Wild Blueberry Fact Sheet C.4.2.0

Wild Blueberry IPM
Weed Management Guide

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Revised 2013

Agriculture, Aquaculture and Fisheries

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Introduction

The weed flora in wild blueberry fields is unique compared to that found in other agricultural fields. Producers manage a native perennial crop that grows in low pH soils without associated tillage or cultivation. Weeds which prefer this habitat thrive if not controlled. Weeds can shade and compete with the crop, reduce bud/flower production and yield, reduce quality and can interfere with harvesting. The origin of a field often determines the weed flora. Fields developed from abandoned hayfields or pastures typically have a large number of grasses and herbaceous perennial weeds. Fields developed from woodland often have plants commonly associated with the woodland undergrowth such as bunchberry, ferns, lambkill, rhodora, and other woody plants and shrubs.

A weed survey conducted in the year 2000 recorded more than 250 species in blueberry fields, compared to only 115 species from a 1985 survey. The number of many of the traditional woody weeds has decreased due to herbicide use, but this has been off-set by greater numbers of herbaceous annuals and perennials. Not all non-traditional species are considered as significant weed problems but some, like lamb's quarters and herbicide resistant fescue grasses, have the potential of becoming major problems. This change in weedy vegetation resulted from herbicide use, especially hexazinone (Velpar/Pronone). Other contributing factors have been changes in production practices that allow weeds to spread and thrive, such as the increased use of fertilizers, increased use of mowing instead of burning for pruning and the use of mechanical harvesters and other equipment that spreads weeds. In the future, growers can expect an increasingly diverse weed flora. It is important to understand the activity and limitations of available weed control options and to use herbicides in conjunction with other practices to manage weeds.

A blueberry weed management program should follow the principles of Integrated Pest Management (IPM). IPM is a pest management strategy that integrates preventive, cultural, mechanical, biological and chemical control methods to achieve a sustainable production system that balances economic, health and environmental concerns. IPM is based on dynamic principles rather than a definitive set of rules and can vary from farm-to-farm or even from field-to-field. A weed management program that follows the principles and practices of IPM is often referred to as an integrated weed management (IWM) program.

Components of an Integrated Weed Management Program

I. Weed Identification and Biology

When planning a weed management program, blueberry producers must first be able to identify the weeds present in each of their fields. Most weed guides do not include many of the important blueberry weeds. The New Brunswick Department of Agriculture, Aquaculture and Fisheries maintains an integrated pest management (IPM) image bank on the www.gnb.ca/agriculture website, available directly here. This site contains images of diseases, insects, weeds and other disorders affecting New Brunswick's blueberry crop. Most images are available in both low and high resolutions and the site is completely bilingual. The site can be accessed by three different methods: 1) the Browse feature where a pest category and/or crop can be selected to find the appropriate images, 2) the Search feature using a key word search or 3) the Complete Listing showing all images in the bank. Clients with slower Internet connections should only select lower resolution images to avoid long download times. Other excellent illustrated publications for identification of blueberry weeds are: Weeds of Eastern Canadian Blueberry Fields by M.G. Sampson, K.V. McCully and D.L. Sampson. NSAC Bookstore, Truro, N.S. 229 pp or Guide d'identification Alliés et Ennemis du Bleuet Nain, by È-C. Desjardins and R. Néron, Centre de Référence en Agriculture et Agroalimentaire du Québec.

Knowing how plants are classified or grouped helps to understand similarities and differences between them. An understanding of the life cycle and the reproductive strategy of weeds is needed in order to use the best approach their control. Based on life cycle, weeds within wild blueberry fields can be categorized as annuals, biennials or perennials.

A) Annuals

Annuals are becoming increasingly common in blueberry fields. Annuals reproduce only by seed and complete their life cycle in less than one year. They grow rapidly, produce large amounts of seed and may require control in both the sprout and crop year. Control methods must focus on preventing annuals from producing and spreading seed. Most annuals found in wild blueberry fields are summer annuals that germinate in the spring, produce flowers and seed and die in late summer or fall. These include such weeds as lamb's quarters, hemp-nettle, cow wheat and witch grass. There are also a few winter annuals found in blueberry fields. Winter annuals germinate in the fall and then over-winter in a seedling or rosette stage. They produce flowers and seeds the following summer and then die. Winter annuals include such weeds as common chickweed and Canada fleabane.

B) Biennials

Biennials complete their life cycle in two years. They produce a low-growing rosette of basal leaves with a taproot that over-winters. Biennials 'bolt' to produce a flowering stalk, set seed and die in the second year. Examples include yellow evening-primrose, wild carrot and meadow goat's-beard. Biennials are also becoming increasingly common.

C) Perennials

Perennial weeds are the most common in blueberry fields and generally more difficult to control. They live for more than two years and can be either herbaceous or woody. Perennial weeds may reproduce primarily by seed (daisy); by both seed and vegetative means (sheep sorrel); or primarily by vegetative means (bunchberry). Many perennial weeds grow in the same manner as the blueberry plant. Therefore, some of the production practices that promote blueberry growth (like pruning) also promote the growth of these weeds. Perennials which are low growing and spread vegetatively by interconnected underground root systems are the most difficult to control and cannot be controlled by hand-weeding. Some perennials can be controlled with selective or non selective herbicides, but for many, there are no satisfactory controls.

Annuals, biennials and perennials can be grouped in other ways. Flowering plants can be broadly classified as dicots (broadleaves) and monocots. There are also primitive plants that do not produce flowers. Plants can also be grouped into herbaceous (non-woody) and woody species.

1) Flowering Plants

Flowering plants produce seed and can be divided into broadleaved species or dicots (with two seed leaves) and monocots (with one seed leaf). Dicot leaves have a branching network of veins and flowers with petals, although these can be inconspicuous, as shown by alders or lamb's quarters. Monocots have leaves with parallel veins. With the exception of lilies and related plants, monocots have flowering heads of many small, reduced flowers (or florets) without petals that produce a single seed. Monocots include grasses, that are annuals or perennials with jointed stems that are usually hollow and round in cross section; sedges, which are usually perennial plants that form tussocks with leaves that are V-shaped and stems that are triangular in cross section; and rushes, that are annuals and perennials with tussocks of needle-like leaves that are round, jointless and filled with a whitish pith in cross section.

2) Non-flowering Plants

There are also primitive, non-flowering plants that reproduce by microscopic spores that include ferns, horsetails and mosses. Ferns, with stalks and fronds, and horsetails, with narrow leaves in whorls at joints of hollow stems, both spread by underground rhizomes and are difficult to control. Mosses are tolerant to most herbicides but may be suppressed by fire.

II. Scouting and Weed Mapping

Scouting and proper weed identification are the foundation of any integrated weed management program. Scouting involves walking fields in a pattern (e.g. "W" pattern) thereby allowing monitoring for potential weed problems over the entire field. Scouting provides an opportunity to evaluate weed control programs and to look for any herbicide injury. Scouting also provides an opportunity to identify and target new invasive weed species that have the potential to become serious weed problems in the future. Scouting results can be compiled into weed maps to highlight the locations of different weed species. Mapping for weeds from year-to-year is helpful in monitoring changes in weed species, weed densities, distribution, as well as, providing an opportunity to plan your future weed control strategy. The management strategy must target the dominant weeds and prevent the spread of others.

The following should be documented when scouting and mapping:

- the weed species and its life cycle (annual, biennial, perennial)
- the size or growth stage of the weed (seedling, small, medium, large, flowering, seed formed, seed dropped)
- the density of the weed (counts or categorize as low, medium, high)
- the distribution (uncommon, scattered throughout, a few patches, numerous patches, common throughout; or estimate the percent blueberry field covered per weed species).
- the location of the weed infestations on a field map
- the date of scouting

Weed scouting in sprout fields should be done:

a) just before blueberry emergence to monitor for bunchberry presence and growth stage;
b) soon after blueberry emergence to monitor for potential grass problems;
c) late June - early July for weeds growing above the blueberry plants that would be susceptible to wiping treatments;
d) late summer-early fall for wiping and evaluating the current year's weed control program and also for planning next year's weed control program.

Weed scouting in crop fields should be done:

a) before blueberry buds swell to determine if Velpar or Callisto applications are required;
b) mid-May to mid-June to scout for grasses;
c) mid-July to harvest to determine presence, densities and location of weeds for fall treatments or next year's weed control program.

Special note should be made of weeds that appear to be increasing significantly in distribution and density or any new weeds. For example, burnweed has been noted in greater abundance in many New Brunswick fields. Weeds which may be undesirable for reasons other than competition should also be noted. Examples include weeds flowering during pollination, weeds known as alternate hosts for insects or diseases, or weeds which can interfere with harvesting.

III. Weed Thresholds and Action Levels

Weed thresholds have not been determined for New Brunswick blueberry fields. As a result, the decision to target a weed for control must be based on knowledge of the weed within your farming

system. From a strictly economic perspective, there is no reason to apply control measures unless the weed population inflicts crop damage greater than the cost of the control measure. To make knowledgeable decisions, growers must scout and monitor their fields and continuously observe weeds and evaluate their effect on the crop. Decisions to control weeds may be made even when the cost of control is greater than the losses resulting from weed competition. For example, weeds may have to be controlled despite low densities when they interfere with harvest, act as alternate hosts for insect pests or diseases, attract bees during pollination, or if they have a high potential to cause future problems if not controlled.

IV. Control Methods

With the information gathered through scouting and the knowledge about the weeds present in your fields, you can make the decision as to whether or not a weed should be targeted for control. If action is warranted, it is important to choose the methods that optimize costs and effectiveness, while minimizing potentially adverse effects. The most economical and effective blueberry weed management programs combine preventive, biological, cultural, mechanical and chemical practices within an integrated system.

A) Preventive

Preventive weed control includes all practices that prevent the introduction and spread of weeds into a blueberry field. It is important to be aware of activities which can introduce new weeds and try to prevent them from being introduced. This will help minimize the build-up and spread of new weed introductions.

An important preventive practice is to clean equipment between fields. This is important as weed seeds and other plant parts can attach to equipment and soil and be transported by farm equipment. This is a particular problem with mowers, wipers and harvesters. Recent wild blueberry research has determined that 200,000 to 400,000 weed seeds could be found on individual blueberry harvesters. All equipment, including tractors, land levelling equipment and berry boxes, should be cleaned. Seed dispersal within and between fields can be limited by avoiding equipment operation though dense weed patches during peak periods of seed drop.

