships.

Integration of Research and Extension Activities:

Integration of activities occurred through phone and mail contacts and copies of the University publication will be distributed to Extension Educator Matt Williams, as well as to each county Extension office. It is anticipated that Williams will include the information gained from this project in future presentations. It should be noted that some integration of research and extension activities was reduced due to Tim Griffin?s leaving Extension during the project. Griffin had a defined role in the original proposal.

Outputs:

Files, Andrew C. and Stewart N. Smith, 2001. ?Agricultural Integration: Systems in Action?. University of Maine, Orono, Maine.

MAC 6: Evaluation and Demonstration for Establishing Blueberry Stands on Former Potato Fields in the St. John Valley

Principle Investigator(s): David E. Yarborough

Background:

To demonstrate currently available methods to establish lowbush blueberry stands on suitable sites in former potato fields and to encourage indigenous blueberries by weed management, mulching and pruning. *Impact of Research/Benefit to Industry* A large number of acres has been taken out of potato production in Aroostook County. In some of these fields in conservation easements wild blueberry have become established. This study will demonstrate if these fields can be successfully converted into lowbush blueberry fields. Data obtained from this site will allow growers to determine if it is economically feasible to establish lowbush blueberry sites in Aroostook County.

Research Description:

A field in Hamlin owned by Rene LeVasseur has blueberry plants that are coming in naturally will provide a good demonstration site. Soil analysis of the Hamlin site had a pH of 4.7 and a sandy loam texture, both of which are suitable for blueberry growth. A 40' x 40' area in the field will be mowed, a preemergence herbicide applied and bark mulch spread at a depth of 4". Blueberry plants put in over a 20' x 40' area . Blueberry plant spread from 20 subplots in the each area will be measured over time. Plots will be staked out with permanent PVC corner markers and cover ratings will be taken each year in August to evaluate spread. Yield samples will be taken in August to evaluate the change in productivity on the site over time. This site will be compared to the progress and productivity of similar sites established at the Blueberry Hill Farm Experimental Station in Jonesboro and Guptill Farms in Wesley. A field day will be held in August each year in Hamlin and growers from the area will be invited to view the plots and discuss the progress. An Experiment Station bulletin will be published detailing the results of the project once it is completed.

Projected Outcomes:

This area will provide information on the feasibility of establishing fields in the St. John Valley. Determination of plant survival, yield and return over cost will identify if this is an economically feasible approach.

Project Continuity

Project will continued to be evaluated over a six years or until plants fill in bare areas. Plots will then be maintained for demonstration.

Methods Used to Evaluate Outcomes:

Methods

Tissue culture wild blueberry plants were planted at a 1 foot spacing and mulched with 3" bark.. In Aroostook County, one 40' x 40' plot was planted in an old potato field in Caribou and 2 lb/a Velpar and 1000 lb/a sulfur was added because the pH was 5.5. Another Aroostook site was established in Hamlin, in a field owned by Rene LeVasseur that had wild blueberry plants coming in naturally and so provided a good demonstration site. Soil analysis of the Hamlin site showed a pH of 4.7 and a sandy loam texture, both of which are suitable for blueberry growth. A 40'x120' area in the field was mowed, Velpar applied at 2 lb/a and bark mulch spread at a depth of 3" in a 80'x40' area. Blueberry plants were put in at 1' spacing over a 40'x40' area. This site will serve as a demonstration on the feasibility of growing blueberry plants in Aroostook. For comparison purposes, plants were inter-planted in bare spots among the established clones at Blueberry Hill Farm, and at Guptils wild blueberry farm in Wesley, a 30'x30' plot with plants at a 1'x1' spacing was established by the freezer. Wild blueberry plant survival and spread from 10, 1 foot square subplots in each area was measured using cover scale ratings taken in the summer of 2000 and 2001. The rating represents the mean cover plants spread in a one-foot square plot.

RESULTS and DISCUSSION:

All rated plants survived at the Wesley and Hamlin sites. There was 20% mortality on the Jonesboro site and 100% mortality on the Caribou site. The plants that died on the Jonesboro site were on slight knolls, the dry conditions at that site resulted in those plants drying out. Alternative plants were chosen for the cover ratings in 2001. At the

Caribou site the pH of the area was quite high (5.4 to 5.7) at establishment and the sulfur was not able to reduce the pH fast enough to suppress the dense weed cover which shaded out the blueberry plants and resulted in their mortality. The pH will have to be reduced prior to planting at a high pH site in order to be successful.

The initial rating on all plants was 2.5%, representing the small size of the plants when put in the ground in the spring of 2000. In 2001 that had increased to 12.5% in Hamlin, 19.7% in Jonesboro and 33.2% in Wesley. The lack of spread in Hamlin may be attributed to the weed pressure observed at the site. The heavier soil and lack of weed management resulted in heavy weed pressure. It appears that a herbicide would have to be used each year on this site. The Wesley site had less weed pressure and the heavier soil provided more moisture than the Jonesboro site, which had the least weed pressure but was limited by the dry conditions in 2001 because the sandy soil was not able to retain water well.

