2-1990

Blueberry Research Progress Reports

H Y. Forsythe Jr

Judith A. Collins

John M. Smagula

Susan Erich

Delmont Emerson

See next page for additional authors

Authors
H Y. Forsythe Jr, Judith A. Collins, John M. Smagula, Susan Erich, Delmont Emerson, David E. Yarborough, Warren Hedstrom, Mary J. Boutet, Rodney J. Bushway, Alfred A. Bushway, Paul R. Hepler, William A. Halteman, Tom DeGomez, E A. Osgood, Luc Guimond, and David Lambert

BLUEBERRY RESEARCH PROGRESS REPORTS

FEBRUARY 1990

Contents

MAINE BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1989 to March 1990

Investigator(s): H. Y. Forsythe, Jr., Project Leader
J. A. Collins, Research Associate

Title: Control of secondary blueberry pests

Methods:
Secondary pest insects were located from field observations, surveys, and grower reports.

Laboratory Tests

Materials were tested for effective control at the lowest possible rates and compared with standard materials to evaluate control measures for use against the most destructive insects. Collections were made of those insects present in sufficient numbers for meaningful tests.

For sprayed stems, square-foot patches of blueberry plants were treated with different materials, using a small hand-pump sprayer at a rate of 23 gallons of water-mixture per acre. Treated stems were cut and taken into the laboratory where they were placed in small screened cages. For dipped stems, foliated blueberry stems were cut, brought into the laboratory, and dipped in a water-mixture solution of each insecticide at the same rate as above. Treated stems were placed in cages as above. A single cage constituted a replication; there were 2 or 3 replications per treatment. A knockdown count of dead or inactive insects was made at intervals after insects were introduced into the cages. Data on leaf consumption by the insects were also recorded.

Field Tests

Field tests were conducted when insect species were present in sufficient numbers and spread homogeneously over a field area. Randomized block designs with 2 to 4 replications were utilized. Each plot measured 23 X 23 ft with 10-ft buffer strips. Thrips' plots measured 5 X 10 ft with 20-inch buffer strips. Plots were treated with a hand-held, CO_2-propelled sprayer at 25 gallons of water-mixture per acre. On a pre- and various post-treatment dates, insects in each plot were counted. The center area of each plot was sampled with 10 sweeps of a standard 12-inch sweep net. After live insects were counted, they were spread back over the same plots. To evaluate control of thrips, the number of emergent blueberry stems with and without thrips' curls was determined for each treatment.

Results:
The table shows the results of control tests on spanworm and sawfly larvae with registered insecticides. Compared to Dylox, Dipel and Javelin (*Bacillus thuringiensis kurstaki*) did not give equivalent knockdown or kill of spanworm larvae; however, laboratory data on leaf consumption showed that larval feeding was reduced very well with high and low rates of each material. Javelin may be slightly more effective than Dipel. Unregistered pyrethroids (including Mavrik = Spur), a high rate of natural pyrethrins (Pyrenone), and rotenone (Rotacide) performed well for spanworm larvae in both laboratory and field tests.

Dylox also gave excellent control of sawfly larvae; the unregistered materials Pyrenone and Mavrik performed well. Diazinon at 16 and 32 oz, and malathion at 16 oz seemed to perform satisfactorily for control of blueberry thrips. Because of extensive commercial spray applications, there were no available sites for tests on spanworm adults and eggs.

Potential predators of secondary pest insects were collected in sweep-net samples or observed during various experiments and biological studies. As in 1988, the only apparent predation observed in the field was by ants on spanworm larvae. Other potential predators captured were spiders, lady beetles, misc. ichneumonid and braconid wasps, and various solitary wasps which provision their nests with lepidopterous larvae such as spanworm.

Conclusions:

There continues to be a limited number of effective, but short residual, insecticides registered for use against pest insects during the bloom period of blueberries. Some other materials, although effective in controlling pests in 1989 tests, remain unregistered and will require further testing as to use patterns, rates, etc. Since Maine is the only state conducting research on lowbush blueberry insects, research is needed to identify and test appropriate new materials, and to assist in the development of tolerances and registrations. In addition, the changing status of pesticides, because of special and reregistration reviews, will necessitate a continuing and active program to provide data on the need for currently registered materials.

Some control data have been accumulated on potentially damaging insects such as grasshoppers, blueberry leaf beetle, strawberry rootworm, leaf tier, and blueberry looper. Additional confirming research will be required when sufficient numbers of these insects are located. Red-striped fireworm began appearing in fields in 1988; there are currently no control recommendatons for this pest, and little informaton about its impact on lowbush blueberries.

Recommendations:

Registered insecticides are available for control of spanworm larvae, sawfly larvae, flea beetle larvae and adults, and thrips. Spanworm larvae may be controlled with Dylox, Marlate, Dipel or Javelin; these are the best insecticides to use when honey bees are present in the area. Repeat applications of these short-residual materials may be necessary. In addition, Imidan or a high rate of Guthion can be used in vegetative fields when bees are not present in the area. All insecticides should be applied judiously and carefully to avoid impacting on honey bees and natural pollinators.

Sawfly and flea beetle can be effectively controlled by Marlate during bloom, and by Imidan at post-bloom.

Diazinon currently remains the material of choice for controlling thrips. Populations in crop-year fields should be noted and marked, and treatment applied after pruning in the spring.

Blueberry Insect Control Tests [a]

	Knockdown of Larvae		
	Laboratory Tests		Field Tests
	Spanworm	Sawfly	Spanworm
Dipel 8 oz	G [b]		P-F
Dipel 16 oz	G [b]		F-G
Dylox 16 oz	E	E	VG
Javelin 32 oz	G [b]		P-F
Javelin 64 oz	G [b]		F-G
Guthion 32 oz	E		
Marlate 48 oz	G	F	G

[a] E = excellent, VG = very good, G = good, F = fair, P = poor; oz = formulation per acre.

[b] Dipel and Javelin, while not giving the best knockdown or kill, reduced feeding by larvae very well.

MAINE BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1989 to March 1990

Investigator(s): H. Y. Forsythe, Jr., Project Leader
J. A. Collins, Research Associate

Title: Monitoring methods, economic injury levels, and action thresholds of secondary blueberry pests

Methods:

Two procedures which were studied in 1988 to determine their potential usefulness in detecting the presence of damaging spanworm larval populatons in pruned fields were tested again in 1989. One procedure was to place collections of litter in the laboratory and observe for 1st instar larval feeding on fresh, intact blueberry leaves. The second method was to compare blueberry plant development in small burned areas with adjacent mowed areas.

An attempt was made to refine the economic injury level and action threshold in vegetative year fields by comparing insect feeding injury on blueberry plants with numbers of spanworm larvae in sweep-net samples, and on the litter and foliage. An indication of feeding injury was based on counts of number and height of stems, evidence of leaf feeding, and flower bud formation during the spanworm activity period and at post harvest.

Biological information was collected for blueberry sawfly and red-striped fireworm to aid in the future development of economic injury levels and action thresholds for these potentially damaging insects.

Results:

Spanworm larvae were recovered from only 1 of 8 litter samples taken from fields which later showed light to moderate spanworm feeding damage.

Measurements of new bud/stem appearance and height in 4 fields treated by burning or scorching of small plots showed no distinct trend toward delayed plant development due to spanworm feeding. Feeding was minimal in the burned, scorched, and mowed plots; spanworm larvae averaged <1 per 10 sweeps over the entire sampling period in the burned plots, <2 larvae per 10 sweeps in the scorched areas, and 2 to 6 per 10 sweeps in the mowed plots. There was no apparent correlation this year between spanworm counts and stem height or number of new buds/stems. Results seem to show a possible economic injury level for vegetative year fields slightly higher than the 3 per 10 sweeps indicated in 1988. However, the presence of a viral disease, present in the research sites, may have reduced feeding by spanworm larvae.

Research on the biology of secondary blueberry pest insects yielded some interesting results. Red-striped fireworm larvae tied up and skeletonized blueberry leaves in August and September in vegetative and crop-year fields. A few examinations of infested stems revealed no apparent feeding on flower buds. Studies thus far indicate that fireworm apparently overwinters as a larva in debris at the base of blueberry plants. Research on blueberry sawfly demonstrated that adult sawflies emerged from the overwintering stage in early to mid-April. Eggs were laid in new leaf buds, and early instar larvae fed inside the developing leaf whorls.

Conclusions:

For the second year, detecting spanworm populations in vegetative year fields by collecting and observing litter samples proved unreliable. Although burning small areas of mowed fields may be useful for detecting large or vigorous spanworm populations, the method may not be effective for measuring insect populations at or near threshold levels. At or below threshold levels, significantly delayed plant development also does not seem apparent.

The potential for economic damage by the red-striped fireworm remains uncertain. Further study will be required to determine the exact status of this insect in lowbush blueberry fields.

The life history of blueberry sawfly is now essentially complete; however, economic injury levels and action thresholds need refinement and verification.

Recommendations:

Sweep-net sampling of both vegetative and crop-year fields remains the most reliable and practical method of determining if and when control measures should be applied for spanworm larvae. Economic injury levels for vegetative year fields range from 3 to 5 larvae per 10 sweeps, depending on the size of the spanworm population. The action threshold in crop-year fields is still 5 to 10 larvae per 10 sweeps. Burning small plots as a monitoring method seems to be valuable when used in conjunction with sweep sampling.

MAINE BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1989 to March 1990

Investigator(s): H. Y. Forsythe, Jr., Project Leader
J. A. Collins, Research Associate

Title: Control of blueberry maggot

Methods:

The development of an alternative to Guthion for control of blueberry maggot remained an important priority in 1989. A test was performed to determine attractiveness and control of blueberry maggot with a low rate of the insecticide Imidan and Nu-lure insect bait. A randomized design with 1 replication of each treatment was used; plots measured 100 X 100 ft with at least 300 ft between plots.

All materials were applied to an abandoned blueberry field in 15 gallons of water-mixture per acre with a CIMA^R P55D Atomizer L.V. Sprayer mounted on a 674 International^R tractor operating at 40 psi, driven at 2 mph.

Evaluation of the effectiveness of insecticidal control was based on counts of adult flies captured on 2-4 yellow sticky traps deployed systematically within and around each plot. Traps were inspected on one pre- and two post treatment dates. The absence of berries in the field neccessitated evaluation based on counts of adult flies rather than the more traditional method of sampling numbers of maggots in berries.

Results:

The continued absence of a vigorous test insect population distributed evenly over the field area resulted in no significant results in a Nu-lure bait test. Fly catches were low within all treatment plots, including plots where Nu-lure alone was applied. All treated plots showed an average of < 1 fly/trap on two post-treatment dates; number of fly captures in adjacent untreated areas averaged 3 flies/trap. Lack of a fly population prevented a test on alternative insecticides, such as the pyrethroids.

Conclusions:

The attractive power of Nu-lure, and its effect in combination with insecticides, is still unconfirmed. Environmental and social problems associated with the aerial application of Guthion make continued research into new insecticides and other non-chemical strategies, that are less hazardous to the environment, a necessity. Generally, higher then normal maggot populations are required to determine the effectiveness of various practices and materials.

Recommendations:

In the absence of definitive results for alternative materials, Guthion and Imidan remain the best registered insecticides for controlling blueberry maggot. Results from 1986 and 1988 indicate 3 applications of malathion may be almost as effective. No recommendations can be made with confidence, at this time, for the use of Nu-lure in combination with insecticides.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATORS: John M. Smagula
Susan Erich
Cooperators: Delmont Emerson

TITLE: PHOSPHORUS DOSE/RESPONSE CURVE

METHODS: Please refer to the 1989 project proposal ouline.

RESULTS:

Nutrient concentrations

Leaf phosphorus concentrations increased linearly with application of increasing amount of phosphorus. This occurred in fields that had very low (figures 1 & 2), low (figures 3 & 4), and high (figures 5 & 6) levels of leaf phosphorus in control plots. The fact that all the fields in a given category or level of phosphorus leaf status did not respond exactly the same (figures 1,3 & 5) supports the need to use multiple locations for a study of this nature. The average response of the three fields (figures 2,4, & 6) gives a good generalization of how we can expect fields to respond to phosphorus application. The greatest increase was in the fields with very low leaf phosphorus (<.110%).

Phosphorus fertilization had only minor effects on other elements and there were no meaningful trends. There was a small increase in nitrogen concentrations when phosphorus was applied to fields with very low (<.110%) leaf phosphorus but not when leaf phosphorus levels were low (.110-.125%) or high (>.125%) (figure 7).

