Internal Research & Development

Final Report
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Wild Blueberry Renovation

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Executive Summary

Lowbush blueberry production was a major asset to the agricultural industry in NL, but in recent years, production has plummeted. Due to the low price for berries, some blueberry producers do not even partake in the pertinent pruning practices to develop the two-year production cycle that ensures fruit set and maximizes yields. An experiment was initiated whereby two pruning techniques (burning and mowing) and three levels of fertilizer (0 kg N/ha, 20 kg N/ha of 14-18-10, and 20 kg N/ha of MESZ) were applied to experimental plots to determine their effects on weed populations, blueberry leaftier (*Croesia curvalana*) populations, and blueberry yields.

It appeared that as the summer progressed, % coverage of blueberry increased more vigorously in the fertilized plots compared to the unfertilized plots, with the unfertilized plots containing a larger percentage of bare ground.

During the prune-year significantly fewer blueberry leaftier moths were present in the burned plots compared to the mowed plots and the control. The number of leaftier moths present in the mowed plots and the control were not significantly different, indicating that mowing does not remove blueberry leaftier eggs from an area, nor control leaftier populations. Over the two-year production cycle, burn-pruning resulted in significantly fewer blueberry leaftier numbers compared to mowing, thus indicating that burn-pruning is an effective management technique to remove and maintain leaftier populations on blueberry land.

In the prune year, burned plots had significantly higher blueberry floral bud numbers compared to mowed plots, and fertilized plots produced higher floral bud numbers compared to the control, with no significant difference between fertilizer blends. During the crop year, yield was assessed and neither pruning method nor fertility had a significant effect on blueberry yields. This is contradictory to prune-year floral bud number results as well as the vast research literature present in the blueberry industry. These results can be accounted for due to the fact that plots were harvested early due to an impending frost which may account for the lack of significance in the treatment effects. A lack of main treatment effects on blueberry yields could also be a result of frost damage on floral bud development.

1.0 Introduction

Lowbush blueberries are generally managed on a two-year production cycle; in the first year of production, fields are pruned (sprout/prune year) and in the second year fields are harvested (crop year), (Barker et al. 1964). Fields are usually separated into two production years so that half the acreage is harvested in any one year (Kinsmen 1993; McIssac 1997). Fields are pruned (via mowing or burning) in the late fall or early spring of the prune year, before blueberry bud break (Barker et al. 1964; Eaton 2005), which stimulates the production of vigorous new shoots from underground rhizomes (Hall et al. 1972). The shoots grow rapidly until the early or middle part of the summer (usually July) at which time they undergo tip die-back (Bell 1950). Buds then develop into either vegetative of flowering buds during the latter part of August and early September (Bell and Burchill 1955). The type of bud that develops depends on which year the shoot arises and vegetative buds tend to be three times larger than floral buds (Kinsmen 1993).

On the Island of Newfoundland there are approximately seven commercial blueberry producers. In 2005, wild blueberry production on the Island totaled 2,100 acres, but as of 2010

production plummeted to 901 acres (Stats Canada, 2011). The blueberry leaftier (*Croesia curvalana*) moth is a common pest in Newfoundland blueberry fields (MADORE 2012) that overwinter in the leaf litter and causes significant crop losses for NL (Ponder and Seabrook 1988), but it not a significant pest of Maritime blueberry fields.

The standard fertilizer used for blueberry production is ammonium sulphate, as it contains sulphur which aids in lowering the soil pH. MicroEssentials (MESZ) fertilizer is constructed to contain all essential macronutrients on one granule of fertilizer. In theory, this is supposed to enhance the nutrient availability to crops, as all essential nutrients are contained in granule of fertilizer as opposed to several separate granules. The Mosaic Company (2012), states that every patented MicroEssentials granule has the same analysis, so that plants will get balanced nutrition, as it eliminates nutrient segregation common with traditional blends. In addition, MicroEssentials fertilizer combines two forms of sulfur; sulfate and elemental sulfur, in every granule to ensure sulfur availability throughout the growing season (Mosaic Company 2012).

On the Island of Newfoundland there are approximately seven commercial blueberry producers. In 2005 wild blueberry production on the Island totaled 2,100 acres, but as of 2010, production plummeted to 901 acres (Stats Canada, 2011). Given that NL's soil is naturally acidic with a low pH that is necessary for lowbush blueberry production, it would be thought that growing blueberries would be relatively easy, but given the recent statistics, it is crucial that the blueberry industry must be re-assessed to determine how it can once again become a profitable and productive industry.

