Winter 1987

Blueberry Advisory Committee Extension Report

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Weed Control.......................................	D. Yarborough

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Addendum:

Moody F. Trevett

- 3 pg article
- 1986 annual report
- Misc. report 128 (1970, revised 1986)

Blueberry Advisory Committee

Extension Report

Date: January 1987

Investigator: Tom DeGomez

Title: Sampling Fertility Levels in Lowbush Blueberry Fields

Methods: In order to locate 10 fields with nutrient deficiencies, a notice was placed in the June Wild Blueberry Newsletter that Extension could help sample fields. By early July no responses had come in for sampling help. At this point I contacted some growers who I thought may have a field with a nutritional problem. Soil and leaf samples were taken on 5 fields.

Results: All the fields sampled were low in at least one nutrient. Recommendations were given to the owners of the fields to put out test strips in their fields. The test strips will be used to determine response to fertilizer application. County agents participated in the sampling of the fields. Outside growers were not invited to observe sampling technics due to the lack of response by growers and the lateness in determining where the eventual 5 fields were.

Project Continuation: Extension will help the growers to set up the fertility test strips and assist them in determining results.

Five to ten additional fields will be located in 1987 and the program will be repeated. Growers will be invited to sampling site for field demonstration. No additional funding is anticipated.

Blueberry Advisory Committee

Extension Report

Date: January 1987

Investigator: Tom DeGomez, Dave Lambert, Dutch Forsythe, Jim Dill, and Judy Collins

Title: Color Pest I.D. FactSheets

Methods: Blueberry diseases and insects were found and identified during 1986. Specific photographs were taken of the pests for factsheet production. Six factsheets are anticipated for the series.

Results: 30 Color pictures were selected for three diseases and eight insects. The three diseases will be on one sheet and the 8 insects will be on three sheets. The copy (text) has been prepared and is in the process of being edited. We are hoping for a completion date of mid-March.

BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1986 to March 1987

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

Title: Development of insect identification information for growers.

Methods:

During the course of other studies on blueberry insects, collections were made of various prevalent secondary blueberry pest species. Arrangements were made to have color photographs taken of the insect stages and species.

Results:

No laboratory rearing of immatures to adults was undertaken this year to correctly identify insects encountered in the field because of time limitations. No life history information was collected. Specimens of a few important stages of secondary insect pests were submitted to Jim Dill for production of color photos (e.g. flea beetle, thrips).

Conclusions:

Over the past several years, important biological information and photographs have been collected on many of the more abundant and prevalent blueberry insects. This information will be used in the development of blueberry insect fact sheets which will allow growers to become more intimately aware of potential insect problems in their own fields. A more concentrated effort is still needed to complete the essentials for some of the other important insects encountered in the field.

BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1986 to March 1987

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

Title: Effect of pruning practices on blueberry insect abundance.

Methods:

In 1985 a single abandoned field was divided into 8 parts, each of which was subdivided into 3, 50 x 140 ft. plots. The 3 plots constituted the spring "treatments" of untreated (bearing), flail mowed and burned. Velpar was applied in the spring to all plots to reduce sampling effort and biased results due to differential weed distribution. Plots were sampled weekly beginning late June 1985. Five sets of 10-sweep samples were taken along a single long transect within each plot. Subsequent samples were taken from a transect located to one side or the other of the previous transect to avoid bias caused by sampling the same plants too often. The number of each type of insect captured in each set of 10 sweeps was recorded. The study was continued in 1986 to determine insect population trends on bearing plants, the second season after different pruning practices.

Results:

Populations of insects were again very low in this field; only sawfly and spanworm larvae, and grasshopper nymphs occasionally averaged more than 10 per 100 sweeps. Data for the most abundant insects are tabulated at the end of this report.

It was planned to locate and sample adjacent mowed and burned fields at 3 to 5 sites in Washington Co. Time limitations did not allow this to be done.

Conclusions:

Although it would be hazardous to conclude much from this study, because of low insect numbers, some trends seem to be apparent. Flea beetle larvae, sawfly larvae, and *S. epigaea* (looper) larvae appeared most abundant on bearing plants which had been flail mowed in 1985. Spanworm larvae seemed most abundant on bearing plants which had not been pruned in 1985. Grasshopper nymphs were possibly least abundant on bearing plants which had not been pruned last year.

Date	1985 Treatment	Grasshopper Nymphs	Sawfly Larvae	Spanworm Larvae	Flea Beetle Larvae	S. epigaea Larvae
		Number of insects per 100 sweeps				
5/9 + 5/16	burn	9.8	0.0	1.2	0.0	0.8
	mow	4.8	0.0	0.8	0.0	1.2
	none	1.2	0.0	0.8	0.0	0.2
5/29 + 6/6	burn	14.5	17.0	6.0	4.0	0.5
	mow	24.2	19.8	14.5	8.5	1.8
	none	19.8	11.0	19.5	3.5	1.0
6/18 + 7/10	burn	12.0	2.2	0.5	0.0	0.0
	mow	15.0	6.5	0.8	0.0	0.0
	none	7.5	2.8	3.2	0.0	0.0
7/26 + 8/15	burn	1.2	0.0	0.0	0.0	0.0
	mow	0.2	0.0	0.0	0.0	0.0
	none	2.2	0.0	0.0	0.0	0.0

BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1986 to March 1987

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

Title: Control of blueberry maggot.

Methods:

General Insecticides

A ground test for blueberry maggot control was conducted on a bearing blueberry field which was reported to have a significant maggot infestation. A randomized block design with 2 replications was utilized; each plot measured 100 x 100 ft.

Insecticides plus Nu-lure Insect Bait

A ground test was performed to determine if blueberry maggot can be controlled by lower rates of insecticides with the addition of a bait. Five combinations of insecticides and/or Nu-lure insect bait were tested. A randomized design with 1 large replication of each treatment was used. Each plot measured 200 x 200 ft.

All materials in both tests were applied at 400 psi in 15 gallons of water-mixture per acre with a Bean FMC[R] airblast sprayer mounted on a 674 International[R] tractor and driven at 2 mph.

Evaluation was based on post-spray counts of blueberry maggots found in 1 qt of berries raked from each of several preselected areas within each treatment plot and compared to collections from adjacent untreated areas. Berries were refrigerated and processed for maggots within one week after collection (berries 90-100% blue).

Results:

In the general insecticide test maggots averaged mostly 3 to 12 maggots per qt. The best insecticides, at least comparable to Imidan, were Zolone and 3 applications of malathion. Lorsban and Ambush also showed promise. Maggot populations were generally low during the Nu-lure tests (mostly ca. 2 maggots per quart in untreated plots), and conclusions must be tentative. Two applications of malathion, even with the addition of Nu-lure, did not seem to control blueberry maggot. The low rate of Imidan performed best when Nu-lure was added to the spray and seemed to be as effective as a standard higher rate of Imidan.

No aerially applied treatments were made because the available test fields were too small. For the same reason, plot size was smaller than desired.

Conclusion:

The development of an alternative less hazardous insecticide control for the blueberry maggot should lessen the hazard and drift problems associated with Guthion. The results obtained this year for most of the insecticides listed are the first to be obtained on lowbush blueberry. Further testing is required before sufficient confidence can be placed in a recommendation.

Similar Nu-lure and Imidan efficacy results, as obtained in 1986, were indicated on a low maggot population in 1983, and a test on a more vigorous maggot population is in order at this point.

Control of Blueberry Maggot[a] (1986)

Material	General Test	Bait Test With Nu-lure	Bait Test Without Nu-lure
Asana	F-P	-	-
Lorsban (XRM 4656)	G	-	-
Ambush	G	-	-
Lorsban 4E	G-VG	-	-
Malathion (2 applications)	P	P	P
Malathion (3 applications)	VG	-	-
Sevin XLR Plus	F	-	-
Imidan (16 oz.)	-	VG	G
Imidan (32 oz.)	VG	-	VG
Rotacide	F	-	-
Zolone	VG	-	-

[a]VG = very good, G = good, F = fair, P = poor

BLUEBERRY ADVISORY COMMITTEE

RESEARCH REPORT

Date: April 1986 to March 1987

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

Title: Economic thresholds and control of secondary blueberry pests.

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

Laboratory Tests

Collections were made of those insects present in sufficient numbers and with few or no potential recommended controls. Square-foot patches of blueberry plants were sprayed with different treatments, using a small hand sprayer at a rate of 23 gals. of water/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 to 3 replications per treatment. At indicated hours after the insects were introduced into the cages, a knockdown count of dead or inactive insects was made.

Field Tests

Field tests were conducted when insect species were present in sufficient numbers and homogeneously distributed over a large field area. Randomized complete block designs with 4 replications were utilized, with each plot measuring 23 x 23 feet with 10 ft. buffer strips. All field plots were treated with a hand-held, CO_2-propelled sprayer at 25 gal. of water-mixture/acre. On a pre-treatment and various post-treatment dates, insects found in each plot were counted. The center area of each plot was sampled with 10 sweeps of a standard 12-inch sweep net. After the live insects were counted, they were spread back over the same plot. In the grasshopper control trial with Nosema set up in 1985, efficacy was evaluated in 1986 by observing the number of insects jumping when disturbed by a wand waved over the plot.

Results:

The relative absence of insects in 1986 did not allow the development of monitoring procedures or of economic injury levels. Insecticide tests were minimal because large suitable populations of pests were scarce.

One test was conducted in 1985 and continued in 1986 for control of grasshoppers by Nosema, a microsporidium. There did not appear to be any residual effects in 1986 from treatments with Nosema in 1985.

The pyrethroids (Asana, Ambush, Spur), Marlate, and Lorsban showed much promise for blueberry insect pests, and seem to compare favorably with Imidan and Guthion. The extremely vigorous population of flea beetle adults (untreated plot counts of ca. 8 to 15 adults per 1 sweep) allowed an excellent field test and the first one for adults in Maine.

Conclusions:

Tests from recent years have begun to indicate some effective and usable insecticidal controls for various secondary blueberry pest insects. While laboratory tests offer leads for effective control, sufficient field-testing is essential before recommendations can be made. Sawfly larvae control tests conducted in the field in the last 3 years have confirmed some effective treatments.

Further testing on other insects is necessary before sufficient confidence can be placed in a recommendation.

Blueberry Insect Control Tests (1986)[a]

Laboratory Tests

Insect[b]	Marlate	Asana	Lorsban	Rotacide	Ambush	Spur	Others
Looper L.	G	E	-	-	-	-	-
Grasshopper N.	-	VG	E	-	-	-	-
Spanworm L.	-	E	E	F-G	E	E	-
Flea Beetle L.	-	E	-	F-G	-	VG	-
Leaf Beetle A.	E	-	E	-	E	E	-
Flea Beetle A.	E	E	E	F-P	-	-	Imidan-E Malathion-E Guthion-E Sevin XLR Plus-E

Field Tests

Insect[b]	Marlate	Asana	Lorsban	Rotacide	Guthion	Imidan	Others
Sawfly L.	VG	VG	VG	-	VG	VG	-
Flea Beetle A.	VG-E	F-G	VG-E	P	-	VG	Sevin XLR Plus-E Malathion-F-P

[a]E = excellent, VG = very good, G = good, F = fair, P = poor

[b]L = larvae, A = adults, N = nymphs

DATE: 12/16/1986

INVESTIGATORS: D.H. Lambert and W.A. Wright

TITLE: EVALUATION OF FUNGICIDES FOR CONTROL OF MUMMY BERRY ON LOWBUSH BLUEBERRY, 1986

METHODS: This study was conducted in a large, well established field in Twp. 19, Washington Co., Me. The field was held over for a second year's fruit production, and was naturally infested with *Monilinia* sclerotia from the previous year's crop. Plots measuring 5 by 10 ft separated by 2 ft or 5 ft spacer strips were replicated eight times in a randomized complete block design. Treatments were applied with an air-powered boom sprayer that delivered 30 gal of spray/A at 30 psi 20 in from the ground. Spray dates were April 28 (budbreak) and/or May 15. Temperatures and rainfall were near average for the area with 4.6 in, 3.6 in, and 2.6 in of rain for April, May and June respectively. During the second week of June primary infection was rated on 135 stems per plot (nine subplots of fifteen stems) and expressed as the percentage incidence of stems with any foliar blight. In almost all cases, no more than one leaf bud per stem was affected.

RESULTS:

Treatment and rate/A		Application date	% foliage blight incidence[1]	
Funginex 1.6 EC	24 oz	4/28	7.6	ab [2]
Funginex 1.6 EC	18 oz	4/28	8.3	ab
Funginex 1.6 EC	12 oz	4/28	7.8	ab
Funginex 1.6 EC	24 oz	5/15	8.7	ab
Funginex 1.6 EC	18 oz	5/15	9.5	ab
Funginex 1.6 EC	12 oz	5/15	9.6	ab
Funginex 1.6 EC	24 oz	4/28, 5/15	3.8	a
Funginex 1.6 EC	18 oz	4/28, 5/15	6.1	ab
Funginex 1.6 EC	12 oz	4/28, 5/15	6.5	ab
Difolatan 80 Sprills	2.5 lb	4/28	11.7	b
Difolatan 80 Sprills	2.5 lb	5/15	9.9	b
Difolatan 80 Sprills	2.5 lb	4/28, 5/15	10.0	ab
Difolatan 80 Sprills	2.5 lb	4/28, 5/15	14.2	b [3]
Difolatan 80 Sprills	5.0 lb	4/28, 5/15	8.5	ab
Control			15.1	b

[1] The percentage of 135 stems with any foliar blight.

[2] Means followed by the same letter do not differ significantly at the 5% level (DMLSD).

[3] This treatment is identical to the previous one but includes two heavilly infected replicates (ca. 35% infection).

TREATMENT AVERAGES

Funginex	24 oz	6.7 %
Funginex	18 oz	8.0 %
Funginex	12 oz	8.0 %
Difolatan	2.5 lb	10.5 %

Funginex	4/28	7.9 %
Funginex	5/15	9.3 %
Funginex	4/28, 5/15	5.5 %

CONCLUSIONS: Complete control of primary (ascospore) infection was not achieved with any of the treatments, the best being 25% of the check. Analysis of Funginex treatments with rates combined indicated no significant difference between the first and second spray date but significant differences between both the single spray treatments and the multiple spray treatments. Difolatan at the 2.5 lb rate was not as effective as the Funginex treatments.

