ABSTRACT

The economic crisis in the cranberry industry continues to impact growers daily. They are spending less time on their farms as they have been forced to work at other jobs to remain financially solvent. To save money, growers are reducing all types of inputs into their farms. In addition to reduced labor costs (i.e., by omitting hand-weeding and IPM consulting), growers applied fewer pesticides. The use of all pesticides (based on sales estimates; see Appendix D-2) declined approximately 30% in the 2-3 years since the economic downturn compared to the brief period just before. What will be the impact of reduced management choices for those farms that remain viable? To answer this and similar questions, our research and extension priorities are shifting to focus on the implications of reduced management practices as well as the development of low-cost pest management alternatives.

Significant pest management concerns have arisen. Cranberry weevil is resistant to all registered insecticides in a large area of Southeastern Massachusetts including South Carver, Wareham, Bourne, and Rochester. Some growers experienced counts in the 100's (the action threshold is 4.5). We currently have no true alternatives to offer growers. A Section 18 was granted for Provado, a product that showed moderate control over cranberry weevil. Cultural practices, such as flash floods or bloom-time floods, may offer some control and will be studied in 2002. Secondly, reduced fungicide input may be impacting fruit quality at harvest. Reports of poor quality, especially of the late varieties, are being heard as the 2001 harvest season winds down. Research is being planned for 2002 to address this and other related problems.

The staff members of the Cranberry Experiment Station held 5 workshops. Attendance at all workshops was much lower than in previous years. Approximately half the number of growers attended our Production Workshop and Beginners' School in 2001 compared to 1999 (241 down to 161, and 36 down to 14, respectively). In an attempt to accommodate the changing needs of our clientele, we offered our Research Update Meeting, free-of-charge, on a Saturday morning. Despite this effort, only 25% of those who attended the Research Update Meeting in 1999 showed up in 2001. We instituted a new type of workshop during the summer of 2001. We met three times during the summer at growers' bogs for informal discussions on all aspects of pest and crop management. This format was very well received. In addition, the Cranberry IPM Advisory Committee met prior to the writing of this report and endorsed the proposed research and outreach activities for FY02.

INTRODUCTION

Despite the largest USDA-mandated set aside in recent history, the cranberry industry continued its economic slide for the third straight year. The price per barrel is anticipated to be around $20 (up from ~$11 in 2000), but growers are still losing at least $15 for each barrel they produce. One small, but significant, player in the fruit handling business declared bankruptcy in 2001. The industry continues to address this crisis with short-term solutions based on requests for government assistance and long-term solutions that rely on aggressive marking, health benefits research and promotion, and product development. A market turnaround is anticipated to take at least 2-5 years.

To remain economically viable, the essential needs of our stakeholders are being re-allocated from maximizing production towards maximizing efficacy. Information regarding the impact of reducing management inputs as well as low or no-cost pest management alternatives is needed. Production recommendations based on this research should allow reliable reductions in crop production costs. Further, it is speculated that a large portion growers will again take bogs out of production in 2002 by flooding during bloom. Little is known regarding the impact of these "crop-destruct" floods on either the bog's subsequent production or the effect on pest populations, and we propose continued research in this area. Finally, some growers are willing to try innovative projects that may provide them with alternative sources of income until the cranberry crisis abates. We propose collaborating with other UMass researchers and extension specialists, state agencies, and growers to evaluate the feasibility of growing dayneutral strawberries on the farm as well as converting a portion of an unused cranberry bog to a prototype aquaculture system.

In sum, the work proposed here will provide recommendations and information to Massachusetts growers to allow them to remain viable through economically efficient production, reduced dependence on crop protection inputs, enhanced environmental quality, and incorporation of reduced-risk agricultural chemicals.

CRANBERRY CROP AND PEST MANAGEMENT RESEARCH OBJECTIVES - FY01

The broad long-range objectives of the Research Component of the Cranberry Crop and Pest Management Program are to:

- **Develop sustainable management programs for insect, disease, and weed pests and nutrient inputs.**

  This objective includes farming practices that maximize the effectiveness of cultural practices for crop and pest management, incorporate second (and higher) level IPM into standard cranberry management, investigate impact of water quality issues on cranberry farming, develop and implement methods of biological control, and reduce reliance on high-risk pesticides.

- **Investigate basic pest biology as related to input needs and timing of applications.**

- **Field-test new products that may manage cranberry pests.**

In response to the economic crisis of the cranberry industry, we will pursue projects that develop low-cost alternatives for pest management. In addition, we will continue an interdisciplinary project to evaluate the impact of crop-destruct floods and reduced management practices on pest populations and crop attributes. To address increasing regulatory concern about surface water issues, another project is underway investigating the use of low rates of phosphorus and alternative application techniques in cranberry farm systems. In FY01, the IPM program received cooperation and support from three University faculty members from the disciplines of entomology, nutrition, and plant pathology. To achieve these broad objectives, we have identified several specific 5-year goals for the research component of the Cranberry IPM Program including:

- Evaluate alternatives for organophosphate (OP) insecticides; reduce overall OP use.
- Evaluate the impact of reduced management practices on cranberry pests and the crop.
- Develop recommendations for nutrient use for farms in proximity to surface water resources.
- Continue research on the impact of crop-destruct floods on pest populations and crop production.
- Develop a management strategy for OP-resistant populations of cranberry weevil.
- Encourage the adoption of second level IPM strategies, such as late water and fall floods.

CRANBERRY CROP AND PEST MANAGEMENT OUTREACH OBJECTIVES - FY01

The overall objectives of the Outreach Component of the Cranberry Crop and Pest Management Program are to:

- Facilitate the transfer of information from research programs to the grower community.
- Provide one-on-one consultation to growers to facilitate the adoption of the most appropriate pest management alternatives to employ for specific situations.
- Provide educational workshops to accommodate and encourage all levels of pest management participation.
- Communicate effectively with the public regarding pesticide issues and cranberry production practices.
- Publish written materials that serve as a resource to assist in the correct identification of pests and the appropriate conduct of production practices.
- Document adoption and/or implementation of IPM practices.

CRANBERRY CROP AND PEST MANAGEMENT RESEARCH AND OUTREACH:

PROPOSED FOR FY02

SELECTED PROPOSED OBJECTIVES FOR FY02

- Develop a management plan for OP-resistant cranberry weevil populations.
- Participate in a feasibility study to evaluate the potential of alternative crops on cranberry farms and/or associated uplands.
- Develop recommendations for fertilizer use for farms in proximity to surface water resources.
- Continue research on the impact of crop-destruct floods and reduced management practices on production and pest populations.
- Continue development, education, and implementation of an integrated program for the control of dodder and *Rubus* spp.
- Identify factors that influence the abundance and distribution of weeds on farms.
- Continue to provide current research and management information to growers via workshops, newsletters, phone messages, and the Internet.
- Provide one-on-one consultation to growers to facilitate the adoption of the most appropriate pest management alternatives to employ for specific situations.

CRANBERRY PROJECT ACTIVITIES FY 01

Concise summaries of project impacts and participants may be found in Appendices.
Projects reported herein were at least partially supported by IPM funds unless otherwise noted.

Critical Pest Management Issues in 2001

Loss of Important Management Options Due to Pest Resistance or Regulatory Concerns.

Managing resistant populations of cranberry weevil. As of 2001, cranberry weevil (*Anthonomus musculus*) is resistant to all registered insecticides in a large area of Southeastern Massachusetts including South Carver, Wareham, Bourne, and Rochester. Some growers experienced sweep net counts in the 100's (see State Bog example below) and there was one report of counts that exceeded 1,000 weevils (the action threshold is 4.5 weevils per sweep set). Work initiated during the 2001 season by the Entomology lab included: determining the pattern of weevil infestation on the bog; assessing the variation of damage among cultivars; and evaluating the damage on an upright level as well as across the bog. These are very large data sets and are being analyzed at the time of this writing.

