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Maine Blueberry Advisory Committee Research Report

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MAINE BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1990 to March 1991

Investigators: H. Y. Forsythe, Jr., Project Leader
J. A. Collins, Research Associate

Title: Biology and action thresholds of secondary blueberry pest insects

Methods: Biology and life history information was collected for red-striped fireworm. Field cages and litter samples were observed during the early season for pupal development and adult emergence. Sweep-net, "pace" sampling, and pheromone traps were evaluated as potential adult monitoring procedures. Also, larval feeding sites, habits, and presence were monitored. Overwintering larvae were collected and will be maintained through diapause dormancy. In addition, infested sites were located for 1991 studies.

Blueberry plant development in small burned areas was compared with growth in adjacent mowed and scorched areas to detect the presence of damaging spanworm populations in pruned fields. An attempt was also made to further refine the economic injury level and action threshold for blueberry spanworm in vegetative-year fields by comparing insect feeding injury to blueberry plants with numbers of larvae in sweep-net samples. Evidence of feeding injury was based on number and height of stems and on flower and leaf bud formation immediately following spanworm activity and at postharvest.

Results: The outbreak of red-striped fireworm became more extensive in 1990. Fireworm larvae tied up and skeletonized blueberry leaves in Franklin and Washington Co. Fairly widespread larval leaf-tying and feeding activities became apparent in late July. Larvae observed at this time appeared to be mid-instar; no early instar larvae were observed in leaf ties. Various degrees of leaf tying were noted from simple 2-leaf ties with no visible external injury to multiple leaf tying and skeletonizing. Although several fields had vigorous fireworm larval populations, few adults were observed. Only three adults were seen in a field heavily infested with larvae in 1989. Adults are small, dark-colored, and quick moving and are difficult to observe in the field. No effective monitoring method has yet been developed.

Some life history information was collected on lygaeids and leaf beetle to aid in the future development of economic injury levels and action thresholds for these insects. In addition, photographs were obtained of various insect species and stages including red-striped fireworm, lygaeids, leaf beetles, and blueberry looper.

Four fields treated by burning, mowing, or scorching showed no trend toward delayed plant development due to spanworm feeding because numbers of insects were too low. Larval feeding was minimal; spanworm larvae averaged <2 larvae per 10 sweeps in the burned and scorched areas; <3 larvae per 10 sweeps were seen in the mowed areas. These results would tend to support an economic injury level for spanworm larvae slightly higher than 3 per 10 sweeps in vegetative-year fields.

Data collected on other insects was not sufficient to make any conclusions on thresholds or monitoring systems because numbers of insects, which are needed to conduct reliable research, were generally very low.

Conclusions: The potential for economic damage by the red-striped fireworm remains unclear. Examinations of infested stems have revealed little evidence of feeding on flower or leaf buds. More information on the biology and life history of this insect is necessary to facilitate development of an effective management program and monitoring system.

Knowledge of the biology, ecology, economic injury levels, and action thresholds of some of the more important secondary pest insects remains incomplete. The extremely high variability among insect pest numbers even within individual fields adds greatly to the difficulty of gathering information. Economic injury levels and action thresholds can only be developed after extensive replication, sampling, and observation.

Recommendations: No recommendations can be made for control of red-striped fireworm. High populations of this insect have occurred in both mowed and lightly burned fields. Further study is required to determine the exact status of this insect in lowbush blueberry fields. Development of a monitoring system should also be a high priority.

More detailed study into the biology and behaviors of secondary pest insects is needed. Various factors can have a major impact on management programs.

Growers should continue to monitor their fields for outbreaks of pest insects. Sweep-net sampling is recommended as the most reliable and practical method of determining the need for control measures.

MAINE BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1990 to March 1991

Investigators: H. Y. Forsythe, Jr., Project Leader
J. A. Collins, Research Associate

Title: Control of blueberry maggot

Methods: The search for control alternatives less hazardous and less toxic than Guthion continued in 1990. A test to confirm the possible usefulness of the bait adjuvant Nu-lure in combination with reduced rates of insecticides was also a priority.

Bearing blueberry fields, which previous years trap records showed to have a history of large maggot infestations, were located and treatment areas established. Untreated areas were designated to detect normal population levels.

All treatments were applied at 40 psi in 15 gallons of water-mixture per acre with a CIMA® P55D Atomizer L.V. sprayer mounted on a 674 International® tractor driven at 2 mph. Materials were applied on 12 or 13 July and again 26 or 27 July. Control evaluation was based on postspray counts of blueberry maggots found in berries raked from various areas within and around each plot. Berries were refrigerated and processed for maggots within 7-10 days after collection.

General Insecticides

Six materials were evaluated for their effectiveness in reducing blueberry maggot populations. A randomized block design with two replications of each treatment was utilized. Plots measured 100 X 100 feet with 100 ft untreated buffer zones between plots. One quart of berries was raked from each of five systematically selected areas within each plot and compared with samples from eight areas in the untreated zones around and 50 ft from the perimeter of each treated plot.

Insecticides plus Nu-lure Insect Bait

Imidan or Guthion, with Nu-lure, were tested to determine if maggots can be controlled by lower than standard rates of insecticides with the addition of a bait. Attractiveness of Nu-lure was also monitored by sampling the post-spray maggot populaton at 50 ft intervals from the center of each plot in all directions (N,S,E,W). Within treatment plots, samples were collected from each of five preselected areas per plot. A randomized design with one replication of each treatment was used; plots measured 100 X 100 feet with at least 300 ft between plots.

Results:

General Insecticides - Materials tested were a) the unregistered insecticides Asana, Ambush, and Pyrenone, b) Malathion, c) Sevin, and d) the standard control of Guthion. The results of the study were inconclusive. Populations of maggots were very low in samples from both treated and untreated areas. Maggots per quart in the control samples ranged from 0.6 to 1.2; 0.0 to 1.0 maggots per quart were present in samples from treated areas. The most maggots found in any one sample was 5 in an untreated sample.

Insecticides plus Nu-lure - The attractiveness of Nu-lure to blueberry maggot was unclear due to low maggot counts. The average number of maggots in treated samples for Study 1 (Guthion + Nu-lure) was 0.3 on 7/31 and 0.5 on 8/15; 1.3 and 0.5 maggots per quart were found in untreated samples on 7/31 and 8/15, respectively. For Study 2 (Imidan + Nu-lure), only 0.1 maggots per quart were found in treated samples and 1.0 in untreated samples.

There was some indication that lower rates of Guthion and Imidan, with and without the addition of Nu-lure, were possibly effective in controlling blueberry maggot; however, maggot counts were too low for definite conclusions.

Conclusions: Guthion and Imidan have been tested at lower than standard rates and in combination with Nu-lure Insect Bait. Thus far, the results are inconclusive but promising. However, the continued absense of a vigorous test insect population means additional tests will be necessary to determine how to best utilize a bait adjuvant to reduce insecticide rates and usage.

Recommendations: No recommendations can be made with confidence for the use of Nu-lure in combination with insecticides. Guthion and Imidan remain the best registered insecticides for controlling blueberry maggot.

Generally, higher than normal maggot populations are required to determine the effectiveness of various practices and materials. Locating fields with suitable maggot populations should continue to be a priority.

MAINE BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1990 to March 1991

Investigators: H. Y. Forsythe, Jr., Project Leader
J. A. Collins, Research Associate

Title: Control of secondary blueberry pests

Methods: Insect concerns for growers in 1990 were rarely the result of a single species being present in a field in large numbers. Many areas had small to moderate populations of 3 or 4 different insect species which, collectively, caused damage to blueberry plants.

When sufficiently abundant test populations were located, candidate chemicals and non-chemical control measures were tested for maximum control at the lowest possible rates and compared with standard materials. Populations of secondary pest insects were located from field observations and grower reports.

Laboratory Tests

Collections were made of those insects present in sufficient numbers. Square-foot patches of blueberry plants were treated with different insecticides 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. A single cage constituted a replication; there were 2 or 3 replications per treatment. At various times after insects were introduced into the cages, a knockdown count of dead or inactive insects was made.

Field Tests

Field tests were conducted when a pest insect species was present in sufficient numbers and homogeneously distributed over a large field area. Randomized complete block designs with 3 replications were utilized. Each plot measured 20 X 20 feet with 5 ft untreated buffer strips between plots. All field plots were treated with a hand-held, CO_2-propelled boom sprayer at 25 gallons of water-mixture per acre. On one pretreatment and various post-treatment dates, insects found in each plot were counted by sampling the center area of each plot with 10 sweeps of a standard 12-inch sweep net. After the live insects were counted, they were spread back over the same plot.

Non-chemical Control

The egg parasitic wasp Trichogramma was released in three areas infested with blueberry spanworm in 1989. Releases were made on 100 x 100 ft plots at weekly intervals for four weeks beginning in mid-April. Insect parasitic nematodes were released in two locations. Nematodes were applied to 15 X 15 ft plots in 20 oz of water-mixture per 225 square feet of soil surface (30 gal/acre).

All fields selected for releases were flail-mowed in the fall of 1989. Pest insect populations in and around the release sites were monitored by sweeping. Blueberry plant growth was also measured.

Results: The table shows the results of laboratory and field tests with registered materials. The unregistered pyrethroids Asana, Ambush, and Spur continued to show promise, proving highly effective against various pest insects and stages. Pyrenone, an unregistered natural pyrethrum was likewise very sucessful in both laboratory and field tests. A variety of Bacillus thuringiensis products performed well in suppressing early-instar populations of Itame brunneata, a relative of spanworm. Imidan, Marlate, and Dylox, all registered materials were effective in laboratory and field tests, as shown in the table.

It was not possible to determine the potential of Trichogramma or insect parasitic nematodes in controlling blueberry spanworm. Spanworm populations were low throughout the study. Measurements of blueberry plant growth in and around release sites showed no trend toward delayed plant development due to spanworm larval feeding.

Progress was made towards the registration of Spur for use on lowbush blueberries. Spur treatments were applied four times through the season, and residue samples were collected to assist in the establishment of a tolerance and national registration for Spur on low- and highbush blueberries for control of blueberry spanworm, flea beetle, and sawfly larvae. Efficacy, phytotoxicity, and yield data were also collected.

Conclusions: Since Maine is the only state conducting research on lowbush blueberries, continuing study is needed to identify and test new control measures. Some insecticides such as Asana and Ambush, although effective in controlling pests in past tests, remain unregistered and will require further testing and development of tolerances and registrations through IR-4. There continues to be a limited number of effective, but short residual, insecticides registered for use on lowbush blueberries. Although control recommendations have been developed and revised for thrips, spanworm, flea beetle, sawfly, and blueberry maggot, the changing status of recommended insecticides, because of special and reregistration reviews, will necessitate a continuing and active program to provide data on the need for currently registered materials.

Recommendations: The future profitability of the blueberry industry in Maine will be at least partially dependent on continued research in pest control. Although control tests conducted during the last several years have confirmed some effective treatments, information on insecticides and other strategies of control will require constant updates and revisions.

Current recommendations for control of blueberry spanworm larvae during bloom will continue to be Dylox, Marlate, and Dipel or Javelin. Imidan or Guthion can be used in vegetative fields or when bees are not present in the area. Sawfly and flea beetle can be effectivly controlled by Marlate during bloom, and by Imidan at postbloom.

Because of public concern for environmental and food safety, continued emphasis will be placed on research into non-chemical strategies such as release of Trichgramma and nematodes, applications of B.t. materials, and use of insect growth regulators and baits.

Blueberry Insect Control Tests [a]

	Laboratory Tests				Field Test
	Spanworm L.	Itame sp. L.	Grasshopper N.	Leaf beetle A.	Sawfly L.
Dipel (8 oz) [b]		G			
Dipel (13 oz)		G			
Biobit (26 oz)		G			
Javelin (32 oz)		G			
Javelin (48 oz)		G			
Dylox (16 oz)	E				E
Imidan (16 oz)			G	E 100% 24H	VG 100% 3 days
Imidan (32 oz)			G		
Marlate (48 oz)				E	
Marlate (64 oz)			E		VG

[a] E = excellent, VG = very good, G = good, F = fair, P = poor; oz = formulation per acre; L = larvae, N = nymphs, A = adults.

[b] B.t. materials effective in controlling early-instar Itame; control of late-instar larvae was poor within the time limits of the test.

MAINE BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: October 1989 to September 1990

Principal Investigators: H. Y. Forsythe, Jr.
J. A. Collins

Cooperators: J. Riley, D. Lambert, and D. Yarborough

Title: Application of steam as a method of controlling secondary pest insects on lowbush blueberry: A feasibility study

Methods: Research in 1990 focused on collecting overwintering stages of various secondary pest insects for use in determining the temperature required to kill the insects with short (< a few seconds) exposures to steam. Insects will be exposed to various dry and steam temperatures and exposure times in the laboratory during the winter or spring of 1991. Some attempts will be made to simulate field litter conditions. An effort will also be made to determine factors necessary for survival of overwintering stages in the laboratory, i.e. relative humidity and temperature.

Results: Blueberry spanworm and blueberry flea beetle eggs were collected from laboratory reared and field collected adults in 1990 and are being maintained in a viable state in the laboratory. These eggs will be maintained through diapause dormancy (late winter 1991), treated with various dry and steam temperatures and exposure times in the laboratory, and then reared to determine mortality. Red-striped fireworm larvae were also collected and will be similarly treated.

In preparation for evaluation of steam treatments in the field, areas were located which showed significant natural pest populations in 1990.

Conclusions: It has become apparent that flail-mowing can have a significant effect on insect populations in lowbush blueberries. A number of damaging insects, especially blueberry spanworm, blueberry flea beetle, and blueberry sawfly, are more likely to be found in higher numbers in mowed rather than in burned fields. Even in lightly burned fields, survival of these pest insects is more common. Red-striped fireworm has become more abundant in recent years; outbreaks have occurred in both mowed and lightly burned fields.

The use of steam has good potential as a non-chemical means for suppressing insect pest populations.

Recommendations: This feasibility study will require a minimum of 2 to 3 more years to complete. Overwintering stages were collected in 1990; however, results of laboratory testing will not be available until 1991 since effectiveness of different treatments will be based on successful development or mortality of immature insects. Work is also required to determine conditions needed for successful laboratory rearing of untreated overwintering stages. The continuing long-term goal of this research should be to provide growers with a means to improve insect control in flail-mowed or lightly burned fields without the use of pesticides.

BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1990 - September 1990

Investigators: E. A. Osgood, Project Leader
F. A. Drummond, Assistant Professor

Title: Pollination of the lowbush blueberry by native bees.

Methods: Specimens of native bees were collected on blueberry bloom using a sweep net with a 15" net ring and a 5' handle. 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. These samples were needed to supplement the specimens of native bees available for the pollen identification study.

A sample of honey bees (incidentally collected while sweeping for native bees) was also kept to determine whether honey bees collect blueberry pollen, and if so, what percentage of them do so in different habitat situations. Therefore, 16 sweep samples were taken in Deblois on the large barrens and 16 were taken on Vienna Mt., in Vienna where it appeared that native bees were much more abundant.

All 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.

Collections of native bees were also made on rhodora in Deblois, T30 MD, and on Vienna Mt. to determine the number of blueberry pollinators that utilize rhodora.

All native bees collected on lowbush blueberry at various times and locations, and which contained good pollen loads, were identified to species. Pollen was removed from the native bees and honey bees using fine tweezers, and dispersed in 10% potassium hydroxide at 90°C for 10 minutes. A 9/1 solution of acetic anhydride and concentrated sulfuric acid at 90°C was used to remove organic matter, and the remaining material was suspended in silicon oil. Samples were analyzed using a high quality Leitz light microscope under 400X magnification. In most instances at least 100 pollen grains were identified from each sample.

As an aid to pollen identification and for other purposes, it is desirable to know the flowering periods of all plant species utilized by blueberry pollinators in the study areas. Therefore, weekly observations on the flowering periods of 13 plant species were made from May 14 - June 29.

The lowbush blueberry is a member of the family Ericaceae. Several other plant species found on or about blueberry barrens also belong to this family, and the flowering phenology of some of these overlaps that of blueberry.

Pollen grains in these species are similar to that of blueberry and can be difficult to distinguish from blueberry or from one another. Currently, keys are not available for this specific plant group, but is currently an objective for this project.

A thorough search of the literature has been made to determine the known plant host records of more than 40 species of native bees which have been previously collected from lowbush blueberry in Maine. This will add to our knowledge of the pollen preferences of bees identified in this study.

Andrena vicina is an important and abundant pollinator of the lowbush blueberry in Maine and is found from coast to coast in the U.S. and Canada. Information on the biology of this species is being compiled.

Some aspects of the biology of Osmia atriventris, a native leaf cutting bee, were also studied. Two types of nesting blocks were constructed and set out prior to blueberry bloom in 9 locations. The first type of nesting "block" was constructed of 5 cm diameter PVC tubing cut in 18 cm lengths. The tubes were fitted with a plywood backing on one end and then filled with ca. 40 paper straws (0.7 cm in diameter) for O. atriventris nesting sites. A second type of nest "block" was constructed of pine blocks (5 cm x 14 cm x 18 cm). Three blocks were fastened together. Each block had 14 holes drilled (16 cm deep) in them of either 0.7 cm, 0.8 cm, or 0.9 cm in diameter. Three blocks, each one of a different hole diameter, were fastened together using plumber's strapping (resulting in 42 holes per trap) and were dipped in polyurethane to provide a water resistant seal in the nesting holes. Five blocks of each type were hung at ca. 2 m height along the border of a blueberry field at a spacing ranging from 30 to 250 m apart. The 9 locations selected represented both small blueberry fields with diverse interspersed vegetation ((5-30 acres) 3 fields) and large sections of blueberry barrens ((> 100 acres), 6 locations). Traps were collected and brought back to the laboratory in late August. The number of O. atriventris nests and % parasitism of nests was recorded. In addition to the 9 locations, a transect of blocks was set out at a small diversified blueberry field (from 50 m into the border to 200 m into the field, a block every 50 m). During bloom, sweep net sampling was conducted (see methods above) at each of the 9 block locations in order to sample the proportion of O. atriventris in the blueberry fields relative to other bee species.

Osmia ribifloris, a western leaf cutter bee and an efficient pollinator of highbush blueberry in the west, is being considered for trials on lowbush blueberry in Maine.

Results: Native bees were much more abundant on Vienna Mt. than on the large barrens in Deblois. Only 2.06 bees/50 sweeps were collected in Deblois and 6.63 bees/50 sweeps were collected in Vienna; 3.2 times as many. Although all of these bees have not been identified as yet, the diversity of bees appears to be higher in Vienna also. No leaf cutter or bumblebees were collected in Deblois and both were collected on Vienna Mt. Native bees and other insect visitors were also much more abundant on rhodora in Vienna and T30 MD than they were in Deblois.

Not all of the bees collected in 1989-90 have been identified, but all of those collected on blueberry, wild blackberry, and shadbush, Amelanchier laevis which were carrying sufficient pollen loads to be utilized in the pollen study have been identified to species.

They include the following:

Host	No. genera	No. Species
Blueberry	8	19
Blackberry	9	24
Shadbush	5	7

Of the native bees collected on blueberry, the pollen load of most individuals and species was composed of more than 99% blueberry pollen. However, many other plant species and groups were represented in the pollen collected including Ribes, oak, hazel, strawberry, willow, rhodora, Viburnum, and Rosaceae.

Native bees collected on shadbush, Amelanchier laevis (Rosaceae) contained mostly Rosaceae pollen. But pollen from maple, willow, and leatherleaf, was well represented and pollen from other plants was found in small amounts.

Native bees collected on wild blackberry, (Rosaceae) contained mostly pollen of Rosaceae. But pollen from Cornus, Ilex, Umbelliferae, teasel, Viburnum, and lambkill was well represented and pollen from other plants was found also.

It has often been mentioned in the literature that honey bees do not collect lowbush blueberry pollen. However, of 711 honey bees incidentally collected while sweeping blueberry bloom for native bees in Deblois, 14% contained a full pollen load, 31% carried some pollen, and 55% had none when collected. Twelve honey bees with full pollen loads were selected, and all the pollen on all specimens was determined to be Vaccinium pollen.

On Vienna Mt. of 209 honey bees collected on lowbush blueberry only 1% contained a full pollen load, 6% contained some pollen and 93% had none. Pollen from these have not been identified as yet but is probably blueberry pollen.

The lowbush blueberry and several other plant species found in and around blueberry fields all belong to the family Ericaceae. Pollen from the various species is similar, and there are no keys available to separate these plants on the basis of pollen structure. Pollen from these plant species were distinguished on the basis of size, shape, wall thickness, surface sculpturing, and colpi characteristics, according to Jacobson (in prep.), a key developed specifically for the Ericaceae flora of the northeastern United States.

For the Deblois area a complete flowering record (% bloom with time) has been prepared for 13 plant species which bloom before, during and after the lowbush blueberry bloom period. All these plants are utilized by native bee species known to frequent the lowbush blueberry.

The literature search to determine all known host plant records of all native bee species which have been collected from lowbush blueberry in Maine has been nearly completed. Scientific names have been updated. Some pollen and nectar records have also been found.

