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Blueberry Progress Reports

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BLUEBERRY PROGRESS REPORTS

MAINE LIFE SCIENCES AND AGRICULTURE EXPERIMENT STATION
and
MAINE COOPERATIVE EXTENSION SERVICE

Prepared for

THE MAINE BLUEBERRY COMMISSION
and the
UNIVERSITY OF MAINE BLUEBERRY ADVISORY COMMITTEE

March 1980

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FY = 1979 Blueberry Extension Program Progress Report
Maine Cooperative Extension Service
University of Maine at Orono
Amr A. Ismail
Extension Blueberry Specialist

I.1. Clientele Problem:

Although commercial lowbush blueberry production in Maine represents a multi-million dollar industry with economic importance to a large number of blueberry producers, pickers, shippers and packers, production efficiency and returns per acre are relatively low. Problems relevant to cultural and field management practices are numerous and range from weed control, pruning, fertility management, using bees for pollination to harvesting methods and fruit quality. Research findings indicate the feasibility of significantly increasing yields in most of Maine blueberry fields if certain cultural practices are adopted. Growers have requested the Extension Service to provide an educational program in blueberry management.

2. Extension Objective:

Provide a formal/informal learning experience for blueberry growers to better educate and equip them to make decisions relevant to the management of their fields and how to improve production and reduce unit (pound) cost. This could be done by holding a Blueberry School.

3. Actions:

- a. Members of the University Blueberry Advisory Committee were asked whether there was a need for holding a Blueberry School. They all identified this need and supported the idea.
- b. Response to a survey of blueberry growers on the Extension blueberry mailing list showed that approximately 250 growers indicated that there is a need for a Blueberry School and requested the Extension Service to schedule and teach the school. Ten growers were not in favor of holding a school. The survey also identified three possible locations where growers would like the school to be held, time of day, duration and topics of discussion.
- c. A Blueberry School was scheduled for four consecutive weeks in March and April 1979. In order to encourage the largest number of growers and interested people to attend, the school was repeated at three locations: Ellsworth, Machias and Union and was scheduled during the evening. News releases were provided for local papers and regular weekly announcements of the school and topics to be discussed were made through 6 radio stations in different blueberry producing areas in the State.

4. Results

- a. Two hundred and seventy active and potential blueberry growers as well as interested citizens attended the Blueberry School. Two hundred and forty people indicated that they shall change cultural practices in their fields; 210 better weed control; 57 better fertility management; 37 use bees for pollination; 29 change (unspecified).
- b. The need for better grower cooperation and marketing efforts were identified.

5. Evaluation:

- a. Answers to a questionnaire at the end of the school revealed that 260 people indicated that it was appropriate for CES to conduct the school; that the school helped them better understand management practices and blueberry production; it was a time well spent on their part as well as by CES. They also indicated that it was a proper use of their tax dollar. Growers asked CES to continue this type of program in the future.
- b. The Extension Blueberry Specialist found out that holding this type of a program three nights a week for four consecutive weeks in different locations with many miles in between was hectic and very demanding for one person. The three locations were away from the home office.

II.1. Clientele Problem:

Blueberry fields in Maine are pruned by fire. Burning blueberry fields has been the accepted and only practical way for pruning these plants. Fuel oil is the most common and widely used source of fuel for burning Maine blueberry fields.

2. Extension Objective:

Blueberry growers will reduce energy consumption and cost in blueberry production by changing from oil burning to flail mowing for pruning their blueberry fields.

3. Action:

- a. Demonstration of mowing equipment and comparison between a mowed as well as properly managed field and a burned one.
- b. Provide News releases and media coverage of CES pruning demonstration activity.

4. Results:

- a. More than one hundred growers attended the equipment and pruning demonstration.
- b. News articles appeared in seven newspapers and was reported by five radio stations.

- c. Approximately twenty growers purchased flail mowing equipment for pruning their blueberry fields. This fall more than 500 acres are expected to be pruned by mowing instead of fire. Estimated fuel oil savings of 25,000 gallons or 25,000 dollars will be realized.
- d. It is estimated that in the next 3-5 years Maine blueberry growers will shift a large acreage to flail mowing instead of burning as a pruning method. Estimates are of savings in fuel oil of approximately 300,000-500,000 gallons and an equivalent 600,000-1,000,000.

