Wild Blueberry Research

in Maritime Canada

2005-2007

Prepared by

Wild Blueberry Producers Association of Nova Scotia

Bleuets NB Blueberries

Prince Edward Island Wild Blueberry Growers Association Inc

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Prepared for Maritime Canada wild blueberry producers by:

Bleuets NB Blueberries,
The PEI Wild Blueberry Growers Inc
and
The Wild Blueberry Producers Association of Nova Scotia

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INTRODUCTION

The challenge of producing wild blueberries in eastern Canada is constantly changing. Improvements in one area of production can often trigger new challenges or questions in other areas. Increasing costs of production and ever changing insect, disease and weed pressures require new management strategies if producers are to remain competitive and profitable. Strong research support is key to continuous improvements in production management.

This summary of wild blueberry research activities has been complied for the benefit of all blueberry producers in the three Maritime provinces. The three wild blueberry producer organizations, Bleuets NB Blueberries, the Wild Blueberry Producers Association of Nova Scotia and The PEI Blueberry Growers Association believe that it is important that all producers be aware of the research activities undertaken to address production problems and opportunities in the wild blueberry industry. This information will also enable producers to provide needed imput into the discussion on research priorities within the region.

The research summaries included in this publication represent the work of Maritime researchers over the past three years. In a few cases, summaries are included for earlier work as well. There are also articles which cover a small amount of the work at the University of Maine. The results presented in these summaries should not be construed as recommendations. They are simply the results of individual research studies. Given the extreme variability between and within blueberry fields, and the wide range of factors which impact on blueberry yields, it can take many research studies to resolve questions. Even then, new recommendations need to be adapted by individual producers to work with their particular set of field conditions. Nonetheless, information is power! The more producers understand about the wild blueberry and its environment, the better position they are in to make sound management decisions for their farm operation.

The summaries provided are very brief. Producers are encouraged to contact the authors or their agricultural representative if they want to get further information on any of these research initiatives.

This publication is a joint project of the three Maritime wild blueberry organizations and has been funded with the support of the Advancing Agriculture and Agri-Food Program of Agriculture and Agri-Food Canada. We would like to express our sincere thanks to the many researchers in the region who have supported this initiative and provided summaries for inclusion.

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John Handrahan, President, PEI Wild Blueberry Growers Association

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CROP AND FIELD MANAGEMENT

An intelligent irrigation system for wild blueberries

Jean-Pierre Privé, Michel Rocheleau and Lindsay Russell

The objective of this study is to evaluate, utilize and integrate leading edge environmental monitoring technologies that will ensure optimal plant growth, development, yield and composition, with minimal use of irrigation and provide simultaneous advances in environmental stewardship. To achieve this, Intelligent Irrigation Systems (IIS) were installed in Tracadie NB (2006) and Debert NS (2007). All the information for both sites has been entered into a variable rate irrigation system software package called Aqualink. The IIS accurately determined soil moisture levels in the lowbush blueberry fields at both sites and provided the communication links to irrigate, on-demand, those areas requiring water.

Modifications to existing plant moisture sensors will be made in 2008 to reduce their costs and ease of use. To help in this exercise, new collaborators from NSAC, Ag Engineering Department (Dr. P. Havard, Dr. A. Martynenko and D. Sampson), have been added to the team to provide technical expertise in the modification of the wireless components of the system. Frost protection components and cycles were successfully added to both sites, tested and modified in 2007. A grant proposal has been accepted for the use of biological foams for frost protection and as carriers for various bioproducts, i.e., fertilizers and pesticides. Greenhouse experiments have been initiated to examine the interaction between water use efficiency and the beneficial effects of irrigation on reducing *Septoria* leaf spot. Vegetation dynamics (weed emergence periodicity, density and biomass) was collected at both sites in 2007 and analyzed without any significant effects.

Evaluation of mixed media for erosion control in lowbush blueberry

K.E. Glover, K. Jensen, P. Hinkleton, K.M.Perrin, and S.A.E. Fillmore

This study evaluated methods to increase the germination and establishment rates of a Velpar tolerant grass, *Agrostis hyemalis* (hairy ticklegrass) for use in commercial blueberry production systems as a living mulch to control soil erosion and encourage re-colonization of blueberry clones. Two methods for improving stand establishment were identified: hydroseeding and covering the eroded soil area with an organic mulch prior to seeding. In the first year, following conventional seedbed preparation, a hydroseeding mix (commercially available ticklegrass seed, fertilizer, tackifier and water) was sprayed on bare soil (control) and one of three different organic materials: i) paper mill sludge, ii) green cart waste and iii) municipal waste. This experiment was conducted at two sites using three replicates of a randomized complete block design. The plots that received organic amendments typically had significantly increased groundcover ratings (80-90%) whereas the bare soil plots were limited to a range of 50-60%.

Based on the success of this experiment, a hydroseeded trial was initiated on eroded soils of two commercial blueberry fields using Velpar tolerant ticklegrass seed and green cart compost. In contrast to the first experiment, the ticklegrass did not establish well in the commercial blueberry fields. *A. hyemalis* is readily found in blueberry fields yet very little is known about its reproduction. While we have clearly demonstrated the ability to hydroseed ticklegrass and improve establishment with organic mulches, further study is required to optimize establishment under the adverse conditions presented in eroded blueberry fields. For example, eroded areas tend to be droughty and therefore the optimal seeding date for establishment may be much earlier than on conventionally prepared soils.

Estimation of wild blueberry fruit yield using digital color photography

Q.Zaman, A. Schumann, D. Percival, and R. Gordon

The wild blueberry industry of North America may benefit significantly from precision agriculture technology. Currently, crop management practices are predominantly dependent upon blanket application of agrochemicals without considering the substantial variation in soil properties, bare spots, topographic features, and fruit yield in blueberry fields. Yield maps along with fertility, weed and topographic maps can be used to generate prescription maps for site-specific application of agrochemicals. Two wild blueberry fields were selected in central Nova Scotia in 2007 to evaluate a photographic method for fruit yield estimation. A 10-megapixel 24-bit digital color camera was mounted on a tripod and pointed downwards to take photographs of the blueberry crop from a height of about one meter. At harvest time, blueberry crop images were collected in each field at 30 different sample locations displaying a range in yield. Actual fruit yield was sampled from the same locations by hand-harvesting out of a 0.5 x 0.5 m quadrat, using hand raking. Custom image processing software was developed to count the blue pixels of ripe fruit in the quadrat region of each image and express it as a percentage of total quadrat pixels. Linear regression was used to calibrate the fruit yield with percentage blue pixels separately in each field and then the calibration equation of field 1 was used to predict fruit yield in field 2 for validation of the method.

Results: A strong relationship between the percentage blue pixels and actual berries was present in field 1 (R^2=0.98, n=30) and field 2 (R^2=0.99, n=30). The relationship between actual and predicted fruit yield in the second field (validation) was also highly significant (R^2=0.99, n=30, RMSE=277 kg/ha). Based on these results an automated yield monitoring system consisting of a digital camera, computer and DGPS will be developed and incorporated into a harvester to monitor and map blueberry fruit yield in real time.

New harvester container for wild blueberries

Leonard J. Eaton, Charles F. Forney and Leigh Gao

Research studies were conducted over four years to assess the feasibility of using pallet-sized high capacity containers to replace the current 20-25 pound plastic box.