Limiting seed production will also help prevent weeds from spreading. Keeping weeds under control in ditches, field edges, and roadsides can minimize the introduction of new problem weeds. Weeds can also be introduced into blueberry fields through the use of weedy straw used for burning. It is critical that growers obtain as weed-free straw as possible. Purchase straw from a reputable source and, if possible, visit the grain field before harvest to check for weeds.

B) Cultural

Cultural practices that encourage a vigorous, dense and healthy crop contribute to reducing weed pressures as a result of less bare ground being exposed. The use of wood chips, sawdust or bark mulch can reduce weed problems and encourage clone expansion into bare areas. Bare areas can also be planted with blueberry plants to increase crop cover. The presence of some grasses, especially in bare spots, reduces invasion of broadleaved weeds and encourages blueberry expansion.

C) Fertility

Wild blueberries are adapted to grow and produce a crop on what is considered, by most agricultural specialists, to be poor in fertility. Plants have a requirement for nutrients from the soil (nitrogen, phosphorus and potassium, among others). Blueberries have a number of adaptations which allow them to thrive in this environment. Weeds are generally better adapted to respond to applied fertilizer than are blueberries. Excessive fertilizer rates that promote weed growth and

vigour should be avoided. Proper fertilizer rates should coincide with adequate weed control to maximize the benefit from each of these inputs. A reliable tool to determine fertility levels is leaf tissue analysis, outlined in this fact sheet.

Blueberries are adapted to a low pH environment, with an optimal range for weed control with a relatively low pH near 4 to 4.5. Many weeds, especially annuals and grass species, are not adapted to these conditions. More forest-type species, like lambkill and bunchberry, will not be affected by lowering the pH of the soil. Sulphur application can reduce the availability of soil nutrients for the weeds but allows the blueberries to grow because they are well adapted to acid soil. Approximately 112 kg/ha (100 lb/acre) of sulphur is required for a reduction of 0.1 pH unit. Do not apply more than 1120 kg/ha (1000 lb/ac) of sulphur in any given year. Application should not occur when the ground is saturated or injury to blueberries could result. Change in pH may take several years to be completed, with limited results soon after application.

D) Biological

Biological weed control is the deliberate use of highly selective enemies to reduce the population of a target weed to an acceptable level. In Atlantic Canada, there have been releases of either insects or pathogens against some weed species, including St. John's wort, Canada thistle, perennial sowthistle and toadflax. Biological control is generally most effective on introduced, non-native species in relatively undisturbed, pesticide-free agricultural habitats like pastures and rangelands. Naturally occurring disease epidemics have been observed for St. John's wort and bracken fern in blueberry fields, giving significant control in some years. The use of insecticides and fungicides within blueberry fields also makes the use of insects and pathogens as biological control agents more challenging. The prospect for biological weed control in wild blueberry is limited.

E) Mechanical

Mechanical methods of weed control include such practices as hand-pulling, pruning (mowing/burn) and clipping.

1. Hand-pulling

Hand-pulling is one of the oldest methods of weed control and is most effective against annuals, biennials and perennial seedlings. Established perennials can only be controlled effectively if the entire root system is removed. This is not possible, in most instances, although hand-pulling perennials can be effective in preventing seed production. If fields have both flowering and non-flowering weeds, flowering weeds should be removed first in order to prevent seed formation. It is also important to remove pulled weeds from the field, as many can still produce viable seed when lying on the soil surface. Hand-pulling is easier when the soil is wet.

2. Pruning (mow/burn)

The main purpose of pruning is to rejuvenate blueberry plants but it also aids in control of some weeds. Burning will control coniferous species and some shallow rooted grasses. The top growth of many woody and herbaceous perennials is generally killed by burning but underground parts re-sprout. Burning also reduces the return of many weed seeds from mature plants to the soil, and will kill many of the weed seeds present near the soil surface. Unfortunately, most burning operations provide only partial or erratic control results. Mowing as a pruning method may give some short-term suppression of perennial weeds and is generally not recommended as the sole method of control. Weeds must be mowed or cut several times during the season to ensure suppression. Species such as maple, birch and willow should be cut back to the ground level. Regrowth from the roots is common and frequently results in additional cuttings. Burning or

mowing alone may promote growth of many perennial weeds with extensive underground root systems by releasing apical dominance.

3. Selective mid-season clipping

Clipping the tops off weeds before seeds ripen prevents seed formation and helps reduce future weed problems. Clipping of species in June, July and August for a few seasons may help suppress weeds to acceptable levels. Clipping weeds every mid-summer has also been found to help control or suppress bracken fern, bayberry, *Prunus* spp., wild rose, and others. Bracken fern should be cut just as the fronds unfold, at least two times, at four-to-six week intervals. Flowering weeds should be clipped before weeds which have not yet flowered. For weeds growing above the blueberry canopy, selective clipping can be performed with “whipper-snippers” or other similar equipment. Alternatively, non-woody weeds can be clipped through whipping. Hand clippers can also be used to target individual low growing weeds, such as sweet fern or lambkill. Clipping is labour intensive and does not generally result in permanent control.

F) Chemical

The use of herbicides to control weeds in blueberry fields is an important component of an integrated weed management program. Herbicides must be used responsibly and judiciously and as just one component within an overall program. Herbicides cannot be used as a cure-all for poor management. No single herbicide or combination of herbicides will control every weed within a blueberry field. Furthermore, excessive weed control that results in long-term bare ground should be avoided as this practice leads to soil erosion and impairs blueberry clone expansion.

Herbicides used within blueberry fields are either selective or nonselective. Following labelled rates and recommendations, selective herbicides control specific weeds without significantly injuring blueberry plants. Some selective herbicides (e.g. Velpar) are only safe to use at prescribed rates and times of application. If excessive rates are applied they are no longer selective and can cause severe crop injury. Nonselective herbicides kill both weeds and crop plants (e.g. glyphosate) and therefore caution must be exercised when applying them. Blueberry herbicides are applied either pre-emergence (applied before any blueberry plant or weed foliage emerges); or post emergence (applied after blueberry plant and weed foliage has emerged). Pre-emergence herbicides provide residual control, whereas post emergence treatments provide little or no residual control. To keep fields relatively clean growers need both a “base program” and a “clean-up program”. The base program refers to the primary method relied on to control most weeds. For blueberry growers, Velpar is relied on most frequently to provide this base level of weed control. The clean-up program relies on herbicides such as Callisto, Ultim, Venture L, Poast Ultra, Spartan, Roundup, Lontrel or Banvel II to target specific weeds that escape the base program.

Even when label instructions are followed, not all weeds will be controlled. Each herbicide controls only specific weed species, and if timing and rates are not followed, control may be poor. In addition, other factors can also reduce weed control. For example, if heavy rains follow pre-emergence applications on sandy soils, some herbicides may leach away from the weed seed germination zone. Likewise for post emergence herbicides, if rain-free periods are not respected, control can be reduced. A pre-emergence herbicide may not be effective if labelled weeds have emerged before herbicide application. If emerged weeds are too large, control with post emergence herbicides will be reduced. Control from herbicides can also be reduced if weeds are under stress. For example, drought stress can cause weeds to form thicker layers of wax on leaf surfaces, thereby reducing herbicide uptake.

Herbicide Use

1. Methods of Application

There are several methods of applying herbicides depending on the properties of the herbicide and target weed. The label gives detailed instructions on mixing and application of each product and should be carefully followed to ensure applications are safe and effective. The following gives general information on methods of applying the approved herbicides discussed in Notes on Herbicides Registered for Use in Wild Blueberry.

A) Overall Broadcast Spray

Overall broadcast spraying involves the use of boom sprayers to apply herbicides uniformly over entire fields or large areas. An overall broadcast spray is recommended for treating areas with a uniform rate of herbicide, such as pre-emergence applications of Velpar in the spring of the sprout year. Broadcast applications can also be made to large infestations of some species, such as sweet fern or lambkill, to treat them in the fall of the crop year with Banvel II. Pronone 10G can also be applied as a broadcast treatment by using a granular applicator such as a Vicon spreader. To apply the herbicides at the recommended rate, the equipment must be calibrated and in proper working order. Avoid irregular spray applications by using flagging tape, foam markers, appropriate dyes or GPS systems as guides.

B) Directed Spot Sprays

The objective of directed spot spraying is to apply herbicides to the weed foliage while avoiding contact with the blueberry foliage. Spot sprays are applied with either backpack or handheld sprayers or by operating a handgun from a line connected to a tractor-mounted sprayer. Depending on the product used and the time of application, blueberry plants can be injured or killed if the foliage is sprayed. Applications are often made in the summer of the sprout year, and can result in crop injury. Many species such as alders, sweet-fern, bayberry, lambkill and blackberry retain their leaves in a viable condition longer than the harvested blueberries. Treatment in the fall after blueberry leaf drop helps to reduce the potential for crop injury.

Herbicide applications to fully expanded leaves of brush species can be useful where there are limited numbers of escaped brush species. Unless otherwise stated on the label, applications should be limited to bushes that are less than 2 meters in height. If higher, they should be cut and the regrowth treated. Coverage should be uniform and thorough to wet all leaves and stems. Mix with water only and spray until wet, but avoid spraying to the point there would be runoff. Extreme caution must be used with any non-selective herbicide. Any spray contacting blueberry plants can cause severe injury or death. Applications made to actively growing bushes will be the most effective when there are good growing conditions and adequate soil moisture. Foliar applications are generally the most effective just after full leaf expansion in late spring or early summer. If foliage remains green and in good condition on some species (e.g. alders, bayberry, sweet-fern, willows and others), effective applications can also be made in early fall after harvest. There may be less herbicide injury to blueberry plants if applications are made after blueberry foliage has turned red and begun to drop, but careful application is still required.

C) Roller and Wiper Applications

There are several roller-type applicators now available, including several tractor-mounted models and small one-man portable machines for use in small fields. The herbicide is slowly delivered to an absorbent covered drum that wipes and transfers herbicide to the foliage of tall weeds. In order to improve coverage, most rollers must be operated relatively slowly. Wipers are also available that do not have a rotating drum. Wiping in two directions improves coverage and results in better

control. Do not wipe in a second direction until the herbicide from the first pass has dried. Wiping and rolling methods can be used where weeds are taller than the blueberry plants. A commercially available “hockey-stick” applicator has been used effectively for applying Roundup and similar products within small areas.

