

WEED MANAGEMENT 2014

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New herbicides and updates.

Check our web site (www.umass.edu/cranberry/) and upcoming newsletters for further information about any new uses or products. The manufacturer of Devrinol 10G and 50DF have discontinued production of these formulations. It is still legal to use Devrinol 10G and 50DF, so please check with local ag suppliers for availability. Cranberries have been removed from the Princep label; recommendations for its use have been deleted. The tolerance is still in place, so use remaining stock.

Weed Life Cycles. *Annual plants* complete their life cycle in one year and reproduce by seed (e.g., dodder). They germinate from seeds, grow to maturity, flower, and make seeds all within a single growing season. *Biennial plants* take two years to complete their life cycle. They typically germinate from seeds and grow vegetatively in the first year, then enter a period of dormancy over the winter. They flower and make seeds the following growing season. *Perennial plants* can live for many years and may reproduce by seed, runners, rhizomes, etc.

Most of the weeds in cranberry production are perennials. With the exception of dodder, annual weeds are much less common and easier to control than perennials. However, infestations of annual weeds should not be taken lightly, especially on new plantings. Annual plants are designated with an (A). Unless otherwise noted, all other weeds are perennials.

Weed priority groups. (1=no tolerance; 2=serious concern; 3=less concern; and 4=lowest concern)

Weeds are grouped into priorities based on their likelihood to cause yield loss, ability to spread, and the difficulty of control. Priority group 1 weeds cause severe losses, spread rapidly, and are difficult to control. Weeds in this group are extremely damaging to cranberry yields and may kill vines. Weeds in Priority group 2 are less damaging to yields than those in priority 1, but they are still aggressive and difficult to control. Weeds in group 3 may reduce yields, but yield impact is low. Spread or growth of these weeds is relatively slow. The lowest-concern weeds are grouped in priority 4. These plant species are primarily found in bare spots¹ areas of poor cranberry vine growth, or at bog edges. Deal with the most yield-threatening weeds first.

Weed Mapping. Weed maps can help you organize the management of your weed problems, especially with perennial weeds. Weed maps should be done every few years, depending on weed pressure and management objectives. Several steps are involved: 1) Correctly identify the weeds, 2) Document the location of the weeds (by drawings or photographs), and 3) Designate a priority number to the weed. Recommended priority groupings are noted in the right-hand margin for each weed. Growers may change and adapt weeds into priority groups to best fit their own management program.

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PRIORITY ONE WEEDS

DODDER (A) *Cuscuta gronovii*

Dodder is an abundant seed producer. All management efforts should be directed towards minimizing or eliminating seed production. A single plant can produce thousands of seeds in one season. The seed bank is very long-lived (>13 yr), so do everything possible to eliminate seed production and/or reduce seed viability.

Dodder is an obligate parasite and must have a host plant to survive. Woody cranberry stems are somewhat less appealing to dodder, so control of succulent weeds (such as goldenrod, loosestrife and asters) early in the season may be important.

Prevention

The best management strategy for dodder control is prevention of infestation. This is best accomplished through **good sanitation**. Dodder seed is easily moved in harvest water and on equipment. When possible, dodder-infested beds should be harvested after clean beds. Floats used to corral berries should be inspected for the presence of dodder seed before they are placed in beds that are dodder-free. This is especially important for custom harvest operations.

Dodder may also be spread vegetatively; pieces of stem can be moved on equipment and become attached to healthy plants. Care should be taken when moving any piece of equipment from a bed infested with dodder to one that is not. Equipment should be sanitized in these situations!

Where dodder infestations are just beginning, **careful scouting and hand removal** of seedlings prior to infection is a good practice. Weeds that are infected with dodder should be completely removed from the bed; dodder stems will re-grow if haustoria (the part of the parasite that penetrates the host) remain embedded in the weed. Infected cranberry vine tips can be cut off and thrown away.

Scouting

Begin scouting for dodder in early-mid April (unless your bog history or unusual weather conditions indicate otherwise). Mild winter temperatures may promote earlier emergence of dodder. Scout in areas where infestation has occurred in the past. Often, dodder seed will accumulate in the areas where berries are removed from the beds at harvest. Dodder seedlings may also be seen in warm, bare areas or newly sanded areas. Newly emerged seedlings are usually yellow in color, very slender, and 0.5 to 3 inches long. If the vine cover is good, move the vines aside so that you can see the duff layer; this is where early emerging seedlings will be seen.

Dodder populations in MA emerge slowly at first, but then quickly peak (50-90% germinate 30-45 days after first emergence) and subside. In addition, as the seeds accumulate year after year in the soil, seedlings emerge later and later, creating overlapping generations. The most vigorous population is the one most recently seeded (from last year). It is not known how variable dodder populations are from bog to bog but variation from farm to farm is likely. Growers should consider previous successful experiences, along with scouting, and plan applications of preemergence herbicides accordingly.

DODDER (A) *Cuscuta gronovii* (continued)***Preemergence Herbicide Use***

Scouting is necessary for correct timing of preemergence herbicide application. Herbicides should be applied within 10-14 days of early seedling emergence, so that the chemical is present when the peak in germination occurs.

Casoron (30-60 lb/A) may control dodder germination. Split applications at least 3 weeks apart can be used (not to exceed 100 lb/A in a 12-month period), and may be more effective than a single application if there are many frost irrigation events or a lot of rainfall. See Notes on Casoron, page 34.

Handlers may be restricting Quinstar use so check before using! It can be used during the preemergence and postemergence phase. Time preemergence QuinStar (8-16 fl oz/A) application as described for Casoron, targeting the majority of the seed population as they are germinating and emerging. Two applications are permitted (not to exceed 16 fl oz/A in a 12-month period) but a minimum of 30 days must elapse between applications. See notes on Quinstar, page 37.

We do not know if Callisto will control dodder populations when applied preemergence, though some growers have experimented with this application timing. Please contact the Station (508-295-2212 x21 or x43) and share your observations.

Postemergence Control

Raking - For heavy infestations, raking can prevent the onset of upright dieback caused by infection, prevent leaf-drop due to shading of the cranberry by the dodder canopy, and reduce dodder seed production. Raking is more effective at reducing seed production if it is done before the seeds are formed (flowering). Raking too early may not be effective because the dodder stems can re-grow from the portions embedded within the cranberry. No benefit is gained from raking more than once. For light to moderate dodder infestations, raking is not recommended.

A good trash flow after harvest is also helpful in removing seed capsules from the bed, but is not a replacement for prevention since subsequent infestation occurs. Sometimes, growers could consider multiple trash flows if seed production is high.

Herbicides – postemergence applications of Callisto seem to control dodder, especially if the host is a weed that Callisto can damage. Callisto is not effective when dodder is attached to cranberry. Dodder will turn white after application, and may re-grow. Applications made before dodder flowers seem more effective than those made after flowering; higher rates are better. Applications can be made as spot treatments or by chemigation. See notes on Callisto, page 37. Growers report backpack applications of sea water and COC can give some control.

Spot treating small areas of dodder with flame cultivation (thermal weeding) may control dodder. Cranberry plants exposed will also be injured but will recover. Call the Weed Specialist if you want to try this control option. We do not have enough data to say whether or not plant growth regulators adequately control dodder.

Spring Floods. Recent research and grower experience has shown that short (24-48 hr) floods in early to mid-May may be effective for reducing dodder infestations. Floods should cover vine tips adequately. No adverse vine or yield impact has been reported when growers have held these spring floods. Dodder floods may coincide with floods used to control black-headed fireworm. Flooding dodder 3-4 weeks after early seedling emergence appears to be more effective (compared with flooding 1-2 weeks after early seedling emergence).

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BRISTLY AND PRICKLY DEWBERRY *Rubus hispidus*, *R. flagellaris* (Running brambles)

Dewberries spread rapidly on bogs by rooting at the tips of canes. Both types will kill vines if allowed to spread. The most effective way to manage dewberries is to eliminate them as they invade the bog. Remove young plants by pulling or digging out by the roots. Control of established plants with glyphosate products is difficult because the weed grows close to vine level. Sparse or moderately colonized spots can be hand wiped with glyphosate products. Clipping stems with Roundup-dispensing applicators may offer partial control. See notes on Roundup, page 40. Wipes with Weedar 64 may also be effective when used in late June and July. See notes on Weedar 64, page 41.

Callisto will discolor and injure dewberries, however, the long-term management of this weed with Callisto is not yet known. Use 2 applications of Callisto (at least 14 days between applications) to manage dewberry infestations. Repeated annual applications will likely be necessary to reduce infestations. If dewberries are in a mixed canopy with tall weeds, target the spray to reach the lower portion of the canopy (where the dewberries are). See notes on Callisto, page 37.