Biological data on Andrena vicina are being compiled in conjunction with a researcher (and former Maine student) at Washington State University. Information will be compared to that of other species in the same subgenus.

The results of the O. atriventris study was as follows. Comparing the preference of O. atriventris to nest in the 3 size holes, when given a choice of the 3 sizes, the 0.7 cm diameter size was chosen over the 0.8 and 0.9 cm diameter holes in all cases (n=23, sex ratio: 10 females and 13 males). This is similar to the results we obtained in 1989. The tube traps were not utilized to any significant degree (on a nest hole/trap basis) more than the wood block traps (paired t-test: t=0.84, p=0.425). O. atriventris was trapped in both small and large blueberry production areas. The distribution, however, was quite variable (ranged from 0 to 1.0/trap) and because of this conclusions as to whether this bee is more prevalent in small fields vs large fields cannot be made unless more intensive trapping is performed (large = 0.31 $\pm$ 0.41 bees/trap, small = 0.77 $\pm$ 0.12 bees/trap). Results of the transect trapping showed that there was no difference in O. atriventris numbers trapped from the field edge to the center of the field, but 50 m into the shrub-woodland border habitat resulted in a reduction of O. atriventris trapped. This corresponds to our findings made in 1989. Parasitism of O. atriventris was only 7% (n=41). In all cases, the parasite was a wasp of the family Sapygidae. Because of the low level of parasitism a comparison between locations or trap types could not be made. The sweep net sampling did not demonstrate any degree of strong correlation between the number of O. atriventris caught in 5 sets of 50 sweeps and the number nesting in the traps (r=0.39, n=9) or the relative abundance of O. atriventris and the number of O. atriventris nesting in the traps (r= -0.19, n=9). This suggests that sweep net sampling is not measuring the same aspect of O. atriventris relative density as the traps are. However, the sweep net sampling did reveal that O. atriventris is a common pollinator in blueberry fields (ranging from 0-33% of the wild pollinator species), but also that its densities are not very high relative to other pollinators (usually less than 0.5 O. atriventris/50 sweeps (ca. 25 m^2 of blueberries).

It is hoped that a healthy population of the western leaf cutter bee can be released and studied in Maine in 1991. At present 386 specimens of this species have been procured and are being overwintered in Orono at 2-3°C and 75% R.H. It is planned to release all of these at one location in May.

Conclusions: The greater abundance of native bees on blueberry on Vienna Mt. as compared to Deblois is probably due in part to an increase in the accessibility of alternative food sources in Vienna. The higher numbers of native bees and other insect visitors occurring on rhodora in Vienna and T30 MD as compared to Deblois is probably also due to an increased availability of food sources in Vienna and T30 MD. No pesticides have been used in recent years in T30 MD which might further explain the very high populations observed at that site.

Most of the native bees collected on lowbush blueberry were carrying pollen which was determined to be more than 99% blueberry pollen indicating that they are effective pollinators. However, they have an adult activity period which is much longer than that of the blueberry flowering period and were found to utilize the pollen from shadbush, wild blackberry and many other plant species.

A substantial percentage of honey bees collect blueberry pollen when little else is available. A very small percentage collected blueberry pollen on Vienna Mt. which appeared to be richer in alternative food sources.

Pollen from several plant species in the family Ericaceae can now be distinguished from that of lowbush blueberry. This and the flowering, records of various plants proved very useful in the pollen identification work. All of the Maine blueberry pollinators were found to utilize many plant species.

It appears that O. atriventris is commonly distributed in blueberry fields and that it is not necessarily restricted to smaller scale more vegetationally diverse blueberry fields. It was never found to be abundant in any of the areas sampled. Only one species of parasite has been found attacking O. atriventris so far and at low levels, but it is too early to conclude that parasites are not significant in the life system of this pollinator. Sex ratio in the 7 cm holes appear to be 50:50 which would be desirable for a commercially viable pollinator. From previous studies we have shown that trap heights 2 m above the ground is preferable to 1 m, and that the density of holes per block does not influence the preference of nesting by O. atriventris. Trap types with 7 cm diameter holes and protection from desiccation should be used as a basis for beginning a suitable trap design.

Recommendations: Work on the habitat project should continue. Some additional slides of plant pollen need to be prepared, and some additional pollen identification work needs to be done with both native and honey bees. All previously collected and prepared specimens of native bees collected on lowbush blueberry should be identified to determine species diversity and abundance. Those collected on shadbush, wild blackberry, and perhaps other plant hosts should also be identified.

The key to pollen utilized in this study belonging to the family Ericaceae should be completed, and the data on Andrena vicina should be published.

All information collected to date on flower, pollen, and nectar records of native bees previously collected on lowbush blueberry in Maine and on the identification of pollen removed from native bees and honey bees collected on shadbush, lowbush blueberry and blackberry, should be summarized in publication form.

Adults of many of the forty plus species of wild bees in Maine which pollinate the lowbush blueberry are active for several days prior to blueberry bloom and for a considerable time period following blueberry bloom. In order for these wild bees to maintain their populations, they must have a continual supply of food (pollen and nectar from flowering plants). This food supply should be uninterrupted before, during, and following blueberry bloom.

Methods of providing this continued food supply is a much neglected area. Probably establishment of most of the plants which flower from mid-May to early July (and beyond for some species of bees) would be beneficial to the wild bee pollinators of the lowbush blueberry. At present, it is known that both shadbush, Amelanchier laevis Wieg. which blooms before blueberry, and wild blackberry, Rubus spp. which blooms after blueberry, are good alternative food sources for many species of pollinators of the lowbush blueberry. Neither overlaps with the blooming period of blueberry. More information on desirable alternative forage plants will be available when the study ends this year.

It is recommended that more work be conducted on O. atriventris specifically on pollination efficacy. Two areas of efficacy should be examined. The first is the effect of weather conditions on the flight behavior of this bee. In other words, will it fly frequently during the extremes of weather conditions experienced in Maine blueberry production areas? The second is the constancy of blueberry pollen collection that this pollinator exhibits (does it visit only blueberry plants for pollen or will it go to other pollen sources if they are present?) and an estimate of the number of blooms that a given female O. atriventris will visit in its life time. This last piece of information is important to estimate the field force of leaf cutter bees which would be needed to pollinate a given acreage of blueberries.

The western leaf cutter bee, Osmia ribifloris should be released in Maine this year. Work which should be carried out is covered in the separate proposal on this species.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATORS: John M. Smagula

COOPERATOR: Delmont Emerson

TITLE: NITROGEN-PHOSPHORUS STUDY

METHODS: DAP was applied at 0, 5.7, 11.4, 17.1 or 22.8 pounds of actual phosphorus per acre in 1987. In 1989, DAP treatments provided 0, 20, 40, 60, or 80 pounds of phosphorus per acre. These fertilizer treatment plots were split in the way they were pruned. One side was mowed, the other pruned by oil fire. Please refer to the 1988 and 1989 project proposal outlines for more details.

RESULTS:

RESPONSE TO DAP

Stem length and branching increased with increasing application of phosphorus from DAP (Fig. 1). Flower buds per stem, which indicates potential yield, and the machine harvested crop yield also increased with each additional 20 lb/acre phosphorus (100 lb/acre DAP) applied (Fig. 2).

The highest yields occurred on plots receiving 80 lb/acre phosphorus or 400 lb/acre DAP. Assuming that berry price is $0.35/lb and it costs $18.75 to apply 100lb/acre DAP, application of 800 lb/acre DAP would increase the value of the machine harvested crop by $461/acre, compared to the control (Fig. 3). The cost of harvesting the extra berries has not been subtracted from this figure.

RESPONSE TO PRUNING METHOD

Pruning method had no major effect on nutrient levels in leaf tissue. Pruning method had little effect on stem length. For example, in 1987 mowed plots had stems with a greater average length (10.1 cm) than burned plots (9.4 cm). In 1989, burned plots had stems that averaged 8.5 cm compared to 7.7 cm for mowed plots (significant at the 10% level). Pruning practice did not influence branching or average number of flower buds per stem in 1987 or 1989. Despite the apparent lack of influence on stem characteristics, the burned plots yielded higher in 1988 (Fig. 5) and 1990 (Fig. 6).

CONCLUSIONS:

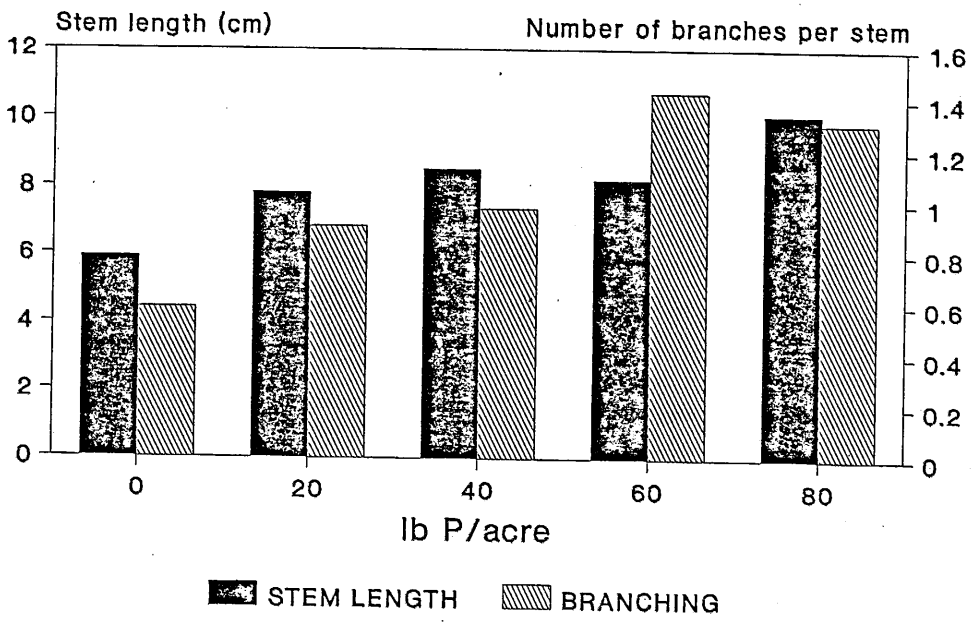
Leaf tissue analysis can identify fields that are low in nutrient elements such as phosphorus. Leaf phosphorus and nitrogen can be raised by application of DAP (Fig. 4). The lack of response to the low rates of phosphorus applied in 1987 indicated that higher rates of phosphorus were required to raise leaf tissue levels to the standard and to increase yield. The higher rates of phosphorus applied in 1989 increased the phosphorus level in leaf tissue to 0.120% and increased the yield 48% compared to the controls. Rates above 80 lb/acre may be necessary to reach 0.125% phosphorus in leaf tissue. Greater yields may also be achieved at rates higher than 80lb/acre phosphorus.

RECOMMENDATIONS:

Apply DAP to fields in which leaf tissue analysis indicates phosphorus is limiting. When levels are near 0.096%, a rate of 400lb/acre DAP to provide 80lb/acre phosphorus should be applied.

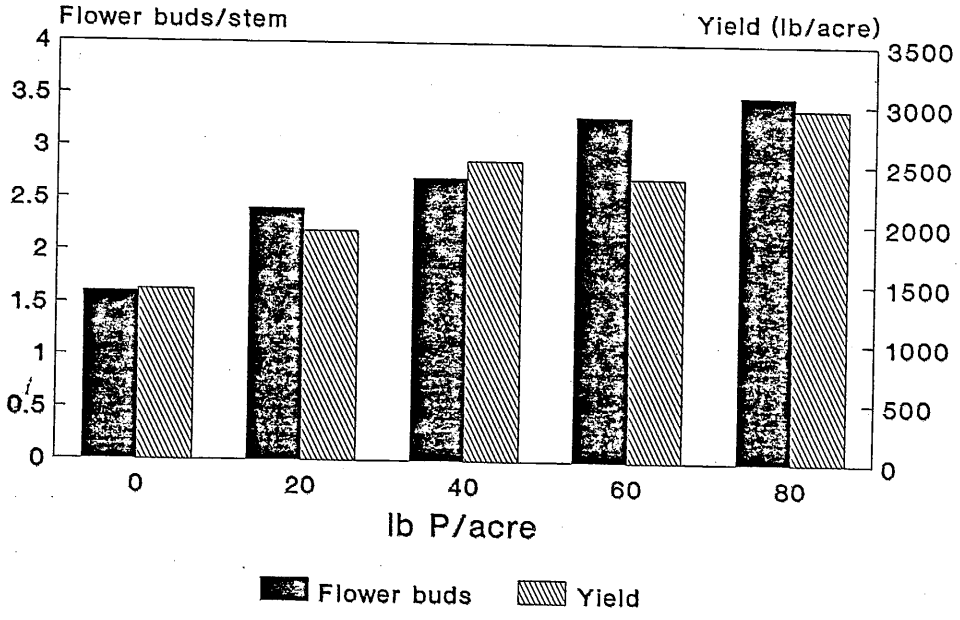
This study should be continued at higher rates of DAP to determine if higher levels of leaf phosphorus can be attained and to determine if higher yields will result.

Figure 1 NITROGEN-PHOSPHORUS STUDY
STEM LENGTH AND BRANCHING



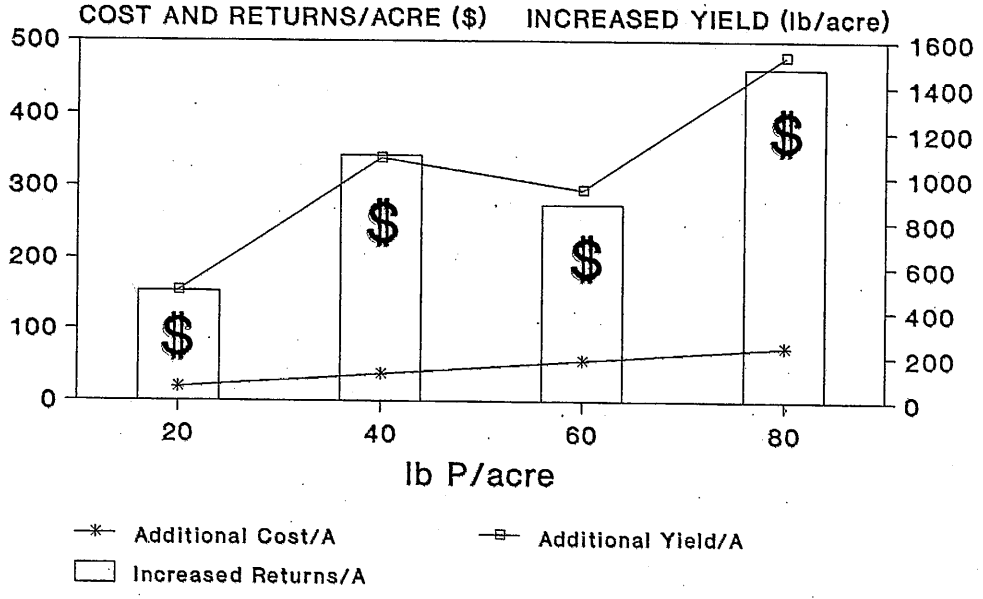
Treatment significant at 0.1% level

Figure 2 NITROGEN-PHOSPHORUS STUDY
FLOWER BUDS + YIELD



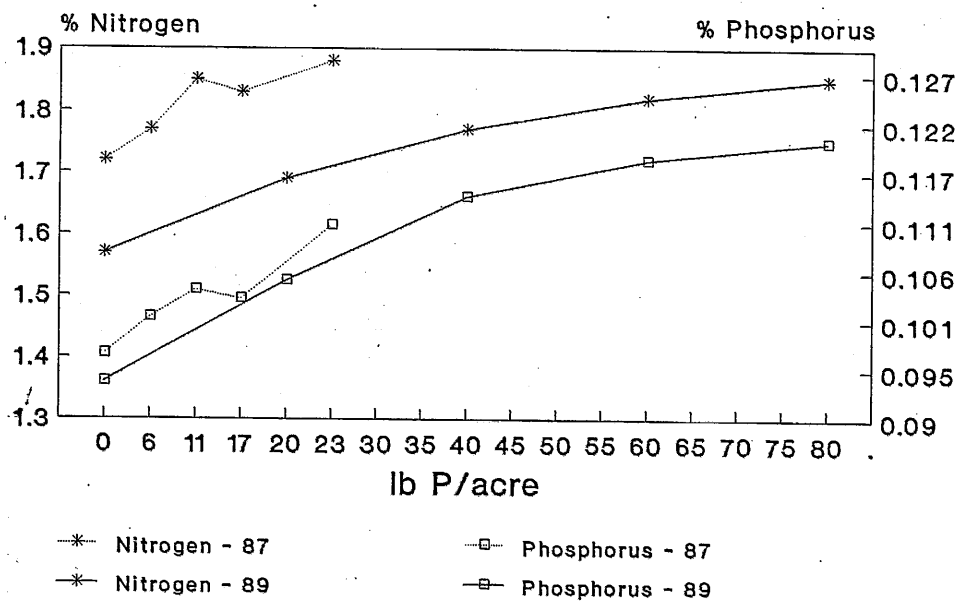
Treatment significant at 0.1% level

Figure 3 NITROGEN-PHOSPHORUS STUDY
COST ANALYSIS



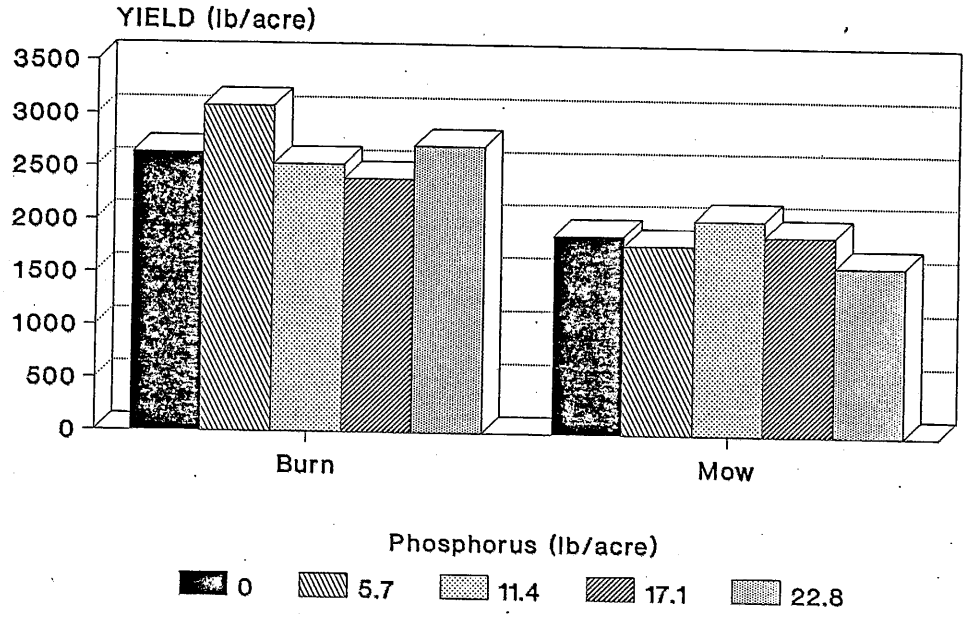
Assumed berry price of 0.35/lb

Figure 4 NITROGEN-PHOSPHORUS STUDY
1987 + 1989 Leaf tissue concentrations



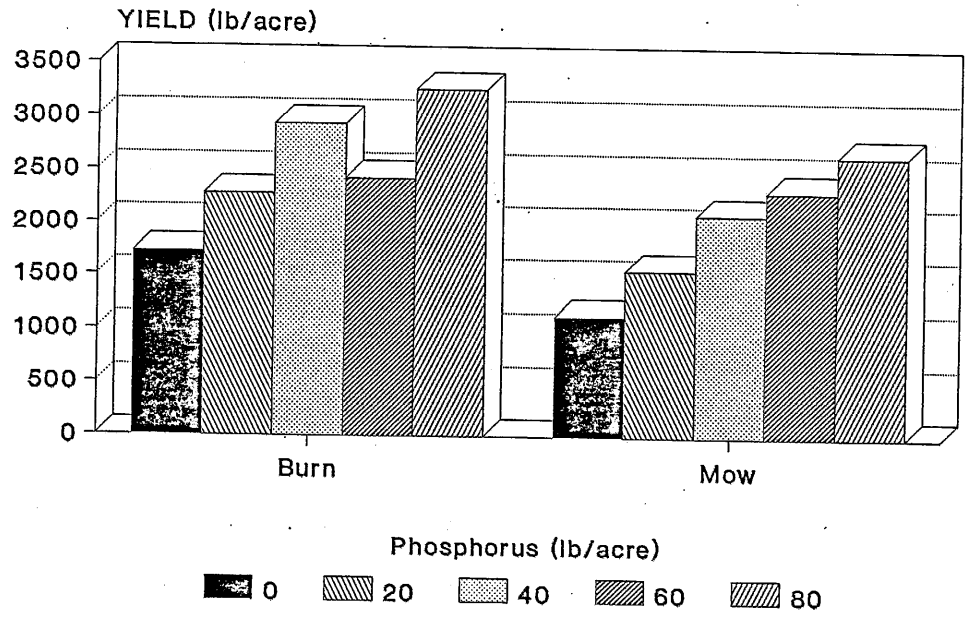
DAP fertilizer (18-46-0)

Figure 5 NITROGEN-PHOSPHORUS STUDY
1988 YIELD



DAP (18-46-0)

Figure 6 NITROGEN-PHOSPHORUS STUDY
1990 YIELD



DAP (18-46-0)

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATORS: John M. Smagula

COOPERATOR: Delmont Emerson

TITLE: POTASSIUM STUDY

METHODS: Potassium was applied in the form of potassium sulfate at 0, 20, 40, 60 or 80 lb/acre. Six blocks or replication of this experiment were established on a field owned by the McKeown family and located on route 9 in Crawford. Leaf samples were taken in July, 1990 and stems were collected in the fall, 1990.

