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Reducing Management Costs in Cranberry Production

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During the past two years, the Cranberry Station and the Cape Cod Cranberry Growers Association have held workshops to discuss ways to reduce cranberry production costs. This publication is designed to bring together the information presented at these workshops, experiences of growers over the last two seasons, and the expertise of the faculty of the Cranberry Station in the area of efficient and low-cost cranberry management.

Analyzing production costs

In each of the past several years, First Pioneer Farm Credit and the Cape Cod Cranberry Growers Association have conducted a "Cost of Production Survey" of Massachusetts cranberry growers. Based on the 1999 average cost in that survey ($4500 per acre) and the average MA crop for 1999 (127 bbl/a), the average cost of production in MA in 1999 was about $35/bbl. As you can see, two factors are used to calculate cost per barrel - cost per acre and barrels per acre. Any change in either of these factors results in a change in per barrel production cost.

In order to formulate a business plan, it is important to have a realistic idea of the productivity (bbl/a) that can be expected for a given bog harvest unit. If your realistic estimate of productivity is in the 200 bbl/a range and your per acre costs are average, your per barrel costs would be in the low $20 range (about $23). However, with MA average production (127 bbl/a in 1999, similar in 2000), per acre costs would need to be reduced to approximately $3000 to achieve a similar per barrel cost.

Realistically, increasing production on a bog may require increased per acre costs, at least initially. This may not be feasible for many growers. For this reason, the focus in this publication will be on reducing costs while maintaining your current level of productivity and gaining some ground in the area of pest control. In order to take full advantage of this information, you should base your choice of management plan(s) on the characteristics of your properties, for both your costs and your bog's yield potential.

Choosing a management plan

The choice of a management plan should be based on a realistic estimate of the expected crop. That is, if a given bog is very productive (>250 bbl/a), extreme caution is advised when cutting back on management activities, as this may lead to reduced cropping. On the other hand, if the bog is producing closer to State average, cost cutting measures may be beneficial to the bottom line. If a bog is producing at well below the State average, managing for no crop while per barrel returns are low may be advisable. Based on a productivity analysis, you may need three management plans: 1) full level of activity; 2) low-cost management; and 3) management for no crop. For the remainder of this publication, the second two choices will be discussed.

Low-cost management recommendations

If you are planning to produce a crop but are looking to reduce costs as much as possible, consider the suggestions in this section. Remember, however, that certain activities must not be neglected if you expect to preserve the vines and meet the yield expectations of your business plan. You may wish to consider the use of higher-risk practices that can lower costs but may be associated with some crop reduction. A late water flood is an example of this type of high-risk practice.

Irrigation, sand, and fertility management

Where water management is concerned, efficient use of water is the most effective means of maximizing returns. In addition, flooding practices can be used to reduce other management costs.

Irrigation: It is difficult to decrease irrigation in cranberry, since most of the water is used by the plants and demand is little affected by changes in crop load. At least 99% of the water used by cranberry plants is lost via transpiration, the process by which plants maintain their internal temperature. Transpiration losses are controlled by light interception, humidity, wind, and temperature - all factors beyond the grower's control. However, increases in efficiency can lower costs and may increase crop.

Be sure that your irrigation system is functioning at top efficiency. Annually, clean and inspect the pump, check mains, lateral lines, and riser gaskets for leaks, inspect all sprinkler heads and nozzles, and straighten risers.

If possible, maintain a water table beneath the bed (sub-irrigation) to reduce the need for sprinkler irrigation. In sub-irrigation, the water level is maintained so that the soil is moist but not saturated at the bed surface. Therefore, you should maintain the water level in the ditches at a level that is adequate to supply water to the root zone

Table 1. Summary of thresholds for irrigation. Data developed by B. Lampinen. (midday tensions and heights relative to root zone)		
	Tension (cbar)	Water table level (inches)
Too wet	0 to -2	0 to 6
OK	-2 to -10	6 to 18
Too dry	-10 to -80	>18

while still allowing adequate drainage from the center of the bed (generally about 14-16 inches below the bed surface, although this will vary based on bed width, soil texture and grade).