Non-chemical options

Late water floods reduce numbers of dewberry crowns and offspring plants in that year. Summer refloods (May 10-12 through July 15-20) may be used in desperate circumstances. This will eliminate the crop for that year! It is particularly helpful to hand pull or hand wipe remaining dewberry plants after the flood has been withdrawn. Fall floods may suppress populations of *R. hispidus*; results have varied from no impact to reduced crown density. Start the flood as early as possible (mid-September) and hold for 4 weeks for best dewberry management. Consider starting a fall flood in early-mid September, if possible. It is important to remove the flood by early November to allow the vines time to become dormant prior to winter.

Recent research indicates that using flame cultivation (thermal weeding) can reduce dewberry plant size. One short duration (3-6 sec/yd² if using an open flame torch; longer times, 15-30 sec are needed with infrared torches) exposure made mid-summer seems effective (reduces shoot and root biomass). Cranberry vines will be injured when exposed to thermal weeding but they will recover. Typically, however, few cranberry vines are present in heavy dewberry infestations, so the risks are much lower than in well-vined areas. Contact the IPM Lab (508-295-2212 x21 or x43) if you have interest or questions about thermal weeding.

Knife-raking or pruning in the fall may help uproot offspring plants. Significant dewberry patches should be scraped and replanted with new vines.

GLAUCOUS GREENBRIER *Smilax glauca* (Silverleaf sawbrier)

Greenbriers are very difficult to control because they have extensive underground storage organs. Glaucous greenbrier (silverleaf or sawbrier) is more difficult to control than common greenbrier (greenleaf). Sawbrier grows in dense patches, spreads rapidly, and usually reaches just above vine level. It significantly impacts fruit production. Digging up the root system is not practical and will cause significant vine and bog damage. Infestations of sawbrier are more likely to occur on high edges or in locations where the bed is out of grade.

Sawbrier may be managed by hand wiping if sufficient coverage is obtained. Summertime wipes of Roundup may offer partial control. Clipping stems with Roundup-dispensing applicators in August may offer an additional partial control. Severe infestations of sawbrier may necessitate bog renovation. Weedar 64 and Callisto may be used on sawbrier as per dewberry recommendations. Flooding is not effective against sawbrier. Recent research indicates that one exposure of a mid-summer thermal weeding (hand-held flame cultivators or torches) treatment may not be effective for reducing sawbrier growth.

POISON IVY *Toxicodendron radicans*

Poison ivy (PI) is getting worse on many bogs. Treat small infestations early and eradicate! Control is very difficult because the weed grows close to the vines. Glyphosate wipes will control this weed, but the potential for vine damage is high. Use of specialized applicators that minimize drip is recommended. Research has shown that clipping the stems with Roundup-dispensing applicators may offer partial control. Early-mid September applications may give better control than August applications. There is a 30 day PHI. Late applications can be used on bogs that will not be harvested due to crop-destruct floods (or very late harvested bogs). Rates as low as 5-10% solutions gave decent control. Control for significant infestations of poison ivy is post-harvest spot treatments with Roundup sprays or mechanical spot renovation followed by replanting. Adding 1 part Weedar 64 to 4 parts of the Roundup mixture may be helpful but will likely increase the possibility of crop injury. See 2,4-D cautions, page 41.

Reports of control with Callisto are variable; some growers have had good luck and others reported no control. If using this herbicide, make 2 applications of Callisto against this tough weed (see dewberry recommendations). Earlier applications (May) seem better than later applications (July). Tank mixes of Poast and Callisto have been reported to control PI patches (repeated annual applications usually needed). Call extension specialist for rates. Consider resistance management concerns when using Callisto.

DO NOT USE thermal weeding or burning for poison ivy control. The toxic plant components can become air-borne and cause significant health problems.

Many people are highly allergic to poison ivy. Protective lotions and soaps are available that minimize the irritation caused by the poison ivy oils; these work very well when applied according to label instructions. Lotions are usually applied prior to exposure and soaps are used to remove oils after exposure to the plant. Rinse with a lot of cool water; small amounts of water may only spread the oils.

PRIORITY TWO WEEDS**POVERTY GRASS**

Poverty grass (little bluestem (*Schizachyrium scoparium*) and broomsedge (*Andropogon virginicus*)) is being reported as increasingly problematic. These species reproduce by seeds. To control these perennial grasses, control effort should be directed at all life stages. It is important to stop seeds from germinating (preemergence herbicides), stop adult plants from making seeds (mowing and postemergence herbicides) and also to control adult plants (postemergence herbicides, hand weeding/digging out clumps).

Preemergence herbicides Casoron (spring or fall), Devrinol, and Evital (spring or fall) may all offer control. Growers report good control when winter sanding followed a fall Evital application (60-75 lb/A).

Postemergence herbicides that work on grasses include sethoxydim (Poast) and clethodim (Select Max, Intensity, and other registered products with this active ingredient). Roundup wipes or sprays that are directed into the base of the grass clumps may also offer control.

COMMON GREENBRIER *Smilax rotundifolia* (*Greenleaf sawbrier, bullbrier*)

Common greenbrier is bushier and spreads more slowly than glaucous greenbrier, and grows well above the cranberry vines. It is easier to control with glyphosate wipes than glaucous greenbrier. Thorough coverage is important. Repeat applications in successive years may be needed for total control. See Notes on Roundup, page 40. Digging up the root system is not practical and will cause significant vine and bog damage.

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WILD BEAN *Apios americana* (*Ground Nut*)

Repeated annual applications may be needed for large or severe infestations. Nuts may be dug out and removed from the bog. Preemergence options can include Casoron 4G (75 lbs/A) followed Devrinol 15 lbs/A). Allow 10 days between applications.

Wild bean can be well controlled with Stinger applications. It is very sensitive to Stinger, and rates are lower than the usual label rate. As a spray use 0.06-0.12 fl oz (0.37-0.75 tsp) per gallon. As a wipe use 2.5 fl oz/gal (5 Tbsp per gallon (2% solution)). When using wipes, stake the wild bean vines to make wiping easier.

Some growers have reported good wild bean control with Callisto; Stinger provides superior control but carries a greater risk of vine injury. Glyphosate products can also be used to wipe wild bean. A salt water solution applied after berry set can also be used to burn the bean tops off (1 lb/gal water, do not exceed 200 gal/A).

ASTER *Aster spp.*

The impact of asters on cranberries is variable. Asters are usually found in bare patches on the bog. Once the patch becomes established, asters are much harder to control. Applications of Casoron in March-April or November offer some suppression but will probably not eradicate this weed.

Glyphosate wipes in the summer may be helpful. Thorough coverage and repeat applications are necessary. Some growers report efficacy with Callisto against asters, but results were not always compelling. Iron sulfate and Weedar 64 may also be effective. Higher rates of Stinger offer the best option; use care to avoid contact with cranberry vines during application to minimize any vine injury. For a spray use 0.33-0.5 fl oz (2-3 tsp) per gallon. As a wipe use 2.5 fl oz/gal (5 Tbsp per gallon (2% solution)).

YELLOW LOOSTRIFE *Lysimachia terrestris*

Yellow loosestrife can cause moderate yield reductions. It may also serve as an early-season host for dodder and tips may harbor *Sparganothis* larvae. Since loosestrife is difficult to control, efforts should begin while patches are still small and before they have a chance to spread.

Fall or spring applications of Casoron may offer some control of loosestrife. Wipes with Roundup or Weedar 64 may also provide control. Efficacy of Callisto on yellow loosestrife seems low. Quinstar seems to be effective for control, but handler restrictions may apply – please check with you handler before using.

CINQUEFOIL *Potentilla canadensis, P. simplex* (*Five-finger*)

The impact of cinquefoil is variable, but infestations seem to be getting worse, thus it's classification as a Priority 2 weed. Colonization of cinquefoil may indicate a problem with vine growth and high pH (too basic, alkaline). Improvement of fertilizer program may help control this weed. If the soil is considered alkaline, the use of sulfur may help improve the soil condition such that the cranberry vines become more competitive. See Notes on Sulfur, page 42.

Callisto seems to work well on this weed, but it takes a while for symptoms to appear and for the weed to die; be patient! Hand wiping or hand pulling can also be used to eliminate small patches. Growers report using 60 lb Casoron in early May (as a spot-treatment) with very good results. Iron sulfate may also work when applied in the summer.

NARROW-LEAVED GOLDENROD *Euthamia tenuifolia*

Narrow-leaved goldenrod (NLGR) causes little direct yield loss, but it's extremely difficult to control and spreads rapidly. For this reason, every effort should be made to control patches before they spread. Preemergence and postemergence herbicides can provide partial control of this weed.