NOTE: A second mummy berry fungicide trial was conducted at the Blueberry Hill Farm, but disease incidence was very low (0 - 2 infections per plot) and useful data could not be obtained.

DATE: 12/16/1986

INVESTIGATORS: D.H. Lambert and W.A. Wright

TITLE: EVALUATIONS OF FUNGICIDES FOR CONTROL OF BOTRYTIS BLIGHT ON LOWBUSH BLUEBERRY, 1986

METHODS: A field plot was laid out at the Ouellette Farm, Mason's Bay, Washington Co., ME., a location often subjected to extended periods of fog. Plots 5 by 25 ft separated by 2 ft spacers were replicated in five blocks. Treatments designed to control *Botrytis* blight included:

Number	Treatment and rate/A		Application dates[1]	Yield g/plot
1.	Benomyl 50 WP	1 lb	6/5	
2.	Benomyl 50 WP	1 lb	6/5, 6/12	
3.	Benomyl 50 WP	1 lb	5/27, 6/5, 6/12	
4.	Ronilan 50 W	1 lb	6/5	673 [2]
5.	Ronilan 50 W	2 lb	6/5	708
6.	Ronilan 50 W	1 lb	6/5, 6/12	764
7.	Ronilan 50 W	2 lb	6/5, 6/12	636
8.	Ronilan 50 W	1 lb	5/27, 6/5, 6/12	804
9.	Ronilan 50 W	2 lb	5/27, 6/5, 6/12	944
10.	Difolatan 80 Sprills	2.5 lb	6/5	
11.	Difolatan 80 Sprills	2.5 lb	6/5, 6/12	
12.	Difolatan 80 Sprills	2.5 lb	5/27, 6/5, 6/12	
13.	Difolatan 80 Sprills	5.0 lb	5/27, 6/5, 6/12	
14.	Control			792
15.	Captan 50 WP	2.0 lb	6/5, 6/12	

[1] These dates correspond to early, mid, and late bloom.
[2] There were no significant differences in weight among these values.

RESULTS: No disease appeared in the plots, regardless of treatment. *Botrytis* blight affecting about 50 % of the blossoms was found in a single early-blooming clone about one hundred feet from the corner of the plots. Berries were harvested mechanically from the control and Ronilan plots and were weighed (see table).

CONCLUSIONS: The occurance of *Botrytis* blight in any given year and location is unpredictable because of variability in the stage of blossom development during critical weather periods, in clone susceptibility and blossom development, in site factors, in frost damage which increases the likelihood of disease, and possibly in the numbers of fungus spores present. For these reasons, any further field testing of fungicides should be preceeded by 1-2 years testing of techniques for encouraging uniform disease development in test plots at the Blueberry Hill farm. Such techniques might include artificial inoculation, misting and overnight tarping, treatments to damage blossoms and increase their susceptibility, and inclusion of nutrients with fungus inoculum to increase infection.

DATE: 12/18/1986

INVESTIGATORS: D.H. Lambert and W.A. Wright

TITLE: PRELIMINARY STUDY OF THE EFFECTS OF LATE SUMMER FUNGICIDE APPLICATIONS, 1986-87

METHODS: Plots were laid out on August 15 in previously mowed portions of the Tracy field, located NE of Cherryfield, ME. The most prevalent disease in this field was powdery mildew, *Microsphaera alni*. Leaf rust (*Pucciniastrum myrtilli*), red leaf (*Exobasidium vaccinii*), and unidentified leafspots were present to a lesser extent. Two large and uniform clones in separate parts of the field were selected and a 10 X 40 ft area in each was subdivided into twenty adjacent strips 10 ft long and two ft wide. Strips were grouped by fours to provide five blocks in each of the two areas. Benomyl, maneb, and Difolatan were applied with a handheld sprayer at 2, 2, and 5 lb in 100 gal/A rates to assure full, uniform coverage. Benomyl and maneb were selected for their particularly good activity against mildew and rust respectively, and Difolatan was selected as a registered, persistant compound with activity against an assortment of blueberry pathogens. The fourth strip of each block was not treated. In mid-September, when defoliation was occurring, nine pairs of twigs were taken at one-foot intervals from the center of the strip. The average number of leaves remaining on the stems were recorded. These plots will be visited again in May to determine differences, if any, in winter injury and fruit bud numbers.

RESULTS:

Treatment and rate/A		Leaves remaining per twig
Benomyl 50 WP	2 lb	4.6 a [1]
Maneb 50 WP	2 lb	4.8 a
Difolatan 80 Sprills	5 lb	4.7 a
Control		3.6 b

[1] Significant at the 5% level by DMLSD test.

CONCLUSIONS: Fungicide treatments, regardless of the activity of the compounds, increased retention of leaves. This was unexpected, as the two defoliating diseases present, mildew and rust, are each within the activity spectrum of only one of the fungicides used. Activity against mildew of certain adjuvents used to formulate fungicides has however been reported. Whether disease control or longer leaf retention improves resistance to winter injury remains to be seen. On a theoretical basis, it may be more likely that such treatments would have greater effect between first and second crops, assuming that photosynthesis in August and September is important to replace food reserves lost in fruit production.

DATE: 12/18/1986

INVESTIGATORS: D.H. Lambert and W.A. Wright

TITLE: MOWING VS BURNING - COMPARISONS OF DISEASE INCIDENCE

METHODS: This study is being conducted in the Tracy field, located NE of Cherryfield, ME. The area was flail-mowed in the fall of 1985. A small fifteen-acre portion separated by a narrow access road was burned in the spring of 1986 just prior to new shoot emergence. Nine transects spaced 15 m apart are laid out perpendicular to the dividing road. These run 100 m into each of the two treatments, allowing detection of disease gradients which cross from one treatment to the other. This is important, because diseases such as mummy berry may spread from a single location, giving the impression that disease is favored by the particular treatment in which such an outbreak happens to start. The transects are divided into 10 m segments, so that each treatment may be subsampled ninety times, producing a 9 X 20 grid which displays any localized incidence of disease (see attached sheet - Fig. 1). In late August 1986, disease severity was rated on 10 leaves from each of the 180 subplots. These were rated for a) the percent area of the leaves which were discolored or mildewed, and b) the number of small, non-mildew leafspots per leaf.

RESULTS: The percentages of diseased leaf area averaged 10.4 % in the mowed treatment and 26.0 % in the burned treatment, a highly significant difference. The ranges among the subplots were 0.5 - 41 % and 8 - 80 % respectively. Although there were several localized areas of high disease incidence, there were no significant disease gradients which ran either from one treatment to the other or across treatments. There were no significant differences between treatments in leafspot ratings, which exceeded one per leaf in only one quarter of the subplots.

CONCLUSIONS: Foliar disease, primarilly powdery mildew, was considerably higher in the burned portion of the field in 1986. This cannot be explained by differences in inoculum, as that would likely have been lower in the burned area. A contributing factor may have been the condition of the new shoots in the burned area. Burning was delayed by mechanical problems until after dormancy was broken, and new growth may have been developing from mowed stems at the time the field was burned. Although the shoots which subsequently developed directly from rhizomes did not appear to be heat-damaged, they were noticably sparcer and redder than those which developed on the mowed side of the field. The difference in disease may have resulted from physiological differences unique to this particular burn, and general conclusions should not be drawn at this point.