Results: Significantly more damage of fruit occurred at the bottom of containers filled to 14 inches than in those filled to 7 inches. Damage of fruit transported in prototype pallet-sized boxes with fruit depths of up to 10 inches was similar to that in the standard 20-25 pound plastic boxes. In addition, damage to fruit during transport, handling and dumping was similar in pallet-sized boxes and standard 20-25 pound boxes. Pallet-sized boxes with storage depths up to 10 inches can be used without causing significant fruit damage during harvest, transport and processing. Reduced handling requirements could result in increased harvest efficiency, improved harvest timing and possible higher fruit quality.

Physical and chemical changes in lowbush blueberry berries during ripening

Lara Gibson, Charles Forney, H.P. Vasantha Rupasinghe and Leonard Eaton

Fruit ripening in lowbush blueberries is dependent on the genetic characteristics of the clone as well as environmental conditions in the field, which results in variable rates of ripening among fruit on a stem. Therefore, identifying the optimal time for once-over harvest to maximize yield and quality is a challenge. The long term goal of this study is to investigate a potential ripening index

to determine the optimum harvest time. This investigation was carried out to understand the effect of date of harvest on the selected physical and chemical properties of physiologically ripe (blue) fruits. Fruits were collected early (% ripe berries was low), mid (% ripe berries was peaked), and late season (berries were turning to overripe) from five commercial fields in Nova Scotia during 2006 and 2007. The density of fruit ranged from 0.7 to 1.1 at the early season, 0.9 to 1.1 at the mid season, and 0.95 to 1.05 at the late season.

Results: In general, the soluble solid content (SSC) of berries increased from 10.5% to 11.5% during the season but depended on field location. In all locations, pH of fruit decreased over the season from 2.9 to 3.2, while titratable acidity (TA) decreased from 0.7% to 0.4%. The concentrations of quinic and succinic acid decreased over the season while the concentration of malic, citric, and shikimic acids remained unchanged. The concentration of glucose and sucrose of ripe fruit were found to increase through the season.

CROP NUTRITION AND SOIL FERTLITY

Leaf nutrient ranges for wild blueberries in Prince Edward Island

Kevin Sanderson, Chris Jordan, Sherry Fillmore and Sylvia Wyand

We collected leaf samples from 61 wild blueberry fields in Prince Edward Island (PEI), Canada from 2003 to 2005 and analyzed for macro- and micro-nutrient content. Leaf samples were collected at the terminal abortion stage which is usually early to mid August from sprout-year fields only. Results of leaf samples were summarized for minimum, maximum and mean concentrations.
Results: Mean leaf nutrient concentrations were: 1.51% nitrogen (N), 0.127% phosphorus (P), 0.51% potassium (K), 0.59% calcium (Ca), 0.16% magnesium (Mg), 0.22% sulfur (S), 2.8 ppm copper (Cu), 32.0 ppm boron (B), 11.4 ppm zinc (Zn), 21.6 ppm iron (Fe) and 1351 ppm manganese (Mn). All elements except for Mn are described by the mean ± 1 standard deviation (SD).

Maritime Provinces wild blueberry fertilizer study

Kevin Sanderson, Leonard Eaton, Michel Melanson, Sylvia Wyand, Sherry Fillmore and Chris Jordan

Field experiments were carried out over a four year period (2001-2004) at one commercial site in each of the Maritime Provinces; Prince Edward Island, Nova Scotia and New Brunswick. The study was designed to determine the effects of applied fertilizer: in sprout year only, and in both sprout and crop year on leaf and soil concentration, plant development and yield.

Results: Sprout-year applications of fertilizers; ammonium sulfate, di-ammonium sulfate and 17-17-17 and crop-year application of ammonium sulfate did not affect soil and leaf concentrations, plant growth or yield. When comparing the mean of fertilizer applications to unfertilized plots, levels of soil, P, K and S were increased and soil pH decreased and leaf tissue concentrations of N, P, K and S were increased. Stem length, number of live buds and number of blossoms were increased; however, yield was not affected in the first cropping cycle and lowered in the second cropping cycle by applications of fertilizers. Crop-year applications of ammonium sulfate provided no benefit to wild blueberry production.

Comparison of consecutive and alternate fertilizer applications in wild blueberry production.

Leonard Eaton, Kevin Sanderson and Sherry Fillmore

Growers must be very conscious of impacts on the environment and keeping fertilizer costs to a minimum. We conducted two experiments to evaluate the response of wild blueberries to soil-applied fertilization over four-cropping cycles in Prince Edward Island and Nova Scotia from 1997-2004. Commercial fertilizers (17-17-17, 18-46-0 and 13-26-5) were soil-applied in the sprout year either as a consecutive fertilizer application (every cropping cycle) or alternate fertilizer application (every second cropping cycle). All fertilizers were applied at a rate of 200 kg ha^{-1}.

Results: Fertilizer applications increased soil levels of P and K, leaf tissue concentrations of N and P and stem lengths of plants. Higher levels of soil P and leaf tissue concentrations of N, P and K were observed with consecutive than with alternate fertilizer applications. Average stem lengths, buds and blossoms per stem were higher, over the length of the study, when fertilizers were applied consecutively compared to alternately. Fruit yields were not affected by any fertilizer treatments, whether applied consecutively or alternately. Alternate fertilizer applications may reduce soil accumulation of P and production costs.

Wild blueberry growth and yield in Prince Edward Island are not affected by applied phosphorus

Kevin Sanderson and Leonard Eaton

Information is required on the response of wild blueberry (*Vaccinium angustifolium* Ait.) to soil-applied phosphorus in Atlantic Canada. To address this issue in wild blueberry production, we studied the effect of soil-applied P fertilizers on yield and soil P content in Prince Edward Island. Two field studies conducted over 3 cropping cycles (1992-1997) evaluated crop response on loamy sand to sandy loam Orthic Podzol soils where residual P levels ranged from 33 to 44 Φg P g^{-1}. Treatments consisted of soil-applied P at 0, 10, 20, 30 and 40 kg ha^{-1} applied to the same plots in the sprout year in each of three consecutive cropping cycles. There was a positive linear relationship between application rate of P and extractable soil P and leaf tissue P concentration. Over the six years of the study, soil extractable P was increased 67, 85, 100 and 98% with applications of 10, 20, 30 and 40 kg P ha^{-1}, respectively. Increases in levels of tissue P concentration were less dramatic.

Results: Plant growth and yields were not affected by rate of soil-applied P fertilizer. Therefore, wild blueberry growers can maintain crop yield with lower fertilizer P applications while limiting the buildup of soil P and reducing the potential for environmental damage.

Effects of summer and fall applications of foliar boron on wild blueberry fruit bud winter injury

Leonard Eaton, Hal Ju and K.R. Sanderson

Boron is a micro nutrient that is important in small fruit production, and plays a role in fruit bud development and possibly in tolerance of harsh winter conditions. Boron is applied to a few wild blueberry (*Vaccinium angustifolium* Ait.) fields in Nova Scotia, but little is known of its effects. This study reports the effects of single and multiple applications of foliar B to two commercial wild blueberry sites during the period, 1999-2001. The effects on tissue B concentrations and winter injury to developing fruit buds were evaluated using Foliar B (Bortrac7).

Results: Foliar B applied in summer, fall and summer + fall, resulted in increased tissue B levels in the first crop fruit buds compared to untreated controls at the North Nova site, but the increases were not observed one year later in second crop fruit buds. Applications of foliar B in the summer + fall applied in two successive cropping cycles at the Fern Walker site reduced winter injury compared to untreated controls. Multiple foliar B applications to wild blueberry fields can reduce winter injury to developing fruit buds as indicated at one site for one year.