The general relationship between the leaf nitrogen level and the phosphorus status of the field is also shown in figure 7; the higher the leaf phosphorus, the higher the leaf nitrogen. Fields with higher leaf phosphorus also had higher leaf potassium (figure 8). While leaf calcium concentrations were higher in fields with higher phosphorus levels (figure 9), this relationship did not hold true for magnesium concentrations (figure 10).

When nutrient concentrations are plotted against locations some interesting relationships become obvious (figure 11). Calcium and magnesium curves are very similar; fields with higher calcium also have higher magnesium. This is expected and is probably related to the pH (figure 12). The importance of this relationship is unclear, especially in light of the fact that levels of both calcium and magnesium were above the current standards
(figures 9 & 10).

CONCLUSIONS:

Lowbush blueberry leaf phosphorus can be increased by applying phosphorus fertilizer. Rates as high as 60 or 80 lb/acre actual phosphorus are needed to bring levels close to the .125% level. The response to phosphorus was greatest for fields with very low levels of leaf phosphorus. Fields with normally higher levels of leaf phosphorus also had higher levels of leaf nitrogen, potassium and calcium.

RECOMMENDATIONS:

No fertilizer recommendations can be made until potential and actual yield data are collected, analyzed and interpreted.

Figure 1 LEAF PHOSPHORUS CONCENTRATIONS
VERY LOW PHOSPHORUS FIELDS

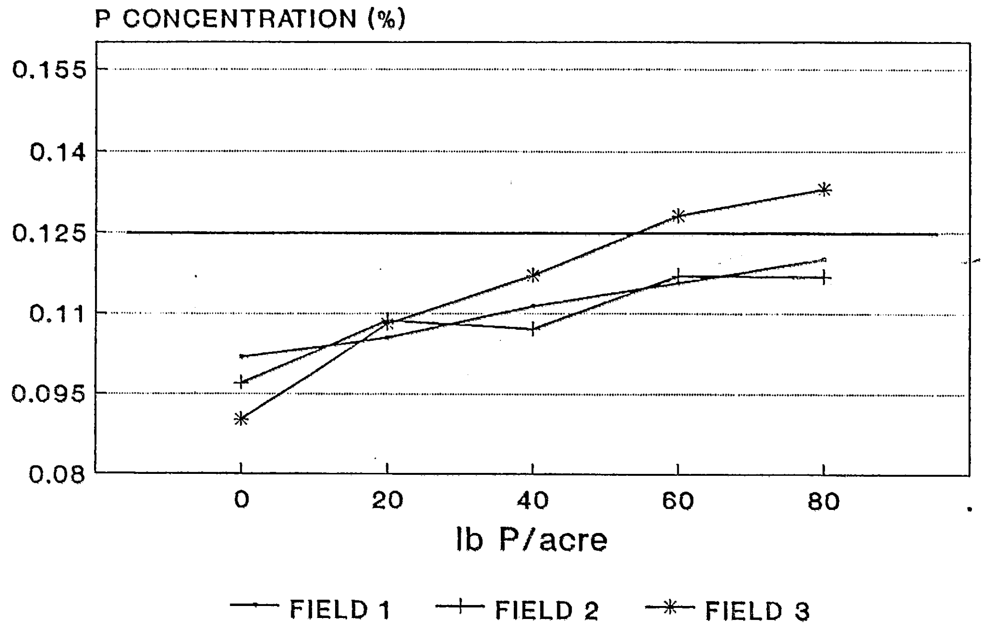


Figure 2 LEAF PHOSPHORUS CONCENTRATIONS
VERY LOW PHOSPHORUS FIELDS

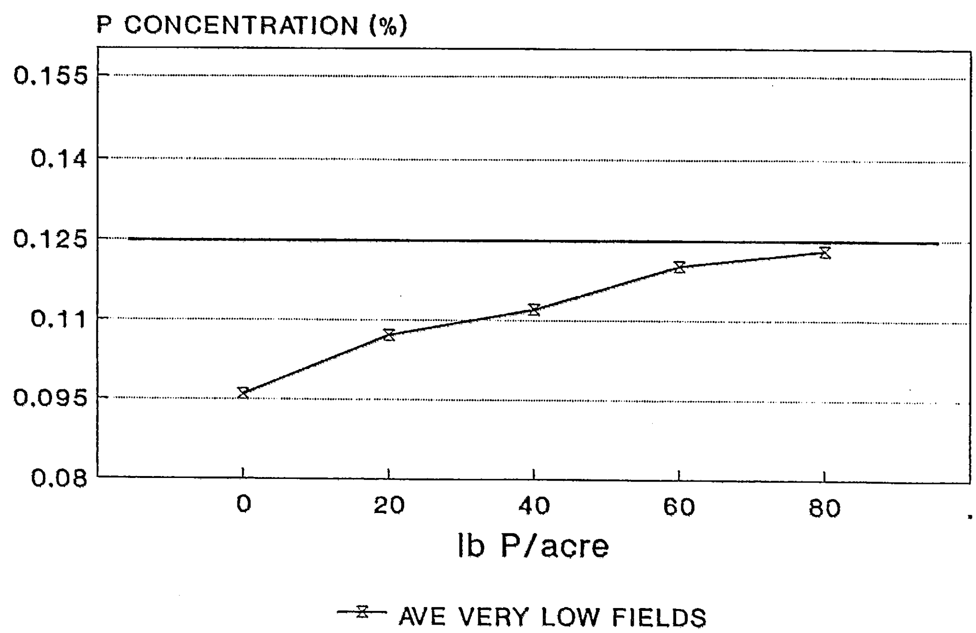


Figure 3 LEAF PHOSPHORUS CONCENTRATIONS
LOW PHOSPHORUS FIELDS

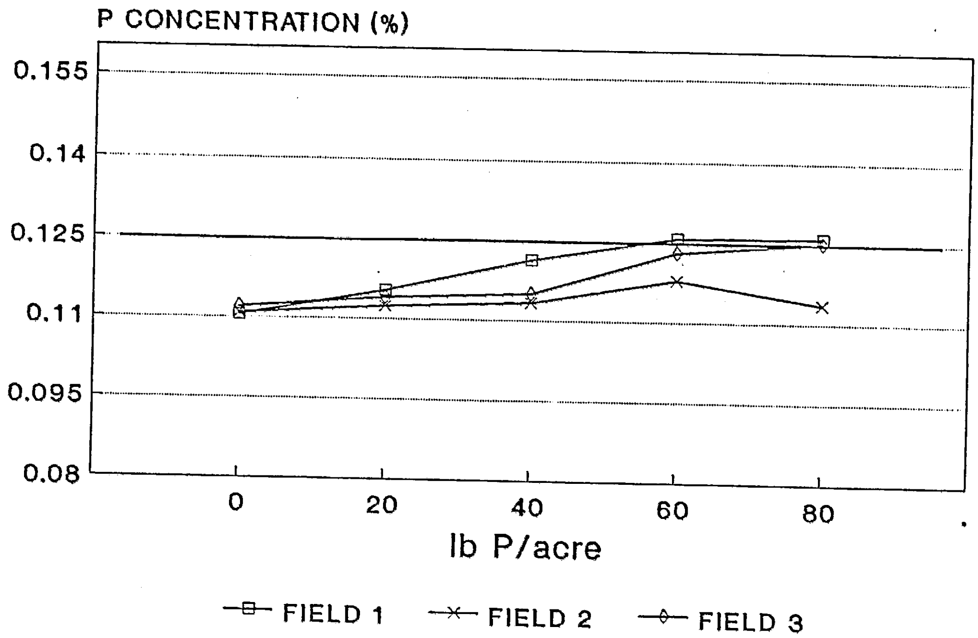


Figure 4 LEAF PHOSPHORUS CONCENTRATIONS
LOW PHOSPHORUS FIELDS

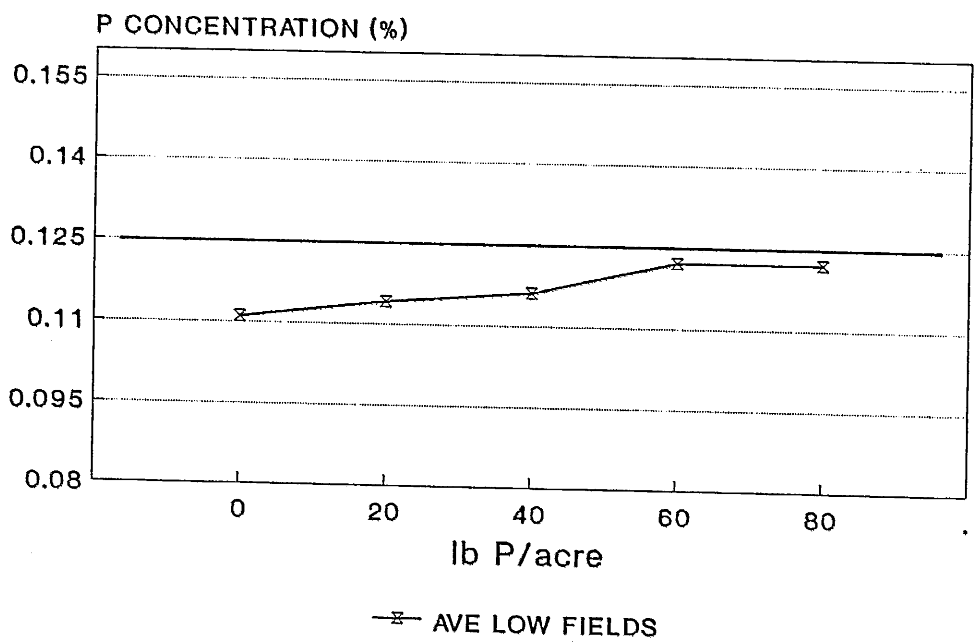


Figure 5 LEAF PHOSPHORUS CONCENTRATIONS
HIGH PHOSPHORUS FIELDS

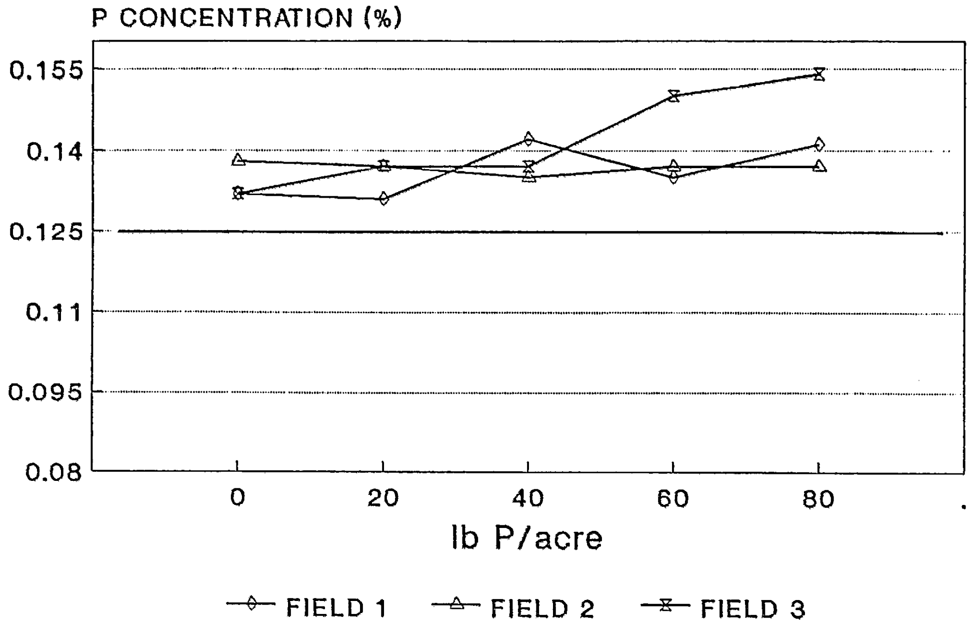


Figure 6 LEAF PHOSPHORUS CONCENTRATIONS
HIGH PHOSPHORUS FIELDS

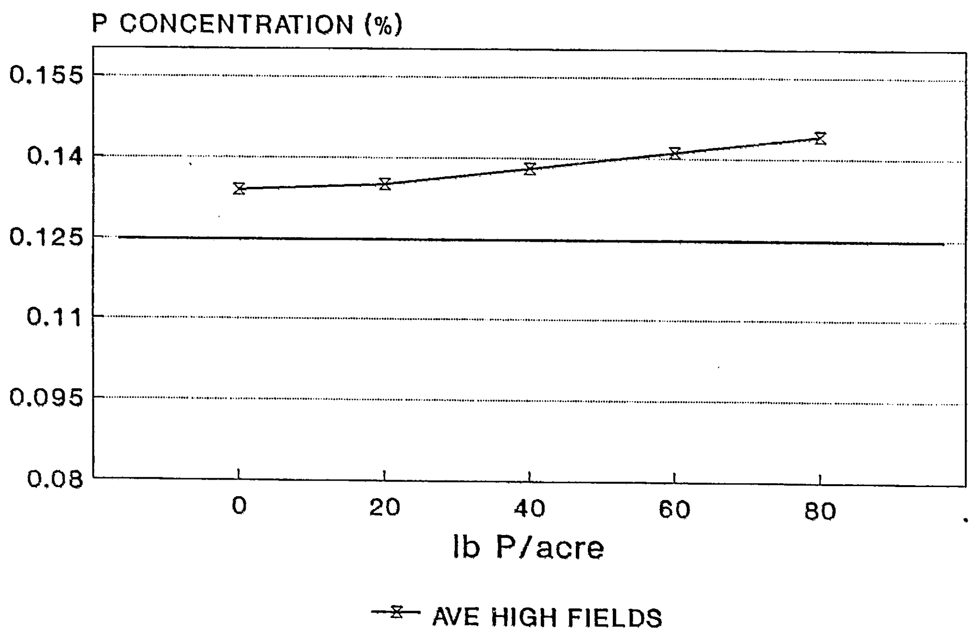


Figure 7 LEAF NITROGEN CONCENTRATIONS

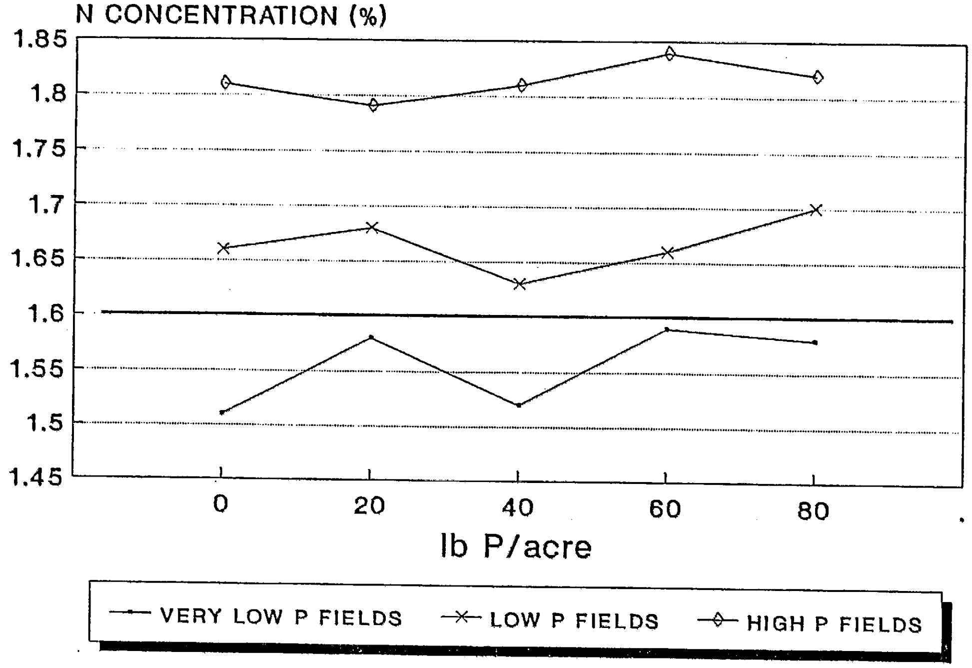


Figure 8 LEAF POTASSIUM CONCENTRATIONS

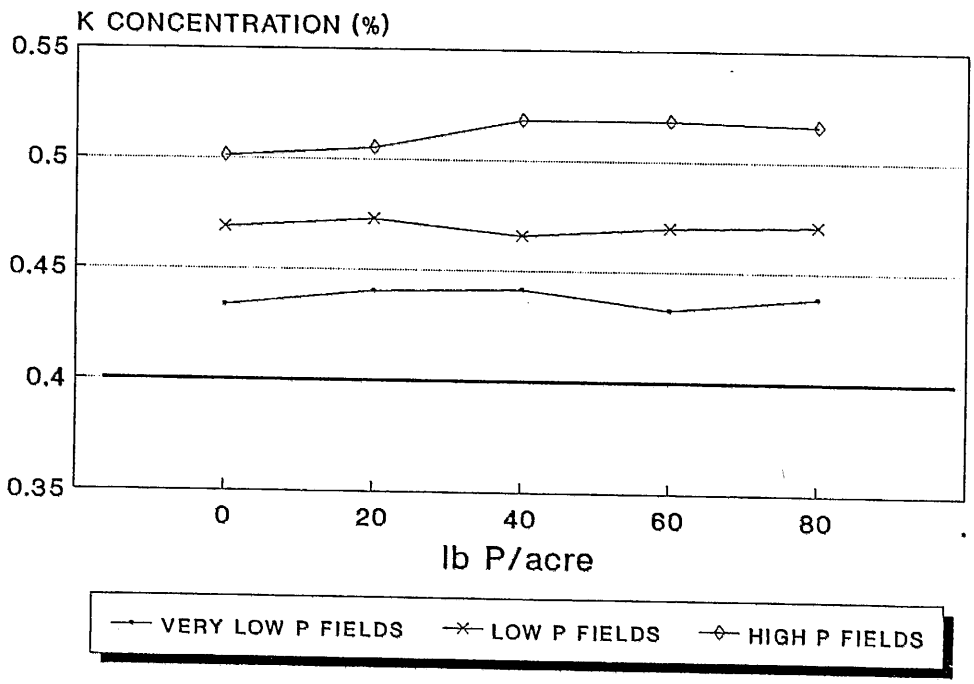


Figure 9 LEAF CALCIUM CONCENTRATIONS

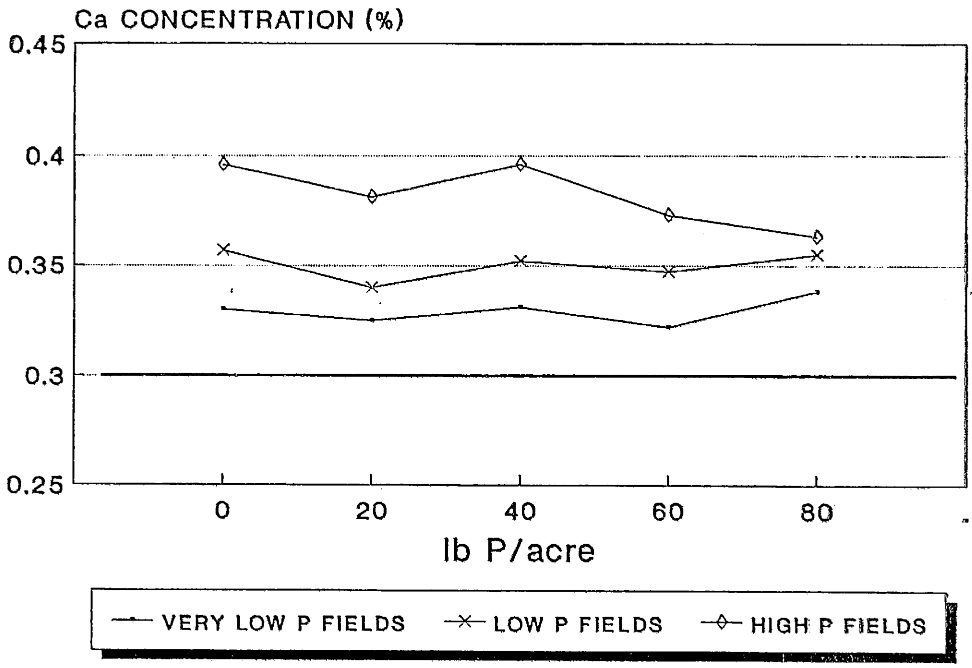
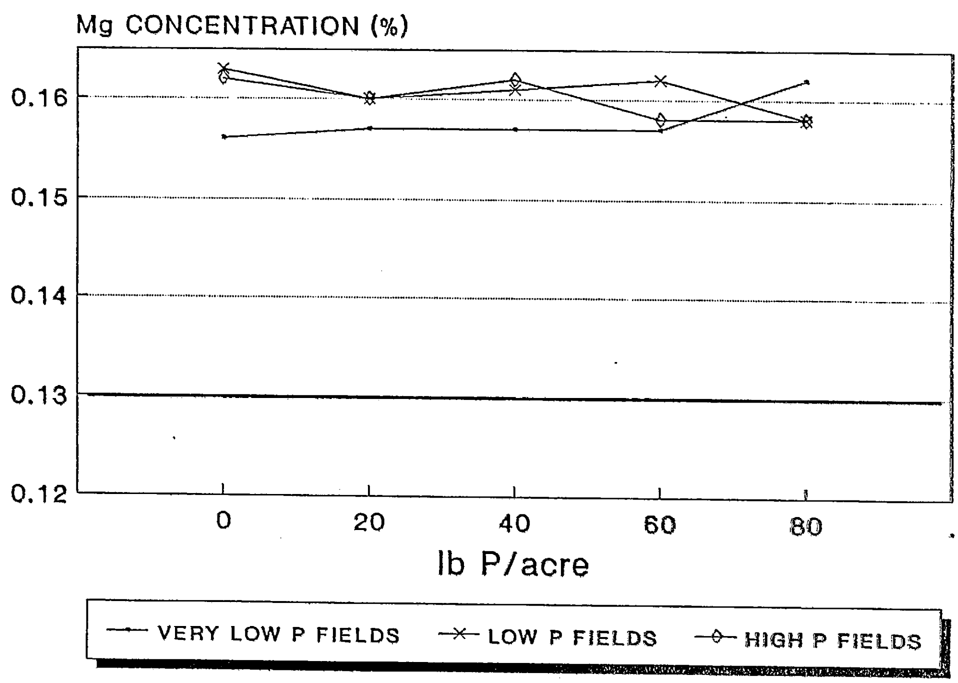


