Irrigation Management

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. In periods of low rainfall and high demand, cranberries must be supplied with additional water through irrigation. During periods of high rainfall, adequate drainage must be supplied to avoid damaging anaerobic conditions in the root zone. In general, cranberries are irrigated by manipulation of the water table or through the use of low-gallonage sprinkler systems or some combination of the two.

Glossary:
Sub-irrigation - Manipulation of the water table by controlling depth of water in the ditches in order to supply water needs in the root zone. Water level is maintained so that the soil is moist but not saturated at the bed surface. Sub-irrigation supplements overhead irrigation and depends on the process of capillary rise.

Capillary rise - The physical process by which water will rise from the water table through the soil towards the surface. The process is driven by the moisture gradient in the soil (wettest at the water table, driest at the surface). The smaller the soil pores, the higher the water can rise by this process. Fine textured and organic soils have smaller pores than coarse sands. Therefore, water can rise to the surface from a deeper water table in fine textured soils.

Tensiometer - A device that measures soil tension, an indirect measurement of the amount of moisture in the soil. Readings are shown in cbars. Tensiometers are used to schedule irrigation.

cbars - Centibars, a unit of measurement for soil tension. One cbar is equal to 10 mbars. This is often expressed as a negative number.

Water level float - A device placed in a cranberry bed to monitor the depth to the water table. It is used for sub-irrigation monitoring and irrigation scheduling.

Water table - The depth beneath the soil surface where the soil is saturated with water.

Recommended Practices

Monitor soil moisture and depth to water table for irrigation scheduling.

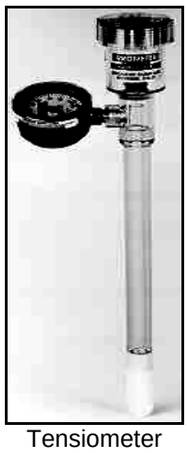
Maintain the water level in the ditches at a level that is adequate to supply water to the root zone while still allowing adequate drainage from the center of the bed (generally about 14-16 inches below the bed surface, although this will vary based on bed width, soil texture and grade).

Monitor water level in the center of the bed using:

Water level float - A simple way to monitor the water level in the center of the bed is with a water level float. The water level float consists of a fiberglass rod attached to a float that rides on the water table in a fabric wrapped pipe. The rod may be painted to indicate various depths to the water table. If the bed is substantially out of grade, you may want to place a tensiometer at the high point and a water level float at the low point of the bed. By comparing the water level in the center of the bed as indicated by the water level float to the water level in the

ditches, you can assess whether water is moving across the bed at a fast enough rate to meet the water demands of the vines. If the water level in the center of the bed is adequate while the ditch level has dropped too low, you can pump up the ditches without running the overhead irrigation system (presuming your irrigation system is set up to allow this). If the water level in the center of the bed is too low, you can run the overhead irrigation system. By observing the water level float through several irrigation cycles, you can determine the length of time required for an adequate irrigation. For more information, see the “Construction, Installation, and Use of Water Level Floats” Fact Sheet available at the UMass Cranberry Station.

Tensiometer - A tensiometer in the center of the bed can serve the same purpose as the water level float. An advantage of the tensiometer is that it can measure the midday drop in moisture in the root zone that occurs when the water table is near the limit of capillary rise and cannot keep up with plant water demands. The disadvantages of a tensiometer include the fact that they are sensitive to freezing damage and require you to walk out on the bed to take a reading.



Tensiometer

Tensiometer readings are normally expressed as centibars (cbars) of tension. A tensiometer reading of 0-2 cbars in the root zone indicates that the water table is too high and that damaging, anaerobic conditions may be occurring. With a water table present, the reading on the tensiometer should be in the 2 to 5 cbar range as long as the water table is between 8 and 18 inches below the surface. As the water table drops below about 18 inches, the soil can dry substantially at midday as the ability of capillary rise to move water up into the root zone lags behind the plant water demands. Because of this midday drop in tension, it is best to read your tensiometers at midday as well as (or instead of) in the morning. A midday tensiometer reading above 10 cbars in the root zone indicates that the water level is too low to supply water by capillary rise and irrigation should be initiated the following morning. A substantial difference (greater than 3-5 cbars) between morning and midday tensiometer readings is a good indication that capillary rise is not able to keep up with plant water needs at midday.

It may be helpful to put a tensiometer next to a water level float to calibrate the relation between water table level and soil moisture tension in the root zone for your individual soil conditions. Be aware that above 10 cbars, the response time of tensiometers in cranberry soils is slow and that under high evaporative demand conditions, the tensiometer may respond too slowly in this range to be relied upon.

