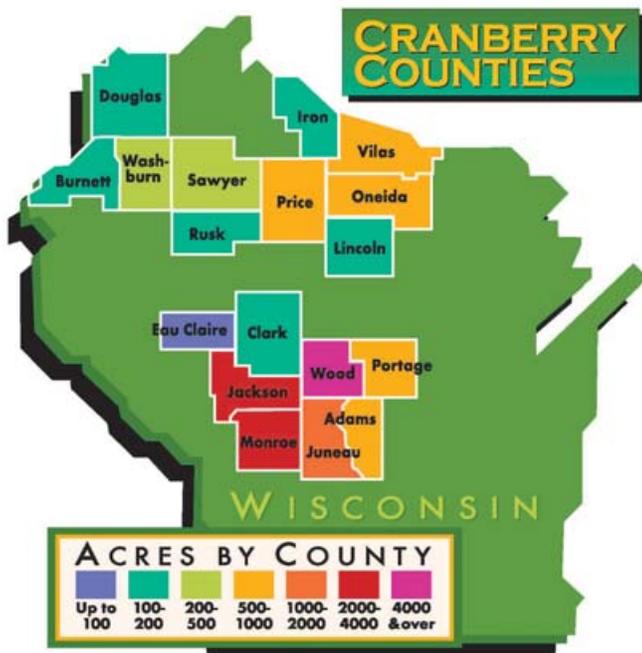


# CRANBERRY PRODUCTION IN WISCONSIN

Cranberries are native to northeastern North America, including Wisconsin. They are Wisconsin's leading fruit crop both in terms of acreage and value. Cranberries are currently (2007) produced on about 18,000 acres in 19 of Wisconsin's 72 counties. The counties with the greatest acreage devoted to cranberry production are Wood, Monroe, and Jackson counties. The initial value at the farm is about \$125 million (2005).

Commercial cranberry cultivation in Wisconsin began near Berlin in about 1860. Early marshes were developed by simply digging ditches around stands of native vines and encouraging their growth. These cranberry pioneers faced hazards of frost, insects, weeds, diseases and fires—most of which are now manageable. During the early 1890's, the center of the Wisconsin cranberry industry shifted to the Cranmoor area, just west of Wisconsin Rapids. Later developments occurred in the Black River Falls, Warrens, and Tomah areas. These were followed by cranberry farms in northern Wisconsin, primarily around Manitowish Waters, Eagle River, Spooner, and Hayward.



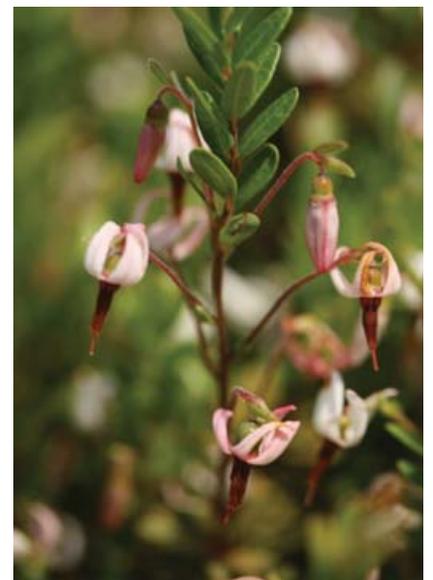
## The Cranberry Vine

The cranberry of commerce [*Vaccinium macrocarpon* Ait] is a low-growing, trailing, woody evergreen vine. Fruit are borne on short vertical shoots called uprights. An upright can grow erect for one or two seasons before its weight bends it downward and new vertical growth is produced at the tip or from axillary (side) buds along the stem. Runners grow horizontally. In very vigorous beds runners may also grow across the tops of vines. Later these runners may produce uprights from axillary (side) buds.

Cranberry leaves are small and attached to the stem with a very short petiole. Leaves typically persist for two years, then fall to the ground.

The cranberry plant produces a terminal bud containing both shoot and flower primordia (mixed bud) or just shoot primordia (vegetative bud). The buds are formed in late summer the season before they open and grow. Thus the buds must survive through Wisconsin winters in order to produce a crop the following year. Critical times for the crop are late summer when the buds form, and the following spring when they open and begin to grow.