Integration of Research and Extension Activities:

A field day held in Hamlin on August 28, 2000, was attended by 19 interested growers. Two newspaper articles were printed at planting and one article at the demonstration. The Jonesboro site was used to demonstrate inter-planting to 18 wild blueberry growers at an Integrated Crop Management field day on June 30, 2001. This information will be reported to the wild blueberry advisory committee. I will continue with the project, maintaining weed control over the next four years, and continue evaluation of cover. I will use these sites to demonstrate feasibility of inter-planting tissue culture wild blueberry plants.

MAC 7: Determining Nutrient Loss or Gain in a Farm Windrow Composting System

Principle Investigator(s): Neal D. Hallee, Bill Seekins, Christa Schwintzer, John Tjepkema

Background:

As farmers struggle with the implementation of nutrient management regulations and the drafting of nutrient management plans for their operations, decisions must be made regarding the handling and use of animal manures. Composting of animal manures will stabilize the nutrients so the product may be stored and utilized with fewer concerns about nutrient loss to the environment. Farmers need to know the resulting nutrient levels they can expect after the composting of the animal manures is completed.

This project has the support of the Maine Department of Agriculture, Food & Rural Resources. It also has the support of the Maine Equine Industry Association Board of Directors as stated in their list of research and extension needs outlined in a letter to the Maine Board of Agriculture dated July 12, 1999.

Research Description:

This study was originally undertaken to determine the amount of nutrient loss that occurs from a windrow compost system under farm conditions and to compare the loss from a mixture that has a relatively high nitrogen content with one having a low level of nitrogen. Some loss of nutrients, especially nitrogen, can occur during the composting process itself due to leaching or volatilization. In theory, the higher the nitrogen content of the original mixture, the greater the potential for loss. This is the second year of a study begun in the Spring of 1999. The first year study measured the changes in nutrients in two different compost recipes that were managed with a windrow compost system. The data collected in the first year showed small losses of nitrogen and potassium from one recipe (bedded cow manure and silage) and small losses of potassium from the other recipe (horse bedding). A surprising finding was that the total amount of nitrogen actually increased in the low nitrogen recipe (horse bedding). Further research into the literature suggested that this increase may be the result of nitrogen fixation. Thus, the current study is being undertaken with three purposes. One purpose of the current study is to confirm the results of the original study. A second is to determine if the increase in nitrogen levels in the horse bedding compost was a result of nitrogen fixation during the composting process. The third purpose is to determine if a nitrogen fixation benefit is present when the horse bedding is mixed with another low nitrogen material, such as leaves.

This study will be a joint project with the Witter Teaching & Research Center, Cooperative Extension Compost School and the Biological Sciences Department. Four compost windrows measuring approximately 12 ft wide by 4 ft high by 40 ft long will be built and managed by the Witter Center staff at the center's compost facility. Each windrow will have a different recipe for ingredients. These windrows will be managed and monitored in the same manner as the other compost windrows by the Witter Center staff. The sampling of raw materials and compost for nutrient analysis will be done with student labor. The nutrient analysis will be done at the University Plant and Soils Lab. The nitrogen fixation testing will also utilize student labor and be managed by the Department of Biological Sciences.

The nutrient concentrations, C:N ratios, ash content, volatile solids, pH, conductivity, pile volumes, bulk density and moisture content will be measured at the beginning of the project, at the end and once a week for ten weeks during the active composting phase. Two samples will be collected from each windrow at each point in time for lab analysis. Thus, eight samples will be collected weekly. A total of 88 compost samples plus 4 or 5 samples of possible ingredients will be tested in the course of this study. In addition to the above tests, the horse bedding recipe will be tested with the acetylene reduction assay to determine if nitrogen fixation is occurring. Two methods will be used to test materials in the windrow: 1) in situ incubation of materials and 2) samples removed from the pile and incubated in the laboratory. This testing procedure will involve 36 samples collected at different times during the composting process.

Upon completion of the testing period, the data will be gathered together, reviewed and analyzed to determine the final results of this study.

Complete details of the project are available on request from Neal D. Hallee.

Projected Outcomes:

A final report on the results of this study will be produced. From the information contained within this report, a fact sheet or fact sheets will be developed for distribution to the agricultural community. Results from this study will be included in public presentations on nutrient management issues and planning. The results of this study will be included within the course content of the UMCE Compost School, since the school is a cooperator in this project.

Objectives Made:

All of the objectives of the study were met in part, but the study results raised many new questions so that it is safe to say that none of the objectives were fully met.