5. Evaluation:

- a. Very positive feed back from growers attending the demonstration.
- b. Acceptance of a new practice by several growers.

III.1. Clientele Problem:

Production in most of Maine's blueberry fields is greatly limited due to presence of a wide variety of competing plant species. Harvesting of the berries is also greatly hindered by the presence of these weeds.

2. Extension Objectives:

Help growers understand the safe use, benefits and pitfalls of herbicide application for controlling weeds.

3. Action:

- a. Work with members of the University Blueberry Advisory Committee, interested County Agents, and growers on formulation and implementation of action plan.
- b. Establish weed control and fertility demonstration plots with cooperating growers. Demonstrate use of equipment, safety precautions and method of application of herbicides. Yield data were also collected.
- c. In order to encourage as many growers as possible to attend and participate in this CES educational activity, announcements of objectives of activity, location of field plots, names of cooperating growers, dates of field days and other relevant information were included in the CES Blueberry Newsletter and in a news release to local and state-wide newspapers.
- d. More than 50 CES-blueberry field demonstration plots were established in six counties during the past five years.

4. Results:

- a. More than 150 growers participated in this educational activity.
- b. News articles about the project appeared in 5 newspapers and were broadcast by 4 radio stations, which assured wider distribution of the information to interested people.
- c. All blueberry growers who cooperated in establishing and evaluating the 50 field demonstration plots adopted and are now practicing a better weed control program. Many other growers who visited the plots did the same.
- d. As a result of a better weed control program, cooperating growers indicated an increase of 50-80% of yield in their fields.
- e. In 1979 (after five years of initiation of the project) more than 50% of the blueberry acreage in Maine was treated with herbicide for grass control.

5. Evaluation:

Cooperating growers were asked of their assessment of CES-blueberry weed control demonstration project. They unanimously agreed that it was appropriate for CES to undertake the project; they benefited educationally and financially from participating; would like to cooperate again with CES in similar future projects.

Resource Allocation

1. See Table 1 (attached). 60% Extension = 140 days.
2. No changes among Program Areas - (Agriculture and Natural Resources.)
3. No changes in Program Component within Program Areas - (Crop Production.)

Narrative

1. Problem - Although commercial lowbush blueberry production in Maine represents a multi-million dollar industry with economic importance to a large number of blueberry producers, pickers, shippers and packers, its efficiency and returns per acre are relatively low. Problems relevant to cultural and field management practices are numerous and range from weed control, fertility management, pruning, using bees for pollination to harvesting methods and fruit quality. Research findings indicate the feasibility of significantly increasing yields in most of Maine blueberry fields if certain cultural practices are adopted. Growers have requested the Extension Service to provide an educational program in blueberry management.
2. Objective - To provide an educational program to Maine commercial blueberry producers with emphasis on improving production and reducing production cost per unit, conserving energy resources, safe use of pesticides, consider alternatives for pesticide use in blueberry production.
3. Expected Results - Blueberry producers will be able to make profitable management decisions that will lead to increased production (per acre unit) of desirable fields and consider alternative uses of marginal and inherently poor producing fields. A 10% increase in the state-wide production of blueberries will result in an approximately 1,000,000 dollar increase in returns to blueberry producers. A 10-25% increase is expected in the next 2 years with additional increases (25%+) within four years. Since practically all blueberries produced in Maine are also packed in the State, an increase in blueberry production will be accompanied by increases in the employment opportunities for pickers, shippers and packers of blueberries. Conserve energy in blueberry production.

4. Staff Involved: Amr A. Ismail.

Actions Planned: Blueberry School, field demonstration plots, Blueberry Newsletter, correspondence, limited farm calls, newspaper articles, radio and TV interviews, field days, and applied studies.

Time Planned: 60% Extension = 140 days.

5. Method of Evaluation: Questionnaire, interviews, growers participation in activities, extent of actual field application of management practices.

6. Program Area: Agriculture and Natural Resources.

Program Component: Crop Production.

Program Development Councils and Committees

1. University Blueberry Advisory Committee
Extension Executive Committees (Hancock & Washington Counties).
2. a. Input and involvement in planning, execution and evaluation
of program.
b. Strength - considerable input and participation in program.

Personnel:

Amr A. Ismail, David Yarborough, Delmont C. Emerson, Eric Hanson.