Wisconsin cranberries flower in late June and early July. The cranberry flower resembles the head and neck of sandhill cranes and the name 'cranberry' was an early name for the fruit. The blossom period lasts for three to four weeks depending on the weather. Pollen is transferred from flower to flower by wild bees, bumble



Cranberry flowers resemble the head of the Sandhill crane from which the name cranberry is derived.

bees, native flies, and commercial honeybees. Cranberries are self-fruitful, meaning that pollen from a flower can pollinate itself. As a result, a single cultivar can be planted in a bed.

Soon after pollination, the berry begins to develop. Cranberries are small and green at first, turning their attractive dark red color between 75 and 100 days from flowering. After washing, cranberries can be eaten fresh, and possess a distinct, crisp, tart flavor.

## Site Selection

A good site for cranberries has acidic soil with a pH between 4.0 and 5.5 and a large supply of water and coarse sand available. Either organic or sandy soils are suitable for cranberry production. The water table should be near the soil surface so that a minimal amount of overlying soil will have to be excavated. Alternatively, an impervious soil layer can be created to perch the water table just below the bed surface.

Traditionally cranberry marshes have been developed in wetland ecosystems. Because wetlands are protected by local, state and federal regulations, permits from the U.S. Army Corps of Engineers and the Wisconsin Department of Natural Resources must be acquired **before** development can begin. Existing cranberry operations must obtain permits before some types of activities are done as well.

Soil pH is very important. Cranberries require acidic soils to thrive. If a potential site does not have an appropriate soil pH it is usually not economically feasible to adjust the pH more than one pH unit.

An adequate supply of water is essential to provide frost protection, soil evaporation replacement, and transpiration from leaves in addition to harvest and winter flooding. The water source should not be alkaline, nor have high carbonate content. It is estimated that four to six acre feet of water per acre of planted vines is required for annual cranberry production. Water sources include lakes, rivers and reservoirs. Reservoirs are built to stockpile water so that an ample supply is available for peak use times.

An adequate and accessible sand supply is also important. During construction, a layer of sand four to

six inches deep is spread on the bed surface. This becomes the planting substrate. Once the vines are established, a thin layer of sand is spread over the ice during the winter every few years and sand must be available for this important practice. See the section on sanding for more complete information.

## Site Preparation

Once a suitable site has been located and all required permits are obtained, site preparation can begin. The overlying topsoil is scraped away and stockpiled for later use. The subsoil is excavated down to about 18 inches above the final water table and rectangular beds are formed that typically measure 150 feet wide by 600 or more feet long. Removing exposed soil reduces later weed and disease problems. The beds are laser-leveled with a slight crown so there are no low spots in which water can collect. Beds are designed so that water flows from an inlet bulkhead to an outlet bulkhead in the opposite end.



Cranberry beds that have been formed with dikes around the perimeter. Sand has been spread on the surface in preparation for planting vines.

Any extra soil is sold and removed or stockpiled on site. A reservoir, ditches, dikes and other water control structures are created. Once all dikes are in place, topsoil is spread on the sides of the dikes and seeded to grass to hold the soil in place and to prevent erosion.

A sprinkler irrigation system including pumps, mainlines and laterals with sprinkler heads is installed

before vines are planted. The sprinkler system replaces water lost through evaporation and protects the cultivars against frost.

Equipment storage buildings and pump houses are usually constructed to protect valuable equipment.

## Cultivar Selection

All vines planted in new marshes today are hybrids produced by crossing native vine types. Including more than one cultivar in a marsh plan allows producers to spread out their harvest season and reduces the risks associated with monoculture. Since cranberry vines will last for many years in a well-planned and constructed bed, it is important to choose a good cultivar and to purchase good planting stock. Mistakes made in cultivar selection or site selection and preparation will impact production for decades. The predominant cultivar in 2007 is Stevens.

## Common Cultivars

**Stevens.** A midseason cultivar with large berries and adequate color. The vines are quite forgiving to environmental conditions and management. Stable production from year to year. A hybrid of McFarlin and Potters Favorite, introduced in 1950.

**Ben Lear.** Early coloring and high coloring cultivar with large berries. Requires careful management. Selected from the wild in Wisconsin in 1901.