In the early spring of 2013, before bud break, 100 acres of blueberry land was straw-burned to prune blueberry land, as well as eliminate weeds, diseases, and overwintering insect pests that were present. In addition to the 100 burned acres, the producer mowed an additional 4 acres of land. After all fields were pruned, the 104 acres of land received Velpar application at the recommended rate of 2.56 kg ha^{-1} for residual weed control, and t fertilizer was applied to ensure fruit set (Eaton 1994) at three different application rates. Randomized plots were setup within the mowed and burned fields to assess the effects of burning versus mowing in conjunction with agrochemical use on weed populations, blueberry leaftier populations and blueberry yields.

2.0 Project Objectives

The main objective of this project is to determine the effect of burning versus mowing in conjunction with agrochemical application on:

a) weed populations;
b) blueberry leaftier populations, and
c) blueberry yields.

3.0 Funding and Partnerships

Funding for this project was provided by Internal Research and Development of the Agrifoods Development Branch. This was a two-year project which commenced in spring of 2013.

4.0 Materials and Methods

Study site. This two-year project took place at Jumper's Brook Blueberry Farm Inc. in Grand Falls, NL. Lowbush blueberry has a biennial cycle, thus two years are required to obtain yield data.

Experimental design. The experimental design was a 2x3 Factorial Design in 4 blocks. The treatments consisted of a management technique at two levels (mowing or burning) in conjunction with the addition of fertilizer at three levels (0, 20 kg N/ha of 14-18-10 and MESZ @ 20 kg N/ha). Each treatment was replicated four times. Velpar 75DF was applied at a rate of 2.56 kg/ha in a water volume of 200 L/ha (1.9 kg of the active ingredient, hexazinone). Plots were 2 x 6m in size.

Data collection. *Percent cover and weed counts.* After agrochemical application, each 2 x 6m plot was assessed via percent cover twice per month throughout the growing season. Percent cover was divided into % bare ground, % *Vaccinium angustifolium*, % *Cornus canadensis*, % *Kalmia angustifolia*, % *Rumex acetosella*, % grasses, and % other. This parameter was assessed to show the effects of mowing or burning with fertilizer addition on weed populations and blueberry cover over time.

Blueberry leaftier monitoring. Blueberry leaftier (*Croesia curvalana*) populations were monitored throughout the sprout and crop year using pheromone traps baited with blueberry leaftier pheromone. Three to six traps were placed within each burned and mowed field as per scouting guidelines (Crozier 2001) for both years. Traps were monitored every two weeks from mid-June until mid-August, and the number of leaftier moths recorded.

Floral buds. In the prune year, twenty blueberry stems were collected from each 2 x 6m plot using a line transect that extended diagonally across each plot. The transect was marked at 40cm intervals and one stem directly below each mark was collected and the number os vegetative and floral bud numbers were recorded.

Yield. In the crop year, all 2 x 6m plots were harvested by hand with the use of a blueberry hand rake. Berries were weighed in the field with the use of a scale, and yields were determined.

Statistical Analysis. The data was analyzed using a two-way Analysis of Variance (ANOVA) in JMP®. Least Squares (LS) means differences were used to test for treatment differences using a probability level of $p \leq 0.05$.

5.0 Results and Discussion

Percent cover and weed counts. From qualitative observational analysis, it appeared that as the summer progressed, % coverage of blueberry increased (via stem density) more vigorously in the fertilized plots compared to the control.

Unfertilized plots appeared to have a larger percentage of bare ground, and blueberry percent cover was low. Both the AS and MESZ fertilizers increased blueberry cover over time, and the percentage of bare ground decreased. This is likely due to a response in nitrogen, which the plants absorbed thereby increasing their stem lengths and density to expand in size, and fill in the bare ground (Kennedy 2010).

Blueberry leaftier monitoring. *Vegetative-year data:* Moths were collected on three different trap periods in 2013. There was no significant difference between leaftier numbers among the three treatments in the first two trapping periods (p=0.1328, p=0.3541, respectively; Table 1). In the final trap period, however there were significantly fewer leaftier moths present in burn-pruned field compared to the mowed field and the control (Table 1). This indicates that burning can effectively control blueberry leaftier numbers, as burning can remove the overwintering larvae found in the organic duff layer on the surface of the ground. There was no significant difference in leaftier numbers between the control and the mowed field (Table 1), thus indicating that mowing and having no pruning technique does not effectively manage or control blueberry leaftier numbers.

Table 1. The effect of pruning on blueberry leaftier moth numbers at three trap dates during the prune-year.