FIG. 1.   DISEASE SEVERITY - TRACY FIELD, 1986

```
         ----------- MOWED PLOT -----------    Avg. = 10.4%

::::****                        ::::::::::::
:11:*20*  5   4   7   5 :12::10::18:
                ::::::::
  8   4   2   2 :16::15:  3   8   5
        ::::::::    ::::::::::::
  4   2 :12::17:  6 :16::12::11:  4
    ::::    ::::    ::::::::::::
  5 :10:  1 :19:  8 :11::17::11:  2
            ::::::::****    ****
  4   5   1 :12::13:*27*  8 *20*  4
::::                ::::::::::::::::
:12:  5   1   6   6 :17::13::14::10:
****####::::::::    ::::****
*29*#41#:11::14:  8 :18:*26*  7   5
****::::        ::::::::::::
*26*:14:  7   8 :18::10::15:  4   5
    ::::            ::::    ::::::::
  2 :14:  4   3   8 :17:  8 :16::11:
****::::    ::::
*39*:15:  5 :11:  8   9   9   9   6
----------------ROAD----------------
****####****::::::::####********####
*27*#58#*20*:14::11:#59#*22**37*#41#
::::****####****####****************
:16:*30*#48#*23*#51#*26**24**23**28*
************::::********    ********
*21**32**31*:16:*37**21*  9 *25**25*
********::::::::::::****************
*29**23*:18::11::18:*29**23**22**30*
::::********::::::::    ::::::::::::
:15:*28**20*:16::14:  4 :18::11::19:
::::::::::::::::********::::::::::::
:15::18::13::14:*3)**21*:12::11::12:
****::::::::****::::****::::********
*29*:13::10:*29*:16:*35*:19:*29**33*
********    ****::::::::::::::::####
*24**21*  8 *29*:15::17::17::18:#57#
::::****************####::::########
:19:*35**25**25**80*#40#:18:#45##47#
********    ########****####::::********
*26**60*  9 #44#*72*#52#:16:*32**28*

         ----------- BURNED PLOT -----------   Avg. = 26.0 %
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PERCENTAGE OF LEAF AREA WITH SYMPTOMS

(   ) = 0 - 9%, :::: = 10 - 19%, **** = 20 - 39%, #### = >40%

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: PROJECT LEADER: John M. Smagula
ASSISTANT SCIENTIST: Edward J. McLaughlin

TITLE: LONG TERM EFFECTS OF N AND NPK FERTILIZER ON PLANT GROWTH AND YIELD

METHODS: Long term fertility research plots (1955-71) established by Professor Moody Trevett on land owned by Cherryfield Foods, Inc. have been maintained and are being used for additional experiments. The original fertilizer treatments (control, N or NPK) were resumed in spring 1981 and 1983. Plant stand, stem length and branching, concentration of nutrients within the leaves, flower bud formation, winter injury and yield have been measured during successive production cycles between 1974 and 1986.

In 1983, extra control plots (200 ft. long) were divided into four 50 ft. subplots and 2 of the subplots were randomly selected to receive NH_4-NO_3.

In 1985, treatment plots were split to accomodate new treatments. In addition to maintaining the original Control, N, and NPK treatments, treatments of N(urea) and NPK were superimposed on randomly selected portions (50 ft.) of the 200 ft. long control plots. Portions of the original N and NPK treatment plots were randomly selected for discontinuation of their treatments.

RESULTS: Data collected between 1975 and 1980 indicated that N and NPK fertilization (1955-1971) resulted in higher plant stand (stems/sq ft) and yield (lbs/A) compared to no fertilization. There was no difference between N and NPK treatments. Second year crop yields taken in 1976 and 1980 averaged 27, 31 and 23% of the first year yields for the N, NPK and control treatments plots, respectively (Table 1).

Leaf analysis in 1978 did not detect any concentration differences among any treatments for N, P, K, Mg, Ca, Al, B, Cu, Fe, Mn, Mo or Zn.

Fertilizer applications (0, 50 lb. N/acre from urea or 50 lb N/A from a 1- 1-1 complete fertilizer) in 1981 and 1983 also resulted in no difference in yields between N and NPK treatments. The yields from either N or NPK treatment plots were, however, more than double that of the control.

Stem length, branching and flower bud formation measurements taken in 1981 indicate urea N had a greater influence on these characteristics than NPK fertilizer. Treatment plots receiving either N or NPK had longer stems (Table 2) and more flower buds per stem than the controls.

Yield data (Table 1) indicated no significant difference between urea and NH_4NO_3 forms of nitrogen in 1984.

Plant stand (stems/sq ft) was determined in 1976 and again in 1981 (Table 3). NPK treatment plots did not have a greater stem density than treatment plots receiving only N fertilizer in 1976 or in 1981.

Table 1

YIELDS (lbs/A)[z]

	1975	1976	1979	1980	1982	1984
Urea	1544b	525b	2322b	434b	3863b	1243b
NH4NO3	-	-	-	-	-	1257b
NPK	1355b	580b	2249b	419b	3750b	1595b
Control	592a	182a	1188a	170a	1576a	682a

[z]mean seperation by Waller-Duncan k-ratio=100.

Table 2

STEMS

	Stem length (cm)[z]		Branches/stem[z]		Flower buds/stem[z]	
	81	83	81	83	81	83
Urea	11.0a	7.7a	1.0a	1.2ab	3.7a	3.7a
NH_4NO_3	-	8.1a	-	1.3a	-	4.0a
NPK	9.0 b	7.6a	0.4 b	0.9 bc	2.9 b	3.1a
Control	6.6 c	5.2 b	0.3 b	0.6 c	2.3 c	1.6 b

[z]mean seperation by Waller-Duncan k-ratio=100.

Table 3

PLANT STAND (stems/ft)^z

	1976	1981
Urea	67a	87a
NPK	72a	75ab
Control	31b	62b

^{z}mean seperation by Waller-Duncan k-ratio=100.

Leaf analysis data from samples collected in 1983 are presented in tables 4a and 4b. Nitrogen concentarations are comparable and higher in treatment plots receiving urea, NH_4NO_3, or NPK compared to the control. It should also be noted that Phosphorus, Potassium and Boron levels were highest for treatment plots receiving NPK; however, this did not result in longer stems, more flower buds or significantly higher yields (tables 1 and 2).

TABLE 4a
Leaf Tissue Analysis 1983

	N^x	CA^y	K	MG	P^y	AL^y	B^y
UREA	1.87	0.255a	0.504a	0.141a	0.120a	84.1a	23.8a
NH_4NO_3	2.05	0.273ab	0.542 b	0.154 b	0.126a	93.4ab	23.3a
NPK	1.99	0.277 b	0.583 c	0.145ab	0.158 b	91.1ab	29.8 b
Control	1.61	0.354 c	0.556 bc	0.166 c	0.122a	111.6 b	25.0a
	**^{z}	**	**	**	**	*	**

^{z}mean seperation by Waller-Duncan, k-ratio=100, treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.
^{y}analysis run on transformed data to normalize distribution.
^{x}analysis by non-parametric ranks procedure.

TABLE 4b cont)

Leaf Tissue Analysis 1983

	CU[y]	FE[y]	MN[y]	MO[y]	ZN
UREA	4.67a	66.4	674 b	0.813	14.5
NH_4NO_3	5.05ab	69.6	710 b	0.760	16.0
NPK	5.04a	64.8	554a	0.662	14.7
Control	5.64 b	67.5	1125 c	0.650	15.7
	*[z]	NS	**	NS	NS

[z]mean seperation by Waller-Duncan, k-ratio=100, treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.
[y]analysis run on transformed data to normalize distribution.
[x]analysis by non-parametric ranks procedure.

Control treatment plots were split in 1985 to accomodate new treatments (designated "new") and some fertilizer treatment plots were split and their treatments discontinued (designated "drop"). Data from NH_4NO_3 plots are reported with these new treatments.

Stem length, stem branching, number of flower buds per stem, plant stand (stems/sq ft) and leaf nutrient concentrations were measured in 1985/86 and compiled and analyzed in 1986.

Table 5

STEMS 1985

	Stem length (cm)^z	Branched stems^z	flower buds/stem ^{z}
Urea-continue	12.3 b	15.4 bc	4.0 de
Urea-drop	11.1 bc	9.9 c	3.6 e
Urea-new	10.2 c	16.0 b	4.7 cd
NPK-continue	16.0a	32.6a	6.5 b
NPK-drop	11.5 bc	14.6 bc	3.9 de
NPK-new	12.1 b	27.8a	8.8a
NH_4NO_3	11.2 bc	15.1 bc	5.4 bc
Control	10.6 c	10.0 c	4.8 cd

^{z}mean seperation by Waller-Duncan k-ratio=100.

Plots which had received NPK continuously since 1955 had longer stems, more branches, more flower buds and higher yields than the continuous urea plots (table 5). This was the first year this happened since 1974 when data collection on these plots had begun. Continuous urea plots and urea plots from which urea fertilization were discontinued had the highest plant stand (stems/ sq ft).

Stem length, flower bud formation and yield were improved when previous control plots (never fertilized) received NPK but not when they received urea or NH_4NO_3 (Tables 5 and 6). Branching was also stimulated by application of NPK or Urea on these plots.

Stem length, flower bud formation and yield decreased when NPK fertilizer was withheld from plots previously receiving it, but not when Urea was discontinued from Urea plots.

Plant stand (stems/sq ft) did not increase when previous control plots received NPK, Urea or NH_4NO_3 fertilizers (table 7). Plant stand decreased when NPK fertilizer was withheld from plots previously receiving it but not when urea was discontinued from Urea plots.

Leaf tissue analysis (table 8) indicated levels of N were higher than the control except for NPK-drop, and Urea-drop treatment plots. NPK-continue, NPK-new and NPK-drop treatment plots had the highest level of Phosphorus in their leaf tissue.

TABLE 6

Yields (lbs/A) 1986

Control	1475de
NPK-continue	4199a
NPK-new	1963cd
NPK-drop	3066b
UREA-continue	2713b
UREA-new	1510de
UREA-drop	2397bc
NH_4NO_3-new	1328e

[z]mean seperation by Waller-Duncan k-ratio=100.

TABLE 7

PLANT STAND (stems/ft^2) 1985

Treatment	Stems/ft^2 [z]
Control	87.8 bc
NPK-continue	96.5 b
NPK-new	88.9 bc
NPK-drop	86.9 c
UREA-continue	110.3 a
UREA-new	96.9 b
UREA-drop	118.4 a
NH_4NO_3-new	90.2 bc

[z]square root transformation used to normalize data. mean seperation of transformed data by Waller-Duncan k-ratio=100.

TABLE 8

Leaf Tissue Analysis 1985

	N[x]		CA[y]		K	MG	P[y]		AL[y]
CONTROL	1.80	c	0.338	b	0.519	0.167	0.126	cd	117.4
NPK-cont.	2.18	ab	0.341	b	0.591	0.155	0.177	a	113.4
NPK-new	2.25	a	0.309	c	0.589	0.138	0.161	ab	119.6
NPK-drop	1.77	c	0.366	a	0.549	0.182	0.149	b	93.5
UREA-cont	2.08	b	0.303	cd	0.539	0.156	0.129	cd	95.6
UREA-new	2.09	b	0.283	de	0.501	0.142	0.126	c	118.7
UREA-drop	1.78	c	0.322	bc	0.527	0.161	0.119	d	107.2
NH_4NO_3	2.12	ab	0.282	e	0.547	0.140	0.123	cd	99.4
	**[z]		**		NS	NS	**		NS

[z] mean seperation by Waller-Duncan, k-ratio=100, treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.
[y] analysis run on transformed data to normalize distribution.
[x] analysis by non-parametric ranks procedure.

TABLE 8(cont)

Leaf Tissue Analysis 1985

	B[y]	CU[y]	FE[y]	MN[y]	MO[y]	ZN
CONTROL	17.3a	6.25	89.9	845a	0.121	16.4
NPK-cont	20.2 bc	5.41	83.1	300 f	0.143	18.2
NPK-new	21.0 c	5.82	104.4	687 b	0.096	17.4
NPK-drop	21.0 c	6.10	76.8	363 ef	0.215	18.1
UREA-cont	20.5 bc	5.96	77.1	430 de	0.112	16.9
UREA-new	19.9abc	6.05	897.7	606 bc	0.164	28.1
UREA-drop	16.7ab	6.10	97.0	515 cd	0.082	17.2
NH_4NO_3	19.6abc	5.41	433.2	615 bc	0.271	24.3
	**	NS	**[z]	**	NS	NS

[z]mean seperation by Waller-Duncan, k-ratio=100, treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.
[y]analysis run on transformed data to normalize distribution.
[x]analysis by non-parametric ranks procedure.

CONCLUSIONS: The data suggest that the area on which this experiment is located has benefited from application of urea or a complete NPK fertilizer. Yields from N or NPK treatment plots have been consistently higher than control plots due to increased stem density and perhaps increased stem length and more flower buds/stem. The effect on yield was seen in 1975 and 1979 several years after professor Trevett's treatments were stopped (1971). This suggests that fertilization every burn cycle may not be necessary at this site. Results of experiments established in 1985, testing the recovery of control plots and the need for fertilization every cycle, should provide this information over several production cycles.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: March 1986

INVESTIGATORS: PROJECT LEADER: John M. Smagula
ASSISTANT SCIENTIST: Edward J. McLaughlin
RESEARCH COOPERATOR: Mike Goltz

TITLE: THE EFFECT OF SEVERAL MULCHES ON FROST HEAVING, SOIL MOISTURE, SOIL TEMPERATURE AND RHIZOME DEVELOPMENT

METHODS: Seedlings of three crosses (Augusta x 4161, 4161 x Augusta and 4161 x 2827) were planted in the spring 1982 on Blueberry Hill Farm. In October 1982, mulch treatments of bark, sawdust, cedar shavings, and wood chips were applied around the plants in a 4 x 10' treatment plot to a depth of 4 inches. Soil temperature and moisture have been monitored since spring 1983. The effect of type of mulch on plant growth, spread and frost-heaving are being studied. These data will be correlated to soil moisture and temperature.

An identical experiment was established in the spring of 1983 on a heavier soil at Highmoor Farm (apple research farm).

RESULTS: Blueberry Hill Farm - Frost heaving and survival data taken in 1983 indicated significant control of frost heaving by all sources of mulch. Mulches reduced frost heaving from 85% in non-mulched plots (control) to 0% in all mulched plots. There was also a significant increase in survival due to mulching. Survival increased from 80% (control) to 90-95% for mulched plots, with no significant difference among the mulches.

After three years, seedlings from crosses 4161 x Augusta and 2827 x 4161 had grown more (covered more area) than cross Augusta x 4161. Seedlings had grown more in the cedar, sawdust and bark treatment plots than in the chip or control plots (table 1).

Highmoor Farm - Frost heaving and survival data taken in 1984 indicated a similar plant response to that observed at Blueberry Hill Farm. Mulches reduced frost heaving from 92% in non-mulched plots to 0% in all mulched plots. Seedling survival increased from 65% for the non-mulched plots to 94-98% for mulched plots. Seedlings from cross 4161 x Augusta grew more than seedlings of the other crosses as determined by photographic area measurements. Seedlings had grown significantly more (covered more area) in all mulch treatment plots compared to the control (table 2).