**Pilgrim.** Large fruited late coloring cultivar. Less forgiving to poor management than Stevens. Yields well. Hybrid of Prolific x McFarlin.

**Grygleski Hybrid 1.** An early coloring, large fruited, regular cropping hybrid of unknown parentage. Originated in Wisconsin by a cranberry grower.

**HyRed.** An early coloring, potentially high yielding cultivar bred in Wisconsin. Thought to yield consistently from year to year. Hybrid of Ben Lear and Stevens.

Other cultivars include Bergman, Mullica Queen, DeMoranville, and Crimson Queen.

## Planting

Once the bed is prepared for planting, cranberry cuttings are spread on the sand at the rate of about two



Spreading vines by hand over the sand surface of a cranberry bed.

tons of vines per acre. After the vines are spread, they are pushed into the sand with a straight dull disk. The bed surface is then firmed with a cultipacker. The vines are then sprinkle-irrigated two or three times per day for several weeks. Within a few weeks the cuttings produce roots and new vine growth begins. The newest hybrid cultivars are only available as sticks or plugs and are set by hand or with a vegetable planter.



Mechanically spreading vines over a cranberry bed as part of the planting process.

The vines grow slowly at first, but once a good root system is established they grow more quickly and fill the bed with a solid mat of vines. It takes about four years to produce a good crop of fruit from a new bed, and up to six years before a new bed is in full production.



Vines are pushed into the sand using a blunt disk. The vines will then be watered daily and soon roots are produced and the vines begin to grow.

## Mineral Nutrition

Cranberries are unusual in utilizing nitrogen primarily in the ammonium form. The vines require very little nitrogen—usually no more than 20 pounds of actual nitrogen per acre per year for bearing beds. This is only about 10% of the nitrogen applied to many agronomic crops. New beds receive slightly more nitrogen, and older beds on peat soils may receive much less nitrogen. Nitrogen is applied in frequent light applications so that the roots can intercept and absorb the fertilizer.

Some phosphate fertilizer is applied to cranberries to assure an adequate supply of phosphorus in the soil solution. A full crop of cranberries requires only 45 pounds of  $P_2O_5$  per acre per year. Potassium is not needed in large quantities by cranberries, but because potassium leaches through soils, potassium fertilizer is applied each year. Less than 200 pounds of potash is required for a full crop of cranberries. Additions of secondary and micronutrients are rarely needed by cranberries.

The nutrient status of cranberry vines can best be determined by tissue testing in late August to early September. Samples of new growth are collected across each bed and sent to a plant analysis lab for testing. Lab results are compared to standards and adjustments are made to keep tissue nutrient con-

centrations in the sufficient range.

## Pest Management

Cranberries encounter many pests, which if not controlled, will reduce yields and fruit quality. Wisconsin cranberry growers follow the principles of Integrated Pest Management (IPM). Using IPM principles, growers monitor pest activity in their marshes and control pests only when the threat of economic damage is imminent.

Studies of the life cycles of insects, diseases, and weeds help determine when they are most susceptible to control. Models of pest progress in relation to temperature have been developed to assist growers in predicting pest outbreaks. Using these principles, pesticide applications have been significantly reduced compared to a generation ago.

## Insect Management

Several insects are major pests of cranberries. Some insects attack the fruit while others harm the vines. In either case, the damage reduces the economic returns of the marsh. The two most significant insect pests of cranberries in Wisconsin are the



Blackheaded Fireworm is a major insect pest of cranberry vines.



Photo by D. Mahr

An IPM scout using a sweep net in a cranberry bed to estimate insect populations.

Blackheaded Fireworm and Cranberry Fruitworm. Other significant pests include Cranberry Girdler, Tipworm, Sparganothis Fruitworm and some general spanworms. However, these pests are not economically significant to every marsh every year. Growers monitor insect populations

within the marsh by sweep netting and using pheromone traps. Growers count the number of insects caught and use these numbers along with their knowledge of insect life cycles to estimate whether economic injury to their crop is likely. If significant damage is imminent, an appropriate control measure is taken. Control measures include flooding, mating disruptions using pheromones, and insecticides. Many growers contract with pest management consultants for scouting services.