	2013 – Prune Year		
Pruning Treatment	Jun 19 – Jul 3	Jul 3 – Jul 17	Jul 17 – Aug 12
	---------- # moths/trap ----------		
Control	0.00 a[1]	0.30 a	3.00 a
Mow	0.60 a	0.00 a	3.33 a
Burn	0.00 a	0.00 a	0.75 b

[1]LSmeans within a column (within trap date) with the same letter are not significantly different (p=0.05)

Fruiting-year data: Four trapping periods were used to monitor blueberry leaftier numbers in the crop year. During the first four trapping periods, there was no significant treatment effect on blueberry leaftier moth numbers. On the final trap date however, there were significantly higher leaftier moth numbers present in the mowed field compared to the control and burned-pruned field (Table 2).

Table 2. The effect of pruning on blueberry leaftier moth numbers at three trap dates during the crop-year.

	2014 – Crop Year			
Treatment	Jun 19 – Jul 11	Jul 11- Jul 24	Jul 24 – Aug 5	Aug 5 – Aug 20
	---------- # moths/trap ----------			
Control	0.83 a[1]	4.66 a	4.33 a	1.17 b
Mow	0.33 a	3.33 a	2.33 a	4.33 a
Burn	0.67 a	1.33 a	2.00 a	1.33 b

[1]LSmeans within a column (within trap date) with the same letter are not significantly different (p=0.05)

When both years of data are assessed together it is apparent that in the final trap period of the prune year, significantly fewer leaftier moths were present in the burned fields compared to the control and the mowed fields. (Table 1). In the final trap period of the crop year, significantly higher numbers of leaftier moths were present in the fields mowed the year prior, compared to

the control and the burned fields (Table 2). Significantly higher leaftier numbers present in the mowed field one year later indicates that mowing did not effectively control leaftier populations. Burn-pruning resulted in significantly fewer leaftier moths compared to mowing in both years of production (Tables 1 and 2).

Floral buds. The main treatment effects of pruning method and fertilizer had a significant effect on floral bud numbers (p=0.03, Figure 1), but there was no interaction effect (p=0.33, Figure 2). Significantly higher floral buds numbers were observed in the burn-pruned plots compared to the mowed plots (Figure 1).

These findings are similar to the finding of Penney et al. (1997) and Ismail and Hanson (1982), whom observed higher yields in burned plots compared to unburned plots.

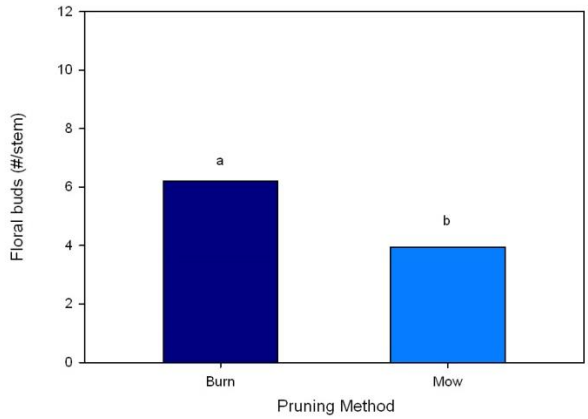

Figure 1. Effect of pruning method on average floral buds numbers. Means with the same letter are not significantly different ($p \leq 0.05$).

Fertility significant affected floral bud numbers (p=0.004). Higher floral buds numbers were observed in the fertilized plots compared to the control (Figure 2). Unfertilized plots obtained an average of six buds stem^{-1}, compared to eight and ten buds stem^{-1} in the MESZ and AS fertilized plots, respectively. This indicates that blueberry plants will experience a higher fruit set when fertilized, as higher floral bud numbers translates to higher flower initiation. It is important to note that all plots were treated with Velpar application, which could have also aided in higher floral bud numbers, as it removed competing weeds.

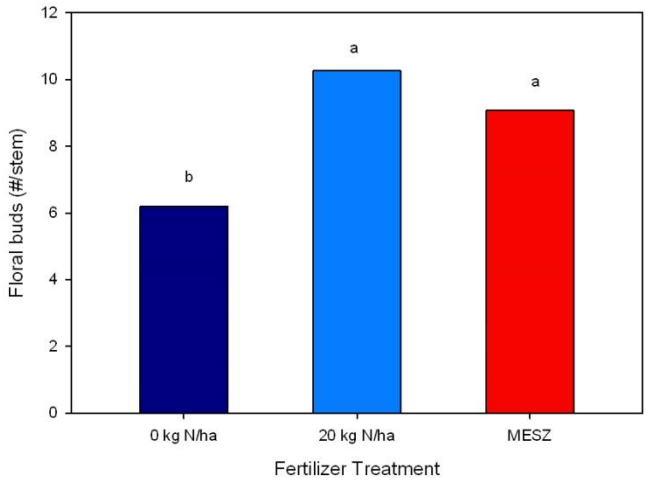

Figure 2. Effect of fertilizer treatment on average floral bud numbers. Means with the same letter are not significantly different ($p \leq 0.05$).