Mission of Project:

To improve blueberry production, reduce energy consumption and pruning cost.

Specific Objectives:

1. Evaluate the effectiveness of various pruning methods (mechanical, thermal, etc.) and time of pruning (fall vs. spring) on plant growth, yield and soil organic matter.
2. Evaluate promising pruning equipment; mowers and burners.
3. Develop or adapt flail mowing equipment for pruning lowbush blueberries.

Status of Current Research:

1. In progress is a study on the effects of burning and mowing in the fall or spring (in addition to one level of terbacyl and fertilizer) on the growth and yield of blueberries, on the concentration of key elements in blueberry leaves, and on the accumulation of soil organic matter. This experiment was initiated in 1968 in Pineo field on the barrens in DeBlois and will be conducted over an eight year period. Data on plant stand and vigor (stem counts, length, branching and flower buds) and leaf nutrient contents were obtained in 1979 and are being analyzed. Yield data will be obtained in the summer of 1980. Plots will be pruned again the fall of 1980 and spring of 1981.
2. A study of the economics of pruning using flail mowers versus burning by oil or straw is being completed.
3. Plant stands and yields are being evaluated at several locations, i.e. Blueberry Hill Farm, TW-18, and Ellsworth to compare the effects of pruning by flail mowing versus burning in commercial fields.
4. Changes in design and construction of a commercially available Mott P-38 flail mower have been made to adapt it for use for pruning lowbush blueberries. Modifications are made to increase the mowers effectiveness considering the lowbush blueberry growing habits and the prevailing irregular field topography.
5. The Bosse' burner is being evaluated in order to reduce fuel consumption and conserve the organic pad.

Significant Research Accomplishment:

1. Identified close flail mowing as a practical method for pruning lowbush blueberries. Blueberries pruned mechanically (mowed with a flail mower) yielded as much as those pruned by fire (oil or straw burn). Results to be published in Proceedings of North American Blueberry Workers Conference, University, Arkansas, Oct. 1979.
2. Determined that a "segmented system" consisting of several narrow mowers is more practical and efficient for pruning lowbush blueberries than a single large rotary mower.
3. Improved the design of a Mott P-38 flail mower to make it more adaptable for use on irregular lowbush blueberry fields.
4. Developed a "trailing system" for 3 Mott P-38 flail mowers for use in lowbush blueberry pruning.

Impact of Research:

Burning with fuel oil is currently the most practical method of pruning blueberries but is costly and destructive to the organic material on the surface of the soil. Fuel oil is a nonrenewable resource that is rapidly increasing in cost and becoming less readily available.

This research provides information on the effectiveness and practicality of different pruning methods and equipment. With improvements in weed control practices and fertility management, it may become possible to reduce the frequency of burning (possibly every 3 or 4 years) or substitute mowing for burning as a pruning method. The development of a more efficient burner would help reduce production cost and conserve energy.

Research Plans for 1980:

1. Continue to evaluate the pruning experiment initiated in 1978.
2. A greenhouse experiment will be conducted to determine the efficacy of the desiccants: paraquat (paraquat CL), dinoseb (Dow general weed killer) and Ametryne (UB1-1201) in chemically pruning lowbush blueberries. If promising, results from this experiment will lead to field evaluation of the promising material(s).
3. Study the effects of burning, mowing and the use of chemical desiccants in combination with mowing to prune blueberries at a single level of terbacil and fertilizer on blueberry plant growth and yield.
4. Evaluate 24" flail mowers that will be provided by Mott Mower Company. Develop or adapt trailing system for a gang of five mowers.

Integrated Management of Blueberry Fields

Personnel:

Amr A. Ismail, David E. Yarborough, Delmont C. Emerson.

Mission of Project:

Develop and demonstrate an integrated management program that combines various cultural practices to achieve maximum yield of blueberries with decreased production and harvesting costs.

Specific Objectives:

1. To evaluate the effects of various combinations of weed control and fertility practices along with irrigation, the use of honey bees for pollination, and pest management on the blueberry plants as well as other present plant species. The goal is to identify and demonstrate compatible and beneficial cultural practices and increase first crop production and possibly to produce an economical second year crop.
2. To identify plant growth habits and establish field conditions that will facilitate ease of mechanical harvesting.
3. Early identification of problems that may be encountered where new cultural practices are adopted on a commercial scale.

