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Flood Management

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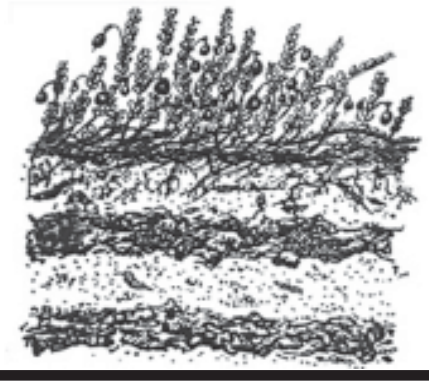

BEST MANAGEMENT PRACTICES GUIDE FOR MASSACHUSETTS CRANBERRY PRODUCTION

Flood Management

Cranberries are native to wetland habitats, requiring plentiful water supplies for their cultivation. During most of the season, well drained soil is required for the development of healthy, functional cranberry root systems. However, evolution in a wetland setting has resulted in the ability of cranberry plants to withstand periodic flooding without harm. In fact, cranberry growers use flooding as a management tool to protect the plants from the cold, drying winds of winter, to harvest fruit and remove fallen leaves, and to control pests. In the past, flooding was also used for frost protection in the spring and fall and for irrigation in the summer, tasks which are now accomplished using sprinkler irrigation. Flooding is so important in cranberry cultivation that bogs that cannot be flooded are no longer considered profitable.

Because of the periodic need for sizable amounts of water, impoundment of water adjacent to the bogs is a normal farming practice in cranberry production. Many cranberry growers have constructed reservoirs adjacent to their bogs to store the water needed for seasonal flooding and irrigation needs. As a general rule, each acre of cranberries will require up to 10 acre feet of water storage capacity to meet all production, harvesting, and flooding needs. The actual figure will vary depending on the rate of recharge of the water supply and water conservation measures possible in the bog system.

Recommended Practices

General flood management:

- **When establishing a flood and releasing flood waters, use caution to avoid causing erosion or discharging sediment.**

  Avoid bank undermining when applying or discharging flood waters. This can occur if flow is rapid and the flume is at a right angle to the banking or ditch edge.

  To avoid discharge of sediment, impound the flood after any activity that causes suspension of sediment in the water. Examples include barge sanding, harvest, and trash floods.

  It is best to release all floods slowly over the top flume boards. This limits sediment suspension and discharge and scouring of the outlet channel.

- **Special care should be taken when flooding mineral soil bogs.**

  In order to protect ground water and retain nutrients in the root zone, avoid deep floods on mineral soil beds. A large 'head' of water can force nutrients out of the upper soil layers, making them unavailable to the plants.

- **Fertilizers and pesticides should not be applied just prior to flooding.**

  Materials applied prior to flooding can be dissolved into the flood water or forced through the upper soil layers by the flood. In either case, efficacy is reduced and water quality may be compromised.

  There is no experimental evidence that herbicide applied prior to a late water flood is more effective in controlling weeds than the flood alone.

  If fall fertilizer (post-harvest) is to be used, apply after the plants have achieved dormant color but as far ahead of the winter flood as possible. Do not use fall fertilizer if holding a post-harvest flood (fall flood) or on mineral soil beds.

Winter flood:

- **Flooding should be used to protect the cranberry bog from winter injury.**

  Cranberry vines may be injured or killed by severe winter weather. The injury is classified as a 'physiological drought' where moisture lost from the vines due to wind and evaporation cannot be replaced due to freezing in the root zone. Such injury can occur within three days if the root zone is frozen to a depth of four inches, the air temperature is below freezing, and strong drying winds occur. Injury is prevented by protecting the vines with a winter flood that should be in place when winterkill conditions exist. To be effective, the flood should cover the plants entirely (no vine tips sticking out).

  The recommended practice is to maintain a winter flood for the minimum time required to protect vines from winterkill injury. Short winter floods are associated with improved yield. The exposure of the vines in winter and early spring slows the development of terminal buds, improving their frost hardiness in the spring.