There were no significant differences between locations for soil temperature or soil moisture effects due to mulches. There were no differences among mulches, although there were significant differences between controls and any mulched plot in both water conservation and temperature moderation.

Between rainfall events exceeding approximately 0.25 inches, mulches decreased evaporation from the soil and maintained lower soil water tensions (higher water content). Rainfall events of less than 0.25 inches seen to be trapped by the mulches and did not replenish the soil reservoir but rather evaporated directly from the mulches. Under such conditions controls had higher moisture conditions for a day or two.

Mulches affected soil temperatures at the two inch depth in several ways. During mid-summer they moderated temperatures significantly by attenuating the diurnal temperature wave. Midday temperatures in control plots were as much as 19 degrees F higher than those under mulches, while night temperatures in controls were as much as 5 degrees F cooler than under mulches. During the fall temperature transition, mulched soils cooled more slowly and rarely froze and thawed. During late fall they were as much as 10 degrees F warmer than controls during the night time. During mid winter, under snow pack, all soil temperatures eventually reached the same value. During spring, mulched soils warmed more slowly (the reverse of fall conditions) and exhibited virtually no freeze-thaw cycling as they warmed to above 32 degrees F.

CONCLUSIONS: Mulching seems to be extremely important to reduce frost heaving and increase survival of any plant material introduced into commercial blueberry fields to increase plant cover. Differences among mulch sources are appearing after three years of growth. Growth and yield of seedlings at the Blueberry Hill Farm location were significantly better in the bark, sawdust, and cedar treatment plots. Soil temperature and moisture measurements may help to explain these differences.

Table 1. Blueberry Hill Farm

Treatment	AREA (%) 1983	1984	1985	1986[y]	Yield (gm/plant) 1985	1986[x]
Control	5.5abc	12.5cd	9.9c		16.0c	
Bark	5.3bc	13.6bc	17.4a		32.0b	
Chips	5.1c	11.2d	14.2b		17.7c	
Sawdust	6.0ab	14.8ab	18.7a		38.5ab	
Cedar	6.1a	16.0a	18.7a		46.2a	
F Value[z]	**	**	**		**	

[z]treatment effects significant at 1% (**) level.
[y]Data for 1986 not yet tabulated.
[x]Data not available because of disease

Table 2. Hignmoor Farm

Treatment	Area (%) 1984	1985	1986[y]	Yield (gm/plant)[x] 1985	1986
Control	1.8c	5.2d			
Bark	3.7ab	9.8b			
Chips	3.1b	6.7cd			
Sawdust	3.9a	14.5a			
Cedar	3.2ab	8.4bc			
F Value[z]	**	**			

[z]treatment effects significant at 1% (**) level.
[y]Data for 1986 not yet tabulated.
[x]Data for 1985 and 1986 not yet tabulated.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: March 1986

INVESTIGATORS: PROJECT LEADER: John M. Smagula
ASSISTANT SCIENTIST: Edward J. McLaughlin
RESEARCH COOPERATOR: Jeff Risser

TITLE: INTERACTION OF UREA FERTILIZER AND PRUNING PRACTICES ON SOIL CHARACTERISTICS AND LOWBUSH BLUEBERRY GROWTH AND YIELD

Objectives: This study was designed to determine the interaction of fertility and pruning practices (mow vs burn) on soil and leaf nutrients and lowbush blueberry growth and yield.

METHODS: Treatment plots were established on land owned by Cherryfield Foods, Inc. Treatments consisting of five rates of urea (0, 40, 80, 120 or 160 lb N/A) were applied in the spring 1983, and 1985, after fall pruning by oil-fire or flail mowing. Stem length and branching, concentration of nutrients within the leaves, flower bud formation and yield data were collected. Soil samples consisting of the organic "pad" and 1 inch of mineral soil immediately beneath it were taken in April and July 1983 and analyzed for NH_4-N. Soil samples were also taken in spring 1984 to determine residual NH_4-N. Organic pad samples were taken again in July 1985. A composite of soil samples from mow and burn plots were analyzed for P, K, Mg and Ca in 1984 and 1985.

The soil nutrient levels will be correlated with leaf tissue analysis data to help establish a more appropriate blueberry soil testing procedure.

RESULTS:

Interactions - There was no interaction of urea fertilizer and pruning method on soil nutrient levels or plant growth and yield.

Pruning practice-

Leaf analysis - There was no effect of pruning method on leaf nutrient concentration (Table 1).

Soil analysis - Composite soil samples from mowed and burned treatment plots had similar levels of phosphorus, potassium, calcium and magnesium in their organic pads in 1984 and 1985 (Table 2).

Growth and yield - There was no effect of pruning method (Tables 3 & 4) on stem length or branching , flower bud formation, winter injury, or yield.

Fertility-

Leaf analysis - Analysis of leaf nutrient data (Table 5) indicated a positive linear trend in 1983 and a quadratic trend in 1985 of increasing nitrogen concentration in leaves with increasing rate of urea fertilization. Blueberry leaves from control plots did, however, contain a nitrogen concentration within the "satisfactory" range (1.6-2.0%) in 1983 and 1985. While leaf N increased, calcium decreased, but not below the lower end of the "satisfactory" range for Ca content of blueberry leaves (0.27%) except at the highest Urea N rates.

Magnesium also decreased with increasing rates of urea. In 1983, magnesium levels in leaf tissue dropped below the satisfactory range (0.13- 0.25%) only at fertilizer rates above 40 lbs N/A. There was no effect of urea fertilization on leaf phosphorus levels, which might be expected if soil phosphorus were limiting.

Soil analysis - Ammonium nitrogen soil testing methods were used to monitor nitrogen levels in the organic "pad" and the mineral soil immediately beneath it. The organic pad was consistently higher than the mineral soil in ammonia nitrogen level and showed a linear increase (8.6-72.8 ppm) in response to increasing rates of urea fertilization (Table 6).
Soil samples collected in 1984, the crop year, indicated a dramatic drop in ammonium nitrogen in all treatment plots. A similar trend of increasing ammonium level with increasing rate of urea fertilization was found but levels were extremely low, ranging from 0.25 to 2.5ppm. The level and linear trend of ammonium nitrogen in the organic pad in 1985 was similar to that found in 1983.

Growth and yield - There was no effect of fertilizer treatments on stem length or branching, flower bud formation, winter injury, or yield (tables 7 & 8).

Table 1.

Prune Method	Leaf nutrient concentration (%) N		Ca		K		Mg		P	
	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985
Burn	1.78	1.94	0.275	0.289	0.511	0.584	0.121	0.137	0.103	0.105
Mow	1.79	1.92	0.255	0.286	0.515	0.559	0.118	0.138	0.097	0.103
Value[z]	NS	NS	NS	NS	NS	NS	NS	NS	**	NS

[z]treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

Table 1(cont.).

Prune Method	Leaf nutrient concentration (ppm) Al		B		Cu		Fe	
	1983	1985	1983	1985	1983	1985	1983	1985
Burn	61.3	90.4	21.4	20.2	4.91	6.13	56.5	82.3
Mow	62.5	85.5	22.4	18.9	4.72	5.78	62.2	83.0
F Value[z]	NS	NS	NS	NS	NS	NS	NS	NS

[z]treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

Table 1 (cont.)
Leaf nutrient concentration (ppm)

	Mn		Mo		Zn	
	1983	1985	1983	1985	1983	1985
Burn	573.1	439.4	0.359	0.002	15.1	16.6
Mow	597.2	469.6	0.332	0.033	14.3	16.9
F Value[z]	NS	NS	NS	NS	*	NS

[z]treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

<u>Table 2</u>
Soil nutrient concentration (ppm)- 1984-1985

Prune Method	Ca		K		Mg		P	
	1984	1985	1984	1985	1984	1985	1984	1985
Burn	334.2	299.0	61.2	63.3	41.9	36.5	4.27	3.41
Mow	320.4	348.3	58.6	62.8	42.2	43.3	3.89	3.48
F Value[z]	NS	NS	NS	NS	NS	NS	NS	NS

[z]treatment effects are not significant at the 5% (*) or 1% (**) level

Table 3.

Prune Method	Stem Length 1983	Stem Length 1985	Branches/ Stem 1983	Branches/ Stem 1985	Flower Buds/ Shoot Tip 1983	Flower Buds/ Shoot Tip 1985	Flower Buds/Stem 1983	Flower Buds/Stem 1985
Burn	7.5	11.5	0.5	1.9	1.8	5.0	2.7	4.9
Mow	7.2	11.4	0.5	1.8	1.5	5.0	2.4	4.5
F Value[z]	NS	NS	NS	NS	NS	NS	NS	NS

[z]treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

Table 4.

Prune Method	Flower primordia/bud 1984	Winter injury Dead flower primordia (%) 1984	Winter injury Dead flower primordia (%) 1986	Yield (kg/ha) 1982[y]	Yield (kg/ha) 1984	Yield (kg/ha) 1986
Burn	8.7	9.2	2.9	1950	1110	1090
Mow	8.9	12.0	5.2	1800	870	870
F Value[z]	NS	NS	NS	NS	NS	NS

[z]treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.
[y]1982 yields taken pre-treatment.

Table 5.

Leaf nutrient concentration (%)

N rate (kg/ha)	N 1983	N 1985	Ca 1983	Ca 1985	K 1983	K 1985	Mg 1983	Mg 1985	P 1983	P 1985
0	1.66	1.73	0.280	0.318	0.507	0.545	0.126	0.148	0.100	0.108
45	1.75	1.87	0.276	0.292	0.515	0.580	0.125	0.142	0.101	0.105
90	1.83	1.99	0.279	0.273	0.523	0.576	0.121	0.130	0.099	0.103
135	1.83	2.01	0.256	0.273	0.499	0.582	0.118	0.135	0.098	0.102
180	1.85	2.04	0.236	0.279	0.521	0.575	0.107	0.133	0.101	0.102
	**	**	**	**		*	**	**		
F Value[z]	L	Q	L	Q	NS	Q	L	Q	NS	NS

[z]Q=Quadratic response L=Linear response, treatment effects are not signicant (NS) or significant at the 5% (*) or 1% (**) level

Leaf nutrient concentration(ppm)

N rate (kg/ha)	Al 1983	Al 1985	B 1983	B 1985	Cu 1983	Cu 1985	Mn 1983	Mn 1985
0	64.8	84.1	21.4	18.3	5.11	6.33	628.5	522.3
45	67.3	105.7	22.1	19.7	4.87	6.16	614.1	483.8
90	63.1	83.6	22.4	18.4	4.73	5.42	588.8	440.3
135	58.1	75.7	21.7	20.3	4.79	5.71	578.8	421.3
180	56.4	90.6	21.8	20.9	4.57	6.14	515.7	404.9
				*			**	
F Value[z]	NS	NS	NS	L	NS	NS	L	NS

[z]Q=Quadratic response L=Linear response, treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

Table 5(cont.)
Leaf nutrient concentration (ppm)

N rate (kg/ha)	Fe		Mo		Zn	
	1983	1985	1983	1985	1983	1985
0	72.4	66.4	0.459	0.005	15.5	16.7
45	66.9	85.5	0.291	0.006	15.0	17.2
90	48.9	69.7	0.293	0.000	13.9	15.2
135	51.9	65.0	0.346	0.000	14.5	16.5
180	56.6	126.6	0.337	0.076	14.5	18.2
F Value[z]	NS	NS	NS	NS	NS	NS

[z]Treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

Table 6
Soil NH_4-N Concentration - 1983

N-rate (kg/ha)	NH_4 - N (PPM) Organic Layer		Mineral Layer
	1983	1985	1983
0	7.9	12.4	1.5
45	18.0	15.4	2.5
90	35.2	36.6	7.9
135	63.6	57.8	9.9
180	72.8	91.5	9.4
F Value[z]	** L	** L	** L

[z]L=Linear Q=Quadratic response; treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

Table 7.

N rate (kg/ha)	Stem Length 1983	1985	Branches/ Stem 1983	1985	Flower Buds/ Shoot Tip 1983	1985	Flower Buds/ Stem 1983	1985
0	6.9	11.0	0.5	1.7	1.6	3.7	2.4	4.5
45	7.0	11.4	0.6	1.7	1.7	4.5	2.7	5.1
90	7.5	11.6	0.5	1.9	1.6	5.5	2.4	5.1
135	7.7	11.2	0.5	2.0	1.7	5.1	2.6	4.5
180	7.5	11.9	0.6	1.8	1.7	3.6	2.7	4.4
F Value[z]	NS	NS	NS	NS	NS	NS	NS	NS

[z]treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level.

Table 8.

N rate (kg/ha)	Flower primordia/Bud 1984	Winter injury Dead flower primordia 1984	1986	Yield Data (kg/ha) 1982[y]	1984	1986
0	8.7	10.9	2.7	1890	2370	1360
45	8.6	16.0	2.7	1910	2140	1020
90	9.0	6.5	3.0	1680	1830	950
135	8.7	6.7	4.8	1820	1790	900
180	8.9	13.0	7.0	2050	1690	690
F Value[z]	NS	NS	NS	NS	**[x] L	**[x] L

[z]treatment effects are not significant (NS) or significant at the 5% (*) or 1% (**) level. L=linear trend
[y]1982 yields taken pre-treatment.
[x]1984 and 1986 yields were adjusted by the 1982 pre-treatment yields and analysis performed on the adjusted data. Yield in the table is the unadjusted yield.

CONCLUSION:

1. Mowing and burning are comparable pruning practices.

2. Plants pruned by mowing do not need more fertilizer than plants that are burned.

3. Fertilizing with urea at this location decreased yields.

Date: March to December 1986

Investigators: T.C.S. Yang, Assistant Professor, Department of Food Science
Linda Benner, Graduate Student

Title: Effect of Block Freezing on Physical Characterization and Sugar Migration in Lowbush Blueberries

Methods:

IQF blueberries from the 1986 crop were obtained from Jasper Wyman & Son and packed in 30, 20 and 10 lb boxes which were stored at -25, -10 and -5 C. Another batch of berries was stored under fluctuating temperatures (-5 to -25 C). A fresh IQF sample was evaluated and served as the 0 time control. Stored samples were evaluated at three month intervals. A typical block frozen sample was obtained and evaluated to serve as a reference.

Boxes were opened in the cooler and and the percentage (w/w) of block freezing was determined. Those samples with 20% or greater block freezing were further evaluated.

Sugar migration was examined by measuring the soluble solids content of the surface, periphery and core of subsamples of the blueberries using a refractometer.

Microstructural changes in the block frozen and free flowing blueberries was analyzed using light and electron microscopic techniques.

The drip loss, color, texture, pH and moisture content of the block frozen and free flowing blueberries was determined.

Results:

The surface soluble solids showed a very definite increase with storage time. Berries subjected to fluctuating temperatures had the greatest increase in soluble solids. The block frozen berries were higher in soluble solids than the free flowing berries, but free flowing samples also had increased soluble solids.

Core and periphery analyses showed a decrease in core soluble solids and a concurrent increase in periphery soluble solids. The sugar migration from core to periphery appeared to be a function of time rather than fluctuating temperatures.