Status of Current Research:

Plots have been established during the past five years. Several years are needed to evaluate and determine the most desirable combinations of cultural treatments and practices under different field conditions (weather, fields, soils, plants, etc.).

Significant Research Accomplishments:

Certain benefits as well as pitfalls of application of herbicides and fertilizer (at various levels) have been identified under commercial growing conditions. Production problems that need further attention or research by this project as well as others have been identified. Effective weed control has been shown to be essential before a progressive fertility program may be adopted.

Impact of Research:

If a combination of weed control, improved fertility and other compatible cultural practices can be combined in an effective field management program, there should be a substantial increase in the yield per acre and a decrease in the cost per pound for producing and harvesting blueberries.

Research Plans for 1980:

1. Maintain and evaluate existing management areas (5-20 acres at several locations in several counties) where herbaceous and woody weeds have been controlled, fertilizer applied and insects and diseases managed according to the latest research findings.

2. Establish new integrated management areas, as mentioned above, in additional locations. Establish irrigation treatment on new burn areas in addition to the various recommended cultural practices.
3. Observe growth and other conditions in certain fields pruned by flail mowing in the fall of 1979.

Personnel:

Amr A. Ismail, David E. Yarborough, Delmont C. Emerson

Mission of Project:

To improve blueberry production and facilitate harvesting by developing new or improved methods of controlling weeds in lowbush blueberry fields.

Specific Objectives:

1. Evaluate herbicides for the control of grasses, sedges, and flowering herbaceous weeds (goldenrod, etc.).
2. Evaluate herbicides for the control of woody weeds (lambkill, barrenberry, poplar, etc.).
3. Develop or improve equipment and methods for application of herbicides for selective control of weeds in lowbush blueberry fields. Emphasis is to reduce amount of herbicides used, and minimize effect on non-target areas.

Status of Current Research:

1. Combinations of terbacil (Sinbar) and simazine (Princep) are being evaluated for herbaceous weed control in lowbush blueberry fields located in Aurora. Simazine is expected to extend the spectrum of control over terbacil and diuron (Karmex). Simazine is currently registered for use in highbush blueberries but efficacy and residue data are needed for lowbush registration.
2. In progress is a study to determine the effectiveness of several rates of 2,4-D and glyphosate (Round up) for lambkill control in blueberry fields (TW-19) applied on different dates after leaf abscission. Data on lambkill and blueberry plant stand and growth, as well as blueberry yield, were collected and evaluated. To determine extended effects on yield, berries will be harvested in 1980. Additional herbicide treatments will be applied in fall 1980.
3. An experiment designed to ascertain the effectiveness of several herbicides selectively applied with a segmented weed roller to control poplar in a lowbush blueberry field was initiated in August, 1979 in Columbia Falls. The chemicals include 2,4-D in water or oil, glyphosate (Round up) fosamine (Krenite), dicamba (Banvel) and a 2,4-D + dicamba mixture (Weedmaster). Poplar stand was determined before treatment. Plots were mowed in fall '79, will be burned in spring '80. Effect of herbicides on poplar will be evaluated in summer '80 and '81, and on blueberry yield in '81.

4. Asulox (Asulam) was shown to control braken fern in England and Canada. Blueberries are reported to be resistant to asulox. A preliminary experiment in which several rates of asulox were sprayed on braken fern on a newburn blueberry field was initiated last summer in Columbia Falls. The effect of asulox on braken growth and blueberry yield will be evaluated in 1980.
5. Preliminary trials were initiated in the summer of '79 to determine the effectiveness of a 10% hexazinone pellet (Velpar gridball) in controlling woody weeds which grow in clumps (i.e. birch, maple, oak and willow). Pellets were placed at the base of the target species, and an indication of injury was obtained in the fall of 1979. Evaluations on the effectiveness of kill of the target species and blueberry growth will be obtained in 1980.