Data indicates that Callisto works very well against NLGR. Stinger applications should also offer reasonable control of NLGR. Use the lowest effective rate of Stinger as cranberry vine injury is likely with over-application or off-target coverage. Wipes with Roundup or Weedar 64 may also offer control.

PRIORITY THREE WEEDS
SEDGES

Management of sedges combines both cultural and chemical controls. Hand dig and/or pull small patches or spot-treat with one of the preemergence herbicides listed below. Encourage vine growth in the bare areas so the sedges will not re-colonize.

Refer to the table below to locate the target weed and recommended control options and related information. TIMING: Spring applications are typically done from March through mid-April; Fall applications are typically done 1-2 weeks after harvest but at least 2-3 weeks prior to the winter flood. (S) or (F) following the weed name indicates 'Spring only' or 'Fall only' applications are preferred.

<u>CHEMICAL RECOMMENDATIONS FOR SEDGES</u>			
<u>HERBICIDE</u>	<u>RATE</u>	<u>WEEDS CONTROLLED</u>	<u>NOTES</u>
<u>Preemergence Options</u>			
Devrinol 50DF	12-18 lb/A 8-12 lb/A	Nut sedge (nutgrass)	Rate for peat-based bogs. Rate for mineral soils.
Casoron 4G	up to 100 lb/A	Cottongrass, Dulichium (S), Fresh meadowgrass (F), Needlegrass Nut sedge, Spike rush, Woolgrass	
Evital 5G	80-120 lb/A 120-160 lb/A	Needlegrass (S), Nut sedge Broomsedge, Needlegrass (F) Spike rush, Woolgrass Dig up clumps	Needlegrass is difficult to hand pull. Broomsedge may be controlled with glyphosate wipes.
<u>Postemergence Options</u>			
Callisto	4-8 fl oz/A	Nut sedge, perhaps others	Spot treatment or chemigation. See Notes on Callisto.
Weedar 64		Three-square (bulrush)	Mix 1 part Weedar to two parts water for hockey stick application. Best results when used in late June and July. Do not drip or touch vines

SHEEP LAUREL *Kalmia angustifolia*

Sheep laurel can spread on the bog and reduce yields. Saplings should be pulled by hand. Larger plants can be wiped with glyphosate products (see Notes on Roundup, page 40).

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RUSHES *Juncus* spp.

Rushes grow in clumps and can become quite large when well established. Control of large plants with preemergence herbicides may be difficult except at very high rates. Control may also be possible with hand-digging or repeated hand wiping with glyphosate solutions.

Casoron and/or Devrinol applied in the spring may offer partial control of rushes. Evital may also offer some control. Salt (1-3 tsp) applied at the base of each clump in the spring can also be effective. Glyphosate wipes can be used in summer. We have preliminary evidence that flame cultivation (thermal weeding) may help to control rushes, and may be practical for use in ditches and along bog edges. Call the IPM Lab at 508-295-2212 x21 or x43 if interested in more information.

RED MAPLE AND OTHER TREES

The best management strategy is to pull saplings before the root system becomes established (hopefully less than 1 year old). Larger trees must be dug out. Glyphosate or Weedar 64 wipes may be used to control small maples and to weaken large trees to facilitate removal. Clipping stems with Roundup-dispensing applicators in August may offer partial control. Wisconsin reports best results with early applications of Callisto at high rates with crop oil concentrate. A weed wrench or pliers can be helpful for removing large saplings.

LEATHERLEAF *Chamaedaphne calyculata*

Leatherleaf is a perennial, woody plant that can spread on the bog and reduce yield. It can be controlled by hand wiping during the summer with a solution of glyphosate products. Weedar 64 can also be used as a wipe as per dewberry recommendations.

UPRIGHT BRAMBLE *Rubus allegheniensis* (Blackberry)

Upright bramble is not as common as the dewberries. It does not trail on the ground. Control may be obtained with glyphosate wipes. Young plants can be pulled or dug out by the roots. Weedar 64 may be used as described for other *Rubus* (dewberries) species. This weed is not common on cranberry farms.

PHRAGMITES *Phragmites australis* (Common reed)

This highly invasive species and aggressive weed has been recently sited on a few commercial bogs. It should be treated and controlled immediately!! The best treatment is glyphosate applications in early to mid-summer (before it gets too tall) followed by mowing approximately 3-4 weeks after herbicide application. You can also mow first and then glyphosate about 4 weeks later. Control any infestations that are occurring near the bog as well.

PINEWEED *Hypericum gentianoides*

Pinweed is becoming more problematic on bogs, especially new plantings. Sometime, other common names are used for this plant (horsetail, horseweed, or mare's tail), but these are very different plants. This plant may also be known as orangegrass, but we are not encouraging use of this name since this plant is a broadleaf and not a grass. High rates of Casoron should control pinweed but be careful using Casoron on new plantings. In Wisconsin, growers reported good control with 30 lb/A Casoron. Some growers are trying fall applications (postharvest) of Poast, but efficacy is not yet verified. There has been a report of efficacy with preemergence applications of Callisto at 8 fl oz/A, but this has also NOT been verified. Success with combinations of Callisto and Devrinol (both as PRE) on new plantings have also been reported. Pinweed can be hand-pulled if infestations are not too large.

CHOKEBERRY *Pyrus melanocarpa*

Infestations of chokeberry can reduce yields and will spread in the beds. The best management strategy is to treat patches before they get too large. Chokeberry plants do not grow tall on the bog. Take extra care when using postemergence wipes of glyphosate products to minimize vine injury. When chokeberry plants are short, it may be more effective to hand wipe them rather than wiping with a hockey stick wiper.

PERENNIAL GRASSES

These grasses often colonize bare areas and are becoming more problematic, especially on newer bogs. Encouraging vine growth may reduce potential for problems. Some species may be difficult to eradicate once established.

Preemergence herbicides Casoron or Evital (spring or fall) or Devrinol (spring only) may all offer control. Postemergence herbicides which work on grasses include sethoxydim (Poast) and clethodim (Select Max, Intensity, and other registered products with this active ingredient). Clethodim product usually have better efficacy against perennial grasses.

Roundup wipes or sprays that are directed into the base of the grass clumps may also offer control.

PREEMERGENCE OPTIONS

<i>Barnyard grass</i>	Evital. In the fall.
<i>Broad-leaved panicgrass</i>	Evital. Gives partial control.
<i>Mannagrass</i>	Use Casoron (Spring).
<i>Poverty grass</i>	Devrinol applications combined with repeated mowing to remove seed heads is the best recommendation we have at this point.
<i>Rattlesnake grass</i>	Casoron (Spring). Clean ditches in infested area. Pulling helps a little.
<i>Rice cutgrass</i>	Best choice is Devrinol applied before April 10. Casoron and Evital can also be used; give partial control. Improve drainage. Can tolerate pH<3.
<i>Smokegrass</i>	Evital (Spring).
<i>Summergrass</i>	Devrinol, Casoron or Evital. Hard to mow.
<i>Switchgrass</i>	Evital (Fall). Difficult to control, repeated mowing helps. Best to dig out plants prior to seed formation.
<i>Velvetgrass</i>	Casoron

PRIORITY FOUR WEEDS**JOE-PYE WEED** *Eupatorium dubium*

This perennial plant generally grows along the ditch areas. Due to its tough stem, it may be difficult to hand-weed. Some growers use pliers to uproot large plants. Glyphosate wipes during the summer offer good control. Stinger should also control this weed.

MEADOWSWEET *Spiraea latifolia*

Meadowsweet is a slow spreader on cranberry bogs. This weed should be pulled out by hand or wiped with Roundup during the summer.

HARDHACK *Spiraea tomentosa* (*Steeplebush*)

Hardhack is a solitary plant that does not spread except through seed. Wiping with Roundup or pulling this weed is very effective, but the roots of hardhack can be woody and larger plants may cause damage to the bog when pulled.

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MOSSES *Polytrichum spp.* (*Haircap moss*), *Sphagnum spp.* (*Sphagnum moss*)

The presence of these plants on the bog may indicate a drainage problem. Evaluate the drainage in the area and improve prior to starting a chemical control plan.

Iron sulfate has historically been recommended for use at 3 oz/ft² for spot-treatment of sphagnum moss in March-April. Crop damage has sometimes been associated with use of this high rate. Recent testing has shown that use of ½ - ¼ of this rate (½ -1 lb/100 ft²) still provided good moss control, even when applied in the summer with no visible damage to the crop.

A 20% acetic acid product by Weed Works, Inc., is sold as a horticultural biopesticide for use on food crops. Applications of 20% acetic acid have shown good control of moss, but actively growing cranberry plants were damaged.