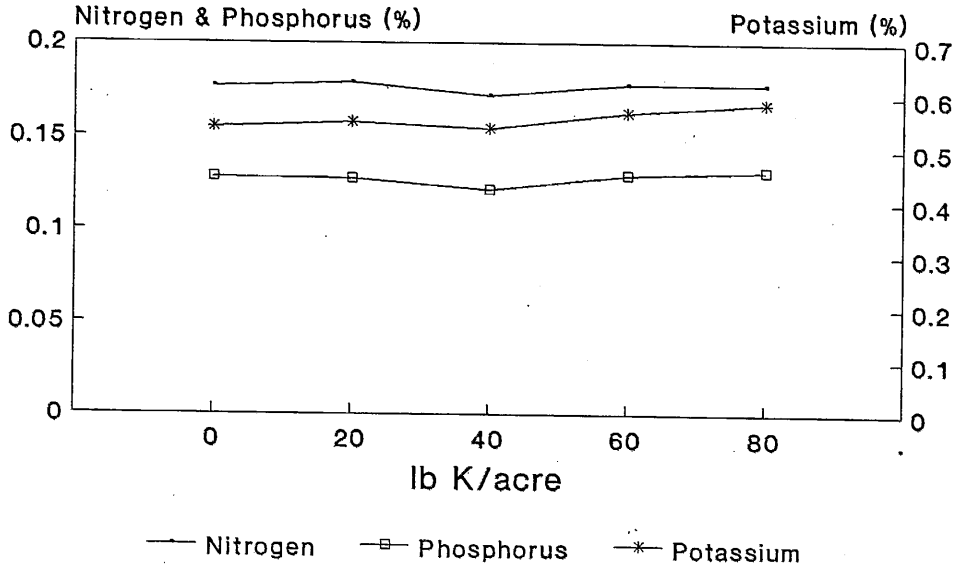
RESULTS: Applying potassium at rates up to 80 lb/acre did not effect leaf tissue concentrations, including potassium (Fig. 1). All treatment plots had leaf tissue levels above the standard of 0.400%. Stem density was not effected by the potassium treatments and ranged from 25 to 29 stems per 1/4 square foot. Potassium fertilizer did not influence stem length and branching (Fig. 2), but the number of flower buds per stem was reduced (Fig. 3). The apparent decrease in flower bud density (Fig. 3) was not statistically significant.

CONCLUSIONS: Potassium levels in leaf tissue sampled from plants in control plots did not have levels below the standard (0.400%). Plants in this field did have low tissue potassium when sampled in 1988. Studies with highbush blueberry indicate that fruit load has a major effect on subsequent potassium levels in leaf tissue. Perhaps a low yield in 1989 resulted in higher than expected levels of potassium in 1990. In our 1987 and 1988 nutrition surveys, only a few fields have been found with low levels of potassium. It is doubtful that differences in winter hardiness will be detected since no differences in potassium levels were detected among the treatments. There was an effect of the treatments on flower bud formation; the number of flower buds per stem decreased with increasing application of potassium fertilizer. Yield should be collected to determined if applying potassium to fields with adequate amounts of potassium will depress fruit production.

RECOMMENDATIONS: No recommendations can be made at this time.

Figure 1

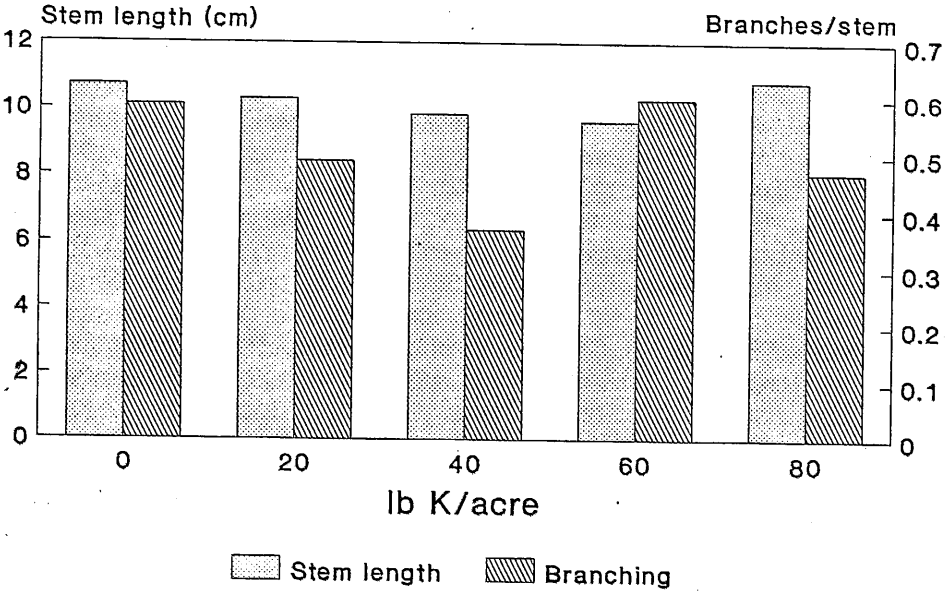
POTASSIUM STUDY
Leaf Tissue Concentrations



Nitrogen value 1/10 actual
Treatments not significantly different

Figure 2

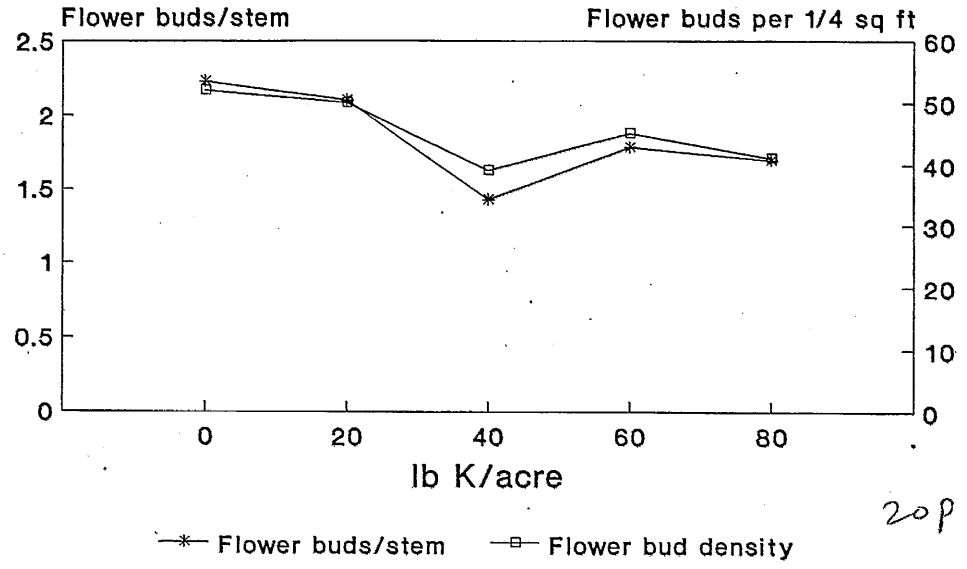
POTASSIUM STUDY
Stem Characteristics



Treatments not significantly different

Figure 3

POTASSIUM STUDY
Stem Characteristics



20P = 100LS DAP

Flower buds decreased linearly with potassium application

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATORS: John M. Smagula

COOPERATORS: Delmont Emerson
David Yarborough
Warren Hedstrom

TITLE: MULTIPLE CROPPING OF WILD STANDS

METHODS: In an attempt to stimulate a higher "second crop" yield, treatments were applied to plots at Blueberry Hill Farm. Treatments 1 and 2 were controls for 2 year and 3 year cycles, respectively, and received no additional inputs. Treatments 3 and 4 had additional fertilizer and weed control applied the crop year (see the 1989 project proposal outline for details). The blocks were split, with half of each treatment plot receiving irrigation (0.5 inch twice weekly, as needed).

RESULTS:

Effect of Fertilizer and Weed Control

Nitrogen and phosphorus concentrations were higher in 1989 leaf tissues samples when NPK fertilizer was used (treatment 4) (see 1990 research report). Treatments had no effect on stem density, which ranged from 31 to 36 stems per 1/3 sq ft. Application of NPK increased stem length and branching (Fig. 1) and the number of flower buds/stem and density of flower buds per 1/3 sq ft (Fig. 2), compared to the other treatments.

In 1990, the crop year, leaf samples indicated that nitrogen and phosphorus levels were higher in the intensively managed plots (treatments 3 and 4) (Fig. 3). Comparing the two intensive management treatments, nitrogen levels were higher in the 3 yr cycle-urea plots and phosphorus was higher in the 3 yr cycle-NPK plots. Leaf potassium levels were also higher in the 3 yr cycle-NPK plots (Fig. 4).

Yield was not effected by treatments (Fig. 5). Machine harvesting 2 ft x 50 ft plots with the Darlington harvester yielded only 48% of the comparable hand harvested plots.

Stem samples collected in the fall 1990 ranged from 18 to 27 stems per 1/3 sq ft. Stem density was significantly less in the 3 yr cycle-NPK plots but stem length was greater than the 2yr cycle (Fig. 7). In general, three year cycle plots had taller stems, more branching, and greater flower bud formation than the 2yr cycle plots (Fig. 7 & 8).

Effect of Irrigation

Irrigation began in June 1989, too late to have an effect on nutrient uptake and leaf nutrient concentrations. Irrigation treatments in 1989 or 1990 had no effect on stem density, stem length, branching or flower bud formation in either year. Hand or machine harvested yield (Fig. 6.) was not influenced by Irrigation treatments.

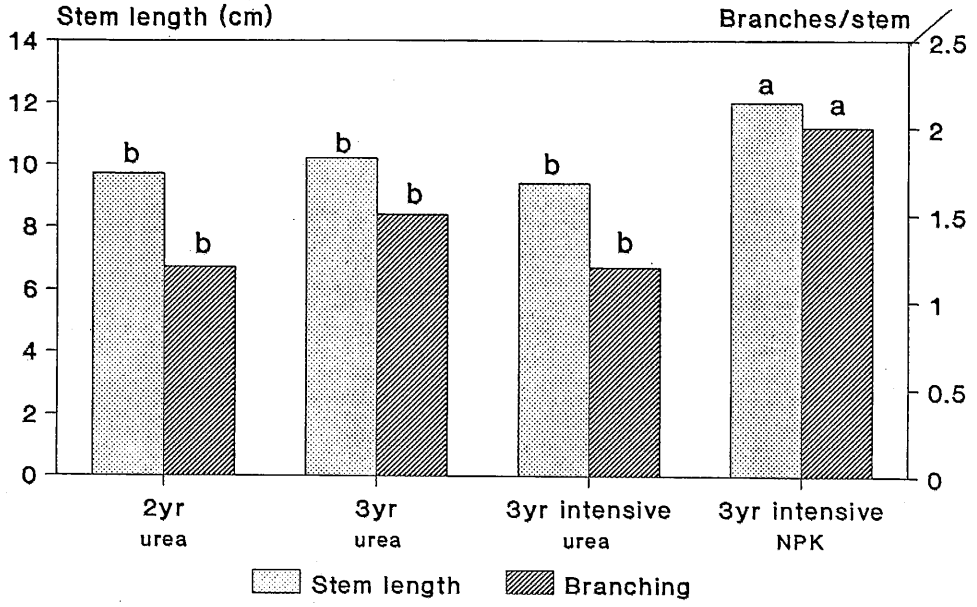
CONCLUSIONS:

Rainfall has been adequate and well distributed in 1989 and 1990. This may explain why irrigation had no effect on growth characteristics or yield. Application of NPK fertilizer increased stem length, branching and flower bud formation compared to the other treatments. Yield, however was not increased by the treatment involving NPK fertilization.

RECOMMENDATIONS:

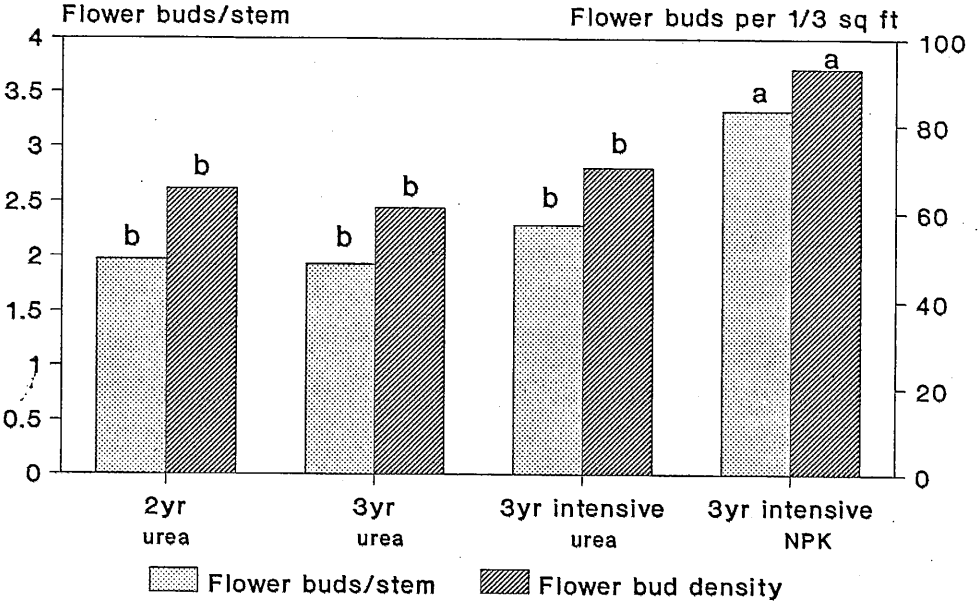
No recommendations can be made at this time.

Figure 1 Multiple Cropping Study
Stem Characteristics



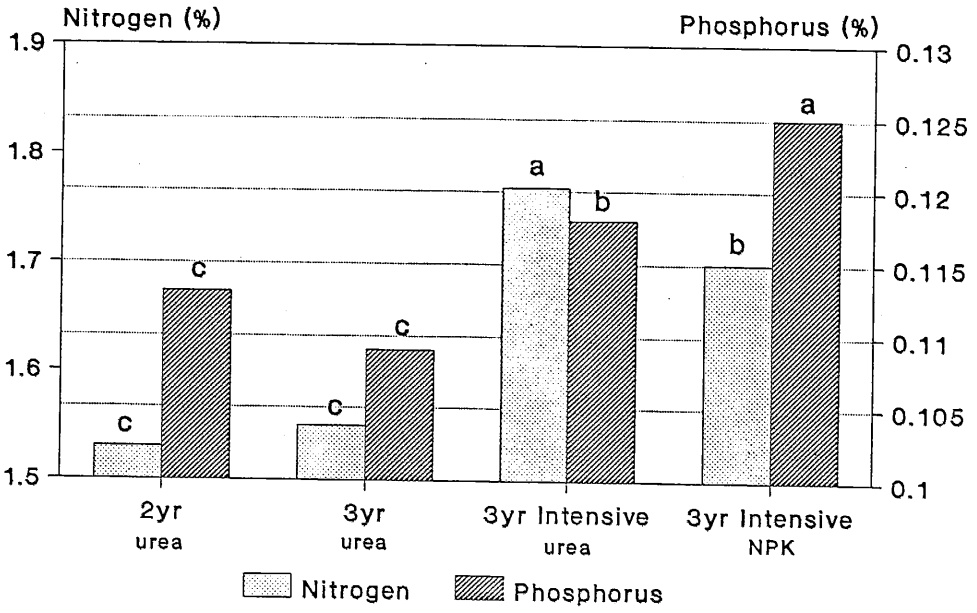
1989 DATA

Figure 2 Multiple Cropping Study
Stem Characteristics



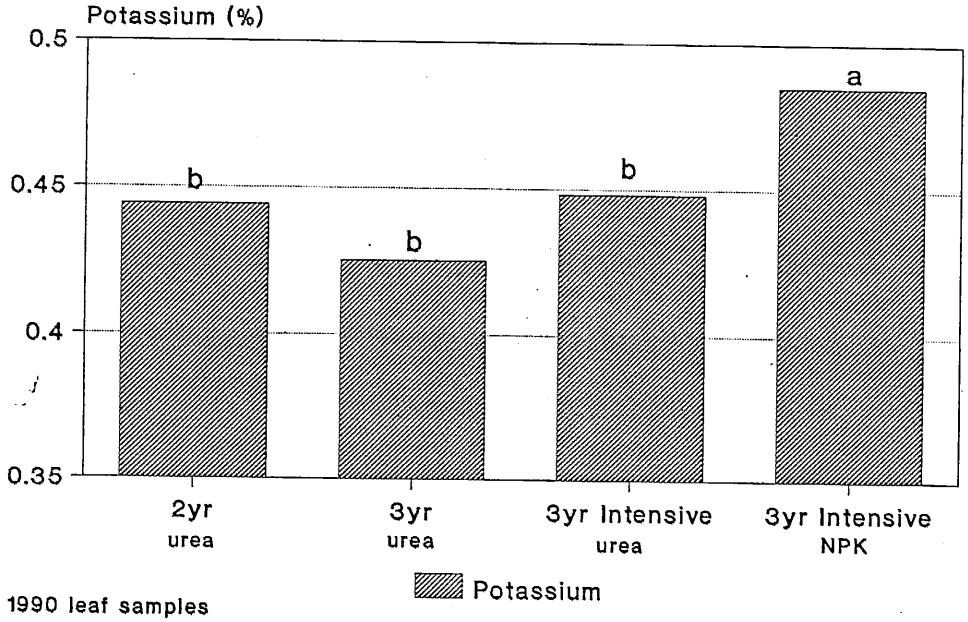
1989 DATA

Figure 3 Multiple Cropping Study
Leaf tissue concentrations



1990 leaf samples

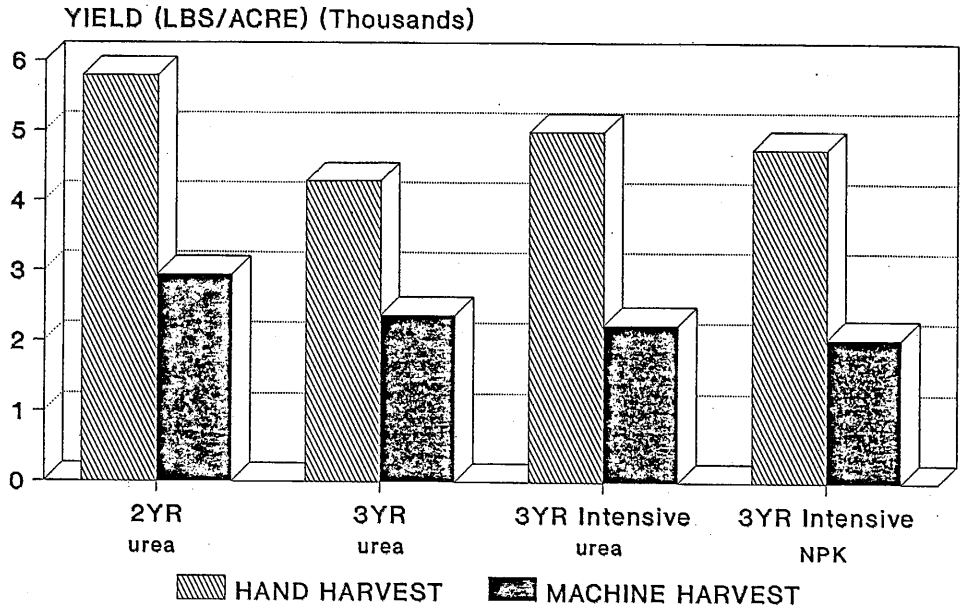
Figure 4 Multiple Cropping Study
Leaf tissue concentrations