We currently have no true alternatives to offer growers. Imidacloprid (Provado) was used during 2001 under a Section 18 permit with moderate success (see Appendix D-1). However, the registrant will not permit a spring application, which further exacerbates the crisis situation. No other registered compounds will control weevils. As an alternative to the organophosphates, a single effective compound has been identified in screening tests, but the compound does not have a clean toxicological and environmental report. Permission to use this compound in 2002 is doubtful at best. Cultural practices, such as flash floods in the spring may offer some control and will be studied next year.

State Bog weevil populations. Data from State Bog typified what many other growers experienced with resistant populations. In 2000, we first noticed a loss of efficacy of Lorsban, but it was not profound. In 2001, when the weevil population reached an average of 16 weevils per sweep set (the action threshold is 4.5), Lorsban was applied. The counts averaged approximately 20 weevils per sweep set two days after application. The counts increased during the season to a maximum of ~130 weevils per sweep. Provado was applied on July 13 and the counts were cut by 50%. The variety Stevens seemed particularly susceptible to weevil damage. The overall harvest from State Bog averaged 20 barrels per acre (State Bog average is 70-100 bbl per acre). Data is presented in Appendix D-1.

Registration of Pronamide for Dodder Control Seems Doubtful. Dodder (*Cuscuta gronovii*) continues to be a pest of major concern for the cranberry industry. Presently, a combination of cultural and chemical controls offers the best management program for dodder. One recent addition to the management program is the pre-emergence herbicide, pronamide (Kerb). Over the three years that it has been available through Section 18 permitting, growers have enthusiastically adapted their programs to include the use of this herbicide. It is easy and quick to apply, and is less expensive than dichlobenil (Casoron). However, pronamide was detected at very low levels in water samples during 2001. It is also a B2 carcinogen and may be placed under critical review by EPA.

A well-timed pre-emergence herbicide application can control early emerging seedlings. Research at the Cranberry Station has demonstrated that dodder populations have a second peak several weeks after the first peak (see Appendix D-5). Kerb can be applied later in the season (at least through early June) without phytotoxic results. Casoron can be applied to about mid-late May and does not have the residual activity that Kerb has shown. Since a post-emergence control for dodder is not yet available, the loss of Kerb would impact the ability of growers to control late-emerging populations.

Implications of Reduced Management for Key Cranberry Pests and Minor Pests.

Many growers have opted to minimally manage their properties in order to "lose less money". The impact of these choices is particularly worrisome for management of perennial weed populations and fruit rot organisms. Many of the ramifications of reduced management of these pest complexes may not be known for years. Several projects were initiated in 2001 and some general comments can be made.

Impact of reduced management on key insect pests. Cranberry fruitworm (*Acrobasis vaccinii*) and cranberry weevil (in areas of susceptible populations), will increase in numbers as timing and number of pesticide applications are relaxed. The key to managing cranberry fruitworm is an understanding of moth movement between the bog and upland habitats. Moth populations are typically eliminated on a bed through water management but beds may be re-invaded by immigrating moths. Nocturnal monitoring of the cranberry bed and surrounding habitats was conducted in 2001 to determine timing and location of moth movement. Sparganothis fruitworm (*Sparganothis sulfureana*), is an induced problem that will wane as insecticide use declines.

Impact of reduced management on key weed pests. Weed management will be a top priority for growers that are reducing management on beds that they hope to "reclaim" once prices improve. Dewberries (*Rubus* spp.), dodder, sawbriers (*Smilax* spp.) and poison ivy (*Toxidendron radicans*) are the weeds that should be prioritized if the grower expects to maintain long-term productivity. These populations can not be ignored as these weeds can cause serious yield loss, spread quickly, and can be difficult to manage.

Effect of reduced management on the incidence of fruit rot fungi. In the years since the economic crisis, many growers have opted to leave many acres untreated or opt for inferior, but less expensive, alternatives. No hard data are available concerning the impact of reduced fungicide use on fruit rot organisms. However, during this harvest season, we have already heard reports of high rot incidence in the late varieties. To build this database, berries were sampled weekly from five beds that received no fungicides in 2001 to assess the populations of rot fungi during the growing season and subsequent growing seasons. Data are being collated and analyzed as of this writing.

Minor pests have become more problematic. Population levels of several minor insect pests have been held in check by broad-spectrum insecticides that target key pests. This past year, where insecticide pressure was lowered, serious and extensive infestations of black-headed fireworm (*Rhopobota naevana*) erupted within a single season. At least two outbreaks of yellow-headed fireworm (*Acleris minuta*) were reported in 2001. Next year, as weeds encroach and beds are further neglected, we also expect outbreaks of flea beetle (*Systena frontalis*), fire beetle (*Cryptocephalus incertus*), and blunt-nosed leafhopper (*Euscelis striatulus*).

Blunt-nosed leafhopper is the vector of false blossom, a devastating disease of past years. Both commonly occur on unmanaged bogs and there is little doubt that we will be dealing with them soon on commercial bogs as inputs are lowered. Thus, sampling on infested wild bogs over the entire season to determine sampling efficacy and population dynamics has begun.

The occurrence of Phytophthora root rot (*Phytophthora cinnamomi*) is also expected to increase on reduced management beds. Phytophthora can be controlled by improving drainage (less expensive than chemicals, but may be a substantial capital investment). The fungicide, metalaxyl (Ridomil) which controls this fungus, is very expensive and growers will be likely to opt out of this management choice. Growers will also need to manage yellow loosestrife (*Lysmachia terrestris*), grass, and sedge populations to a minimal extent to keep these minor pests from becoming serious long-term problems.

Pesticide Use Has Declined During the First Two Years of the Economic Crisis.

Pesticide applications, expressed as number of "treated acres", were lower for the past two seasons compared to the seasons just prior to the economic collapse (see Appendix D-2). Treated acres were calculated based on average annual sales estimates and are not necessarily equivalent to the "number of acres treated" (please see explanation in Table 2). The use of dichlobenil (Casoron), a pre-emergence herbicide registered for dodder control (as well as some other broadleaf weeds) declined significantly in 2000-01. Even though the use of another pre-emergence herbicide, pronamide (Kerb), increased by 51%, the total number of acres targeted for dodder control decreased by 32%. The number of treated acres (based on annual sales estimates) for other common pre-emergence herbicides declined 54% for napropamide (Devrinol) and increased 33% for norflurazon (Evital).

Use of organophosphate insecticides has also declined. In 2000-01, the estimated number of acres treated with clopyrifos (Lorsban) decreased by approximately 19% and the estimated use of Diazinon decreased by approximately 55%. Due to the expense of the new reduced risk insecticide, tebufenozide (Confirm), its use also declined about 17% in 2001 compared to 1999-2000 usage. The use of chlorothalonil products (Bravo, Echo, etc.) declined 34%. In addition, the number of treated acres with the less-effective EBDCs (e.g., Dithane, Manex) also decreased by 38%. Overall, there were 35% fewer treated acres in 2000-2001 with chemicals targeting fruit rot management.

While decreased use of pesticides is generally viewed as a positive result, growers still need some chemicals (e.g., dichlobenil) to manage damaging pest populations on their farms. If sales fall off too far, manufacturers may not pursue the re-registration of these products due to lack of reasonable profits.