- **Proper winter flood management is necessary to prevent oxygen deficiency injury.**

  A lack of dissolved oxygen in the winter flood water will cause injury to the plants, which in turn reduces the yield potential. **Oxygen deficiency injury** may occur when oxygen levels in the winter flood water drop below 4 mg/l (40% of full oxygenation - 10 mg/l). If the flood remains unfrozen (open water) or light penetrates the ice covering the flood, oxygen levels in the flood should remain adequate. However, if the ice is cloudy or covered by snow or sand, oxygen levels will begin to fall as the plants use the oxygen supply. Under such conditions, growers should monitor oxygen levels and remove water from beneath the ice when oxygen levels are 5 mg/l or less. Be aware that sample collection in areas with significant algal growth can give falsely high readings. Failure to prevent oxygen deficiency can result in leaf drop, inability of blossoms to set fruit, and crop reduction.

  Avoid oxygen deficiency injury by removing the water from beneath the ice. It is critical that the water level be drawn down well in the ditches so that no shallow puddles are trapped beneath the ice. Vines trapped in such shallow pools of water deplete oxygen rapidly leading to severe injury in those areas.

  While the ice rests on the vines, daytime melting followed by night-time freezing usually incorporates some of the vines in the lower surface of the ice. If it becomes necessary to reflood the bog to protect areas where the ice cover has melted away, the remaining ice will float and trapped vines may be uprooted. Gradual flooding will usually melt enough of the existing ice so that the vines are released unharmed.

- **The winter flood should be reapplied to prevent exposure to temperature extremes.**

  If the water has been removed from beneath the ice to prevent oxygen deficiency, the remaining ice may melt during a mid-winter thaw, leaving the vines exposed. Bogs may be left exposed as long as winterkill conditions are not present. However, if winterkill conditions occur, the bog should be reflooded.

  Long exposures to abnormally warm temperatures (>55^{o}F) may lead to loss of chilling. The result could be a reduction in hardiness - greater susceptibility to spring frost. Depending on the conditions prior to the winter flood, loss of chilling during a mid-winter thaw could also lead to reduction in bud break and flowering the following season. This is especially true if the previous fall was warmer than usual, leading to lack of chilling accumulation. To guard against these possibilities, the bogs should be reflooded if a long warm spell is forecast during mid-winter. The water will cool at night and re-warm slowly during the day, buffering against the warm daytime temperatures.

Late water flood:

- **A one month spring flood (late water) can be used to control certain insects and disease organisms.**

  A month or more after the removal of the winter flood, a spring flood (late water) may be re-applied to the bog for the control of Southern red mite, cranberry fruitworm, spring caterpillars and fruit rot organisms. The late water flood should be applied on or about April 15th and kept on the bog for 30 days. The flood depth should be maintained so that all vines are well covered by water. Shallow floods and/or flood temperatures consistently greater than 65ºF should be avoided to prevent injury and crop reduction. Flood water temperatures will generally be cooler if the flood is deep (> 12 inches above the vines).

- **Late water is only recommended under certain conditions.**

  To minimize crop reduction, late water should not be used more often than once every three years.

  It should be noted that on occasion, crops on late water bogs are poor. A likely cause is depletion of carbohydrate reserves during the late water flood. Any factor that leads to low carbohydrate reserves prior to the late water flood may affect subsequent yield. Possible negative factors include lower than average sunlight the previous summer and fall, heavy crop the previous season, and oxygen deficiency conditions during the winter flood.

  Bogs with poor quality water supplies may not be good candidates for late water.

- **Late water floods should be terminated early under adverse conditions.**

  If air temperatures become unseasonably warm, and flood water temperature becomes too high, the late water flood may need to be removed before 30 days have passed.

  Growers should scout the flood water for the presence of algae. If algae are found, early withdrawal of the flood may be necessary.

- **Weed management strategies should be modified when using a late water flood.**

  DO NOT apply herbicides prior to the flood.

  The germination and growth of certain weeds may be retarded with the use of a late water flood. After withdrawal, scout for problem weeds. If necessary, treat with post-emergence herbicides.

  Late water does NOT control dodder.

- **Modify bog management following a late water flood.**

  After removal of a late water flood, cranberry buds are sensitive to frost injury. Frost tolerance after late water is 29.5ºF. This is the case even if you must remove the late water early (after 2 weeks). Research has shown that shorter spring floods (1 week duration) have no effect on frost tolerance.

  Following a late water flood, pesticide and fertilizer needs should be reduced for that season.

  Late water controls Southern red mite - no miticide should be needed for up to two seasons.

  Late water also controls cutworms and cranberry fruitworm. However, because these pests can migrate back onto a late water bog, careful monitoring is required after the flood. Cranberry fruitworm may be managed with one timed insecticide spray followed by egg monitoring or by egg monitoring alone.