Spatial variation of wild blueberry N, P and K levels using hyperspectral techniques

Camille Bourguignon, D. Percival, J. P. Privé and R. Robinson

Current wild blueberry leaf macronutrient analyses are costly and time consuming. VIS/NIR hyperspectral techniques have been considered as an alternative for various crops. A CASI 550 and a FieldSpec Pro radiometer were used to determine whether spatial (in-field) variations of wild blueberry leaf N, P and K contents could be accurately estimated. In May 2004, a multiple location N-P-K experiment (16 treatments, 4 replications) was established. Combinations of amounts of nitrogen, phosphorus and potassium were applied to induce variations in leaf nutrient contents. Leaf sampling and CASI data collection occurred in August and September 2004, as well as in June and August 2005. Radiometer data was collected within the research plots in September 2004 and July 2005. Foliar N, P and K were conventionally determined and used as standards to compare the results from the CASI and radiometer data. Results indicate that both CASI and the Personal II radiometer can detect foliar N and P variations. Variability in results reflected the lack of response of plants to fertilization, as weather, poor pollination and disease had more influence. Overall, best results were obtained in September 2004 for both sensors.

Results: Results from this study indicate that commercial use of CASI involves intensive data organization and analysis, and may be cost prohibitive. In addition, the use of a VIS/NIR radiometer may have the potential to assess leaf tissue nutrient levels on a geospatial basis within wild blueberry fields. However, further replication and continued refinement of appropriate techniques is required before commercial adaptation can occur.

Environmental losses of soil-applied nitrogen sources in lowbush blueberry production

Gloria Thyssen, David Percival, Kevin Sanderson, and David Burton

Environmental losses of soil applied nitrogen fertilizers were examined in two separate trials. The volatilization trials, examining ammonia loss, were established in commercial wild blueberry fields in the vegetative phase of production in Nova Scotia (NS) and Prince Edward Island (PE) in 2004 and 2005. A leaching experiment was established and completed in the winter 2005, in a controlled environment using intact soil cores collected from the Wild Blueberry Research Centre (Debert, NS) in November 2004. A randomized complete block experimental design with five replications was used in all trials. Treatments used in the volatilization trial consisted of a control (no fertilizer application) and nitrogen applications (35 kg $N \cdot ha^{-1}$) of ammonium sulphate (AS), urea (U), diammonium phosphate (DAP) and sulfur coated urea (SCU). The leaching trial consisted of the same treatments along with Isobutylidene diurea (IBDU) and Nutroform (NF).

Results: As far as results from the volatilization field trial were concerned, significant treatment effects were present at the Kemptown site in 2004, with volatilization rates of the U and SCU treatments being 321 and 207% greater than the control respectively. Significant treatment effects were also present in 2005, with the DAP and U treatments having the highest emissions in NS and PEI, respectively. Significant results from the controlled environment leaching trial were

also present, with IBDU having the highest nitrate leaching rate, and AS having the highest rate of ammonia leaching. Therefore, results from this study indicate that volatilization and leaching losses are significant and site specific and can provide the basis of inadequate blueberry growth.

Wild blueberry nutrient management

David Percival, Michel Melanson, Étienne Thériault and Gaëtan Chiasson

Trials were initiated in New Brunswick in 2005, to examine the impact of existing and reduced environmental risk fertilizers on (i) the release of nitrogen from ammonia volatilization and leaching; (ii) soil residual N, (iii) plant N (including carryover and crop removal considerations); and (iv) subsequent plant growth, development and berry yield. Results from controlled environment leaching studies indicated that overall, the diammonium phosphate and sulfur coated urea treatments leached more ammonia than the other nitrogen sources examined (urea, sulfur coated urea, IBDU and Nitroform™). Although there were no significant treatment effects on nitrate leaching, leached nitrate levels were higher than anticipated.

Results: Upon examining the influence of nitrogen source on volatilization and greenhouse gas emissions, urea and sulfur coated urea had volatilization rates that, at selected dates, were more than 50% greater than the other nitrogen sources. However, from a cumulative perspective, these N losses were only 5 to 12% of nitrogen applied. Similarly, nitrous oxide and carbon dioxide emissions were very low, resulting in wild blueberry fertility practices not being a significant contributor of greenhouse gases.

Soil analysis results from the residual nitrogen trials provided insight into the fate of fertilizer applications in wild blueberry production. Three weeks after applying the fertilizer treatments, the majority of the soluble nitrogen in the blueberry soils was found in the top 0 to 15 cm of soil; less than 30% of the total soluble nitrogen was in the form of either ammonium or nitrate; and residual soil nitrate levels were higher than ammonium levels at all three depths examined (0 to 15, 15 to 30, and 30 to 45 cm). An impact on harvestable yields was evident with all three nitrogen sources (ammonium sulfate, urea and Nitroform™) having greater stem lengths and harvestable yields than the control.

This research project also demonstrated that the use of hyperspectral technologies can accurately estimate leaf tissue nitrogen levels, and that leaf tissue nutrient levels appear to have no relationship to the occurrence or severity of either *Septoria* leaf spot or blueberry rust. However, care must be taken not too facilitate too tall or dense a wild blueberry canopy, otherwise, conditions most likely conducive to leaf diseases will occur.

Results from this study have provided needed information on the influence of various forms of nitrogen on environmental losses, soil nitrogen dynamics and resulting effects on wild blueberry growth and development.

The use of phosphorous and potassium fertilizer in the fall preceding the first production cycle in a new blueberry field

Gaétan Chiasson et Bernard Savoie

A trial was established in 1999 to evaluate the effect of a fall application of phosphorous and potassium preceding the first production cycle of a new blueberry field versus a spring application of these elements in the first sprout year. The experiment consisted of a control treatment (without fertilizer), a fall treatment with P and K followed by a spring application of N, and a spring treatment of a complete fertilizer (NPK). The treatments with fertilizer all received the equivalent

of 50 kg/ha of N, P_20_5 and K_20. Soil and leaf analysis were taken at the tip dieback stage. The soil was analyzed at depths of 0-5 cm, 10-15 cm and 10-15 cm. These analyses permitted the evaluation of nutrient movement in the soil, as well as, nutrient content in the tissue. It was noted that the movement of phosphorous was more rapid than anticipated, and that there were no differences in leaf content of P and K between the two treatments receiving fertilizer.

Results: The availability of these elements with a spring application was similar to that of the fall application. From a financial point of view, a fall application is not justified to improve the absorption of P and K by the plants. This trial also permitted us to determine the level of principal nutrients in the various levels of soils analyzed.

Effect of kelp in wild blueberry production

Kevin Sanderson and Leonard Eaton

Wild blueberry growers continually seek new options for fertility programs in wild blueberry production. Nutrient uptake and yield response to chemical fertilization have been inconsistent. Gypsum as an organically accepted amendment benefits tissue nutrient status but also gives inconsistent yield response. There is presently much interest in organic seafood compounds as organic fertilizers. We evaluated Kelp as an organic amendment in blueberries, with replicated trials at Culloden, PE and East Gore, NS over two cropping cycles. Kelp was applied at several rates with or without chemical fertilizer either in the spring or the fall of the sprout year.