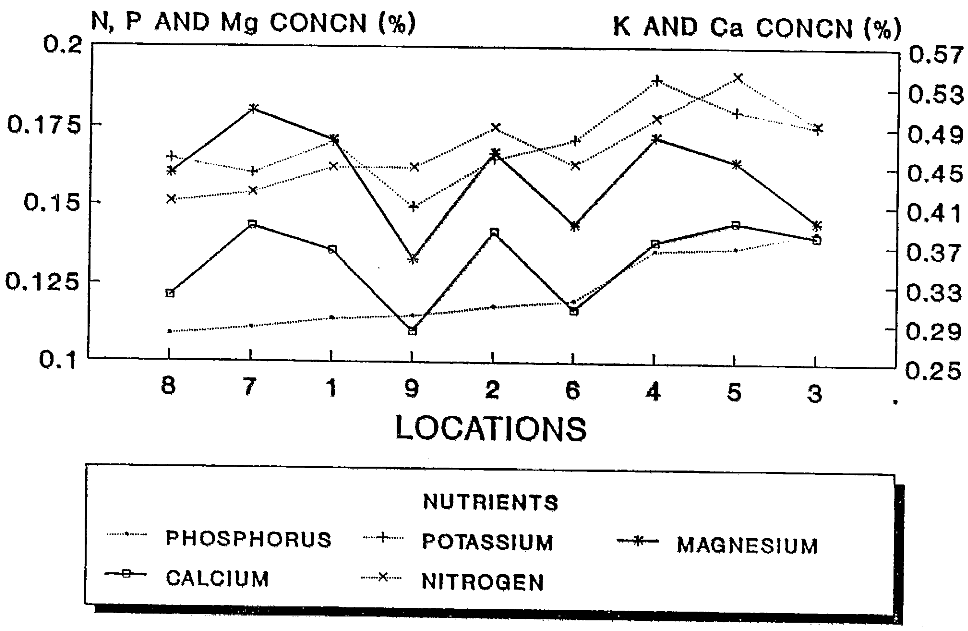
Figure 10 LEAF MAGNESIUM CONCENTRATIONS



VL,L and H not significantly different from each other

Figure 11

PHOSPHORUS STUDY
NUTRIENT CONCENTRATIONS AT LOCATIONS



N value is 1/10 actual

Figure 12

PHOSPHORUS STUDY
pH INFLUENCE ON Ca AND Mg

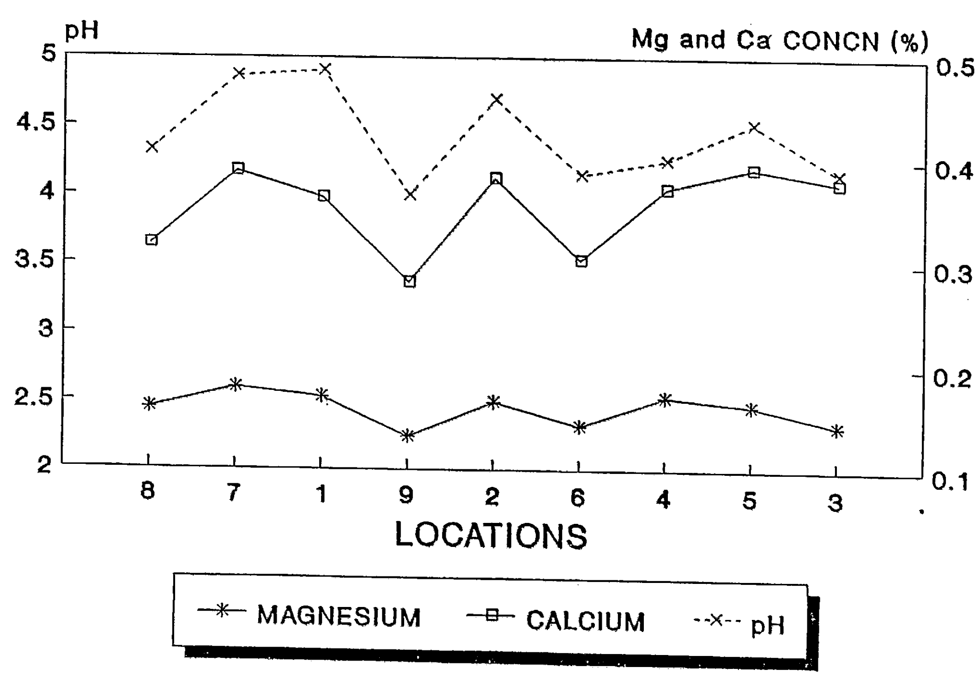
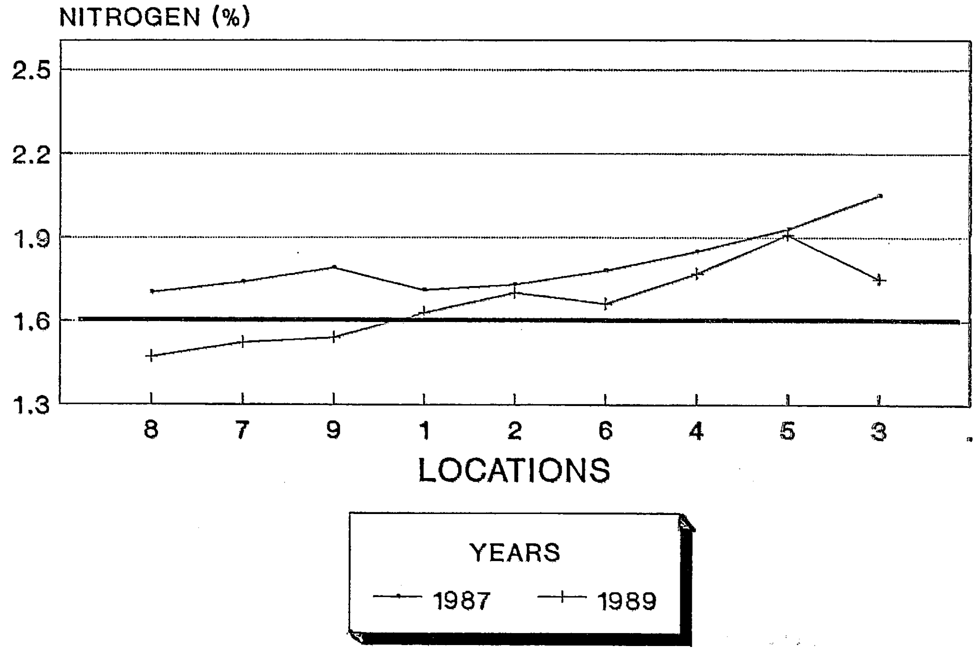


Figure 13 LEAF NITROGEN CONCENTRATIONS
1987 VS 1989



BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: John M. Smagula
Cooperator: Delmont Emerson

TITLE: NITROGEN-PHOSPHORUS STUDY

METHODS: Please refer to the 1988 and 1989 project proposal outlines

RESULTS:
Nutrient concentrations

Nitrogen and phosphorus levels in leaf tissue increased with application of increasing amounts of DAP (fig. 1). Nitrogen was lower in the control plots in 1989 than in 1989 and increased in response to DAP application in both years (fig. 2). Applying rates of phosphorus as high as 80 lb P/acre in 1989 did not raise the level of leaf phosphorus to .125% .

There was no interaction between the main effect of pruning method and treatment on nutrient concentrations. In other words, it didn't make any difference how the plots were pruned; the plants reacted the same to the application of DAP. There were only minor effects of pruning method on leaf nutrient concentrations. For example, mowed plots had lower concentrations of calcium, magnesium and boron but the concentrations were lower by only .013%, .010% and 2ppm, respectively. Mowed plots had on the average .004% higher concentrations of phosphorus.

Stems have been sampled from within three 1/3 foot quadrats for each treatment plot to determine treatment effects on stem length and branching, stem density and flower bud formation. Measurements have not been completed on these samples at this time.

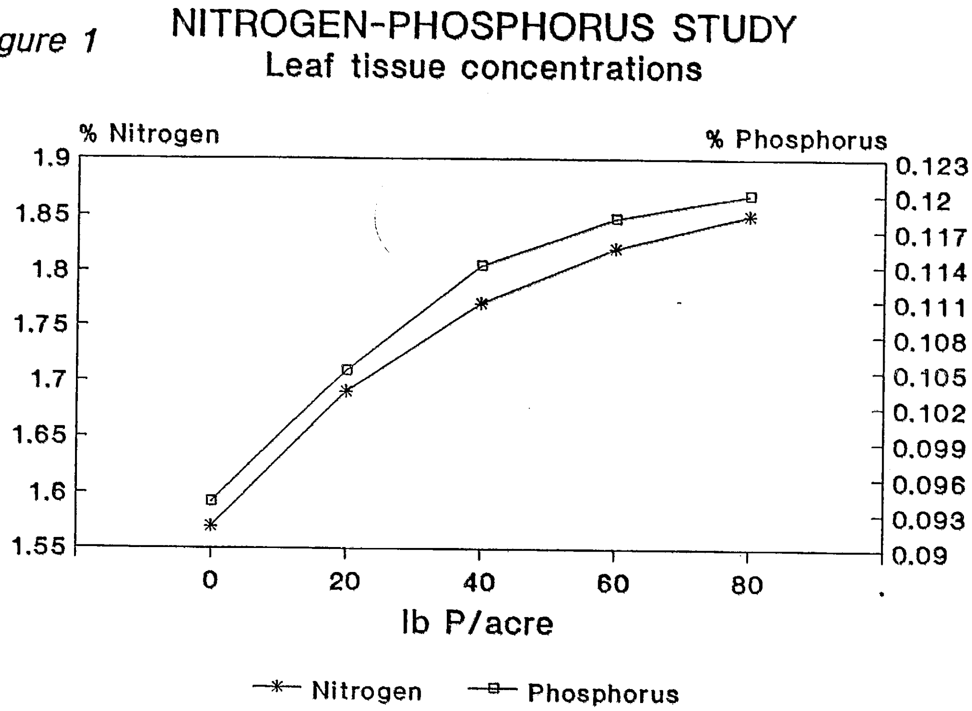
CONLUSIONS:

Leaf tissue phosphorus levels were raised to .120% with application of 80 lb P/ acre from DAP. Pruning method did not have a major effect on leaf nutrient concentrations. No conclusions can be made concerning potential or actual yield until these data are available.

RECOMMENDATIONS:

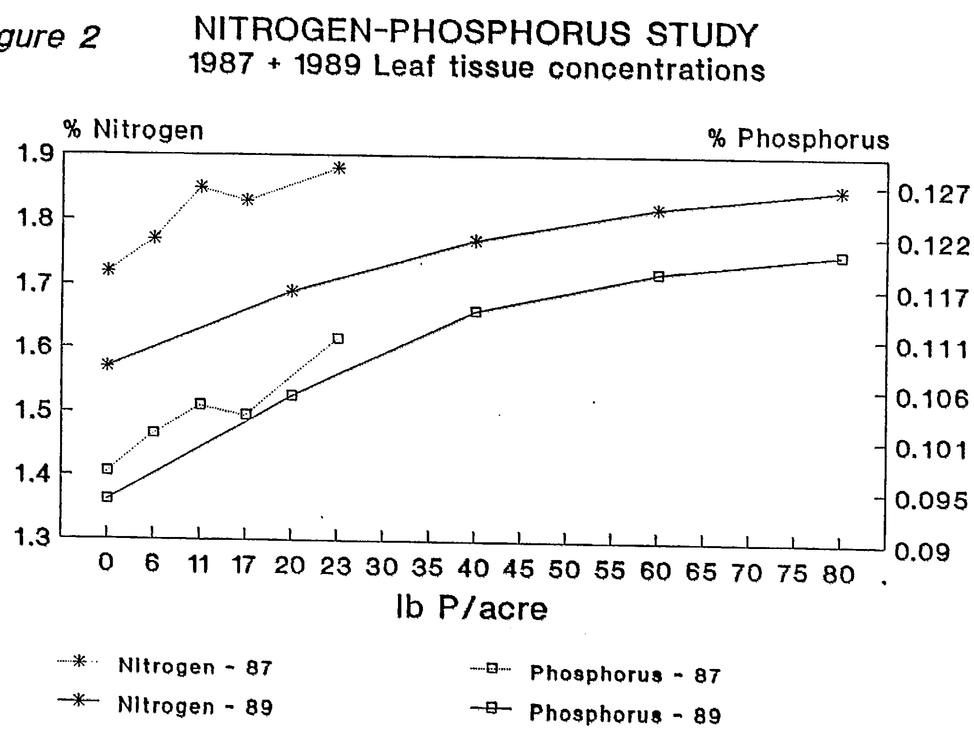
The data presented in this report suggest that a rate higher than 80 lb P/ acre (from DAP) is needed to raise phosphorus leaf tissue levels from .094% to .125%. Burned and Mowed fields respond the same to fertilization and should receive the same recommendation based on foliar analysis.

Figure 1



DAP fertilizer (18-46-0)
1989 data

Figure 2



DAP fertilizer (18-46-0)

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: JOHN M. SMAGULA
Cooperators Delmont Emerson
David Yarborough
Warren Hedstrom

TITLE: MULTIPLE CROPPING OF WILD STANDS

METHODS: Please refer to the 1989 project proposal outline.

RESULTS:

Nutrient Concentrations

The levels of nitrogen, phosphorus and potassium were adequate in all treatment plots according to the currently accepted standards (see wild blueberry fact sheet No. 223). Nitrogen and phosphorus concentrations were higher in leaf tissue when NPK fertilizer was used instead of urea to supply 50 lb N/acre (figure 1.). Potassium concentration was not effected by fertilizer source.

Rainfall was supplemented by overhead sprinkler irrigation. Irrigation was applied about every three days to ensure that half of the plots received a total of 1/2 inch of water from rain and irrigation (figure 2).

The stems in three 1/3 foot quadrats per treatment plot were sampled to determine treatment effects on length, branching and flower bud formation. Samples have been taken but measurements have not been completed at this date.

CONCLUSIONS:

No conclusions can be drawn at this time.

RECOMMENDATIONS:

No recommendations can be made at this time.