D) Stump Treatments

A stump treatment is a safe and effective way of controlling bushes and small trees. Stump treatments involve herbicide applications to tree stumps that were recently cut, thereby causing the stumps to decay faster. 2,4-D (low volatile ester formulation) or Garlon in oil can be either sprayed or painted onto freshly cut stumps and exposed roots. Best results are usually obtained on stumps 5 cm across or larger (refer to individual labels). All exposed bark, roots, and cut surfaces should be wet thoroughly either by painting or spraying. Most of the stump treatments will control crown suckering species, like birches, maples and pin cherries, but there may be regrowth of species that sucker from lateral roots, like poplars. Many woody weeds are affected by these treatments, and on certain species, stump treatments are more effective than foliage applications.

Stump treatments can be applied any time of the year, including the winter months as long as snow or water does not prevent application. Trash from brush cutting operations such as sawdust, leaves, branches, etc. should also be removed from the base of the stumps before treating. Unless otherwise stated, applications should be made to freshly cut stumps. For old stumps, it is best to drill several holes or split the stump with a wedge before applying the treatment. Care must be taken to ensure that all cut stems in a clump have been treated or regrowth can result. Dye can also be added to the mixture to help ensure all exposed surfaces of the stump have been treated, and stumps do not get retreated or skipped.

Unless otherwise stated on the label, the herbicides used as stump treatments should be applied in vegetable or mineral oil to help penetrate the exposed bark and cut surfaces. If regrowth appears it should be treated with an appropriate herbicide. Note that 2,4-D alone, glyphosate and Garlon are registered for general weed control and used in preparing land for blueberry production. These products are not registered for use in producing blueberry fields and can cause crop damage if applied directly to actively growing blueberry plants. Crop damage can be minimized by careful application.

E) Basal Bark Treatments

Many shrubs and small trees (up to 15 cm diameter) can be controlled by spraying or wiping the basal parts of their stems or tree trunks from the soil level up to a height of 50 cm or as recommended on the label. Basal bark treatments are advantageous because the entire shrub or tree does not require spraying. Treatments are applied in vegetable or mineral oil as recommended on the label. Use a nozzle that forms a very narrow band or stream when spraying basal bark treatments. Low volatile esters of 2,4-D or Garlon in oil can also be used for basal bark treatments. Old or rough bark requires more volume than young or smooth bark. Treatments can be applied any time of the year except when snow or water prevents application to the lower trunk and exposed roots.

2. Sprayer Calibration

Calibrating the sprayer regularly is extremely important. Broadcast herbicide applications should be made with an accurately calibrated boom sprayer. Blueberry plants can be injured if too much herbicide is applied. Backpack and air-blast sprayers should not be used for broadcast herbicide applications as coverage and distribution will not be uniform. Complete directions on sprayer calibration and calculating the amount of herbicide required can be found in the New Brunswick

Department of Agriculture, Aquaculture and Fisheries's Sprayer Calibration Fact Sheet (C.1.2.0) or in the Guide to Weed Control (Publication 75) from the Ontario Ministry of Agriculture and Food (available here). Calibration of fertilizer spreaders for Pronone 10G application is equally important, with more information found in this fact sheet: C.4.4.0.

The boom should be adjusted to the appropriate height above the target, either the ground for pre-emergence applications or the weed canopy for post emergence applications. The sprayer must be set up and operated to provide the correct amount of spray overlap. Overlap within a boom swath depends on both nozzle spacing and boom height. Overlap between boom swaths can result in a double application and crop injury. GPS systems and various boom-end marking systems (foam markers) can be used to mark the outer edge of the swath pass.

Herbicides are usually applied with flat fan nozzles. Nozzles such as the Delevan Raindrop nozzles or the air induction (venturi) type nozzles are effective. Cone-type nozzles are not recommended as spray pattern and distribution are poor at the lower pressures required for herbicide applications. Sprayer pressure should not exceed 276 kPa (40 psi) for herbicide applications unless otherwise recommended by the equipment manufacturer.

3. Best Management Practices

Blueberry growers can respond to the public's concern for the environment in a proactive manner through the adoption of Best Management Practices (BMP). Best Management Practices are recommendations and guidelines to help growers make sound environmental decisions in their farming operation. They are a combination of management, cultural, and structural practices that are considered effective and economical in reducing environmental impacts. They provide opportunities for growers to evaluate and choose the best management practices that are most appropriate for their own operation. Many of the production and management activities that blueberry growers practice influence not just themselves but their neighbours and community. Anything that can be achieved to prevent environmental pressures will make both the grower's operation and the blueberry industry more sustainable.

It is important that growers identify problem areas within their operation and select and implement the appropriate changes. Examples of Best Management Practices include:

- scouting fields and spray only when and where necessary
- making sure your sprayer or spreader is calibrated properly and accurately
- matching appropriate herbicide rates with soil type
- not mixing or loading near water, bringing the water to the sprayer
- not applying herbicides to rock formations and exposed ledges as they may provide a direct channel to groundwater
- avoiding spraying if heavy rainfall or winds are forecast
- using an anti-backflow device when filling sprayers from a water source to prevent contamination from backflow
- leaving an untreated vegetation strip near any water sources to act as a buffer and filter
- reading and following all instructions as stated on the labels

The use of hexazinone (Velpar DF, Pronone 10G) has been associated with groundwater contamination and soil erosion. A fact sheet, Best Management Practices for Hexazinone (C.4.5.0), has been prepared to help minimize these problems. It is important that these instructions be followed to safeguard the use of this herbicide.

4. Tank Mixing

A tank mix of a pest control product occurs when two or more products are applied at the same time through the same set of nozzles. Tank mixes can be mixtures of the same product type (herbicide + herbicide) or of different types (for example, herbicide + fungicide). Tank mixing provides benefits to producers by broadening the spectrum of pests controlled, helping to manage pest resistance and reduces application time and costs. Products may not be suitable for tank mixing due to physical incompatibility, increased risk of crop injury or decreased pesticide performance.

Some pesticide labels provide specific recommendations and instructions for applying products as tank mixes. These tank mixes have been evaluated for performance and safety. When using a labelled tank mix, follow all directions included on the product label. If a tank mix does not appear on a product label, producers can apply unlabelled tank mixes for registered products, provided that these six conditions are met:

a) All products are registered for use on the crop
b) All products require the same adjuvants to be used. If you have to add a new adjuvant to a product which does not require its use, you cannot apply that tank mix. Any adjuvant added to a tank mix must be registered for use with all products.
c) The stage of application for the crop and all pests for all products must overlap. The pests and crop must all be in an appropriate stage for application for all products in the tank mix.
d) All label directions are followed, including the use of the most restrictive buffer zone, personal protective equipment, restricted entry interval etc.
e) Tank mixing is not excluded on any of the product labels. Some pesticide labels specifically prohibit mixing with other products.
f) Applying the products together provides a value to the end user, either through increased pest control spectrum, reduced application time/costs or resistance management.

Anyone who recommends or applies an unregistered tank mix does so at their own risk and liability. More information on the use of unlabelled tank mixes can be found in these documents: Memo – Use of Unlabelled Tank Mixes or Frequently Asked Questions.

Before tank mixing any pesticides, it is very important to test the compatibility of the products. When certain pesticides are mixed, they may gel or form a precipitate, either of which will be difficult to clean out of spray equipment. An easy method to test compatibility is a jar test. Before beginning the jar test, make sure to wear the appropriate personal protective equipment. Add water to a small jar or container, then add small amounts of the pesticides you are interested in mixing, in the order and ratios in which you plan to apply the products. Cover the jar and shake it vigorously, then leave it to settle for 15 minutes. If the mixture is smooth and free of clumps, the products should be physically compatible. If the jar feels warmer, or if there is any clumping or particles that do not disappear after additional shaking, the products are not compatible and should not be tank mixed.

Follow all mixing instructions on the product label. When the label does not provide mixing instructions, pesticides should be mixed in the following manner. Fill the spray tank ½ full with water and start agitation. Add in the different formulations in the order below, allowing time for complete mixing and dispersion of each product.

1) Dissolvable Packs (WSP)
2) Wettable Powder (WP, W)
3) Water-Dispersible Granules and Dry Flowables (WDG, DF)

Maintain agitation and fill the spray tank to ¾ of the final water volume, then add:

4) Water-based Solutions (S, L, SC, F)
5) Emulsifiable Concentrates (EC, E)
6) Spray Adjuvants (surfactants, fertilizers)

Finish filling the tank and maintain agitation throughout the entire spraying procedure.

Notes on Herbicides Registered for Use on Wild Blueberry

Herbicide label information overrides any discrepancies between information presented in this guide and the label. Herbicides are presented in alphabetical order and rates are given in kilograms or litres of commercial product. Additional information on weed susceptibility, herbicide use and toxicity are given in tables that follow.

1. Callisto 480 SC (mesotrione)

Callisto is a selective broadleaf herbicide for the control of labelled weeds in the sprout or crop year of wild blueberry production. Callisto has both pre-emergent (soil) and post-emergent (leaf) activity. Callisto can be broadcast using ground application, once per year, over the top of the blueberries. Within the cropping season, applications must be made prebloom to the crop. Treated areas cannot be harvested within 60 days of application. Apply in 100-200 L water per hectare with a spray pressure of 206-300 kPa. Two application timings are registered; however, most grower experience indicates improved weed control from post-emergent use.

Pre-emergent: Up to the 2 leaf weed stage, apply 0.3 L Callisto/ha. No surfactant is required.

Post-emergent: Up to the 8 leaf weed stage, apply 0.3 L Callisto/ha. A non-ionic surfactant, Agral 90, must be added at 0.2% v/v (2 L Agral 90 per 1000 L spray solution).

In susceptible plants, herbicide activity results in bleaching symptoms, followed by plant death. Bleaching typically begins in leaf foliage and at growing points 3-5 days after application, with weed death 2-3 weeks later. Although weed competition is quickly halted, visual symptoms of dying weeds (discolouration) may take up to 2 weeks to appear, depending on the weed species and growing conditions. The bleaching symptom may be noted on less susceptible plants (like tree species) but may not result in plant death. For best results, apply Callisto to actively growing weeds. Weeds that emerge after an application may be controlled when they absorb the herbicide from the soil provided there is sufficient moisture for uptake. When applied post emergent, thorough coverage of emerged weeds is essential for effective control. Under unfavourable conditions, such as drought, heat, flooding or prolonged cool temperatures, adequate control may not be achieved and re-growth may occur. Active weed growth is required for optimal herbicide activity.