## Disease Management

Several diseases cause economic losses for cranberry growers in Wisconsin. The most significant disease is Cottonball. Although Cottonball is not widespread, it can cause substantial losses when it does occur. Pre-harvest fruit rots are not typically a major problem in Wisconsin. However, post-harvest rots of fresh fruit are frequent problems. Several species of *Phytophthora* root rots have been identified in Wisconsin, but none of these have been proven to be pathogenic to cranberry vines. Root rot problems are best managed by improving drainage in beds where they occur.

Because common Wisconsin cranberry diseases are caused by fungal pathogens, fungicides can be used to control the incidence and spread of these diseases. Typically in Wisconsin, only beds that will be harvested for fresh fruit are treated with fungicides.

## Weed Management

Because cranberries are low-growing, weeds are a major pest problem. Weeds compete with cranberries for water, nutrients and most importantly, light. Weedy beds are also difficult to harvest because weeds become tangled in harvesting equipment. Weeds can be controlled mechanically and chemically. Mechanical methods include pulling weeds by hand or mowing off the tops of weeds to allow light to reach the cranberry vines. Once the vines completely cover the soil surface they will shade out most germinating weed seeds, reducing the need for other weed management measures. Chemical weed management has become more widespread as herbicides have been labeled for cranberries. Two chemical approaches are possible. The first is

using pre-emergent herbicides that prevent weeds from germinating, and the second is using post-emergent herbicides to kill weeds once they are growing. Most growers use a combination of both mechanical and chemical weed control measures.



Weeds are a major pest in cranberry beds. They compete with vines for water, light, and nutrients.

## Harvest

The harvest method for cranberries varies according to how the fruit will be used. Fresh fruit are harvested with a picking machine. Such machines have tines that comb through the vines and catch the fruit that are then lifted onto a conveyor then into a bin. After harvest, fruit for fresh use is dried in boxes with slatted bottoms and stored in heavily insulated or mechanically refrigerated buildings. Later fruit are sorted and packaged for retail sale.



A mechanical cranberry picker in use in a cranberry bed. Fruit to be sold as fresh cranberries is usually harvested this way.



A water reel harvester at work in a cranberry bed that has been flooded for harvest.

Fruit that is destined for processing into juice, sauce, or sweetened dried cranberries is wet harvested. For wet harvesting, beds are flooded with eight to ten inches of water. A machine with a circular beater mounted on the front is driven through the bed to remove berries from the vines. Alternatively a “slipper” is drawn through a bed to remove fruit from the vines. The berries float to the water’s surface are corralled into a corner, and then conveyed or pumped out of the bed to a waiting truck. Berries for processing are delivered to a receiving station where they are graded, cleaned and frozen for later use.



Cranberries are corralled with floating booms then pumped or conveyed out of the bed into waiting trucks.

## Water Management and Frost Protection

Water is essential for cranberry production. Water is used for sprinkler or flood frost protection, spring reflow, irrigation, harvest and winter protection.

Growers utilize water from lakes, rivers, streams, drainage ditches, reservoirs and other surface water impoundments. Groundwater is rarely used for cranberry culture.

Although cranberries are wetland plants, they do not grow under water or in standing water. Excellent drainage is essential, as is the method of application. Typically cranberry beds are bordered by drainage ditches to allow water to drain from the beds. Many beds have one or more drainage tile lines running the width of the bed. The water table is manipulated during the growing season to remain 12 to 18 inches below the surface of the bed.



Sprinkler irrigation of a cranberry bed. Cranberry beds are not flooded during the growing season and water is supplied through the sprinkler system.

Modern cranberry marshes are sprinkle-irrigated. Sprinkler systems may be buried under the surface of the beds, or placed on the surface of the beds every spring and removed before harvest every fall. Each type of sprinkler system has advantages and disadvantages. Sprinkler systems must be designed to provide even, thorough coverage across the beds. Because sites suitable for cranberry production are frequently low-lying, frost is a constant threat. Air temperatures below 32 degrees F can damage new growth, flowers, and immature fruit. Growers must constantly be aware of weather conditions and be prepared to frost-protect at all times. Sprinkler irrigation is the primary method of frost protection. Water is applied to cranberry vines using sprinklers. As the liquid water changes to ice, heat is released. This heat, called the latent heat of fusion, is sufficient to protect the vines if the air temperatures do not drop too low and if it is not too windy. Liquid water must be applied to the vines continuously or the tempera-

ture will quickly drop and the vines or fruit will be damaged. Frost forecasts are provided twice daily in the spring and fall based on weather observations, satellite imagery and computer modeling.