- Objective 1. The nutrient levels and changes measured in the 2000 study were very similar to those measured in 1999 in several instances (Potassium and Phosphorus in cow manure compost and Potassium in horse bedding compost) but differed in others (Nitrogen in cow manure compost and Nitrogen and Phosphorus in horse bedding compost). Due to differences in moisture content, weather conditions during the projects and site conditions, the results of the 1999 trials were not all exactly reproduced.
- Objective 2. Some of the factors that contribute to nutrient changes were identified. As hypothesized, the materials with the higher C:N ratio had lower nitrogen losses (or higher gains) than the cow manure which had a lower C:N ratio. It was clear that the original nutrient levels had an impact on the loss of all nutrients during the process. In both trials, the cow manure compost demonstrated greater losses of nutrients than the horse bedding compost. It also appears that moisture content also contributes to nutrient losses or gains. The rate of concentration of nitrogen in the horse bedding pile was greater in 1999 when the moisture content was much higher than in 2000. In addition, the nutrient concentrations seemed to be related to pile size and to the amount of soil picked up in the process of turning the windrows, but these factors need to be studied further to determine the overall impact.
- Objective 3 & 4. It was clear from the results obtained in the trials that nitrogen fixation can occur in compost piles having the percent moisture and Carbon to Nitrogen (C:N) ratio within certain ranges. In particular, the leaf compost pile demonstrated nitrogen fixation activity through the use of the acetylene reduction test. In this pile, the moisture was initially on the high side and the C:N ratio was also high.(>55%) The horse bedding pile, on the other hand, displayed almost no nitrogen fixation. This material also had a high C:N ratio, but was initially dry and became very dry through the composting process. It was not determined, however, if nitrogen fixation would occur in horse bedding under other conditions.

Methods Used to Evaluate Outcomes:

This research has two intended audiences. The first is the agriculture community that is looking for ways to manage the manure and other waste products on the farm in a way that will make use of the nutrients in those materials with the least loss to the environment. The second is the composting community that is trying to compost materials that may not be ideal for efficient composting. This audience needs to know how to improve the nutrient content of its products and in some cases how to maximize the amount of nitrogen available for use within the compost process. Both audiences want to know how much loss of nutrients may be expected during the compost process as a baseline for making improvements. They also will need to know how these nutrient losses may be affected by different conditions.

The method used to evaluate the outcomes of this project is to simply look at the results obtained to see if useful information was obtained about these topics and if it identified further information needed by these audiences. In both cases, the answer was yes. Through comparisons between the original nutrient content (N,Pand K; carbon, moisture, ash) with the content of the materials at weekly intervals and at the end of the active compost phase, the researchers were able to measure the nutrient changes that occurred under two sets of conditions in a farm windrow system. These changes themselves will be useful in making recommendations about agricultural compost systems aimed at maximizing the retention of nutrients in the process.

A second question was whether the results of the study were consistent with expectations or represented something unexpected. For the most part, the changes to nutrient content and other parameters observed were consistent with expectations. The amount of loss of most nutrients from the system was consistent with expectations, with the

exception of nitrogen from the horse bedding pile during the first year of the trial. The unexpected results of a net gain of nitrogen in this material led to the testing for nitrogen fixation in the second year. The fact that the net gain did not occur in the second year under a different set of conditions pointed to the need for a better controlled process when trying to reproduce something as ephemeral as nitrogen fixation.

Integration of Research and Extension Activities:

The research project has been integrated with extension from its initiation. The project has been conducted jointly by the Witter Farm (Research Station) and the Maine Compost School which included two Extension Educators. The research piles were used by the Maine Compost School as a teaching tool during the compost schools conducted during the time when the project was ongoing. In total, approximately 120 students of the Compost School have benefited from directly observing the project while underway and another 60+/- will have learned about the results when they attended schools following the conclusion of the active field work. The results have also been shared by the school faculty in the normal course of their interactions with the public.

MAC 8: Management Alternatives for Powdery Mildew on Pumpkin

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

Background:

Pumpkins are an important crop for Maine vegetable farmers. Retail and wholesale sales of pumpkins in September and October provide substantial income to many small and part-time farmers in the state (estimated between 00 and 00 net profit per acre). A significant portion of the crop is marketed as "pick-your-own", bringing the customers to the farm and into the fields to select and purchase the fruit.

Powdery mildew is a fungus disease that poses a major threat to the success of pumpkin crops in Maine. The disease infects the leaves of the pumpkin vines causing white, powdery lesions, which spread and eventually kill the leaves and vine. Severe infections may kill the plants before the fruit mature. The fungus may also infect the stems of the fruit, causing the fruit to rot shortly after harvest. Much of the value of pumpkins lies in their ability to hold well after leaving the field. The loss of a substantial post-harvest life due to powdery mildew infection can severely reduce the profitability of the crop. While powdery mildew can be managed in pumpkin fields by applications of fungicides such as benomyl or chlorothalonil, growers are often resistant to spraying such materials because of cost, loss of organic certification, or customer concerns about synthetic chemical use. The latter is especially germane for "pick-your-own" markets where customers have a more personal investment in the crop and a higher level of exposure. Both the Maine Vegetable and Small Fruit Growers Association and the Maine Organic Farmers and Gardeners Association have expressed support for research to address this issue.

Several alternative materials for managing powdery mildew on pumpkins and other crops are now being suggested for organic farmers, and for those wanting to use low toxicity/low residual materials. These include applications of copper materials, peroxides, and milk. While preliminary research suggests that these materials may reduce the severity of powdery mildew infections on some crops, there has not been a detailed, replicated trial comparing the efficacy of alternative materials such as these to registered synthetic fungicides and a control. If any of these materials provide economically significant control of powdery mildew, this would provide growers with new, low toxicity, organically acceptable options for managing this important disease.