The **water requirement** of cranberries during the growing season can vary from 0.4 to over 1.5 inches per week. Because of this variability, it is essential to adjust water management practices based on soil moisture monitoring to avoid deficit or excess conditions, both of which can affect crop. **Apply irrigation based on soil water status and plant needs.** Plant needs increase when temperatures are high, skies are clear, or wind is present. Cranberries can use up to 0.20 to 0.25 inches of water per **day** during the hottest, driest, windiest weather, considerably more than the historic benchmark of 1 inch/week. Conversely, during cool damp periods, water demand will be much lower than 1 inch/week. Monitor soil moisture during the season to schedule irrigation.

Applications of more than one-half inch in a single irrigation can lead to waterlogging and puddling. The amount needed on a specific bog will be related to soil texture, permeability, and drainage characteristics. Surface dryness does not always indicate the need for irrigation.

It is important to monitor soil water conditions to schedule irrigation efficiently. When irrigating primarily by sprinkler, the driest areas will tend to be near the edges of the bed while the wettest areas will tend to be near the center. The reverse will be true if you depend on sub-irrigation. Therefore, you should monitor soil moisture (and/or water table level) both near the edges of the bed (approximately 5 to 10 feet in from ditch) as well as in the center of the bed.

Water table depth may be monitored using a 'water level float', a device that is simple to construct and install (see references). Soil moisture is generally monitored using tensiometers. Tensiometers are a bit more expensive and can be tricky to read, since cranberry soils typically register within a narrow tension reading range (0 to -10 cbars generally). Table 1 shows the threshold values to use when scheduling irrigation with tensiometers or water level floats.

Drainage is extremely important to cranberry production. **Regardless of irrigation method used, it is critical to maintain adequate drainage across the bed to prevent waterlogging in the root zone.** Saturation status of the soil can affect root growth and function as well as disease incidence. Suboptimal soil moisture (too wet or too dry) leads to poor uptake of fertilizer nutrients. Excessively wet soils increase the likelihood of *Phytophthora* infection while excessively dry soils can promote fairy ring disease. By providing adequate drainage early in the season, you should be able to improve rooting depth and productivity. As is the case with fertilizer, how you manage your bog's drainage this season has a large impact on next season's performance.

Frost protection: As with irrigation, the best one can do for cost cutting in frost protection is to maximize efficiency. Check and calibrate thermometers and evaluate tolerance frequently. Avoid start-up until the temperature is close to tolerance to minimize pumping costs. If the winter flood is held until mid-March, development may be slowed so that loss of tolerance occurs later in the spring when the likelihood of frost is less.

Sanding: Sanding can be an expensive practice, particularly if sand must be purchased and trucked. However, beds left unsanded for too many years tend to decline. This is especially true for the Early Black variety. Sanding is important in maintaining a good stand of uprights and a strong root system. In the short term, some of the benefits of sanding can be gained by a combination of lightly pruning the vines and using a trash flood to remove excess debris from the bog (normally this 'trash' would be covered by the sand). Research in Massachusetts (Demoranville and Chandler, unpublished) showed that plots subjected to yearly light pruning (<0.5 tons/A removed) had similar yield to those that were sanded every 3 years.

Fertilizer management: When planning fertilizer management, it is critical to keep in mind that much of the effect of fertilizer applied in the current year will be on the crops for the following 2 years. Avoid micronutrient supplements unless the bog has a documented nutrient deficiency. Do not use SulPoMag unless vines are severely stressed or a soil test shows low K or Mg. If you do use it, 100 lb/A should be sufficient.

Apply the major nutrients - nitrogen, phosphorus, potassium - in moderation to effectively satisfy the needs of the plants and the crop. Recommended moderate rates (per acre per season) are: 25-30 lb N, up to 20 lb P, and up to 60 lb K. Adjust to each specific bed based on growth response. Nitrogen use should be conservative on fresh fruit beds to assure fruit quality and ease of harvest. Use the upper range of rates for large fruited cultivars such as Stevens. Reduce nitrogen rate by 30-40% if late water was used.

When choosing fertilizers, make sure that quality is not sacrificed for price. Blended fertilizers with varied particle sizes will sort during application, leading to uneven distribution of the nutrients. Avoid nitrate fertilizers. Limit soil testing to every 3 years to check pH unless you suspect a deficiency problem. Tissue testing may be helpful if you are attempting to cut back on fertilizer - it can provide a good 'report card' on how the plants are doing nutritionally.