1990 leaf samples

Figure 5

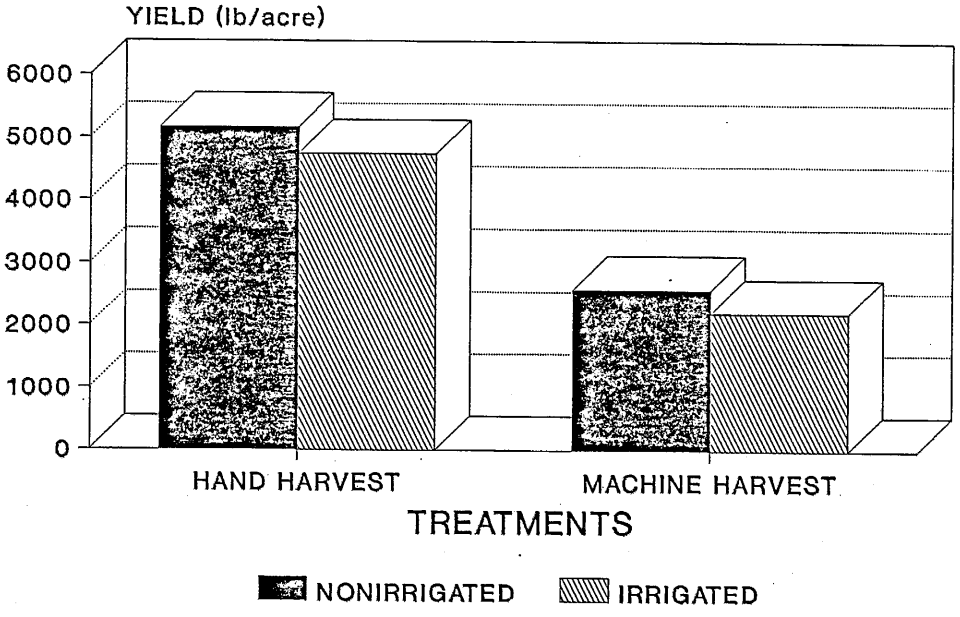
MULTIPLE CROPPING STUDY
YIELD



1990 DATA ns

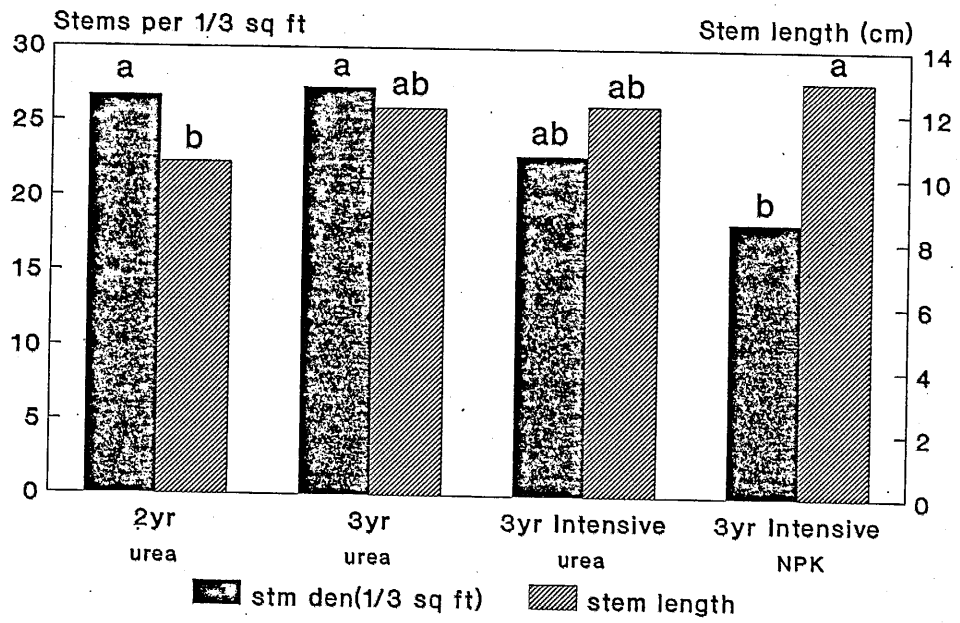
Figure 6

MULTIPLE CROPPING STUDY
YIELD



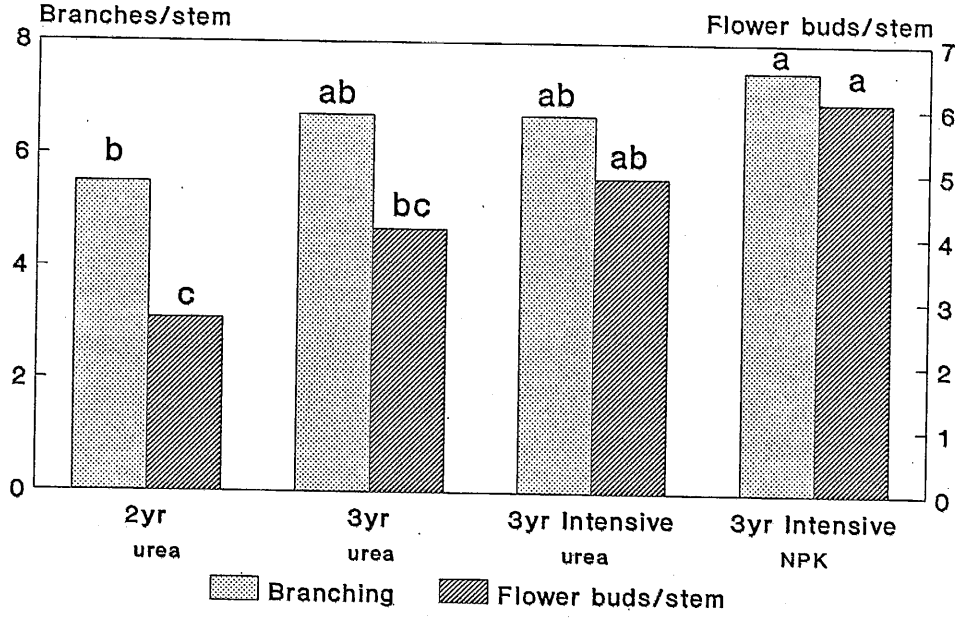
1990 DATA IRRIGATION NS

Figure 7 MULTIPLE CROPPING STUDY
STEM CHARACTERISTICS



1990 DATA

Figure 8 MULTIPLE CROPPING STUDY
STEM CHARACTERISTICS



1990 DATA

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATORS: John M. Smagula

COOPERATORS: Delmont Emerson

TITLE: PHOSPHORUS DOSE/RESPONSE CURVE

METHODS: Please refer to the 1989 project proposal outline.

RESULTS: Stems were cut from 4 randomly placed 1/4 ft quadrats in each treatment plot. Stem density (stems per 1/4 sq ft) averaged across treatments was significantly greater at the very low P fields than at the low P and high P fields (Fig. 1). The average stem density was not different between the low P fields and the high P fields. There was no meaningful trend or effect of phosphorus treatments on stem density.

Very low P fields, as a group, had shorter stems than low P fields or high P fields (Fig. 2). There was no difference in average stem length between the group of low or high P fields. Phosphorus applications had no effect on stem length of the very low, low, or high P fields.

Branching differed among the very low, low and high P fields (Fig.3). The very low P fields increased branching with increasing rates of phosphorus fertilization, but the low and high P fields were not effected.

The very low, low and high P fields differed in the number of flower buds produced per stem (Fig. 4). Flower bud formation was highest for the stems in the group of low P fields. Fields with very low P had a greater number of flower buds/stem than fields with high P. The number of flower buds/stem increased with increasing rates of phosphorus in the very low P fields, but not the low or high P fields. However, analysis of the density of flower buds (number of flower buds per 1/4 sq ft) indicated that only the low P fields increased with increasing phosphorus fertilization (Fig. 5).

Yield was determined for each treatment plot by harvesting a 2 foot wide strip using the darlington harvester. At one location where the terrain was too uneven for its use, 2 foot wide strips were hand harvested and the data were adjusted for the different efficiency between hand and machine harvest. Average yields for very low, low or high P

fields were not significantly different from each other, probably due to high variability in yields of the three fields in each group (very low, low or high P). Although the yield appears to increase in response to phosphorus application for the very low and high phosphorus fields as a group, the treatment effect was not significant. This is probably due to the variability in response among the three fields making up each group (very low, low or high P).

Variability in yield within each phosphorus group and among all the fields in this study is apparent when the yield of control plots (no treatment) is plotted for each field (Fig. 7). Note that there is a low and high yielding field in each phosphorus group. The yield response to phosphorus fertilization in each field within each phosphorus group is illustrated in figure 8. This shows that all but one field responded to some level of phosphorus fertilization; the magnitude of response depended on the particular field.

We need to characterize each field in more detail and determine which characteristic correlate well with inherent yielding ability. This should also help us to explain why some fields in the same phosphorus level group respond better to phosphorus fertilization than others. This will ultimately improve our ability to recommend fertilization.

CONCLUSIONS: Yields increased in response to phosphorus fertilization. Fields characterized by the phosphorus content of their leaf tissue differed in stem density, stem length, branching and flower bud formation. However, there is considerable variation within each group of three fields.

Data analysis will continue and examine the specific response at each field. Correlations will be made between yield and leaf tissue concentrations, stem characteristics and flower bud formation.

RECOMMENDATIONS: Current recommendations for phosphorus fertilizations should be followed. This project should continue as planned, but with the addition of plots at each location that will receive DAP instead of P alone.