Research Description:

Plots of pumpkin (cv. "Hybrid Pam") will be established in rows at Highmoor Farm, the Maine Agricultural Experiment Station in Monmouth. Each plot will be 16 feet long and six feet wide, and contain eight plants. Each plot will receive one of the following five treatments for powdery mildew:

- Control (water)
- Benomyl fungicide
- Copper (Kocide 4.5 LF)
- Peroxide (Oxidate)
- Milk (15% solution)

Treatments will be applied as foliar sprays when powdery mildew lesions are observed on 10% of the plants, and repeated on a weekly basis, as needed. Each treatment will be replicated three times within the trial. As the season progresses, each plot will be rated for severity of powdery mildew infection. At harvest, yield, fruit size, fruit number and quality measurements will be taken. After harvest, fruit will be cured then put into storage and rated for post harvest quality over a six week period. 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, 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 newsletter, and a regional trade journal 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 one of two

field days to be held at Highmoor Farm during the 2000 growing season. Results may also be presented to other agricultural research and extension staff at scientific meetings such as the American Society for Horticultural Science.

Methods Used to Evaluate Outcomes:

Plots of pumpkin (cv. 'Hybrid Pam') were established in rows at Highmoor Farm, the Maine Agricultural Experiment Station in Monmouth. Each plot was 16 feet long and six feet wide, and contained eight plants. Each plot received one of the following five treatments for powdery mildew:

1. Control (water)
2. Benomyl fungicide
3. Copper (Champ DP)
4. Peroxide (Oxidate)
5. Potasium Bicarbonate (Armicarb)

Treatments were applied as foliar sprays when powdery mildew lesions were observed on at least 10% of the plants, and repeated twice at 10-day intervals. Each treatment was replicated three times within the trial. Each plot was rated for severity of powdery mildew infection. All fruit were harvested on September 21, 2000. At harvest, yield, fruit size, fruit number and quality measurements were taken. After harvest, a sample of five fruit per plot was cured in an unheated greenhouse and rated for post harvest quality after an eight-week period.

Integration of Research and Extension Activities:

None of the treatments offered significantly improved control of powdery mildew over untreated plots, including a commercially recommended fungicide (benomyl). Subjective plant infection levels were not significantly different between treatments, and all treatments produced very similar yield and quality of fruit (Table 1). This suggests that disease pressure was very high this season and the disease was able to overcome all treatments used against it. However, it is interesting to note that, despite heavy fungal infections of the plants late in the season and mildew lesions on the stems of the fruit, the overall quality of the fruit was good. Furthermore, only one fruit from any treatment showed any significant post-harvest breakdown after eight weeks of storage.

The natural infection of the plants of the plants by powdery mildew in this trial occurred relatively late in the season and, despite the fact that it eventually overcame most of the plants in the trial, it did not appear to seriously effect fruit quality or storage life. Because none of the treatments provided significant control of the disease, it can not be determined if yield in terms of fruit size or fruit numbers might have been improved if the disease could have been kept in check. However, it appears that late infections of the disease may not warrant the expense of chemical treatments in order to prevent fruit quality problems and post-harvest fruit losses.

Table 1. Effects of fungicide treatments on yield and quality of pumpkins infected with powdery mildew, Monmouth, Maine.

Treatment	No. fruit/ plot	Kg. fruit/plot	Average fruit wt. (kg.)	No. culls	% Stem lesions
Control	13.00	26.75	2.065	.6667	83.02
Benlate	12.67	28.13	2.226	1.667	88.89
Copper	14.33	33.38	2.333	.3333	97.92
Peroxide	14.00	30.03	2.152	1.667	92.83
Bicarbonate	14.67	32.02	2.204	.3333	77.64
LSD .05	4.307	7.543	.2382	1.929	22.21

Outputs:

The results of this study have been presented at the Maine Vegetable and Small Fruit Growers Annual Meeting and the New England Vegetable & Berry Growers Winter Meeting. The results were also presented in a statewide Extension vegetable newsletter and the regional Extension horticulture journal the Yankee Grower. Growers and Master Gardeners were able to view the experiment in progress at two field days held at Highmoor Farm during the growing season.

MAC 9: Management Alternatives for Corn Earworm on Sweet Corn

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

Background:

Sweet corn is the most important retail vegetable crop grown in Maine. It accounts for roughly half of the acreage planted to vegetables for retails sales in the state and a significant portion of the wholesale receipts. With approximately 2500 acres of sweet corn grown in the state each year and estimated net returns of between 0 to 00 per acre, this crop is a major component of fresh vegetable production and marketing. Further, sweet corn is an important draw to bring consumers to local vegetable stands and farmer's markets, where they often make other purchases as well. Thus, having sweet corn fresh, high quality sweet corn available adds to the value of other crops.

Corn earworm (*Helocoverpa zea*) is one of the most important insect pests of sweet corn in Maine. Although this insect cannot overwinter in Maine, each year millions of moths fly into the state from southern overwintering sites in early to mid summer and lay eggs on the silks of developing corn ears. When the eggs hatch, the larvae crawl into the silk channel on feed on the ear. The damage ruins the market value of the corn and, left unchecked, could destroy the entire crop in a field. Corn earworm can be managed through judicious applications of insecticides, including organo-phosphates, carbamates, and synthetic pyrethroids. However, complete coverage of the silks during moth flights must be maintained in order to prevent earworm infestations. This can result in relatively heavy insecticide use on this crop, which reduces its net profitability, and increases the environmental and personal risks associated with its production.