Significant Research Accomplishments:

1. Glyphosate or 2,4-D applied selectively with a weed roller after harvesting reduced the number of barrenberry stems without seriously affecting blueberry stem length or flower bud number. Higher rates of herbicides provided a greater reduction in barrenberry plant stand. Glyphosate or 2,4-D provided adequate control of black barrenberry plants in lowbush blueberry fields. Results were reported in the Journal of the American Society of Horticultural Science, 104(6):786-789, 1979.
2. Endothall (des-i-cate) applied in a blueberry field with extensive barrenberry population selectively defoliated the blueberry plants. Later application of glyphosate resulted in 61 to 85% reduction in barrenberry stand without affecting blueberry stand. Herbicide treatments did not affect yield of mixed berries (3 years after treatment). Untreated barrenberries accounted for 30% of the mixed berry yield and only for 3% of total yield when treated with 2 lbs/acre glyphosate preceded by endothall. Research results of effect of treatments on blueberry and barrenberry plant stand and vigor were reported in the Canadian Journal of Plant Science, Vol. 59: 737-740, 1979. Yield and mixed berry data were submitted (January, 1980) for publication in the Canadian Journal of Plant Science.
3. Glyphosate and 2,4-D were applied on two dates after blueberry leaf abscission to determine their effectiveness in controlling lambkill. Glyphosate and 2,4-D reduced the number of lambkill stems. The late application of glyphosate was more effective than 2,4-D in reducing lambkill plant stand. Increasing the rate of glyphosate (from 0.5 - 2 lbs/acre) resulted in a greater number of blueberry stems, more flower buds per stem and higher yield. This work was submitted in January 1980 for publication in Weed Science.

4. The Federal Insecticide, Fungicide, and Rodenticide Act (1972, amended 1978) requires that all the registered uses for the pesticide be listed on the label. A state label was obtained for woody weed control with 2 lbs/2,4-D (Esteron 99 concentrate) using a selective herbicide application after the crop is harvested or in the summer 3 years after pruning. A provision to use 3 lbs. 2,4-D from Esteron 99 concentrate per acre after leaf drop for lambkill control in lowbush blueberry fields was also added on the state label. (The Dow Chemical Co. product Esteron 99 concentrate is the only product which may be legally used.)
5. A greenhouse experiment was conducted to investigate the herbicidal effects of 2,4-D and glyphosate on barrenberry plants. The controlled environment of the greenhouse allowed for detailed observations on phytotoxic symptoms, survival, and regrowth. The results were published in the Journal of the American Society of Horticultural Science, 1979.

Impact of Research:

This research provides essential information on the ability of certain herbicides to control specific weeds, and the effect of their application on blueberry plant growth and yield.

Blueberry growers will benefit by being able to control certain weeds in blueberry fields, improve their productivity, increase ease of harvesting, reduce costs, and improve the quality of the blueberry pack.

Research Plans for 1980:

1. Complete existing experiments:
 - A. Herbaceous weed control; Terbacil and Simazine.
 - B. Lambkill control; glyphosate and 2,4-D in TW 19.
 - C. Poplar control; 2,4-D, glyphosate, fosamine, dicamba, and weedmaster in Columbia Falls.
 - D. Braken fern control; asulox in Columbia Falls.
 - E. Woody weed control; hexazinone in Jonesboro.
2. Initiate a greenhouse study to further evaluate the effect of different rates of glyphosate applied to dormant blueberry plants on plant growth. Field observations suggest that dormant sprays of glyphosate produced desirable effects on blueberry growth: branching, vigor, flower buds, etc. (Was initiated, February 1980.)
3. A greenhouse experiment to determine whether terbacil or terbacil and diuron have growth regulating effects on blueberries will be conducted. Field data indicate that blueberries treated with terbacil or terbacil and diuron have greater number of flower buds and yield than non-treated plants. Under greenhouse conditions plants will be free from weed competition and the effect of the chemicals on the growth and potential yield could be evaluated. (Was initiated in February 1980.)

4. Initiate a study to further evaluate the practice of glyphosate application preceded by endothall for barrenberry control on a scale larger than the initial studies 1977-79. The experiment will be conducted in Spring Pond area on the barrens in Deblois.
5. Evaluate the efficacy of pre-emergent spray of hexazinone (WP formulation) in certain herbaceous and certain weeds control (emphasis on goldenrods and spirea). The effect of hexazinone on blueberry plants will also be studied.
6. Initiate a study to further explore the effectiveness of 10% hexazinone pellets in woody weeds control. Rates of application will be based on observations made from the 1979 preliminary study.
7. An experiment to further test the effects of asulox on bracken fern will be initiated. Leads provided by the 1979 preliminary study will help determine rates and dates of asulox application.