Temporary crop injury (bleaching) may occur if applications are made under extreme weather conditions or when the crop is under stress. Blueberry growers have observed more crop injury when applications are made under hot and/or humid conditions or when the crop is stressed from flooding. The injury is most visible where excessive rates have been applied, such as sprayer overlaps. If heavy rain is expected within 48 hours, application should be delayed. Do not make a foliar post-emergent application of any organophosphate or carbamate insecticide within 7 days before or 7 days after Callisto application or severe crop injury may occur. No tank-mixes with Callisto are currently registered for use in wild blueberry. There is an increased potential for crop injury when extra surfactant is added. The use of high surfactant rates or non-labelled surfactants has caused leaf burning to the crop.

In wild blueberry production, mid-June applications have provided the most consistent weed control. This product has a more limited control spectrum than hexazinone (Velpar/Pronone) and is best used to supplement current weed control practices. Improved weed control has been shown when a hexazinone application is followed with a Callisto application post-emergence, especially on difficult to control weeds like goldenrod species. More information on the use of Callisto in wild blueberry is available in this fact sheet (C.4.6.0).

2. Chateau (flumioxazin)

Chateau is a pre-emergence herbicide for suppression of hair-cap moss and control of selected grass and broadleaf weeds. Chateau has not been extensively tested in wild blueberry, so the level of weed control is not well understood. All applications should be made to dormant wild blueberries in the sprout year (spring and/or fall) or as a dormant post harvest (fall). Ideally, applications should be made in the late fall of the crop year, following crop pruning or complete blueberry leaf drop. Unacceptable crop injury, including yield loss, can occur if Chateau comes into contact with non-dormant blueberry plant parts, including green leaves or green bark. Research trials have shown extensive crop injury when Chateau is applied to non-dormant blueberry plants.

The application rate is dependent on soil texture and weed target. Apply 280 g/ha on coarse-textured soils or 420 g/ha on medium-textured soils to suppress hair-cap moss. A lower rate is registered for control of lamb's quarters and other labelled annual weeds. Apply 140 g/ha on coarse soil and 210 g/ha on medium textured soils when controlling annual weeds (as listed on the label). Do not apply Chateau on soils with greater than 5% organic matter (OM) or on fine-textured soils like clay. A second application may be applied if required for weed control for a maximum of two applications per year. The second application must not occur until 30 days following the first application while the blueberry plants remain dormant.

Control is most effective when applied to clean, weed-free soil surfaces. Apply in adequate water volume to ensure thorough coverage. For residual weed control, moisture is required to activate the herbicide in the soil. Dry conditions following application may reduce effectiveness. Crops injury may occur from applications made to poorly drained soils or applications made under cool, wet conditions. Spray equipment must be thoroughly cleaned after Chateau use to ensure that herbicide residue in the sprayer does not harm the crop when the sprayer is next used.

3. Dicamba (Banvel II, Oracle)

Dicamba is the active ingredient found in Banvel II and Oracle herbicides. These non-selective broadleaf herbicides, when applied to the foliage, are absorbed by the leaf and translocated throughout the plant. Banvel II and Oracle can be applied alone or in combination with 2,4-D L.V. (low volatile) ester as either an overall broadcast or spot spray. Banvel II/Oracle or Banvel II/Oracle plus 2,4-D L.V. ester can cause serious damage to lowbush blueberries if applied directly on actively growing blueberry plants, or if applied improperly.

Broadcast application

Application must be made in the fall of the fruiting year when the weeds are moderately green but after **90%** of the blueberry plants have dropped their leaves. Two application rates are registered.

1. Banvel II or Oracle alone. For control of lambkill and suppression of sweet fern, apply Banvel II (480 g/L) or Oracle (480 g/L) at a rate of 4.6 to 7.1 L/ha (1.9 to 2.9 L/acre).

2. Banvel II/Oracle + 2,4-D L.V. ester. For additional control of broadleaf weeds, Banvel II/Oracle may be mixed with 2,4-D L.V. ester (600 g/L) and applied in the fall of the crop year. Apply Banvel II or Oracle at 2.3 L/ha (0.93 L/acre) with 2,4-D L.V. ester (600 g/L) at 5.7 L/ha (2.3 L/acre).

If possible, fall pruning should be carried out 4 to 5 weeks after spraying. In New Brunswick research, there was no change in weed control or crop injury when mowing was carried out 2 to 3 weeks after application. If spring pruning is planned, it should be done as early as possible to reduce the chance of injury to the blueberry plants. Banvel II or Oracle should be applied in 550 L of water per hectare. Blueberry tolerance decreases with the use of lower water volumes. Rainfall within 4 hours of application may reduce effectiveness. Significant delays in emergence have been observed in the spring following a fall application, particularly where mowing has replaced burning. A longer delay of emergence and a lower blueberry plant density have been observed if mowing height is not adequate. Proper sprayer calibration and agitation in the spray tank is essential to avoid crop injury. When working with these herbicides, growers should experiment on a small area for the first time until they become familiar with broadcast applications.

Spot spray application

During site preparation, Banvel ll or Oracle can be applied as a spot spray to control Velpar resistant weeds such as maple, alders, willows and honeysuckle. Apply 2.1 L of Banvel II or Oracle per 1000 L of water. Contact with actively growing blueberry plants must be avoided or severe injury or death will result.

4. Garlon (triclopyr)

On newly cleared sites, Garlon can be used to control alder, ash, birch, poplar, pin cherry, maples, and other woody species. Some species (e.g. red maple and choke cherry), are more difficult to control and may require re-treatment the following year. Two formulations of Garlon are available for use. Garlon XRT should be mixed with oil, either vegetable or mineral oil, where 13 to 19 L of Garlon XRT is added to enough oil to make 100 L of spray mixture. Garlon RTU is ready to use and does not require any additional oil before treatment. Apply either formulation using a knapsack or backpack sprayer with a flat fan or solid cone nozzle, or with a wick attachment. Low pump pressures of 70 to 210 kPa are recommended. Blueberry plants are very sensitive and may be killed if Garlon comes in contact with the plants. Only one application per year is permitted. Rainfall within 2 hours of application may reduce effectiveness.

Garlon is registered for the control of woody weed species during field site preparation as either a basal bark or stump treatment. For basal bark application, spray the basal or lower 30 cm of trunks up to 15 cm in diameter as well as to any roots that may be exposed. To control re-sprouting of cut stumps of woody species, all exposed bark, roots and cut surfaces should be wet thoroughly either by painting or spraying. This solution can also be applied to the base of suckers or saplings with a small brush for effective control of many species. All surfaces should be coated, including individual stems when applying to clumps of trees.

5. Glyphosate (Roundup, etc.)

There are a number of commercial products currently registered for use in wild blueberry that contain the active ingredient glyphosate. These include Roundup, Roundup WeatherMax, Touchdown, Credit, Vantage, Factor, Sharpshooter, Polaris and Glyfos with several formulations for each commercial product. Although glyphosate is common to each of these products, the salt formulation and surfactants present in these products may vary. In addition, the application rate and rain-fast period can differ for each type of product. Differences in weed control between these products are generally considered minimal by many weed scientists. Consult the label for additional information on the use of individual glyphosate products.

Glyphosate is effective against most broad leaved species including maple, beech and ash. Glyphosate is absorbed into the foliage and translocated throughout the plant, killing both above

and below ground growing points. It is generally most effective when applied in June through August to fully expanded and actively growing foliage. To be effective, application must be made immediately after cutting the plant if used as a cut stump treatment. It is not effective as a bark treatment as it does not readily penetrate bark. Glyphosate will not have any activity on conifer species. Glyphosate has no activity when applied to the soil and provides no residual weed control.

Glyphosate can only be used in blueberry fields if it is selectively applied to the weed foliage. Glyphosate has a role in the preparation of fields for blueberry production and also as a spot or wiper treatment in established fields. Glyphosate can be applied selectively, either as a directed spot spray or as a wiping treatment. Blueberry plants are very sensitive to glyphosate treatments and contact will result in blueberry plant injury or death. Rainfall within 1 to 6 hours may reduce effectiveness, depending on the commercial product used. Glyphosate, mixed and applied in hard water, is known to result in reduced weed control. For optimal results, glyphosate should therefore be applied in soft water. The addition of ammonium sulfate to hard water can counteract the negative action of the hard water and improve weed control.

Spot Spray

Apply as 1% to 2% solution of 356 g acid equivalent per litre of glyphosate (356 g.a.e./L – Roundup Original formulation). A 2% solution is equivalent to 2L of product in 98L of water. For Roundup WeatherMax, apply as 0.67% to 1.34 % solution. A 0.67% solution is equal to 670 mL of product with enough water to make a 100 L solution and a 1.34% solution is equal to 1.34L of product with enough water to make a 100 L solution. The mixture should be applied to the foliage of woody weeds in the sprout year. Ensure uniform coverage and apply enough product to wet the leaves but not to the point of runoff.

Roller and Wiper Treatments

The use of glyphosate in rollers or wipers is an effective way to control weeds growing above the blueberry plants. The roller or wiper should touch the weeds at a minimum 5 cm above the blueberry canopy, ideally 15 cm above the crop. Care must be taken to avoid dripping the product from the application equipment onto the blueberry crop. For roller applicators, prepare a 5 to 10% solution by mixing 0.5 L to 1.0 L of 356 g.a.e./L herbicide with enough water to make 10 L of solution. For Roundup WeatherMax, prepare a 3.3-6.7% solution (0.33 to 0.67 L with enough water to make 10 L of solution). Roller speed should be maintained at 50 to 150 rpm. For wick or other wiper applicators, mix 1L of herbicide with 2L of water to prepare a 33% solution. For Roundup WeatherMax, mix a 22% solution (0.57 L in 2 L of water). Not all glyphosate products are registered for use in rollers or wipers and rates may vary between products. Please consult the glyphosate label for more specific information before using in this manner.

Fall Roundup WeatherMax Use for Lambkill Control

This herbicide treatment pattern for Roundup WeatherMAX is only registered within newly cleared wild blueberry production. There still is a risk of crop injury when using this treatment, although this potential risk is better tolerated during early production years. Crop safety of this application pattern in mature fields was not evaluated and use in mature fields cannot be recommended at this time. Other glyphosate formulations can still be used in wild blueberries as spot or wiping treatments in established fields but are not recommended for a late fall application for lambkill control. These glyphosate formulations were not tested using this application pattern and cannot be recommended at this time.

As the correct application conditions are a balance between the stage of development of the lambkill and blueberry plants, potential treatment areas should be monitored closely in the fall. Since harvesting the crop places stress on the blueberry plants and contributes to early leaf drop,

any treatment areas should be harvested in the year of application. Applications should be made in the fall before pruning the field, when blueberry plants have 95% leaf drop. The typical timing in research evaluations was late October or November.