Results: In the first cropping cycle, no effect was observed on live buds, blossoms, or yield. Limited movement of leaf tissue Fe and B was observed in PE in sprout year and soil Ca and Mg in crop year in NS. In cycle 2, stem length in the PE site and live buds, blossoms and stem length in NS were increased by chemical fertilizer (10-10-10 at 300 kg/ha). Minor changes were observed in leaf and soil nutrient concentrations, but these were not consistent across sites. Results indicate that kelp applied as a natural organic soil amendment either alone or in conjunction with chemical fertilizer did not affect wild blueberry growth or yield.

Evaluation of fertility strategies in wild blueberry organic production

Kevin Sanderson and Sylvia Wyand

This study is designed to evaluate a group of approved organic fertility amendments in wild blueberry production systems. The trial was established in 2007 on a sprout field. We plan to evaluate 2 cropping cycles with a re-application of each product in the sprout year of the second cropping cycle. Treatments include a control (no application), Greensand, potassium sulphate, gypsum, Boron, Tiger 90 and a combination of gypsum, Greensand and Boron. We will be monitoring soil and plant nutrient, stem growth parameters and yield. The study will provide a comparative assessment of these products.

WEED MANAGEMENT

Integrated weed management for lowbush blueberries

Nathan Boyd

Sole reliance on the limited herbicides available to manage weeds in lowbush blueberries will lead to herbicide resistance, population shifts, and increased chemical inputs over time. The goal of the Vegetation Management Research Program at NSAC is the development of integrated weed management systems. Initial research efforts focus on; (i) the importance of preventing the spread of weed species within and between fields, (ii) understanding the biology of the organisms we are attempting to manage, and (iii) the effective use of herbicides to manage weed populations. Simple models will be presented to illustrate the potential economic benefit of taking a proactive approach to managing weed infestations. The development of integrated approaches to weed management will help ensure the long-term sustainability of the production system.

Grass and sheep sorrel management with herbicides and fertility inputs in lowbush blueberry

Nathan Boyd and Scott White

Weeds are a significant yield-limiting factor in lowbush blueberry fields. Effective weed management requires an integrated approach. Four experiments were conducted in commercial fields in Nova Scotia, New Brunswick, and Prince Edward Island to evaluate herbicide products for sheep sorrel and ticklegrass control and examine the impact of fertility inputs on sheep sorrel and ticklegrass growth and management.

Results: Applications of 143 kg/ha of 14-18-10 fertilizer more than doubled the ticklegrass and overall weed biomass produced. Across all fertility treatments, Venture (fluazifop-p-butyl) applications reduced ticklegrass biomass production from 819 kg/ha to 425 kg/ha.

Herbicide and seasonal effects on weeds in wild blueberry fields

Shaun Sharpe, David Percival, Nathan Boyd, Gordon Brewster and Qamar Zaman

Weed populations are a major limiting factor on the production of wild blueberries, competing for light, moisture, space and nutrients. To assess the impact of existing pre- and post emergence herbicides on vegetation dynamics, a field experiment was conducted at two commercial fields in Nova Scotia during 2006 and 2007. The herbicides used were applied at label rates and treatments consisted of: (1) no herbicide application, (2) application of Velpar, (3) application of Venture, (4) application of Velpar and Venture. Plot uniformity was measured using a 15 cm diameter circular quadrat, 16 times within a plot, over 4 timings in the crop year of production.

Results: The most frequently occurring uncontrolled weeds were bunchberry (no significant treatment or timing effect), sheep sorrel (significant treatment and timing effect at one site, an interaction at the other) and moss (significant timing effect at both sites). Goldenrod, poverty oat and wood rush occurred primarily in control plots. Cow wheat plot uniformity was highest within the Velpar and Venture treatment. Given the hemi-parasitic nature of cow wheat with blueberries, the impact of this plant species on wild blueberry growth and productivity needs to be further examined.

Weed research in wild blueberry and late season weed control

Nathan Boyd and Scott White

Weeds are a significant yield-limiting factor in lowbush blueberry fields and have been identified as a key research need in several regions. The Vegetation Management Research Program located at NSAC conducted a wide range of experiments in 2007 that: (i) examined the impacts of fertilizer applications on weed growth, (ii) evaluated herbicide products for sheep sorrel and grass control, and (iii) evaluated multiple application timings for Mesotrione (Callisto) applications.

Results: Preliminary results from herbicide evaluation trials found that at least 80% ticklegrass control was achieved with Venture, Ultim (Nicosulfuron /Rimsulfuron), and Sinbar (Terbacil) applications. We also found that Velpar (Hexazinone), Kerb (Propyzamide), and Casaron (Dichlobenil) applications significantly reduced sheep sorrel shoot density across a range of sites. Optimal control of goldenrod infestation in the sprout year was achieved when Mesotrione was applied when the plants were between 10 and 30 cm tall. Unsatisfactory control of sedges/rushes was obtained at all sites in the crop and sprout year.

Grass management in lowbush blueberry.

Nathan Boyd

Perennial and annual grasses are a significant yield-limiting factor in lowbush blueberry fields in the Maritimes. The development of best management plans for grassy weeds is one of the top priorities of the Vegetation Management Research Program. Experiments have been conducted in commercial fields in Nova Scotia, New Brunswick, and Prince Edward Island in 2007 to evaluate herbicide products for grass management and examine the impact of fertility inputs on grass growth and reproduction.

Results: Preliminary results from multiple trials suggest that fertility inputs significantly impact grass growth and can alter their reproductive and competitive potential. For example, applications of 143 kg/ha of 14-18-10 fertilizer can double ticklegrass biomass in the sprout year. Inadequate grass control can hinder harvest operations and significantly reduce yield potential. Post emergence applications of fluazifop-p-butyl, nicosulfuron/rimsulfuron , and sethoxydim adequately controlled ticklegrass and witchgrass in the sprout year. Crop year applications of nicosulfuron/rimsulfuron and rimsulfuron controlled witchgrass but fluazifop-p-butyl was less effective. Lower fluazifop-p-butyl efficacy is attributed to the plant growth stage at time of application. Preemergence applications of terbacil consistently provided adequate control of ticklegrass and witchgrass. Preemergence applications of dichlobenil in the spring and fall effectively controls tickle grass and poverty oat in the crop or sprout year. Fall applied pronamide controls tickle grass in the crop or sprout year but is not effective on poverty oat. Preliminary observations suggest that pronamide may control multiple grassy weeds in lowbush blueberry.

The impact of time of Callisto application on Goldenrod and Black Bulrush control

Scott White and Nathan Boyd

Emergency registration was obtained in 2007 for the use of Mesotrione (Callisto) in the sprout year of lowbush blueberries. Mesotrione has been used by growers with varied success on goldenrods and sedges/rushes. Experiments were conducted at sites in Nova Scotia and New Brunswick to evaluate application timings in sprout and crop year fields. In sprout year fields,

Mesotrione was applied at 333 g a.i./ha in 200 L/ha of water. Applications occurred when the target plants; (i) were10 cm tall, (ii) were 30 cm tall, (iii) had developed flower buds, and (iv) were in full flower. In crop year fields, Mesotrione was applied at the same rate when plants were 10 cm tall, had developed flower buds, and were in full flower.

Results: Preliminary results suggest that optimal control is achieved in the sprout year when Mesotrione is applied when the plants are between 10 and 30 cm tall. In the crop year, optimal control was obtained at the flower bud growth stage. Later applications in the crop year are warranted due to the need of the goldenrod to grow above the blueberry canopy before adequate control was possible. Unsatisfactory control of sedges/rushes was obtained at all sites in the crop and sprout year.