Figure 1 Multiple Cropping Study
Leaf tissue concentrations

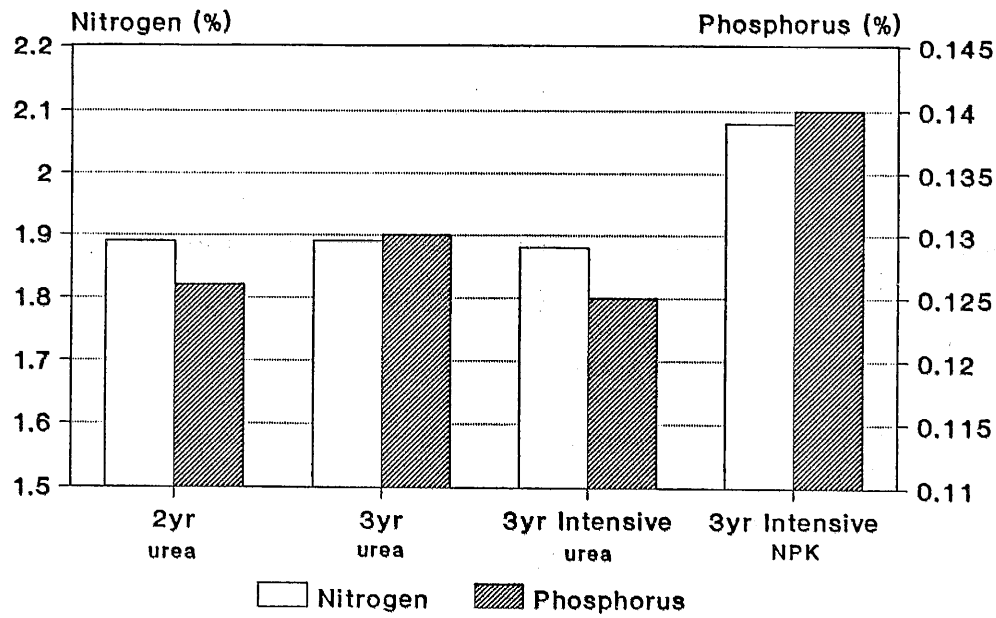
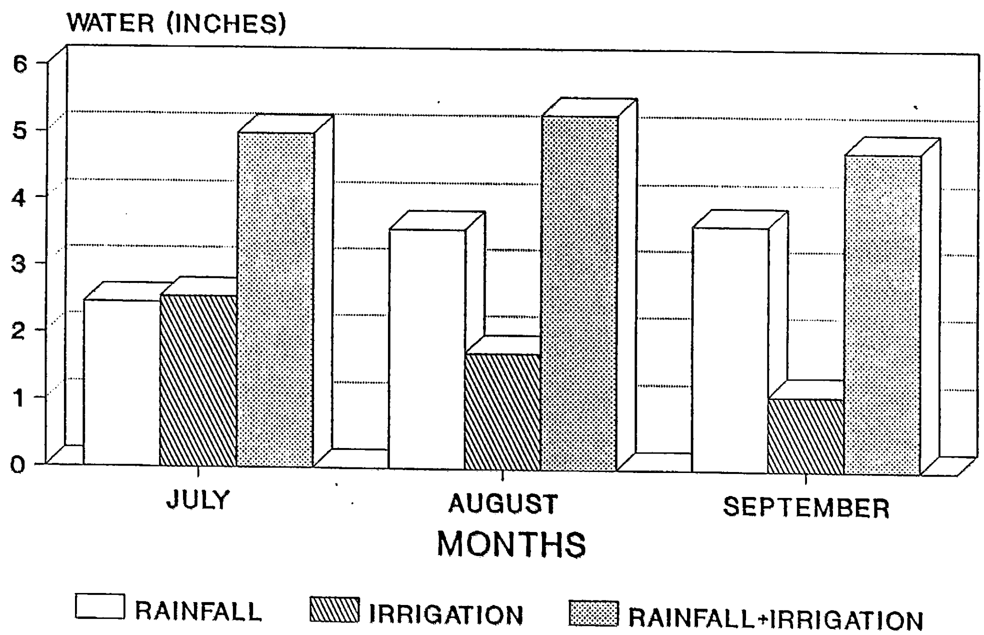


Figure 2 RAINFALL AND IRRIGATION COMPARISON
for JULY, AUGUST, SEPTEMBER



Maine Blueberry Committee
Research Report

Date: June, 1989 to January, 1990

Investigators: Mary J. Boutet, M.S. Candidate in Food Science
Rodney J. Bushway, Professor of Food Science
Alfred A. Bushway, Associate Professor of Food Science
Paul R. Hepler, Associate Professor Emeritus of Horticulture
William A. Halteman, Assistant Professor of Mathematics

Title: Changes in Sugars and Organic Acids of Blueberries During Development

Methods: Whole berry sugars were extracted using a method of Richmond et al, 1981, and quantified using a high performance liquid chromatography (HPLC) method developed by Bushway et al, 1981. Organic acids were extracted and quantified by the method of Bushway et al, 1984. A method developed by Spanos and Wrolstad, 1987, was used to purify the acid samples for HPLC.

The blueberries for the maturation study were handpicked on the barrens in Deblois. The berries were obtained from three clones and divided into four stages of maturity based on color. The four stages were green, green red, red blue and blue, respectively. The handpicking continued until the field processing began, approximately three weeks.

Results: Using the SAS program on the mainframe computer, the following results were generated from the data collected thus far.

The general linear model ($p<0.05\%$) showed a highly significant difference between the four stages of development in relation to fructose, glucose, sucrose and total sugar. Additionally, a significance was also seen over the three week period, but no significant difference was seen between the three clones with the exception of glucose. In viewing the interactions of week X treatment and clone X treatment no significant differences were detected. The general linear model also showed no significance in reference to moisture over the four stages of development, during the three week period or amongst the three clones.

Four organic acids were identified in the blueberry maturation study. Oxalic, citric, quinic and shikimic acids were identified using UV ratios on HPLC.

The moisture content for the handpicked berries remained relatively stable between 77-82%, with a slight increase after a significant rainfall.

Conclusions: In summary, a significant difference was seen for total and individual sugars for the different stages of maturity and over time, whereas no significance was seen amongst the three clones.

The identification of organic acids in the lowbush blueberry is of great importance because there has been no previously reported literature of this nature. The impact of these acids on the flavor of blueberries is not yet known, but will be pursued. It is thought that the sugar to acid ratio which will be quantified as part of this research also has an important impact on the flavor of blueberries.

Fiber and pectin analysis is in progress. A method by Englyst et al, 1988, is being used to quantitate soluble and insoluble fiber as well as pectin. The isolation and determination of the structure of pectin is also being pursued. The results of the fiber and pectin analyses may provide important data to be used as a marketing tool in light of the public's interest in dietary fiber and colon cancer.

Recommendations: Based on the limited evaluation of three lowbush blueberry clones, it would appear that differences in the concentration of sugars and organic acids cannot explain the differences in flavor which has been noted between clones. Completion of the research on fiber and pectin changes may lead to recommendations with regards to a marketing strategy.

Future Work: No future work is proposed in this area at this time, although some sensory evaluation research may prove of assistance in determining how the chemical composition of clones affects flavor.

Maine Blueberry Committee
Research Report

Date: June, 1989 to January, 1990

Investigators: Mary J. Boutet, M.S. Candidate in Food Science
Rodney J. Bushway, Professor of Food Science
Alfred A. Bushway, Associate Professor of Food Science
Paul R. Hepler, Associate Professor Emeritus of Horticulture
William A. Halteman, Assistant Professor of Mathematics

Title: Investigation of Preprocess Changes (Chemical and Physical) that could lead to the Development of a Simple and Inexpensive Mehtod to Measure Preprocess Berry Spoilage.

Methods: Blueberries were obtained by hand raking and transported on ice to the Department of Food Science. The berries were divided in to seven lb aliquots and stored at three temperatures (5, 10, and 24°C). Samples were taken at 1, 2 and 3 days of storage and analyzed for the following physical and chemical parameters: pH, drip loss, decrease in sugars, changes in organic acids and color. Samples were obtained for approximately three weeks.

The pH was analyzed using a Beckman pH meter and soluble solids were analyzed using a refractometer. Color was measured using the Hunter Labscan II. Organic acids and sugars were extracted and analyzed as previously described.

Results: The results were generated using the SAS mainframe computer.

For moisture a significance was seen over the three week period. This increase noted during week two could be attributed to a significant rainfall prior to raking of that week's samples, however, no significance was detected for the three days of storage or for the three storage temperatures.

Fructose also showed a significant decrease after the rainfall during week two, but showed no significance for the three days of storage or temperature.

Glucose showed similar results in that a decrease was seen during week two. Additionally, a significance was detected for the three storage temperatures, but no significance was seen for days of storage.

In reference to sucrose, no significance was seen for weeks, temperature or days of storage.

The pH showed similar results to that of sucrose, hence no significances were detected.

In viewing the data for color, no significant differences were seen for weeks, days or storage temperatures with the exception of the L value. L designates the degree of lightness or darkness and a significance was detected over the three week period.

In agreement with the significant decrease of fructose and glucose during week two, soluble solids also showed a significant difference during that time period, however no differences were indicated for days or storage temperature.

A significant difference was seen over the weeks for texture, but not for days or storage temperatures.

The analysis of ethanol production is in progress. The samples were extracted but have not yet been quantified.

Conclusion: Given the above data, it was evident that no significant differences occurred due to treatment (storage temperature), or blocking (storage days), on the parameters studied herein. Hence, a longer storage time of perhaps 6-9 days may be necessary to demonstrate any adverse changes that occur.

Recommendations: Although storage of blueberries at temperatures as high as 24°C caused no significant adverse changes, visual inspection of the fruit indicated some loss in the textural properties which may require a modification of the method that was used to detect differences. A second year of research is needed before specific recommendations can be made in terms of the most appropriate method(s) to be used to determine preprocess quality loss.

Future Work: In light of the results obtained from these analyses, the following research is proposed for next year: (1) to maintain berries at the three temperatures for up to nine days, (2) to include microbiological analyses as a possible indicator of deterioration and (3) to modify the methods of textural analysis.

Maine Blueberry Advisory Committee Research Report

Date: January 11, 1990

Investigators: Rodney J. Bushway, Professor of Food Science; Alfred A. Bushway, Associate Professor of Food Science; Mary Boutet, Graduate Student in Food Science

Title: Development of simple and less expensive methods to analyze pesticides used on Maine and Canadian blueberries

Methods: Pesticide methodology for this research has employed the following analytical techniques: high-performance liquid chromatography (HPLC), capillary gas chromatography (CGC) and immunoassay.

Results: We have developed HPLC procedures to analyze guthion, imidan and benomyl in blueberries at a lower limit of detection of 40 ppb. To confirm the HPLC results we can use the CGC. Immunoassay methods have been developed to analyze benomyl and atrazine in blueberries at a lower detection limit of 5 to 10 ppb. The immunoassay methods are definitely less costly than HPLC or CGC procedures and somewhat simpler.

Recommendations: (1) To monitor some real samples this coming growing season for the above mentioned pesticides. (2) To continue working on other pesticides used on blueberries, in particular captan by immunoassay if the test can be developed in time.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist
Delmont C. Emerson, Farm Manager

TITLE: Evaluation and modification of commercial wipers

METHODS: As indicated in 1989 project proposal outline 1 .

RESULTS: Row wick units were mounted in a V configuration using the frame and drip control unit of the super sponge unit. Wiper was used in the bracken fern control trial.

CONCLUSION: Wiper was able to treat bracken fern and dogbane with little visual injury to blueberries. Adjustment of the height of the wiper and drip control flow essential for proper application. Evaluation of efficacy will be done when counts are made next year.

RECOMMENDATIONS: Further modifications should be made by incorporating an electronic drip control mechanism and further treatments be should be evaluated.

RWIPE90.DOC

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Effect of rate and formulation of hexazinone (VELPAR) on bunchberry.

METHODS: As indicated in 1989 project proposal outline 2 .

RESULTS: Hexazinone at 2.2 and 4.4 kg/ha reduced bunchberry over the control and 1.1 kg/ha treatments. Formulation had no effect. No differences in yield were found.

CONCLUSION: Higher hexazinone rates will reduce bunchberry but does not provide effective control. Yield data low because of poor blueberry plant stand so no conclusion may be made.

RECOMMENDATIONS: The ULV formulation provided equivalent results to the liquid and may be used later in the season since it is a granular formulation. Further testing should be done with this formulation.

Effect of rate and formulation of hexazinone on bunchberry and blueberry stand and yield, BBHF - 1989.

Hexazinone Rate (kg/ha)	Bunchberry/0.1m2	Blueberry/0.1m2	Yield (kg/ha)
0	89	26	539
1.1	69	42	543
2.2	58	35	430
4.4	58	26	382
Significance	L*	NS	NS
Form			
Liquid	64	33	520
ULV	73	31	426
Significance	NS	NS	NS

NS=Nonsignificant, L*=significant linear trend.

RVELRT90.DOC

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Bracken fern control alternatives.

METHODS: As indicated in 1988 project proposal outline 7 .

RESULTS: The treatments did not decrease fern density in the prune year but hexazinone and cutting reduced fern density in the crop year and did not affect yield (Table 1).