Pest management

When attempting to cut costs, an IPM approach is critical where all actions are evaluated for cost and benefits. Applying chemical controls for minor pest outbreaks may not be warranted if the value of the crop loss does not exceed the cost of treatment. Aside from scouting and treating only documented problems, our best tools for reducing pest management costs are floods. This will be discussed in the next section.

Insect management: In an IPM framework, certain key insects should be managed. The insects in this list are selected because they have the greatest potential to damage the cranberry plants and/or have severe impacts on yield. The key insects to monitor are: 1) cranberry fruitworm; 2) Sparganothis fruitworm, 3) cranberry weevil, 4) cutworms/ gypsy moth (and perhaps blackheaded fireworm), and 5) soil insects (grubs). The fruitworms are direct fruit feeders, the weevils destroy flower pods, and the cutworms and soil insects can destroy the cranberry plants. To minimally address these pest problems, sweep once or twice in the spring, walk your acreage making careful observations early and late in the season, and calculate percent out-of-bloom to correctly time at least one spray for cranberry fruitworm.

Spring sweeping for cranberry weevil, Sparganothis fruitworm, cutworms, and gypsy moth should not be eliminated. Sweep at least once, preferably twice, particularly if weevil have been a problem. In a normal spring, sweep netting should be done during the weeks of May 25th and June 1st.

If cranberry weevils show up early, you may want to hold back on spraying until the population increases. Weevils continue to move onto cranberry from surrounding uplands (particularly from blueberry) over a period of time. Early sprays may miss later infestations that target the flower pods as a site for egg-laying. Thresholds for cutworms may be relaxed a bit given the current low price of cranberries. However, high numbers of cranberry weevil, Sparganothis fruitworm, and blackheaded fireworm should not be ignored since this will result in difficulty managing the second generations during bloom. In addition, ignoring these pests increases the possibility of the infestation becoming so well established as to become a serious problem in subsequent years.

Sparganothis is easiest to control in the spring generation. If this insect has been a problem, monitor with sweeps in the spring and follow Cranberry Station Entomology recommendations for control. Remember that large areas of resistant populations exist. Invest in pheromone traps to properly time summer control sprays.

While not historically common in Massachusetts, blackheaded fireworm can be a devastating pest in that it can quickly and completely destroy large areas of vines. As other management activities such as sanding and trash flooding are relaxed and fewer insecticide sprays are applied, this pest may become a greater problem. Blackheaded fireworm larvae may show up in spring sweeps. You should also watch for clusters of uprights that are webbed together, a common behavior for this pest. An excellent low-cost option for detecting this pest is pheromone traps.

Cranberry fruitworm is the most important insect in cranberry management. Virtually all Massachusetts bogs have this insect. Aside from late water beds (see below), large crop losses will occur if this insect is not controlled. Apply a spray timed to coincide with egg laying: 3-9 days after 50% out-of-bloom. The exact range varies by cultivar: 7-9 days for Early Black and Howes, 5-7 days for Ben Lear, 3-5 days for Stevens. Additional sprays should be applied based on the presence of unhatched, viable eggs, found by inspecting fruit.

You should walk you bogs thoroughly early and late in the season. Pay particular attention to weak areas. Inspect such areas for cranberry girdler and other soil insects. Pheromone traps are also recommended for monitoring girdler. Girdler infestations are more likely to occur in unsanded beds. Discolored areas of vines may indicate infestations of Southern red mite, which is readily controlled by late water (see below). As you visually inspect your bogs, look for chewing damage or webbing of uprights. These are signs that insects pests are present.

The key to low-cost and effective insect management is monitoring by inspection and sweeping. Missed or uncontrolled insect outbreaks may lead to ongoing problems, particularly with cranberry

weevil and cranberry fruitworm. Recognize that blackheaded fireworm may become an increasing problem for low-cost management bogs.

Disease management: The two key diseases that must be monitored and managed are fruit rots and Phytophthora root rot. For some bogs, upright dieback or fairy ring may also need to be managed. All growers should watch out for the return of false blossom disease as fewer insecticides are applied. The disease is vectored by the blunt-nosed leaf hopper.