Apply Roundup WeatherMAX at 1.67 litres per hectare in 200-300 litres per hectare of clean water using a boom applicator. Do not add adjuvant to the spray mixture. Treat only areas of the field which have lambkill present. Do not prune for at least 14 days after application. All fields treated with Roundup WeatherMAX must be pruned post treatment in the fall or pruned the following spring before May 15th. Any delay in pruning in the spring can decrease the level of weed control. Pruning as close as possible to the ground is recommended to improve weed control.

Only one application of glyphosate is registered in a typical cropping cycle (2 year rotation). As a general precaution, only apply fall glyphosate once for two cropping cycles. One glyphosate application, if made under the proper application conditions, generally provides a very high level of lambkill control and follow-up lambkill control treatments are usually not required. More information on the use of glyphosate to control lambkill is available in this fact sheet (C.4.7.0).

6. Kerb SC (propyzamide)

Kerb is a soil active herbicide that will control or suppress many perennial grasses, including Venture L and Velpar-tolerant fescues. It does not control poverty oat grass or woody species. It has little activity on broadleaved species, but has shown activity on sheep sorrel. Kerb is registered for use at 4.1 to 5.6 L/ha (1.7 to 2.3 L/acre) in late October and November of either the sprout or crop year. Application should be made in 300-500 L water per hectare. Applications should be made when the ground is cool but before it freezes. Rainfall is required to move Kerb into the soil where it is active. Herbicide losses are greatest when applications are made to frozen ground or when soil temperatures are high (greater than 10 ^{o}C). Weed control is best when the soil moisture level is high and soil temperatures are cool. Lowbush blueberry is very tolerant to Kerb. Variability in weed control has been found with this product, mainly attributed to poor weather at application (e.g. too dry, too warm, frozen ground).

7. Lontrel 360 EC (clopyralid)

For the control of tufted vetch apply Lontrel 360 in late spring of the sprout year when tufted vetch is in the early flowering stage. Lontrel 360 generally gives excellent control of established tufted vetch but it gives no control of seedlings that emerge after application. Early application provides a longer period of weed control and will prevent seed production. Often there are no obvious visible crop injury symptoms following application, but there may be a reduction in bloom and blueberry canopy the following crop year, particularly if late applications, which can interfere with the developing fruit bud, were made. Applications in July and August have resulted in blueberry yield loss. In extreme cases, there may be malformations of the blossoms. **Lontrel 360 should never be applied in fruiting blueberry fields.**

Only one application per year is permitted. Small infestations can be treated with backpack or hand-gun applicators; larger infestations can be treated with a calibrated boom sprayer. Applications should only be made to areas infested with vetch. Application to the crop should be avoided as much as possible. When using a hand gun or backpack sprayer to treat small infestations, apply Lontrel 360 herbicide at a rate of 42 ml per 1000 m2 area in 200 L of water. When applying with a boom sprayer to treat larger infestations, apply 420 ml per hectare (2.5 acres) in 150 to 200 L of water.

8. Option 2.25 OD + UAN (foramsulfuron)

Option is registered for use in the spring of the sprout year when the targeted weeds are at the appropriate leaf stage. This herbicide will control mainly grasses in wild blueberry, including quackgrass (3-6 leaf stage), witchgrass (2-4 leaf stage) and suppress fescues (1-6 leaf stage of fine-leaf sheep fescue, sheep fescue, red fescue and tall fescue). Timing of application is very important for fescue control. The appropriate stage can vary from field to field and season to season, but typically occurs after blueberry emergence in the sprout year, but before seedhead emergence of the fescue. This timing is earlier than the typical post-emergent grass timing in wild blueberry, so proper scouting and staging is required for best results. In research evaluations for wild blueberry, Option has controlled ticklegrass and suppressed poverty oatgrass. Only a few broadleaf weeds may be controlled, including lamb's quarters and redroot pigweed. For best results, apply to emerged, young, actively growing weeds. Option will have an effect on more mature weeds, but the speed of activity and level of control will be reduced.

Apply Option at 1.56 L/ha. Option must be applied with a spray-grade liquid nitrogen fertilizer, such as 28% UAN, at a rate of 2.5 L/ha. Grassy weed control will be decreased if the fertilizer is not used. Apply in a minimum of 150 L water per hectare and at a pressure of 175 – 275 kPa. The use of 80^{o} or 110^{o} flat fan nozzles is highly recommended for optimum spray coverage and canopy penetration. Use 50 mesh filter screens or larger. Do not apply Option to any field more than once per year. Apply by ground application only.

The speed of action of Option is influenced by environmental factors. Weed growth typically stops within 1-3 days following application. Warm, moist conditions promote the activity of herbicide action. Typically, the weeds will turn yellow, usually in 5-10 days. Under cool and/or dry conditions, activity may be reduced or delayed. Weed control may also be reduced if application is made when weeds are covered by dust or in the presence of heavy dew, fog or mist/rain. Option works primarily as a contact herbicide with limited soil residual activity. Uniform spray coverage is important to achieve consistent weed control. Control may be reduced if the blueberry canopy has closed over the weeds, intercepting the spray.

9. Poast Ultra + Merge (sethoxydim)

Poast Ultra can be applied broadcast in the late spring of both the sprout and fruiting year for post emergent control or suppression of certain annual and perennial grasses. Poast Ultra is a contact and a systemic herbicide. Uptake into the plant is primarily through its leaves. Thorough coverage of the foliage is important for consistent grass control. Degree of control will depend on the level of susceptibility to the herbicide and the rate applied. Once treated, susceptible grasses that were actively growing prior to treatment stop growing and undergo a burn-back. Colour changes first to a yellow, then purple and finally a brown colour. The time required for complete control is normally 7 to 21 days following treatment, depending on growing conditions and crop competition.

Control of quackgrass (and other perennial grasses) happens more slowly than control of annual grasses. Poast Ultra is translocated through the quackgrass plant to the rhizomes and kills actively growing rhizome buds, as well as above ground vegetation. Dormant rhizome buds will remain unaffected by the spray and regrowth can occur from these buds. When Poast Ultra is applied according to label directions, the regrowth of the quack grass will not be significant until 6-8 weeks after treatment, depending on growing conditions and crop competition.

Apply 0.47 L/ha Poast Ultra plus 1 L/ha Merge post emergence for the control of annual grasses at the 1 to 6 leaf stage (witch grass and fall panicum) and for ticklegrass control. Apply 1.1 L/ha Poast Ultra plus 1-2 L/ha Merge for the suppression of quackgrass, poverty oat grass, blue grasses and other perennial grasses. Apply when perennial grasses have 10 cm of new leaf growth – usually in

late May or early June. These applications are useful in some grass-infested fields during the crop year to increase harvest efficiency. Assist Oil Concentrate can be substituted for Merge Adjuvant at the same rates. Poast Ultra should be applied in 100 to 200 L water per hectare. Blueberry plants are very tolerant to Poast Ultra, even during bloom.

Most effective control is achieved when application is made at the 2 to 5 leaf stage when annual grasses are small and actively growing, soil moisture is good, and the crop is small enough to permit thorough spray coverage. Applications made to grasses greater than 20 cm in height or grasses that have reached the heading stage will not give adequate control or suppression. When grasses are stressed due to drought, flooding, hot or prolonged cool temperatures (15°C or less), control can be reduced or delayed since grasses are not actively growing. Grass escapes or re-tillering may occur under prolonged stress conditions or low fertility. Do not make applications to grasses stressed longer than 20 days due to lack of moisture, as unsatisfactory control can result. If stress conditions exist at the time of application and have existed for less than 20 days, then use the higher recommended rates of Poast Ultra.

Rainfall within one hour of application may reduce the effectiveness of the spray. This product does not provide residual control. The preharvest interval is 15 days. Poast Ultra does not control rush, sedge or broadleaf weeds. Do not mix or apply Poast Ultra with any other additive, pesticide or fertilizer unless recommended on the label. Allow 4 days between application of Poast Ultra and any other chemical.

10. Princep Nine-T (simazine)

Princep Nine-T (1.5 to 2.0 kg/ha; 0.6 to 0.8 kg/acre) is registered for use in lowbush blueberries. This herbicide should be applied in a minimum water volume of 300 L/ha. This herbicide has not been frequently used within the blueberry industry. As a result, the weed spectrum controlled is not well documented. Woody weeds and most established perennial species will not be controlled with simazine. Princep Nine-T can be applied in late fall or early spring when blueberries are still dormant. Only one application is permitted per season. Apply the lower rates on coarse sandy soil and the higher rates on clay soils and soils high in organic matter. Rainfall is required to activate simazine. Crops must not be harvested within 60 days of application.

11. Sinbar WDG (terbacil)

Sinbar is recommended for grass and hay-scented fern control, but is also effective against lamb's quarters and other annual broadleaf weeds. Sinbar is residual and provides control of many later germinating weeds. It is not recommended to continuously apply Sinbar as this may promote the growth of tolerant broadleaf weeds, such as goldenrods, sheep-sorrel and asters. Apply Sinbar at 1.5 to 2.5 kg/ha (0.6 to 1 kg/acre) in the spring of the sprout year, after the pruning operation, but before new blueberry shoots emerge. Later applications may cause crop injury. Sinbar can be applied in late fall of the crop or sprout years when blueberry plants are dormant. Apply the lower rates on coarse sandy soil and the higher rates on clay soils and soils high in organic matter. Use 150-300 L water per hectare. Apply Sinbar within 24 hours of mixing as product degradation may result. Moisture within 2 weeks of application is required to activate Sinbar.

12. Spartan + Agral 90 (tribenuron methyl)

A) Broadcast applications for bunchberry control

Spartan is a post emergent herbicide that must be absorbed through emerged weed foliage to be effective. Proper application timing is critical with this herbicide and will directly influence the level of bunchberry control and crop injury. For bunchberry control, apply Spartan at 40 g/ha (16 g/acre) with 0.2%v/v Agral (200 mL per 100 L water) in 150 to 250 L water per hectare. Add Agral 90 after

Spartan is well mixed and in suspension. Spartan may degrade in water and should be applied on the day it is mixed. Disperse the granules in a small amount of water before adding them to the spray tank to ensure the herbicide is thoroughly in suspension. Only one application per year is permitted. Rainfall within 4 to 6 hours after application may also reduce control.