An integrated pest management (IPM) program for sweet corn, developed and managed by the University of Maine, has enabled many farmers to significantly reduce the number of insecticide applications needed to prevent earworm damage. The program utilizes accurate monitoring techniques to assure that sprays are only applied when pest populations in an individual field exceed an economic threshold. However, because insecticides are presently the only practical earworm control method available, growers who wish to produce the crop organically, or reduce the amount of high toxicity pesticides used, face the potential of high yield losses and customer dissatisfaction. Low risk, organically-certifiable alternatives to present insecticides that provide acceptable levels of earworm control would be a valuable component of sweet corn production for many Maine farmers. This project will evaluate several promising insecticide alternatives for control of corn earworm. Both the Maine Vegetable and Small Fruit Growers Association and the Maine Organic Farmers and Gardeners Association have expressed support for such research.

Several alternative materials for managing corn earworm are now being investigated in other regions for organic farmers, and for those wanting to use low toxicity/low residual materials. These include applications of oils and *Bacillus thuringiensis* to the silks. In addition, other materials that block the silk channel, or cover it with a protective coating have also been suggested. While preliminary research suggests that some of these materials may reduce corn earworm injury, there has not been a detailed, replicated trial comparing their efficacy. If any of these materials provide economically significant control, this could provide growers with new, low toxicity, organically acceptable options for managing this important pest.

Research Description:

Plots of sweet corn (cv. "Lancelot") will be established in rows at Highmoor Farm, the Maine Agricultural Experiment Station in Monmouth. Each plot will consist of five rows, 50 feet long. As the silks develop, the ears in each plot will be treated with one of the following treatments:

- Control
- Corn oil
- Soybean oil
- Kaolin clay
- Lecithin
- Bacillus thuringiensis
- Paper bag cover

Treatments will be applied to the silks just after pollination to interfere with egg laying and or movement of the larvae into the silks. Each treatment will be replicated three times within the trial. At harvest, ears will be evaluated for insect injury, phytotoxicity of the treatments (e.g. poor pollination) and treatment residues which may effect marketability. 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, 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 newsletter, and a regional trade journal 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 one of two field days to be held at Highmoor Farm during the 2000 growing season. Results may also be presented to other agricultural research and extension staff at scientific meetings such as the American Society for Horticultural Science.

Methods Used to Evaluate Outcomes:

Plots of sweet corn were established at Stevenson's Farm in Wayne, Maine during the 2000 growing season. Each plot consisted of five rows fifty feet in length. When the silks on the corn ears began to wilt they received one of the following treatments:

1. Control (untreated)
2. Corn Oil
3. Bacillus thuringiensis
4. Corn oil + Bacillus thuringiensis
5. Paper Bag Cover
6. Kaolin Clay

Treatments one through four were applied to the silk channels with a Zealtor and were prepared according to similar experiments done by Ruth Hazzard of the University of Massachusetts Extension. Calibration of the Zea-later was checked both before and after treatment, confirming the recommended 0.5ml /ear rate. The kaolin clay (Surround) was mixed in water at the label-recommended rate and applied to the silks with a hand sprayer. All treatments were applied to the corn ears just as the emerged silks had begun to wilt. Each treatment was replicated three times within the trial. Treated ears were harvested on September 11, 2001. At harvest, ear quality and infestation rates were evaluated.

Integration of Research and Extension Activities:

Only the oil + B.t. provided significant control of corn earworm. However, all of the oil treatments and the paper bag treatment caused significant ear development problems, reducing its market value (see photos). The clay treatment, applied using a hand-pump sprayer, left a residue that may also reduce market value.

CEW: Corn Earworm The amount of ear injury due to oil treatments has not been previously reported and may be due to an interaction with Maine environmental conditions this season. If these treatments are to provide a viable alternative to present insecticides, determining the cause of injury must be a priority. Weather conditions in Maine last summer were markedly cooler and wetter than usual. Even untreated ears showed some tip-fill problems, probably due to poor pollination.

Outputs:

Results of this study were presented to growers at the Maine Vegetable and Small Fruit Growers Association Annual Meeting; the New England Vegetable & Berry Growers Winter Meeting; twilight meetings held in North Berwick on June 14, 2001 and at Highmoor Farm on August 6, 2001; as well as the Small Farm Field Day held at the MOFGA fairgrounds on August 12, 2001. The results were also presented in a statewide Extension vegetable newsletter.

Research on this subject continues, and further sharing of outcomes, including the work completed as part of this grant will continue.

MAC 10: Development of Commercial Opportunities in the Propagation and Marketing of Woody Plant Species Native to Maine

Principle Investigator(s): Reeser C. Manley, Lois Berg Stack

Background:

The production and marketing of native plant species are receiving increasing attention from the Maine Nursery and Landscape Industry. This interest is prompted in part by an increasing public desire to create sustainable landscapes that reflect the uniqueness of Maine's natural landscape. The public is also concerned about the current use of non-native invasive species that threaten Maine's natural areas, a concern that is shared by land managers, environmentalists and Green Industry professionals.