Integrating Cultural and Production Practices for Pest Management

Evaluation of Fall Floods for Pest Management and Plant Impacts. *Work on this project was mostly supported by monies from SARE. However 15% of the Cranberry Specialist's salary was used as matching funds for the project and the IPM Research Technician allocated 10% of her time to duties related to this project.*

Post-harvest floods have less impact than spring floods on yield while seeming to offer at least some control of pests. In 1998-2000, post-harvest floods were shown to eliminate cranberry fruitworm hibernacula (overwintering stage) and to suppress *Rubus* spp. growth (approx. 30% less growth than in unflooded beds). A three-week flood was sufficient to control cranberry fruitworm, but at least four weeks were required for effect on dewberry. No adverse effect on plant growth or yield has been found, but reduced fruit set in the year following the flood bears further study. A fall flood followed by a 4-week spring flood reduced yield with no additional pest control benefit (see Appendix D-11).

In 2001, weekly samples were taken from a pair of 'Early Black' beds, one that had received a four-week post-harvest flood in 2000, while the other bed was not flooded. Fungal populations in the two beds were determined prior to the flooding, and were determined in the growing season after the flooding to determine whether the either flood reduced any of the rot fungi.

Comparison of Weed Management Techniques and Vine Planting Densities. *Costs for this project were partially defrayed by a small grant from Ocean Spray Cranberries. The IPM Research Technician allocated 20-25% of her time to duties related to this project.*

Assuming that the cranberry economic crisis will abate within the next few years, several seasons of neglecting weed management will cause problems for growers who wish to reclaim their farms. Information gained from this study will provide valuable information for these surviving growers such as: What is the most efficient density at which to plant vines (to minimize invasion by weed species)?

and, How does weed management strategy in the first year influence vine coverage and weed growth for the second year? Four vine densities were planted within four nitrogen application rates on a newly renovated section of State Bog during the 2000 growing season. Four weed management strategies were implemented during the study. Samples from the 2001 season are being processed as of this writing.

Grass biomass was harvested from the Devrinol-treated plots in July 2000 and were evaluated for: total number of individuals present, stem length, number of different grass species, and stem and root dry weight. Devrinol was equally effective in controlling grasses irrespective of nitrogen or density treatment. Weed biomass was removed (simulating hand-weeding) during late July-early August and evaluated for: type of plant present, number of individuals, stem and root dry weight, and the time needed to remove all live plant materials. ANOVA indicated vine density significantly affected the total number of individual weeds produced. Number of weeds was lowest in the plots with the mid-range vine density of 1.6 tons per A. All biomass within a 900 cm^2 quadrat was harvested in mid-September. Samples were evaluated for: cranberry root and stem dry weights and weed stem and root dry weights. Many significant interactions were seen (see Appendix D-3). As nitrogen application increased, the disparity between weed management and no management was magnified. Data from this study will provide practical information that growers can use when making initial and long-term weed management and production decisions on a new planting.

Influence of Sand Applications on Weed (Re)Infestation and Management.

Sand, destined for horticultural or pest management use, is typically stored as piles in the vicinity to the production area. These stockpiles may be a significant seed bank source allowing (re)introduction of populations of weed seeds into the production system. Sand piles, located in 4 different states of the U.S. cranberry production area (MA, NJ, WI, and WA), were sampled quarterly in 2000 and 2001 (winter, spring, summer and fall) from interior and exterior portions of the pile. Seedlings were identified and quantified. Species diversity and abundance were determined.

During the first four samplings (Fall 99 – Summer 00), over 40 different plant species were identified. Seedling number and species abundance on the interior and exterior portions of the piles were not statistically different according to mean separation by t-test at $p \leq 0.05$. However, in piles with high seedling numbers, samples taken from the outside of the pile tended to have more weed seeds that germinated than samples taken from the inside. WA had significantly more germinated seedlings in its summer sampling than any other date (whole pile numbers analyzed by ANOVA; $p \leq 0.001$).

We have developed a simple method for identifying weed species from cranberry sand sources. This technique could be easily adopted by IPM consultants and growers. We have also demonstrated that application of sand for pest management (e.g., dodder, cranberry girdler) or horticultural purposes may introduce viable weed seeds into the farm system. Other researchers have estimated that weed densities of 1 plant per m^2 can cause yield reductions in annual crops. In our study, 1 germinated seedling extrapolates to a weed density of 15 plants per m^2. Previous work from the Cranberry IPM Program has shown that different cranberry weeds can impact yield and production in various ways. Thus, any impact of a germinating individual on cranberry yield and its subsequent management will depend heavily on what particular species it is. Based on this study, growers could minimize weed seed infestation by excavating sand close to the time of on-farm application. Data is presented in Appendix D-4.

Implementation and Development of an IPM Program for a Key Disease Complex.

Fruit rot is the most prevalent disease problem faced by cranberry growers and accounts for nearly all of the fungicide inputs made into the cranberry agroecosystem. The underlying factor that belies easy management of this disease is more than 12 species of fungi have been identified as causal agents of fruit

rot. In addition, not all of these fungi will be present in any given year on any given bog. The IPM Program consistently educates and encourages growers to adopt cultural management techniques (e.g., proper irrigation scheduling, regular vine pruning, sanitation, etc.) that would make the fruit less susceptible to infection by fruit rot fungi. Other strategies available include the incorporation of the Keeping Quality Forecast and scouting for the progression of upright phenology to properly time fungicide applications.

Evaluation of antagonistic microorganisms versus the fruit rot pathogens. Two actinomycetes isolated from cranberry tissue that had shown antagonism against cranberry fungi were screened for activity *in vitro* to determine which fungi were affected by the microorganisms. Mycelial growth was monitored over a four-day period. These actinomycetes were also sprayed three times on flowers and berries in small field plots to determine whether they were able to reduced the incidence of fruit rot.

Different timing schedules for fruit rot control. A trial conducted in 2000 was repeated in the same area of the cv. 'Ben Lear', as well as in the cv. 'Stevens'. Field rot and storage rot will be evaluated. Weekly samples were taken from one of two untreated check (the other used for rot evaluation) plots. One half of the sample (initially blossoms, then berries) was used to culture fungi throughout the period of late June through late August. The other half of the sample will eventually be sent to Dr. Andre Levesque at Agriculture Canada in Ottawa for dot blot analyses. Isolations performed on potato dextrose agar will be compared to the DNA extractions, as they were in 2000. A rotorod spore sampler was also operated at vine level as it was in 2000. Rods will be sent to Dr. Levesque for DNA extraction of the spores so that an analysis of the aerial spores can be determined.

Investigation of possible resistance development by fruit rot pathogens to two new fungicides. Fenbuconazole and azoxystrobin (registration of both expected in 2003) and chlorothalonil were applied three times for comparison of their ability to control field and storage rot. A mixed schedule of the three fungicides was set up twice; in one the fungicide schedule will be varied whereas the other will be repeated. This trial will be repeated in the same area of the cv. 'Crowley' and 'Early Black' for three successive growing seasons. Efficacy will be evaluated as usual. The purpose of this trial is to determine whether the fruit rot fungi are developing any tolerance to the two new fungicides.

Fertilizer Studies to Protect Water Resources

Phosphorus Fertilizer in Cranberry Production: Can the Case be Made for Low Rates and Alternative Application Methods? (3-4 year study began in 2000). *Work on this project is supported by monies from MA Department of Environmental Protection. The IPM Research Technician allocated 5% of her time to duties related to this project.*

Phosphorus use and potential movement of P into surface water bodies has become a major issue for US Agriculture. Under the provisions of the Clean Water Act, EPA has charged local DEP officials with developing nutrient management plans for critical water bodies focusing on phosphorus management. Many of the bodies identified receive incoming water from cranberry systems. It is critical that we know how much cranberry P use can be limited without impacting the ability to produce crops. Further, lowering fertilizer rates has the potential for significant cost savings for cranberry growers.