Monitor soil moisture in the appropriate area of the bed.

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.

A water table depth more than about 18 inches below the surface or a midday tensiometer reading higher than 10 cbars indicates that irrigation is needed. Since morning irrigation is recommended (see below), it is important to do regular tensiometer readings in order to avoid the situation where finding a too-dry midday reading requires immediate irrigation.

When monitoring tensiometers on a daily basis, if a morning reading rises above about 5 cbars, you can initiate an irrigation immediately. As an alternative, you can read the tensiometers at midday and irrigate the following morning when the midday reading is above about 10 cbars. Ideally, if you monitor the tensiometers in the morning and again at midday, you can initiate irrigation (the following morning) when the morning and midday tensions begin to deviate by more than about 3-5 cbars.

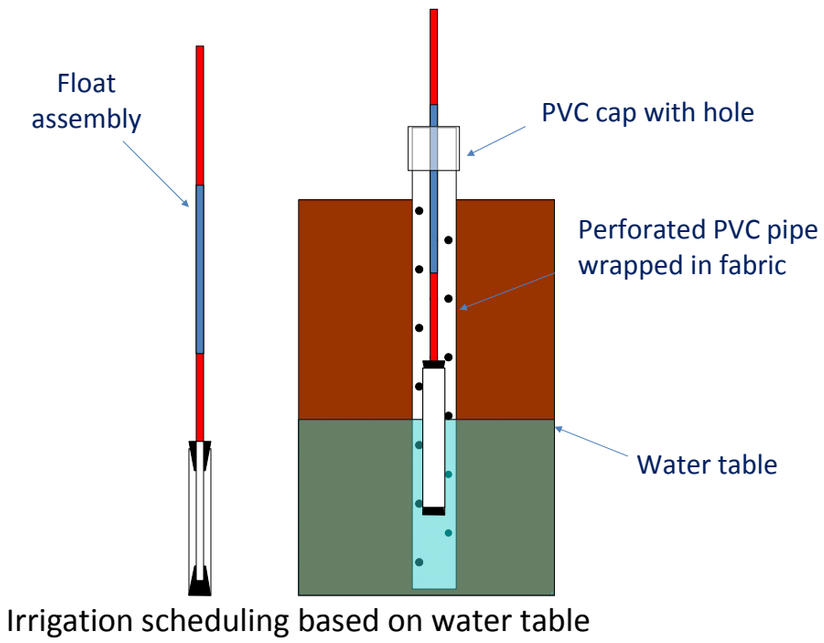


Illustration of a water float device to monitor water table level.

When using sprinkler irrigation, time applications for maximum efficiency.

When irrigation is required, the sprinkler system should be run early in the morning rather than in the evening. Vines can get watered with minimal evaporation, and the surface of the vines (and fruit) can dry out in the sun's heat. When the sprinkler system is run in the evening, the vines remain wet for an extended period, thus creating favorable conditions for infection by fruit rot fungi.

Use sub-irrigation to maintain an even water supply to the roots.

Sub-irrigation is accomplished by maintaining a water table beneath the surface of the bed

throughout the growing season. Maintaining water in the ditches at a level about 18" below the bed surface is an essential component of this method.

Capillary rise from the water table can meet a substantial portion of cranberry water needs under many conditions. In a typical cranberry bed in Massachusetts, sufficient water can move up to the roots from the water table if the depth is no greater than about 18 inches below the soil surface. However, with water tables lower than 18" below the surface or under high evaporative demand conditions (hot and dry), capillary rise may not be adequate to meet plant demands.

It is essential that you know the characteristics of your individual bed before attempting to irrigate primarily by capillary rise. The height of capillary rise will vary from bed to bed with finer textured soils (fine sand, silts, clays) as well as those with higher organic matter contents tending to have higher capillary rise. Conversely, capillary rise will be less in coarse sand beds.

Since soil conditions and contours of beds vary, you must be certain that water is moving at an adequate rate up from the water table into the root zone as well as horizontally across the bed to meet the water demands of the vines at the center of the bed.

Combine sub and sprinkler irrigation to maximize efficiency.

Water use efficiency can often be maximized by combining sub and sprinkler irrigation. This can best be accomplished by monitoring soil moisture using tensiometers and/ or floats at both the center of the bed and near the edge of the bed (about 5-10 feet from the ditch).