Figure 1

STEM DENSITY

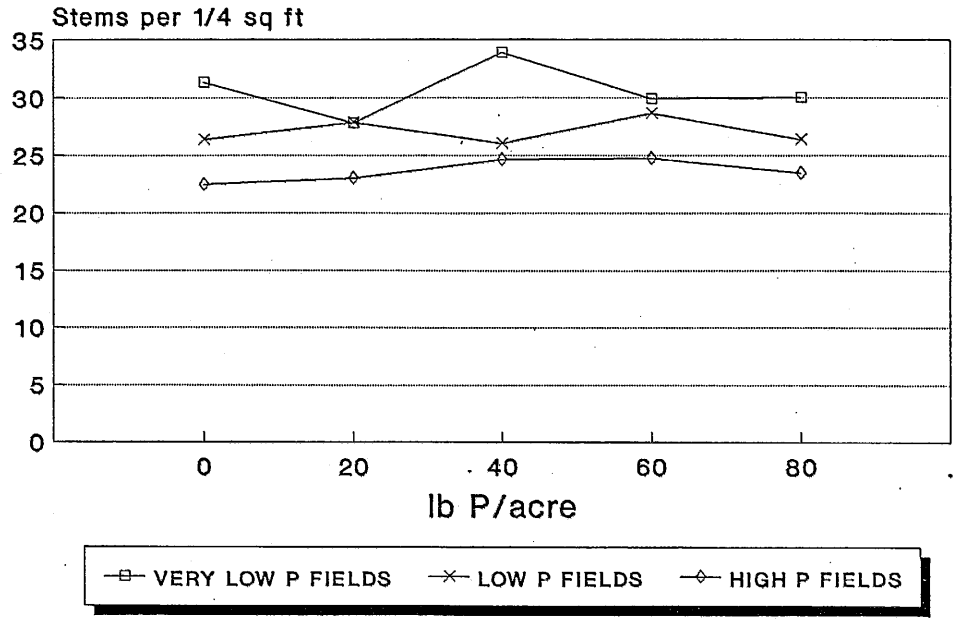


Figure 2

STEM LENGTH

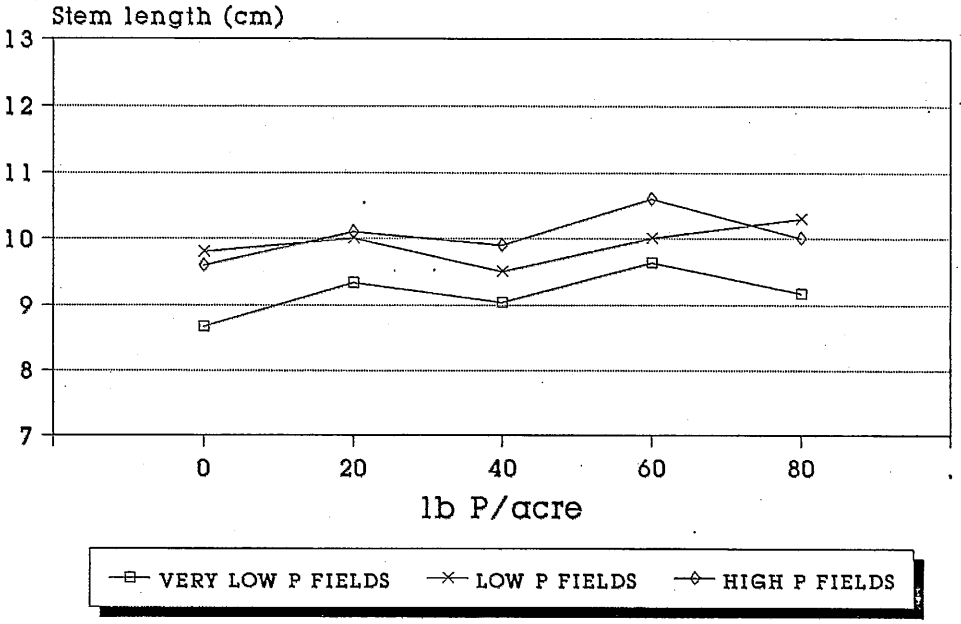


Figure 3

BRANCHING

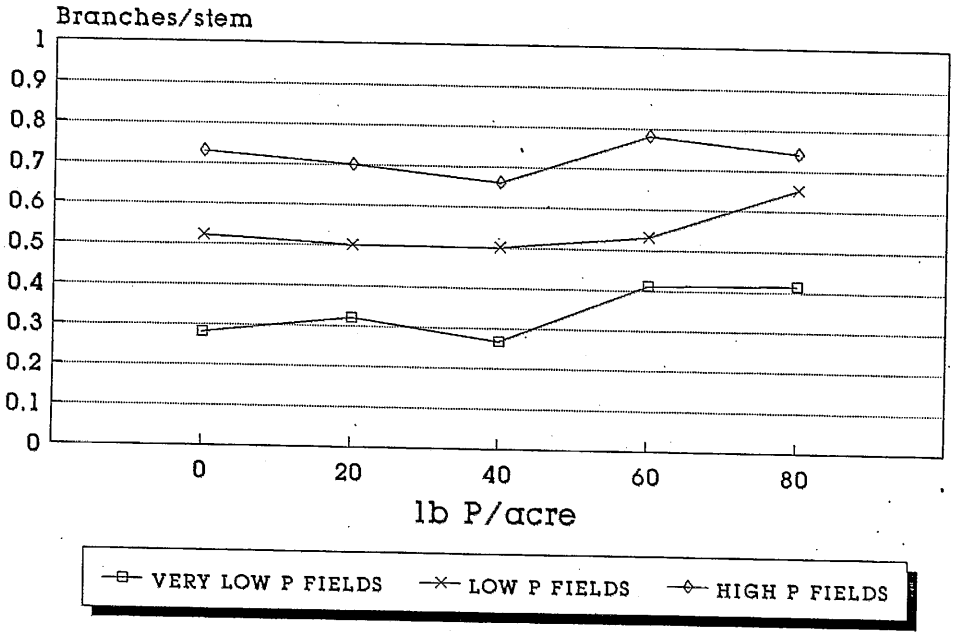


Figure 4

FLOWER BUD FORMATION

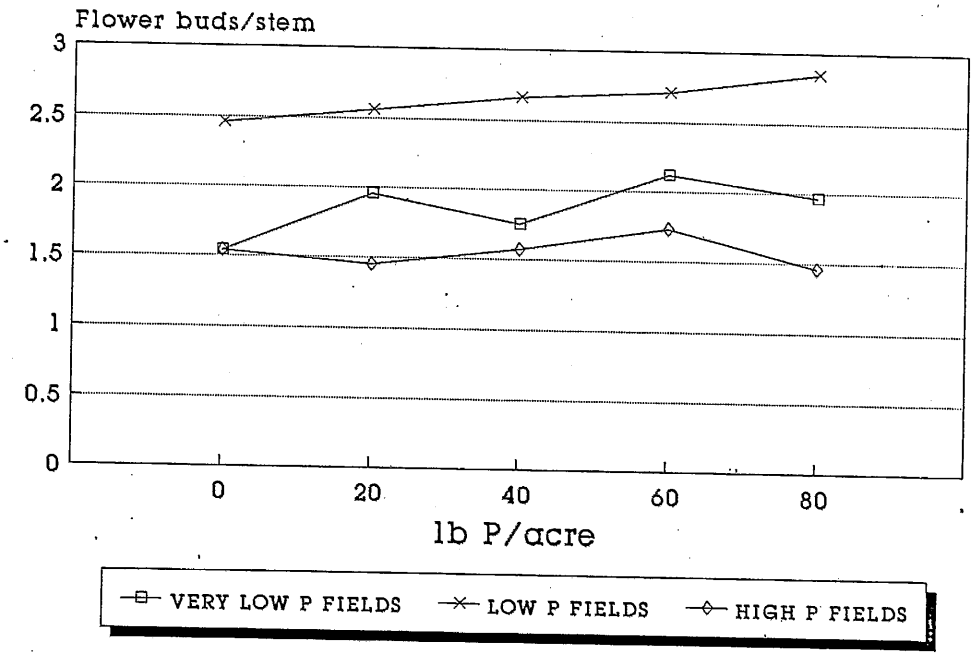


Figure 5 FLOWER BUD DENSITY

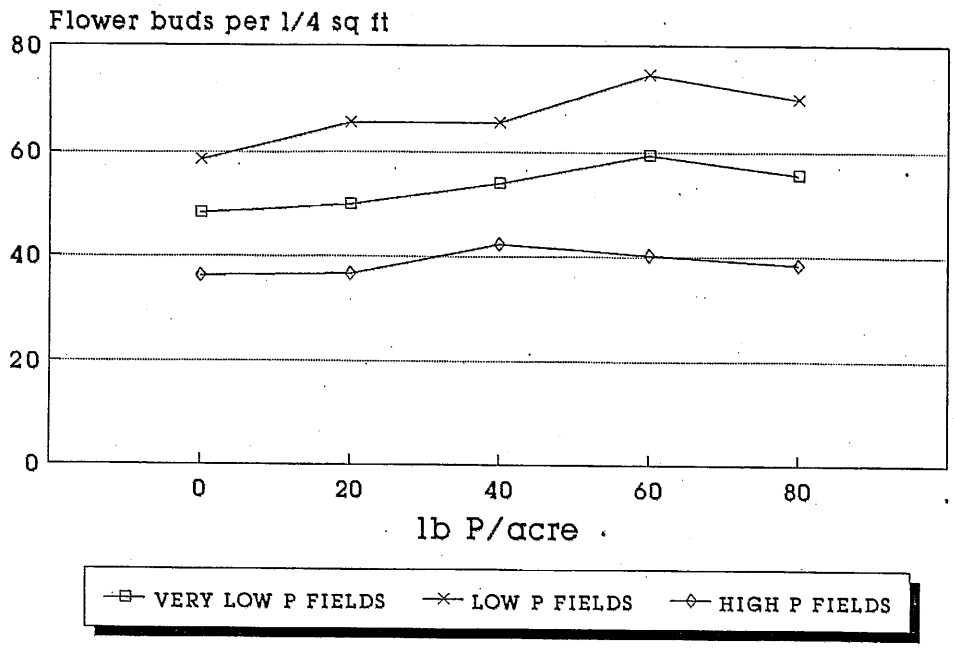


Figure 6 MACHINE HARVESTED YIELD

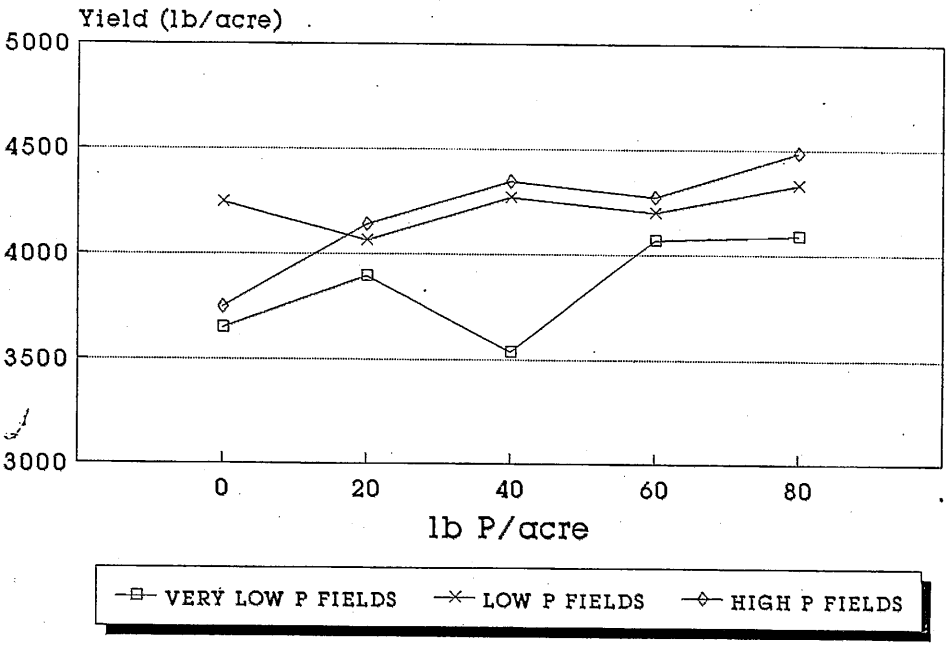


Figure 7 YIELD AT LOCATIONS
CONTROL PLOTS

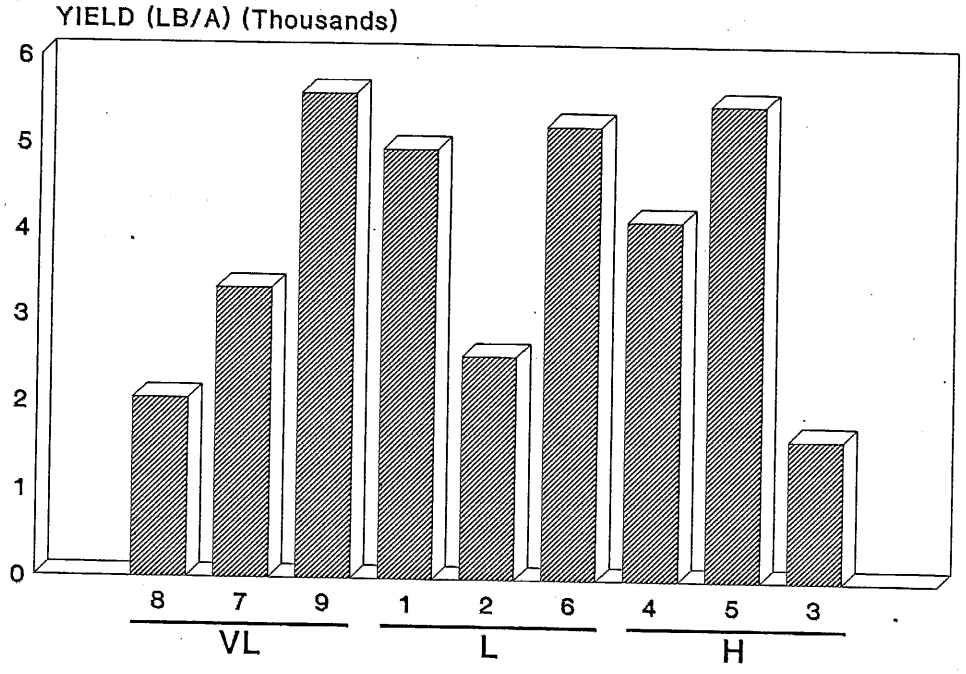
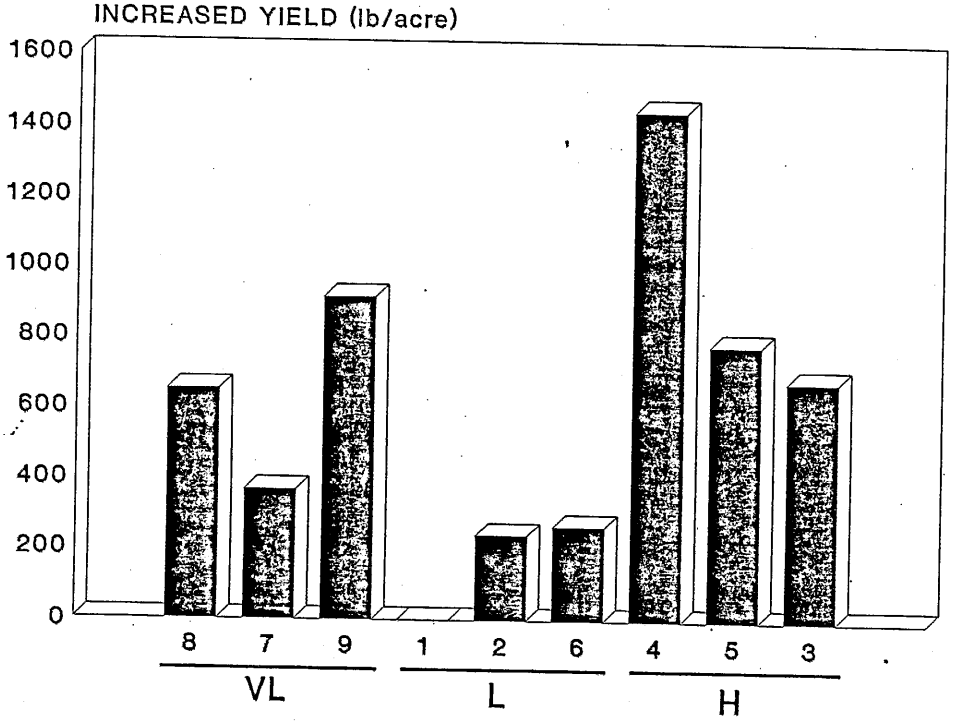


Figure 8 YIELD INCREASE DUE TO P



BLUEBERRY RESEARCH ADVISORY COMMITTEE
RESEARCH REPORT

Date: June 1990 to January 1991

Investigators: Alfred A. Bushway, Professor of Food Science
Mary Ellen Camire, Assistant Professor of Food Science
Rodney J. Bushway, Professor of Food Science
Susan A. Ismail, Scientific Technician

Title: Improvement in the Color and Texture of the Canned Blueberry

Methods: Individually quick frozen blueberries were furnished by Maine Wild Blueberry Company. Product was prepared in fifty can lots using the following firming agents to improve product texture:

a. Control - Industry method
b. 500 ppm Calcium chloride
c. 1000 ppm Calcium chloride
d. 1500 ppm Calcium chloride
e. 500 ppm Calcium lactate
f. 1000 ppm Calcium lactate
g. 1500 ppm Calcium lactate
h. 500 ppm Calcium gluconate
i. 1000 ppm Calcium gluconate
j. 1500 ppm Calcium gluconate

Processing was performed using traditional industry practices. The textural properties of canned blueberries were examined using physical (Instron Universal Food Testing Machine) methods. Color was measured using a Hunter LabScan II Spectrocolorimeter. The pH and calcium content of the blueberries was measured and compared with values obtained prior to thermal processing. All analyses were performed after thermal processing and after three and six months of storage at room temperature.

Results: The pH of the blueberries and the juice in the cans was affected by the calcium salt used (Tables 1 and 2). The pH values decreased as the concentration of calcium chloride increased, and increased as the concentration of calcium lactate and calcium gluconate increased.

The data does demonstrate a dose response to all of the calcium salts (Tables 1 and 2), which means that as the calcium concentration increases in the liquid the level in the blueberries also increases. Storage time does not appear to affect the uptake of calcium by the blueberries.

Differences in berry color (Tables 1 and 2) reflects the variations that occur within clones, although changes in the b-values of those blueberries treated with calcium lactate and gluconate may be the result of the effect of pH on anthocyanins.

The six month storage samples are currently being analyzed and the results will be available in the next two weeks.

Textural analyses of the blueberries was inconclusive as the result of berry deterioration caused by the quality of the fruit (Canadian berries which hadn't been treated with chlorine during processing) used in this experiment.

Conclusion: Calcium salts can be used to increase the concentration of calcium in blueberries, but the choice of salt can affect the pH of the fruit. The effect of these pH changes on canned blueberry quality (color and mold spore survival) should be investigated. The pH of the fill solution may have to be adjusted with citric acid prior to addition to the cans.

Conclusions regarding textural changes in berries as affected by calcium concentration will be available upon completion of the next canning experiment.

Recommendations: No recommendations can be made until the experiment has been completed which will require further in-plant processing and organoleptic evaluation of those treatments demonstrated to produce the most satisfactory product.

Future Work: A factorial experiment has been designed to examine the effect of two of the calcium salts at two concentrations on the color and textural properties of canned blueberries. A production run will be made in plant in February and response surface analysis will be used to select two to three optimum treatments that can be tested in muffin preparations using organoleptic techniques.

Table 1. pH, Calcium and Color of Canned Blueberries Treated with Various Calcium Salts - Zero Time Data

Treatment	Juice pH	Berry pH	Berry Calcium	Berry Color		
				L-value	a-value	b-value
Control	3.30[1] ± 0.08	3.29 ± 0.04	16.9 ± 1.4	7.97 ± 0.4	8.40 ± 0.3	1.33 ± 0.1
Calcium Chloride (500 ppm)	3.28 ± 0.04	3.25 ± 0.05	28.5 ± 0.5	8.59 ± 0.5	7.24 ± 0.5	1.15 ± 0.1
Calcium Chloride (1000 ppm)	3.19 ± 0.03	3.16 ± 0.01	38.8 ± 1.1	8.08 ± 0.7	7.19 ± 0.5	1.18 ± 0.2
Calcium Chloride (1500 ppm)	3.08 ± 0.03	3.08 ± 0.04	69.3 ± 2.7	9.13 ± 0.8	7.67 ± 0.3	1.22 ± 0.1
Calcium Lactate (500 ppm)	3.52 ± 0.05	3.45 ± 0.04	43.4 ± 7.8	9.00 ± 0.4	6.58 ± 0.3	0.85 ± 0.1
Calcium Lactate (1000 ppm)	3.60 ± 0.02	3.51 ± 0.03	61.4 ± 4.3	9.44 ± 0.8	6.61 ± 0.7	0.74 ± 0.1
Calcium Lactate (1500 ppm)	3.49 ± 0.33	3.63 ± 0.03	69.7 ± 2.1	8.91 ± 0.3	6.79 ± 0.4	0.67 ± 0.05
Calcium Gluconate (500 ppm)	3.52 ± 0.04	3.47 ± 0.02	35.4 ± 1.1	8.18 ± 0.4	7.54 ± 0.5	1.12 ± 0.2
Calcium Gluconate (1000 ppm)	3.58 ± 0.02	3.58 ± 0.01	54.0 ± 0.4	8.83 ± 0.4	6.52 ± 0.6	0.84 ± 0.1
Calcium Gluconate (1500 ppm)	3.75 ± 0.06	3.69 ± 0.06	75.3 ± 1.2	8.74 ± 0.6	7.29 ± 0.8	0.84 ± 0.1

[1] Each value is the mean of one determination from three cans

Table 2. pH, Calcium and Color of Canned Blueberries Treated with Various Calcium Salts - Three Months Storage Data

Treatment	Juice pH	Berry pH	Berry Calcium	Berry Color		
				L-value	a-value	b-value
Control	3.40[1] ± 0.01	3.37 ± 0.02	15.0 ± 0.5	8.23 ± 0.3	7.85 ± 0.3	1.08 ± 0.1
Calcium Chloride (500 ppm)	3.36 ± 0.03	3.28 ± 0.08	22.1 ± 5.8	8.81 ± 0.6	7.82 ± 0.6	1.18 ± 0.2
Calcium Chloride (1000 ppm)	3.25 ± 0.03	3.28 ± 0.02	38.8 ± 4.3	8.64 ± 0.6	8.27 ± 0.3	1.17 ± 0.1
Calcium Chloride (1500 ppm)	3.22 ± 0.02	3.21 ± 0.02	74.8 ± 0.9	9.72 ± 1.0	8.10 ± 1.1	1.11 ± 0.2
Calcium Lactate (500 ppm)	3.54 ± 0.01	3.49 ± 0.02	34.2 ± 0.7	9.65 ± 0.4	7.24 ± 0.6	1.01 ± 0.1
Calcium Lactate (1000 ppm)	3.61 ± 0.03	3.59 ± 0.03	51.9 ± 3.6	9.41 ± 0.6	6.79 ± 0.5	0.82 ± 0.04
Calcium Lactate (1500 ppm)	3.76 ± 0.01	3.75 ± 0.02	75.3 ± 2.2	9.94 ± 0.8	6.43 ± 0.2	0.43 ± 0.1
Calcium Gluconate (500 ppm)	3.43 ± 0.00	3.46 ± 0.03	34.7 ± 1.1	9.42 ± 0.7	7.45 ± 0.7	1.27 ± 0.1
Calcium Gluconate (1000 ppm)	3.62 ± 0.03	3.59 ± 0.03	55.5 ± 0.3	9.79 ± 0.6	6.52 ± 0.7	0.78 ± 0.2
Calcium Gluconate (1500 ppm)	3.72 ± 0.03	3.70 ± 0.04	80.0 ± 2.8	9.69 ± 0.3	6.86 ± 0.3	0.79 ± 0.1

[1] Each value is the mean of one determination from three cans

BLUEBERRY RESEARCH ADVISORY COMMITTEE
RESEARCH REPORT

Date: June, 1990 to January, 1991

Investigators: Alfred A. Bushway, Professor of Food Science
Therese M. Work, Associate Food Scientist
Linda J. Irvine, Scientific Technician

Title: The Effect of Fertilization and Irrigation on Blueberry Fruit Quality

Methods:

Blueberries were harvested from plots at Blueberry Hill Farm at the time of fruit maturity using traditional methods and transported on ice to the Department of Food Science. Chemical and physical analyses were conducted on five subsamples of each of the following treatments:

Non Irrigated	2 year cycle
	3 year cycle
	3 year cycle + urea + weed control
	3 year cycle + NPK + weed control
Irrigated	2 year cycle
	3 year cycle
	3 year cycle + urea + weed control
	3 year cycle + NPK + weed control

Upon arrival the blueberries were cleaned, sorted and 150 g samples were prepared for analyses. Fruit color was determined using the Hunter Labscan II Spectrophotometer (L, a, b values). Texture was measured using the Instron Universal Food Testing Machine equipped with a Kramer Shear Cell. Titratable acidity and pH were measured using AOAC methods.

Sensory tests were conducted to evaluate flavor and texture preferences for the 2-year cycle with and without irrigation and the 3-year cycle with and without irrigation. Samples were presented in a randomized block design to sensory panels of 30 members. Panelists were instructed to indicate their preference using a 9-point hedonic scale where 1 = dislike extremely, to 9 = like extremely. A copy of the evaluation form is shown in Figure 1.

Data from the chemical, physical and sensory tests were analyzed using the SAS Statistical package.

Results:

Sensory Evaluation

The flavor and texture preference means are shown in Table 1. No significant differences ($P \leq 0.05$) were found for either flavor or texture preference between the 2 year cycle irrigated as compared to the non-irrigated berries. Similarly, the preference scores for flavor and texture of the 3 year cycle berries, irrigated and non-irrigated, were not significantly different ($P \leq 0.05$).

Physical and Chemical Analyses

The results of the physical and chemical analyses of the eight blueberry treatments evaluated are shown in Tables 2 and 3. A significant difference was found in the size of the blueberries. Those treated in the 3-year cycle with NPK and weed control were significantly ($P \leq 0.05$) larger than the other seven treatments.

All other analyses showed no significant differences ($P \leq 0.05$) among the eight treatments.

Conclusions:

Based on a single year's data it would seem that fertilization and irrigation had little effect on blueberry fruit quality, but it must be remembered that environmental conditions vary greatly from year to year and recommendations cannot be made on a single year's data.

Recommendations: None at this time.

Future Work:

Evaluation of the effect of fertilization and irrigation on blueberry fruit quality should be performed each year for the duration of the project.

FIGURE 1

Date_____ Presentation_____ Selection_____

Please drink some of the water provided before tasting each sample, taste a teaspoonful of the sample, then circle the number that most closely describes your opinion.

SAMPLE_____

How much do you like/dislike the **FLAVOR** of this product overall?

1	2	3	4	5	6	7	8	9
Dislike Extremely		Dislike Moderately		Neither Like nor Dislike		Like Moderately		Like Extremely

How much do you like/dislike the **TEXTURE** of this product overall?

1	2	3	4	5	6	7	8	9
Dislike Extremely		Dislike Moderately		Neither Like nor Dislike		Like Moderately		Like Extremely

---

SAMPLE_____

How much do you like/dislike the **FLAVOR** of this product overall?

1	2	3	4	5	6	7	8	9
Dislike Extremely		Dislike Moderately		Neither Like nor Dislike		Like Moderately		Like Extremely

How much do you like/dislike the **TEXTURE** of this product overall?

1	2	3	4	5	6	7	8	9
Dislike Extremely		Dislike Moderately		Neither Like nor Dislike		Like Moderately		Like Extremely

---

Please determine if samples are the same or different. Mark your responses below.

_____ Samples are the same.

_____ Samples are different.

Thank you very much for your cooperation!

Table 1. Flavor and Texture Preferences of Irrigated and Non-Irrigated Lowbush Blueberries (Vacinium augustifolium) Harvested From 2 and 3 Year Cycle Plots.

	2 year cycle		3 year cycle	
	Flavor[1,2]	Texture[1,2]	Flavor	Texture
NON IRRIGATED	7.10	6.67	6.63	6.23
IRRIGATED	7.13	6.27	6.17	6.03
LSD 0.05	NS	NS	NS	NS

[1] Preference mean of 30 panelist's scores

[2] 1 = dislike extremely, 5 = neither like nor dislike, 9 = like extremely

Table 2. Fertilization and Irrigation Effects on the Physical and Chemical Characteristics of Lowbush Blueberries (Vacinium augustifolium)

TREATMENT	pH[1]	BRIX[1]	Titratable Acidity[1,2]	Greens[1]	Reds[1]	Debris[1]	Blues[1]	Crush[1]	Size[1,3]
NON IRRIGATED									
2 year cycle	3.28	9.88	0.35	0.28	0.40	0.46	48.88	2.22	123.40 a
3 year cycle	3.24	9.96	0.37	0.56	0.42	0.18	49.04	2.32	116.80 a
3 year cycle urea + weed control	3.36	10.08	0.34	0.32	0.18	0.18	49.32	2.40	129.40 a
3 year cycle NPR + weed control	3.33	10.48	0.33	0.32	0.30	0.28	49.10	2.96	91.00 b
IRRIGATED									
2 year cycle	3.32	10.02	0.34	0.78	0.54	0.16	48.52	3.08	119.00 a
3 year cycle	3.21	9.64	0.38	0.68	0.74	0.20	48.40	1.92	119.80 a
3 year cycle urea + weed control	3.41	10.22	0.31	0.40	0.34	0.22	48.66	3.54	120.80 a
3 year cycle NPR + weed control	3.40	10.22	0.30	0.64	0.32	0.16	48.92	2.50	117.60 a
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	27.26

[1] Mean of 5 blocks

[2] Reported as % citric acid

[3] Reported as number of berries in a 50g sample

Table 3. Fertilization and Irrigation Effects on the Physical and Chemical Characteristics of Lowbush Blueberries (Vacinium augustifolium)

	Texture	Moisture	L	A	B
NON IRRIGATED					
2 year cycle	98.50	87.28 a	18.56	0.40	-3.31
3 year cycle	91.00	87.38 a	18.09	0.35	-3.30
3 year cycle urea + weed control	95.00	87.58 a	18.14	0.25	-3.13
3 year cycle NPK + weed control	82.50	87.43 a	17.55	0.57	-3.14
IRRIGATED					
2 year cycle	84.50	87.56 a	17.95	0.21	-3.26
3 year cycle	90.00	87.58 a	18.21	0.44	-3.23
3 year cycle urea + weed control	100.00	87.58 a	18.53	0.51	-3.63
3 year cycle NPK + weed control	96.50	87.71 a	18.33	0.28	-3.33
LSD 0.05	NS	NS	NS	NS	NS

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

Date: June, 1990 to January, 1991

Investigators: Alfred A. Bushway, Professor of Food Science
Rodney J. Bushway, Professor of Food Science
Craig J. Schroeder, Assistant Professor of Food Science
Jasotha Kugabalasooriar, Graduate Student in Food Science

Title: Investigation of preprocess changes (chemical, microbiological and/or physical) that could lead to the development of a simple and inexpensive method to measure preprocess berry spoilage.

Methods: Blueberries were obtained after field harvesting, which includes setting in the field for 2-3 hours, and brought back to the Department of Food Science where two pound samples (12 for each treatment) of mature berries were packaged individually in plastic bags containing holes for circulation. Packages were stored in tiers of three and stored at the following temperatures:

a. 3-5°C
b. Room temperature (25-28°C)
c. 40°C

Samples were taken at 1, 3, 6 and 9 days of storage and analyzed for the following physical and chemical parameters which provide potential for the development of a simple and inexpensive method to measure preprocess berry spoilage.

a. pH using a Beckman pH meter
b. Drip loss
c. Decrease in sugars (fructose, glucose) using high performance liquid chromatographic (HPLC) techniques developed by Bushway et al.
d. Increase in ethanol concentration using the gas chromatographic method of Bushway et al.
e. Determining changes in organic acids by the HPLC method of Bushway et al.
f. Color as measured by a Hunter LabScan II Spectrocolorimeter.
g. HPLC determination of acetic acid production.
h. Total aerobic microorganisms, yeasts and molds.
i. Titratable acidity and percent soluble solids.

The experiment was performed three times during the harvest season to reflect berry maturity from early to mid to late season.

Results: The data from the experiment conducted with the early season blueberries is presented in Table 1 as an example of the results that were obtained from this research. The analyses for ethanol, acetic acid and naturally occurring organic acids are still in progress. Statistical analysis of the data will be performed upon completion of these analyses, but some important trends can be briefly discussed.

First, the microbial population reflects the storage temperatures which the berries are exposed to. At normal field temperatures growth of yeasts are optimized while at higher temperatures molds become the major species (Table 1). Refrigeration greatly slows microbial growth and can extend the keeping quality of blueberries. Even at field or plant temperatures spoilage begins within 24-48 hours of harvest. Due to the time required to enumerate the microorganisms in a sample these methods cannot presently be used to develop a rapid method to examine preprocess berry spoilage.

Secondly, chemical tests which have potential for the development of a simple and inexpensive method to measure preprocess berry spoilage may include acetic acid production, decrease in the concentration fo glucose and/or sucrose and the increase in titratable acidity (Table 1).