CONCLUSION: Mowing in June and July of prune year or a second application of hexazinone at 2.2 kg/ha in the crop year decreased fern cover in the crop year but did not increase yield.

RECOMMENDATIONS: Mowing ferns in the nonbearing year may be used to decrease the density of bracken fern in the bearing year. A second study is being conducted at blueberry hill farm to confirm these results. Hexazinone is not labeled for the bearing year so it may not be used for fern suppression.

Table 1. Effect of mowing (prune year) or spring (crop year) hexazinone application on bracken fern cover and blueberry yield, T-24 - 1988,1989.

Treatment	Burn 1988	Crop 1989	
	Fern/meter	Fern/meter	Yield (Kg/ha)
Untreated	8.1	7.6	1602
Mow 1988	6.7	0.2	1481
Hexazinone 1988+1989	4.3	3.5	1305
Significance	NS	*	NS

NS = nonsignificant, *=significant at 5% level

RBRACK89.DOC

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Evaluation of hexazinone (VELPAR) with spot treatments of glyphosate (ROUNDUP), sethoxydim (POAST) or fluazifop-P (FUSILADE 2000) for bunchgrass control.

METHODS: As indicated in 1989 project proposal outline 4 .

RESULTS: The 4.4 kg/ha rate of hexazinone provided the best grass suppression but resulted in unacceptable injury and reduction in cover and yield of lowbush blueberry (Table 1). Postemergence treatments reduced the number of clumps but did not provide additional grass suppression or affect yield. Spot treatment of bunchgrass resulted in considerable grass suppression and height reduction (Table 2). Glyphosate provided the best suppression, and a reduction in suppression of fluazifop-P was seen at the later dates.

CONCLUSION: A combination of 2.2 kg/ha of hexazinone and postemergence sprays of glyphosate will provide the best suppression of bunchgrass without injury to lowbush blueberries. However, the July treatments of sethoxydim or fluazifop-P were also effective in suppressing bunchgrass and would have less potential for blueberry injury.

RECOMMENDATIONS: A combination of a preemergence application of hexazinone combined with postemergence sprays of sethoxydim or fluazifop-P; or if the clump density is less, spot treatments of sethoxydim, fluazifop-P or glyphosate are needed to adequately control bunchgrass.

Table 1. Effect of hexazinone and spot treatment on bunchgrass and blueberries.

Treatment Hexazinone (Kg/ha) 1988	Bunchgrass Clump (No.) 1988	Cover (%) 1989	Height (cm) 1988	1989	Blueberry Injury (0-10) 1988	1989	Cover (%) 1989	Yield kg/ha 1989
0	25	62	47	57	0	0	20	1635
2.2	16	19	27	37	1	1	57	2480
4.4	3	3	5	12	6	6	27	1197
Significance	**	**	**	**	**	**	**	**
Broadcast spray within hexazinone treatments.								
Untreated	20	33	28	40	2	2	16	1498
Glyphosate	10	24	25	32	2	2	39	1644
Sethoxydim	13	28	25	34	2	2	39	1835
Fluazifop-P	16	26	25	36	2	2	33	2106
Significance	*	NS	NS	NS	NS	NS	NS	NS

Rating 0=no effect, 10=dead, **=highly significant, *=significant, NS=nonsignificant.

Table 2. Effect of timimg of spot treatment on injury and cover of bunchgrass.

	Grass Injury (0-10)	Height (cm) 1988	1989	Injury (0-10)	Height (cm) 1988	1989	Injury (0-10)	Height (cm) 1988	1989
Timing	Glyphosate			Sethoxydim			Fluazifop-P		
Untreated	0.8	49	30	0.8	49	30	0.8	49	30
7/25/88	8.9	53	5	5.5	49	15	6.8	51	12
8/30/88	8.8	68	7	4.9	54	19	4.2	68	20
9/29/88	8.5	68	7	5.7	66	16	1.3	64	26

Significance	Injury	Height 1988	Height 1989
Treatment	**	NS	**
Time	*	*	*
Treatment by Time	**	NS	NS

Rating 0=no effect, 10=dead, **=highly significant, *=significant, NS=nonsignificant.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Directed sprays of glyphosate (ROUNDUP) for bunchberry control.

METHODS: As indicated in 1988 project proposal outline 9.

RESULTS: Directed sprays of glyphosate among clones significantly reduced number and cover of bunchberry. Timing of application did not affect efficacy but the 2% glyphosate treatment was the most effective rate for reducing bunchberry number and cover. Blueberry bushes in the plots comprised less than 2% cover but were also reduced with treatment.

CONCLUSION: Glyphosate is effective in reducing bunchberry growing among blueberry clones.

RECOMMENDATIONS: A 2% directed spray of glyphosate may be used from June through September in the nonbearing year to reduce bunchberry cover. However, since glyphosate will also reduce blueberry stand, particular care must be taken in the application to insure that the glyphosate does not drift on to the blueberry bushes.

Effect of directed sprays of glyphosate on bunchberry BBHF, 1988-1989

Rate % v/v	Bunchberry $0.1m^2$ 1988	Bunchberry $0.1m^2$ 1989	Bunchberry % Cover 1988	Bunchberry % Cover 1989
0	76	67	50	44
1	69	21	36	10
2	63	13	41	7
Significance	NS	**	NS	**

Precount 6/9/88, Postcount 6/9/89,
NS=not significant, **=Highly Significant
Treated as directed spray on June, July, August or September, Date of treatment not significant.

RBUNDR90.DOC

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Evaluation of norflurazon (SOLICAM) with or without hexazinone (VELPAR) for bunchgrass control.

METHODS: As indicated in 1989 project proposal outline 7 .

RESULTS: Phytotoxicity to the bunchgrass from the norflurazon and hexazinone was evident (Table 1 and 2.) but the grass cover was not effected and height was only suppressed slightly.

CONCLUSION: Solicam does not appear to provide adequate suppression of bunchgrass. However, I have re-treated half of the plot in the fall of 1989 and will gather the additional data next summer.

RECOMMENDATIONS: Will be made upon termination of the experiment.

Table 1. Main effects of SOLICAM and VELPAR on bunchgrass Bucksport, 1989

Herbicide	Rate lb/a	Phytotoxicity (0 - 10)	Grass cover (%)	Height (cm)
Velpar	0	2.5	38	76
	2	4.6	34	64
Significance		**	NS	**
Solicam	0	1.9	38	71
	3	3.3	36	76
	6	3.9	38	66
	9	5.1	33	66
Significance		L**	NS	L**

L= linear trend, ** = Sig at 1%, NS = non-significant
Grass phytotoxicity 0= no effect 10= complete control

Table 2. Effect of SOLICAM by VELPAR on bunchgrass Bucksport, 1989

Herbicide	Rate lb/a	Phytotoxicity (0 - 10)	Grass cover (%)	Height (cm)
		Velpar 0 lb/a		
Solicam	0	0.6	38	77
	3	2.4	33	80
	6	3.0	43	74
	9	3.8	37	71
Significance		L**	NS	NS
		Velpar 2 lb/a		
Solicam	0	3.1	38	66
	3	4.1	38	71
	6	4.2	33	59
	9	6.3	28	61
Significance		L**	NS	L**

L= linear trend, ** = Sig at 1%, NS = non-significant
Grass phytotoxicity 0= no effect 10= complete control

OM 14.5% by loss on ignition, pH = 4.8
Treated: with velpar 5/5/89, with solicam 5/10/89
Evaluated: 8/16/89

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Selective wiper and mechanical control of dogbane.

METHODS: As indicated in 1989 project proposal outline 8. Bracken fern counts included in trial and an asulox treatment was added.

RESULTS: Pretreatment counts taken in 1989, posttreatment counts needed for evaluation.

CONCLUSION: Will be made when postcounts are made in 1990.

RECOMMENDATIONS: None yet.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Evaluation of sulfonyl urea herbicides for bunchberry control.

METHODS: As indicated in 1988 project proposal outline 10.

RESULTS: Preemergence applications - Chlorosulfuron stimulated blueberry stand and reduced bunchberry count. Sulfmeturon methyl stimulated blueberry stand, length and buds but did not affect bunchberry count. Chlorimuron had a variable effect on blueberry but did not affect bunchberry count. Tip-diebck applications - Sulfmeturon methyl had a variable effect on blueberry. None of the herbicides reduced bunchberry. Fall application - All three herbicides reduced bunchberry but chlorosulfuron also reduced blueberry stand and yield.

CONCLUSION: Sulfonyl urea herbicides can selectively remove bunchberry from lowbush blueberry fields, but the best material, rate and timing still need to be determined.

RECOMMENDATIONS: Continue testing these and other sulfonyl urea compounds to determine the best material, timing and rate of application.

Table 1. Effect of sulfonyl urea herbicides on blueberry and bunchberry, Jonesboro 1989.

Herbicide	Rate G/ha ai	Blueberry	Bunchberry	Blueberry			
		Carryover count 1989 $(0.1m^2)$		Length (cm)	Buds $(0.1m^2)$	Yield kg/ha	
PREEMERGENCE							
Chlorimuron	0	73	22	317	101	1109	
	50	83	18	339	69	837	BBS01P89
	100	37	40	203	69	565	
	200	73	22	426	127	944	
Significance		Q*	NS	Q**	NS	NS	
Chlorosulfuron	0	39	59	173	41	576	
	50	45	35	184	85	404	
	100	45	30	123	73	597	
	200	74	12	145	71	426	
Significance		L**	L**	NS	NS	NS	
Sulfmeturon methyl	0	44	48	286	128	843	
	50	36	45	334	115	821	
	100	75	30	315	92	553	
	200	73	15	495	186	453	
Significance		L*	NS	L*	Q**	NS	
TIP-DIEBACK							
Chlorimuron	0	62	24	337	93	1067	
	25	39	33	308	73	784	BBS01T89
	50	64	18	477	103	704	
	100	53	31	360	126	645	
Significance		NS	NS	NS	NS	NS	
Chlorosulfuron	0	84	23	340	69	464	
	25	68	14	386	103	704	
	50	63	19	386	101	373	
	100	96	13	372	68	272	
Significance		NS	NS	NS	NS	NS	
Sulfmeturon methyl	0	59	33	323	78	704	
	25	84	19	367	110	902	
	50	97	16	528	103	538	
	100	65	27	409	93	469	
Significance		Q*	NS	NS	NS	NS	

Table 1. Continued.

*=5%, **=1%, L = linear trend, Q = quadratic trend, NS = nonsignificant

Table 1. Continued.

Herbicide	Rate G/ha ai	Blueberry	Bunchberry	Blueberry		
		Carryover count 1989 ($0.1m^2$)		Length (cm)	Buds ($0.1m^2$)	Yield kg/ha
FALL-PRESENECENT						
Chlorimuron	0	58	47	323	93	768
	50	91	20	418	75	533
	100	62	27	306	62	357
	200	69	12	316	63	309
Significance		NS	L*	NS	NS	NS
Chlorosulfuron	0	42	37	211	50	581
	50	12	0	344	75	0
	100	10	0	311	70	0
	200	8	0	344	92	21
Significance		L**	L**	NS	NS	L**
Sulfmeturon methyl	0	45	43	274	70	939
	50	41	18	281	64	730
	100	49	11	297	101	709
	200	54	0	299	86	928
Significance		NS	L*	NS	NS	NS

*=5%, **=1%, L = linear trend, Q = quadratic trend, NS = nonsignificant

BBSU1F89

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist
John M. Smagula, Professor of Horticulture

TITLE: Seedling Pruning Study

METHODS: As indicated in 1988 Blueberry Advisory Committee Research Report.

RESULTS: Plant cover increased steadily up to 1988 and then declined slightly. The cross 4161 x Augusta spread more rapidly than Augusta x 4161. Plants spread was greater if pruning was delayed (Table 1).

CONCLUSION: In this study the seedling source was the most important factor influencing plant spread. The final pruning and evaluation will need to be made before a final conclusion can be reached.

RECOMMENDATIONS: Final evaluation of spread will be made in 1990 and yields taken in 1991.

Table 1. Main effect of year, time of pruning and cross on blueberry plant cover, planted at BBHF, Jonesboro May 1985, evaluated August 1989.

YEAR	Cover(% ft sq)	Treatment	Cover(% ft sq)	Cross	Cover(% ft sq)
1986	38	mow 1986	63	4161 x Augusta	84
1987	48	mow 1987	75	Augusta x 4161	65
1988	110	mow 1988	87		
1989	104				

All differences significant.