High rates (15 oz/100 ft²) of ammonium sulfate (21-0-0) applied in the spring may also offer some control of haircap moss. If used, fertilizer must be adjusted accordingly. Growers report using 100 lb/A Evital in the spring against Sphagnum moss with good results.

FEATHER, ROYAL, CINNAMON, AND SENSITIVE FERNS

Dryopteris thelypteris, *Osmunda regalis*, *Osmunda cinnamomea*, *Onoclea sensibilis*

Spring (S) or Summer (Smr) follow the weed name in the chart below to indicate when applications are preferred. When using iron sulfate treatments, apply a small amount to each plant. See Notes on Casoron, page 34 and Iron Sulfate, page 35.

<u>CHEMICAL RECOMMENDATIONS FOR FERNS</u>			
<u>HERBICIDE</u>	<u>RATE</u>	<u>WEEDS CONTROLLED</u>	<u>NOTES</u>
<u>Preemergence Options</u>			
Casoron 4G	up to 100 lb/A	Bracken fern (S) Royal fern (S)	Appears on bogs showing signs of stress Spot-treat and use moderate rates.
<u>Postemergence Options</u>			
Iron sulfate	2 oz/sq ft	Feather fern (Smr) Sensitive Fern (Smr)	Sensitive fern is difficult to hand weed due to perennial rhizomes breaking. Use caution on bogs that have been sanded within 18 months.
Iron Sulfate & Salt	9:1 ratio (iron:salt)	Cinnamon fern Feather fern Sensitive fern	Treat during the summer months. Place a small amount at the base of each plant.

PITCHFORK, RAGWEED, AND FIREWEED (A)

Bidens frondosa, *Ambrosia artemisiifolia*, and *Erechtites hieracifolia* (*Beggarstick*, *stick-tights*, *Spanish needles/Common ragweed*, *hogweed*, *bitterweed*, *Roman wormwood/Cottonweed*, *pilewort*.)

Casoron may be applied in the spring or fall for control of ragweed. Weedar 64 wipes may be used for ragweed control postemergence. Stinger (wipes or spray) may be used for pitchfork, ragweed, and fireweed control.

WHITE VIOLET *Viola lanceolata*

Found most often in bare patches on beds, white violet is thought to compete poorly with established vines. Thus, the best management approach is to fill in bare spots on the bog by encouraging runner growth. Otherwise, hand pulling is the next best recommendation, especially on new bogs. No chemical controls are recommended.

JAPANESE KNOTWEED *Polygonum cuspidatum* (Mexican bamboo, Fleecflower)

This is an invasive species that has been seen on bog ditches and rarely on the bog itself. It is common (relatively) on new plantings. JK has heart-shaped leaves that become quite square at the end close to the stem. It produces abundant white flowers in June-July. It is a perennial plant and can form dense patches (large rhizome system underground). It may die back at the end of the season and form a dense mat of dead material.

The best control is prevention!! Cutting, mowing and flame cultivation should also provide control of established plants, but it is absolutely best to eradicate before the plant establishes.

ANNUAL GRASSES

Generally, annual grasses are most likely to appear in bare patches and/or on new bogs. Hand pulling and/or treatment with postemergence grass herbicides may be used on new and established bogs. Encourage vine growth to reduce ability of weeds to colonize the bog surface. Preventing seed production may also be important in managing these weeds.

Devrinol, Casoron, and Evital give effective preemergence control for annual grasses.

Postemergence herbicides that work on grasses include sethoxydim (Poast) and clethodim (Select Max, Intensity, and other registered products with this active ingredient). Callisto may provide variable control.

CLOVER AND VETCH *Trifolium repens* and *Vicia* spp.

Clover and vetch tend to occur in areas of very high pH (alkaline soils). If soil pH is 5.0 or above, spot treat with two applications of sulfur at the rate of 0.2 oz/sq. ft. Apply in the late spring when soil is drained and frost protecting is over. For more details, refer to Notes on Sulfur, page 42. Lower rates of herbicides may be effective when sulfur has been added and the pH is lowered.

Stinger offers good postemergence control of these weeds. See Stinger notes, page 38. Control clover early spring prior to budbreak.

Callisto can also control clover (see Notes on Callisto, page 37). However, vine overgrowth has been reported in heavily infested (treated) areas after clover dies back (apparently acts like a green manure, releasing nitrogen into the soil).

MINOR WEEDS

Blue joint (*Calamagrostis canadensis*), Hawkweed (*Hieracium* spp.), Horsetail (*Equisetum* spp.), *Hypericum* spp., Marsh St. John's Wort (*Triadenum* spp.), Sweet pepperbush (*Clethra alnifolia*), Plantain (*Plantago* or *Littorella* spp.), Smartweed (*Polygonum* spp.), Sorrel (*Rumex* spp.), and Wild Strawberry (*Fragaria* spp.)

If weeds are scattered or of minor importance, consider potential vine stress or injury when choosing herbicide and rate. Consider hand pulling instead. For localized weed patches, consider spot treatment. Postemergence treatment with glyphosate products may also offer some control. Combine herbicide treatments with steps to improve vine growth.

Casoron will control many of these minor weeds. Postemergence Roundup wipes may also control these minor weeds. Weedar 64 wipes are labeled to control *Hypericum* species and sweet pepper bush. A grower has reported success controlling horsetail with 60-75 lb/acre Evital in the fall followed by winter sanding.

HERBICIDES

ALWAYS read the label of any chemical before use, and always comply with the manufacturer recommendations.

Preemergence – (PRE) These are herbicides that are applied prior to the emergence of weeds. In general they work by prevent weeds that are germinating from seeds from growing, but can also act on perennial plants that spread by rhizomes, tubers, and stolons. Their application is timed to coincide with when the target weeds are about to begin germinating. They prevent new weeds from establishing, but do not impact weeds that are already growing.

Multiple frost or rain events in the spring following the herbicide application might affect herbicide effectiveness. Preemergence herbicides move through the soil at different rates. We do not have good information on how these chemicals move in cranberry soils. Based on information from noncranberry soil types, Evital has high soil mobility. Devrinol is also likely to leach through the soil profile. In a loamy sand soil, it will move about 1 inch for every inch of rain or water. Casoron is relatively less likely to leach but we have no numbers for Casoron (like with Devrinol). Sandier soils are less likely to hold onto herbicides than soils with some organic matter. Whenever possible, it is best to delay applications of herbicides until a reasonable window of dry weather is predicted.

Postemergence – (POST) These herbicides work on actively growing weeds. They can be absorbed by the leaves or roots of the plants, depending on the chemical.

Adjuvants – These products are added to a pesticide mixture to improve its effectiveness. They include surfactants, stickers, penetrants, compatibility agents, etc. Pesticide labels may list specific types of adjuvants that will maximize effectiveness of the pesticide. Be sure to use the proper category of adjuvant if the manufacturer makes a specific recommendation

Several herbicides require the use of adjuvants, commonly either nonionic surfactants or crop oil concentrates. Nonionic surfactants spread the spray droplet evenly over the leaf surface and help it adhere to the leaf. It increases penetration of the herbicide through the leaf cuticle. Common commercial products include Induce or Activator 90. Crop oil concentrates (COC) may consist of petroleum, vegetable, or methylated vegetable or seed oils designed especially for use in agricultural pesticide spray programs. Many COCs are available and may be sold as Crop Oil or under other trade names such as Herbimax.

CASORON 4G (Dichlobenil) – Used PRE

Annual allowable formulation	Restricted entry interval (REI)	Preharvest interval (PHI)	Max number of applications
100 lb/Acre	12 hrs	N/A	N/A

Casoron is a preemergence herbicide that works on germinating seeds, very small seedlings, and also some perennial weeds that propagate by rhizomes, tubers, and stolons. It is effective against both grasses and broadleaf weeds. Applications of Casoron are most effective when applied as close to the time of weed germination or emergence as possible. Casoron is labeled to be applied in early spring (pre-budbreak) while perennial weeds are still dormant and annual weeds have not started to germinate, or in late fall after the crop has been harvested. The efficacy of fall applications for many weeds has not been documented, but growers have reported good success in some cases.

Casoron may be applied by air or by ground equipment. Since Casoron volatilizes quickly, avoid applying during warm temperatures (air and soil temps should be $>60^{\circ}\text{F}$). It must be incorporated by irrigation or rainfall ASAP after application. Do not exceed 100 lb/A in any 12-month period. Multiple applications may be made as needed. Allow an interval of 3-6 weeks between applications. Single doses of high rates of Casoron may be needed to control some perennial weeds. Cranberry vines with weakened root systems are more susceptible to stresses such as drought and may become more stressed with herbicide application. Application of Casoron to stressed vines may cause yellow vine syndrome symptoms or other injury. Vine injury is likely with mid to higher rates if the buds have begun growth. Some vine injury may occur from herbicide applications made in areas where puddling is a problem.