All sites (paired bogs for water quality evaluation) were selected and viewed in July 2001. Installation of monitoring devices (water flow) has begun but is as yet incomplete. We plan to monitor flow in flumes using water level loggers, staff gauges, and flow meters. Flow through pumps will be monitored with impeller-type pump monitors, inserted into the pipe feeding into the pump. Installations and testing will take place in the fall of 2001. Water samples were collected at a natural wetland site and at commercial

bog sites during 2001. At harvest, water was collected early and late in the flooding, from above the vines after fruit removal, and during release. Samples will be analyzed for ammonium, nitrate, and total and dissolved P. Plot locations have been established to study the effect of changes in P rate on cranberry yield. Rates from 0 to 30 lb/a are included as are various ratios of N and P. Harvest samples have been collected -- processing of these samples is ongoing. These plots will continue through 2003. At the end of this study, it is expected that recommendations will be made for P rates in cranberry production which will support high yields and which will withstand scrutiny by governmental bodies.

Basic Biology

Epidemiology of Upright Dieback Disease. A survey of the possible causal agents of upright dieback was continued by doing monthly isolations from affected and symptomless uprights at seven locations. Artificial inoculations of cranberry uprights were performed with several isolates of the fungus *Phomopsis*. Yield was collected in one bed along transects where disease incidence is severe to determine the effects of the disease on crop productivity.

Elucidation of the Causal Agent of Fairy Ring Disease. Vine samples were periodically collected from 15 beds with the disease. Symptomatic tissue was cultured for elucidation of the causal agent, in conjunction with research conducted in the lab of Dr. Peter Oudemans at Rutgers University. Several cultures of the suspected causal fungus have been sent to Dr. Lori Carris, Washington State University for identification. Pathogenicity studies will be conducted soon.

Studies on Funky Flower. Beds with this “condition” were visited again in 2001. Affected areas were measured, and samples were sent to Dr. Jim Polashock at Rutgers University for determination of the causal agent. Affected areas have most definitely increased in diameter during the past three years, and the condition is probably caused by a phytoplasma. Seeds collected from 2000 berries were germinated and there are seedlings from 1999 and 2000 in the greenhouse for subsequent analysis.

Germination Patterns of Native Dodder Populations. Knowledge of germination patterns is critical for proper timing of pre-emergence herbicides. Similar germination patterns have been documented with both sets of containers over the past 3 years (see Appendix D-5). The most interesting observation is an apparent second peak of germination approximately 2 weeks subsequent to the initial peak. Markedly, the second peak is greater than the first peak for both sets of studies in the 2001 season. Initial sequence analysis of the bimodal populations revealed consistent differences within variable regions of chloroplast DNA (See Appendix ?? for abstract). Consistent use of pre-emergence herbicides may be producing an ecotype that germinates later (thus "escaping" the effects of the herbicide).

The Role of Grape Mealy Bug as a Disease Vector in Grape. As part of an interdisciplinary coalition of UMass researchers, reports of the implication of grape mealy bug as a vector of a disease problem in Southeastern New England vineyards was investigated. For 2001 at least, insects were ruled out as major players in this disease syndrome.

Grower Service Projects

Field Evaluation of LPE for Improved Post-Harvest Characteristics of Cranberry Fruit. *Work on this project was partially supported by monies from Nutra-Park, Inc. The IPM Research Technician allocated 5-10% of her time to duties related to this project.*

Unpublished research conducted on Wisconsin cranberry farms (J. Palta, University of Wisconsin-Madison) has shown improvement in fruit storage quality (percentage marketable fruit) in cranberries treated with LPE. A cooperative project (university and commercial operators), was conducted during the 2000-01 growing seasons on several varieties of cranberry in Massachusetts. Post-harvest analysis (e.g., brix, acid, and anthocyanin content) were conducted by the manufacturer and firmness evaluation of treated fruit was conducted in late fall-early winter 2000. The LPE-treated fruit were no different from the untreated fruit for most measured parameters (mean comparisons made by t-tests at $p \leq 0.05$). Data is presented in Appendix D-6.

A timing trial was conducted on State Bog during the 2001 growing season to determine the best time to apply LPE to maximize brix, anthocyanin levels and improve storage life. Due to severe cranberry weevil infestations, the number of viable fruit available in the test plots may not provide enough material to adequately assess these test parameters. If this is the case, the trial will be repeated in 2002.

Use of Dilute Rates of Roundup for Postemergence Weed Control. Plots were established in several sites during August 2001. Poison ivy (*Toxidrendron radicans*), narrowleaved goldenrod (*Euthamia tenuifolia*), and saw brier (*Smilax glauca*) were treated with 0. 2.5, 5, 10, or 20% solutions of Roundup Ultra. The broad spectrum herbicide was applied as a wipe ('hockey stick'). At least one set of each species was treated August 13, 2001. Subsequently, another set of each species were treated in mid-September. Visual evaluations indicated that NLGR was severely affected by wipes of 5, 10, and 20% dilutions for both August and September applications. Poison ivy (PI) had 50-100% mortality with 10 and 20% wipes made in August. Equal efficacy on PI was obtained with more dilute solutions when applications were made in September. In general, saw brier was not affected by Roundup applications when made in either August or September. Data presented in Appendix D-7.

Determination of Seed Viability of Nut Sedge to Evaluate Potential for Mowing to Provide Nonchemical Weed Control. Starting in early July, approximately 100 cc of seeds from nut sedge (*Cyperus dentatus*) were collected weekly from a grower's farm. The seeds were sown into sand-filled pots in the greenhouse. The sample was divided into thirds: one-third was planted on top of the sand (to simulate seeds mowed and fallen to the bog surface), one-third was covered by one-half inch of sand (to simulate seed covered by sanding or other practices), and one-third are being kept in the lab and will be planted in the spring (to assess viability after dormancy).

Germination of seeds was documented twice per week. Appendix D-8 shows the data tables and graphs of the germination patterns for the surface and buried seeds. Very few seedlings germinated from the mowed seeds, whether placed on the surface or buried (Graphs 1&2). During the early mowing dates, more seeds germinated that were sown on the surface than those that were buried (Table 1). Seeds that were harvested on the first date (July 5, 2001) had significantly lower germination rates than most other mow dates. A clear trend relating the germination rate to mowing date was not apparent (Table 2). From this first year's data, it seems that growers would have to mow nut sedge as soon as the seed heads formed to minimize the placement of viable seeds onto the bog floor.

Use of Raptor-Friendly Devices to Enhance Wildlife on Commercial Cranberry Farms. *Work on this project is partially supported by monies from USDA Wildlife Habitat Enhancement Project. The IPM Research Technician allocated 10-15% of her time to duties related to this project.*

Joanne Mason, of The Cranberry IPM Program, has taken the lead in wildlife enhancement projects such as the "Raptor Retrofit Project". The RRP is dedicated to identify utility poles owned by cranberry growers that have either caused raptor fatalities or injuries in the past or have the potential to cause raptor mortalities in the near future. Since the cranberry farm habitat provides open space for which raptors

perch, hunt, and reproduce, this project will protect individual birds from harm and also help to sustain their populations in Southeastern MA. More information may be found in Appendix D-10.

Is 12-24-12 the Most Effective Fertilizer? 12-24-12 is the industry standard was compared to other product combinations, so N rate was held constant but P and K rates were varied. 12-24-12 is relatively high in P and low in K. Other combinations as shown in the table. Year 1 results: (Yield in bbl/a)

Treatment	Loc 1	Loc 2	Loc 3	Loc 4
12-24-12	90	135	143	60
similar P, much more K	140	155	124	61
much less P, much more K	94	158	137	40
less P, more K	109	155	138	114
less P, similar K	70	160	130	138

As can be seen, the results were quite variable. There may be a trend in the data, indicating that a more balanced approach to P and K (both high, both moderate, or both low) may be associated with greater yield than that with 12-24-12 where P is high but K is low. However, 12-24-12 did give the best results at one location (3). None of the yield differences were significantly different, so no recommendation for change in practice is supported at this time.