PHYSIOLOGY AND CULTURE OF THE LOWBUSH BLUEBERRY

Personnel:

Project Leader: - Dr. John M. Smagula
Research Technician: - Edward McLaughlin
Graduate Student: - John Frett

Mission of Project:

To develop effective methods of increasing plant cover that will permit more intensive management and increased yields from natural and cultivated blueberry fields.

Specific Objectives:

- a) To develop a method for in vitro culturing of lowbush blueberry tissue.
- b) To investigate the role of growth regulators in rhizome initiation and development.
- c) To study nutritional responses of the lowbush blueberry related to growth habit, particularly rhizome production.
- d) To study the effect of Promalin (a growth regulator formulation) on fruit set and yield of lowbush blueberries.
- e) To evaluate the influence of different bark mulches on growth and spread of the lowbush blueberry.

Status of Current Research:

- a) Tissue culture propagation of the lowbush blueberry using shoot tip culture is being investigated. Graduate student John Frett is studying methods of altering the growth of adult blueberry plants to make them more responsive to tissue culture. Methods currently being studied include treatment with Ethrel, a plant growth regulator and subjecting plants to low temperature and darkness (etiolation).
- b) The effect of N fertilization on the rate of clonal spread is being studied in Hancock and Eddington, Maine. This work is partially supported by Tennessee Valley Authority (TVA) funding. In 1978, urea was applied at 0, 40, and 80 lb. N/A to treatment plots within each of 5 clones located on Mr. Frank McGinley's farm, Eddington. This past spring, six additional clones located on Merrill's land in Hancock, Maine, received similar treatments. Clonal spread, winter

injury, plant stand, concentration of nutrients within leaves and yield are being measured during successive production cycles.

- c) Methods of introducing selected plant material into existing fields is being investigated. In 1978, seedlings and cuttings were planted in tilled or non-tilled blueberry soil, with or without a surface bark mulch. The survival of rooted cuttings was 94% compared to 88% for seedlings. Plant survival was 100% in non-tilled soil and 83% in tilled soil. Survival was slightly better in mulched (94%) than non-mulched (88%) plots. Mulching had a marked effect on frost heaving; none of the plants showed signs of frost heaving when mulched, whereas, 75% of the non-mulched plants were heaved to some extent. Tilling the soil also seemed to contribute to frost heaving, since 50% of the plants in tilled soil showed signs of being lifted compared to 25% in the non-tilled soil.

In a second plot, larger two-year-old plants responded similarly. Survival was 94% for both rooted cuttings and seedlings. Frost heaving was 44% and 50% for the tilled and non-tilled plots, respectively. Mulched plots had no plants frost heaved, while in non-mulched plots 94% of the plants showed evidence of heaving.

- d) Several containerized systems for mass production of selected plant materials are being evaluated. To obtain a uniform seedling source, Augusta x 4161 and 4161 x 2827 crosses were made by placing a small beehive in cages containing the respective clones. Seeds extracted from the collected fruit will be used as the plant material for container evaluation this winter.
- e) A fruit set experiment, partially supported by Abbott Laboratories, was conducted on Merrill's land in Hancock, Maine. GA₃ was substituted for GA₄ + GA₇ in the Promalin formulation (GA₄ + GA₇ + Benzyl Adenine). GA₃ + Benzyl Adenine was applied at 0, 12.5, 25, 50, 100 or 200 ppm to 1 x 1m treatment plots within each of 6 clones. Half of each treatment plot was caged to exclude pollination by bees brought into the field. Yield was not affected by the growth regulator formation on the uncaged portions of treatment plots. Within the caged portion of treatment plots, however, there was a linear increase in yield within increasing concentrations of GA₃ + Benzyl Adenine. Normal appearing blueberries were produced; however, ripening was delayed by almost one month. Since a large difference in clonal response was also observed, work in this area will be discontinued. Promalin and other growth regulator formulations will be tested for stimulating growth and enhancing rhizome production.