Distribute Casoron uniformly. Avoid overlapping of herbicide. Temporary reddening of vines may occur, especially with late spring application or when applied on sandy bogs. Do not apply after bud elongation as vine injury may occur and yields may be reduced. Do not apply to young beds (less than 3 years old unless root systems are well established) or on bogs prior to or immediately after mowing vines. Do not sand (spring or fall) on top of a Casoron application. Applications on top of sand or late applications can be made, but must be watered in *immediately*. Low rates (<40 lb/A) may be applied after removal of a late water flood to control dodder with minimal risk of phytotoxicity.

After Casoron is applied and is incorporated by initial irrigation or rainfall, it binds to soil particles. The efficacy of Casoron may be reduced if excessive irrigation or rainfall (+ 0.5 inches) follows application, as the chemical will be washed too deeply into the soil to affect germinating seeds. It is not known if frequent frost protection impacts the efficacy of Casoron.

Casoron is labeled for use on:

Sensitive fern	Rice cutgrass	Tideland clover
Bracken fern	Bunch grass	Ragweed
Royal fern	Muskrat grass	Sorrell
Haircap moss	Nutsedge (Nutgrass)	Wild strawberry
Common horsetail	Short wiregrass	Aster
Water horsetail	Wideleaf grass	Buckbean
Rush (Juncus spp.)	Stargrass	Hawkweed
Dodder	Woolgrass	Western Lilaeopsis
Bluejoint grass	Cotton grass	Marsh pea
Rattlesnake grass	Needle grass	Plantain
(Manna grass)	Oniongrass	Smartweed
Summer grass	Arrowleaved tear thumb	Pacific silverleaf
Velvetgrass	Beggarsticks	Marsh St. Johnswort
Bent grasses	Knotweed	Crabgrass
Little hairgrass	Loosestrife	

IRON SULFATE – Used PRE

May be spread as a broadcast application through conventional fertilizer rigs, such as hand cranks. Traditional use has been with 2-3 oz/ft² of a 20% ferrous sulfate (fine powder) product, but other formulations are available. Application rates listed in the Chart Book are for the 20% a.i. product. Adjust accordingly if using another percent active ingredient. Iron sulfate at rates exceeding 1.1 oz/sq. ft (20% a.i. product) may kill vines if they have been sanded within the past 18 months. Do not use on new bogs. To be most effective, rain should follow within 4 days of an iron sulfate application or the bog should be irrigated. When a 9:1 iron sulfate to salt combination is used, rain or irrigation is not necessary for incorporation.

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DEVIRINOL DF-XT (Napropamide) - Used PRE

	Annual allowable formulation	Restricted entry interval (REI)	Preharvest interval (PHI)	Max number of applications
Established beds				
Peat beds:	18 lbs/Acre	24 hrs	N/A	3
Sand beds:	12 lbs/Acre	24 hrs	N/A	3
New plantings	6 lbs/Acre	24 hrs	N/A	3

Devrinol 50DF is available (24c label) for use on cranberries but is being phased out. Devrinol is a preemergence herbicide and will not control existing weeds. Unlike Devrinol 10G (has been discontinued but is still legal to use, and must be applied by air or ground), the DF formulation can be injected through the irrigation system. Be sure to get the supplemental label at the point of purchase. It is typically applied in the spring before growth begins, but it may also be applied in the fall after harvest. Do not apply when beds are under winter flood. The efficacy of fall applications for many weeds has not been documented. A liquid formulation (2-XT) should be available in limited quantities in 2014.

Rate differences for the soil types (higher rates with more OM) are primarily due to efficacy issues rather than toxicity or groundwater concerns. The label states that it should be applied with sufficient water to wet the soil to a depth of 2 to 4 inches. Use the appropriate rate for the age of the bog and soil type. Devrinol can be used under or on top of sand.

This herbicide provides some control of grassy weeds, nutsedge, and annual broadleaf plants, but works best on weed-free areas. Since Devrinol will control grasses, give careful consideration to use of 50DF if you are establishing ditch banks and your irrigation system delivers coverage to the ditch bank area.

EVITAL 5G (norflurazon) - Used PRE

	Annual allowable formulation	Restricted entry interval (REI)	Preharvest interval (PHI)	Max number of applications
Established beds	160 lbs/Acre	12 hrs	N/A	1
New plantings	80 lbs/Acre	12 hrs	N/A	1

Apply Evital 5G as a single application in the early spring after removal of winter flood and before weed growth resumes OR in the fall after harvest at least 2 weeks before winter flood. Only one application per year (12 months) can be made. Vine injury may occur in areas where water stands several days after flooding or heavy rains. Use lower rates on stressed vines or sensitive cultivars such as Stevens and McFarlin. Growers have reported good results with low rates (50-75 lb/A) for fall applications on these varieties; spring applications should not exceed 60 lb/A.

Sanding can be done on top of an Evital application, but be careful especially on bogs that have drainage problems or sensitive varieties. Sanding after applications of 50 lb/A or less has given good weed control. Growers have reported that applications of Evital (50-60 lb or less) on top of sanded vines work adequately on healthy well-drained beds. Although higher rates may injure cranberry, the product label does recommend using higher rates for poverty grass control (120-160 lbs).

Be conservative when applying Evital to new plantings! Usually, new vines are very sensitive to Evital. However, growers have reported using 35 lb/A in the fall on Stevens that were planted in the same year with good success. In other instances, vines have shown severe phytotoxicity to rates as low as 25 lb/A when applied 3-4 weeks after planting.

CALLISTO (Mesotrione) - Used PRE and POST

Annual allowable formulation	Restricted entry interval (REI)	Preharvest interval (PHI)	Max number of applications
16 fl oz/Acre	12 hrs	45	2

Callisto is a systemic preemergence and postemergence herbicide. It works mainly on broadleaf weeds, and does not work well against most grasses. When used preemergence, weeds take up the product through the soil during emergence. When used as a postemergence, susceptible weeds absorb the herbicide through the treated foliage and also through the soil.

Callisto can be used through the chemigation system; this method is commonly used by growers. Adjuvants may be added for postemergence use. Use a “per acre” rate for the adjuvant, not a % or v:v rate. Under chemigation situations, the amount of adjuvant would be very large, very costly, and difficult to handle logistically (mixing issues) if applied at volumes other than on a “per acre” rate. NIS and COC should work equally well with Callisto; however, some COC may cause injury on cranberry, under certain conditions.

Some growers also used Callisto to spot treat weeds using backpack sprayer applications. If you want to add a dye to the herbicide mix, the manufacturer recommends using Spray Tracer; they recommend AGAINST using Blazon Blue (this product is NOT labeled for food crops). As a spot application, use 20-30 gal/A water. Mix 0.8 teaspoon in 1 gal water for 4 fl oz/30 gal water rate. Add a nonionic surfactant (NIS) at 0.25% v:v or 1.9 tsp per gallon or crop oil concentrate (COC) at 1% v:v or 2.5 Tbsp per gallon with all postemergence applications, regardless of Callisto rate.

Plants affected by Callisto will turn white. Injury may take several days or weeks to show. Allow a minimum of 14 days between applications. Hardier weeds will likely need 2 applications over a period of successive years for control. Callisto should work well against crabgrass but is weak against foxtails. Callisto is rain-fast in less than 4 hours and has no known bee issues.

Use on New Plantings. Data from both Massachusetts and Wisconsin indicates that Callisto is an excellent choice for use on newly planted vines. Growers have first applied Devrinol (within 3 weeks of planting) and then followed up with one or two Callisto applications; this combination seems to have worked well. No injury has been reported. Lower rates are often a good choice as many of the early weeds are grasses or annuals.

Resistance Management Concerns. Resistance to Callisto has been reported in other crops after only 7 years of use. It is important that we do not lose this tool for dodder and general weed management. Occasionally rotate Callisto out of your herbicide sequence and substitute other herbicides. Use non-chemical forms of weed control whenever possible. Do not use Callisto repeatedly year after year.

QUINSTAR 4L (quinclorac) - Used PRE and POST

Annual allowable formulation	Restricted entry interval (REI)	Preharvest interval (PHI)	Max number of applications
16.8 fl oz	12 hrs	60 days	2

There are export issues with this herbicide. Check with your handler before using, because handler restrictions may apply. Do not apply to crops that are stressed. Do not apply by air.