Stakeholder Involvement

Cranberry Chart Book-Management Guide Meeting. January 25, 2001. Cranberry Experiment Station, E. Wareham, MA. Thirty stakeholders were invited to attend a meeting to revise and update management recommendations for the Massachusetts cranberry industry. Recommendations are published annually in the Cranberry Chart Book-Management Guide for Massachusetts.

Cranberry IPM Project Advisory Committee Meeting. September 26, 2001. Cranberry Experiment Station, E. Wareham, MA. The committee reviewed and approved the proposed areas of research and extension activities as proffered by the IPM Project Leader. Several growers requested dismissal from the group due to new employment responsibilities. Other growers will be asked to serve in their place for the 2002 season. See Appendix A-2 for meeting minutes.

Meetings with A.D. Makepeace Company to establish additional research projects and sites. April 12, May 15, and July 17, 2001. A.D. Makepeace Compound, Wareham, MA. Staff members met with the Makepeace Company and Ocean Spray researchers to discuss the establishment of additional research projects based on acreage that the cranberry company was either relegating to "non-production" (crop-destruct or crop-neglect) or completely abandoning. Insect, disease, and weed experiments were designed for implementation at several bog sites.

End-of-Meeting Evaluation Surveys. In 2001, two end-of-meeting surveys were distributed to attendees of Cranberry Experiment Station Extension meetings. The surveys were distributed after the Cranberry Production Training meeting and the Research and Extension Update meeting. These surveys queried respondents on their opinions of topics covered at the meeting, venue location, and potential new subjects for future meetings. Survey results may be found in Appendix D-9.

Interactions with IPM Consultants, Public Agencies, and Private Groups. The members of the Cranberry Crop and Pest Management team routinely interact with these groups. For example, the

Project Leader contacts private IPM consultants throughout the growing season to obtain input on their observations of pest outbreaks, management tools adopted by growers, and any other unusual events. Several of the team members have grants though the Department of Food and Agriculture and interface with this agency as well as Natural Resources Conservation Service (NRCS) and Department of Environmental Protections (DEP). Members of the Cranberry IPM Team are conducting research on monies from a grant sponsored by the USDA'S Northeast SARE (Sustainable Agriculture Research and Education Program) Granting Program located at the University of Vermont. Additional groups include Cape Cod Conservation District and Plymouth Conservation District, the Sandy Neck governing Board, Cape Cod National Seashore, Farm Bureau, Farm Services Administration and various conservation commissions. Through the broadening of our Advisory Committee, team members continue to interact with representatives of private groups such as the Buzzard's Bay Coalition and the Wood's Hole Rinehart Coastal Research Institute.

OUTREACH ACTIVITIES, RESULTS, AND IMPACTS - FY01

Information Delivery

CRANBERRY PRODUCTION TRAINING. The forum was attended by 161 growers and covered a wide array of basic topics including disease management, managing key insect pests, using herbicides effectively, and making economical fertilizer decisions. In response to the severe downturn of the industry, the keynote subject featured a panel discussion of cost-cutting methods. Staff from CES and growers from the industry presented information related to their areas of expertise.

ANNUAL RESEARCH AND EXTENSION UPDATE MEETING. This meeting, held on March 17, 2001 at the Wareham High School, Wareham, MA, was attended by approximately 70 people. Cranberry Station staff presented research results to the grower audience. In addition, the staff presented a round table discussion on the use of late water floods for pest management and horticultural impacts.

BEGINNER'S CRANBERRY SCHOOL. This meeting was held on April 24, 2001, and approximately 14 new and experienced growers attended. In an effort to accommodate growers that may be working other jobs in addition to their cranberry farms, the meeting was held at night. The focus of the meeting was a review of the basics of IPM and pest identification.

THIRD ORGANIC CRANBERRY GROWING CONFERENCE. This meeting was held on May 14, 2001, with 22 people in attendance. Many aspects of organic production were discussed including marketing and promoting organic products as well as the new USDA Organic Certification Guidelines.

BOGSIDE WORKSHOPS. Three workshops were held at growers' farms and the CES on a monthly basis to assist growers in identifying insect, weed, disease, and plant nutrition problems and provide an opportunity to interact with other growers and staff members. Staff members from CES were present at all meetings to provide advice and expertise. A total of 25 growers attended these meetings, averaging approximately 8 growers per workshop.

New! WEED MANAGEMENT FACT SHEETS. Two new disease fact sheets were authored by Hilary A. Sandler. All fact sheets contain updated integrated management information and color photographs to facilitate correct identification and management. The fact sheets produced were: Dodder (*Cuscuta gronovii*) and Dewberries (*Rubus hispidus* and *R. flagellaris*). See Appendices B2 and B-3.

New! LOW-COST MANAGEMENT STRATGIES. A new fact sheet authored Carolyn J. DeMoranville, addresses the realities of alternative strategies needed for farmers attempting to produce cranberries economically in Massachusetts (see Appendix B-4).

New! NEW PLANTINGS FACT SHEET. Acting upon the suggestion of growers at the 2001 Chart Book meeting, the New Plantings section has been removed from the Chart Book (to save costs) and will now be available as a fact sheet (authored by Carolyn J. DeMoranville, Hilary A. Sandler, and Frank L. Caruso). See Appendix B-5.

New! MANAGING RESISTANT SPARGANOTHIS FRUITWORM. A fact sheet developed by Anne Averill and Martha Sylvia addresses the history of the problem, the biology of the insect, and general recommendations for managing this pest (see Appendix B-6).

New! BEST MANAGEMENT PRACTICE – COMPOSTING CRANBERRY LEAVES. Authored by Hilary A. Sandler, the leaf composting BMP is the end-product of a grant provided by the MA Department of Food and Agriculture Agro-Technology Grants Program and several years of research by personnel of the Cranberry IPM team. The mandate to appropriately manage the disposal of excess fruit, underscores the need for more information on composting leaves and fruit (see Appendices B-7 & B-8).

Other Extension Impacts

CRANBERRY IPM ADVISORY COMMITTEE. The working group that advises and provides input to the IPM program continued to include members of Natural Resource and Conservation Service, MA Pesticide Bureau, MA Department of Environmental Protection, Woods Hole Research Center, and the Coalition for Buzzard's Bay in addition to the traditional coalition of university personnel, growers and IPM consultants. A total of 20 people comprised the committee.

CRANBERRY STATION NEWSLETTER. Eleven issues were published during the period from October 1, 2000 through September 30, 2001. Information reported in the newsletter was provided by University of Massachusetts Cranberry Experiment Station staff. In 2001, 329 subscribers were on the mailing list; approximately 6% were paid subscriptions. This latter group included out-of-state growers, industry personnel, as well as growers from other countries such as Canada and Russia. (See Appendix B-1).

CRANBERRY STATION WEB PAGE. The Web Page for the Cranberry Experiment Station continues to provide up-to-date information on all issues concerning cranberry production, research, and extension during the past fiscal year. Growers may download our newsletters (PDF format) from the web, sign up for our mailing list, obtain information on meetings and current issues, etc. The web address is http://www.umass.edu/umext/programs/agro/cranberries.

SECTION 18s GRANTED IN 2001.