Maine consumers of landscape plants are being asked to "urge your garden center managers to expand their selection of propagated native plants" (UMCE Bulletin #2500, Gardening to Conserve Maine's Native Landscape: Plants to Use and Plants to Avoid). While hundreds of native woody species could be used in man-made landscapes, fewer than 100 are currently widely available. In many cases, lack of information on how to propagate certain species has prevented their commercial production. Also, many Industry professionals and most consumers have not had the opportunity to see these landscape-worthy native species used in a landscape setting. In a March 2000 industry survey conducted by UMCE, the second and third most frequent answers to the question "What are your biggest challenges in selling native plants?" were "I can't find sources of native plants" and "I need to learn more about native plants."

The proposed project would accomplish the following objectives:

- Identify and publish for Industry use a comprehensive list of native woody plant species that can be used in landscapes;
- Identify and publish for Industry use currently known propagation methods for any listed species;
- Compile information on reproductive biology that will be useful in developing commercial propagation methods for the listed species;
- Establish a native woody plant species collection that will provide both the Industry and consumers with opportunities to see these plants in a landscape setting and provide experimental material for future propagation studies.

Research Description:

Research

A comprehensive list of native woody plant species that can be used in landscapes has recently been developed by the Principal Investigators. The proposed project includes a thorough review of the existing literature to develop the following information for each species: flowering time, fruit morphology (dry, pulpy, etc.), time of fruit and seed ripening, number of seeds per fruit, recommendations for collection of fruit, recommendations for storage of seed, recommendations for seed treatment, germination information, information on seedling development, and information on methods of vegetative propagation. This information will be compiled in database format, allowing for identification of gaps in knowledge that can be filled with data from future research. The database will also be shared with the Industry in the form of published UMCE bulletins.

Extension

One Extension component of the proposed project will be establishment of a comprehensive collection of the native woody plant species that are currently or potentially commercially useful. This collection will be planted in the Lyle E. Littlefield Ornamental Trial Garden where the diversity of landscape conditions will allow us to create a diverse collection. This collection will serve as the focus of future Industry meetings and for future UMCE publications as well as providing material for longer-term research on propagation. The second Extension component of this project will be development and publication of the plant propagation database, distributed in printed form as an Extension bulletin and in electronic form as a webpage.

Projected Outcomes:

The proposed database will be shared with the Industry via a printed bulletin and an electronic webpage. The proposed collection will be the focus of future Industry meetings and will be open to the Industry and general public on an ongoing basis. The results of future research findings on the propagation of native species will be published as refereed articles and/or UMCE bulletins.

Appendix I: Native Maine Plants with Landscape Potential that are Underrepresented in the Maine Nursery Industry

Scientific Name:	Common Name:
Acer pensylvanicum	Moosewood, Striped maple
Acer spicatum	Mountain maple
Andromeda polifolia	Bog rosemary
Amelanchier canadensis	Shadblow se rviceberry
Amelanchier laevis	Alleghany serviceberry
Arctostaphylos uva-ursi	Bearberry
Aronia arbutifoli	Red chokeberry
Aronia melanocarpa	Black chokeberry
Betula lenta	Sweet birch
Carpinus caroliniana	Ironwood, American hornbeam
Ceanothus americanus	New Jersey tea
Celastrus scandens	American bittersweet
Cephalanthus occidentalis	Buttonbush
Clematis virginiana	Virginsbower
Clethra alnifolia	Summersweet
Comptonia peregrina	Sweetfern
Cornus alternifolia	Pagoda dogwood
Cornus canadensis	Bunchberry
Cornus rugosa	Round-leaf dogwood
Cornus sericea	Red-osier dogwood
Corylus cornuta	Beaked hazelnut
Diervilla lonicera	Dwarf bush honeysuckle
Dirca palustris	Leatherwood
Gaultheria procumbens	Wintergreen
Gaylussacia baccata	Black huckleberry
Ilex glabra	Inkberry holly
Ilex verticillata	Winterberry holly
Juniperus communis	Common juniper
Kalmia angustifolia	Lambkill kalmia
Lindera benzoin	Spicebush
Mitchella repens	Partridgeberry
Myrica gale	Sweetgale
Myrica pensylvanica	Northern bayberry

Scientific Name:	Common Name:
Nemopanthus mucronatus	Mountain holly
Ostrya virginiana	American hophornbeam
Prunus virginiana	Common chokecherry
Rhamnus alnifolia	Alder buckthorn
Rhododendron canadense	Rhodora
Rhododendron maximum	Rosebay rhododendron
Rhododendron viscosum	Swamp azalea
Rhus copallinum	Shining sumac
Rhus typhina	Staghorn sumac
Rosa carolina	Carolina rose
Rubus odoratus	Flowering raspberry
Sambucus canadensis	Common elderberry
Sambucus racemosus	Red-berried elder
Shepherdia canadensis	Canadian buffaloberry
Sorbus americana	American mountainash
Sorbus decora	Showy mountainash
Spiraea alba var. *latifolia*	Meadowsweet
Spiraea tomentosa	Steeplebush
Vaccinium angustifolium	Lowbush blueberry
Vaccinium caespitosum	Dwarf huckleberry
Vaccinium corymbosum	Highbush blueberry
Viburnum acerifolium	Maple-leaved viburnum
Viburnum alnifolium	Hobblebush
Viburnum dentatum	Arrowwood
Viburnum edule	Moosebrush
Viburnum lentago	Nannyberry viburnum
Viburnum nudum	Smooth withered
Viburnum opulus var. *trilobum*	American cranberrybush viburnum