Additionally, changes in blueberry texture were noted with toughening of the skin occurring at higher storage temperatures being reflected in the greater force required to shear the fruit (Table 1). Color changes were seen as the content of acid increased in the berries at higher storage temperatures (increases in the color a-values).

Similar results have been obtained with the blueberries harvested during mid- and late-season.

Conclusions: Based on the second year of this research project the increase in acetic acid content could provide a means to evaluate preprocess blueberry spoilage. We are presently analyzing samples for ethanol production which may lead to the development of an additional method to examine quality loss. As rapid methods for the enumeration of microorganisms are improved, they could become potentially useful in this regard. At refrigeration temperature, berries can be held for up to nine days with minimal loss in quality.

Recommendations: Research should continue on this project with plans for having a rapid method for measuring berry quality within the next two years. Also, recommendations concerning holding and storage temperatures can be made next year.

Future Work: During the next year research on this project will continue in two areas, (1) repeating the storage study using temperatures between 4-22°C, (2) development of a rapid enzyme linked method to measure acetic acid and/or ethanol production which could be used to determine quality loss.

Table 1. The Effect of Storage Temperature and Time on the Chemical, Microbiological and Physical Properties of Lowbush Blueberries.

Day 1

Analyses	Storage Temp. (°C) 3	26	40
% Soluble Solids	10.3[1] ± 0.36	10.8 ± 0.12	10.7 ± 0.34
Total Aerobes/g	3.7×10^4	1.5×10^6	7.1×10^5
Yeasts/g	1.5×10^4	1.1×10^5	4.0×10^4
Molds/g	1.1×10^4	3.0×10^4	3.0×10^4
% Titratable Acidity[2]	0.33 ± 0.02	0.30 ± 0.01	0.33 ± 0.02
pH	3.42 ± 0.05	3.43 ± 0.01	3.42 ± 0.03
% Crushed Berries	2.7 ± 0.9	1.2 ± 0.2	2.6 ± 0.8
% Moisture	87.6 ± 0.1	87.8 ± 0.1	87.8 ± 0.1
Texture (g force)	197.5 ± 4.3	203.3 ± 5.2	194.2 ± 7.6
Color			
L-value	15.39 ± 1.02	20.23 ± 0.42	15.17 ± 0.28
a-value	1.25 ± 0.33	0.38 ± 0.19	2.23 ± 0.46
b-value	-0.89 ± 0.47	-2.43 ± 0.28	-0.12 ± 0.29
Fructose (mg/g)	1.97 ± 0.01	1.98 ± 0.04	1.80 ± 0.08
Glucose (mg/g)	1.77 ± 0.01	1.77 ± 0.01	1.70 ± 0.06
Sucrose (mg/g)	0.28 ± 0.0	0.26 ± 0.0	0.26 ± 0.03

Day 3

Analyses	Storage Temp. (°C) 3	26	40
% Soluble Solids	10.4[1] ± 0.15	10.0 ± 0.15	10.3 ± 0.10
Total Aerobes/g	4.2×10^4	1.5×10^7	9.2×10^5
Yeasts/g	4.0×10^3	3.7×10^6	3.2×10^5
Molds/g	3.0×10^3	1.2×10^5	7.1×10^5
% Titratable Acidity[2]	0.30 ± 0.01	0.36 ± 0.02	0.32 ± 0.03
pH	3.47 ± 0.01	3.41 ± 0.02	3.39 ± 0.01
% Crushed Berries	1.1 ± 0.5	4.5 ± 0.7	2.2 ± 0.7
% Moisture	87.7 ± 0.1	88.1 ± 0.1	87.7 ± 0.4
Texture (g force)	156.7 ± 2.9	183.3 ± 15.3	228.3 ± 29.2
Color			
L-value	15.79 ± 0.97	18.14 ± 0.92	15.42 ± 0.87
a-value	1.13 ± 0.26	0.99 ± 0.49	1.36 ± 0.68
b-value	-1.08 ± 0.35	-2.15 ± 0.51	-0.69 ± 0.49
Fructose (mg/g)	1.96 ± 0.09	1.93 ± 0.18	1.88 ± 0.04
Glucose (mg/g)	1.77 ± 0.07	1.70 ± 0.17	1.65 ± 0.04
Sucrose (mg/g)	0.28 ± 0.03	0.17 ± 0.15	0.19 ± 0.01

Table 1. Cont'd.

Day 6

Analyses	Storage Temp. (°C) 3	26	40
% Soluble Solids	10.3[1] ± 0.6	8.9 ± 0.4	9.1 ± 0.10
Total Aerobes/g	3.8×10^5	4.3×10^7	1.0×10^7
Yeasts/g	2.3×10^4	2.2×10^7	4.3×10^6
Molds/g	3.0×10^3	3.0×10^3	4.9×10^6
% Titratable Acidity[2]	0.30 ± 0.01	0.91 ± 0.18	0.34 ± 0.01
pH	3.46 ± 0.02	2.99 ± 0.09	3.36 ± 0.02
% Crushed Berries	1.0 ± 0.1	10.6 ± 2.4	3.0 ± 1.2
% Moisture	87.6 ± 0.1	88.4 ± 0.27	87.6 ± 0.8
Texture (g force)	163.3 ± 6.3	161.7 ± 15.3	264.1 ± 42.9
Color			
L-value	19.22 ± 0.91	14.37 ± 1.25	19.17 ± 0.49
a-value	0.28 ± 0.06	4.23 ± 1.08	1.27 ± 0.31
b-value	-2.31 ± 0.31	-0.49 ± 0.74	-1.38 ± 0.08
Fructose (mg/g)	1.99 ± 0.06	1.52 ± 0.10	1.74 ± 0.10
Glucose (mg/g)	1.81 ± 0.07	1.43 ± 0.30	1.47 ± 0.08
Sucrose (mg/g)	0.24 ± 0.05	0.06 ± 0.11	0.16 ± 0.06

Day 9

Analyses	Storage Temp. (°C) 3
% Soluble Solids	9.6[1] ± 0.5
Total Aerobes/g	1.2×10^6
Yeasts/g	5.4×10^4
Molds/g	2.6×10^4
% Titratable Acidity[2]	0.27 ± 0.01
pH	3.52 ± 0.04
% Crushed Berries	2.0 ± 0.2
% Moisture	87.7 ± 0.2
Texture (g force)	190.8 ± 15.9
Color	
L-value	18.87 ± 0.93
a-value	0.20 ± 0.23
b-value	-2.05 ± 0.06
Fructose (mg/g)	1.81 ± 0.05
Glucose (mg/g)	1.59 ± 0.07
Sucrose (mg/g)	0.0

[1] Each value represents the mean of three determinations.
[2] Reported as citric acid.

BLUEBERRY RESEARCH ADVISORY COMMITTEE
RESEARCH REPORT

Date: June, 1990 to January, 1991

Investigators: Rodney J. Bushway, Professor of Food Science
Alfred A. Bushway, Professor of Food Science
Jasotha Kugabalasooriar, Graduate Student in Food Science

Title: The Effect of Postharvest Handling on the Dietary Fiber and Ellagic Acid Content of Lowbush Blueberries

Methods: Samples of the blueberries to be used in the CSRS study for the development of a rapid method to determine blueberry quality were used to generate baseline data on the concentrations of dietary fiber (soluble and insoluble and pectin) and ellagic acid in blueberries under field handling conditions. Samples were analyzed through the harvest season to determine the effect of maturity on these chemical compounds. Samples were also analyzed after processing, IQF freezing and every two months through 10 months of frozen storage (-25°C).

At each sampling period, samples were analyzed (in triplicate) for total dietary fiber, soluble and insoluble dietary fiber and the percent of soluble fiber as pectin. AOAC (1984) methods were used for fiber analysis while the methods developed by Simpson et al. (1984) and our laboratory were used for pectin extraction and quantitation. The ellagic acid concentration were determined in triplicate by the high performance liquid chromatographic method of Mass (personal communication) with modifications.

Results: Samples for fiber and ellagic acid analysis have been freeze-dried and the literature methods modified for the examination of blueberries. These analyses are currently being performed and should be completed in June.

The results of the fiber analysis of blueberries at different stages of maturity and with different clones has been completed (Table 1). Uronic acids and soluble fiber increased significantly ($p \leq 0.10$) from week one to week three. Insoluble and total fiber decreased over the three week period. Uronic acids and soluble fiber showed a decline in the green-red and red-blue stage of development with an increase during the blue stage. Insoluble and total fiber declined significantly ($p \leq 0.10$) throughout the last two stages of development. Differences in fiber content were noted between clones.

Conclusions: The results of the analysis for fiber can be related to textural changes as the blueberries mature. As the content of soluble and total fiber decreases, the fruit will soften. Although blueberries are not extremely high in dietary fiber, they could provide enough fiber to be used as a marketing tool. A dried or semi-dried product would be moderately high in dietary fiber.

Recommendations: Recommendations with regards to the use of the dietary fiber and ellagic acid content of blueberries in marketing must await the completion of this research project.

Future Work: This project will continue for a second year in order to generate statistically significant data.

Table 1. The Effect of Maturation on the Fiber Content of Blueberries REGW[1] Mean Values for Fiber (dry weight)

	g/100g			
Week	Uronic Acid	Soluble	Insoluble	Total
1	3.68*	3.58*	47.76	51.35
2	8.19*	6.08*	34.94	41.02
3	9.14*	8.81*	33.84	42.64

	g/100g			
TRT	Uronic Acid	Soluble	Insoluble	Total
A	6.98	6.42	39.54	45.96
B	6.01	5.69	40.42	46.12
C	6.92	6.92	37.43*	44.35*
D	8.12	6.26	35.48*	41.74*

	g/100g			
Clone	Uronic Acid	Soluble	Insoluble	Total
1	5.88	6.19	35.61	41.80
2	6.96	5.63	40.23	45.86
3	8.17	7.08	38.68	45.76

* Significant at $p \leq 0.10$
[1] Ryan-Einot-Gabriel-Welsch multiple range test
A = green
B = green-red
C = red-blue
D = blue

BLUEBERRY RESEARCH ADVISORY COMMITTEE
RESEARCH REPORT

Date: June, 1990 to January, 1991

Investigators: Rodney J. Bushway, Professor of Food Science
Alfred A. Bushway, Professor of Food Science
Jasotha Kugabalasooriar, Graduate Student in Food Science

Title: Determination of Pesticide Residue Levels in Freshly Harvested and Processed Lowbush Blueberries

Methods: Blueberry samples were obtained from Ed McLaughlin who gathered samples during harvest and after processing from a processor (5 pound samples). Frozen samples were transported to Orono in coolers containing ice. The total number of samples that were analyzed was 32.

Samples were analyzed for three pesticides - guthion, phosmet and benomyl. Each of the 5 pound samples were macerated to make a homogenous sample in which an aliquot was removed for pesticide analysis using FDA procedures and methods developed in our laboratory.

Results: Methods for the analysis of guthion, phosmet and benomyl have been developed and samples are presently being extracted and analyzed.

No good methods exist for the analysis of funginex. Thus, samples will not be analyzed for this pesticide until an acceptable method can be developed.

Conclusions: Conclusions cannot be made until all analyses are completed.

Recommendations: With continuation of this project over a five year period, the blueberry industry will have baseline data on levels of commonly used pesticides. This data could be used to alleviate any consumer concerns regarding food safety issues with lowbush blueberries.

Future Work: This project should be continued for the next four years at the same or an increased level of sampling.

Potential New Areas of Study for 1991: No new areas for research are proposed for the 1991-92 funding period, but at some point in the near future research projects in the following areas should be considered: (1) Effect of mechanical harvesting on quality changes in blueberries, (2) Changes in nutritional quality during storage, and (3) Control of color changes in blueberry puree.

BLUEBERRY RESEARCH ADVISORY COMMITTEE
RESEARCH REPORT FOR 1990

DATE: January, 1991

PRINCIPAL INVESTIGATOR: David H. Lambert

TITLE: Evaluation of Defoliating Diseases

METHODS: Sets of 4 m X 10 m replicated plots were established on a bearing field (the Cotton piece south of Schoodic Lake) with a history of brown spot disease, and on a nonbearing field (Tracy field, Cherryfield) with a history of powdery mildew. Disease was suppressed on treated plots with sprays of the fungicides captan and benomyl every two weeks from budbreak until August. At the brown spot trial, data collected included percent leafspot severity at harvest, fruit yield per plot and average berry weights.

RESULTS/CONCLUSIONS: At the brown spot plot, leafspot severity (percent of leaf surface affected) at harvest was 9.8% for nontreated plots and 1.7% for treated plots. While leafspot was more severe at this site than at most other fields, it was not as severe as in certain previous years. Fruit yields averaged 0.91 kg/m^2 in the nontreated plots and 1.09 kg/m^2 in the treated plots. This difference (+19%) was not statistically significant ($P < 5\%$). A portion of this increased yield appeared to come from a reduction in mummy berry disease, which was severe at the edge of certain plots. Berry weights averaged 31.0 g/100 in the nontreated plots and 32.8 g/100 in the treated plots. The difference (6%) was not statistically significant. Leaf retention in the treated plots was striking. At the time when leaves had turned red, most were still attached in the sprayed plots, while few remained in the control plots. This may have been an effect of disease reduction and/or benomyl treatment. Initial comparisons of the pathogen isolated from lowbush leaves indicate that it is the same as the organism (Septoria albopunctata) which causes a leafspot disease on highbush leaves. In culture, Benlate and Captan, but not Funginex, prevented growth of the pathogens at low fungicide concentrations.

RECOMMENDATIONS: At this point, the value of fungicide treatment for brown spot control alone is questionable. The disease appears to be more severe under stress conditions (drought, low nitrogen fertility). To the extent that disease control is practical, extra nitrogen fertilization and/or selection or addition of an appropriate fungicide might be of value. The time at which infection occurs and the environmental conditions required for infection are not known, making fungicide timing recommendations difficult.

PROJECTED RESEARCH: The effects of fungicides, brown spot and mildew on bud survival and development will be determined in April. Infection studies are projected.

BLUEBERRY RESEARCH ADVISORY COMMITTEE
RESEARCH REPORT FOR 1990

DATE: January, 1991

PRINCIPAL INVESTIGATOR: David H. Lambert

TITLE: Vacuum Sanitation for Disease Control

METHODS: Three sets of mummy berry sclerotia in their spring condition (black, free of fruit tissue) were placed in a line in the path of the vacumn sterilizer. Debris produced during mowing, vacumning and crushing was collected. Sclerotia remaining on the ground after mowing were counted and sclerotia fragments present in the debris were collected. The germinability of these fragments is being determined.

RESULTS/CONCLUSIONS: In each of the three trials, all but 2-4 of the sclerotia were picked up by the vacumn. Mechanical damage by the mower blades appeared to contribute to mummy berry destruction. After a period of operation, cut stems tended to collect and to clog the vacumn intake. This problem is being addressed. The ability, if any, of sclerotia fragments to germinate will be reported later. A hyperparasitic fungus was isolated from developing Mummy berries which had been collected from plants just prior to harvest. This fungus (apparently Trichothecium roseum) is a very aggressive invader of sclerotia. Its use as a biological control agent might be limited by its reported ability to infect fruit and to produce a potent toxin.

RECOMMENDATIONS: The ability of the vacumn to pick up and crush or crack sclerotia is encouraging. Development of the machine should proceed.

PROJECTED RESEARCH: Evaluations of the vacumn sanitizer will continue. The effectiveness of the machine in mummy berry control will be determined under field conditions in conjuction with insect control trials.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATORS: David E. Yarborough, Associate Scientist
Delmont C. Emerson, Farm Manager
Richard J. Rowe, Professor of Agricultural Engineering

TITLE: Evaluation and modification of commercial herbicide applicators.

METHODS: Review of available literature and a survey of manufactures producing selective herbicide applicators determined that the Wick Master pressurized no-drip rope wick applicator had the most promise. The applicator has been modified for use in lowbush blueberry fields by cutting the unit to a three foot length and mounting it in a tandem wheel carrier. This configuration will allow application of non-selective herbicides to weeds taller than lowbush blueberries and will provide more efficient weed control with less injury to blueberry plants.

Since electronic moisture sensors for maintaining herbicide solution on the applicator are not commercially available, a sensor will be made in Agricultural Engineering and an existing wiper will be modified to include the sensor. Both units would be evaluated as to how well weed foliage is covered and how much drip and injury can be expected. Modifications on mounting and delivery systems will be made to enhance their effectiveness in lowbush blueberry fields.

RESULTS: Field trials to evaluate pressured rope wick and electronic moisture sensors will be scheduled during the summer of 1991. Results will be available in 1991 and 1992.

CONCLUSION: This project will provide information on the effectiveness of these units to apply nonselective herbicides such as glyphosate to control woody and herbaceous weeds taller than the lowbush blueberry. These units will allow for more efficient weed control, less injury to blueberries to produce fields with less weeds which will provide higher yields and be easier to mechanically harvest.

RECOMMENDATIONS: Continue evaluation and refinement of both wiper systems.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATORS: David E. Yarborough, Associate Scientist
Gilles H. Lemieux, University of Quebec at Chicoutimi (UQC)
Rene Verrault, UQC

TITLE: Evaluation of the suitability of remote sensing to evaluate plant cover in lowbush blueberry fields.

METHODS: A preliminary test to determine the spectral signature of the blueberry plant from multiband videography was discussed with scientists for the University of Quebec at Chicoutimi. These reflectance characteristics are necessary before specific protocol may be developed for data acquisition and analysis. Flights will be scheduled over the blueberry fields in Deblois in 1991 to provide data imagery to rapidly classify and evaluate plant populations in lowbush blueberry fields. WBANA and the University of Quebec are also contributing equivalent amounts to this project. This will be compared to cover data taken from ground plots.

CONCLUSION: Computer evaluation of images is expected to provide quantitative cover data and allow for accurate assessment of field cover and weed populations. Results are expected in 1991.

RECOMMENDATIONS: Continue with project to obtain field cover data.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATOR: David E. Yarborough, Associate Scientist

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

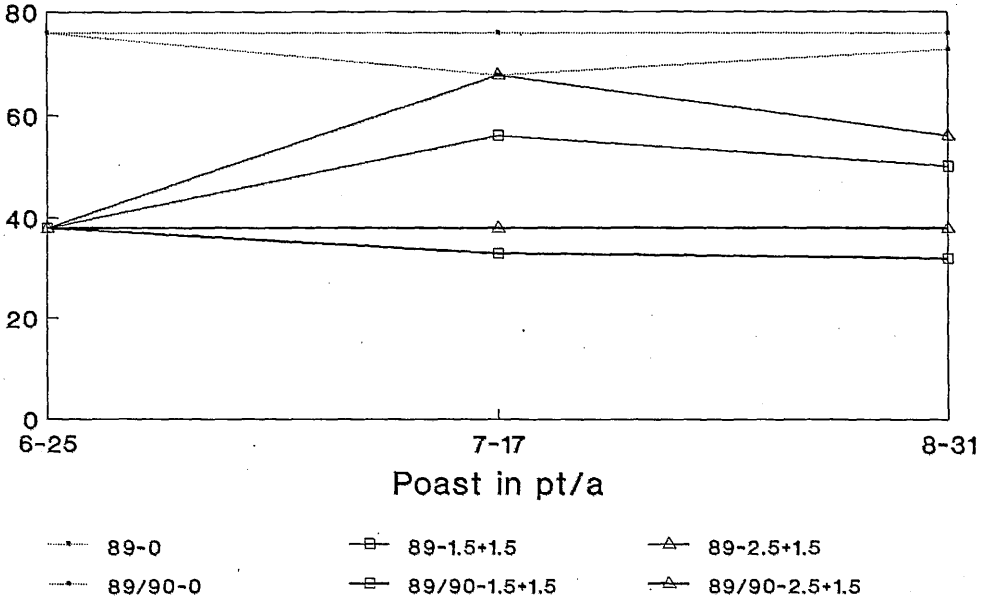
METHODS: Poast was sprayed broadcast on bunchgrass in 1989 as indicated in the 1990 advisory committee report on the evaluation of Poast in lowbush blueberry fields. Stem samples were cut from a 0.5 m^2 subplot in each of the plots in the fall of 1989. Stem density, total length and total fruit buds were determined. Poast was sprayed broadcast on half of the plots on 6-25 and 7-17-1990. Cover and height were evaluated on each date. Phytotoxicity (0 = no effect and 10 = complete kill) was determined, and plots were hand-harvested on 8-31-90.

RESULTS: The application of Poast in the crop year suppressed both bunchgrass cover and height as compared to the untreated areas and to the areas that were treated with Poast in 1989. Percent cover of bunchgrass was less than the untreated for plants treated in 1989 but height was almost the same. Significant phytotoxicity to the bunchgrass was evident on the bunchgrass treated in 1990, symptoms included severe stunting and a reddish coloration. The 1989 Poast treatment resulted in more blueberry stems, but the increase in length and buds were not significant, possibly because of the large variation in plant stand. Poast treatment resulted in greater blueberry yield over the untreated control but there was no difference in yield produced by the additional treatments in the yield year or by the higher treatment rate.