Fruit rot disease has great potential to affect the bottom line. Like the fruitworms, fruit rot disease is a direct fruit pest complex. Fruit rot can be suppressed by proper air circulation (non-lush vines), good leaf and fruit trash removal practices, and proper irrigation. Aside from the use of late water (below), the major control for fruit rot is the application of fungicides. Fungicide management should be based on the Keeping Quality Forecast (Cranberry Station), the history of fruit rot on the bed, and costs of fungicides. Rates and applications may be reduced if the Forecast is good, particularly if the fruit is for the processed market. When late water is used, no fungicides are needed that year and may not be needed in the second year (minimally, use a reduced schedule). Reduced rates may also be warranted in the second year after late water. Because populations of the organisms that cause fruit rot can build up in the bog over time, the repercussion (increased fruit rot) of reduced management may not be apparent until two or three years after the fact.

Phytophthora root rot can be a devastating disease in poorly drained beds. The fungus that causes this disease requires water for its spore dispersal. *Phytophthora* is the causal agent for this disease that causes large patches of dead vines in low, wet areas of cranberry beds. The single best practice for controlling this disease is to improve drainage and modify irrigation to avoid standing water on the bed. Practice good sanitation to prevent the spread of this disease to other beds. Do not use expensive fungicides to control this disease unless you have improved drainage first. Once drainage is improved, have the disease confirmed by the Cranberry Station Plant Pathologist to avoid unnecessary and expensive fungicide use. Note that the increased use of flooding practices for pest control and crop destruction may contribute to an increase of this disease. Be vigilant.

Upright dieback should not be a problem if vines are maintained with good air circulation and appropriate water management (no drought stress). Likewise, avoid drought stress to minimize the incidence of fairy ring disease.

Weed management: Weed management should be based on long-term goals for a bed, cost of control measures, efficacy of control method, and your willingness to use a strategy. Dodder and dewberries (*Rubus* spp.) are the weeds that MUST NOT be ignored.

Dodder can severely impact crop in the current year and also affect the ability of infested uprights to set bud for next year. Currently, dodder is controlled with pre-emergence herbicides or hand removal of *small* infestations. Control (by herbicides or hand-removal) of early season hosts, such as loosestrife and narrow-leaf goldenrod, is also very effective. Dodder may also be controlled by flooding (see the next section).

Dewberry (trailing bramble) infestations can lead to a bed that is only fit for renovation. Scout for infestations early and stay on top of this problem. Dewberries often infest high areas and move in from edges. Monitor bog edges and shores for this weed. Dewberries are difficult to control. They are suppressed by late water and fall floods (see below). Otherwise, control by hand wiping with glyphosate.

Aside from flood management and hand pulling, weed control in cranberry is accomplished through the use of herbicides. In general, pre-emergence options are much more expensive then post-emergence options. Thus, in a low-cost management scheme, use pre-emergence herbicides for dodder control only. The only exception is grass control on new plantings — treat with 30 lb/A Devrinol 2-3 weeks after planting for excellent control of grasses.

For all other herbicide uses, compare the total cost of the various options (pre- and post-emergence) including application cost when selecting a weed control option. For example, grass control on established beds using Poast is much less costly than using Devrinol for this purpose.

Using alternative or novel flood practices to save costs

The best available tool for reducing the cost of cranberry pest management is the judicious use of flooding. Cranberries are true wetland plants, and while they require well drained soil during active growth periods, they tolerate periods of flooding at certain times during the season. Since most cranberry pests are not as well adapted to life underwater, they are impacted by the flood to a greater extent than are the cranberry plants.

Late water: Late water floods have been extensively studied and are the most commonly used pest control floods in Massachusetts today. The late water flood, as it is used today, consists of removing the winter flood by mid-March, then reapplying a deep flood from mid-April through mid-May. Water used for this purpose should have good clarity and fully cover the vines. Algal growth may occur, in which case control measures may be needed (for more information, see the UMass Cranberry Chart Book for current recommendations).

Table 2. Cost comparison — late water vs. control bed. Selected costs are per acre in 1996.

Item	Late Water	Standard (control)
Pesticides	$474.36	$699.38
Fertilizer	316.34	384.68
Labor for flood	82.52	
Pumping for flood	23.30	
Frost protection	53.92	179.16
Total	**$951.44**	**$1,263.22**

While there are costs associated with applying and maintaining the flood, late water can cut costs by eliminating the need for spring insecticides, reducing or eliminating the need for cranberry fruitworm sprays, eliminating the need for fungicide sprays for fruit rot, and reducing fertilizer needs by 30-40%.