Using this method, sprinkler irrigation is initiated if the soil moisture in the center of the bed reaches critical levels (see previous float and tensiometer sections for details). If the center of the bed has adequate water but the ditch water level drops too low (more than 18" below the bed surface) or the soil moisture near the ditch is too low, the ditch water level can be pumped up. At a research site, the balancing of pumping up the ditch level with sprinkler irrigation allowed the average sprinkler irrigation interval to be extended to every 5-6 days during the 1999 season.

Use caution when scheduling irrigation for mineral soil and dry beds.

For beds where a water table is not maintained below the surface, proper irrigation scheduling is even more critical. Tensiometers placed so that the ceramic cup is in the root zone can be a useful tool. It is essential to locate a tensiometer in the driest part of the bed to avoid water stress related damage in these areas.

Under high evaporative demand conditions, water stress related damage has been observed on mineral cranberry beds in Massachusetts when the midday tension reading in the root zone was less than 10 cbars the day before the damage occurred. Therefore, when a water table is not maintained below the surface, you should monitor midday soil moisture tension and schedule an irrigation (for the following morning) when the midday tension reaches about 8 cbars in the root zone.

When high evaporative demand conditions are predicted (hot, windy weather), you should schedule an irrigation (for the following morning) when the midday tension reaches about 6 cbars in the root zone.

Modify management in extreme conditions.

During periods when temperatures are predicted to be excessive, it is important to have the vines fully watered before the hot conditions arrive.

Based on research done in New Jersey, conditions that require you to pay particular attention to proper irrigation are (1) air (off bog) temperatures of 80°F or more (2) dewpoints of 55°F or less during midday and afternoon hours, (3) clear or scattered sky conditions during the day, (4) wind speeds average greater than 11 mph, and (5) no rainfall has occurred during the last 48 hours.

When the above conditions are present, particularly in newly-planted beds and on mineral soil beds, you should monitor soil moisture in early morning and again in late morning to assure that there is still adequate moisture in the root zone. If moisture is inadequate, sprinklers should be run for 1-2 hours in the late morning or early afternoon to replenish the soil water as well as to cool the vines and berries to prevent injury. However, it should be emphasized that irrigation in the early morning is preferred when possible.

Maintain good drainage and water table management.

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 effect root growth and function as well as disease incidence. Suboptimal soil moisture leads to poor uptake of fertilizer nutrients. By providing adequate drainage early in the season, you should be able to improve rooting depth and productivity. As is the case with fertilizer, what you do this season has a large impact on next season's performance. Excessively wet soils increase the likelihood of *Phytophthora* infection while excessively dry soils can promote fairy ring disease.

As described above, a water level float or tensiometer will give you an indication of periods when the water level is too high in the center of the bed. Any time the water level is closer than 8" from the surface, an attempt should be made to lower ditch water level to improve drainage. With the tensiometer, a reading of 0-2 cbars indicates that drainage needs to be improved.

It is important to remember that the level of the water table beneath the surface of the bed is not necessarily flat. After sprinkler irrigation or a rainfall event the water level is higher in the center of the bed. It can take 1-5 days for water to drain from the center of the bed to the ditches depending on soil characteristics and the ditch water level. If you are sprinkler irrigating every 3 days or less, you may always have a higher water table in the middle of the bed than near the ditches.

After a period of sub-irrigation the plants draw down the water table in the center of the bed by using water at a higher rate than it can be replenished by moving across laterally from the ditches to the center of the bed. This situation indicates that sprinkler irrigation is needed to replenish the water in the center of the bed.

Conserve water. Manage irrigation so that the objective is achieved with the minimum water necessary.

Cranberry bog low-gallonage sprinkler systems supply water at the rate of about one-tenth inch per hour; therefore under ideal conditions, five hours of irrigation will apply one-half inch of water. Measure the irrigation rate of each system with catch cans to determine the actual rate for that system.

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 (see above).

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.

If you plan to use your sprinkler system for chemigation, make sure that application will be uniform and safe and that first-to-last head travel times are minimized.

See the Chemigation BMP for more information on safety, calibration, and techniques for chemigation.

For more information:

Council for Agricultural Science and Technology. 1988. **Effective use of water in irrigated agriculture.** Report No. 113.

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Prepared by Bruce Lampinen, Carolyn DeMoranville, and Hilary Sandler, 2000.

Irrigation Management Checklist

✓ Monitor soil moisture and depth to water table for irrigation scheduling.

✓ Combine subirrigation and sprinkler irrigation to maximize efficiency.

✓ Modify water use management during periods of high plant stress.

✓ Maintain good ditch drainage and water table management.

✓ Apply irrigation based on soil water status and plant needs.