- f) The effectiveness of GA₃ and GA₄ + GA₇ was compared in a germination study conducted in the spring, 1979. Seeds were treated for 24 hours with 0, 1000, 2000, 3000 or 4000 ppm GA₃ or GA₄ + GA₇. There was no significant difference between the kinds of Gibberellic acid. All concentrations (1000, 2000, 3000, 4000 ppm) resulted in an earlier cumulative germination than the control. There was no significant difference among concentrations.
- g) The effect of mycorrhizal associations on growth and development of the lowbush blueberry is being studied. A literature review of mycorrhizal fungi has been conducted. Fungi believed to be associated with the lowbush blueberry have been collected from commercial fields. Pure cultures of these fungi are being prepared. Seedlings will be grown in media inoculated with these fungi as a means of testing their effectiveness in enhancing growth.
- h) A bark mulch study was established in 1977 at Blueberry Hill Farm with the financial support of the USDA and cooperation of Walter Grant. The mulch treatments were bark, bark amended with nitrogen, composted sludge, and composted sludge amended with sulfur; and their pH at the time of application (June, 1977) were 6.8, 9.2, 7.9 and 7.2, respectively. The pH of all mulches decreased with time, and by October, 1978, only the unamended composted sludge was above pH 6. The pH of bark samples taken during October, 1979 were comparable to the pH values of 1978, with the unamended composted sludge having the only relatively high pH (6.8). The pH of the bark + N and composted sludge + S treatments continued to decrease slightly with time, while the pH of the bark and unamended composted sludge have apparently stabilized or leveled off.

Significant Research Accomplishments:

- a) Etiolated shoot tips from a sod-piece stored for several months at 37°F produced axillary shoots and adventitious shoots when cultured on a medium described by Zimmerman. Multiple shoots developed from buds of the cultured stem and from callus which developed at internodal areas as well as leaf margins. When new shoots generated from callus or existing buds were transferred to fresh medium, their rate of proliferation was even greater.
- b) GA₃ and GA₄ + GA₇ were comparable in stimulating early germination of lowbush blueberry seed under normal greenhouse conditions. Treatment with 1000 ppm GA₃ for 24 hours is suggested as a method of enhancing lowbush blueberry seed germination.
- c) Bark mulch significantly reduced frost heaving of 1 and 2 year old plants in a Deblois field planting. The data suggest that one year old plants are more susceptible to heaving in tilled than non-tilled soil.

- d) A growth regulator formulation (GA_3 + Benzyl Adenine) induced the development of parthenocarpic (seedless) fruit on 6 clones when pollination was excluded. GA_3 and GA_4 + GA_7 appear to be equally effective as components in a fruit setting growth regulator formulation.

Research Plans for 1980:

The following studies will be conducted during 1980:

- a) Tissue culture propagation of lowbush blueberries using shoot tip culture.
- b) Effect of growth regulator formulations on growth and rhizome production of the lowbush blueberry.
- c) The effect of N fertilization on clonal spread.
- d) The interaction of fertility and pruning practices on growth characteristics and yield of the lowbush blueberry.
- e) Introduction of selected plant material into existing lowbush blueberry fields; containerized systems and growing media.
- f) Effect of mycorrhizal associations on growth and development of the lowbush blueberry.

Effect of Plant-Water Stress on "Lowbush"
Blueberry Growth, Yield and Quality

Personnel:

G.R. Benoit, W.J. Grant and Amr A. Ismail

Mission of Project:

1. To determine the effect of duration and magnitude of plant-water stress on lowbush blueberry plant growth, fruit bud development, fruit set, yield and quality.
2. To determine the amount and timing of water required for optimum blueberry growth and yield under various soil and climatic conditions.

Status of Current Research:

Greenhouse Study:

Rooted cuttings of clone 4161 were established during 1978 in 32 automatically watered pots. Soil moisture treatments of .2, .6, 1 and 5 bars of tension were imposed on the plants during the vegetative growth phase of 1979. These water levels yielded 8 replications of 4 treatments. The plants were placed in cold storage in the fall. The effect of water stress on flowering will be determined by flower counts during the spring of 1980.

Field Study:

Eight clones located in a Deblois, Maine blueberry field were selected and subdivided with wooden barriers during the summer of 1977. These clones were burned and treatments established in the spring of 1978. Treatments consisted of three levels of soil-water maintenance (soil-water levels of .2 and .6 bars of tension and no added water) and three levels of fertilizer (45, 90 and 135 lbs. of N. per A. in a 5-10-5 fertilizer). Soil-water level was monitored and water levels were maintained automatically throughout the summer. The effect of water levels on potential production was determined by blossom counts, berry counts and yields during 1979. Results indicated a 23-25% increase in potential production for the .2 water level treatment as expressed by numbers of blossoms and total numbers of berries. This translated into an actual 23-25% increase in yield as expressed by grams of berries harvested. No fertilizer effect was noted and no differences in berry sugar content was observed with respect to water levels or fertilizer application.