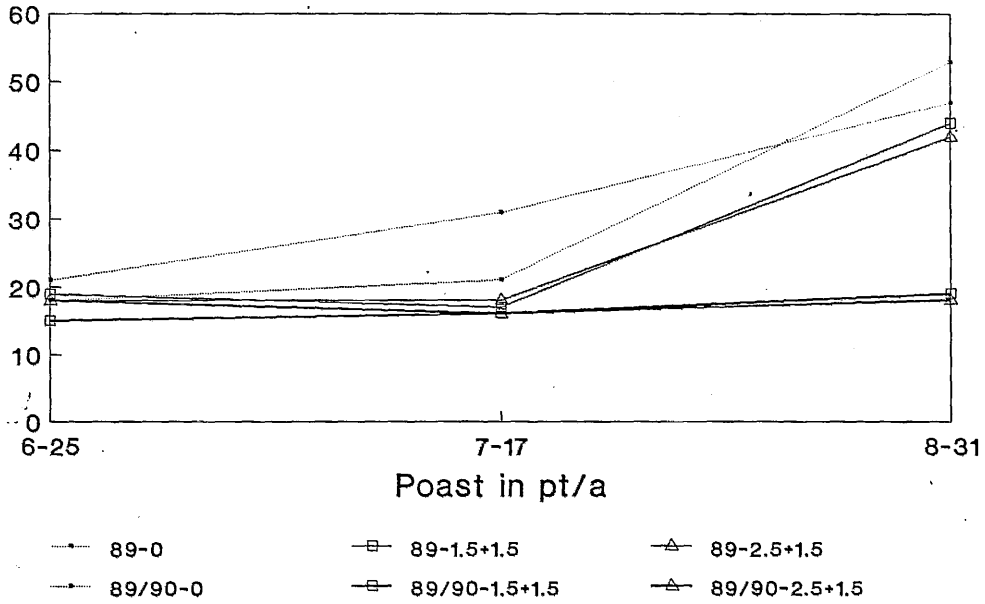
CONCLUSION: Poast suppressed grass growth, thereby reducing competition and allowing for enhanced blueberry growth and yield. The higher rate of Poast and the additional treatment continued to suppress the bunchgrass but did not result in greater yields over the single lower rate treatment.

RECOMMENDATIONS: Although additional Poast treatments did not result in enhanced yield it may be important to continue the suppression of the grass in order to reduce its cover in the field.

Effect of Poast on Bunchgrass
Percent cover



Effect of Poast on Bunchgrass
Grass height in cm

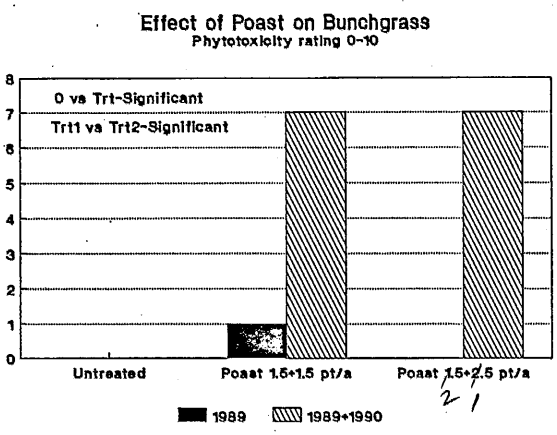


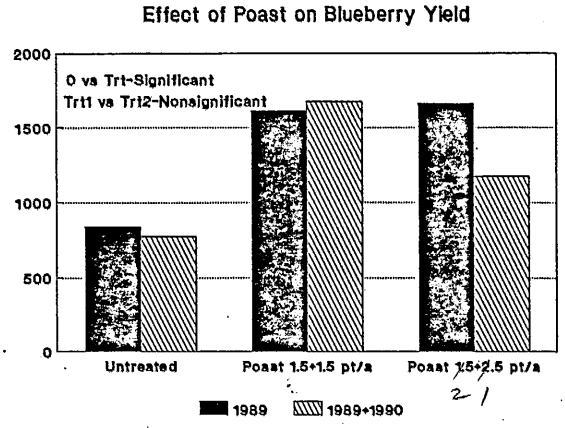
RPOAST91

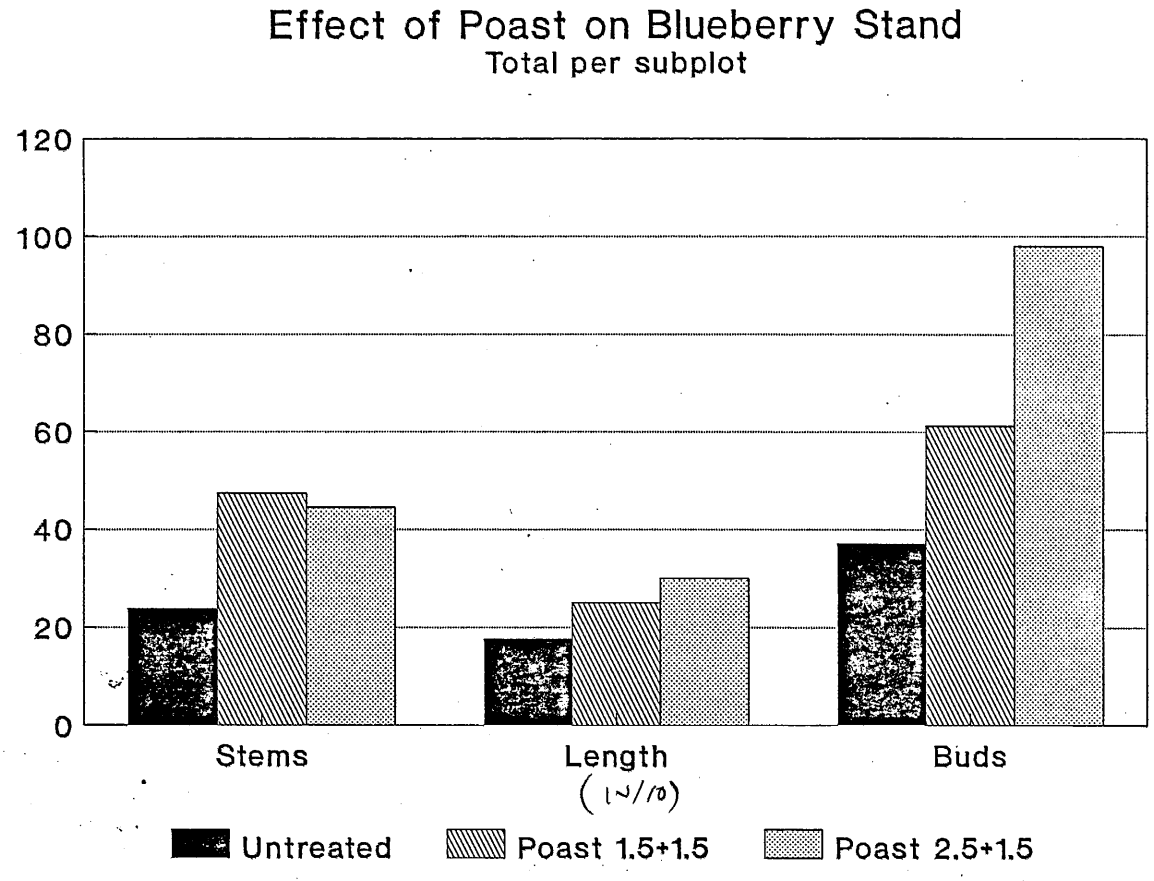
Poast bunchgrass evaluation - Broadcast, 1990

Poast w/COC Pt/A	6-25 Cover (%)	6-25 Ht (Cm)	7-17 Cover (%)	7-17 Ht (Cm)	8-31 Cover (%)	8-31 Ht (Cm)	Phyto (0-10)	Yield (Kg/ha)
			Treated - 1989 only					
0	76	18	76	21	76	53	0	838
1.5+1.5	38	19	56	17	50	44	1	1614
2.5+1.5	38	18	68	18	56	42	0	1658
Sig.	NS	NS	NS	NS	*	*	*	NS
			Treated - 1989 + 1990					
0	76	21	68	31	73	47	0	774
1.5+1.5	38	15	33	16	32	19	7	1674
2.5+1.5	38	16	38	16	38	18	7	1174
Sig.	*	*	*	*	*	*	*	NS

Poast was sprayed broadcast at 20 gpa, 30 psi with 80015 tjet tips, 20" above plants on half of the plots on 6-25 and 7-17-1990. Phyto = phytotoxicity to grass where 0 = no effect and 10 = complete control. NS=nonsignificant, ** = highly significant. No phytotoxicity to blueberries noted.


Effect of Poast on Bunchgrass
Phytotoxicity rating 0-10
0 vs Trt-Significant
Trt1 vs Trt2-Significant
8
7
6
5
4
3
2
1
0
Untreated
Poast 1.5+1.5 pt/a
Poast 1.5+2.5 pt/a
1989
1989+1990


Effect of Poast on Blueberry Yield
0 vs Trt-Significant
Trt1 vs Trt2-Nonsignificant
2000
1500
1000
500
0
Untreated
Poast 1.5+1.5 pt/a
Poast 1.5+2.5 pt/a
1989
1989+1990


Effect of Poast on Blueberry Stand
Total per subplot
120
100
80
60
40
20
0
Stems
Length
Buds
Untreated
Poast 1.5+1.5
Poast 2.5+1.5

RPOAST91

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

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.

CONCLUSION: In this study the seedling source was the most important factor influencing plant spread. Final pruning was made in the fall of 1990. Evaluation of spread and yield will need to be made before a final conclusion can be reached.

RECOMMENDATIONS: Final evaluation of spread will be made in 1991 and yields taken in 1992.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

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: Velpar application did not effect blueberry stand but an increase in the rate of solicam produced an decrease in blueberry stem length. Velpar application resulted in a decrease in bunchgrass cover and an increase in blueberry yield over the untreated areas. An increase in solicam rate increased phytotoxicity on the bunchgrass which appeared as white foliage. However, grass cover increased and blueberry yield decreased with solicam application. Phytotoxicity and blueberry yield increased with a second application of solicam.

CONCLUSION: Hexazinone suppressed bunchgrass and resulted in yield increases, but solicam produced a reduction in yields as the rate was increased. Grass suppression was not obtained with the solicam treatments.

RECOMMENDATIONS: Although solicam is registered for use in blueberries it does not provide adequate suppression of bunchgrass and may reduce yields. It should not be recommended for use in lowbush blueberry fields.

Effect of SOLICAM and VELPAR on blueberry Bucksport, 1989

Herbicide	Rate lb/a	Blueberry Stems	Blueberry Length (cm)	Blueberry Buds
Velpar	0	39	284	51
	2	48	318	65
Significance		NS	NS	NS
Solicam	0	43	335	71
	3	49	383	76
	6	50	275	66
	9	32	216	66
Significance		NS	L**	NS

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 and 10/26/89

Main effects of SOLICAM and VELPAR on bunchgrass and blueberry Bucksport, 1990

Herbicide	Rate lb/a	Bunchgrass Phytotoxicity (0 - 10)	Bunchgrass Cover (%)	Bunchgrass Height (cm)	Blueberry Yield (lb/a)
Velpar	0	1.7	51	27	886
	2	1.6	38	28	1189
Significance		NS	**	NS	**
Solicam	0	1.0	43	29	1133
	3	1.1	35	26	1374 *
	6	1.4	49	25	875
	9	3.1	51	28	768
Significance		L**	L*	Q**	L**
Solicam (Frequency)	Once	1.3	43	28	866 —
	Twice	2.0	46	27	1208 —
Significance		**	NS	*	**

L= linear trend, ** = Sig at 1%, NS = non-significant
Grass phytotoxicity 0= no effect 10= complete control
Evaluated: 7/26/90 harvested 7/31/90.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Selective wiper and mechanical control of dogbane and bracken fern.

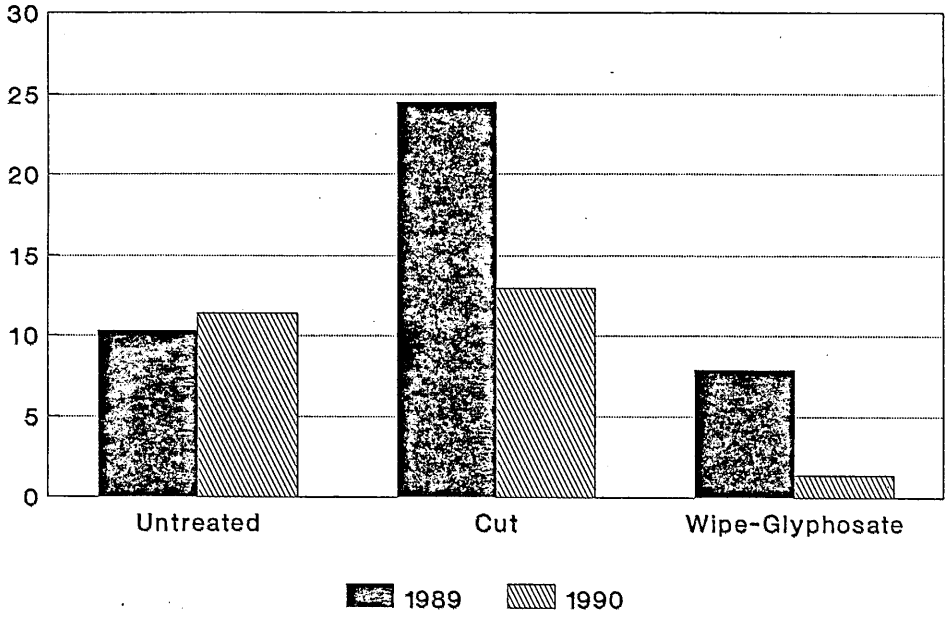
METHODS: As indicated in 1989 project proposal outline 8. Pre-treatment counts taken in 1989, post-treatment counts in 1990.

RESULTS: The following figures compare the 1989 pretreatment dogbane and bracken fern stems to the 1990 post-treatment numbers. The dogbane from the untreated area showed little change whereas the cut stems were reduced by 50% (from 24 to 12 m^2). The stems wiped with a 10% glyphosate solution from a super-sponge wiper mounted on a tandem wheel carrier reduced dogbane by 5 fold (from 8 to 1.5 m^2). The bracken fern stand declined by 50% on both the untreated and cut plots. The plants from the wiper area showed a 10 fold decline (from 1.9 to 0.2 m^2). Observations at the time of wiper application indicate that the wiper produced negligeable injury to the blueberry stems. Use of the hand-held mechanical mower resulted in some injury to the blueberry stems.

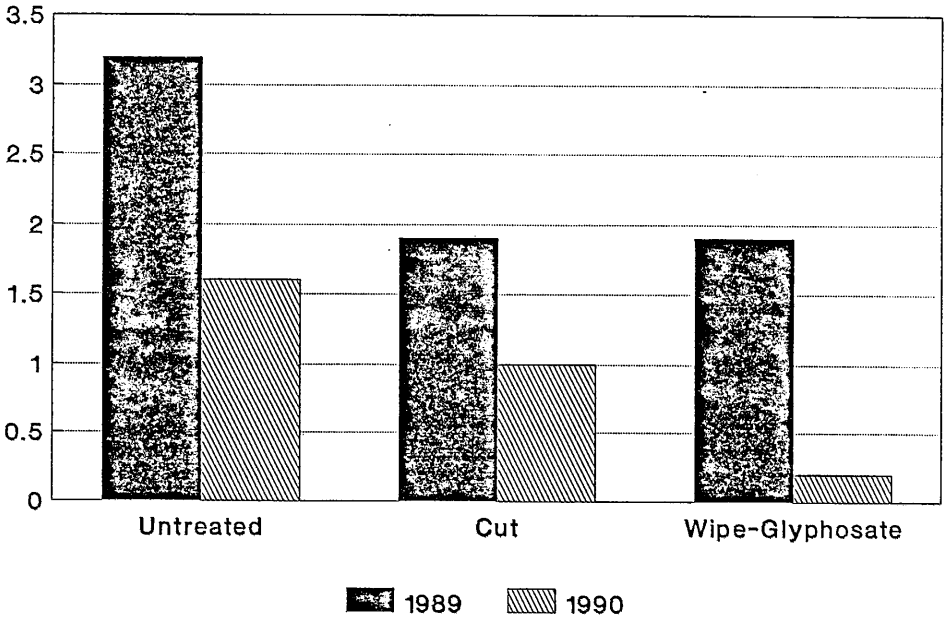
CONCLUSION: Wiper applications produced the best results for control of dogbane and bracken fern. Mowing did provide for suppression of dogbane but was not different from the untreated area for the bracken fern. These results are contrary to results of suppression of bracken fern produced by mowing in 1988-1989.

RECOMMENDATIONS: Continue to evaluate wipers and compare to mowing in other field experiments.

Dogbane at Blueberry Hill Farm
Stems per square meter



Bracken Fern at Blueberry Hill Farm
Fronds per square meter



RWIPM91

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Evaluation of Norflurazon (SOLICAM) in fall vs spring for oatgrass control.

METHODS: As indicated in 1990 project proposal 9, except that no blueberry stems were cut and no yields are planned to be harvested.

RESULTS: No suppression of oatgrass was obtained with increase rates of norflurazon up to 9 lb/a. Grass cover and height was less for the fall vs the spring treatment.

CONCLUSION: Norflurazon was not effective in suppressing oatgrass in lowbush blueberries.

RECOMMENDATIONS: Current experiment in Deblios should be terminated. Although norflurazon is registered for use on blueberries it should not be recommended for oatgrass control in lowbush blueberry fields.

PSOLSF91

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

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 had no effect on blueberry stand or reduced bunchberry count. Sulfmeturon methyl reduced blueberry stand, length and buds and bunchberry count. Chlorimuron had no effect on blueberry or bunchberry. Tip-diebck applications - Chloro-sulfuron had reduced blueberry buds. None of the herbicides reduced bunchberry. Fall application - All three herbicides reduced bunchberry. Chlorimuron reduced blueberry stand but stimulated blueberry buds, and chlorosulfuron reduced blueberry stand and yield.

CONCLUSION: Results are similar to those reported last year, there is no clear reduction in bunchberry without injury to blueberry. The lack of bunchberry in the field hampered the evaluation.

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

RSUFBN91

Effect of sulfonyl urea herbicides on blueberry and bunchberry, Jonesboro 1990.

Herbicide	Rate gm/ha	Blueberry	Bunchberry	Blueberry		
		Carryover count 1990 ($0.1m^2$)		Length (cm)	Buds ($0.1m^2$)	Yield kg/ha
PREEMERGENCE						
Chlorimuron	0	63	3	603	134	2342
	50	52	1	580	127	2124
	100	50	3	514	127	1961
	200	62	1	419	107	1830
Significance		NS	NS	NS	NS	NS
Chlorosulfuron	0	68	3	412	127	2386
	50	51	3	385	201	2386
	100	34	2	256	174	1536
	200	35	0	142	55	1448
Significance		L**	L**	L**	Q**	NS
Sulfmeturon methyl	0	41	9	460	151	1701
	50	41	4	407	184	1890
	100	40	8	324	192	1592
	200	52	6	338	208	2146
Significance		NS	NS	NS	NS	NS
TIP-DIEBACK						
Chlorimuron	0	47	10	482	137	2053
	25	31	10	364	146	2346
	50	47	7	538	161	1939
	100	40	3	391	112	1421
Significance		NS	NS	NS	NS	NS
Chlorosulfuron	0	53	1	577	155	2358
	25	47	1	416	88	1859
	50	42	1	434	98	1677
	100	47	0	487	69	1405
Significance		NS	NS	NS	L**	NS
Sulfmeturon methyl	0	58	3	500	141	2244
	25	45	4	470	159	2053
	50	50	7	472	162	2048
	100	57	1	456	148	2533
Significance		NS	NS	NS	NS	NS

Continued.

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

BBS01P90

BOSITP90

Table continued.