Dodder, loosestrife, and other broadleaf and grasses may be controlled by this herbicide. A maximum of 2 applications are permitted per calendar year, not to exceed 16.8 fl oz/A. Applications must be separated by at least 30 days. COC at a rate of 2 pt/A may be added to the spray mixture.

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Quinclorac is taken up through roots and leaves. Adequate rainfall after application and good soil moisture is important for root uptake. Symptoms include twisting, stunting, reddening and chlorosis; symptoms on perennial plants may take more than 3 weeks to show. The full effect of the herbicide may not be evident for 3-6 months after application.

STINGER (Clopyralid) – Used POST

Annual allowable formulation	Restricted entry interval (REI)	Preharvest interval (PHI)	Max number of applications
16 fl oz	12 hrs	50 days	2
Type of application		Rate	
Wipe	2% solution - 2.5 oz (5 Tbsp) per gallon		
Spray (wild bean)	0.06-0.12 fl oz/gal (0.37-0.75 tsp) per gallon		
Spray (asters, ragweeds, etc.)	0.33-0.5 fl oz (2-3 tsp) per gallon		

Stinger **CANNOT** be applied by air or through the irrigation system! Do not apply within 5 hours of expected rainfall or irrigation.

Stinger is a postemergence herbicide used to control wild bean, narrow-leaved goldenrod (NLGR), asters, clover, ragweed, pitchfork (and other members of the Composite and Legume families), and certain other weeds within the treated area. Growers have reported effective control (and reduced vine injury) when using lower rates than recommended on the label. This is particularly true for wild bean control.

Apply when weeds are actively growing. It is best to apply Stinger when vines are dormant, if possible. For weeds that emerge late (NLGR, wild bean, etc.), wait until after fruit set to apply. Cranberry plants are most sensitive to Stinger applied prior to bloom. Do not apply Stinger from 1 week prior to bloom until 1 week after bloom. After bloom, Stinger can be applied up until 50 days prior to harvest. Higher rates of Stinger can be applied to cranberry plants post-bloom because the plants are less sensitive to Stinger than during the spring flush. Stinger can also be applied in autumn after harvest.

Stinger may be applied as a broadcast spray, as a wipe or as a spot treatment with a handheld sprayer. Spray to just wet the weeds, but not to run-off. **BE VERY CAREFUL!** Overspray can cause injury that may take 1-3 years for full vine recovery. Minimize drift when applying as a spray. Results may be slow to show; be patient. Two applications per season are permitted, not to exceed a total of 1 pint per acre.

POAST (Sethoxydim) - Used POST

Annual allowable formulation	Restricted entry interval (REI)	Preharvest interval (PHI)	Max number of applications
Broadcast: 5pts/Acre	12 hrs	60	N/A
Spot treat: 1-1.5% solution	12 hrs	60	N/A

Poast **CANNOT** be applied through the irrigation system! It may be applied by broadcast applicator or air. Spot treatments with small sprayers are effective.

Poast is a postemergence herbicide that controls true grasses (most annual grasses and some perennial grasses). Sedges and rushes are not controlled. Poast is absorbed through foliage after application. The effects range from slowing or stopping growth (generally within 2 days), to foliage reddening and leaf tip

burn. Subsequently, foliage burnback may occur. These symptoms will generally be observed within 3 weeks. Do not apply Poast if rainfall or irrigation is expected within one hour of application. Poast should be applied when grasses have 6 to 8 leaves to provide enough leaf surface for absorption.

Cranberry plant injury may occur if the herbicide is applied during the heat of the day or during bloom (due to COC). Application during cool periods of the day, but after dew has dried, is preferable. If you have never used this material before, it may be wise to test a small area before applying the product to a larger area.

Poast should always be used with a crop oil concentrate (COC) or Dash HC. Physical incompatibility, reduced weed control, or crop injury may result from mixing Poast with other pesticides (fungicides, herbicides, insecticides, or miticides), additives, or fertilizers.

For spot treatment use a 1-1.5% solution. To make one gallon of a 1.5% Poast solution, mix 2 fl oz of Poast with 0.6 fl oz of Dash HC (or 1.3 fl oz of crop oil concentrate) in 1 gallon water. Thoroughly wet the grass foliage, but do not let the solution run off the leaves.

Broadcast Application. Use standard high-pressure hollow cone or flat fan nozzles only. Use 5-20 gal of spray solution per acre at 40-60 psi. Inadequate coverage of grasses due to heavy cranberry canopy may reduce control. Do not use re-circulating sprays, wiper applicators or shielded applicators. Use of Poast with control drop application is not recommended due to erratic coverage.

Aerial Application. Do not apply if wind speed is greater than 10 mph.

Use on New Plantings. Poast can be safely used on newly planted vines. Wait for roots to develop before application. Growers report mid-July applications approximately 6 weeks after planting worked well. Grass control was enhanced when Poast applications were followed by Callisto applications.

SELECT MAX, INTENSITY, ARROW, etc. (Clethodim) – Used POST

Clethodim herbicides **CANNOT** be applied through the irrigation system! They may be applied by broadcast applicator or air. Spot treatments with small sprayers are effective. Clethodim is similar to Poast (sethoxydim). It is also a postemergence herbicide that controls true grasses (most annual grasses and some perennial grasses). Sedges and rushes are not controlled.

There are several products registered for use in cranberry which contain the active ingredient clethodim. The labels are different for each product (rates and adjuvants). Please read the label carefully and follow the manufacturer recommendations. For example, you can use an NIS with SelectMax but not with Select 2EC.

Select Max 9-16 fl oz/A per application (not to exceed 64 fl oz/A per year). Add 0.25% v/v non-ionic surfactant (NIS). For each gallon, mix 1.3 Tbsp (0.65 fl oz; 19 ml) + 0.65 Tbsp (0.33 fl oz; 10 ml) NIS for a mid-range rate. Allow 14 days between applications. Do not apply between hook and full fruit set. 30 day PHI.

Intensity 6-8 fl oz/A per application (do not exceed 32 fl oz/A per year). Add 1% v/v crop oil concentrate. For each gallon, mix 0.25% to 0.50% (0.33 fl oz. to 0.65 fl oz/gal.) and include crop oil concentrate at 1% (1.3 fl oz/gal.). Treat to wet vegetation, while not allowing runoff of spray solution. Allow 14 days between applications. Do not apply between hook and full fruit set. 30 day PHI.

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ROUNDUP and other Glyphosate products – Used POST

Many Roundup and glyphosate products are available on the market. **Please read the label of any product you use to ensure compliance.** Available glyphosate products vary as to whether they carry a 'Caution' label or 'Warning' label. Check the label for appropriate protective clothing. These products may also vary in the amount of active ingredient, the REI times, and length of dry time before they are rain-fast. Check the label. For example: Roundup Weathermax has 48.8% active ingredient (a.i.) while Roundup Ultra has 41% a.i.

Most Roundup products do not need an additional surfactant. It may be necessary to add a nonionic surfactant to other glyphosate products (again, check the label of the specific product you are using). Ammonium sulfate may improve uptake of these Roundup products when moderate to large amounts of carbonates ('hard water') are present in water, but this rarely a problem in MA. Follow instructions on the label.

Make herbicide mixtures fresh each day for maximum effectiveness. Do not store in galvanized containers. Always use a dye to track your coverage with any wipe product. Depending on the label, glyphosate products can be applied by wiper, by clipper, as a spot treatment spray in dry ditches, and as a spot treatment post-harvest spray.

Glyphosate is absorbed into plants through the leaves. Cranberry vines are very sensitive to glyphosate and can be killed by exposure. Avoid cranberry plants and do not allow material to drip onto vines during application. Glyphosate can be applied any time weeds are present, and repeat applications are permitted. There is a 30-day preharvest interval.

During the growing season glyphosate can be applied (on bog) by wiper. Some products (but not all) are also labeled for clipper use (stump-cut). Some products are also labeled for spray use in DRY ditches, and ditches must remain dry for 2 days after application.

Type of application	Rate
Wiper	10-20% (1 part glyphosate product to 4-9 parts water)
Dry ditch spray	1-1.5 % (2.5-3.8 Tbsp or 38-57 ml per gallon water)
Clipper	50-100% (use full strength or dilute by half)
Post-harvest spray	0.4 – 0.7% (3-5.5 tsp or 15-27 ml per gallon water)
IF additives are needed	
Surfactant	1 oz (2 tablespoons or 30 ml) per gallon of mixed solution
Ammonium sulfate	3 oz (6 tablespoons or 90 ml) per gallon of mixed solution

Wipes - Use an applicator that permits excellent coverage with minimal dripping. Adequate coverage of weeds must be obtained for glyphosate to be absorbed. Several leaves (at least 50%) on each stalk must be treated with the herbicide. Application by hand with sponges or specially designed applicators may be necessary with low-growing weeds (e.g., bristly dewberry, poison ivy).