  Late water decreases the incidence of fruit rot disease. Fungicide treatments (number of applications and/or amount of active ingredient applied) for fruit rot on late water bogs should be reduced and may be eliminated if the bog has a history of low disease pressure and fruit are being harvested for the processed market. Number and rates of sprays may also be reduced in the following year.

  Late water bogs respond readily to fertilizer, so nitrogen dose should be reduced to avoid overgrowth. A 20-30% reduction of nitrogen is possible by eliminating the spring application and/or reducing the fruit set dose. However, severely cutting back on fertilizer may compromise bud development for the following crop.

Harvest flood:

- **Harvest floods should be managed so that water use is minimized.**

  The most common method used to harvest cranberry fruit involves flooding the cranberry bog with a shallow layer of water followed by a deepening of the flood to facilitate removal of the fruit from the bog. In order to conserve water, harvest should be managed so that water is re-used to harvest as many sections of bog as possible before the water is released from the system.

- **Manage harvest water to minimize release of sediments.**

  During harvest, sediments are suspended into the flood water. Discharge of sediment into wetlands and waterways is not permitted. Sediments should be allowed to settle and flood water should be discharged over the top flume boards gradually to avoid sediment discharge to surface water.

  A novel practice of holding the harvest flood for up to 4 weeks is under investigation by scientists at the Cranberry Station and a team of growers. This practice may have additional benefits in pest and weed control. Refer to the Harvest and Post-harvest Management BMP.

- **Avoid moving pests from bog to bog.**

  Plan harvest water flow from bog to bog so that, whenever possible, water is **not** moved from disease or weed infested bogs into clean bogs.

Other flood practices:

- **Spring and summer floods of various durations may be used to control certain insect pests.**

  Flooding can be used to control insects without the use of pesticides under certain conditions. When using such floods, depth of flood and duration of flood are key. Failure to manage these floods properly may result in lack of control or damage to the plants and crop. Summer floods for grub control result in crop loss for that season and may kill vines. For more information on management of these floods, see the Insect Management BMP and the Cranberry Chart Book.

- **Fall floods may be used for insect and weed control.**

  Fall flooding in late September is a recommended option for the control of cranberry girdler. Cranberry girdler can be controlled with a fall flood beginning between September 25 and October 1 and lasting one week. The flood should completely cover the cranberry plants and is considered 'reasonably safe' even if fruit remained on the vines.

  Ongoing research (suggested by grower practices) has shown that holding the harvest flood for up to 4 weeks post-harvest suppresses dewberry populations. Emergence of cranberry fruitworm the following spring was also suppressed. No reduction of crop has been reported after several years of experimentation with post-harvest floods.

- **Flooding may be used for removing leaf trash and disease organisms from the bog.**

  Water supplies permitting, cranberry bogs may be flooded after harvest for the removal of 'trash'. Dead cranberry leaves and twigs and bruised berries float to the surface and are wind-driven to the bog edge where they can be skimmed from the flood for disposal. By removing fallen cranberry leaves, the grower may not need to sand as frequently. These leaves are a source of disease inoculum and a habitat for insect pests and as such are best removed from the bog.

- **Flooding may be used for frost protection under certain circumstances.**

  While sprinkler irrigation is the method of choice for frost protection, flooding may also be used for this purpose. In the early spring, flooding may be the superior method when temperatures are very low and below the bud tolerance and wind is present. Under such circumstances, sprinkler heads will freeze, offering little protection to the buds. A flood may also be necessary if there is a failure in the sprinkler pump. Flooding for frost protection in the fall is most unusual. However, a flood may

be applied to a bog a day or so ahead of harvest to protect it from frost once the sprinkler heads have been removed in preparation for harvest. Probably the most important consideration in flood frost protection is the fact that water must be present on the soil surface under the cranberry vines before the occurrence of critically low temperatures. This requires sure knowledge of the length of time required to put the protecting flood in place in advance of the coming frost. It is practically useless to apply the frost flood after the arrival of critically low temperatures.

For further information:

Cranberry chart book - management guide for Massachusetts. University of Massachusetts Cranberry Experiment Station. Sections on late water and winter management.

DeMoranville, C. J. "Flood management". in Sandler, H. A., ed. **Cranberry Production: A Guide for Massachusetts**. UMass Extension Publication SP-127. December 1997. Second printing February 1998. pp.35-39.

Water Resource Protection and Enhancement and **Harvest and Post-harvest Management** BMPs in this series.

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