Herbicides: Clopyralid and Pronamide: (renewal) for control of wild bean, narrow-leaved goldenrod and other composite species. Pronamide is used for control of dodder. *(submitted by H.A. Sandler).*

Insecticides: Spinosad and Provado: Spinosad (renewal) is used to manage populations of *Sparganothis* fruitworm. This reduced-risk compound has a novel mode of action and provides an exceptional advantage for the integrated management of this severe secondary pest. Provado was obtained as an emergency use product for limited management of cranberry weevil populations that have become resistance to organophosphate insecticides *(submitted by A.L. Averill).*

Appendices

CRANBERRY IPM ADVISORY COMMITTEE MEMBERS 2001

Anne Averill, UMass-Amherst, Dept. of Entomology

Matt Beaton, Cranberry Growers Service

Frank Caruso, UMass Cranberry Experiment Station

Bill Coli, UMass-Amherst, Dept. of Entomology

Lee Corte-Real, MA DFA, Pesticide Bureau

Carolyn DeMoranville, UMass Cranberry Experiment Station

Bob Fagan, MA DEP

Jeff LaFleur, Cape Cod Cranberry Growers Association

Dave Nolte, Decas Cranberry Company

Mark Rasmussen, The Coalition for Buzzard's Bay

Len Reno, Natural Resource and Conservation Service

Matt Rhodes, Edgewood Cranberry Trust

Hilary Sandler, UMass Cranberry Experiment Station

Bruce Tripp, Woods Hole Oceanic Institute, Rinehart Coastal Research Center

Mike Utley, RASP Ag Supplies

Don Weber, Ocean Spray Cranberries

Monika Weldon, Clean Sweep Cranberry Consulting

SUMMARY OF PROJECT RESULTS AND IMPACTS

Number of farms participating with the project	30
Number of IPM workshops held	5
Number of growers receiving IPM training	294
Number of pesticide contact hours issued	697
Advisory meetings held	1
Surveys distributed	2
Stakeholder meetings held	7
Number of talks given	29
Number of fact sheets produced	5
Number of publications:	
Refereed	1
Abstracts	5
Nonrefereed articles	10
Number of fact sheets sold*	74
Number of publications sold*	47
Revenue from publications & fact sheets*	$1,031
Issues of Station Newsletter	
Subscriptions:	
In-state	309
Out-of-state	20
External funds generated (approximated 1 yr period for multi-year grants)	$92,950

* Due to a subsidy of a one-time grant from the State to the Cranberry Station in support of research and extension activities, all extension materials produced with these monies were distributed at no-cost to the cranberry grower community.

SPECIFIC IMPACTS:

Number of Growers Receiving IPM Training

Cranberry Production Training, January 18, 2001, Plymouth Sheraton Inn, Plymouth, MA: **161 people.**

Research Update Meeting, March 17, 2001, Wareham High School, Wareham, MA: **72 participants.**

Bogside Workshops, June-August, 2001 Grower farms and CES, E. Wareham, MA: ranged from 6-11 people, averaging approximately 8 people at each workshop (**25 attendees** for 3 workshops).

Beginner's Cranberry School, April 24, 2001, CES, E. Wareham, MA: **14 people**.

Third Organic Cranberry Growing Conference, May 14, 2001, CES, E. Wareham, MA: **22 people**.

Number of Growers Receiving Pesticide Certification Credits

Cranberry Production Training (4 contact hours). **121 people**.

Research Update Meeting (2 contact hours). **48 people**.

Bog Workshops (1 contact hour each). **11 people**.

Beginner's Cranberry School (2 contact hours). **5 people**.

Publications Purchased by the Grower Community:

CRANBERRY PRODUCTION-A GUIDE FOR MASSACHUSETTS (SP-127). 27 copies of this new publication were sold in 2001 to growers at a cost of $14 each (includes shipping).

FROST FACT SHEET. 14 copies of this new publication were sold in 2001 to growers for $7 each.

BOG CONSTRUCTION AND RENOVATION MANUAL. 6 copies of this publication were sold in 2001 to growers at a cost of $20 each.

FACT SHEETS. Approximately 60 pest management fact sheets were sold in 2001 to interested growers and industry personnel.

2001 CRANBERRY CHART BOOK. 13 copies of this year's chart book were sold at $10 each.

OLDER EXTENSION PUBLICATIONS. 1 copy of an older extension publication, Bulletin 201, (1 @ $5.00) was sold in 2001.

EXTERNAL FUNDS GENERATED:

Total generated during FY01: $92,950

SARE, **$130,000**. (C.J. DeMoranville, Principle Investigator). Integrated management of cranberry insect, weed, and disease pests using fall and spring floods. (Project participants: A.L. Averill, F.L. Caruso, H.A. Sandler, and M. Sylvia --- on going 4-year project: extended closing date: 30 November, 2002). Estimated value for this fiscal year: $24,000 *Sandler salary (15%) from IPM funds used as matching funds on this grant.*

Hatch Funding. $17,000. (F.L. Caruso). Etiology, epidemiology, and management of cranberry diseases.

Hatch Funding. $10,000. (C.J. DeMoranville). Nutrition, developmental physiology, and flood management in the culture of the American cranberry.

Hatch Funding. $9,050. (H.A. Sandler). Integrated weed management for cranberry production.

Nutra Park, Inc. $10,000. (H.A. Sandler). Use of LPE for improvement of post-harvest characteristics in cranberry. One year of funding.

USDA Wildlife Habitat Enhancement Program. **$10,000.** (J. Mason). Raptor retrofit project. One year of funding.

IR-4 Pesticide Registration Program. $4,000. (H.A. Sandler). Chlorimuron-ethyl: Magnitude of residue on cranberry. March 2001- December 2001.

Ocean Spray Cranberries, Inc. $3,500. (C.J. DeMoranville). Physiological and horticultural responses of cranberry to sanding, fertilization, and irrigation method. April 1999-November 2001.

Ocean Spray Cranberries, Inc. $3,400. (H.A. Sandler). Comparison of weed management techniques and vine planting densities. Spring 2000-Fall 2001. Full funding obtained for two years.

Kaddas Enterprises, Inc. $2,000. (J. Mason). Raptor retrofit project. Donation of materials plus shipping costs.

TITLES OF PUBLICATIONS RESULTING FROM PROJECT

Refereed Articles

Caruso, F.L., P.R. Bristow, and P.V. Oudemans. 2000. Cranberries: The most intriguing native North American fruit. **American Phytopathological Society Web site** - Feature Story November 1-30, 2000. http://www.apsnet.org/online/feature/cranberry.

Abstracts

Catlin, N.J. and F.L. Caruso. 2000. Impact of upright dieback in one cranberry bed in Massachusetts. **Phytopathology** 91:S193.

Catlin, N.J. and F.L. Caruso. 2001. Further insight into the causal agent(s) of upright dieback of cranberry. **Phytopathology** 91:S14.

DeMoranville, C.J., H.A. Sandler, A.L. Averill, M.M. Sylvia, and D. Shumaker. 2001. Integrated management of cranberry pests using fall and spring floods. **HortScience** 36(3):571.

DeMoranville, C.J. and B.D. Lampinen. 2001. Can plant growth regulators, combined with sanding, alter crop load in cranberry? **HortScience** 36(4): 643.

Ellis, D.J., A.K. Kim, H.A. Sandler, J.E. Darga, D. Keeney, and T.A. Bewick. 2001. Differences in chloroplast DNA indicate the presence of intraspecific populations of dodder, *Cuscuta gronovii*. **Amer. Chem. Soc. Abstr**. #434230.

Non-refereed Publications and Articles

Averill, A.L. 2001. **Insect management.** In: 2001 Cranberry Chart Book - Management guide for Massachusetts. *UMass Extension publication*. (*Copies available upon request.)*

Averill, A.L. and M.M. Sylvia. 2001. **Biology and management of Sparganothis fruitworm** fact sheet, *UMass Extension publication*. (*See Appendix.).*

Caruso, F.L. 2001. Fruit rot studies in Massachusetts, 2000. **Cranberries** 65(5):20-23.