Late water resulted in Southern red mite control for two seasons. In addition, late water suppresses dewberries and may save on frost protection (depending on weather conditions during and after the flood). It should be noted that in some years, late water has been associated with up to 10% crop reduction. This should be included in your management analysis when planning to use this practice. Table 2 shows a cost comparison from 1996 of late water vs. standard practice. Note that if all pesticides were eliminated, the per acre cost differential would increase from $312 to $786.

In a four-year study of late water, participating growers reduced insecticide use by 25% and fungicide use by 30%. It is believed that even greater reductions are possible. Based on plot work done in association with that project, we believe that fungicide use can be eliminated in the year of the flood, severely reduced or eliminated in the year after the flood, and applied at reduced rates in the second year after the flood. Less rigorous reductions may be called for if the bed is to be harvested for fresh fruit. Insecticide use can be eliminated or reduced to a little as one spray, depending on cranberry fruitworm reinfestation from surrounding beds. However, a full 4-week late water flood is needed to eliminate cranberry fruitworm populations on the bog. Shortened late water (~2.5 wks.) floods were significantly less effective than 4-week floods in suppressing cranberry fruitworm. Remember, late water does NOT control Sparganothis fruitworm, dodder, or sawbriers (*Smilax* spp.).

Fall flood (post-harvest): During the past three seasons, we have been investigating the use of a fall flood for control of fruitworm and dewberries. Previous research by Dr. Henry Franklin showed that a fall flood can control cranberry girdler. Post-harvest floods, consisting of keeping the harvest flood in place for a length of time, have been shown to eliminate cranberry fruitworm hibernacula (overwintering stage) and to suppress dewberry growth. A three-week flood appears sufficient to control fruitworm, but at least four weeks are required to adversely affect dewberry (Table 3).

Previous observations indicated that starting the flood early (September 20-25) is a key to good dewberry control. However, we did get some control of dewberry with a four-week flood starting as late as early October. Cranberry fruitworm was controlled by 3 or 4 week floods starting as late as October 8. At this time we continue to recommend starting as early as possible if flooding for dewberry control. But if you are mainly interested in controlling cranberry fruitworm populations, holding the harvest flood, even when harvesting later, should be beneficial. Early floods are especially suited to early varieties or beds where a crop-destruct flood is applied. By reducing the cranberry fruitworm population with a fall flood, you may be able to use fewer sprays for this insect the following season. However, this is a mobile insect and populations may move in from neighboring bogs or surrounding areas. Monitoring should not be eliminated.

Our experience, and that of several growers, is that the fall flood has no detrimental impact on growth or the next year's crop, making it a more attractive pest suppression option than late water. It is important to remove the flood by early November (at the latest) to

Table 3. Effect of fall flooding on cranberry fruitworm and dewberry.

Flood Start Date	Flood Length	CFW Mortality	Change in dewberry crowns
10/08/98	4 weeks	100% (80% in control)	27% decrease (3% increase in control)
10/08/98	4 weeks	100% (80% in control)	31% decrease (3% increase in control)
9/26/99	3 weeks	100% (88% in control)	7% increase (3% decrease in control)
10/01/99	3 weeks	100% (no control)	41% decrease (no control at this site)
10/03/99	3 weeks	100% (97% in control)	2% increase (35% decrease in control)

allow the vines to become dormant prior to winter. If an unusual cold snap occurs soon after the fall flood, the vines may be susceptible to winter injury. Note that following a fall flood with late water the next spring is NOT recommended, as a severe reduction in crop may result.

Dodder floods: Based on a grower experience on a mowed planting, we believed that dodder can be controlled by a 12 to 36 hour flood. However, until recently, this was not attempted on producing beds as crop effects (reduction in yield or quality) were feared. During the 2000 season, dodder control (with no apparent negative effect on crop) was accomplished using an 18 to 24 hour flood applied in mid-May, soon after dodder germination. The floods were timed to coincide with a frost event so that overall costs of the flood were mitigated (flooding instead of running the irrigation for frost protection). In addition, growers using crop-destruct floods at bloom reported dodder was also killed by these floods. Based on these experiences, the use of flooding for dodder control should be considered as an alternative to more costly herbicide applications.