In the year following Spartan application, some bunchberry regrowth can be expected, but densities will be much lower than pre-treatment levels. It may be necessary to use Spartan in following sprout years to maintain bunchberry control levels. When used in the manner described below, Spartan has generally resulted in 70 to 90% control of bunchberry with minimal effect on the crop. Two distinct application timings are registered, with more information available in this fact sheet (C.4.3.0). The fall timing has shown increased and easier weed control with a wider application window and should be the preferred method of treatment.

i) Spring, sprout year application

This is the original application window registered on the Spartan label. For best results, applications should be made when the majority of the emerged bunchberry plant leaves have unfolded to form a 45 degree angle, but no later than when the first white blossoms are visible on the most advanced plants. Bunchberry plants generally turn pinkish red to yellow following spraying but may take weeks to die down. If Spartan applications are made too late, bunchberry plants turn red and remain so for the entire season and reduced control can be expected. If Spartan is applied too early, bunchberry regrowth can be expected later in the season.

Spartan should also be applied before blueberry sprout regrowth exceeds 2 cm in height. Some stem height reduction, with yellowing and reddening of the blueberry leaves, might be observed for 6 to 8 weeks after application. This is more likely to occur if there have been prolonged cool temperatures or wide fluctuations in day and night temperatures just prior to or soon after treatment. Blueberry plants, however, recover and fruit bud numbers and potential yields are not generally affected. Recommended fertilizer applications before or after Spartan applications may be beneficial. Applications made at later stages of blueberry development or applications in spring-burnt fields are not recommended due to potential crop injury and potential yield reductions.

ii) Fall, crop year application

A fall application timing, evaluated through research conducted in New Brunswick, has been accepted for registration. This timing occurs one to four weeks after the completion of the blueberry crop harvest. Typically, this application would occur in September of the crop year. There are no restrictions on crop stage, although application should be made while bunchberry has active growth. Reddening of bunchberry may occur after harvest, especially in mechanically harvested areas. No effect of harvest type, either hand or mechanical harvest, was found in research trials. Higher levels of weed control in sprout year evaluations were noted following fall applications, as well as decreased visual crop injury as compared to typical spring Spartan applications. However, no difference in blueberry yield was measured between the spring and fall application timings in research trials.

B. Spot applications

Spartan can be used as a directed spot spray with a backpack sprayer or handgun to control alders, bracken fern, wild rose and yellow loosestrife. Mix 2.5 g of Spartan plus 20 mL Agral 90 for every 10 L of water and spray to thoroughly wet the foliage. Apply only during the summer of the sprout year when the foliage is fully expanded. Alders and wild rose can be controlled with early fall applications as they retain their leaves longer. Bracken fern shows few symptoms after application but control the following year is excellent. Foliage of the other species turns yellow or red and the stem terminals die soon after application. Control of vetch, poplars, willows,

goldenrods and fly honeysuckle has been erratic and others like chokepear, bayberry, black bulrush, sweet fern, and birch, are resistant. Blueberries growing among treated weeds generally show few symptoms. However, when the crop is sprayed directly, it may be stunted with reduced bloom and yield. Spartan may degrade in water and should be applied the same day it is mixed.

13. Ultim 75 DF + Agral 90 (nicosulfuron/rimsulfuron)

For control of black bulrush, apply Ultim 75 DF plus Agral 90 in June of the sprout year. Apply when the first flower heads begin to emerge from the bulrush tussock. Ultim 75 DF should be applied as a directed spot spray to thoroughly wet bulrush foliage. Control may be erratic or unsatisfactory from later applications or if the bulrush is under stress. Stunting and yield loss may occur when blueberry plants are sprayed directly, but with careful application, injury is minimal to those plants growing among the bulrush. Ultim is a contact herbicide and will not provide residual control of grass or broadleaf weed seedlings that may germinate after application.

Ultim 75 DF is pre-packaged in water soluble bags containing 33.7 g commercial product, or enough to mix 800 L of spray solution. This is equivalent to 4.2 g per 100 L of spray solution. Ultim 75 DF should always be applied with 0.2% Agral 90 surfactant (equivalent to 2 L per 1000 L water or 200 mL per 100 L water). Disperse the DF granules in a small amount of water before adding them to the spray tank to ensure the herbicide is thoroughly in suspension. Add the surfactant after Ultim is well mixed and in suspension. Ultim spray solutions should be used within 24 hours of mixing or product degradation may occur. Mix no more than can be used in one day. Rainfall within 2 to 4 hours after application may reduce Ultim effectiveness.

14. Velpar DF and Pronone 10G (hexazinone)

A. Formulations

Two commercial formulations containing the active ingredient hexazinone are available: Velpar DF, a 75% dry flowable granule that is mixed with water and Pronone 10G, a 10% solid granule. Velpar DF and Pronone 10G are pre-emergence residual herbicides applied for the control of many grasses, broadleaf weeds, and woody weeds.

Pronone 10G consists of clay granules impregnated with the herbicide. Following rainfall, the herbicide is released by leaching. Pronone 10G is approved only for sprout year applications and is applied with a calibrated fertilizer spreader, such as the Vicon spreader. Calibration information on the Vicon spreader is available here (C.4.4.0). Patchy crop injury or control indicates uneven distribution of granules. Control may therefore be poor during dry weather, but gradual release may prolong and improve control of some species.

If blueberry sprouts or leaves have emerged, the risk of crop injury is much less from Pronone 10G applications than from liquid sprays of Velpar DF. However, herbaceous weed control is generally better with pre-emergence applications of Velpar DF than with Pronone 10G. When using Velpar DF, follow label instructions to ensure the dry flowable granules completely disperse in the spray tank before application.

B. Sprout year applications

Velpar DF is registered for use in the sprout year at 1.92 to 2.56 kg/ha (0.78 to 1.0 kg/acre) and Pronone 10G at 14 to 20 kg/ha (5.7 to 8.0 kg/acre). The high rate is recommended for use in weedy or new fields to control common herbaceous and woody weeds. The low rate is recommended for maintenance weed control in relatively clean fields. Applications should be made in the spring after the pruning operation, but before new sprouts or leaves emerge. Apply Velpar DF in at least 200 litres of water per hectare.

On mature, well-established fields, it is suggested that growers experiment with different hexazinone rates in order to determine the minimal effective rate for the weed types present. In some instances, it may be feasible to even skip hexazinone applications or just treat known problem areas. For growers who are concerned that unmanageable weed populations may result if hexazinone applications are skipped, it is suggested that only a small area of their field be left untreated. If weed levels in the area are acceptable, then the untreated area could be expanded the following cycle.

Crop tolerance to Velpar DF is generally the greatest and weed control the best when applications are made soon after pruning but before new blueberry sprout emergence or new leaf growth. Best results occur when the herbicide is present in the root zone during active growth of the target weeds. There is no difference in tolerance between mowed and burned blueberry plants. Applications made after the foliage has emerged can cause serious leaf burn. Crop injury has consistently been associated with late applications. However, blueberry plants on sandy or shallow soils, or those weakened by heavy weed competition or frost heaving, may be more prone to hexazinone injury than those in vigorous stands.

Hexazinone is principally a soil acting herbicide that is leached by rain into the root zone. Herbicide activity is affected by too little or too much rainfall and by soil texture. Lower rates are used on light textured soils and higher rates are used on heavier soils and in high organic matter soils. Hexazinone is very water soluble and subject to leaching and lateral movement. Therefore, do not apply to gravely soils or on steep slopes or to roadways or other areas subject to erosion in the absence of plant cover. Follow Best Management Practices to minimize the risk of contaminating water sources, as outlined here (C.4.5.0).

Experience has shown that blueberry rhizomes do not colonize ground kept bare by repeated hexazinone use. Hexazinone is an important tool in developing blueberry fields and managing weeds, but over-use that results in bare ground may lead to soil erosion and prevent clone expansion.

C. Velpar DF in the fruiting year

Velpar can be applied in the early spring of the crop year, although the risk of crop injury is high when applied at this time. When the crop contains weed species that could affect its development or harvest efficiency, an application of 1.3 kg/ha (0.53 kg/acre) Velpar can be made. It is recommended that this treatment be applied only to those areas of the field where weed density will cause yield losses or harvesting problems. This treatment will control or suppress most goldenrods, asters, sheep sorrel, some annual broadleaved weeds and most grasses that have not developed hexazinone tolerance. Timing of application is critical. Applications should be made no later than the early bloom stage before the flower buds separate and show the white floral tube. This corresponds to when the bud scales are separating or the F1 and F2 developmental stages. This stage generally occurs no later than mid May. Later applications can result in serious crop injury and much reduced yield. This treatment should only be used on soils with a well-developed organic layer and should not be used on sandy or gravely soils. Crop injury is strongly influenced by soil and environmental conditions. Velpar application in the crop year should only be used as a rescue treatment for severe weed infestations. Growers should evaluate alternative weed control options before using Velpar applications in the crop year.

D. Response of weeds to hexazinone

Repeated hexazinone use has led to many changes in the weed flora of blueberry fields. It is now difficult to predict the response of some species to hexazinone. The susceptible/tolerant ratings of common weed species in Table 1 are based on trials in fields with little or no previous exposure to

hexazinone and may be most applicable to new fields. The susceptibility of some species has changed with long-term exposure to hexazinone (or reduced rates) in the following ways:

Incomplete control. Majority of seedlings and immature plants may be killed but mature plants recover from initial injury and reproduce, especially in the fruiting year. Examples of weeds which show incomplete control include many perennial herbaceous species, like black bulrush, black knapweed, St. John's wort, goldenrods, vetch, ferns, and others. The level of weeds which exhibit incomplete control increases as growers decrease the herbicide rate, as shown by the increase in sheep sorrel and narrow-leaved goldenrod in fields which have used reduced hexazinone rates.

Inherent tolerance. Like the blueberry plant, many other plant species are tolerant to labelled rates of hexazinone, e.g. bunchberry, bayberry, chokeberry, yellow loosestrife, lilies and orchids, and others. Some 'new' weeds like goat's-beard and sow-thistle appear to have inherent hexazinone tolerance.

Developed tolerance. Many native grasses have developed hexazinone tolerant populations with repeated exposure, as have some annual ones like witch grass. There is no evidence that populations of herbaceous broadleaved weeds have developed tolerance, or if the decreased control of some woody weed species (e.g. wild rose, bristly arilia, blackberry) results from decreased rates of herbicide or increased tolerance.

Germination patterns. Although residual, hexazinone may only provide several months of weed control. Many weed species germinate and establish later, like witch grass, chickweeds and others. Annual weeds germinate in both the sprout and fruiting year. When plants like lamb's quarters, witch grass, and hemp-nettle germinate in the crop year, control by sprout-year hexazinone is not achieved. Observing emergence patterns can help determine why some weed species are not controlled.