Caruso, F.L. 2001. **Disease management.** In: 2001 Cranberry Chart Book - Management guide for Massachusetts. *UMass Extension publication*. (*Copies available upon request.)*

DeMoranville, C.J. 2001. **Nutrition.** In: 2001 Cranberry Chart Book - Management guide for Massachusetts. *UMass Extension publication*. (*Copies available upon request.)*

DeMoranville, C.J. 2001. **Low-cost Management Strategies** fact sheet. *UMass Extension publication*. (*See Appendix.).*

DeMoranville, C.J., A.L. Averill, H.A. Sandler, and F.L. Caruso. 2001. **Late Water.** In: 2001 Cranberry Chart Book - Management guide for Massachusetts. *UMass Extension Publ*. (*Copies available upon request.)*

DeMoranville, C.J., H.A. Sandler, and F.L. Caruso. 2001. **New Plantings** fact sheet. *UMass Extension publication*. (*See Appendix.)*

Romaneo, L.K. and H.A. Sandler. 2001. Use of 2,4-D granular on Massachusetts cranberry bogs. **Cranberries** 65(5): 24-25.

Sandler, H.A. 2001. **Weed management.** In: 2001 Cranberry Chart Book - Management guide for Massachusetts. *UMass Extension publication*. (*Copies available upon request.)*

Sandler, H.A. 2001. Weed management and Identification. pp. 12-15, In: **Wisconsin Cranberry School 2001 Proceedings**. University of Wisconsin Extension Publication.

Sandler, H.A. 2001. **Dodder** fact sheet. *UMass Extension publication*. (See Appendix.)

Sandler, H.A. 2001. **Dewberry and Brambles** fact sheet. *UMass Extension publication*. (See Appendix.)

Sandler, H.A., B. Lampinen, and S. Ward. 2001. **Irrigation and chemigation**. In: 2001 Cranberry Chart Book - Management guide for Massachusetts. *UMass Extension publication*. (*Copies available upon request.)*

PROFESSIONAL AND EDUCATIONAL PRESENTATIONS OF PROJECT MEMBERS AND TECHNICAL STAFF

(all presentations were oral unless otherwise noted)

Anne L. Averill

Managing key insect pests. *Cranberry Production Training*. January 18, 2001. Plymouth Sheraton, Plymouth, MA.

Entomological research results. *Annual Cranberry Research and Extension Update*. March 17, 2001. Wareham High School, Wareham, MA.

Poster presentations. *Research and Update Meeting.* March 17, 2001. Wareham High School, Wareham, MA.

A preliminary analysis of the 2000 population of cranberry fruitworm and specific insect parasites in wild and abandoned cranberry bogs in Sandwich, MA. B. Matsumoto (UM-D), A.L. Averill, and M.M. Sylvia.

Basic insect management and identification. *Beginner's Cranberry School*. April 24, 2001. Cranberry Experiment Station, E. Wareham, MA.

Growing cranberries organically in MA – Insect management. *Third Organic Cranberry Growing Conference*. May 14, 2001. Cranberry Experiment Station, East Wareham, MA.

Current topics in cranberry insect management. *Bogside Workshops*. June 6, June 27, and August 8, 2001. On-site at Slocum-Gibbs Cranberry Company, Jenkins Cranberry Company and Cranberry Experiment Station, E. Wareham, MA.

Frank L. Caruso

Pathological consequences of reduced disease management. *Cranberry Production Training*. January 18, 2001. Plymouth Sheraton, Plymouth, MA.

Plant pathology research results. *Annual Cranberry Research and Extension Update*. March 17, 2001. Wareham High School, Wareham, MA.

Poster presentations. *Research and Update Meeting.* March 17, 2001. Wareham High School, Wareham, MA.

Analysis of genetic variation among isolates of *Colletotrichum acutatum* and *C. gloeosporiodes* using Ribosomal DNA sequence and RAPD markers. J. Darga (UM-D), D.J. Ellis (UM-D), F.L. Caruso, J.S. Mika, and T.A. Bewick.

Potential of Bacillus spp. To alter anoxic soil geochemistry. E. Sabo(UM-D), D.J. Ellis (UM-D), F.L. Caruso, C.J. DeMoranville, and B.D. Lampinen.

Analysis of actinomycete populations in wild and cultivated cranberry soils. K. Holton **(**UM-D), D.J. Ellis (UM-D), F.L. Caruso, N. Sheppard (UM-D), and F. Scarano (UM-D).

Impact of upright dieback in a Massachusetts cranberry bed. N.J. Catlin and F.L. Caruso.

Basic disease management and identification. *Beginner's Cranberry School*. April 24, 2001. Cranberry Experiment Station, E. Wareham, MA.

Growing cranberries organically in MA – Disease management. *Third Organic Cranberry Growing Conference*. May 14, 2001. Cranberry Experiment Station, East Wareham, MA.

Current topics in cranberry disease management. *Bogside Workshops*. June 6, June 27, and August 8, 2001. On-site at Slocum-Gibbs Cranberry Company, Jenkins Cranberry Company, and Cranberry Experiment Station, E. Wareham, MA.

Carolyn J. DeMoranville

Can plant growth regulators, combined with sanding, alter crop load in cranberry? Northeast Weed Science Society/Northeast American Society of Horticultural Science Joint Meeting. Marriott Hotel, Cambridge, MA. January 2-5, 2001.

Alternative Practices. *Cranberry Production Training*. January 18, 2001. Plymouth Sheraton, Plymouth, MA.

Lowest input management. *Cranberry Production Training*. January 18, 2001. Plymouth Sheraton, Plymouth, MA.

Low-cost management options. Panel discussion presented at the *Cape Cod Cranberry Growers' Annual Meeting and Environmental Workshop*. March 2, 2001. Plymouth Sheraton Inn, Plymouth, MA.

Nutrition and frost protection research results. *Annual Cranberry Research and Extension Update*. March 17, 2001. Wareham High School, Wareham, MA.

Poster presentations. *Research and Update Meeting.* March 17, 2001. Wareham High School, Wareham, MA.

Integrated management of cranberry insects and weeds using fall and spring floods. D. Shumaker, C.J. DeMoranville, H.A. Sandler, A.L. Averill, and M.M. Sylvia.

Fundamentals of fertilizer application and frost protection. *Beginner's Cranberry School*. April 24, 2001. Cranberry Experiment Station, E. Wareham, MA.

Growing cranberries organically in MA – Nutrition management. *Third Organic Cranberry Growing Conference*. May 14, 2001. Cranberry Experiment Station, East Wareham, MA.

Current topics in plant health management. *Bogside Workshop*. June 6, June 27, and August 8, 2001. On-site at Slocum-Gibbs Cranberry Company, Jenkins Cranberry Company and Cranberry Experiment Station, E. Wareham, MA.

Hilary Sandler

Discussion of cranberry IPM and various wetland issues. Guest speaker for Wetlands Ecology class, Yale University, New Haven, CT. Lecture held on-site at the Cranberry Experiment Station, E. Wareham, MA. October 27, 2000.

Role of sand piles as weed seed banks in commercial cranberry production. Northeast Weed Science Society/Northeast American Society of Horticultural Science Joint Meeting. Marriott Hotel, Cambridge, MA. January 2-5, 2001.

Weed scouting and identification. Guest speaker at the *Wisconsin Cranberry School*. January 10, 2001. Holiday Inn, Stevens Point, WI.

Scouting your own bogs. *Cranberry Production Training*. January 18, 2001. Plymouth Sheraton, Plymouth, MA.

Cranberry weed management. *Cranberry Production Training*. January 18, 2001. Plymouth Sheraton, Plymouth, MA.

Low-cost management options. Panel discussion presented at the *Cape Cod Cranberry Growers' Annual Meeting and Environmental Workshop*. March 2, 2001. Plymouth Sheraton Inn, Plymouth, MA.

Integrated pest management research results. *Annual Cranberry Research and Extension Update*. March 17, 2001. Wareham High School, Wareham, MA.

Poster presentations. *Research and Update Meeting.* March 17, 2001. Wareham High School, Wareham, MA.

> **Use of chloroplast DNA variability to determine the existence of subpopulations in dodder, *Cuscuta gronovii*.** A. Kim, D.J. Ellis, H.A. Sandler, J. Darga, D. Keeney, and T.A. Bewick.