Impact of Research:

Results indicate to date that under field conditions a 25 percent increase in berry yield can be achieved by proper irrigation during the first year of the blueberry growth cycle.

Research Plans for 1980:

The effect of water treatment on potential production will be determined over one more complete growth cycle.

BLUEBERRY PATHOLOGY

Personnel:

F.L. Caruso and M.G. Zuck

Mission of Project:

To study the prevalence of diseases of the lowbush blueberry, and to determine the effectiveness of the present means of disease control.

Specific Objectives:

To observe blueberry fields for the evidence of diseases such as Botrytis blight, red leaf, mummy berry, witch's broom, and other problems.

Status of Current Research:

Samplings were taken of vigorously growing clones to be utilized in future greenhouse inoculations. Clonal plants were dug up and potted for storage in the cold room. Attempts at isolation of the red leaf fungus, Exobasidium vaccinii, were unsuccessful. Preliminary studies of Botrytis tolerance to Benlate were initiated.

Significant Research Accomplishment:

There was a reasonable amount of Botrytis blight and red leaf disease present in 1979, due to the particularly rainy May.

Impact of Research:

Observations will direct the research into finding the best and most economical means of disease control.

Research Plans for 1980:

1. Conduct an intensive search of Benlate-sprayed and non-Benlate sprayed fields for tolerance to the fungicide displayed by Botrytis. The effectiveness of Benlate will be compared to other Botryticides.
2. Assist Jack Smagula in his project with mycorrhizal fungi associated with blueberry plants.
3. Continue the survey for particularly bad disease problems, especially noting whether disease incidence increases in fields mowed rather than burned.

Personnel:

Steven B. Johnson, Dr. Simeon S. Leach

Mission of Project:

1. Identify initial inoculum source of Botrytis cinerea.
2. Establish inoculum potential of Botrytis cinerea.
3. Determine timing for application of fungicides.

Status of Current Research:

Research completed.

Significant Research Accomplishments:

1. The primary inoculum for Botrytis cinerea was determined to be the leaf fraction of the duff of the lowbush blueberry field.
2. The infection period was shown to be as short as seven hours under favorable environmental conditions, not the previous reported 3-5 days.
3. Fungicide application did not reduce primary inoculum.

Impact of Research:

1. Identified source of primary inoculum, therefore, control management practices can be more effectively developed.
2. For fungicides to be successful in controlling the disease they must be present prior to when the spores land on the plant.

Research Planned for 1980:

None - Mr. Johnson completed the research for a Masters Degree which was devoted to the study of Botrytis blossom and stem blight of lowbush blueberries.

INSECTS AFFECTING THE BLUEBERRY

Personnel:

Howard Y. Forsythe, Jr.

Mission of Project:

Protect blueberry crop from loss due to insects.

Specific Objectives:

- (a) To find more effective and less hazardous insecticides which are less damaging to the environment.
- (b) To determine the feasibility of utilizing trapping methods to monitor for blueberry maggot fly activity.
- (c) To study biology, ecology, and behavior of blueberry pests as necessary for development of control measures.

Status of Current Research:

No research was conducted in 1979. A few traps were set up and maintained in one field to monitor for blueberry maggot fly activity.

Significant Research Accomplishment:

None

Impact of Research:

Maggot fly trapping research, which was conducted prior to 1979, can lead to a commercial use of a trap in determining the timing and necessity of a maggot insecticide spray, thus potentially reducing the use and cost of insecticides. The feasibility of this pest management method can only be determined by repeated and expanded testing. Due to the availability of CES funds, an IPM project will be initiated in 1980.

Research Plans:

A cooperative research effort will be initiated by myself and the new project leader. The primary objectives will be to refine trapping procedures and the action threshold for the blueberry maggot. Also, research will be conducted on the development and use of ground spray applications and on the reduction of drift of highly toxic insecticides from aerial sprays.