The amount of drip loss increased with length of frozen storage with the block frozen samples having a slightly higher drip loss than free flowing samples.

The soluble solids content of the drip increased in those samples stored at -10 C and those exposed to fluctuating temperatures while decreasing in samples stored at -25 C. The drip from block frozen samples was higher in soluble solids than that from free flowing berries.

The pH of the drip and the puree remained unchanged, and the moisture content of the berries was fairly constant.

The results of textural analysis (using an Instron Universal Testing Machine) demonstrated a toughening of the berries as a function of length of storage time and temperature fluctuations. Block frozen berries had higher shear values. The berries stored at -10 C and at fluctuating temperatures had much higher Instron values than those stored at -25 C.

The color data is currently being analyzed.

Conclusions:

These preliminary experiments indicate that storage temperature, length of frozen storage and changes in freezer temperature probably play a significant role in the amount of block freezing and in the physical and chemical properties of IQF blueberries. Changes in textural properties of blueberries may be greatly influenced by these parameters.

These experiments should be repeated over a second season with slight modifications in the methodology. In particular sugar migration should be monitored using high performance liquid chromatography to determine if there is any specificity as to which sugar(s) can pass through the blueberry membrane.

Date: March to December 1986

Investigators: Tom C.S. Yang, Assistant Professor, Department of Food Science
Robert Phillips, Jasper Wyman & Son
Amr Ismail, The Maine Wild Blueberry Co.

Title: Demonstration of the Rota-Cone Vacuum Drying Process on Lowbush Blueberries

Methods:

Two batches of IQF blueberries which were donated by Jasper Wyman and Son were dried using a Rota-Cone vacuum dryer (Paul O. Abbe, Inc., 146 Center Avenue, Little Falls, NJ).

Batch 1:

Twenty-three and one half pounds of defrosted (27 F) and drained blueberries were processed in a Rota-Cone vacuum dryer under the following parameters: 30-32" Hg vacuum, 4 rpm, temperature settings are shown in Fig. 1A.

Batch 2:

Twenty-two pounds of defrosted (38 F) and drained blueberries were processed in a Rota-Cone vacuum dryer under the following parameters: 30-32" Hg vacuum, 4 rpm, temperature settings are shown in Fig. 1B.

Results:

In processing Batch 1 (Fig. 1A), the chamber was not preheated prior to introduction of the blueberries and as a result drip loss after 75 min of drying was 3.2 lbs. No further drip loss was found after 105 min of drying. At start up the oil-in temperature was set at 150 F which resulted in the product temperature only reaching 50 F after 20 min of operation. After a series of temperature adjustments, the oil-in temperature reached 250 F after 90 min while the product temperature was only 85 F which was much lower then the saturation temperature at 30" Hg vacuum (100 F); therefore, as the temperature of the product finally reached the saturation temperature at 120 min, the product still contained 69% water. As the product temperature continued to rise, the moisture content was reduced to 52 and 42% at the end of 135 and 180 min, respectively. Operation was terminated at this point and an excellent multiple linear regression equation was calculated to predict the percent moisture of the finished product.

$$Z = 227.07 - 5.26X + 3.06Y; \; r = 0.9924$$

where Z = % moisture in finished product
X = product temperature (F)
Y = processing time (min)

After 3 hours of drying, the blueberries demonstrated a moderate amount of shrink, had a mild flavor and where semi-wet.

In processing Batch 2 (Fig. 1B), the chamber was preheated to the usual operating temperature prior to introduction of the blueberries which enhanced the rate of moisture loss. No drip was observed during the operation. The drying time was reduced by 50% by using a higher starting temperature. Operation was terminated after 165 min (4% moisture blueberries) and again a multiple linear regression equation was calculated to predict the percent moisture of the finished product.

$$Z = 73.17 + 0.32X - 0.81Y; \; r = 0.9971$$

(Z, X & Y same definition as above)

After 2 hours of drying, an excellent raisin like product was produced. Further drying produced a very dry, crunchy berry which had excellent flavor.

Conclusion:

By optimizing the time-temperature combination, it is possible to control the quality of the finished product. The possibility also exists for producing products of different moisture contents which may have specific application to various segments of the food industry.

Although the cost of production of the raisin-type product using rotational vacuum drying was not determined, it would be much cheaper than using the previously proposed freeze drying process.

The sticky film which built up inside the dryer after both batches was due to the exudation from the blueberries during drying, a pre-treatment to exclude a certain amount of juice before drying would not only reduce film development thus improve heat transfer efficiency, but would also reduce the waste and save time and labor for clean-up.

The process must be feasible on a larger scale since one of Maine's processors is presently using this drying method to produce a commercial product.

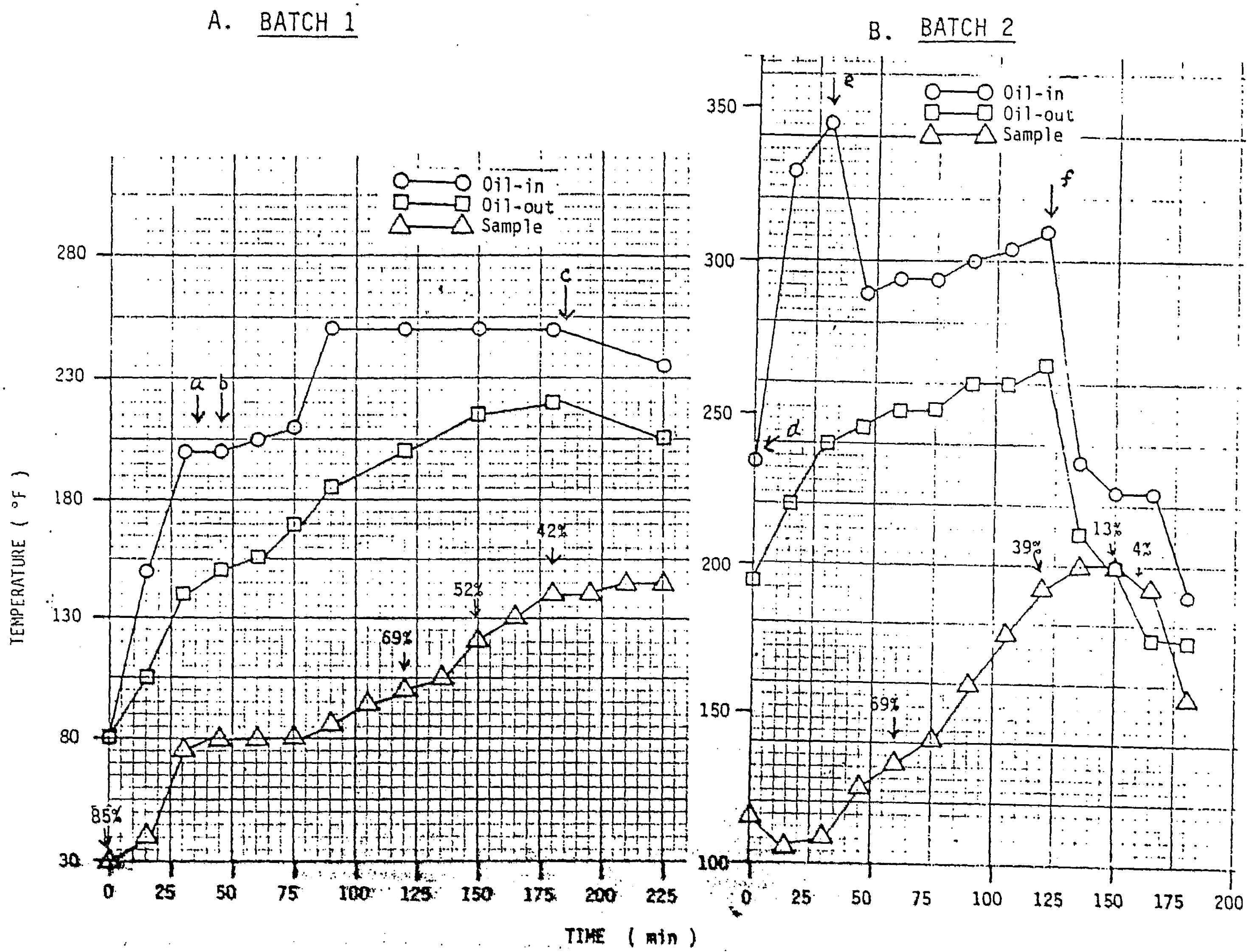


Figure 1. Time course for the temperature of heating medium (oil) and blueberry samples in the Rota-Cone Vacuum Dryer. (A) Batch 1; (B) Batch 2.

Date: March to December 1986

Investigators: Tom C.S. Yang, Assistant Professor, Department of Food Science
Linda C. Benner, Graduate Student

Title: Production of a Blueberry Gelatin

Methods:

IQF frozen blueberries were defrosted for 4 hr, pureed in a pulsing blender and the juice handpressed through 4 layers of cheese cloth. The juice was refiltered through 8 layers of cheese cloth to remove large particulate matter. Clarification of the juice was attempted by heat treatment (heating to 185°F, holding for 5 min, transferring to a blast freezer at -21°F for 15 min followed by vacuum filtration).

A blueberry gelatin mixture, comparable in soluble solids to commercial blackberry and raspberry flavored gelatin, was prepared by combining 3.5g of pure gelatin, one tablespoon of sugar and one-half cup of boiling blueberry juice. Another half cup of cold blueberry juice was added and the soluble solids were then measured using a refractometer. The pH of the gelatins was then adjusted to determine the effect on gel strength. One sample was allowed to remain at its natural pH, the others were adjusted to pH's of 2.5, 3.0, and 3.5 with phosphoric acid and sodium hydroxide, accordingly.

The solutions were placed in the refrigerator until gelation occurred. Gel strength was examined using an Instron Universal Food Testing Machine while color of the gels was determined on a Hunter Lab Scan II.

Results:

Optimum clarification of the juice was not obtained by use of heat treatment as large quantities of pectins, starches and proteins remained in suspension.

The gel strength of the blueberry gelatins (0.208 kg to 0.350 kg) was found to fall between that of the commercial samples (blackberry - 0.357 kg and raspberry - 0.200 kg). Previous research has shown that the lower the pH of a gel the lower the metting point and the stronger the gel. The results of this study are in agreement with this research.

As expected, the color of the gels was affected by pH since the pigment anthocyanin which is responsible for the blue color in blueberries is pH sensitive. At lower pH's the pigment is more red and at higher pH's the pigment is bluer. Therefore, in comparison the 2.5 pH sample was redder than the pH 3.0 and 3.5 samples.

Conclusion:

The two major problems to overcome in the production of a naturally flavored blueberry gelation are clarification of the juice and development of a drying system to produce an easily reconstituted product.

Clarification may be carried out using ultrafiltration processes which have been developed for the apple juice industry or by the use of specific enzymes (pectinases) which are available commercially.

A spray dryer could be used to produce a dry prowdered blueberry product which could be mixed with the dry gelatin and other ingredients.

Date: March to December 1986

Investigators: Tom C.S. Yang, Assistant Professor, Department of Food Science
Ali M. Yamany, Graduate Student

Title: Isolation and Characterization of Blueberry Pectin

Methods:

Lowbush blueberry pectin was isolated by the method of Owens et. al. (USDA Report AIC-340, June, 1952). The effect of the blueberry pectin on the gelation properties of citrus pectins was examined.

Results:

Extraction of pectin from blueberry pulp and juice demonstrated that the pulp contained 7-9 times more pectin than the juice. These results are not surprising since pectic substances are distributed in plant tissues as the cementing material between cells.

Although the yield of pectin from lowbush blueberries is quite small, the pectin possesses some unique properties which could be of benefit to the Industry. Preliminary experiments have shown that blueberry pectin interferes with the gelation properties of commercial citrus pectins and produce products which do not gel.

Conclusion:

Further research needs to be performed to investigate the functionality of blueberry pectin. Basic research on pectin may be invaluable in determining specific commercial applications for its use.

Date: March to December 1986

Investigators: Tom C.S. Yang, Assistant Professor, Department of Food Science
Mohammed Sultan, Graduate Student

Title: The Effect of pH, Chemicals and Holding Time-Temperature on the Color of Blueberry Puree

Methods:

Blueberry puree was prepared from IQF blueberries using a pulsing blender. The pH of subsamples of the puree was adjusted to pH 3.0 or 3.8 using citric acid or sodium citrate, respectively and the color determined using a Hunter Lab Scan II. Similarly the effect of the addition of various chemicals (100 ppm EDTA, 0.2% $AlCl_3$, 0.2% $SnCl_2$, or 0.2% $SnCl_4$) on the color of blueberry puree was examined.

Results:

It was found that as the pH shifted from low to high, the puree became darker and more bluish-purple which corresponds with the effect of pH on the color of the blueberry pigment, anthocyanin. Chemicals such as EDTA and $AlCl_3$ tended to produce a redder and yellower puree whereas $SnCl_2$ and $SnCl_4$ made the color of the puree a bluish purple. The combined effect of pH and chemicals had a stabilizing effect on puree color which was independent of a holding time of 24 hr at 50°C or 4 wk at -20°C.

Conclusion:

The development of methods for stabilizing the color of blueberry puree is extremely important in increasing the shelf-life and maintaining the color attributes of the puree during fresh or frozen storage. The results of this research has been accepted for publication in the Journal of Food Science.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Effect of Hexazinone on Species Distribution in Lowbush Blueberry Fields

METHODS: EXPERIMENT I. A comparison of weed and blueberry populations on hexazinone-treated (2 lbs/A) vs non-treated fields was initiated in the spring of 1984 in Aurora and T-18 MD. Species composition was recorded and cover was rated in September 1984 and 1986 from 30 - 1 square meter quadrats per site, using a Daubenmire Cover Abundance Scale. Cover and frequency of all species was also obtained on only the treated areas in 1985 and will be obtained again in 1987. Blueberry stems were cut from 20 - 1 square foot quadrats per site in 1984 and 1986 to determine stand density and productivity. Yields were obtained in August 1985 and will be taken again in 1986. The sites were pruned this spring and hexazinone was applied at 2 lbs/A. The 1985 data was discussed in the March 1986 report. Blueberry stem samples measurements for 1986 have not been completed. Comparisons of 1985 and 1986 data will be made in the final report.

EXPERIMENT II. A survey was initiated in June 1985 to determine the species distribution in fields treated once vs twice with hexazinone. In July, species abundance rated with the Daubenmire Scale was determined from 10 - 1 square meter quadrats on two or four transects at 14 locations. Soil samples and blueberry stems were collected in 1985. Fields were selected from those that were included in the 1980 IPM survey. Data obtained on species density from the IPM survey will provide baseline information on weed populations for comparison with the 1985 data. Results of one vs two applications will be presented, a comparison to the pretreatment data will be made at a later date.

RESULTS: EXPERIMENT I. Results in Table 1 show that blueberry cover and the ground surface not covered by blueberries or weeds increased on the hexazinone treated areas in both locations. Grasses and 12 other species listed in Table 1 were reduced by hexazinone application. Weed species which were not reduced include; sheep laurel, dogbane, bunchberry, violets, and wintergreen. Other species which were not significantly different but had low cover and frequency include willow, aspen, birch, yarrow and clover.

