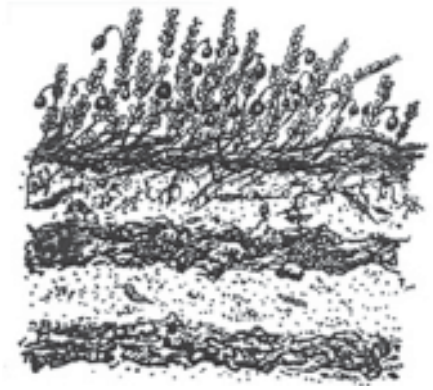
1996

Nutrient Management

Carolyn DeMoranville
Cranberry Station, carolynd@umext.umass.edu

Hilary A. Sandler
Cranberry Station, hsandler@umass.edu

Tom Bicki



BEST MANAGEMENT PRACTICES GUIDE FOR MASSACHUSETTS CRANBERRY PRODUCTION

Nutrient Management

Nutrient elements are required by cranberry plants for the production of vegetation (new leaves and stems), roots, and fruit (crop). Cranberry plants get these nutrients from the soil, from water, or from fertilizers added to the bog. While cranberries require the same nutrients as other plants, they are unique in that the *amounts* required are much smaller than for most crop plants. The reason for this is that cranberries have adapted through evolution for growth on acid, sandy soils. These soils have little nutrient content, and the plants in the family Ericaceae such as cranberries and blueberries that evolved on them have correspondingly low nutrient needs. Further, cranberries are perennial plants with the capacity to store and reuse nutrients in old leaves, wood, and roots. A unique and important feature of cranberries is that they maintain their leaves over the winter. These leaves also serve as a nutrient source when the plants resume growth in the spring.

Commercially, cranberries are grown in either organic soils modified by surface application of sand, or in mineral soils. The rooting zone typically contains about 95% sand. Average organic matter in the surface horizon of Massachusetts cranberry soils is less than 3.5% and silt and clay make up less than 3% of the soil. Therefore, cranberry soil has low cation exchange capacity - little ability to hold positively charged nutrients such as ammonium, potassium, magnesium, and calcium. However, downward leaching of nutrients is minimized by the layered structure of cranberry bog soil. Layers of sand are added to the bogs every 2-5 years leading to alternating sandy and organic layers. The organic layers are comprised of decaying roots and leaves. Nutrient leaching is also minimized in peat based soils by the high organic matter content of the subsoil.

Why cranberries need fertilizer: Each season nutrients are removed from the bog during harvest and detrashing (removal of fallen leaves from the bog floor). When the fruit is harvested, the elements removed in the largest quantities are nitrogen, potassium, and calcium, at >20 lb/A (nitrogen) or >15 lb/A (potassium and calcium) in an average (150 bbl/A) crop. The amount of nutrient removal increases with increasing crop load and is less when crops are small. It is to compensate for nutrient removal that cranberry growers add fertilizer to their bogs. Most fertilizer added to producing cranberry bogs contains nitrogen, phosphorus, and potassium (N-P-K fertilizer). Phosphorus is included in the mixture to maintain nutrient balance and because much of the phosphorus in cranberry bog soil is not available to the plants at crucial growth stages.

Fertilizer is applied to cranberry bogs using ground rigs (spreaders and seeders), helicopters (aerial application), and the sprinkler system (fertigation).

Recommended Practices

- **Base fertilizer dose on the properties of your bog.**

  Nitrogen is the controlling element in cranberry nutrition. The average recommended seasonal dose of N varies from 10 to 60 lb/A depending on plant vigor and variety. High vigor bogs and bogs with a deep organic base require the least N; bogs with low vigor require more N; and bogs planted to robust hybrid cultivars such as Stevens have the highest N requirements. Decisions regarding N dose for your bog should be based in part on length and density of uprights. Other factors to be considered include bog history (previous crops and response to fertilizer), results of soil and tissue tests,

and weather conditions. It is strongly recommended that growers keep good records of previous crops and response to fertilizer along with the results of soil and tissue tests. Application of excess N can lead to adverse effects on crop. In addition, the ability of the plants to recover excess N is limited and unrecovered N could leach into water.

- **Avoid excessive use of nitrogen.**

  N requirements differ for different varieties. Generally Stevens require more N than Howes or Early Black. Excess N leads to over-vegetative plants with long uprights, many runners, and few fruit. Excess vegetative growth may increase susceptibility to disease, spring frost, or insect feeding. High N doses may also lead to poor fruit quality and delay color development in the fruit. High N doses can have adverse carry-over effects in following years as stored excess N is remobilized.