Other pest control floods: The Cranberry Chart Book lists some short spring floods that can be used for insect control. However, these are little used and may be associated with crop reduction and increased fruit rot.

A summer flood, lasting from May 12 to July 20 will eliminate all insects and most weeds. However, the crop is eliminated and severe and lasting vine damage may result. For further information, see the crop elimination section.

In *very limited* recent experiences, late season short-term (~30 hours) floods effectively controlled Sparganothis. Crop was largely unaffected. However, this may not always be the case. The trial floods were applied in the evening followed by a day with cool, cloudy conditions. Further evaluation is needed to determine more accurately the efficacy and safety of this practice.

Management for crop elimination

Tto remain classified as a farm for purposes of property taxes (Chapter 61A) and to qualify for the agricultural exemption for certain management activities, it is crucial that your operation not become classified as an abandoned bog. Normal and continued maintenance activities associated with preserving the beds for future production should suffice to keep an agricultural classification. However, a property must generate some gross income from farming in order to qualify for Chapter 61A classification. For further information on Chapter 61A issues, contact CCCGA or Massachusetts Farm Bureau.

Flooding during bloom is a proven method to eliminate crop for a given year. If you are planning to flood for this purpose, you may also consider eliminating some flowering potential by allowing the bog to be exposed to cold temperatures. Exposure to temperatures below the frost tolerance will damage flower buds and decrease flowering.

Short summer flood. If using this method, do not protect from frost in the spring unless a so-called 'black frost' (temperature at least 5° below tolerance, rapid temperature drop, low dew point) is predicted. Omitting frost protection may eliminate some flower buds (depending on how the frost season goes). Once the buds have passed the 25° F stage, exposures to temperatures below 25° may damage the new growth as well as the flower buds. However, exposures as low as 15° F can be tolerated, the plants will recover by side-shooting to produce new uprights.

Late water can also be used on bogs where a bloom-destruct flood is planned. Late water synchronizes flowering, increasing the success of the bloom-destruct flood. After late water, the flowers buds are particularly sensitive to frost and consequently a frost event after late water may eliminate many or most of the flowers, again making it more likely that the remainder will be eliminated by the bloom flood.

What not to skip in low-cost management

- Irrigation - monitor soil moisture and irrigate only as required, do not over or under water
- Frost protection
- Sanding - at least every 4th year
- Fertilizer - apply sufficient to maintain vines and meet crop expectations in your business plan
- Spring scouting - at least 1-2 times in May-June
- Careful bog inspection early and late in the season
- Cranberry fruitworm - at least one spray timed based on out-of-bloom counts
- Treatment of spring generation outbreaks of cranberry weevil, Sparganothis fruitworm, and blackheaded fireworm
- Fruit rot management
- Phytophthora root rot management - use cultural methods first, improve drainage
- Dodder control with pre-emergence herbicide or by flooding
- Dewberry control

Time the bloom-destruct summer flood to begin when pinheads are observed. By this time, most flowers will have opened or be in the pinhead stage (unopened pods will survive the flood). Hold a deep flood for about 5 days. The exact duration will depend on water depth and temperature. If the water is warm and the flood is shallow, floods as short as 2-3 days have been effective. However, if temperatures are low and the water remains cool, a longer flood is recommended. Some growers held the crop destruct flood for as long as 7-8 days in 2000 with good bloom kill and no impact on the vines except where water puddled after the flood was withdrawn. Temperatures at the Cranberry Station observation station were in the high 70s during late June and early July 2000.

For whatever duration the flood is held, complete coverage of the plants (a good deep flood) is the key to success). In 2000, vine damage was observed on areas where the flood was shallow. If the water is warm and oxygen levels fall below 3 ppm, vine damage will occur.

Irrigation management should remain unchanged as generally it is the vines that use most of the water. Judicious lowering of the water table can encourage increased rooting depth, leading to greater productivity when the bog returns to production. Fertilizer application amounts should be reduced to 1/3 the amount applied to a cropped bog. Apply the fertilizer late in July or early in August to assure strong buds for the following season. Maintain dikes and flumes and keep ditches clear to promote efficient drainage.

Scout in the spring prior to the bloom flood and control outbreaks of leaf-feeding insects, especially fireworms. The crop-destruct flood will likely eliminate any insect larvae that remain on the bed at the time of the flood. If no spring outbreaks occur, you should be able to manage with no insecticide applications on crop-destruct flood beds.