Repeat applications within a season are legal and may be necessary, especially for well-established perennial weeds. Poor growing conditions such as drought stress, disease, or insect damage may reduce effectiveness.

Some growers have had success staking the vines (tomato stakes or similar) for wiping and allowing them to dry prior to laying them back on the vines. This certainly reduces vine injury.

Clipper Applicators (Roundup only) - Roundup products are the only products currently labeled for use in clipper application (Section 2ee-'Cut Stump'). Availability of commercial clippers has become limited over the past few years. Growers may need to manufacture their own clippers.

Concentrations of 50-100% Roundup have worked well. The herbicide should flow out consistently, but not so fast that herbicide drips from the blades. Be sure to use a dye. Clip weeds close to the ground, without contacting the vines. Roundup must contact the stem as you are cutting! 'Clip and dab' or 'mow and wipe' techniques may have reduced efficacy as the herbicide is not applied simultaneously with the cut. Late-season treatments give better results than early-season treatments. The effectiveness of post-harvest treatments with clippers is not known. Be sure to clean the blades after use to prevent corrosion.

Spray application to DRY ditches - Some products are also labeled for spray use in DRY ditches. The ditch should be dry for 1 day before application, and ditches must remain dry for 2 days after application.

Post-harvest sprays - Certain products allow for post-harvest sprays. Supplemental labels may be needed with certain generic glyphosate products when doing post-harvest sprays (0.5%-1%), applied as a spot-treatment, or sprays in dry ditches (1%-2%). These uses are included in the regular labeling for Roundup WeatherMAX and PowerMAX. CHECK THE LABEL of the product you are using for specific uses. Recent research indicates that Howes may be slightly more sensitive to postharvest spray injury than Early Black.

RODEO – Used POST

This glyphosate product can only be used to control weeds that occur in dry ditches and canals outside of the production area. Application is spray to wet leaf surfaces, not to runoff. Extremely cool or cloudy weather following application may slow the activity of this herbicide. Best control is obtained when plants are at late growth stages approaching maturity. Weeds under stress will not be controlled as well as healthy plants. Rainfall within 6 hours of application may reduce effectiveness and heavy rainfall within 2 hours of application may necessitate reapplication. Do not add ammonium sulfate to Rodeo mixtures.

WEEDAR 64 (2,4-D) – Used POST

Weedar 64 is a State-restricted use product!! These products have considerable potential to evaporate and cause crop injury. 2,4-D products can be highly effective at controlling some weeds. However, the potential for significant vine injury may outweigh the advantages of using these materials.

Avoid applying 2,4-D on hot, sunny, and humid days when there is little air movement. Weedar 64 is the only 2,4-D product that can be used on the bog. Weedar 64 has a 30-day PHI and may only be applied once per season. For wipers, mix 1 part Weedar to 2 parts water for hockey stick application. Best results are obtained when used in late June and July. Do not drip or touch vines.

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SALT – Used POST

Salt (sodium chloride) may be used as a spot-treatment for control of certain weeds (e.g., wild bean, rushes). Judicious applications do not inhibit re-colonization of cranberry vines once the weed dies. Do not use during bloom. It may be sprinkled at the base of weeds (for rushes use 1-3 teaspoons per clump) or sprayed in a solution. For wild bean, 1 lb/gal water used after fruit set can help to control this weed. Do not exceed 200 gallons per acre. One grower recently reported that they obtained some control of dodder using a salt water spray. Use of calcium chloride or other types of salts is not recommended. Salt is corrosive to machinery. Be sure to wash equipment thoroughly after application.

FLAME CULTIVATION (FC) or THERMAL WEEDING – Used POST

We have preliminary evidence that the use of hand-held propane torches can provide control of some weeds (e.g., dewberry, rushes, and dodder). Applications (in test studies) have been made in the summer months. FC is a good option on organic farms or as an alternative to continual POST herbicide use. Several torches (open flame (OF) or infrared (IR)) are available. Cranberry vines can be injured during a FC application but the vines will recover. Short exposures (~5 sec) provide control when using OF; longer exposures are needed (~15-30 sec) with IR.

VINEGAR – Used POST

Vinegar (acetic acid). We have data that show efficacy with 20% acetic acid for moss control, but this injured cranberry vines. Data is limited for control of other weeds. In our experience, applications of vinegar (especially store-bought, 5%) are mostly ineffective and may cause injury. Washington studies showed control of false lily-of-the-valley with soil drench applications (7500 gpa).

Soil pH management to improve weed control

SULFUR

Determine soil pH in the weedy area prior to sulfur application. If pH is 5.0 or above, use two applications of 500 lb/A each (or 4 applications of 250 lb/A) to reach 1,000 lb. of elemental sulfur per season. Begin application in late spring when soil is drained and the need for frost protection is over. Most growers allow 3-6 weeks between applications. Do not apply sulfur to puddled or waterlogged areas as resultant production of hydrogen sulfide can cause severe vine toxicity. Changes in pH can be very slow. Granular applications may take up to nine months to reduce pH enough to affect weed populations. The smaller the sulfur pellet size, the faster the pH is lowered. Use pelletized sulfurs only. Do not use flours of sulfur; they can be phytotoxic and are difficult to apply. Do not use potassium sulfate. Yearly sulfur applications may be needed as the pH can creep up in subsequent years. Test soil pH yearly to determine the effectiveness of sulfur applications. The effect of lowered pH on control of cinquefoil is moderate. Eye protection and dust masks are recommended when making sulfur applications.

DITCH MANAGEMENT

WOODY AND BROADLEAF PERENNIALS ON DIKES (BOG-SIDE)

Cultural controls include mowing the ditch and dike areas during the summer months. Some areas may need to be done more than once. Hand pulling is most beneficial in the spring and early summer when the soil is moist and the plants are fairly small. Controlling weeds on the dikes may be useful in reducing spread of these weeds onto bogs.

DITCH WEEDS (e.g., Arrowhead, Pickerelweed, Pond lilies, Bur-reed, Duckweed)

Clean ditches by hand or mechanically preferably twice a year. Draining ditches can sometimes be helpful in killing some aquatic weeds (e.g., duckweed). Preemergence herbicides registered for use on the bog may **NOT** be used in the ditches for weed control. Roundup use is permitted in dry ditches as a wipe or a spray. See notes on Roundup. Evidence also suggests that flame cultivation may be an effective nonchemical tool for ditch weed management.

AQUATIC WEEDS on bog (Hydrilla, Elodea, Water lettuce, etc.)

Make sure any aquatic weed control that is performed within the bog system (irrigation laterals, ditches) is done with a product labeled for CROP use. Nautique (by SePro) has crop uses on its label. It is labeled to control floating, emersed, and submersed vegetation in still or flowing aquatic sites such as reservoirs, ponds, slow-flowing water bodies, crop and non-crop irrigation systems. Application rate varies by vegetation density and depth of treated area. Please read the label. If you have any questions, please consult with a Weed Extension specialist prior to treating.

ALGAE (Green scum)

Algaecides are usually prescribed on an acre-foot basis. An acre-foot is the amount of water needed to cover one acre of bog with one foot of water (~300,000 gallons of water, assuming the bog is level). Barley straw can also be used to help control algae. When water temperatures are cool (<50°F), it may take 6-8 weeks for the straw to decompose; 1-2 weeks if water temperature is >68°F. The bales should be contained in nets and maintained at the surface (floats can be inserted) to be most effective. Manufacturers recommend 4 bags (5-7 lb each) per 0.25 acre.

The products listed below are legal for use in cranberry farms. Many other available algaecide products are not for use in food crop systems; check with the Weed Specialist if you have questions about other products.

CHEMICAL RECOMMENDATIONS FOR ALGAE

Copper sulfate	4 lb/A-ft	Apply evenly in bog waters. When bogs are treated during winter months, water should be impounded for 5-7 days to allow for degradation in cool-temperature water. May also be used in late water.
Algae-Pro	0.75-1.5 gal/A-ft	Amount will vary depending on product, water volume, and algal density. Carefully read the label before application. See Notes on Copper Sulfate and Copper Complexes, page 44.
Cutrine-Plus	0.6-1.2 gal/A-ft	

NOTES ON CONSERVATION SEED MIXES FOR DIKES AND DITCHES

Several criteria were used to compose the seed mix recommended by Plymouth County Conservation District. The seed mix needed to contain perennial species, must contain at least one nitrogen-fixer, must be drought-resistant, must not introduce known weed seeds, contain at least 3 species and be economical to purchase. The current seed mix is creeping red fescue (39.7%) with a germination rate of 85%, perennial ryegrass (34.2%) with a germination rate of 90%, empire birdsfoot trefoil (24.5%) with a germination of 70%, and 5% hard seed and some inerts.