- **Keep detailed records of fertilizer use and response.**

  This is the single most important practice you can do when it comes to managing cranberry bog nutrition. Every bog responds differently depending on soil factors, organic matter content, depth of underlying peat, location (spring temperatures), and previous cultural practices. Learn how your bog will respond to fertilizer and plan accordingly. Collect soil and tissue tests as recommended in the Cranberry Chart Book and use the results as one factor in your fertilizer decision-making process.

- **Observe your bog often. Do not be afraid to modify your fertilizer plan as conditions warrant.**

  Make a plan for the season in the early spring based on your records and expectations. Then monitor response as the season progresses. Dose may need to be adjusted depending on spring temperatures, stress from diseases or insects, or plant response (or lack thereof). However, remember that all fertilizers are not fast-acting and cold weather can slow response. Do not add more until you are SURE that it is warranted.

- **Avoid large fertilizer doses applied at one time.**

  The root zone of cranberry soils is quite sandy and has little capacity to hold added nutrients. Fertilizer doses in excess of the amount that can be taken into the plants within a reasonable period of time will result in some of the nutrients moving out of the plant root zone. These nutrients are potential sources of off-site contamination.

- **Apply fertilizers to respond to crop demand.**

  The timing of nitrogen and phosphorus applications is an important factor affecting the potential for nutrient loss to the environment. The greater the time between application and plant uptake, the greater the chance for loss to ground or surface water. It is best to time fertilizer applications based on the stage of plant growth. Applications should be delayed when spring temperatures are cold. Cranberry plants respond to nutritional support during initial leaf expansion in the spring, during bloom, during fruit set, and during bud development for the following season. Fall application of N should be minimized.

- **Do not starve the plants before bloom then apply a heavy fertilizer dose.**

  Aside from water, the most important constituents of the fruit are carbohydrates (acids and sugars) which the plants make in the green leaves and transfer to the fruit. Plants that are starved for mineral nutrients in the spring will not make enough new green leaf surface to produce the carbohydrates necessary to support a large crop. Adding large amounts of fertilizer to stunted plants will not set a large crop of fruit. By that time, fertilizer is no longer the limiting factor *if* nutrition was inadequate earlier.

- **Good drainage and adequate irrigation are essential for best response to fertilizer.**

  Roots in waterlogged areas will not receive adequate oxygen for proper functioning in nutrient uptake. Proper soil drainage improves fertilizer efficiency so that less fertilizer is required. Check soil

moisture twice a week; soil should be moist to within 2" of the surface. One inch of water per week from rainfall or irrigation is sufficient to maintain plants and crop. Remember, most of the weight of the fruit is water. Heavy doses of fertilizer will not set and size fruit where soil moisture is the limiting factor. Plant growth and crop production will also be poor if drainage is inadequate. High tissue test manganese levels may indicate poor drainage.

- **After sanding or a late water flood, reduce the nitrogen dose to be applied.**

  Spring fertilizer dose may be eliminated on late water bogs (apply first fertilizer at bloom). Overall dose reduction should be 20-30%. Sanded bogs are warmer due to the sunlight being absorbed by the light-colored sand. Warm soils release more native N so less should be added as fertilizer.

- **Avoid unnecessary use of minor elements.**

  Minor elements are very available in acid soils. For this reason, cranberries seldom suffer minor element deficiencies, nor do they require minor element fertilizers in general. One exception is the use of minor element supplements in fertilizer blends during the first season of a newly planted mineral soil bog. Another exception is the use of calcium-boron supplements at bloom. For bogs with poor yield histories, such calcium-boron supplements may increase fruit set.

- **Take steps to minimize direct input of fertilizers into surface water.**

  Preventing direct application of fertilizers to streams and ditch water is the single most important step in reducing the potential for off-site movement of nutrients. Use of part-circle sprinklers or sprinkler guards can be effective in minimizing direct application to water. Persons applying fertilizers with ground rigs should be cautious about keeping fertilizer out of ditch water. It is difficult to control non-target application of aerially applied fertilizer, so consider other methods in environmentally sensitive areas. Avoid heavy irrigation immediately following fertilizer applications to minimize surface runoff.

- **Reduce the level of water in ditches as much as possible prior to application of fertilizer.**

  Lowering the water level in ditches before a fertilizer application will allow for adsorption of nutrients onto sediment and vegetation in the ditches and increases the water holding time in the system. Research has shown the cranberry bogs have a great capacity to filter nutrients from water. Slowing the water movement through the system maximizes this process.