Use only one fungicide application to prevent buildup of fruit rot organisms if the bed has a history of problems with this disease. This will prevent build-up of organisms that may also cause upright dieback disease. Summer flooding may increase the incidence of Phytophthora root rot. If dying patches appear, have samples checked by the Station Plant Pathology Lab. Maintain drainage as much as possible after the flood.

Dodder should be controlled by the flood. Since there are no berries on the vines, this presents an excellent opportunity to make extra efforts in weed control by glyphosate wiping. Since you will not need to observe the 30-day preharvest interval (no fruit will be harvested), you can take advantage of the most effective period for using this herbicide. Glyphosate is most effective against perennial weeds when applied late in the season (the herbicide is transported to the roots of the weeds as they prepare for dormancy). Best translocation of glyphosate occurs when sunny days are followed by a cool nights. In Massachusetts, the most effective period is September-October. If late water was not used and will not be used in the following year, consider a fall flood (see above) to reduce pest populations.

If the crop destruct flood is not completely effective for some reason and significant crop (>20-30 bbl/A) is produced on the bog, the fruit should be removed prior to the following season. Leaving fruit on the bog will provide a source for disease inoculum and may present problems during the harvest of the next season's crop.

Traditional long summer flood. In addition to crop elimination, this flood will also control soil insects and sawbriers (partial control of dewberry). Keep the bog well drained in the early spring. Apply the flood on May 12 and remove the flood on July 20. This flood is very destructive - severe vine injury may occur and next year's crop will likely be reduced as well. If you do not need to control the target pests, this flood is NOT recommended. You should scout carefully for large cutworms after the flood, as they may move in soon after the flood is removed. Do not use fertilizer in the year of the summer flood. Remaining dewberries can be hand removed or wiped with glyphosate.

At the CCCGA winter meeting workshop on low-cost management, Northland Cranberries' use of a 1-month flood (June 1 to July 1) during the 2000 season was discussed. All crop was eliminated and at this duration, some weed species appeared to have been affected. Extensive vine damage also occurred, with all new growth killed. The vines appeared to recover by side shooting within two weeks of flood removal, and buds were visible on the side shoots by the end of the season. However, we do not know the long-term effects of this flood.

Mowing the bog. Mowing will eliminate all crop for the year. The new growth that follows mowing is vegetative and may set bud poorly so next year's crop will also be reduced. A good crop in the third year should be expected. Monitor mowed beds for leaf-feeding insects. Dodder may be controlled with a brief flood in mid-May (see weed management section above). Apply fertilizer after mowing to encourage regrowth as well as in late July - early August to promote bud production.

Activity checklist for crop-destruct bogs

- ✓ Maintain dikes and flumes. Keep ditches clear enough to avoid drainage problems.
- ✓ Irrigate so that the plants are preserved. Use a tensiometer or water level float for scheduling. Take the opportunity to manage the water table so that rooting depth is increased. Production of deeper roots takes energy from other plant processes such as fruit production, but when crop is eliminated, this is not a problem. With deeper roots, the bed should be more productive in later years.
- ✓ Consider frost protection only when the prediction is for more than 5° below tolerance or a severe frost warning is issued for the uplands. Plants will recover from as low as 15° F by side shooting.
- ✓ Scout for and control foliage chewing insects such as cutworms, armyworms and especially fireworms.
- ✓ Dodder should be controlled by flooding.
- ✓ Consider extensive weed wiping if warranted.
- ✓ Control diseases as needed. Use no more than one fungicide application to prevent buildup of fruit rot fungi that may also cause upright dieback. Note that Phytophthora root rot may be a problem in poorly drained areas after a summer flood is used.
- ✓ Use 1/3 the fertilizer rate as that for a producing bog (none if using long summer flood). Apply in late July or early August.

For further information:

B. Lampinen. 2000. **Construction, installation and use of water level floats.** Fact sheet published by Cranberry Experiment Station and UMass Extension. Available at the Cranberry Experiment Station.

B. Lampinen and C. DeMoranville. 2000. **Using tensiometers to schedule irrigation.** Cranberries August 2000: 14-17.

UMass **Cranberry Chart Book**.

Cranberry Station/UMass Extension **Fact Sheets**. Dewberry, dodder, Sparganothis management, Phytophthora.

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