Herbicide	Rate gm/ha	Blueberry Bunchberry		Blueberry		
		Carryover count 1990 ($0.1m^2$)		Length (cm)	Buds ($0.1m^2$)	Yield kg/ha
FALL-PRESENECENT						
Chlorimuron	0	75	3	453	102	2108
	50	52	1	530	99	1579
	100	60	5	525	94	1977
	200	58	1	492	154	2615
Significance		Q*	C*	NS	L*	NS
Chlorosulfuron	0	59	7	369	96	1655
	50	29	0	364	105	893
	100	35	0	386	111	713
	200	42	0	441	95	976
Significance		Q**	L**	NS	NS	Q**
Sulfmeturon methyl	0	46	8	367	136	1279
	50	50	0	533	121	1312
	100	67	0	468	132	1890
	200	51	2	474	134	1612
Significance		NS	Q**	NS	NS	NS

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

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Evaluation of postemergence applications of DPX-L5300 for bunchberry control. TRISEN UROW METHYL

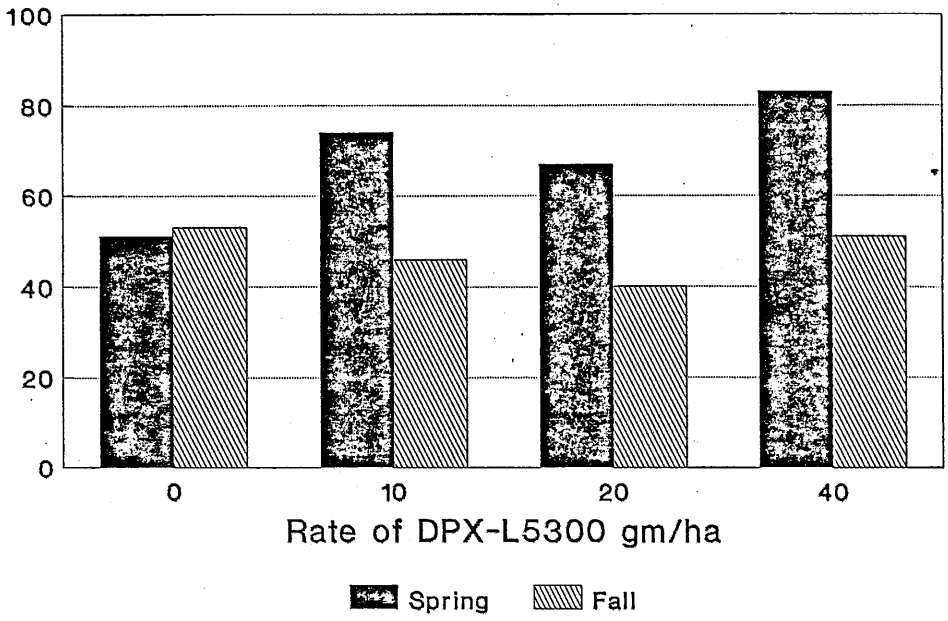
METHODS: As indicated in 1990 project proposal outline 10.

RESULTS: Results from spring applications indicate a suppression of both blueberry and bunchberry stand. Total length and buds from blueberry stems ~~were~~ tre reduced by the spring vs the fall treatment. Results from fall application will be made after recounts of blueberry and bunchberry stems are made and yield is harvested in 1991.

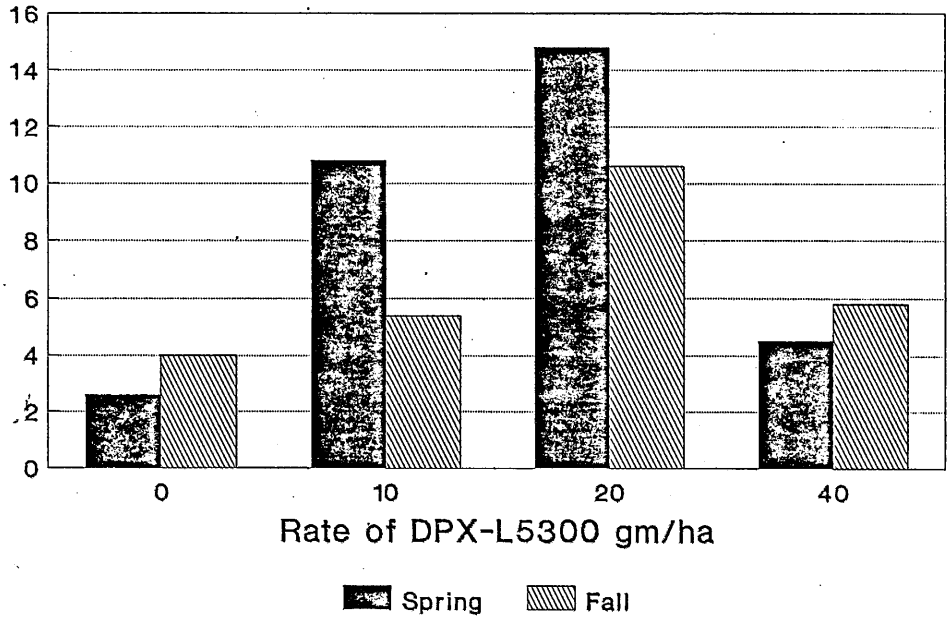
CONCLUSION: DPX-L5300 treatment suppressed both blueberry and bunchberry stand but stimulated blueberry stem growth.

RECOMMENDATIONS: Continue experiment through next year.

Effect of DPX-L5300 on blueberry
Stems per subplot

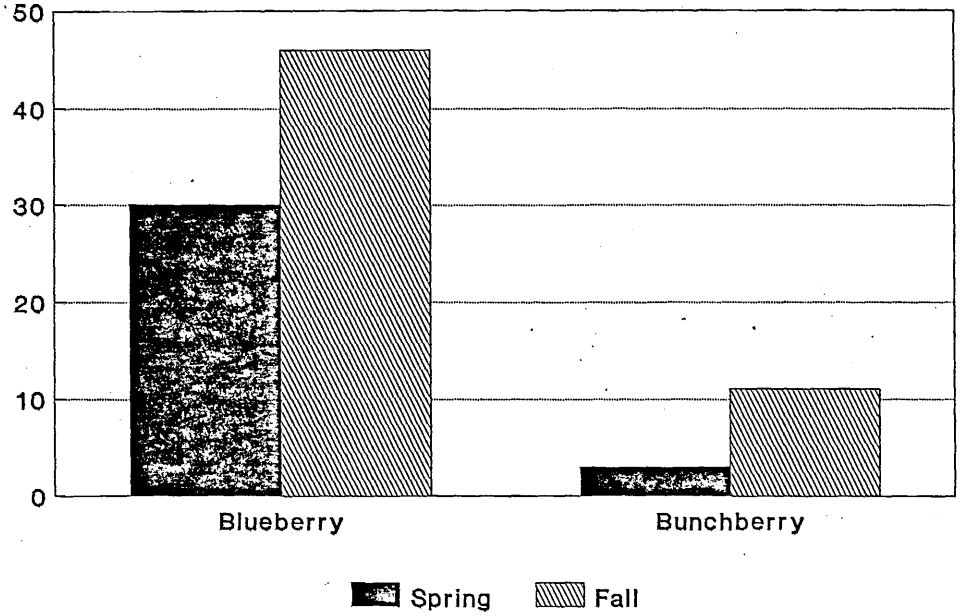


Effect of DPX-L5300 on bunchberry
Stems per subplot



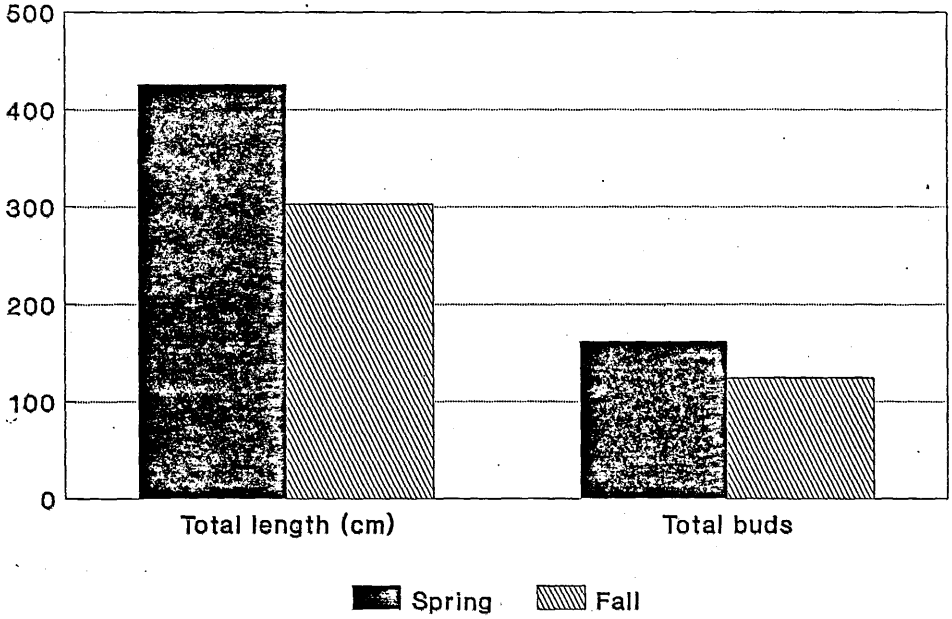
Effect of DPX-L5300 by time

Stems per subplot



Effect of DPX-L5300 on Blueberry

Total per subplot



REXP91

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January 1991

INVESTIGATOR: David E. Yarborough, Associate Scientist

TITLE: Effect of time of application and formulation of hexazinone (VELPAR) on blueberry and bunchberry.

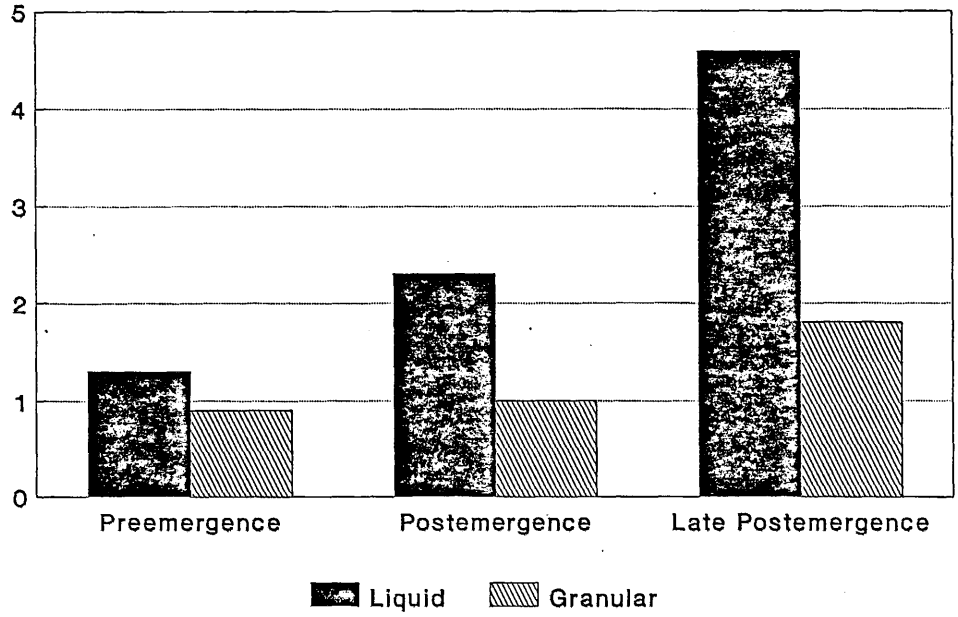
METHODS: As indicated in 1990 project proposal outline 11.

RESULTS: Visual injury to both blueberry and bunchberry increased with later application dates of velpar. The granular formulation resulted in less injury to both blueberry and bunchberry on the postemergence application dates. Blueberry length and buds decreased as a result of later velpar applications and stems, length and height were reduced by the 3.0 lb/a velpar treatment. Blueberry length and buds were higher on the granular vs the liquid velpar treatments. Bunchberry stems were not effected by timing, rate or formulation of velpar.

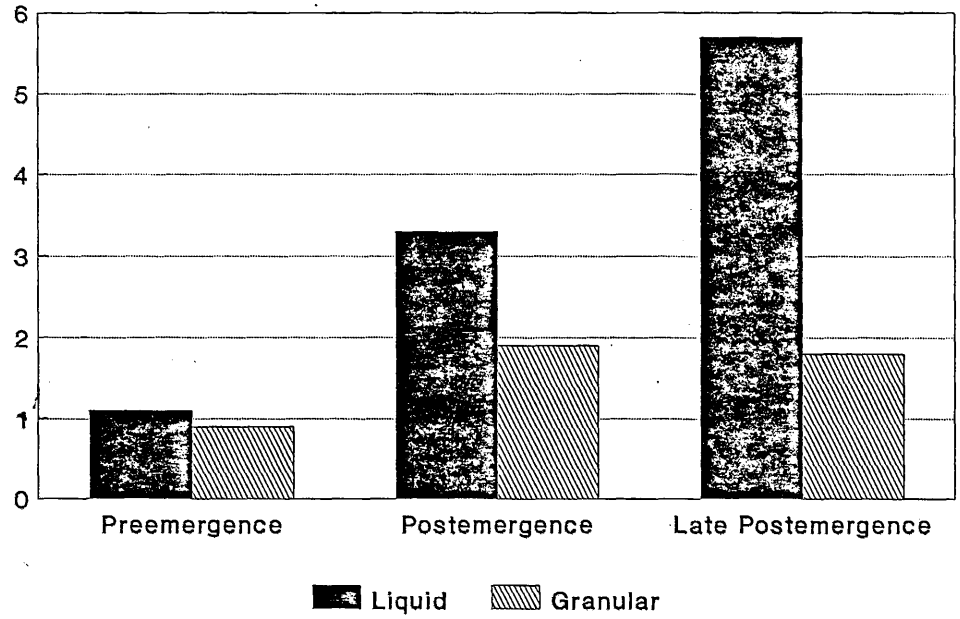
CONCLUSION: Velpar should not be applied postemergence or at high rates for the control of bunchberry. Late applications of the granular provided more crop safety than the liquid application.

RECOMMENDATIONS: Continue experiment through next year for carryover counts and yields.

Effect of Velpar by form and time
Blueberry rating (0 - 10)



Effect of Velpar by form and time
Bunchberry rating (0 - 10)



RVELF91

Main effects of velpar on bunchberry and blueberry.

Effect	Bunchberry	Blueberry		
	Stems	Stems	Length (cm)	Buds
Application date				
5-17-90	5	33	9.1	3.5
6-7-90	6	36	8.9	3.1
6-18-90	5	37	7.9	1.9
Significance	NS	NS	*	*
Velpar (lb/a)				
1.5	6	42	9.3	3.2
3.0	6	28	7.9	2.4
Significance	NS	*	*	*
Formulation				
Liquid	6	34	8.3	2.6
Granular	5	36	9.1	3.0
Significance	NS	NS	*	**

* = Significant at 5%, ** = Significant at 1%, NS = non-significant

MAINE BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

Date: January 1991

Investigator: Paul E. Cappiello
Assistant Professor, Landscape Horticulture
115A Deering Hall
581-2918

Title: Investigations of lowbush blueberry fruit-bud cold-hardiness.

Methods: The 1990 season was the initial phase of this multi-stage project. The general plan for the course of the investigations was to assemble a system for exposing plant material to controlled low-temperature stress. An existing freezer unit located at Highmoor farm was moved to Orono for use. Major electrical work was required in order to prepare the site for the freezer. In addition, the unit required a great deal of repairs.

The planned course of the experiment was to collect cuttings of several clones from the wild on several dates from late winter through peak bloom. The low-temperature tolerance of the fruit buds and flowers at these various stages of development was to be determined.

Results: It was determined that the existing freezer unit was not worth further investment in repairs and that a new unit was needed. The new unit has been ordered and should be in place for a series of preliminary investigations this spring.

Clones in the field have been identified for sampling. The group of clones includes the typical red-stemmed as well as a yellow-stemmed clone.

Plant production has begun for future phases of this work. A field plot has also been prepared for planting this spring to supply additional plant material. Work on planning and construction of a container production facility continues.

Preliminary photographs are being evaluated for identification and labelling of discrete morphological stages of fruit-bud development.

Recommendations: The current project is still in stages of developmaent and should continue for several seasons. It is expected that the coming season will provide ample opportunity to refine the low-temperature stress system and that this system will then be available for use on a number of other projects (ie. effects of fertilization etc. on potential cold-hardiness).

BLUEBERRY ADVISORY COMMITTEE

RESEARCH PROGRESS REPORT

January, 1991

Investigators: James D. Leiby and Michele C. Marra

Title: The Economics of Investing in Irrigation for Lowbush Blueberries

Methodology: Standard partial budgeting and capital investment analysis techniques will be used to develop a model of the profitability of investing in irrigation equipment for use on lowbush blueberries. This profitability will be a function of expected additional yield and/or quality achieved through irrigation and the annual fixed and variable costs of irrigating. Sensitivity analysis will be performed on the model so that various farm-specific scenarios can be analyzed.

Progress to Date: The preliminary results reported by Smagula, et al. and Bushway, et al. reported elsewhere in this volume indicate that no yield or quality response to irrigation could be found in the test plots. We were, therefore, not able to attempt to estimate a preliminary response function. We have begun to gather the required equipment cost information for the model and to adapt it to the lowbush blueberry case. We also have begun to build the general investment model in a Lotus framework. The majority of the effort will take place during the summer and fall of this year. By early spring, 1992, the general computer model will be completed and, hopefully, some more interesting yield and quality response information will be available from the 1991 crop season.

Conclusions: None can be drawn at this time.

Recommendations: None can be made at this time.

BLUEBERRY ADVISORY COMMITTEE

CSRS BLUEBERRY PROJECT REPORT

January 1, 1990 - December 31, 1990

1. PRINCIPAL INVESTIGATOR: Warren E. Hedstrom, Associate Professor
Bio-Resource Engineering, Univ. of Maine

2. TITLE: Effects of Irrigation on Lowbush Blueberry Yield and Quality

3. METHODS:

The site selected for the installation of the underground sprinkler irrigation system, i.e., Section 5 at the Blueberry Hill Farm, was surveyed preliminary to the design of the system. Consideration was given to various arrangements of plots and the final plot layout was determined. System components were selected to be similar to those used by cranberry growers in Massachusetts. Therefor, a visit to Plymouth County, Massachusetts was made during this past summer. The sprinkler irrigation system was designed with the assistance of Mr. Jack Hayward of Stearns Irrigation who has several years experience with irrigation design and installation in cranberry bogs.

The irrigation system will be installed as early as possible in 1991. Its operation will be as outlined in the project proposal.

An effort was made successfully to identify some of the clones in Section 5 and their areal extent. Yield samples were taken from several clonal areas in order to establish a data base which could be used in future harvests as a basis of comparison.

4. RESULTS/CONCLUSIONS:

As this study is centered around the operation of the sprinkler irrigation system which could not be installed until after the 1990 season, there are no results to report at this time.

5. FUTURE WORK:

As indicated above, the sprinkler irrigation system will be installed in 1991 and irrigation treatments will begin as proposed. Some minor revisions to the proposed treatments are under consideration, namely, the use of the sprinkler irrigation for frost protection on some plots.

BLUEBERRY ADVISORY COMMITTEE

CSRS BLUEBERRY PROJECT REPORT

January 1, 1990 - December 31, 1990

1. INVESTIGATORS: Warren Hedstrom, Bio-Resource Engineering, UM
Willem Brutsaert, Civil Engineering, UM
581-2170
David Brooks, Grad Asst, Civil Engineering, UM
Call ⇐ 829-5016 Sewall + Maher Eng. - Portland area firm

2. TITLE: Groundwater and Surface Water Development for Blueberry Irrigation

3. METHODS:

The project was carried on following the methods as indicated in the 1990 Project Proposal.

4. RESULTS/CONCLUSIONS:

This past year's activity was devoted toward obtaining hydrologic data relative to the Pineo Ridge aquifer as follows:

a) rainfall - monitored on a continuous basis at two sites
b) surface runoff - flow was measured in three key streams in the study area
c) elevation of the water table - four observation wells were monitored at frequent intervals throughout the year
d) temperature - a continuous during the growing season was obtained to provide data that will be used to estimate blueberry crop water use.

Background information on the site's geology was assembled. A seismic survey was carried out with the assistance of the Maine Geologic Survey.

No conclusions can be presented at this time as this study is continuing through 1991.

5. FUTURE WORK:

The hydrologic data listed above will continued to be obtained. The drilling of a small diameter well is planned for the purpose of investigating the stratigraphy and properties of the aquifer material and the aquifer response to pumping which will indicate the transmissivity of the aquifer. The simulation model will utilize all these data in predicting aquifer response under various pumping rates which will be based in the irrigation water requirements for blueberries.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: January, 1991

INVESTIGATOR: E. R. Huff, Associate Professor,
Bio-resource Engineering

TITLE: Design, Fabrication, and Testing of an Experimental Sterilizer for Blueberry Fields

METHODS:
To avoid both burning (which over the years decreases soil organic matter) and pesticides (use of which is good to reduce), killing of pests was to be accomplished by picking the litter up off the ground and then using one or both of smashing (largely for mummyberry) and raising temperature to kill the pests or their eggs.

A machine was built with a blower for picking up litter, a rotating brush to smash mummyberries, and an oil burner to raise temperature of the litter to kill bugs and eggs.

It was tried on blueberry fields at Blueberry Hill Farm in April and May, 1990. It was planned to assess its effectiveness by comparing pest viability on plots on which the machine had been used with those on which it had not.

RESULTS:
The machine picked up some, but not all, of the litter from blueberry fields. On one field there was matted litter which the machine failed to pick up. Also, debris got caught between the rear roller and the rear wall of the mower and plugged the flow of material. The brush seemed to break up satisfactorily those mummyberries that came through it, but volume flow was too low to tell whether it would smash all of them with full flow.

A planned test on plots, with control plots, to determine the machine's effectiveness in killing pests could not be done due to failure of the machine to pick up most of the litter. The burner did not work well due to back pressure from the blower.

CONCLUSIONS:
There are insufficient data to draw conclusions at this time.

RECOMMENDATIONS:
The equipment is being revised over the winter of 1990-91 and will be tested in April-May 1991. A larger blower and separate engine to drive it is being installed, a system to disturb matted litter to facilitate its pick up is being considered, and the air-heating system is being revised to avoid the problems encountered last year.