In this study, there was no significant difference in blueberry floral bud numbers between the MESZ fertilized plots compared to the AS fertilized plots (Figure 2). This indicates that the two fertilizers produced the same number for blueberry floral buds per stem and should in theory produce yields that are not significantly different from one another.

These findings indicate that it may be more beneficial to use the standard AS fertilizer for lowbush blueberry crops, as there were no significant difference in floral bud numbers, and the price of MESZ fertilizer is more expensive than the traditional AS fertilizer.

Blueberry yields. Floral bud numbers are collected in the prune year to provide an estimate of the potential yield for the crop year as fruit are not yet produced. Neither pruning method nor fertility, affected blueberry yields ($p=0.07$ and $p=0.43$, respectively; Table 3). The highest yields were obtained in the mowed plots, though these yields were not significantly different than those obtained from the burned plots.

Table 3. Main effects of pruning method and fertilizer treatment on blueberry yield in the crop year.

Pruning Method	Yield (lbs/acre)
Burn	921.2 a[1]
Mow	1423.1 a

Fertilizer	Yield (lbs/acre)
0 kg/ha	1164.1 a[1]
20 kg/ha	1438.2 a
MESZ	972.2 a

[1]LSmeans within a column (within trap date) with the same letter are not significantly different ($p=0.05$)

Applying 20 kg N/ha of ammonium sulfate resulted in the highest blueberry yields, which is the standard fertilizer rate for commercial blueberry production (Kennedy 2010). Plots that received MESZ fertilizer application had lower yields than plots that were treated with the standard AS fertilizer, though not significant. It is important to note that, there was not a significant difference in floral bud numbers or yields between the MESZ fertilizer and the

standard ammonium sulphate fertilizer. MESZ fertilizer claims to enhance the nutrient availability to crops, as all essential nutrients are contained in granule of fertilizer as opposed to several separate granules (Mosaic Company, 2012), thus the crop would produce higher yields. This was not the case for this study. MESZ fertilizer is considerably more expensive than the standard ammonium sulphate fertilizer, so farmers should not spend the extra money on this fertilizer as it does not equate to higher yield or profits.

Plots were harvested early due to an impending killing frost. A lack of significance in prune method and levels of fertility in the crop year (Table 3) with a clear significant pruning and fertility treatment effect on floral bud numbers (Figures 1 & 2) could be explained by the early harvest and frost events throughout the growing season which affected floral bud development.

1.5 Conclusion and Future Recommendations

Blueberry leaftier monitoring. The blueberry leaftier moth lays its eggs in the leaf litter of blueberry fields. Fields that are mowed or not pruned at all, will have significantly more litter compared to those that are burned. In this study, significantly fewer blueberry leaftier moths were present in the burned plots compared to the mowed plots in both years. This indicates that pruning by burning effectively removed blueberry leaftier eggs present in the leaf litter. In the final year of the study, significantly higher numbers of leaftier moths were present in the fields mowed the year prior compared to the burned fields and the control. This indicates that mowing did not effectively control leaftier populations. Burn-pruning resulted in significantly fewer blueberry leaftier numbers over the 2-year production cycle compared to mowing, thus indicating that burn-pruning is an effective management technique to remove and maintain leaftier populations on blueberry land (Campbell 2004; Ponder and Seabrook 1988).

Floral buds and Yield. Floral bud numbers are an indicator of potential yield in the prune year when lack of yield data is not obtainable. Significantly higher floral bud numbers were observed in burn-pruned plots compared to mowed plots. The fields that were pruned in this study were left untouched for more than three years, and had a significant amount of organic matter on top of the duff layer, which could explain why the burned plots resulted in higher floral bud numbers compared to the mowed plots. Significantly fewer floral buds were present in the unfertilized plots compared to the plots that received fertilizer indicating that fertilizer aids in floral bud development.

Neither pruning method nor fertility had a significant effect on blueberry yields, which is contradictory to what the floral bud numbers in the prune year would have indicated. Plots were harvested early due to an impending frost which may account for the lack of significance in the treatment effects. A lack of main treatment effects on blueberry yields could also be a result of frost damage on floral bud development. Whether a field is opted to undergo burning or mowing is producer-specific decision, and largely depends upon time, health of the field, diseases or pests present in the field, and money. Burning pruning is significantly more costly than mowing due to the cost of either oil or imported straw to conduct the burn (Gomez 1988), but as this study exhibited, burning effectively lowered leaftier numbers and higher floral bud numbers.

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