RESULTS: EXPERIMENT II. No difference in blueberry cover, stem length, or number of blueberry stems was found comparing one vs two hexazinone treatments (Table 2). However, the number of laterals, number of buds per stem and total buds per square foot increased on the fields which received two hexazinone treatments. Grass cover decreased and ground cover increased with hexazinone treatment (Table 3).

Table 1. Effect of hexazinone on species cover and frequency.

Species	Location	Rate (kg/ha)	Cover (%)	Frequency (%)	Significance
Blueberry	T-18	0	44	100	
		2	64	100	**
	Aurora	0	.7	90	
		2	46	97	**
Ground	T-18	0	23	97	
		2	32	100	**
	Aurora	0	28	97	
		2	37	100	*
Grasses	T-18	0	58	94	
		2	20	88	**
	Aurora	0	55	100	
		2	19	73	**
Chokeberry	T-18	0	10	37	
		2	2	8	**
Pin cherry	T-18	0	11	45	
		2	0	0	**
Bracken fern	T-18	0	6	23	
		2	4	20	**
	Aurora	0	9	40	
		2	0	0	**
Sweetfern	T-18	0	5	3	
		2	0	0	**
	Aurora	0	17	40	
		2	0	0	**
Bush honeysuckle	T-18	0	1	3	
		2	0	0	**
	Aurora	0	7	27	
		2	1	3	**
Blackberries	T-18	0	5	20	
		2	0	0	**
	Aurora	0	15	53	
		2	0	0	**
Goldenrods	T-18	0	12	43	
		2	0	0	**
	Aurora	0	10	40	
		2	0	0	**
Meadowsweet	T-18	0	4	11	
		2	0	0	**
	Aurora	0	5	27	
		2	0	0	**
Cinquefoil	Aurora	0	22	83	
		2	1	10	**
Asters	Aurora	0	19	80	
		2	0	0	**
Strawberry	Aurora	0	16	53	
		2	0	0	**
Red sorrell	Aurora	0	5	30	
		2	0	0	*

* = 5%, ** = 1% level of significance

The grass species that were reduced by hexazinone treatment were predominantly wild oatgrass (Danthonia spicata), found on 13 of the 14 locations; quackgrass (Agropyron repens) found on 8 fields, and bluegrass (Poa pratensis) and Mullenbergia umbrosa found on 7 fields. Fifteen species of grasses and one sedge and one rush were identified. The predominant grass species was wild oatgrass. Fifteen weed species had less cover on fields treated once vs twice with hexazinone (Table 3). Only blue toadflax showed an increase with a second hexazinone treatment and this species was found predominantly in one field in the survey. Twenty four other species showed no change with one vs two applications (Table 3).

DISCUSSION. Experiment I The data show a decrease in susceptible species with hexazinone treatment. Although several species were not reduced no increase in the resistant species was detected on these two sites. An increase in the number of blueberry buds and a greater yield was obained after one cycle of treatements. Yield data will be taken in 1987 for the second cycle.
Experiment II. Although blueberry cover and stem density and length was not greater with a second application of hexazinone the greater number of buds per area should increase the yield on the fields treated twice. The second application of hexazinone resulted in a reduced cover for grasses and fifteen other species surveyed and an increase in potental blueberry yield. Hexazinone has little carry-over effect and the reason for an decrease in weed populations with a second application may be that those species not completely controlled have recovered or that new species have established from seed. Follow-up applications with hexazinone or other herbicides will be needed to keep competing species from re-establishing themselves in lowbush blueberry fields.

Table 2. Effect of hexazinone applied once or twice on lowbush blueberries on 14 fields.

Treated	Blueberry					
	Cover (%)	Stem legnth (in)	Stems (ft^2)	Laterals (ft^2)	Buds (ft^2)	Buds /stem
Once	51	3.4	82	52	137	1.8
Twice	58	3.4	79	79	171	2.4
Significance	NS	NS	NS	**	**	**

NS = nonsignificant, ** = 1% level.

Table 3. Effect of hexazinone applied once or twice on weed populations on 14 lowbush blueberry fields.

Species	Treated	Cover (%)	Frequency (%)	Significance
Grasses	1	17	80	
	2	6	27	**
Ground	1	26	97	
	2	28	99	NS
Sheep	1	7	26	
laurel	2	2	9	**
Bracken	1	4	16	
fern	2	1	4	**
Goldenrods	1	3	9	
	2	1	2	**
Meadowsweet	1	3	10	
	2	1	5	**
Grey Birch	1	2	6	
	2	<1	1	**
Bunchberry	1	12	34	
	2	8	30	**
Cinquefoil	1	2	9	
	2	1	2	**
Violet	1	1	8	
	2	<1	1	*
Black-eyed	1	2	8	
susan	2	0	0	**
Asters	1	1	4	
	2	0	0	*
Clovers	1	2	8	
	2	0	0	**
Red sorrel	1	2	7	
	2	1	3	**
Turtlehead	1	3	11	
	2	<1	1	**
St. Johnswort	1	4	14	
	2	0	0	**
Blue toadflax	1	<1	1	
	2	5	21	**
Interrupted	1	1	2	
fern	2	0	0	*

Species surveyed showing no significant difference with number of applications include : chokeberry, pin cherry, sweetfern, bush honeysuckle, dogbane, blackberries, willows, aspen, yarrow, wild lilly of the valley, strawberry, blue flag, daisy, hawkweed, huckleberry, cow vetch, rose, whorled loosestrife, rhodora, fireweed, nannyberry, sugar plum, hayscented fern, and sensitive fern.

NS = nonsignificant, * = 5% level, ** = 1% level

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Evaluation of Postemergent Herbicides for Grass Control.

METHODS: Bunchgrass (*Andropogon scoparius*) control ratings, where 0 = no effect and 10 = complete control, were made in July 1986 on a field in Brunswick treated in the summer of 1984 with sethoxydim and flauzifop-P-butyl to assess any carryover effects. Yield samples were not taken because poor road conditions prevented access.

A field in Surry with a heavy stand of bunchgrass was treated with a postemergent application of sethoxydim (plus 1pt/a crop oil concentrate) at 0, 2.5 pt/a or 2.5 + 2.5 pt/a in 20 gal/a water, with or without ammonium sulfate at 2.5 lb/a. The first treatment was on July 16 and the second on August 17, 1986. Grass control ratings and the height of 5 clumps of grass per plot were made in August 1986. Stem samples were cut in October but have not yet been measured. Carryover ratings will be taken and yield samples will be harvested in August 1987.

RESULTS: Carryover results indicate a significant supression of the bunchgrass with either herbicide, no difference between the herbicides but less supression with the low rate of sethoxydim (Table 1).

Ammonium sulfate did not enhance the activity of sethoxydim on bunchgrass in this experiment. Considerable supression of grass vigor and growth was obtained by the one and two applications of sethoxydim (Table 2).

DISCUSSION: Since bunchgrass is resistant to hexazinone, postemergent grass herbicides are being evaluated. This species is primarily found in the Southern and Western part of the state but may be increasing in the Eastern portion. Although statistically significant, the level of supression indicated by the carry over ratings from Brunswick were very low. This indicates the bunch grass recovered from the postemergent applications. Good supression was observed during the first year on the bunchgrass treated in Surry. Supressing the grass the first year may allow the bluberry plant to achieve sufficient growth and flower bud production to increase yields the following year. The stem measurement and yield data will indicate if the weed supression will result in increased yields. When the yield data is available the economics of using this herbicide will be determined and included in next years report.
Note: Both sethoxydim (Poast) and fluazifop-P-butyl (Fusilade 2000) are registerd for use in lowbush blueberries in the non-bearing year.

Table 1. Bunchgrass control ratings, carryover effect, Brunswick 1986

Treatment	Rate (pt/a)	Rating (0-10)	Significance
Untreated	0	0	
Sethoxydim	1.5+1	0.3	
	2.5+1.5	1.8	
Flauzifop-P-butyl	1.5+1.5	2.0	
	2.5+1.5	1.2	
Treated vs untreated			**
Sethyoxdim vs flauzifop-P-butyl			NS
Low vs high sethoxydim			*
Low vs high flauzifop-P-butyl			NS

Treatments applied summer 1985
All treatments include 2 pt/a crop oil concentrate
Rating 0 = no effect, 10 = dead.
NS = nonsignificant, * = 5% level, ** = 1% level.

Table 2. Supression of bunchgrass by sethoxydim, Surry 1986.

Rate (pt/a)	Rating (0-10)	Average height of clump (in)
0	0	21.5
2.5	5	9.6
2.5+2.5	8.5	3.9
Significance	**	**

Treatments applied summer 1986
All treatments include 2 pt/a crop oil concentrate
Rating 0 = no effect, 10 = dead
** = 1% level

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Evaluation of Sulfonyl urea and Imidazoline compounds for Bunchberry Control.

METHODS: Two sulfonyl urea herbicides, DPX-F6025, DPX-6316 and three imidazoline herbicides, imazapyr, imazaquin and AC263,499 were included in a trial to test the efficacy for bunchberry control and phytotoxicity to lowbush blueberries. Experimental plots established on Blueberry Hill farm and treated preemergent in May and postemergent in July 1986. Experimental design was a split block with 6 replications with 5 herbicides applied at 3 rates on 2 dates for a total of 180 plots. Ratings where 0 = no effect and 10 = complete control or injury were made on blueberry and bunchberry stand in August 1986. Two subsamples were taken from each plot in October and the number of stems were counted. Carryover ratings will be made and yields will be harvested in August of 1986 for a final assessment of the herbicidal effects.

RESULTS: Preemergent applications of the sulfonyl urea herbicides had no effect on either the blueberry or bunchberry (Table 1). Postemergent applications of the imadazoline herbicides injured both blueberry and bunchberry and resulted in reduced stem numbers in all cases except for AC263,499 which did not reduce bunchberry stem numbers. Injury observed for the untreated imazapyr was due to drift on to the control plots. Postemergent applications of DPX-M6316 had no significant effect but the DPX-F6025 treatments resulted in an increase in blueberry stems and a decrease in bunchberry stems (Table 1). Postemergent applications of the imadazoline herbicides resulted in less injury and control than the preemergent applications but did not affect bluebrerry or bunchberry stand with the exception of a stimulation of blueberry stems at the 12 g/ha rate of imazapyr.

DISCUSSION: All treatments except the postemergent application of DPX-F6065 were either too toxic or were ineffective. The increase in the number of bluebery stems may be indicative of a proliferation of shorter stems. Stem measurements will be made to determine if the herbicide had a detrimental effect on blueberry growth. Carryover assessments and yields taken in 1987 will enable a final assessment of the treatments. Further trials will be conducted in 1987 with DPX-F6025 to further evaluate its potental for bunchberry control.

Table 1. Effect of herbicides on blueberry and bunchberry, Jonesboro 1986.

Herbicide	Rate g/ha ai	Blueberry	Bunchberry	Blueberry	Bunchberry
		Rating (0-10)		Stems (ft^2)	
PREEMERGENT					
DPX-F6025	0	0	0	60	76
	35	3.0	2.2	44	51
	70	1.5	0.9	90	45
Significance		NS	NS	NS	NS
DPX-M6316	0	0	0	78	32
	22	1.5	0.7	90	35
	44	1.4	0.7	62	51
Significance		NS	NS	NS	NS
Imazapyr	0	4.7	3.8	17	71
	23	10	9.8	0	2
	46	9.3	9.3	0	0
Significance		Q*	Q*	L**	Q**
Imazaquin	0	0	0	73	48
	23	6.0	3.8	19	48
	46	7.6	5.3	26	47
Significance		Q**	L*	Q**	NS
AC263,499	0	3.0	2.5	76	42
	23	9.3	9.3	2	8
	46	9.7	9.5	0	2
Significance		Q**	Q**	Q**	Q*
POSTEMERGENT					
DPX-F6025	0	0	0	39	59
	18	0.5	0.2	50	41
	35	1.6	1.2	84	32
Significance		NS	L*	L*	L*
DPX-M6316	0	0	0	64	51
	11	0.8	0	78	34
	22	2.0	0.4	71	43
Significance		NS	NS	NS	NS
Imazapyr	0	0	3.8	76	51
	12	5	2.7	122	26
	23	5.4	3.4	56	47
Significance		Q**	L**	Q**	NS
Imazaquin	0	1.3	0.8	65	43
	12	1.0	0.3	112	22
	23	0.8	0.8	94	46
Significance		NS	NS	NS	NS
AC263,499	0	0	0.8	86	33
	12	0.7	0.3	81	48
	23	1.2	0.8	91	46
Significance		L**	L**	NS	NS

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Use of Mechanical wiper with glyphosate or dicamba for control of dogbane.

METHODS. A site on Blueberry Hill Farm in Jonesboro with a severe dogbane infestation was was treated with either glyphosate or dicamba at 0, 5 or 10 % v/v with a selfpropelled mechanical wiper on August 21, 1986. The experimental design was a randomized complete block with two herbicides at 3 rates replicated over 4 blocks. All of the dogbane stems in 2, 1 meter square quadrats in each plot were counted before treatment and will be counted again in July 1986 to assess efficacy of treatments. A evaluation of any injury to lowbush blueberries will also be made at that time.

RESULTS: Results will be obtained in 1987.

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Hand-wiper Applications of Herbicides on Woody Weeds

METHODS: A commercial blueberry field on T-18 MD, treated preemergent with 2 lbs ai/A hexazinone, was selected because of a large number of surviving woody weeds. Maple, willow and cherry stems were hand-wiped with 0, 1, 2 or 4% v/v solutions of glyphosate or dicamba in water. Five replications of each treatment were made. Stems were marked with a metal tag and colored flag and herbicides were applied with a Sideswipe Weed Wiper in July 1985. Efficacy ratings, where 0 = no effect and 10 = complete kill, made in July 1986 revealed that a large number of the metal flags had been pulled up making identification of many of the treatments nearly impossible. The cherry data was disgarded because of insufficient samples but the maple and willow was analyzed with the missing data points.

RESULTS: Increasing rates of glyphosate and dicamba provided supression of both willow and maple (Table 1). There was no difference in the efficacy of glyphosate vs dicamba but the supression of willow was slighly greater than that of the maple.