An assessment of mesotrione (Callisto) and hexazinone (Velpar) on weeds in wild Maine blueberries

David Yarborough and Kerry Guiseppe

Hexazinone has been the principle herbicide used in Maine wild blueberry fields for over twenty years. There is evidence that reliance on hexazinone without other alternative herbicides has resulted in increased populations of grasses and other herbaceous weeds. There is a need for herbicides with different modes of action for herbicide rotations in wild blueberry fields. In order to evaluate the herbicide mesotrione with and without hexazinone a split block design was established on six wild blueberry fields throughout the state to obtain a diversity of soil types and weed species. A block was established in the Maine towns of Union, Belfast, Penobscot, Orland, Township 19 and at the Blueberry Hill Experimental Farm in Jonesboro. A 16 x 20 m block was comprised of 4 X 16 m treatment plots including an untreated control, mesotrione at 444 ml/ha pre-emergence, 222 ml/ha pre-emergence and 222 ml/ha post-emergence on the same plot, and 222 ml/ha post-emergence. At right angles on an 8 X 20 m plot of either an untreated control or a hexazinone treatment at 1 kg/ha was applied to give a total of eight combinations. Pre-emergence treatments were sprayed on 8-11 May. Post emergence treatments were sprayed on 6-9 June. Treatment effects were assessed for broadleaf, fern and grass weed cover using a Daubenmire cover scale and wild blueberry phytotoxicity as percent injury from four 1m square subplots within each treatment. The first weed cover evaluation was on June 19 and 23 and the second was on August 14 and 23, 2006. A carryover weed control assessment and yield samples were taken from the six sites treated in 2005. Weed assessment occurred on June 19 and 23. Plots were harvested using four 1m square subplots within each treatment and weights are in pounds per plot. Blocks were harvested on 26 July to 3 August.

Result: The mesotrione applications at the higher rate preemergence or at the low rate pre and post emergence gave equivalent control to the hexazinone application. When these applications were combined with hexazinone additional suppression of both grasses and broadleaf weeds were obtained. These treatments, except for the post emergence flumioxazin resulted in higher yields than the control and equivalent yields to the hexazinone standard treatment. Mesotrione may be used alone or in combination to provide weed suppression and increased yields in lowbush blueberries.

Evaluation of herbicides for weed control in lowbush blueberries

Glen Sampson & J. Costain**,**

Weed control remains a high priority to ensure an effective lowbush blueberry crop production system. The reliance on hexazinone has resulted in weed population shifts to tolerant weeds and

herbicide resistant weeds. It is important to provide additional tools to producers that would allow them the opportunity to rotate weed control options to reduce selection pressures for such shifts. This has been the focus of the research program of the Weed Science Research Laboratory at the Nova Scotia Agricultural College for the past 20 years. Research conducted this past season was the continuation of a longer term project dedicated to providing low bush blueberry producers with as many weed control options as possible. Current high priority weed species were used to screen new herbicides (e.g. flumioxazin (Valor), sulfentrazone (Spartan)). In order to maximize weed control with mesotrione, this herbicide was evaluated alone and tank mixed with herbicides designed to provide grass control.

Results: Initial results from the 2006 growing season provided excellent data which will encourage further research into the concentration, timing, and surfactant selection of new herbicides to further define the use spectrum of these new herbicides.

Evaluation of fall herbicide application for lambkill and rhodora control in wild blueberries followed by varied crop pruning method

K.V. McCully, G. Chiasson, E. Theriault, M.J. Melanson and G.L. Graham

A trial was established in the fall of 2004 in Val Doucet, NB to evaluate the effect of a fall application of dicamba, 2,4-D ester plus dicamba, triclopyr, glyphosate or glyphosate plus Sylgard on weed control of lambkill (*Kalmia angustifolia* L.) and rhodora (*Rhododendron canadense* L.) followed by mowing or burning for vegetation management. In addition to crop yield, visual observations on crop injury and weed control were collected.

Results: Pruning practices after herbicide application did not have an effect on weed control efficacy or crop tolerance in this trial. All herbicides tested caused significant blueberry injury early in the season, with the triclopyr, glyphosate and glyphosate plus Sylgard recovering to commercially acceptable levels by the end of the test period. Dicamba injury was severe and crop yield was reduced. Only dicamba offered extended control of lambkill, with the remaining treatments showing a level of suppression. Dicamba mixtures were also successful in controlling rhodora, with greater than 80% control over all evaluation timings. Triclopyr offered moderate suppression and the glyphosate mixes demonstrated limited to no activity against these weed species. As these are major weed problems in blueberry production, producers may accept a higher level of blueberry damage if the weed problem can be controlled. The damage shown by dicamba mixtures would not be acceptable in a well established field, but a reduction in yield may be acceptable within the establishment years, especially if rhodora could be effectively controlled. Further testing is required to verify the results found and to examine other innovative herbicide combinations.

Evaluation of fall and spring applied tribenuron methyl (Spartan) for bunchberry control after hand and mechanical harvest of wild blueberries

K.V. McCully, G. Chiasson, E. Theriault, M.J. Melanson and G.L. Graham

Two trials were established in the fall of 2004 to evaluate the control of bunchberry (*Cornus canadensis* L.) and crop injury with fall and spring applications of tribenuron methyl (Spartan) in a wild blueberry field following hand and mechanical harvest. Treatments of Spartan were applied at the label rate one week, two weeks, three weeks, four weeks and the following spring after harvest to the assigned blueberry plots. An untreated control plot was included for control and injury comparisons. Visual evaluations of crop injury and weed control were collected, along with crop yield parameters in the fall of the sprout year and crop yields at maturity.

Results: No difference in crop injury or weed control was noted between the harvest methods, where a fall Spartan application to control bunchberry proved to be successful. No significant difference was shown between the fall application timings. Less blueberry injury after a fall application was observed as compared to a spring application, especially within early season evaluations. Bunchberry control in the sprout year was improved in the fall applied Spartan treatments, with final control ratings between 90-100%, compared to the spring application with only 82% control within the hand harvest trial. A similar trend was observed within the mechanical harvest data. Furthermore, the fall application timing did not reduce any of the measured yield potential factors or have a significant effect on crop yield. The possibility of a fall application would help expand the application window for this herbicide, eliminating the restrictive nature of the current herbicide label. From these results, the use of Spartan after hand and mechanical harvest is recommended and could potentially be added to the product label as a new application timing which would be a benefit to commercial wild blueberry production.

Evaluation of the effect of varied nitrogen fertility on lamb's-quarters growth within a wild blueberry field

G.L. Graham, G. Chiasson and É. Thériault

A trial was initiated in the Lord and Foy region of New Brunswick to evaluate the effect of varied nitrogen fertilizer application rates on the growth and groundcover of lamb's-quarters (*Chenopodium album* L.) within the sprout year of a wild blueberry field. This experiment was established in an area which historically had problems with lamb's-quarters, consequently a large natural seed-bank was expected. Five levels of nitrogen fertility (0, 25, 50, 75 and 100 kg N/ha) were applied to 3m x 6m plots with four replicates in the spring before crop and weed emergence. Visual estimates of percent lamb's-quarter ground cover and average lamb's-quarters height were recorded for each plot area.