Appendix III: Accessions to the Lyle E. Littlefield Ornamental Trial Garden Native Plant Collection

Vernal Pool Shrubs:
Alnus incana
Alnus incana ssp. *rugosa*
Alnus serrulata
Alnus viridis ssp. *crispa*
Aronia arbutifolia
Aronia melanocarpa
Cephalanthus occidentalis
Chamaedaphne calyculata
Cornus smomum
Cornus sericea
Ilex verticillata
Kalmia angustifolia
Myrica gale
Nemopanthus mucronata
Rhododendron viscosum
Rhododendron canadense
Sambucus canadensis
Sambucus racemosa ssp. Pubens
Viburnum dentatum

Vernal Pool Herbs:
Calamagrostis canadensis
Calla palustris
Caltha palustris
Carex stricta
Eleocharis ssp.
Glyceria ssp.
Juncus effusus
Juncus canadensis
Phalaris arundinacea
Pontederia ssp.
Saggitaria ssp.
Symplocarpus foetidus
Utricularia ssp.

Vernal Pool Submergents:
Cerataphylum
Elodaea
Myophylum

Upland Woody Plants:
Acer pensylvanicum
Cephalanthus occidentalis
Comptonia peregrina
Cornus alternifolia
Cornus rugosa
Corylus cornuta
Dirca palustris
Juniperus communis 'Berkshire'
Juniperus communis 'Depressa Aurea'
Juniperus communis 'Repanda'
Kalmia angustifolia 'Carolina'
Kalmia angustifolia 'Hammon Asset'
Kalmia angustifolia 'Kennebago'
Kalmia angustifolia 'Poke Logan'
Lindera benzoin
Myrica pensylvanica
Nemopanthus mucronatus
Ostrya virginiana
Prunus maritime
Rhododendron canadensis
Rhododendron viscosum
Rhus typhina
Rosa carolina
Sambucus canadensis 'Adams No. 1'
Sambucus canadensis 'York'
Sambucus racemosus
Sorbus decora
Spiraea latifolia
Viburnum acerifolium
Viburnum alnifolium
Vaccinium corymbosum 'Blueray'
Vaccinium corymbosum 'Bluecrop'
Vaccinium corymbosum 'Duke'
Vaccinium corymbosum 'Northblue'
Vaccinium corymbosum 'Northland'
Vaccinium corymbosum 'Patriot'
Vaccinium corymbosum 'Polaris'
Viburnum cassinoides

MAC 11: Investigation of the Incidence of Johnes Positive Cows in Maine Dairy Herds

Principle Investigator(s): Dr. David Marcinkowski, Dr. Gary Anderson, Dr. Mike Opitz,, Dr. Jim Weber

Background:

Johnes disease is caused by the bacterium Mycobacterium paratuberculosis. Infected cattle exhibit a progressive thickening of the intestinal lining reducing absorption of nutrients. The disease is untreatable in infected cows causing a slow wasting away, followed by death. The disease progresses very slowly, with death occurring 2-8 years following the initial infection. The disease is rarely seen by producers because infected cattle are usually culled for poor performance before the clinical signs of the disease are fully expressed. The disease is found throughout the world and affects cattle, goats, camels and other cloven footed animals. Infected animals shed the bacterium in manure and the disease is spread to uninfected animals by a fecal-oral route. It is reported that as little as one-eighth of a teaspoon of infected manure is enough to infect a calf.

Studies conducted in other states estimate the incidence of Johnes disease in dairy cattle to be 4-10%. In addition the disease can be found in about 20% of herds. In the US, the economic losses due to Johnes disease have been estimated to exceed .5 billion annually.

The Johnes organism has also been found in the milk produced by infected cattle. There have been reports in the literature suggesting a link between Johnes in cattle to Crohn's disease in humans. No definitive work has been done.

Manure culture is the standard for determining if an animal is infected. Manure culture takes up to three (3) months to complete. We propose using a screening test and following up animals testing positive on the screening test with the manure culture.

There are a number of components to a control program that include changing management practices on the farm and developing a testing program to determine infected animals. Infected animals are not brought into the herd and infected animals in the herd are managed within the practices of the farm rather than being culled. The youngest animals on the farm are the most susceptible. One of the basic components of a biosecurity program is to develop a means of identifying infected cattle.

Dairy producers in the state of Maine are increasing their herd sizes as herds consolidate to fewer larger herds. In order to stock these herds, animals are purchased from a variety of sources. We are interested in developing a pilot biosecurity program for Johnes disease. Several large dairy farms are interested in developing a Johnes biosecurity program. We see this as a proactive program to develop disease control practices that can be multiplied to other herds statewide (or larger) rather than a reactive program responding to a crisis situation sometime in the future.

We plan to develop a collaborative program utilizing the skills of UMaine faculty, diagnostic lab, state veterinarians, a number of large animal veterinarians in Maine, and several cooperating herd owners.