DISCUSSION: Earlier wiper experiments suggested that lower rates of herbicides may provide effective contol of woody weeds. The highest rate, 4% did not give complete control of either species but even the 2% rate provided good supression. The 1% rate, missing for the willow, gave less than 50% supression. This study incicates that herbicide rates of at least 4% or more should be used to insure supression of woody weeds. It also illustrates that the dicamba is as effective as the glyphosate for control of these species and should be persued for registration so it may be available for use in lowbush blueberries.

Table 1. Effect of hand-wiper applications of dicamba or glyphosate on maple and willow on T-18, 1986.

Herbicide	Rate (%)	Rating (0-10) Maple	Willow
Dicamba	0	0	0
	1	3	--
	2	5.2	6.6
	4	7.6	9.2
Glyphosate	0	0	0
	1	3	--
	2	7	8.3
	4	9	9.8

Contrasts	Significance
Dicamba vs glyphosate	NS
0 vs treated - dicamba	**
Linear within dicamba	*
0 vs treated - glyphosate	**
Linear within glyphosate	**

Rating 0 = no effect, 10 = complete kill, -- = missing
NS = nonsignificant, * = 5%, ** = 1% level

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Dogbane Control with 2% Glyphosate

METHODS: Twenty stakes were located in the middle of clumps of dogbane, at Blueberry Hill Farm, in July 1985. All dogbane stems within a square meter area around the stake were counted. Glyphosate at 2% v/v in water was applied with a Sideswipe Weed Wiper, to the leaves of the dogbane plants. Treatments were replicated 10 times. Dogbane stems were counted again in July 1986 and any injury to blueberries was recorded using a rating scale where 0 = no effect and 10 = dead.

RESULTS: A wiper application of 2% glyphosate resulted in a 93% reduction in the number of dogbane stems but also caused considerable injury to the lowbush blueberries below (Table 1).

Discussion: Although the low rate of glyphosate wiped on the dogbane stems provided a substantial reduction, the injury to blueberries occuring from splatter or runoff would limit the use of this method to control dogbane.

Table 1. Effect of glyphosate wiper applications on dogbane and lowbush blueberries, Jonesboro 1986.

Rate (%)	Number of stems ($1\ m^2$) before	after	Percent change	Blueberry injury rating (0-10)
0	16	12	16	0
2	22	1	93	3.3
Significance				
	NS	**	**	**

NS = nonsignificant, ** = 1% level

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Low Volume Solution of Asulam for Bracken Fern Control

METHODS: A site with a heavy infestation of bracken fern was selected in July 1985, at Blueberry Hill Farm. All bracken fern fronds in 20, one meter square sample areas were counted. Areas were marked with a numbered, metal tag and colored flags. Asulam at 1.5 lbs ai/A was applied across 10 of the sample areas in 3 gal per acre water, with a knapsack sprayer delivering 10 psi from a flood jet nozzle. The portion of the field containing the other ten areas remained untreated as a control. Bracken fern fronds in the sample areas were counted again in July 1986.

RESULTS: The low volume application of asulam resulted in a complete elimination of the bracken fern one year after treatment (Table 1).

DISCUSSION: This experiment shows that asulam at 1.5 lb/a , applied in as low as 3 gallons of water per acre is effective in controlling bracken fern. A grower with a backpack sprayer could use this method to spot treat bracken fern. However, asulam is currently under review by the EPA and until this is cleared up there is little hope for registration in lowbush blueberries.

Table 1. Effect of low volume application of asulam on bracken fern Jonesboro 1986.

Rate	Bracken fern (1 m^2)		
lb/a	before	after	Percent change
0	33	23	30
1.5	27	0	100
Significance	NS	**	**

NS = Nonsignificant, ** = 1% level

BLUEBERRY ADVISORY COMMITTEE
RESEARCH REPORT

DATE: December 1986

INVESTIGATORS: David E. Yarborough
John M. Smagula

TITLE: Integrated Weed Management

METHODS: A preliminary study was established at Blueberry Hill Farm in August 1985. Approximately one acre was divided into two blocks each containing four treatments: 1) untreated, 2) cultural controls, which inclued mulching open areas and mowing above the blueberries in at the end of June, July and August, 3) chemical controls, which inclued a preemergent application of hexazinone at 2 lb/a and mechanically wiping the plot with 10 % glyphosate at the end of August, and 4) chemical controls with mulching. Species abundance and percent cover were estimated using the Daubenmire Cover Abundance Scale on 5 - 1 meter quadrats per plot in August 1985 and 1986. Preliminary yield data was obtained by mechanically harvesting 4 strips from each plot. Stems were be cut in October 1986, from 10 - 1 square foot quadrats per plot and will be used to estimate stem density. Yield and cover data will be taken again in 1987. This site will be maintained to provide baseline information on the amount of time, money and resources that would be required for a more extensive study which was proposed in last years advisory committee request.

RESULTS: Data is currently being reviewed and is not ready for presentation.

1986 Annual Report to the Maine Lowbush Blueberry Commission

M. F. Trevett
Professor Emeritus
Univ. of Maine at Orono
December 1986

As you read this Report you may come to the conclusion that you are being bombarded with odds and ends of irrelevant data. That is, engulfed by data that is irrelevant to the presumed research project at hand: a comparison of Flail and Rotary mowing.

And you will be right about the odds and ends. The reason for the odds and ends? Since 1983 my project has evolved into a study of the mechanics of converting fields from a two year production cycle into an ultra profitable three year cycle.

What is the fundamental problem that confronts us when we try to make this conversion? This: we have got to know what must be done the first crop year to produce enough growing points to ensure a second crop as large or larger than the first - and do it without diminishing the first crop.

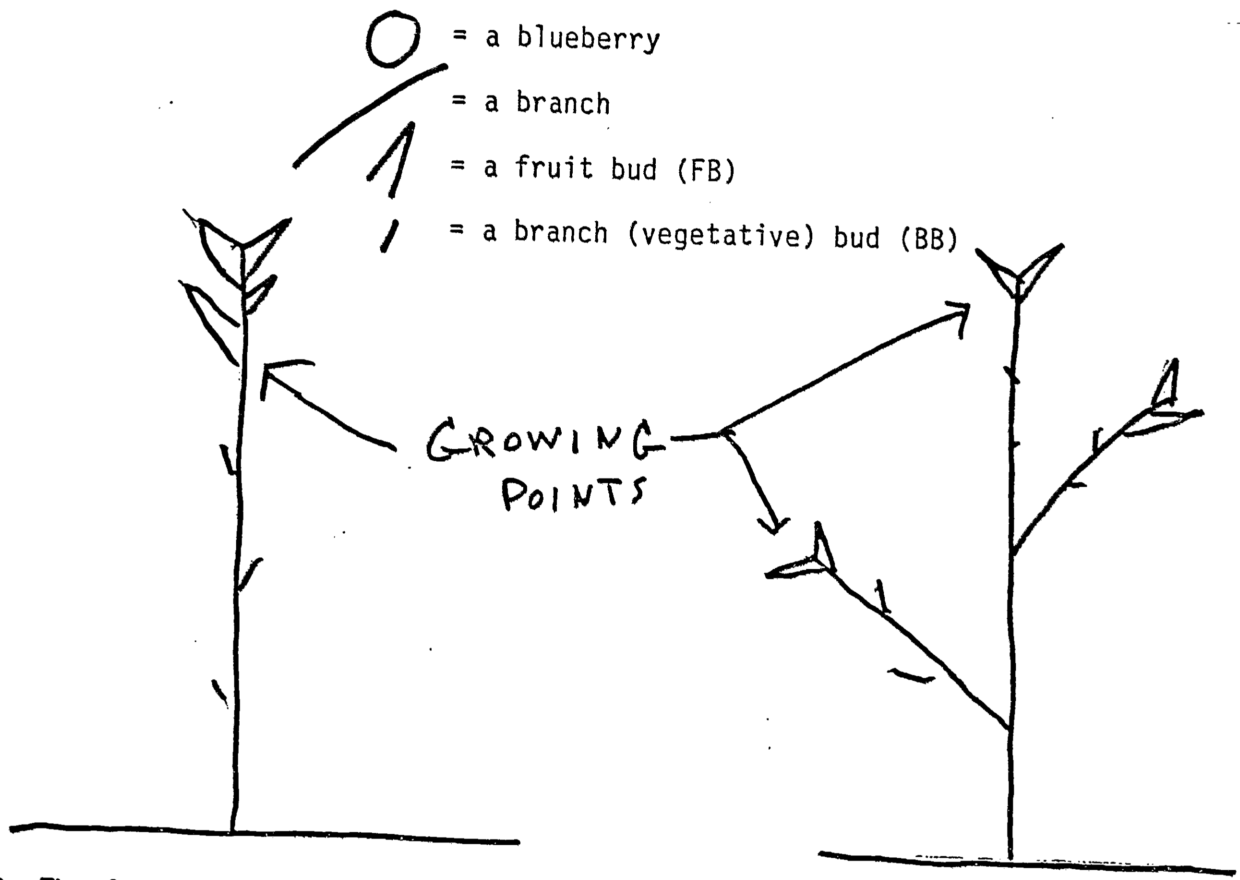
What is a growing point? It is the outer half inch or so of a developing branch or stem. It may range from an inch to five or six inches or more long. This is vegetative growth.

Sooner or later vegetative growing points must change to reproductive growth. That is, begin to initiate fruit buds for next year's crop - the second crop in a three year cycle. And, while this is happening, and on the same stem, on other branches, we seek to mature on last year's wood an abundant crop of large high quality berries. This too is reproductive growth.

A diagram of growth made year by year in a three year cycle will look about like the following (ideally):

A. The pruning year: 1984.

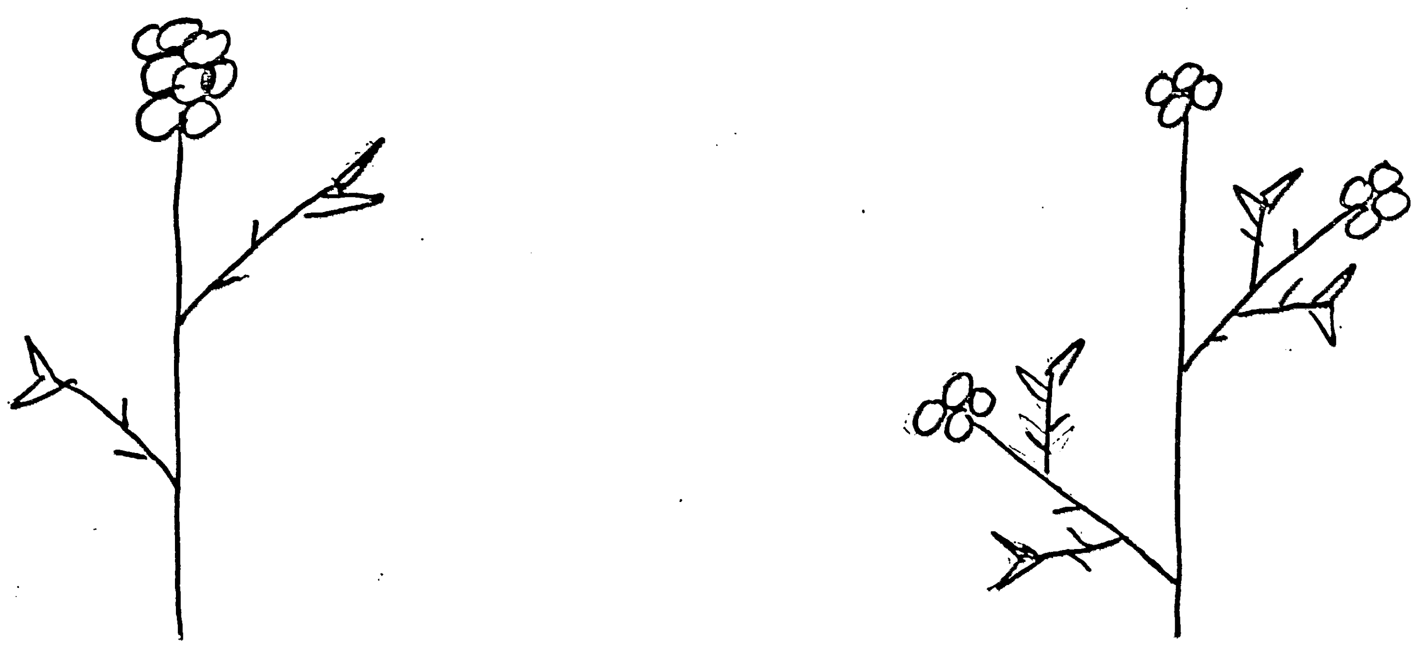
Unbranched Stem | Branched Stem



B. The first crop year: 1985.

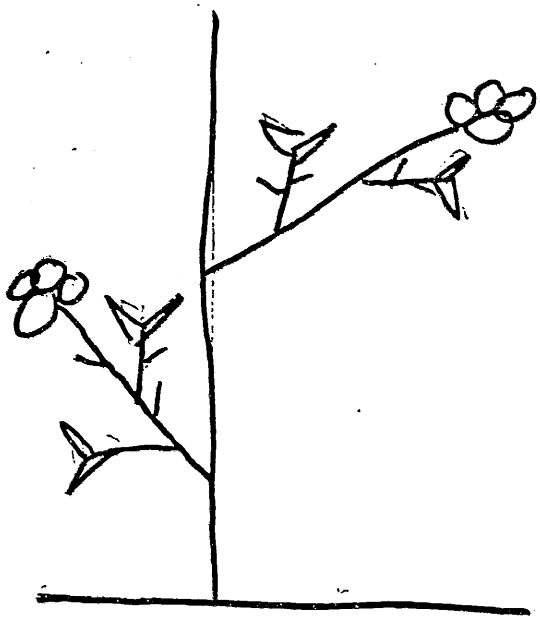
The unbranched stem of 1984 grows a set of branches, Plus berries, and fruit buds

The branched stem of 1984 grows a set of branches, and fruit buds and berries.

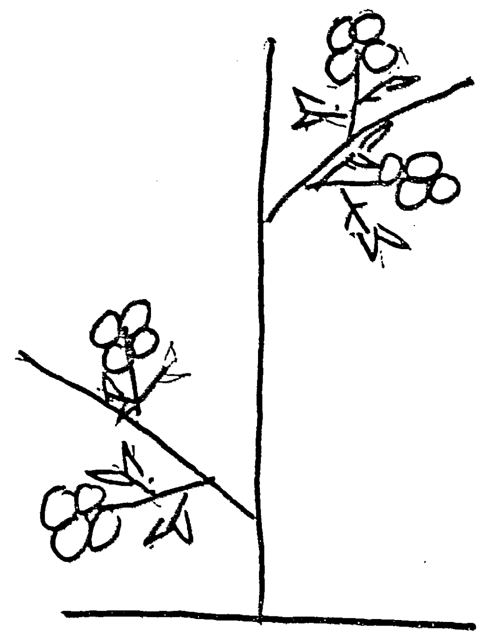


C. The second crop year: 1986.

Branches, fruit buds, and berries grow on the initially unbranched stem of 1984.



Branches, berries and fruit develop on the initially branched stem of 1984.



Notes to the above diagrams:

1) The fruit buds on unbranched stems are assumed to have 5.1 blossom buds per fruit bud, on branched stems 4.2.

2) Fruit buds are formed one year before raking.

3) Fruit buds form on new wood - this year's growing points (branches).

4) The more branches per stem the more fruit buds - if all goes well.

As a generalization, because branched stems will have more fruit buds than unbranched, if we can stimulate profuse branching the first crop year, the second crop should be larger than the first by factor of at least 1.5, maybe 2. This is the specific research goal we should be aiming for: a second crop twice as large as the first. Note: the fewer blossom buds per fruit bud on branched stems is more than compensated for by the extra fruit buds per branched stem.

Can research reach that goal? Well, it does sometimes. Consider the following table made up of data Trevett and Durgin gathered in 1948:

Thirty five pounds of nitrogen applied per acre before bud break the spring of 1948 on selected clones of Vaccinium Angustifolium.

Clone, and fertilizer treatment the first crop year, 1948	Number of mature berries per stem Aug. 1948, the first crop year	Number of fruit buds per stem Oct. 1948
Clone 1		
Fertilized	13.8	9.2
Unfertilized	13.8	4.6
Clone 2		
Fertilized	9.3	11.3
Unfertilized	7.4	6.0
Clone 3		
Fertilized	8.4	6.2
Unfertilized	7.6	3.8

Can we get these same results consistently, year in and year out? Not yet. Such desirable consequences of spring fertilizing the first crop year do occur - but they occur haphazardly - largely at Nature's whim. More in some clones than in others. More in some seasons than in others. Perhaps eventually we will know the rhyme and the reason for such haphazardness. But we do not now know it.

Getting the facts won't be easy, but hopefully it will be possible. Why the touch of pessimism? Because in attempting to regulate growth in the manner that we now perceive it must be done, we run head on into a double barrelled naturally occurring ever present antagonism. And we have this antagonism whether we are dealing with apples, peaches, or lowbush blueberries. Reproductive growth is antagonistic to vegetative growth, and conversely vegetative growth is antagonistic to reproductive growth. Woody plants have difficulty correctly apportioning mineral nutrients and organic plant food between these two kinds of growth.

Undoubtedly every grower has encountered antagonism. Or, rather, he has seen the effects on plant growth when antagonism has been destroyed. If, for example, in 1970 a late spring frost killed most of the blossoms in a first crop field, in 1971 the crop would be as large as the usual first crop. The reason: the destruction of the blossoms in 1970 permitted a rank growth of new branches with one or two or more fruit buds per growing point. Here was the potential for a large second crop, and the potential was there because a frost had destroyed the reproductive apparatus that would otherwise have dampened the growth of new branches studded with fruit buds. At the risk of repeating, again, what has already been written: We can have second crops as large or larger than the usual first crop, by stimulating during the first crop year strong vegetative growth while at the same time, on the same stems an abundant crop of quality fruit ripens.

The number of plant and soil factors that enhance antagonism may not be unlimited, but undoubtedly they are plentiful. At least numerous enough to prevent us from studying them all at the same time in one block in one year.

So, in the beginning, the study will have to be made piece meal, two or three factors at a time. Eventually when all have been examined and measured, those factors that appear to be the most influential in either eliminating antagonism or minimizing it, can be combined into a more inclusive study.

Here is a brief outline of some of the factors needing research scrutiny.

I. Pruning

A. Equipment

B. Date of pruning - spring or fall, early or late.

C. Height of pruning: 1,2,3 or four inches.

II. Fertility management

A. Ratio of fertilizer:

1-0-0, 1-1-0, 1-0-1, 1-1-1, 1-2-1, 1-2-2, etc.

The use of other nutrient elements combined with N, P, K:

S, Ca, Mg and so on.

B. pH regulation

C. Time of application of fertilizer - between years.

a. First, second, or third year of cycle

b. Apply fertilizer annually

D. Time of application of fertilizer within years.

a. Pre-emergence or at emergence or post emergence.

b. Some combination of "a" above

E. Rates of nutrients to apply: for example nitrogen at 25, 35, 50, 60, or 70 pounds per acre

F. The Fertilizer formulation:

a. Solid forms - as out of a fertilizer bag and applied to the soil.

b. Water soluble kinds applied to leaves and stems as a spray, either by ground rigs or by plane or copter.

In 1983 one or two factor studies were begun. Their progress is given in this, the 1986 Annual Report.

THE 1986 REPORT

A COMPARISON BETWEEN FLAIL AND ROTARY MOWING-1986

The 1986 pruning was done the fall of 1985. Stems were measured the fall of 1986.

Location	Kind of Pruning	Number of fruit buds per stem (branched stems)	Percent of stems without fruit buds (zero stems)	Number of branches per stem
#1	Flail	2.78	44.8	3.99
#1	Rotary	3.10	43.2	4.28
#3	Flail	3.99	52.4	3.74
#3	Rotary	4.51	22.1	3.67

Rotary mowing was generally better than Flail in 1986, but the differences are so small that they may not be of practical significance. Truly practical differences, however, may show in growth made the first crop year - 1987.

Location #1, however, does neatly and without possible misunderstanding show the need for growers to take into account stem height and overall stem vigor before settling on a rate of nitrogen to apply to their entire acreage the pruning year, or any year.

Location #1 had been fertilized in both 1984 and 1985 with about 100 pounds per acre of nitrogen, producing stems the fall of 1985 that were seven to nine inches tall. As shown in the table below three rates of nitrogen were applied pre-emergence in the spring of 1986: no nitrogen, 25 and 50 pounds per acre, with these results:

Pounds per acre of nitrogen	Number of fruit buds per branched stem	Percent of all stems without fruit buds (zero stems)
No nitrogen	3.67	39.0
25 lbs.	2.81	42.7
50 lbs.	1.81	51.6