Results: Nitrogen fertilizer had a significant effect on the lamb's-quarters population, with an increasing population density within each increase in nitrogen fertility. The addition of fertilizer also caused a significant increase in the average lamb's-quarters height, as all fertility treatments resulted in significantly taller lamb's-quarters plants. This finding confirms what has been observed in producer's fields where distinct strips of lamb's-quarters were noted, coinciding with the overlapping of fertilizer treatment. This research suggests that producers could potentially reduce nitrogen fertility in areas prone to heavy lamb's-quarters infestations or ensure the application of adequate herbicides to areas with high nitrogen fertility. Expanded work on the link between fertility and weeds is required to ensure producers are utilizing fertilizer in the most sustainable manner.

Reducing soil pH to control weeds in wild blueberries

David Yarborough and Kerry Guiseppe

Maintaining wild blueberry production in Maine requires the control of a variety of grass, broadleaf, and woody weeds that can increase competition for light, nutrients and moisture. In recent years growers have become reliant on the few herbicides available. Weed shifts have been documented in wild blueberry fields indicating that weed species are adapting and there is evidence of several grasses developing resistance to currently used herbicides. During the period of 2000-2005, thirteen blocks were established in the non-cropping year. Each block has an area of 16.5 m x 22 m. Plots (5.5 x 22 m) within each block were treated with 0, 567, or 1134 kg/ha of sulfur as 80% sulfur pellets. When each block was in a non-cropping year, it was sprayed pre-

emergence at a right angle to the sulfur treatments with 0, 0.5, 1, or 2 kg/ha of the herbicides Hexazinone (Velpar L) or Terbacil (Sinbar 80WP).

Results: Grass, broadleaf and woody weed cover were significantly reduced by either the herbicide treatment or the sulfur treatment in several of the study years. Sulfur treatment reduced the pH but for some fields it took two years after treatment. The 1134 kg/ha sulfur rate reduced the pH more rapidly, resulted in the pH staying lower longer, and resulted in the greatest reduction of weed cover. The sulfur treatment decreased the competitive ability of both grasses and broadleaf weeds for several years. Although the herbicide treatments reduced weed cover, there was no significant interaction between the herbicide and sulfur treatment, though there was a greater decrease in weed cover when both were used.

Organic weed management in wild blueberries

David Yarborough

A randomized split block design was used to assess the effects of pruning method, and fertilizer and sulfur application on weed cover and blueberry for the experimental site located on an organic field located in Amherst, Maine. Total block size was 66' x 110'. Prune treatments of 66' x 50' included either burned by oil burner or mowed by a flail mower in the Fall of 2005. Within each prune treatment, sulfur was applied at 0 lbs/ac or 1000 lbs/ac on 11 May 2004 on 33' x 50' area. Fertilizer was applied at rates of 0 lbs/ac, 20 lbs N/ac or 40 lbs N/ac on 11 May 2006. The block was replicated 8 times. Weeds were cut using a weed wacker on 22 June, 31 July and 30 August 2006. Plots were harvested for yield assessments by using an Emerson mechanical harvester with a 2 foot picking head on 2 August 2007. Grass, broadleaf, fern and tree weed cover were assessed prior to the sites being cut on all three dates.

Results: Mowed treatments had significantly higher grass and broadleaf weed cover than burned treatments for all three evaluations. Fern cover was not significantly effected, though tree seedling cover was also higher in mowed than burned treatments. Plots treated with sulfur had significantly less grass and broadleaf weed cover than the untreated. In all three months, plots treated with 40 lb/acre of fertilizer had significantly higher grass and broadleaf cover than those left untreated. There was a significant treatment effect of pruning with the burned plots having higher yield than the mowed plots. The sulfur treatment resulted in an almost doubling of the yield over the untreated area when the plots were pruned by fire. There was also significant interaction of pruning so that the burned plot without sulfur was equivalent to the mowed plot with sulfur and the burned plot with sulfur was almost double that of the non sulfur plot and both mowed treatments.

The role of blueberry harvesters in weed seed dispersal

Scott White, Nathan Boyd, Glen Sampson, and David Percival

Wild blueberry harvesters could play a significant, but undocumented, role in the dispersal of weed seeds within or between wild blueberry fields. Harvesters entering or leaving fields in Nova Scotia (11) and harvesters entering Nova Scotia from Maine (2) were sampled for weed seeds during the 2006 wild blueberry harvest. Samples were collected from components of tractors and harvesting equipment, stored in paper bags, and brought back to the lab for analysis. All samples were sieved to remove large debris, and weed seeds were counted in five, 1 gram sub-samples.

Results: A total of 515,447 broadleaf weed seeds and 399,624 grass weed seeds were collected from a harvester in Nova Scotia, for a total of 915,070 weed seeds. The majority of these weed

seeds (86%) were found on or around the loading belts of the harvester. Weed seed counts were reduced by up to 98% when comparing a pressure washed harvester from Maine to the Nova Scotia harvester that had not been cleaned. However, total seed number from the cleaned harvester still exceeded 20, 000 seeds.

DISEASE MANAGEMENT

Valdensinia leaf spot of lowbush blueberry: an emerging new threat.

P.D. Hildebrand and W.E. Renderos.

Valdensinia leaf spot is caused by the fungus *Valdensinia heterodoxa*. Ascospores produced on over wintered infected leaves infect new growth. Large, heavy secondary spores (conidia) are then produced during June on leaf lesions that appear as brown, circular lesions variable in size up to 1 cm in diameter. A single lesion results in leaf abscission. Defoliated crop stems may recover by producing new leaf shoots, but sprout stems produce new leaf shoots in leaf axils where flower buds normally occur resulting in reduced yields the following year. The disease usually begins in moist shaded areas of fields in early June. During wet weather, the disease spreads to encompass large areas. The disease was first observed in 1997 in two fields, but by 2006 it occurred in numerous fields causing substantial crop losses. Disease spread from field to field likely occurs by movement of machinery and foot traffic. Spray trials in 2006 showed that Pristine reduced disease, whereas Bravo, Topas and Captan were less effective.

Identification and control of leaf spot diseases in lowbush blueberry

Paul D. Hildebrand and Willy E. Renderos

Research has shown that there are several pathogens causing leaf spot diseases in blueberry that can result in significant premature leaf drop and reduced yields. They are Septoria leaf spot, leaf rust and Valdensinia leaf spot. Powdery mildew can also cause leaf spotting, but this disease will not be discussed here.

Spores of the Septoria Leaf Spot fungus are released from infected blueberry leaf debris and lesions on stems over a 6-8 week period beginning at early bloom, but most are released during the bloom period. Symptoms of this disease first appear as very small pin point, water soaked lesions on leaves in early-mid July. With time, the under surface of leaves becomes speckled with dark green-brown lesions while the upper surface becomes reddish brown in colour. Leaves on fruiting stems may drop their leaves prematurely which can result in reduced yields. This disease also infects sprout fields at the same time. The lower leaves on sprouts become infected and drop prematurely. Symptoms on the sprout stems do not develop until spring of the following fruiting year and appear as purple-coloured lesions. Burn pruning will help to reduce this disease. Research is in progress to identify fungicides for disease control.