It is clear that many weed problems cannot be solved with hexazinone use. Growers must adapt their control strategy to control these escaping species.

15. Venture L (fluazifop-p-butyl)

Venture L can be applied broadcast in the late spring of both the sprout and fruiting year for post emergent control or suppression of certain annual and perennial grasses. Degree of control will depend upon their level of susceptibility to the herbicide and the rates applied. Susceptible annual grasses like witch grass or native perennials like ticklegrass (rough hair grass) can be controlled with Venture L, but many native grasses, like poverty oat grass and blue grasses, are more tolerant and are only suppressed. Suppressed grasses are severely stunted and flowering and vigour is greatly reduced for at least one season. The presence of these suppressed species, particularly in bare areas of blueberry fields, is beneficial and may enhance expansion of blueberry clones and reduce soil erosion. Other grasses, however, are highly tolerant.

Apply 1 L/ha (0.4 L/acre) Venture L post emergence for control of annual grasses at the 2 to 5 leaf stage (e.g. witch grass and fall panicum) and for tickle grass suppression. Apply 2 L/ha (0.8 L/acre) Venture L for the suppression of quack grass, poverty oat grass, blue grasses and other perennial grasses. Apply when perennial grasses have 10 cm of new leaf growth, usually in late May or early June. These applications are useful in some grass-infested fields during the crop year to increase harvest efficiency. When applications are made to grasses greater than 20 cm in height or grasses that have reached the heading stage, the grasses will not be adequately controlled or suppressed. Venture L should be applied in 100 to 200 L of water per hectare. Blueberry plants are very tolerant to Venture L, even during bloom. Venture L requires a minimum 2 hour rain-free

period after application and has no activity in the soil. The preharvest interval is 60 days. Venture L does not control rushes, sedges nor any broad-leaved weeds.

Notes on Herbicide Tables

Information provided in the following tables are provided to facilitate choosing the best treatment and are not a guarantee of performance. Producers should refer to the product label for more specific information. Factors such as weather, stage of growth, herbicide rate and difference in tolerance among plant populations can influence the information presented. Selective treatments can be applied with little risk of crop injury, provided label directions are followed. Non-selective herbicide treatments must be applied only to the weeds as blueberry plants that come in contact with the herbicide spray may be injured or killed.

Table 1. Herbicide Effect on Common Blueberry Field Weeds

Ratings s - susceptible t - tolerant sd - suppressed v - variable n/a - not applicable A - Annual P - Perennial	Life Cycle	Pre-Emergence					Post Emergence				Spot Treatments					
		Chateau	Kerb	Princep Nine-T	Sinbar	Velpar/Pronone	Callisto	Option	Poast Ultra	Venture	Banvel II / Oracle	Glyphosate	Garlon	Lontrel	Spartan	Ultim
Grass Type Weeds																
Black bulrush	P		t	t	t	v	sd		t	t	t	s		t	t	s
Browntop	P			s	s	s	t		s	s	t	v	t	t	t	
Canada blue grass	P				s	s	t	sd	sd	sd	t	v	t	t	t	v
Fescue (*Festuca sp*)	P		s		v	v(3)	t	sd	t	t	t	v	t	t	t	v
Kentucky blue grass	P					s(3)	t		sd	sd	t	v	t	t	t	
Mexican muhly grass	P				sd	v(3)	t		sd	sd	t	v	t	t	t	
Poverty oat grass	P		t	t	s	s(3)	t	sd	sd	sd	t	v	t	t	t	sd
Quack grass	P		v	t	sd	sd	t	s	sd	sd	t	v	t	t	t	sd
Tickle grass (Rough hair)	P				s	s(3)	t	s	s	s	t	v	t	t	t	sd
Rush Species	P					v	v		t	t						
Witch grass	A			t	s	v(3)	t	s	s	s	t	v	t	t	t	s
Herbaceous Broadleaf																
Asters	P		t		t	v	v		t	t	s	s		v	v	
Bunchberry	P		t	t	t	t	t		t	t		n/a		t	s(1)	v
Burnweed	A					v	s		t	t		s		sd		
Cinquefoil (Rough, 5-finger)	P				s	v	v		t	t		n/a			v	v
Cow wheat	A					v	s		t	t		n/a				t
Fireweed	P			s	s	s	sd		t	t		s				
Goldenrods	P		t	sd	t	v	sd		t	t	s(1)	s		v	v	sd
Hawkweed	P				sd	v	t	v	t	t		n/a		s		sd
Lamb's quarters	A	s		s(3)	s	v	s	s	t	t	s	s		t		sd
Old field toadflax	A,P						sd		t	t		n/a		t		
Ox-eye daisy	P				t	s			t	t	s	s		v		
Sheep sorrel	A,P		sd	t	t	v(3)	t	t	t	t	s	n/a		v		sd
Spreading dogbane	P			t	t	t	v		t	t	s	s	s	t	t	t
St. John's wort	P		t	t	t	t	v		t	t	s	s		t	t	t
Vetch	P		t	t	t	v	sd		t	t	s	v		s	v	sd
Wild lily of the valley	P			t	t	t			t	t		n/a		t	t	t
Yellow loosestrife	P			t	t	t	v		t	t	s	s		t	s	t
Woody Weeds																
Alder	P		t	t	t	t	t		t	t	s	s	s	t	s	t
Barrenberry	P		t	t	t	t	v		t	t	s	s		t	t	t
Birch	P		t	t	t	s	v		t	t	s	s	s	t	t	t
Cherry (*Prunus* spp)	P		t	t	t	t	t		t	t	s	s	v	t		t
Huckleberry	P		t	t	t	t	t		t	t	t	s	t	t	t	t
Lambkill	P		t	t	t	s(1)	t		t	t	s	v	v	t	t	t
Maple	P		t	t	t	t	t		t	t		s	s(2)	t	sd	t
Poplar	P		t	t	t	v	v		t	t	s	s	s	t	v	t
Rhodora	P		t	t	t	s(1)	t		t	t	sd	v	v	t	t	t
Wild rose	P		t	t	t	t	v		t	t	s	v	s	t	s	t
Willow	P		t	t	t		v		t	t		v	s	t	v	t
Non-flowering Plants																
Bracken fern	P			t	t	v	s(1)		t	t		s		t	s	t
Hair-cap moss	P	s(1)	t	t	t	t	t		t	t	t	t	t	t	t	t
Sweet fern	P		t	t	t	t			t	t	s	v		t	t	t

(1) may require additional applications in following cycles for satisfactory control
(2) Red maple requires high rate and possible re-treatment (3) Herbicide Resistant species suspected

Table 2. Herbicides Registered for Broadcast Application						
Active Ingredient	**Product**	**Product Rate**		**Water Volume**	**Pre Harvest Interval (Days)**	**Application Timing (see label for additional information/precautions)**
		kg or L / ha	**kg or L / ac**			
Soil-applied residual herbicide treatments						
flumioxazin	Chateau WDG	Suppress Moss: 0.28-0.42 kg/ha	Suppress Moss: 0.11-0.17 kg/ac	Min 100 L/ha (9 gal/ac)	None available	Apply to dormant blueberry, ideally late fall of crop year after pruning. Use low rate for coarse textured soils and high rate for medium soils, <5% soil O.M.
hexazinone	Pronone 10G Velpar DF	14-20 kg/ha 1.92-2.56 kg/ha	5.7-8.1 kg/ac 0.78-1.0 kg/ac	Min 200 L/ha (18 gal/ac)	None available	Spring of sprout year, before new blueberry plant growth emerges.
	Velpar DF	1.3 kg/ha	0.53 kg/ac			Early spring of fruiting year.
mesotrione	Callisto 480 SC	0.3 L/ha	0.12 L/ac	100-200 L/ha (9-18 gal/ac)	60	Spring of both sprout and crop year, PRE to 2 leaf weed stage. One application per season.
propyzamide	Kerb SC	4.1-5.6 L/ha	1.7-2.3 L/ac	300-500 L/ha (27-45 gal/ac)	None available	Late fall of fruiting or sprout year, after blueberry plant defoliation. Best results when soil temperatures are low, but above freezing and soil moisture is high.
simazine	Princep Nine-T	1.5-2.0 kg/ha	0.6-0.8 kg/ac	300 L/ha (27 gal/ac)	60	Late fall, after blueberry defoliation; or spring of sprout year, before new blueberry plant growth emerges.
terbacil	Sinbar WP / WDG	1.5-2.5 kg/ha	0.6-1.0 kg/ac	Min 200 L/ha (18 gal/ac)	None available	Spring of sprout year, before new blueberry plant growth emerges or late fall, when dormant.
Selective, over-the-top, foliar herbicide treatments						
fluazifop-p-butyl	Venture L	1-2 L/ha	0.4-0.8 L/ac	100-200 L/ha (9-18 gal/ac)	60 fruit, 420 sprout	Late spring, sprout and fruiting year, control of grasses only. Low rate for annual grass control.
foramsulfuron	Option 2.25 OD	1.56 L/ha + 2.5 L/ha UAN	0.63 L/ac + 1 L/ac UAN	Min 150 L/ha (13 gal/ac)	None available	Sprout year only. One application per season after blueberry emergence.
mesotrione	Callisto 480 SC + Agral 90	0.3 L/ha + 200 ml Agral 90 per 100 L water	0.12 L/ac + 200 ml Agral 90 per 100 L water	100-200 L/ha (9-18 gal/ac)	60	Late spring of sprout or crop year, prebloom. Apply up to 8 leaf weed stage. One application per season.
sethoxydim	Poast Ultra + Merge or Assist	0.47-1.1 L/ha + 1-2 L/ha Merge or Assist	0.19-0.45 L/ac + 0.4-0.8 L/ac Merge or Assist	100-200 L/ha (9-18 gal/ac)	15	Late spring, sprout and fruiting year, control of grasses only. Low rate for annual grass control.
Non-selective, over-the-top herbicide treatments						
dicamba	Banvel II/Oracle	4.6-7.1 L/ha	1.9-2.9 L/ac	550 L/ha (50 gal/ac)	None available	Fall of fruiting year after 90% blueberry plant leaf drop.
dicamba + 2,4-D ester	Banvel II/Oracle + 2,4-D LV ester 600	2.3 L/ha + 5.7 L/ha	0.93 L/ac + 2.3 L/ac	550 L/ha (50 gal/ac)	None available	Fall of fruiting year after 90% blueberry plant leaf drop. Only use low volatile formulations of 2,4-D ester.
glyphosate	Roundup Weathermax	1.67 L/ha	0.68 L/ac	200-300 L/ha (18-27 gal/ac)	None available	Newly cleared land only. Fall of fruiting year after 95% blueberry plant leaf drop. Must prune after treatment.