Compare these numbers with those from a field in which stems averaged four to six inches tall:

No nitrogen	5.68	10.3
25 lbs.	6.68	12.8
50 lbs.	6.20	13.9

It is for these reasons I have always recommended that trial fertilizer strips be run in each field, with rates applied based on stem height - before fertilizing the entire field. It looks as though what was true in 1950 is also true in 1986.

See page 1 of the accompanying Misc. Report 128.

TABLE XXII

Stem measurements from fertilized lowbush blueberry clones (*Vaccinium angustifolium var. laevifolium* House) expressed as percent increase of fertilized stem over unfertilized, 1960-1966.

Fertilizer treatment	1960	1962	1964	1966
	Stem length			
	Actual measurements (inches)			
Not fertilized	2.60	2.90	2.77	2.62
	Length of fertilized stems as % increase over unfertilized			
N[1]	73*[3]	59*	43*	39*
NPK[1]	80*	69*"[3]	47*	37*
NPK + Mg (in '65 + '66)[2]				50*"@[3]
	Number fruit buds per unbranched stem			
	Actual measurements			
Not fertilized	1.70	3.82	3.04	1.51
	No. per fertilized stem as % increase over unfertilized			
N	—19	— 2	12	—11
NPK	—63*	49*	37*"	34*
NPK + Mg (in '65 + '66)				93*"@
	Total fruit buds: average of unbranched and branched stems combined			
	Actual measurements (average per stem)			
Not fertilized	1.71	3.82	3.11	1.60
	No. per fertilized stem as % increase over unfertilized			
N	— 6	2	12	10
NPK	—51*"	72*"	45*"	32
NPK + Mg (in '65 + '66)				94*"@
	Fruit bud ratio per unbranched stem			
	Actual ratio[4]			
Not fertilized	.65	1.32	1.10	.58
	Ratio of fertilized stem as % increase over unfertilized			
N	—54*	—34*	—21*	—21*
NPK	—80*"	—13*"	— 6	— 2"
NPK + Mg (in '65 + '66)				28*"@

[1] Fertilized preemergence after burning in May of 1960, 1962, 1964, 1966. Total amount of nitrogen (N) applied 1960-1966: 280 lbs. per acre; phosphorus (P) as P_2O_5: 660 lbs. per acre; potassium (K) as K_2O: 590 lbs. per acre. Each year the same acre rate of nitrogen was applied to all fertilized plots. In the NPK plots ratio except for 1 year was 1-2-2.

[2] Mg = magnesium. Plots that had received NPK in previous years were fertilized with NPK as usual in 1966 plus 200 lbs. per acre of Epsom salts in 1965 and 1966. Deficiency of Mg was first indicated by leaf analyses in 1962.

[3] An asterisk (*) indicates significance between fertilized and unfertilized leaves at the 5% level; absence of an asterisk indicates non-significance. A quote (") indicates that this treatment is significantly different at the 5% level from nitrogen (N) fertilizer alone. Leaf samples were taken during first two weeks in July, after terminal dieback had begun. An @ indicates that the number for NPK + Mg is significantly different at the 5% level than the number for NPK. A dash (—) before a number indicates a decrease.

[4] $\frac{\text{Number fruit buds per unbranched stem}}{\text{Stem length (inches)}}$

And while you have Report 128 open turn to page 12. After that, glance at Table XXII, page 8 of this 1986 Report. To so do will refresh your memory that other nutrients besides nitrogen, phosphorus, and potassium are required for balanced and ample plant growth. This remembrance ought to help you put into perspective the statement sometimes made that because successive fertilization in successive production cycles are not followed by successive increases in yield maybe we won't have to fertilize every cycle. It has never occurred to those who take this position that the reason why yields do not steadily increase might be that some other nutrient has run short - like magnesium (Mg) in Table XXII, page 8 of this Report (Table XXII was authored by Trevett, Carpenter, Durgin).

In addition to nutrient deficiences, faulty ratios of mineral nutrients to certain organic nutritive components may result in unfruitfulness. One such ratio of apparent tremendous importance is the Carbohydrate/Nitrogen Ratio (Chy/N). (Do not confuse this ratio with the carbon/nitrogen (C/N) of soils.) The carbohydrate nitrogen ratio of plant tissue was once used exclusively to explain fruitfulness and non-fruitfulness. W.D. Chandler has summarized the relationship as follows:

Four classes of plants were described with reference to growth and fruitfulness and the ratio.

Class I: Plants in this class are high in nitrogen, low in carbohydrates, unfruitful, and weak in vegetation.

Class II: Plants in this class are well supplied with both nitrogen and carbohydrates are highly vegetative but unfruitful.

Class III: Plants in this class have a less supply of nitrogen in relation to carbohydates and are less highly vegetative than plants in Class II, but they are fruitful.

Class IV: Plants in this class are low in nitrogen, high in carbohydrates, but feebly vegetative, and produce few blossoms, which tend to fall off without setting fruit.

At one time most plant physiologists believed that this ratio utterly and singly governed fruitfulness. Within the last 20 or so years however, this view has been tempered, by the acknowledgment that the level of growth regulators in plants may be as important as the carbohydrate ratio. Such an acknowledgement does not mean that the ratio is inoperative. It merely points out that the determination of fruitfulness is more complicated than it was formerly thought to be. No single component totally determines the kind of growth a plant makes.

And again turn to Misc. Report 128, page 11, to the heading Fertilizing THE FIRST CROP YEAR. This section of the Misc. Report may introduce you to the notion of fertilizing at the pink cluster bud stage the first crop year to increase the second crop and thereby make feasible a three year production cycle.

In the following portion of this 1986 report, some of the consequences of fertilizing at the pink stage will be examined. The first test reported is one showing response to pre-emergence application of nitrogen at three rates the pruning year. The average stem height in all tests was four to six inches before fertilizing.

A RESPONSE TO NITROGEN APPLIED PRE-EMERGENCE THE PRUNING YEAR

(This data was given in the previous section under Rotary vs Flail mowing)

Measurements Fall of the pruning year

Pounds of N per acre	Number of fruit buds per branched stem	Number of branches per stem	Number of stems without fruit buds
No nitrogen	5.68	5.04	10.3
25 lbs.	6.68	4.29	12.8
50 lbs.	6.20	4.40	13.9

Per ?

SPLITTING THE AMOUNT OF NITROGEN APPLIED BETWEEN A PINK CLUSTER BUD APPLICATION AND A PRE-EMERGENCE APPLICATION THE FOLLOWING SPRING

	When N was Applied		Fall of the pruning year-1986	
Total Acre Rate of N Applied	Pink Stage: 1985, second crop year	Pre-emergence: 1986, the pruning year	Number fruit buds per stem: for '87 1st crop	Number of branches per stem
50 lbs.	25 lbs.	25 lbs.	8.24	4.09
50 lbs.	None	50 lbs.	7.31	4.59

CARRY OVER FROM A PINK CLUSTER BUD APPLICATION OF NITROGEN INTO THE PRUNING YEAR

		Fall of the pruning year	
Acre rate of N	When N was applied	Number fruit buds per stem for 1st crop'87	Number of branches per stem
50 lbs.	Pink cluster bud stage the 2nd crop year-1985	5.92	4.66
50 lbs.	Pre-emergence after pruning - 1986	5.34	5.06

HOW MANY POUNDS OF NITROGEN OUGHT TO BE APPLIED AT THE PINK CLUSTER BUD STAGE THE FIRST CROP YEAR?

To get an answer to this question a block was set up in 1986 in first crop land. Data from this block is given in the table below:

Number of fruit buds per branched stem following application of four rates of nitrogen at the pink cluster bud stage.

	Check: no nitrogen applied	25 lbs. N per acre applied	35 lbs. N per acre applied	50 lbs. per acre applied
Number of fruit buds per stem, for 1987, 2nd crop	2.92	2.96	3.23	3.38

Fifty pounds of nitrogen was significantly better than either no nitrogen or 25 pounds, but was not better than 35 pounds. It is thought that the differences between rates are small because rain did not fall soon enough or heavy enough after nitrogen application to bring out the true differences.

This matter of getting nitrogen into stems and leaves at critical physiological stages of growth is a tricky one. You cannot depend on rainfall. And since most growers do not have irrigation, they will have to depend upon spraying leaves with nutrient solutions using either ground spray rigs or plane, or copters. Slow release fertilizers do not offer any advantage over standard fertilizers. Their effectiveness still depends upon rain falling at the right time.

TIMING THE APPLICATION OF FOLIAGE NUTRIENT SPRAYS

Successful timing will depend on growers keeping track of the progress of stem development. This seems like a straight forward chore. I guess that in the end it will be, but before that day comes, researchers are going to have to identify visual signs of plant development, and of other matters, that to date have been ignored.

Consider two aspects of timing stumbled over in 1986:

1) Pink cluster bud spraying is done to stimulate new woody growth to hold next year's fruit buds, and at the same time nourish this year's crop. Until now, fertilizing at the pink stage seemed the critical and opportune time to accomplish both of these objectives.
   But, is this truly the critical and opportune time? In 1986 a week to ten days before the onset of the pink stage, many branches that should have held the 1987 crop had stopped elongating. In fact they had never started or at least had never really started. The new branch buds had broken and elongated about one sixteenth of an inch, then stopped, leaving the first three leaves plastered tight against the tiny stem in a small rosette no more than three sixteenths of an inch in diameter.

   Is it possible that the recommended pink cluster bud stage has never been completely right?

2) A second aspect of timing. Theoretically, nitrogen sprayed sometime before or after raking might be a means of increasing organic food reserves in stems, branches, and rhizomes during late summer and early fall. This seemed an easy problem to solve, or even, maybe, this was not

a problem. But it turned out to be something of a conundrum. Sprays applied a week after raking did not significantly green up leaves and keep them functioning into late September. On the other hand sprays applied a week before raking kept leaves vigorous and green until 22 October. Soil applied fertilizers did not green up leaves, whether applied before or after raking. An obvious answer to why late spraying did not green is that during raking leaves were so badly battered that they could not function normally. But, is it the only possible answer?

From the brief discussions in this Report and from past research, nitrogen appears to be the key to manipulating lowbush blueberry stems into producing successive (annual) high yielding crops in a 3-year cycle. Thus, as of this date nitrogen will be the only nutrient whose precise timing of application will occupy growers' attention. This being so it is likely that the fertility management of lowbush blueberry soils will follow an ancient scheme:

1) Fertilize the soil with all the other essential plant nutrients except nitrogen, at pre-emergence, or in the fall.

2) Fertilize blueberries with nitrogen at times and at rates that will direct growth in the direction we want it to go.

The goal of such a program is to always keep soil supplies of all other nutrients except nitrogen at levels that will without question furnish clones with all the nutrients they need plus a little more. There is one exception to this: minor (trace elements). When trace element deficiencies appear they will be eliminated by foliage sprays.

To help growers fertilize soils a set of standards is needed. In the next section I offer a First Approximation of satisfactory amounts of several nutrients. By satisfactory I mean pounds of a nutrient per acre that will meet, absolutely meet, the highest demands that the highest producing clones will make on the soil.

I suspect that this Approximation will need drastic revision. So be it: I offer it not so much in the belief that I am completely right, but that maybe the offering will stimulate (goad) other researchers in the State to combine their data with mine for a Second Approximation that will be nearer the truth than the First.

A FIRST APPROXIMATION OF SOIL NUTRIENT STANDARDS FOR MAINE LOWBUSH BLUEBERRY FIELDS

These standards are for soil samples taken to a depth of 4 inches for analysis at the Soils Laboratory, Department of Plant and Soil Sciences, Deering Hall, University of Maine at Orono.

Nutrient	Pounds per acre of available nutrient to a depth of 4 inches
Phosphorus (P)	4.0
Potassium (K)	50.0
Calcium (Ca)	300.0
Magnesium (Mg)	45.0
Percent Calcium saturation	40.0
pH, Soil	4.8

How Derived? What is needed

AMOUNTS OF NUTRIENTS THAT MUST BE APPLIED TO BRING SOIL UP TO THE LEVELS GIVEN FOR THE FIRST APPROXIMATION

Soil samples were taken in 1986 for analysis with this objective in mind. The samples have not yet been analyzed, partly because I have not known if I have enough left of my 1986 Grant money from the Blueberry Commission to have the soils analyzed and have sufficient funds remaining to furnish the requisite gas and oil and other materials (fertilizer, twine and so on, a bit of hired help) for the period 15 March to 1 July 1987.

I suspect I may need another $1500 - bringing my total for 1986 fiscal, or whatever, year to $5000 (the amount I asked for initially). Hopefully that will be enough.

You realize that this 1986 report is essentially a proposal for a project that began three or four years ago.