- **Exercise particular caution in applying fertilizer to bogs constructed on mineral soils.**

  Bogs constructed on mineral soils without a permeability restricting or confining layer have a greater potential for leaching. Use organic or slow-release nitrogen and avoid large doses of fertilizer applied all at once. Mineral soils contain less of the essential nutrients so fertilizer requirements may be larger than those of organic bogs. This requirement may be best satisfied by frequent small applications of fertilizer or slow-acting, low-leaching materials. Mineral soil bogs may also require minor element supplementation during the first season.

- **Use of fall fertilizer should be conservative.**

  Fertilizer applied in the fall has the greatest potential for leaching loss, especially on mineral soil bogs. Fall fertilizer may be moved below the root zone by the weight of the winter flood. However, fall fertilizer applications may provide cultural benefits on bogs showing symptoms of stress or where crops have been especially heavy. If fall fertilizer is used, the nitrogen dose should be low (5 lb/A or less) to avoid loss of winter hardiness. Fish fertilizer, applied pre-harvest, can serve as fall fertilizer. If fall fertilizer is applied too soon after an early harvest, cold tolerance may be reduced. For late harvest, fertilizer should be applied soon after the harvest flood is removed to maximize the time between fertilizer application and the winter flood and minimize nutrient leaching.

- **Apply nitrogen in the ammonium-N form (NH_4).**

  Field and greenhouse experiments have demonstrated that cranberries show a preference for ammonium nitrogen rather than nitrate nitrogen. Cranberries can use nitrate if ammonium was also present but do poorly if fed nitrate alone. Do not use fertilizers in which all of the nitrogen comes from nitrate. Fertilizers containing all N in the ammonium form (ammoniated or blends with N from ammonium sulfate or ammonium phosphate or urea) should remain your first choice. Fertilizers containing both ammonium and nitrate may be used - both N types will be taken up by the plants. However, we continue to recommend keeping nitrate content to a minimum. By choosing ammonium forms, the potential for leaching nitrate to the surrounding environment is minimized.

- **Wait for soil temperature to rise to 55^{o} F before applying spring fertilizers.**

  Cranberry plants have little ability to take up nutrients when the soil is cold. Fertilizers applied too early in the spring may wash out of the root zone before the soil warms enough for uptake into the plants.

- **Use foliar fertilizers as supplements only. Apply at the proper time of the season.**

  Cranberry plants have some ability to take up nutrient elements through their leaves. However, effective uptake will only occur during the period beginning at hook stage and ending at the approach of dormancy in the fall. Foliar feeds are a "quick fix" for urgent nutritional needs but do not replace a sound, soil-applied nutrition program.

- **Calibrate fertilizer application equipment.**

  Proper calibration of application equipment including the irrigation system, ground rigs, and aircraft will ensure that the desired dose of fertilizer is applied.

For further information:

Bizzozero, R. 1995. **Guide to pollution prevention and nutrient management in cranberry cultivation.** Masters thesis, University of Massachusetts, Amherst.

Caruso, F. L. and Ramsdell, D. C. 1995. **Compendium of blueberry and cranberry diseases.** American Phytopathological Society Press, St. Paul, MN. 84 pp. (for a guide to nutrient deficiency symptoms)

Cranberry chart book - management guide for Massachusetts. University of Massachusetts Cranberry Experiment Station.

Davenport, J. R. 1993. **Nitrogen: its role and function in cranberry plants.** Cranberries Magazine 57(8): 14-15.

Davenport, J. R., C. DeMoranville, and P. C. Fletcher. 1994. **Fertilizer mobility in cranberry soils.** Cranberries Magazine 58(1):11-13, 15-19.

Davenport, J., C. DeMoranville, J. Hart, K. Patten, L. Peterson, T. Planer, A. Poole, and J. Smith. 1995. **Cranberry tissue testing for producing beds in North America.** Fact Sheet. Available from Cranberry Experiment Station.

DeMoranville, C. J. 1992. **Fish fertilizer: lessons for low input production.** Cranberries Magazine 56(3):12-13.

DeMoranville, C. J. and J. R. Davenport. 1994. **Field evaluation of potassium supplements in cranberry production.** J. Small Fruit Viticulture 2(3): 81-87.

Prepared by Carolyn DeMoranville (Project Leader), Hilary Sandler, and Tom Bicki. Production of this Management Guide was supported by Massachusetts Department of Food and Agriculture as part of the Agro-Environmental Technology Grants Program. Matching funds were provided by University of Massachusetts Extension (USDA Cooperating), Cape Cod Cranberry Growers Association, and Ocean Spray Cranberries, Inc. UMass Extension offers equal opportunity in programs and employment. Artwork by Meredith Albright, freelance scientific illustrator, Bellingham, MA. 1996