Table 3. Herbicides Registered for Spot Application					
Active Ingredient	**Product**	**Type of Application**	**Herbicide Mixture (g or L product)**	**Pre Harvest Interval**	**Application Timing (see label for additional information/precautions)**
Selective spot herbicide treatments					
clopyralid	Lontrel 360	Spot spray	Spot: 42 ml in 200 L water, treats 1000 m^2 Boom: 420 ml/ha in 150-200 L water	10 months	Sprout year – June or when tufted vetch is early bloom. Later applications may result in yield reductions the following year.
nicosulfuron/ rimsulfuron	Ultim 75 DF + Agral 90	Spot spray	Spot: 4.2 g plus 200 ml Agral 90 per 100 L water	14 months	Early summer of sprout year - black bulrush.
tribenuron methyl	Spartan + Agral 90	Spot spray	2.5 g in 10 L water plus 20 ml Agral 90 per 10 L water	None available	Summer or early fall of sprout year. Varies with weed targeted.
		Bunchberry	40 g/ha + 0.2% v/v Agral 90 (20 ml Agral 90 per 10 L water); Spray in 150-250 L water/ha	None available	**Spring sprout year:** Bunchberry leaves unfolded at a 45 degree angle, before blueberry re-growth more than 2 cm. **Late summer fruiting year:** apply 1-4 weeks after blueberry harvest.
Non-selective spot and wiper herbicide treatments					
2,4-D LV ester	Numerous trade names	Spot spray	Consult individual labels	None available	Site preparation, non crop.
dicamba	Banvel II / Oracle	Spot spray	2.1 L per 1000 L water	None available	Site preparation – brush control.
glyphosate	Roundup Original, Roundup Weathermax, Touchdown Total, Factor, Factor 540, Credit, Credit Plus, Glyfos, Vantage Plus MAX, Polaris, Traxion and others	Spot spray	1-2 % solution Roundup Weathermax: 0.67 to 1.34 % solution	Non crop year	Site preparation, sprout year, after harvest.
		Roller	5 to 10 % solution Roundup Weathermax: 3.3–6.7 % solution	Non crop year	
		Wiper	33 % solution Roundup Weathermax: 22% solution	Non crop year	
triclopyr	Garlon	Spot spray or wiper	13 – 19 % solution in mineral or vegetable oil for Garlon XRT; No mixing for Garlon RTU	None available	Site preparation, one application per year.

Label Information: Information listed in this guide is provided to growers as a convenience. Pesticides must be applied according to label directions. Please refer to the product label before application and for more information on each product. Label information overrides any discrepancies between information presented in this guide and the label. Label information can be found at the Health Canada Pesticide Label Search, available on-line at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php.

Table 4. Additional Information for Herbicides Used on Wild Blueberry

Active Ingredient	Product	Group	Hazard	Protection Equipment	Buffer Zone (metres)		Restrictions (hours)		Herbicide Activity		Leaching Potential	Bee Toxicity	Winter Storage
					Water <1m	Terrestrial Habitat	Rain-free Period	Re-Entry Interval	Foliar	Soil			
2,4-D	2,4-D	4	Warning	d f g j	1	2	2	12	yes	no	moderate	low	C
clopyralid	Lontrel	4	Caution	b f j	-	-	4	12	yes	no	low to moderate	low	A
dicamba	Banvel II /Oracle	4	Warning	d f	1	15	4	12	yes	limited	very high	low	B
fluazifop-p-butyl	Venture	1	Caution	b e h j	15	15	2	12	yes	no	very low	low	C
flumioxazin	Chateau	14	Caution	d f g j m	5	30	0	12	limited	yes	low	low	C
foramsulfuron	Option	2	Caution	a f g	1	3	2	12	yes	limited	low	low	C
glyphosate	Various	9	Caution	a f j	15	15	1-6	12	yes	no	extremely low	low	B
hexazinone	Pronone	5	Warning	b f	50	-	0	48	no	yes	very high	low	C
hexazinone	Velpar	5	Caution	a f j	1	5	0	48	limited	yes	very high	low	C
mesotrione	Callisto	27	Caution	a f j	1	4	3	12	yes	yes	low	low	B
nicosulfuron/ rimsulfuron	Ultim	2	Warning	a f h	1	5	2-4	12	yes	no	high	low	C
propyzamide	Kerb	15	Caution	d f h	-	10	0	24	no	yes	low	low	C
sethoxydim	Poast Ultra	1	Caution	d f h j	0	1	1	12	yes	no	low	low	B
simazine	Princep Nine-T	5	Warning	d f h j	1	5	0	12	no	yes	high	low	C
terbacil	Sinbar	5	Caution	a g j	10	35	0	12	limited	yes	very high	low	C
tribenuron-methyl	Spartan	2	Warning	a f j	1	10	4-6	12	yes	no	moderate	low	C
triclopyr	Garlon	4	Caution	d f h j	-	-	2	12	yes	no	low	low	B

Protection Equipment: **a** - long-sleeved shirt and long pants, **b** - coveralls or disposable spray suit, **d** - coveralls or disposable spray suit over long sleeved shirt and pants, **e** - waterproof gloves, **f** - chemically-resistant gloves, **g** - shoes plus socks, **h** - chemically resistant footwear plus socks, **j** - protective eye wear, **l** - chemically resistant head gear for overhead application, **m** - approved respirator, **n** - chemical-resistant spray suit.

Herbicide Activity: Foliar – Indicates whether or not susceptible weeds will be controlled by herbicide contact with above ground plant tissue (leaves). **Soil** – Indicates whether or not late emerging susceptible weeds will be controlled for some time after application by residual herbicide activity as they germinate from the soil.

Bee Toxicity: Degree of toxicity to honey bees. If possible, all pesticide applications should be avoided during times of bee activity within fields, such as mid-day during bloom periods.

Winter Storage: Winter storage requirement codes are: **A** - Do not allow to freeze, **B** - Preferably should not freeze. If frozen, return to original state by allowing product to warm to 10-20^{0}C and agitate thoroughly before use, **C** - Not usually damaged by freezing. Store in cool dry place.

Pesticide Emergency Information

Poison Control Centres

New Brunswick	Dial 911, ask for Poison Information
Newfoundland	Dr. Charles A. Janeway Child Healthcare Centre, St. John's (709) 722-1110
Nova Scotia Prince Edward Island	The Izaak Walton Killam Hospital for Children, Halifax 1-800-565-8161

Environmental Pesticide Spill

New Brunswick Prince Edward Island Nova Scotia	1-800-565-1633
Newfoundland	1-800-563-9089

PMRA Websites

Pesticide Label Search

http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php

Drift Mitigation

Buffer Zone Calculator Link

Helpful Conversions

Units

kPa x 0.14 = pounds per square inch
hectares x 2.47 = acres
kilograms x 2.2 = pounds
1000 grams (g) = 1 kilogram (kg)
millilitres x 0.035 = fluid ounces
litres x 35 = fluid ounces
litres x 0.22 = imperial gallons
1000 millilitres (mL) = 1 Litre (L)
°F = (°C x 9/5) + 32
°C = (°F-32) x 5/9
miles per hour x 1.61 = km per hour
5 mL = 1 tsp

Volume per Area

kg per ha x 0.89 = pounds per ac
kg per ha x 0.40 = kilograms per ac
g per ha x 0.015 = ounces per ac
tonnes per ha x 0.45 = tons per ac
L per ha x 0.40 = litres per ac
L per ha x 0.09 = gallons per ac
L per ha x 14.17 = fluid ounces per ac
L per ha x 0.71 = pints per acre
mL per ha x 0.015 = fl. ounces per ac
L per ha x 0.11 = US gallons per ac
L per ha x 0.86 = US pints per ac

Abbreviations

Formulation

DF	Dry flowable
EC,E	Emulsifiable concentrate
F	Flowable
G	Granular
L	Liquid
LV	Low Volatile
SC	Suspension concentrate
Sn	Solution
SP	Soluble Powder
WDG	Water Dispersible Granule
WP,W	Wettable Powder
WSP	Water Soluble Pouches

Measurements

ac	acre
g	gram
g.a.e.	grams acid equivalent
ha	hectare
kg	kilogram
kPa	kilopascal
L	litre
m	metre
mL	millilitre
psi	pounds per square inch
% v/v	percent volume to volume

Personal Protection Equipment

Gloves

e - waterproof gloves **f** - chemical resistant gloves

Head and Lung

j - eye protection, application **m** - approved respirator

l - chemically resistant headgear for overhead application

Clothes

a - long-sleeved shirt/pants **b** - coveralls or disposable spray suit

d - coveralls or disposable spray suit over long sleeved shirt/pants

n - chemical-resistant spray suit

Footwear

g - shoes plus socks **h** - chemically resistant footwear plus socks

Pre Harvest Interval (PHI): The minimum number of days between the last application of the pesticide and harvest.

Group: Weed Science Society of America's nationally accepted grouping of herbicides based on site of action.

Hazard: The signal words Danger, Warning and Caution appear on the pesticide label and indicate the level of hazard associated with handling or using the product. Products bearing the signal word **Danger** have an extreme or high hazard rating. Products labeled **Warning** have a moderate hazard rating and a **Caution** warning is associated with a low level of hazard. The degree of hazard may be due to toxicity, flammability, explosiveness or corrosiveness.

Buffer Zones: Distance between the closest point of direct pesticide application and the nearest downwind edge of sensitive terrestrial habitats (such as grasslands, forested areas, shelter belts, woodlots, hedgerows, riparian areas and shrublands) and sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands). Water < 1m refers to wet areas with less than 1 meter of water depth. All buffer zones are for boom sprayers unless indicated. A buffer zone calculator is available here.

Rain-free Period: The recommended minimum time in hours between pesticide application and rain. If rain occurs during the rain-free period, pest control may be significantly reduced.

Restricted-Entry Interval (REI): The minimum time in hours before you can enter a field that has been treated with the pesticide.

Leaching Potential: The potential for a pesticide to be leached or carried by surface run-off is determined by characteristics of both the pesticide and the field. Surface slope, proximity to surface water, low organic matter content, depth to aquifer and heavy rainfall are some of the factors which lead to run-off and leaching problems when combined with pesticides of a moderate to high leaching potential.