RSPRN90.DOC

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1990

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Evaluation of Sethoxydim (POAST) in lowbush blueberry fields.

METHODS: Poast was applied by three growers as a broadcast spray or spot treatment on bunchgrass and applied by me as a broadcast and spot treatment on pruned and cropping fields with oatgrass and bunchgrass. All pruned fields had received a preemergence application of hexazinone.

RESULTS: Table 1, grower treated applications of bunchgrass on non-bearing fields after velpar provided a significant and sizeable suppression of the grass. Tables 2 and 3, broadcast and spot treatments in the non-bearing year provided good suppression of bunchgrass but the treatments in the crop year did not and no effect on yield was seen. Tables 4 and 5, broadcast and spot treatments on the oatgrass had no effect in the non-bearing year because it was adequately controlled by velpar but if used in the bearing year when velpar was not used it provided good suppression of the oatgrass, again no yield effect was seen.

CONCLUSION: My conclusions are that Poast is effective in suppression of bunchgrass the non-bearing year when velpar is used but not in the crop year, and for oatgrass that it is not needed in the non-bearing year when velpar is used but is effective in the crop year when velpar is not used, it may also be needed in the non-crop year when velpar is not used.

RECOMMENDATIONS: Poast is effective in the suppression of oatgrass and bunchgrass.

Table 1. Poast bunchgrass evaluation - growers fields, 1989

Poast + COC	Rating (0-10)	Ht (cm)
	Union - Nash Farms Applied 6/27 and 7/21	
None	0.1	72
Broadcast 2.5+2.5 pt/a	6.6	19
	Union - Coastal Blueberries Applied 6/21	
None	0	81
Spot 1.5%	8.6	20
	Grey - Cherryfield Foods Applied 6/21 and 7/11	
None	0.6	74
Broadcast 2.5+1.5 pt/a	7.4	15

All differences between treated and non treated highly significant.

Grass 4 to 6 " in Union, 2-4 " in Grey at time of treatment.
Rating of 20 random clumps in grower-treated fields evaluated on 8/17/89, 0= no effect 10= complete control.
No blueberry phytotoxicity observed.
Union - Coastal Blueberries - Backpack sprayer with variable tip, and no presure regulator
Union - Nash farms - 20 gpa,12 psi,8004 tjet tips,20" above ground
Grey - Cherryfield Foods - 20 gpa,30 psi,80015 tips,20" above ground

Table 2. Poast bunchgrass evaluation - Broadcast, 1989

Poast w/COC Pt/A	6-19 Cover (%)	6-19 Ht (Cm)	7-14 Cover (%)	7-14 Ht (Cm)	8-8 Cover (%)	8-8 Ht (Cm)	8-8 Phyto (0-10)	8-8 Yield (Kg/ha)
				Bucksport - pruned field (with velpar)				
0	44	12	61	13	68	69	1	-
1.5+1.5	50	13	21	13	18	18	8	-
2.5+1.5	49	12	12	13	18	13	9	-
Sig.	NS	NS	**	**	**	**	**	-
				Surry - crop field (without velpar)				
0	33	17	33	19	33	61	0	1525
1.5+1.5	50	20	50	19	43	60	7	1899
2.5+1.5	44	21	44	17	39	70	8	2841
Sig.	NS	NS	NS	NS	NS	NS	**	NS

Poast sprayed broadcast at 20 gpa, 30 psi with 80015 tjet tips, 20" above ground on 6-19 and 7-14-1989. Evaluated on 8-8-89. Phyto = phytotoxicity to grass where 0 = no effect and 10 = complete control. NS = nonsignificant, ** = highly significant. No phytotoxicity to blueberries noted.

Table 3. Poast bunchgrass evaluation - Spot spray, 1989

Poast w/COC (%)	6-19 Ht (Cm)	7-14 Phyto (%)	7-14 Ht (Cm)	8-16 Phyto (%)	8-16 Ht (Cm)
		Bucksport - pruned field (with velpar)			
0	13	0.2	24	1	84
1.5	12	8.4	9	9.5	4
1.5+1.5	13	8.3	9	9.8	1
Sig.	NS	**	**	**	**
		Surry - crop field (without velpar)			
0	20	0.7	30	0.8	60
1.5	21	9.0	12	9.3	55
1.5+1.5	21	9.3	9	9.7	51
Sig.	NS	**	**	**	NS

Poast spot sprayed at 20 gpa, 30 psi with one 80015 tjet tip, 2" above plant on 6-19 and 7-14-1989. Evaluated on 8-16-89. Phyto = phytotoxicity to grass where 0 = no effect and 10 = complete control. NS=nonsignificant, ** = highly significant. No phytotoxicity to blueberries noted.

Table 4. Poast oatgrass evaluation - Broadcast, 1989

Poast w/COC Pt/A	6-20 Cover (%)	6-20 Ht (Cm)	7-14 Cover (%)	7-14 Ht (Cm)	8-3 Cover (%)	8-3 Ht (Cm)	8-3 Phyto (0-10)	8-3 Yield (Kg/ha)
Deblois - pruned field (with velpar)								
0	26	13	18	15	9	17	2	-
1.5+1.5	26	17	18	17	23	14	5	-
2.5+1.5	39	35	35	17	39	17	3	-
Sig.	NS	NS	NS	NS	NS	NS	NS	-
Deblois - crop field (without velpar)								
0	74	18	74	21	90	64	0	786
1.5+1.5	74	19	63	17	50	24	7	854
2.5+1.5	79	18	63	18	44	21	8	1278
Sig.	NS	NS	NS	NS	**	**	**	NS

Poast sprayed broadcast at 20 gpa, 30 psi with 80015 tjet tips, 20" above ground on 6-20 and 7-14-1989. Evaluated on 8-3-89. Phyto = phytotoxicity to grass where 0 = no effect and 10 = complete control. NS=nonsignificant, ** = highly significant. No phytotoxicity to blueberries noted.

Table 5. Poast oatgrass evaluation - Spot spray, 1989

Poast w/COC (%)	6-20 Ht (Cm)	7-14 Phyto (%)	7-14 Ht (Cm)	8-3 Phyto (%)	8-3 Ht (Cm)
		Deblois - pruned field (with velpar)			
0	15	4.6	16	3.3	15
1.5	17	4.2	19	2.4	22
1.5+1.5	16	3.7	18	1.7	18
Sig.	NS	NS	NS	NS	NS
		Deblois - crop field (without velpar)			
0	19	0	39	0	46
1.5	17	6.7	15	6.6	12
1.5+1.5	18	5.6	19	6.7	16
Sig.	NS	**	**	**	**

Poast spot sprayed at 20 gpa, 30 psi with one 80015 tjet tip, 2" above plant on 6-20 and 7-14-1989. Evaluated on 8-3-89. Phyto = phytotoxicity to grass where 0 = no effect and 10 = complete control. NS=nonsignificant, ** = highly significant. No phytotoxicity to blueberries noted.

University of Maine
Cooperative Extension

Orono, Maine 04469

BLUEBERRY ADVISORY COMMITTEE
EXTENSION REPORT

Date: January, 1990

Investigator: Tom DeGomez

Title : Blueberry Extension Program

Results of Planned Program Activities:

1. Pest Control Recommendations.

a. March 1989, insect, disease, and weed control fact sheets published and distributed
b. March 1989, "Spray Drift and Your Neighbor" fact sheet published and distributed.
c. March 1989, "Postemergence Grass Control" fact sheet published and distributed.
d. March 1989, "Weed Management" fact sheet published and distributed.
e. April 1989, four spring blueberry meetings with two hours of talks on pesticide recommendations.
f. April 1989, newsletter on spring field work and pesticide use.
g. Currently working on updating insect, disease and weed control fact sheets, and "Weed Management".

2. Changes In Pest Control Recommendations.

a. June 1989, newsletter on the use of Asulox to control bracken fern.
b. November 1989, newsletter on non-renewal of Esteron 99.

3. Blueberry IPM.

a. June and July 1989, 5 field demonstrations on monitoring blueberry fields for pests.
b. July 1989, 2 meetings to discuss crop associations for IPM scouting.
c. June 1989, newsletter on blueberry fruit fly trapping.
d. November 1989, wrote blueberry portion of BMP manual. Newsletter article on BMP manual.
e. November 1989, newsletter article on 1989 insect survey.
f. December 1989, newsletter article on food safety, pesticides, and ICM.
g. January 1990, 1 hour talk at Ag. Trades Show on blueberry pests.
h. Recieved $5,000 grant from MDAFRR to hire ICM scout in Washington County.

4. Fact Sheet Updates/Revisions.

a. Benefits of mulching research information is being incorporated into a revision of the 1987 fact sheet "Filling Bare Spots in Blueberry Fields". The revised publication is in its first draft and will be ready for distribution in March.
b. "Introduction to Growing Blueberries" - Presently finishing the first review by authors. Will be ready for distribution by March.
c. "Blueberry Enterprise Budget" - Completed.
d. 1990 Insect, Weed and Disease Control Guides are in final review.
e. "Weed Management" is in early review. Will be ready for distribution by March.

5. New Fact Sheets.

a. "Block Freezing of Blueberries" - Al Bushway is finalizing and will get it to me in January, 1990.
b. "Influence of Pruning Method on Insect and Disease Control" - Final draft is done and it is being type set.
c. "A Comparison of Lowbush Blueberry Harvesting Technologies" - Final draft in done and it is being type set.

6. Transfer of Appropriate Technology.

a. Land leveling. I took a trip to Nova Scotia to see land that had been leveled and smoothed. At the Maine Agricultural Trades Show, January 1990, I organized a 2 hour program on this practice. I have received a grant from the CSRS funds to do a demonstration/research project on land leveling.
b. Field Management for Machine Harvesting. At the Maine Agricultural Trades Show, January 1990, I organized a 2 hour program on this practice. Fact sheet is under way. Computer decision making program was developed and is being distributed.
c. Blueberry Shelf Life (Fresh). I have introduced a new style (Oregon raspberry box) to the co-op for testing summer of 1990.
d. Over Wintering of Bees. I visited a over wintering facility in Nova Scotia and am planning on distributing information on over wintering to Maine growers.
e. Blueberry Field Reclamation. I visited several fields in Nova Scotia that were undergoing reclamation.

7. Plant Cover Improvement.

a. June and July, 1989. I held 5 field demonstrations to show growers how to use mulch and plants to improve plant cover.
b. Currently I am working with a committee to obtain funds to research the potential of direct seeding bare spots.
c. Maintained the 8 established demonstration plots.

8. Fertilizer Management.

a. Developed nitrogen and phosphorous recommendations using leaf tissue tests.
b. June and July, 1989. I held 5 field demonstration to show growers how to take leaf and soil tests.
c. August and Sept., 1989. I formulated and sent out fertilizer recommendations for 114 fields that had been sampled using the Extension leaf tissue tests. Due to wide acceptance of the tissue test program it will be necessary to computerize the recommendations for subsequent years, I will be working with the UM analytical lab on developing a program to handle the recommendations.

BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: May 1989 - March 1990

Investigators: E. A. Osgood, Project Leader
Luc Guimond, Graduate Student

Title: Pollination of the low-bush blueberry by native bees.

Methods: Native bees were collected on blueberry bloom using sweep nets with 15" net rings and 5' handles. A sweep was made every third or fourth step in a transect across blueberry fields so that bees would not be disturbed ahead of the collector. Each sample consisted of 50 sweeps. Some of the samples were taken in smaller fields in Beddington but most of the 122 fifty sweep samples were taken on the larger fields in Deblois. Bees were killed with ethyl acetate in the field. They were separated from debris in the laboratory, pinned and labeled as to date, location, host and collector. Bees will be identified to determine species diversity and their relative abundance.

Ten 3 ft. X 6 ft. plots were established over a wide area in a smaller field in Beddington, and the same was done in the middle of a large field in Deblois. Pollinator counts were made on May 23, 25, 26, 29, 1989 and included the number of honey bees, bumble bees, other native bees, bee flies, and syrphid flies visiting a given plot during a 30-second interval. A total of 60 counts was made each day in each of the two fields; a total of 240 counts/field. Counts in the two fields were made simultaneously by two observers. Observers were alternated between fields.

Sweep collections of native bees were also made on bloom of nine other plant species and were prepared in the laboratory as noted above.