Research Description:

- One thousand dairy cows from cooperating herds in the state of Maine will be screened for Johnes disease. Screening will be done using a new enzyme-linked immunoassay (Tip TestTM: Johnes) developed by ImmuCell Inc. Portland ME. One thousand cows represent 2.5% of the total dairy cows in the state.
- Several cooperating dairy herds will be identified with the help of practicing veterinarians. Cooperating dairy producers will be charged a minimal fee (.00/test) to help subsidize the costs of the testing. In addition they will be responsible for any veterinary costs that may be incurred in obtaining samples. This will insure their interest and willingness to cooperate in the project.
- Individual cows will be randomly selected from the herd. Blood samples will be collected from each animal with the help of the herd veterinarian. The blood samples will be returned to the University of Maine Veterinary Diagnostic Laboratory for analysis. Due to the large number of samples, additional student technician help will be required to conduct the testing. Test results will promptly be returned to the owner of the cattle and herd's veterinarian. Individual test results will be kept confidential.

- Manure samples will be collected from cows that test positive in the initial screening process. The screening test identifies the presence of antibodies to the Johnes organism in the blood. Presence of the Johnes organism will be confirmed in the manure samples at the Cornell University Veterinary Diagnostic Laboratory using the more definitive fecal culture technique.
- Screening and fecal culture test results will be summarized. Extension fact sheets and presentations will be developed to inform Maine dairy producers of the potential risks of this disease within their herds.

Projected Outcomes:

Results of this project will form the core of information used by the Maine Regional Quality Assurance Program to develop a Maine Johnes control program. This project will give us a background on the reliability and interpretation of diagnostic tests, an indication of incidence of Johnes in Maine, and a baseline from which to work.

Blood Sample Collection:

Five practicing veterinarians have collected and submitted 1001 blood samples from 24 dairy herds. These herds are geographically distributed throughout the state and represent 2.4 % of the dairy cows and 5.2% of the herds in the state.

Testing for Johnes Disease:

The identity of the herds was kept confidential. Each veterinarian coded the samples and sent them to the University of Maine Veterinary Diagnostic Laboratory for analysis. Due to the large number of samples, a senior animal science student was hired to conduct the testing. This student is using the data from the study as a senior research project. Johnes screening was done using a new enzyme-linked immunoassay (Tip Test: Johnes) developed by ImmuCell Inc. Portland ME. When testing was completed on an individual herd, the results were returned to the herd veterinarian so that they could interpret the results and share them with the herd owner. Blood samples were also tested using the IDEXX test for Mycobacterium paratuberculosis and by the Cornell University Diagnostic Laboratory using a proprietary test developed by that lab. At the present time, results from all blood samples have been completed. Fecal samples were collected from cows determined to be positive for Johnes Disease using the Tip Test. Johnes Disease will be confirmed at the Cornell University Veterinary Diagnostic Laboratory using the more definitive fecal culture technique. Fecal samples have been collected on all cows (that are still in Maine herds N=155) that tested positive using the TipTest and submitted to the Cornell University Diagnostic Laboratory for culture (sent April 2001); the fecal culture of Mycobacterium paratuberculosis takes several weeks to complete. We expect these results soon.

Leveraging of Funds:

With the funds from this grant we were able to obtain additional support from a variety of sources. Other laboratories have donated more than ,000 of diagnostic tests, supplies and software enabling us to compare their tests to the ImmuCell test on the samples collected. In addition, a grant of ,000 was obtained from the Walker Trust Foundation to expand the Johnes testing to all dairy producers in the state and develop a Maine Cattle Health Assurance Program that will improve disease prevention and food safety.

Projected Outcomes

- The incidence of Johnes Disease in Maine dairy herds will be determined.
- The three available diagnostic tests for Johnes Disease will be compared. This will give us valuable information on the accuracy and sensitivity of these tests.
- A committee composed of representatives from University of Maine, the Maine Department of Agriculture, Food and Rural Resources, practicing veterinarians, dairy cooperatives and cattle and deer producers has been formed to educate producers and address livestock health assurance issues in Maine.
- Results of this project will help form a core of Johnes information used by the Maine Cattle Health Assurance Program (MeCHAP)

Methods Used to Evaluate Outcomes:

Results of our testing indicated that 39 of 1011 blood sampled tested using the IDEXX test were positive for an incidence rate of 3.84%. Using the ImmuCell TipTest, 171 of 1009 blood samples were positive for an incidence rate of 16.95%. Similarly, the Cornell enzyme linked immunosorbant assay gave positive results for 176 of 949 blood samples

for an incidence rate of 18.57%. We were interested in the agreement of the three tests. While unfortunately, not all samples were tested with all three tests, the IDEXX test and Immucell TipTest. Both gave positive results on 11 of the 1009 samples and both gave negative results on 811 of the 1009 samples resulting in disagreement on 187 samples (18.5%). The IDEXX and Cornell tests both gave positive results on 24 of 949 samples and both gave negative results on 756 of 949 samples resulting in disagreement on 169 samples (17.8%). The ImmuCell TipTest and Cornell test both gave positive results on 37 of 949 samples and both gave negative results on 655 of 949 samples resulting in disagreement on 257 samples (27.1%).

Outputs:

These data will be used in an educational program across Maine to provide information on Johnes disease in Maine and to provide a base for the development of best management practices to reduce the incidence of Johnes disease.