The Leaf Rust fungus requires the hemlock tree as part of its life cycle. Spores of this fungal pathogen are released from diseased, overwintered, blueberry leaf debris in early June at the time when new growth of the hemlock tree is emerging. Infection of the hemlock needles occurs and then spores that are subsequently produced on needles are carried by wind back to blueberry fields where they cause infections during late June to mid-July. Spores arising from these early infections on blueberry cause subsequent infections. A repeated cycling of new spores and infections occurs approximately every 2 weeks and continues until mid-October

causing increasing amounts of damage to sprout leaves. Symptoms of leaf rust on blueberry can first be seen in late July or early August and appear as red spots on upper surfaces of leaves. Yellow/orange spore masses can also be seen on the undersurface of leaves directly beneath the red spots. As the disease intensifies in late August and early September, the upper surface of leaves become speckled with reddish-brown spots and the undersurface becomes speckled with the yellow/orange spore masses. Noticeable, premature defoliation begins in late August and early September. If defoliation is severe, fruit bud development can be substantially reduced resulting in reduced yields in the following fruiting year. Burn pruning will not help to control this disease since spores of the fungus tend to travel long distances by wind and spread from field to field. A single application of Bravo fungicide in late July will control leaf rust for the remainder of the growing season. Research is in progress to identify additional fungicides for leaf rust control.

Valdensinia Leaf Spot is a new disease to the blueberry industry. Relatively few fields are infected with this disease, but it is spreading to new sites annually on contaminated machinery, vehicles and foot wear. Unlike Septoria leaf spot and leaf rust which occur each year at about the same time, Valdensinia leaf spot is dependent on the right combination of temperature and wetness. The fungal pathogen overwinters on infected blueberry leaves. During prolonged wet weather, spores are produced on the leaf litter, released, and then infect blueberry foliage. Symptoms of this disease on leaves appear as circular, brown lesions variable in size up to 1 cm in diameter. A single lesion on a leaf is enough to cause it to drop. Defoliated fruiting stems may appear to recover by producing new leaf shoots, but yields are reduced. Affected sprout stems produce new vegetative shoots where flower buds would normally occur resulting in reduced yields the following year. The disease usually begins in moist, shaded areas of fields during June or July as small focal points encompassing a few stems. During wet weather, these focal points can expand very rapidly to cause severe defoliation in large areas throughout a field. The disease subsides during dry weather, but may resume in late summer with the return of more frequent rain. Although not studied, burn pruning will likely help to destroy infected leaf debris. The fungicide Pristine will hopefully be registered for this disease in time for the 2008 growing season. Research is in progress to identify weather conditions affecting disease and additional fungicides useful for disease control.

Epidemiology and disease control strategies of the powdery mildew pathogen, *Microsphaera vaccinii*

Lynda I. Stewart, Paul D. Hildebrand and David C. Percival

The obligate plant pathogen *Microsphaera vaccinii* is the causal agent for the wild blueberry disease powdery mildew. Two sites in northern New Brunswick (Val Doucet and Renous) were selected in 2006 for epidemiology studies of powdery mildew pathogen. Disease incidence was evaluated as the presence or absence of the pathogen on the blueberry foliage. The pathogen was first identified by strands of fine white mycelia on the foliage in crop fields in early June and mid-June, at the Val Doucet and Renous sites, respectively. In sprout fields, the pathogen was not detected until late June. By mid-July foliar symptoms in the form of red spots and masses of white mycelia were visible. At this time the foliar disease incidence was greater than 30% for all sites, except the cropping field in Renous. While the overwintering stage of powdery mildew in wild blueberries is unknown, cleistothecia, small black fruiting bodies containing ascospores, were first identified on the foliage on 04 August. Commercial fungicides were evaluated for their effectiveness on blueberry powdery mildew in field trials also located in Val Doucet and Renous. Disease incidence was evaluated, and preliminary results have identified Quintec, Bravo and Topas as potential controls.

An evaluation of Bravo 500™ (chlorothalonil) for the control of leaf diseases in wild blueberry

Kelvin Lynch and Michel Melanson

A trial to evaluate both rate and number of applications of chlorothalonil (Bravo 500™) was carried out in Charlotte County, NB in 2007. Bravo was applied at 7.2, 5.0 and 2.8 liters per hectare using a CO_2 handheld sprayer delivering the equivalent of 500 liters per hectare at 207 kPa., with applications on June 21, July 23 and August 23. In addition, the entire trial was repeated on adjacent areas which had been pruned by mechanical mowing in the previous fall or mechanical mowing in the fall followed by burning on 12 April 2007. The combination of oil burning and dry plant debris on the surface from the previous fall resulted in an intense burn.

Results: No leaf rust was observed in the field. Septoria leaf spot was observed only at trace levels. Some powdery mildew was obvious after mid August but overall disease severity was very low in these trials until mid October. No differences were observed in the level of powdery mildew between the mowed-only trial and the trial which had received both mowing and burning and the data. The severity of powdery mildew was decreased by both increasing the rate of Bravo applied and by increasing the number of sprays. A single early spray at 7.2 L/ha gave equivalent control to two sprays of 5.0 L/ha.
Severe feeding damage by blueberry flea beetle (*Altica Sylvia*) was observed in the trial area which had received only mechanical mowing. In the trial area which was burned on 12 April only trace amounts of feeding damage was observed showing that burning is a highly effective means of controlling flea beetle.

Wild blueberry foliar disease suppression and fungicide residue concerns in harvested berries.

David Percival and Paul D. Hildebrand

Foliar disease research activities focused on suppressing *Septoria* and rust continued for the 2007 field season with trials situated in Nova Scotia, New Brunswick and Prince Edward Island. Compared to the 2006 field season, *Septoria* sporulation occurred for a longer period of time (May 14 - July 24 in 2007 versus May 24 - June 29 in 2006), and visible rust symptoms were present on a larger portion of the blueberry shoot in 2007.

Results: Field trial results indicated (i) variability between experimental locations with respect to the type and severity of foliar diseases; (ii) control measures to suppress foliar diseases may be required in both the sprout and cropping phases of production; (iii) in addition to the fungicide Bravo™ (a.i. chlorothalonil), Pristine™ (a.i., pyraclostrobin and boscalid) is effective in suppressing *Septoria* and rust; (iv) cropping phase of production applications of Bravo™ resulted in detectable residues of chlorothalonil (the active ingredient in Bravo™) in harvested berries even when applied at a portion of label application rates; and (v) other active ingredients appear to be very effective at suppressing *Septoria* and rust.

Recommendations: As a result of the detectable chlorothalonil residues that occurred when Bravo™ was applied in the crop phase, it is advised that cropping phase applications of Bravo™ should not occur when processed berries could be exported to destinations including the European Union.

The effects of foliar diseases infection on the photosynthetic rate of the wild blueberry (*Vaccinium angustifolium* ait)

J. Dawson, D. Percival, P. Hildebrand, B. Gray and N. Pitts

The wild blueberry (Vaccinium angustifolium Ait) is an important horticultural crop in Eastern Canada, with 50,160 ha of wild blueberries situated in the Atlantic Provinces and Quebec producing 57 million kg of fruit with a farm gate value exceeding $110 million (2006 data). Recently, foliar diseases once thought to be minor pests to wild blueberry production have begun to incur significant yield losses. These diseases are identified as the blueberry rust Neohidemycetes vaccinii, Gloeosporium leaf spot caused by the fungi Gloeosporium minus, and Septoria leaf spot caused by an unclassified fungus in the genus Septoria. A study into the photochemical effects of these diseases was undertaken to better understand the relation ship between host and parasites.

Results: Significantly higher photosynthetic rate and light adapted photosystem efficiency were observed from plants with protective fungicide Bravo® as compared with control plants as the season progressed. These observations suggest that the pathogens damage and reduce the ability of blueberries to create carbohydrates. These decreases in photosynthetic values coincided with increased disease pressures in the control treatment. The effects of this carbohydrate assimilation reduction may be more far reaching if the plant is in a carbohydrate limitation situation during growth or bulking plant organs associated with yield. This was shown by significant differences in floral bud numbers at the end of the sprout seasons growth.