Twenty five trap nesting blocks for Osmia atriventris were attached to trees (at a height of five feet) at the edges of blueberry fields in Beddington, Deblois, Orono and T32·MD in mid May. Each trap nesting block consisted of nine 1.9 X 1.9 X 17.8 cm pine strips bored to a depth of 15 cm. Six strips in each block contained an 8.0 mm diameter hole, and the remaining 3 were 6.4 mm in diameter. Other similar nesting structures were set out in and around a blueberry field in Winterport. This study by Dr. Drummond was separate from this project but directly related to it.

To determine the sources or pollen preferences of native bees before, during and following blueberry bloom, pollen has been removed from native bees collected on blueberry and other plant species. Pollen has been treated by acertolysis, permanent slides have been and are being made and the pollen is being identified by comparing with prepared standards. Flower constancy of bees will be determined. An attempt is being made to determine whether or not honey bees collect blueberry pollen under certain circumstances.

A nesting site of a probable important blueberry pollinator, Andrena vicina, was located and will be used for biological study next season.

Results: Bees collected during the past season have not yet been identified and the pollen identification study is in progress. Numbers of native bees collected in the 50 sweep samples varied from 0-8 showing that native bee populations were low in many areas. Plot counts of native bees in one area of the Schoodic Barrens showed an almost complete lack of native pollinators. A comparison of native pollinators in this area and in a smaller field in Beddington with more alternative plants in the area is shown in Table 1.

Populations of native bees observed and collected on blackberry appeared to be much higher in two areas where there were many alternative plants than in several areas around the larger fields where little forage exists. One area near an organic field appeared to have a particularly high population of native bees. Definitive counts for comparative purposes were not made.

Osmia atriventris did establish nests in some of the trap nests in some areas. Populations were low in most areas and many of the trap nests were not occupied. A good population was found in Winterport and overall enough specimens were collected to use for further observation and study. The smaller diameter holes were used almost exclusively and bees preferred nests located in open areas. Mortality of bee larvae was found to be high in nests established in the kiln dried wood. This may be due to the drying of larval food; moisture from the food being absorbed by the wood.

Many slides for the identification of pollen collected from bees, including honey bees, have been prepared and many more are yet to be made. Slides (standards) containing pollen collected directly from various plant species have been made and will be used to identify (by comparison) pollen taken from native bees.

Conclusions: Many areas of the blueberry barrens in Deblois contain very low populations of native bees as compared to some smaller fields. Lack of alternate forage plants may be one reason for this. Good populations of *Osmia atriventris* exist in some areas and can be used for further study. Pollen analysis is in preliminary stages and no conclusions should be drawn as yet. However, it appears that many of the honey bees and species of wild bees are not flower constant and that the pollen loads of most of the native bees collected on blueberry consists mainly of blueberry pollen.

Recommendations: The percentage of honey bees (with pollen loads) found in blueberry fields with little alternate forage in the area should be determined. Also the plant species from which the pollen was collected should be determined for honey bees and native bees. More information on native bee population numbers and species diversity should be collected, and the biology of *Andrena vicina* should be studied. A thorough search of the literature should be made to add to the pollen and nector preferences of native bees collected on blueberry in this study.

Survival of *Osmia atriventris* in polyurethane treated trap nests should be compared to untreated nests in an effort to devise a better nesting site. Population buildup should be attempted and other aspects of their nesting biology should be studied.

Table 1. Native pollinators counted in two blueberry fields.[1]

Pollinator	Small Field - Beddington				Large Field - Deblois			
	May 23	May 25	May 26	May 29	May 23	May 25	May 26	May 29
Bumble bees	4	2	8	3	0	0	0	1
Other native bees	19	23	17	14	1	3	1	0
Syrphid flies	1	0	0	4	0	0	0	0
Bee flies	2	2	1	0	2	0	2	5

[1]The number in each cell represents the sum of 60 observations of 30 seconds each.

MAINE BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT FOR 1989

DATE: January 21, 1990

INVESTIGATOR: David Lambert

TITLE: Postharvest fungi of lowbush blueberries

METHODS: **Effect of Burning** In 1989, fruit samples were collected at two research field sites in eastern Maine. These sites were designed as split plots with treatments pruned either by mowing or by burning. At site 1, thirty-six samples were taken from each of the two adjacent treatments. At site 2, thirty samples were taken from each treatment. One hundred berries per sample were placed without rinsing in moist chambers, and were incubated at room temperature for three weeks. During this period, infected berries were recorded and removed two times each week. Data for Botrytis, Glomerella, Alternaria, and Gloeosporium were analysed by regression with site and pruning treatment as variables to determine if the incidence of each disease was affected by the method of pruning.

Identification of Heat-tolerant Fungi Strains of heat-tolerant fungi were isolated from the fifty fruit samples obtained in 1988 and from additional berry samples. The times and temperatures selected were similar to those used during canning. After being frozen at -20 C for 6 mo, 25 g samples were thawed in sterile 50 ml centrifuge tubes to which 25 ml hot (80 C) sterile water was added. These were placed in an 82-83 C water bath, and incubated for 20 min after the samples had come to 81 C (ca. 30 min total). The tubes were inspected for fungal growth over a 1 month period, and fungi which survived the heat treatment were isolated. In addition, isolates of Penicillium spp. which formed sclerotia or ascocarps were saved from the fresh fruit survey.

RESULTS: **Effects of burning.** The relative incidence of major fruit-inhabiting fungi in fields pruned by mowing or by burning is given in Table 2. Glomerella, and Alternaria isolations were significantly but not substantially higher in the mowed plots, implying that periodic burning reduces inoculum levels of these organisms. This is, presumably, a residual effect from the year prior to fruit production, as both treatments accumulate inoculum in dead leaves and winter-killed stems between the vegetative and fruit-bearing seasons. At Site 1, where the pruning trials had been maintained for 12 yeares, Monilinia (mummy berry disease) was 90-fold higher in the mowed treatment than in the burned treatment. At site 2 (trials maintained for 4 years), the treatment differential for the disease was only 6-fold. This compounding of disease with time was not evident for Glomerella and Alternaria. Botrytis isolations were somewhat more frequent in mowed treatments but the difference was not statistically significant. Gloeosporium was recovered only twice at site 1.

RECOMMENDATIONS: Results at site 1 indicate that, in the past, burning has kept *Monilinia* levels low by the destruction of overwintering pseudosclerotia. Minimal burning, intended only to scorch blueberry stems (and perennial weeds), has a modest effect on disease in single cycles. The calculated 2.3-fold difference between treatments in disease per cycle at site 1 and the similar values obtained at site 2 indicate that such burns reduce disease and, presumably, the number of pseudosclerotia only 50 - 60% on average. However, the compounded effects of repeated burnings or mowings is substantial, resulting in a 90-fold difference in disease after twelve years. Inversely, a return to light burning may be expected to reduce disease as slowly as the shift from burning to mowing increased it. Results from site 2 indicate that the differential between mowing and burning develops at about the same rate regardless of the previous pruning practice on which these treatments were superimposed. More intensive burning should hasten this process, but a decision to change pruning practice should not be made on the basis of disease control alone.

PROJECTED RESEARCH: (Steam sanitation)

Table 1. Differential effects of pruning method on incidence of *Monilinia vaccinii-corymbosi* for consecutive crops at two sites.

	Diseased buds/m^2 [a]				Disease Gradient [d]	
Site/Year	Burned	Mowed	Difference [b] (Mow/Burn)	Crop [c] Cycles	Burned	Mowed
Site 1-1987	0.55	39.50	71.1	5	none	none
Site 1-1989	4.12	369.39	89.8	6	none	none
Change 89/87	7.5	9.4	1.3			
Site 2-1987	5.56	19.85	3.6	1	B --> M	B --> M
Site 2-1989	6.85	44.97	6.6	2	B --> M	none
Change 89/87	1.2	2.3	1.8			

[a] Units of infection are all leaves developing from a single foliar bud. Differences between treatments were highly significant ($P < .001$) at both sites in both years.

[b] Mow/Burn = the ratio of disease in the mowed treatment to that in the burned treatment. Change 89/87 = the ratio of disease in 1989 to that in 1987.
[c] Number of two-year crop cycles following establishment of the mow/burntreatments.

[d] Direction along transects in which a statistically significant increase in disease incidence occurs. Regression analyses were done within treatments and evaluated at the $P < .05$ level. B ---> M indicates that disease increases along the transects in the burned to mowed direction.

MAINE BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT FOR 1989

DATE: January 21, 1990

INVESTIGATOR: David Lambert

TITLE: Effects of Pruning Method on Mummy Berry Incidence

METHODS: Sampling grids were established in 1986 at two Washington Co., ME lowbush blueberry fields to quantify differences in disease associated with mowing or burning. At site 1 (University of Maine Blueberry Hill Farm, Jonesboro), comparisons were made on adjacent 0.4 ha plots. One treatment was mowed in the previous five crop cycles, the other was pruned only by burning over the previous 40 yr. This site was used to demonstrate the cumulative effects of a long-term shift to mowing. At site 2 (Tracy Field, Cherryfield) a 7-hectare portion of a larger field was burned following two cycles in which the entire field had been mowed. This site was selected to demonstrate the short-term effects of a return to burning. Treatments at both sites were repeated for an additional cycle (burning and vegetative growth - 1988, infection and fruit production - 1989). At site 1, six parallel transects (130 m long, 10 m apart) were laid out to cross from one treatment to the other. The transects were each subdivided into six 10 m subplots per side with a central 10 m space between the surveyed areas. At site 2, eight transects (210 m long, 15 m apart) were each subdivided into two sets of ten subplots with a lane separating the treatments. Mummy berry disease was evaluated at late bloom in 1987 and 1989 in two randomly selected 0.25 m^2 areas per 10 m subplot. The number of all stems showing any foliar blight symptoms was recorded.

RESULTS/CONCLUSIONS: At site 1 in 1989, after six cycles, the difference in disease was 90-fold (Table 1). Site 1 received 28 cm of rain in May 1989, and disease increased considerably over 1987. There was a 7.5- fold disease increase in the burned treatment and a 9.4-fold increase in the mowed treatment. The apparent differential between mowed and burned areas for the 1988-1989 crop cycle was thus 1.3-fold, considerably less than the 2.3-fold average for the previous five cycles. At site 2 in 1989, after two cycles of burning, the difference in disease between the two treatments was 6.6-fold. Using the 1987 data as a base, the difference resulting from burning in 1988 was 1.8-fold. The correlations between disease counts between individual subplots in 1987 and 1989 were significant, r = .437 for the mowed plots and r = .333 for the burned plots (79 d.f.). These correlations are, however, too low to use limited disease scouting as the basis for application or scheduling of fungicide treatments in the next crop cycle.

At site 2, nearly all isolates were from the burned treatment. Although the fungus was widely distributed in this treatment (present in 12 of 30 samples), lack of a rational explanation and of confirming data from Site 1 advise caution in interpretation of the results.

Heat-tolerant Strains. Eupenicillium lapidosum or a closely related species was recovered from several samples of heat-treated berries and was also the most common Penicillium anamorph isolated in the 1988 fruit survey. These isolates differed from the species description only in their faster growth on malt extract agar at 25 C and on Czapek Yeast agar at 37 C. A second sclerotial Eupenicillium species was recovered from heat-treated fruit. This one resembled the related species E. brefeldiamum, E. levitum, and E. ehrlichii. Additional isolates were closely related or identical to Talaromyces striatus. A fourth type of heat-resistant isolate had a Penicillium-like anamorph but has not been further identified. None of the identified species are known to produce mycotoxins. An additional isolate produced aleuriospores similar but not identical to those of the described species of Humicola and Thermomyces.

RECOMMENDATIONS: The incidence of postharvest fruit infection in the lowbush crop is similar to that in the highbush crop, despite the season-long use of fungicides on highbush fruit. At room temperature, mold does not begin to develop until several days after harvest, reducing fresh market problems. At this time, attempts to reduce fruit infection with fungicides do not appear neccessary or desirable. Fresh market processors should monitor their product for potential problems and minimize storage time if possible.

PROJECTED RESEARCH: (Fruit Quality Project - CSRS Grant)

Table 2. Incidence of major fruit-infecting fungi at two sites as affected by pruning treatment[a].

	Site 1		Site 2	
Genus	Mowed	Burned	Mowed	Burned
Botrytis	3.9	3.1	5.5	3.9
Glomerella	5.1	2.9	13.3	4.4
Alternaria	1.5	0.9	1.2	0.4
Gloeosporium	0.0	0.1	0.1	1.3

[a]Incidences of Glomerella, and Alternaria were significantly higher in the mowed treatments with data from both sites analysed together, $P < 0.05$. Incidence of Gloeosporium was significantly lower in the mowed treatment of site 1 analysed by itself.