Introduction to cranberry IPM fundamentals. *Beginner's Cranberry School*. April 24, 2001. Cranberry Experiment Station, E. Wareham, MA.

Growing cranberries organically in MA – Scouting practices and weed management. *Third Organic Cranberry Growing Conference*. May 14, 2001. Cranberry Experiment Station, East Wareham, MA.

Current topics in cranberry weed management. *Bogside Workshops*. June 6, June 27, and August 8, 2001. On-site at Slocum-Gibbs Cranberry Company, Jenkins Cranberry Company and Cranberry Experiment Station, E. Wareham, MA.

Current cranberry IPM: Outreach and research. *Cape Cod Cranberry Growers' Association Annual Meeting*. August 21, 2001. East Wareham, MA.

ADDITIONAL OUTREACH ACTIVITIES BY PROJECT LEADER

Meetings Attended or Services Provided by Project Leader

CHAIR, SEARCH COMMITTEE FOR ENVIRONMENTAL PYSIOLOGIST. Spring 2001-October, 2001. Coordinated the successful search for an Extension Assistant Professor position in the discipline of environmental physiology to be housed at the Cranberry Experiment Station. The selected candidate, J. Vanden Heuvel, is anticipated to start by June 1, 2002.

ON-FARM VISITS. Periodic throughout evaluation period. Visited cranberry growers' bogs and grape farms to offer advice on various aspects of IPM, weed management, and nutrition. Various locations throughout the growing region.

MAINTENANCE OF UMASS CRANBERRY STATION WEB PAGE. On-going throughout evaluation period. Responsible for maintaining and update the Cranberry Station's web page as needed throughout the year. Respond to national and international queries posed by visitors to the web page.

MASTERS' THESIS COMMITTEE MEMBER. Fall, 1998-present. Serving as an advisor and reader on the Masters' thesis committee for Gabrielle Myers of Bard College, NY. Her thesis is entitled, "Cranberry IPM in Massachusetts: Identifying important factors influencing grower adoption".

UMASS EXTENSION BOARD OF PUBLIC OVERSEERS. October 27, 2000. Attended meeting to hear discussion of the SEMAP (Southeastern Massachusetts Agricultural Partnership) plan and reports from UMass Extension units. Cranberry Experiment Station, E. Wareham, MA.

2001 NORTHEAST UNITED STATES CRANBERRY PESTICIDE CHART FOR PRODUCING BEDS. (distributed February, 2001.) Provided expert advice and editorial services for the Cranberry Institute in the publication of the pesticide reference chart.

DODDER RESEARCH MEETING. February 23, 2001. Met with scientists from UM-Dartmouth to discuss on-going research projects on dodder population biology. Cranberry Experiment Station, E. Wareham, MA.

CURRENT TOPICS IN MARINE SCIENCE PROGRAM, May 8, 2001. Attended lecture entitled, "There's something fishy about that cranberry bog." Lecture presented by aquaculture specialists and cranberry growers attempting to farm fish on their cranberry farms. Redfield Auditorium, Wood Hole, MA.

ALL-AGROECOLOGY MEETING. May 22, 2001. Attended meeting for all extension personnel within the Agroecology Program to learn about various aspects of education technology. Campus Center, University of MA-Amherst.

UMass EXTENSION WEB COMMITTEE MEETING. April 25 and June 25, 2001. Attended working group meetings with other Extension professionals who maintain Web pages for their respective programs. Stockbridge Hall, UMass-Amherst, MA.

CCCGA ANNUAL GROWERS' MEETING. August 21, 2001. Discussed current research during a bog tour of research plots on State Bog and hosted a booth featuring Extension materials for the cranberry industry. Cranberry Experiment Station, E. Wareham, MA.

PLANNING COMMITTEE FOR UM-DARTMOUTH CRANBERRY SYMPOSIUM. March 13 and April 30, 2001. Member of the committee responsible for scheduling, obtaining speakers, and planning the 2001 Cranberry Research Symposium. The symposium is slated for November 8, 2001.

PEST MANAGEMENT STRATEGIC MEETING. August 16-17, 2001. Participated in a planning meeting to determine and summarize the needs of the cranberry industry in terms of the efficacy of current pest management practices and the feasibility of identified alternatives. Holiday Inn, Providence, RI.

Professional Development of Project Leader

CONTINUATION OF Ph.D. PROGRAM AT UNIVERSITY OF MASSACHUSETTS-AMHERST. Fall, 1998-present. Fulfilled a portion of standard degree requirements by attending classes at UMass-Amherst campus. Submitted prospectus to the Graduate School, May, 2000. Research projects towards completion of the degree continued during this fiscal year.

HAZARDOUS WASTE MANAGEMENT TRAINING. October 30, 2000. Successfully completed on-line training certification as required by Environmental Health and Safety, UMass-Amherst.

NORTHEAST DIVISION OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY. November 1-3, 2000. Attended various lectures and meetings. Sea Crest Conference Center, North Falmouth, MA.

CIVIL RIGHTS EDUCATION. December 5, 2000. Attended meeting with Civil Rights Coordinator from USDA. Meeting held at the Cranberry Experiment Station, E. Wareham, MA. Reviewed the mission and priorities of the Cooperative State Research, Education, and Extension Service (CSREES).

GOOD LABORATORY PRACTICES TRAINING. January 5, 2001. Trained in GLP in field data bookkeeping and technical field aspects by E. Lurvey, IR-4 Northeast Regional Field Research Coordinator. Marriott Hotel, Cambridge, MA.

ANNUAL MEETING WEED SCIENCE SOCIETY OF AMERICA. February 11-14, 2001. Attended various symposia and weed management forum presented at the annual national meeting. Sheraton Four Seasons Hotel, Greensboro, NC.

IR-4 TRAINING WORKSHOP. February 17-21, 2001. Attended participatory workshop with IR-4 officials and received training in IR-4 procedures. Received a *Certificate of Training* in IR-4 Field Training and a *Certificate of Training* in IR-4 Orientation and Introduction to GLPs. Radisson Hotel, San Antonio, TX.

CAPE COD CRANBERRY GROWERS' ASSOCIATION WINTER MEETING AND ENVIRONMENTAL WORKSHOPS. March 2, 2001. Attended workshops given by CCCGA staff, cranberry growers, and invited guests. Plymouth Sheraton Inn, Plymouth, MA.

INTRODUCTION TO DREAMWEAVER. March 12 & 14, 2001. Trained in the basic skills needed for operating the website management software, Dreamweaver. Office of Information Technology Workshop Programs. Lederle Lowrise, Amherst, MA.

LABORATORY AND RIGHT-TO-KNOW TRAINING. April 6, 2001. Attended training session taught by A. Sorenson of the UMass Environmental Health and Safety Office. Cranberry Experiment Station, E. Wareham, MA.

LIBRARY LONG DISTANCE LEARNING PROGRAM. April 17, 2001. Trained in various aspects of utilizing the library resources available at UMass-Amherst. Calipari Room, Du Bois Library, Amherst, MA.

PROJECT PARTICIPANTS AND SUPPORT STAFF

Main Project Participants

Hilary Sandler, Project Leader

Anne Averill, Cranberry Team Leader, Small Fruit Entomologist

Frank Caruso, Plant Pathologist

Carolyn DeMoranville, Cranberry Nutrition Specialist

Support Staff

Nora Catlin, Graduate Student, Plant Pathology

Joanne Mason, Research Technician for IPM Program

Jane Mika, Research Technician for Plant Pathology program

Daniel Shumaker, Research Technician for Nutrition/IPM Program

Martha Sylvia, Research Technician for Entomology Program

Summer Assistants

Krystal Demoranville

Andrienne Blanchard

Jenna Morrison