Efficacy of the biological control agent Serenade MAX® against *Monilinia vaccinii-corymbosi* in lowbush blueberry

D. Langdon, P.D. Hildebrand, J.A. Traquair and G.J. Boland.

Mummy berry blight, caused by the fungus *Monilinia vaccinii-corymbosi*, is an important disease of lowbush blueberry. In early spring, ascospore infections can cause substantial loss of leaves and flowers. The purpose of the current study was to evaluate the efficacy of the commercial biological control agent Serenade MAX® (*Bacillus subtilis* QST 713) against ascospore infections. Three rates, 2 kg/ha, 5 kg/ha, and 8 kg/ha applied either once or twice were tested in two lowbush blueberry fields in Nova Scotia in 2007. The first spray was applied before the first infection period of the year followed by a second application 7-10 days later. The incidence of diseased leaf shoots and flower clusters on stems was evaluated. Disease incidence with two applications at 8 kg/ha was comparable to the fungicide propiconazole, the industry standard. Interestingly, in controlled environment experiments, Serenade Max® displayed postinfection activity on inoculated plants. When the bacteria of Serenade Max® were filtered out, the filtrate containing lipopeptides (bacterial by-products) suppressed disease on plants; indicating that the antifungal activity of Serenade Max ® does not rely on the presence of the bacteria on plant surfaces.

Results: However, no inhibition of germination by Serenade Max® was observed in counts of ascospores on treated young blueberry leaf tissue indicating that the mechanism of action on *M. vaccinii-corymbosi* ascospores and infection is not clearly understood. The use of Serenade Max® may have potential in organic production systems.

INSECT PEST MANAGEMENT

Is Cranberry Tipworm (Diptera, Cecidomyiidae, Dasineura oxycoccana) a new pest of lowbush blueberry?

Melissa Reekie, Kenna MacKenzie and Beata Lees

In 2005, investigations of extreme yield reductions and unusual growth over the past five to six years in lowbush blueberry fields in Yarmouth County, Nova Scotia led to the discovery of *Dasineura oxycoccana*, commonly known as cranberry tipworm (CTW). While a pest of cranberry and highbush blueberry, this is the first record of CTW in lowbush blueberry. The biology of CTW and the degree of infestation and damage in four suspect blueberry fields in Yarmouth Country, Nova Scotia was evaluated in 2006 and 2007. Four different methods were used to assess population density of CTW in 2006: bud dissection, sticky board traps, insect sweeps and *in-situ* rearing but only *in-situ* rearing method was used in 2007. Of these four methods, bud dissection was the most sensitive measure of CTW presence.

Results: A significant number of buds died in all four field sites in both 2006 and 2007 and there was no difference among sites in the extent of damage. However, the number of insects per growing bud differed significantly among fields in 2006/07. This suggests that CTW was not the primary cause of the extensive damage observed in these fields. However, changing weather conditions due to global warming may lead to more serious future infestations.

IPM of the blueberry fruit fly – 2007

Sonia Gaul and Leonard Eaton

A field study was conducted at eight commercial lowbush blueberry sites in Nova Scotia to determine the impact of vegetative field management on the blueberry fruit fly, on adult fly captures and fruit infestation. In addition, the efficacy of addition of selected blueberry volatiles to traps on the captures of adult flies was assessed. Each lowbush blueberry site consisted of a crop field and an adjacent vegetative field. Seven sites have been utilized for 6 years and one for 2 years. Yellow sticky traps were used to capture adult flies. 10 traps were set at the edge of the fruiting field at each site to assess the captures from the adjacent vegetative field. Traps were set within the crop field, perpendicular to those at the edge of the crop field, at distances of 20, 40, 80, and 160 m. Traps were monitored three times per week from June 29 to August 10, 2007. Fruit samples (1 liter each) were collected within a 3 m radius of each trap to monitor the level of infestation of the fruit prior to commercial harvest.

Results: Total trap captures of adult *R. mendax* declined with years in the vegetative spray program, and most were captured in traps placed at the border between the fruiting and the vegetative field. There was a low level of infestation of fruit, and the infestation was at the border of the fruiting field next to the vegetative field.

Distribution of *Rhagoletis mendax* (Diptera: tephritidae) in lowbush blueberry in north western regions of New Brunswick, Canada

Sonia Gaul, Evans Estabrooks, Charles Vincent and Kenna MacKenzie

The distribution of Rhagoletis mendax, the blueberry fruit fly, is expanding within eastern Canada. To determine the current distribution within New Brunswick, standard yellow sticky traps were placed in selected fields of lowbush blueberries to the north of known areas of blueberry maggot

infestation. Captures of adult flies were recorded. In addition, fruit was harvested and larval counts were obtained.

Results: Adult flies were trapped in 4 fields, and larvae were found in fruit from 2 fields of the 11 sites monitored 1-3 years each. The distribution of *Rhagoletis mendax* in New Brunswick has been extended to include sites in the north western region.

FOOD AND BIO SCIENCES

Pre-harvest practices and blueberry bioactive content

Joanna MacKenzie and David Percival.

Bioactive compounds present in wild blueberries, particularly anthocyanins and polyphenolics, have beneficial health effects due to their antioxidant properties. An experiment examining the effects of organic management practices was performed at the Wild Blueberry Research Center to determine the impact on bioactive levels of the wild blueberry. The trial, established in a commercial sprout field in 2003, included an organic fertilizer (Nutri-Wave® at 25 and 50 kg $N \cdot ha^{-1}$) and an organic weed management strategy (sulfur at 1000 and 2000 kg $S \cdot ha^{-1}$). Weed counts and harvest occurred in August 2004. Berries collected from this trial were analyzed for phenolics and anthocyanins using the Folin-Coicalteu and pH differential methods, respectively.

Results: Sulfur was found to have little ability to suppress weed growth, but the application of high levels of the organic fertilizer led to significantly elevated levels of polyphenolics

Use of plant growth regulators to increase bioactive compounds in the wild blueberry

David Percival and Joanna MacKenzie

With increasing awareness of the antioxidant properties of the wild blueberry (*Vaccinium angustifolium* Ait.), more emphasis has been placed on developing cultural management practices to enhance fruit polyphenolic levels and using processing byproducts as potential polyphenolic sources for the nutraceutical market. Trials were initiated in 2004 and 2005, with four plant growth regulators (methyl jasmonate, abscisic acid, riboflavin and Retain®) applied to maturing berries of the select clone 'Fundy' at the Wild Blueberry Research Centre (Debert, N.S.). Berries were harvested approximately one month after treatment applications, with collections of green leaf tissues at harvest and red leaf tissues two weeks after harvest in 2005. Assessment of polyphenolic and anthocyanin levels within the berry and leaf tissues followed the Folin-Ciocalteu and pH differential methods, respectively.

Results: Overall, substantially higher levels of polyphenolic compounds were found within the leaf tissues, although anthocyanin content was highest in the berries. The application of methyl jasmonate elevated levels of bioactives within the harvested berry and leaf tissues. This increase in bioactives occurred, however, at the expense of harvestable yields, with lower yield in plots treated with methyl jasmonate in 2004. Results thus suggest that the use of some PGRs may effectively increase bioactives, but their value must be assessed against a possible yield reduction. In addition, these studies indicate that leaf debris may provide a superior polyphenolic source for the nutraceutical market.