Mixes may also contain timothy grass, riverbank rye, switchgrass, Virginia wildrye, orchardgrass, deer tongue, perennial wildrye, and clover. For more information on planting rates and cost, please contact the West Wareham office at 508-295-5151.

Other seed mixes may be used for dike stabilization but if you want to take advantage of cost-sharing, be sure to confer with NRCS prior to using a non-standard, non-recommended seed mix. Creeping red fescue and hard fescue may offer good stabilization coupled with low maintenance. You may want to consider the addition of an annual ryegrass (small proportion of total) for quick colonization along with the fescues. If you wish the fescues to predominate, be sure to mow the ryegrass prior to seed production (late summer-early fall).

Use herbicide with caution when re-seeding dikes, as some herbicides will control grasses and legumes present in seed mixes. A UMass Cranberry Station greenhouse study showed that red clover was susceptible to injury from Callisto applications. Hard and creeping red fescue and switchgrass showed symptoms briefly but recovered within a few weeks.

AQUATIC USES

COPPER SULFATE and COPPER COMPLEXES (Algae-Pro, Cutrine-Plus). Copper sulfate may be used to control algal growth on winter or late water floods. Cutrine-Plus and Algae-Pro work best when water temperatures are warm (~ 60°F). These copper-complex products are formulated to last longer than copper sulfate in hard water (carbonates present). Copper-complex products work best when applied under calm and sunny conditions.

If you are holding a 4-week late water flood, plan to apply a copper product mid-way through the flooding cycle (for more details, see Prevention of Scum in the Late Water section). These products are typically applied directly through the irrigation systems (with heads on risers). For winter floods or late water floods of short duration, scout for algae and apply when growth is first visible on the water surface. Remember, these products only prevent further algal growth; they do not kill or remove what has already grown. Crystal copper sulfate will dissolve easily in water and can be applied as a spray solution. Though somewhat uncommon now, crystalline products can be placed in burlap bags and dragged across the water surface. When bogs are treated with copper sulfate during the winter months, water should be impounded for one week. Since late water floods tend to be warm, there is no need to impound these waters. Do not apply to water except as directed on the label. These products are toxic to fish. Do not use any other algaecide products; consult with the Weed Specialist if you have any questions.

Nautique is a copper carbonate (double-chelated copper formulation) product that can be used to control certain aquatic plants in irrigation systems (ditches, canals) in crop systems. It is highly corrosive and carries a DANGER label. It may be fatal if absorbed through the skin. Be very careful with this product!! Wear all recommended protective equipment. Fish toxicity is dependent on the hardness of the water; in soft water, trout or other fish may be injured or killed. Do not use if carbonate hardness of the water is less than 50 ppm. If applying to public waters, check with the local authorities for permit process. Nautique can be mixed with other aquatic herbicides; check the label. When applying to irrigation ponds, hold water for a minimum of 3 hours before irrigating plants.

NON-CROP USE !! OUTSIDE OF BOG AREA – WEED MANAGEMENT

AQUATIC WEEDS. Reports of grower problems with aquatic weeds have been increasing. Aquatic weeds can be submersed, floating plants, floating leaf plants or emergent plants. Common aquatic species for our area may include fanwort, variable watermilfoil, bladderwort, hydrilla (a new one to look out for), duckweed, and water lilies. Be sure to get a correct identification of the weed problem before treating. Treatment of some water areas may require a permit. Non-chemical methods (e.g., harvesting, suction, hand pulling, dredging) are available but are very expensive. The use of grass carp for aquatic weed control is NOT permitted per MA Fish and Wildlife. Call 508-389-6300 for more information.

CHEMICAL RECOMMENDATIONS FOR AQUATIC WEEDS

Diquat	1-2 gal per surface acre	Use during Summer months. Water use is restricted for various time periods depending on product and pattern of use. CHECK THE LABEL! Use only on <u>still water</u> areas outside of bog (e.g., farm ponds, reservoirs). Water temperature should be >50°F for best activity. Do not use in or on bog ditches.
Reward	(37% ai diquat bromide)	
Rodeo	(54% ai) 1.25% solution	Apply during the Summer months. Rodeo is registered for use on noncrop land only. Use in interior ditches is not permissible. Recommended spray solution: 5 fl oz/3 gallons. <u>Add a nonionic surfactant</u> at the rate of 0.25-0.50% volume basis (1-2 fl oz or 2-4 Tbsp in 3 gal.). More effective against cattails and water lilies. Not effective against submersed weeds.

WOODY AND BROADLEAF PERENNIALS (not in ditches or canal banks)

Hand pulling is most beneficial in the Spring and early Summer when the soil is moist and the plants are fairly small. Both of these herbicides are restricted use compounds. Be sure you have the proper license or use licensed personnel to do the application.

CHEMICAL RECOMMENDATIONS – WOODY PERENNIALS – NON-BOG USE ONLY!!

Weedone CB	Do not dilute.	Apply in February and March. Spray to wet. Avoid drift onto bog. Controls woody plants on roadsides and non-crop areas. It is no longer produced, but available product may be used <u>off the bog</u> .
Crossbow	up to 2 gal/A	Mix with enough water to deliver 10-30 gal/A. Application rates vary depending on target species and application method. Drift to desirable plants may cause injury (esp. grapes and tomatoes). Do not apply to water. Read the label! See Notes on 2,4-D.

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CROSSBOW, WEEDONE CB (2,4-D). **State Restricted use!!** Crossbow and Weedone are labeled for **non-bog use only**. Be cautious! Crossbow contains trichlopyr for which there is **no food tolerance**. Do not use Crossbow or Weedone CB on dikes or canal banks. Use it only on weeds located far away from the bog. These products have considerable potential to evaporate and cause crop injury. They have the potential to drift very far from the site of application, and can injure nearby plants such as apple trees, grapes, etc. Avoid applying 2,4-D on hot, sunny, and humid days when there is little air movement. 2,4-D products can be highly effective at controlling some weeds.

DIQUAT. This herbicide should only be used on water weeds growing in areas **outside of the bog**. Do not use in any ditch associated with the production area. Diquat will control water weeds such as bladderwort, coontail, elodea, and pondweeds. A non-ionic surfactant (e.g., X-77) may improve performance. Check the label for rate information.

RENOVATION AND NON-PRODUCING BOGS

FUMIGANTS. Basamid (dazomet) and Vapam (metam-sodium) are soil fumigants that can be used on cranberry beds. **DO NOT USE FUMIGANTS AS A SPOT-TREATMENT IF ANY VINES WITHIN A DIKED SECTION WILL BE HARVESTED.** If you are renovating an entire section, a portion of that section can be spot-treated with a fumigant. More information on the use of fumigants may be found in the New Plantings Fact Sheet (available at the Station).

REGLONE (Diquat dibromide). Non-selective herbicide. Reglone should only be used on bogs that will be renovated or will not be harvested for 1 year. The intended use is as a site-preparation product, not for use for spot weed control on an active farm. This product works as a plant desiccant and should be used as a directed spray. Reglone cannot be applied by chemigation. Use 1.5-2 pt/15 gallons water by ground. May need repeat applications. Add NIS.

FUSILADE (FLUAZIFOP). This selective grass herbicide can only be used on non-producing bogs. It is used postemergence for control of true grasses. Sprayed will grass turn yellow and die back over a 1-4 week period depending on climatic conditions. It is rainfast after 1 hour. Add a COC at 0.5-1% v:v or 0.25-0.5% v:v if using a NIS. Use 0.75 fl oz herbicide per gallon water. REI is 12 hr.

CAUTIONS AND OTHER NOTES

1. Chemicals not registered for use on cranberries must not be used.
2. Herbicide use may weaken vines and crops may be reduced.
3. To be most effective, rain should follow the application of any dry herbicide formulation within 4 days or the bog should be irrigated.
4. Wash equipment with soap (or detergent) and water immediately after using. Rinse with ammonia after using hormone-type herbicides (such as 2,4-D).
5. Hand wiping with glyphosate products is often practical with some weeds if roots are weakened. This is particularly useful for dewberries after late water or a summer flood.
6. Mowing of tall weeds helps to prevent shading and reduces seed formation.
7. Late water causes general reduction of annual grasses and may reduce dewberry populations and re-growth.
8. Agricultural burning of brush or grass is allowed under regulations from the Director of Air Pollution Control, Southeastern Office of the Dept. of Environmental Protection and under permit from the local fire chief.
9. Review the Weed Management BMP in the UMass Best Management Practices Guide.
<http://www.umass.edu/cranberry/pubs/bmps.html>.