## Winter Management and Sanding

Because cranberries are a perennial crop, they must survive Wisconsin's harsh winters. Even though the vines go dormant, they must be protected against widely-fluctuating temperatures and drying winds.

As the fruit begins to redden in early September, the plant has already begun its preparation for winter dormancy. In December during the first bitter cold weather, the dormant vines are flooded with water that quickly freezes into a solid covering of ice. This ice layer protects the cranberry vines from extreme cold and fluctuating temperatures and prevents winter winds from desiccating the vines.



A half-inch layer of sand is being spread over ice on a cranberry bed from a dump truck. Sanding helps to control pests and to rejuvenate a bed.

Cranberry vines grow longer each year. Placing a thin layer of sand over the vines every few years helps rejuvenate the planting by keeping the fruiting buds closer to the root area of the plant and by helping to control weed, insect and disease pests. Sanding in the winter when the vines are covered with ice is convenient. Dump trucks are driven onto the ice over the beds and a layer of sand about one-half to one inch thick is spread uniformly on the ice with a sander. As the ice melts in the spring, the sand settles onto the surface of the beds. New plantings

may be sanded each year for two or three years to stimulate rooting and to aid runner and upright development.

## Environmental regulations

Cranberry growers are subject to environmental regulations including the federal Clean Water Act, the state non-point rules, and state and federal pesticide regulations. Wisconsin cranberry growers have the right under state law to divert some surface waters for the purpose of growing cranberries.

Prospective growers interested in developing cranberry acreage should have the land surveyed for the presence of wetlands. If wetlands are present at the site, permits will be required from the US Army Corps of Engineers and the Wisconsin Dept. of Natural Resources before development can proceed. Mitigation for wetland loss may be possible, but this must be determined prior to the beginning of construction.

## Marketing

Potential cranberry growers should secure a contract to sell their fruit before site work and planting begins. Several marketing groups purchase Wisconsin cranberries. Growers who belong to the Ocean Spray Cooperative comprise about 60% of the cranberry acreage in Wisconsin. Other producers operate independently and sell their fruit to other processors and handlers. Most of the Wisconsin cranberry crop is sold for processing. Only about 5% of the state crop is sold as fresh fruit. Growing cranberries for the fresh fruit market requires additional management skill and great attention to detail.

Marketing cranberries in the United States is regulated by a federal market order that is authorized to limit the quantity of cranberries that can be marketed in a crop year. New growers would be advised to carefully examine this market order. Wisconsin growers also assess themselves fees to provide funds for research and generic promotion for the industry.

## Economics

Depending on the specific equipment needed and the initial cost of the land, the cost of establishing a cranberry marsh is estimated to be between \$25,000 and \$30,000 per acre. This includes vines, bed construction and leveling, dike and bulkhead development, reservoir construction, and wells and pumps. Other investments may include heavy equipment and storage buildings, and housing for the marsh manager and workers.

In addition, a grower requires a sizable capital reserve for annual operating expenses. Production costs are estimated (1995) at \$6300 per acre or roughly \$46 per barrel per year. These numbers do not include a return to the owner.

Along with their 18,000 acres of planted vines, Wisconsin cranberry growers also own and manage an additional 120,000+ acres, resulting in a ratio of roughly seven acres of support lands per acre of planted vines. Much of this acreage includes wetlands and woodlands which are inaccessible, providing undisturbed sites for birds and animals to feed, nest, and rear their young.

This native fruit continues to be cultivated and upgraded to meet today's needs. The cranberry offers a low calorie, high vitamin and mineral fruit with good fiber content. These traits are important in today's health-conscious market. Research suggests that cranberry products can be useful in reducing urinary tract infections and some aspects of heart and circulatory system disease. The popularity of cranberries is increasing as people discover how versatile this tart, deep red, native fruit can be.

## Resources

Wisconsin State Cranberry Growers Association  
<http://www.wiscran.org/>

Cranberry Institute  
<http://www.cranberryinstitute.org/>

USDA Cranberry Marketing Committee  
<http://www.uscranberries.com/>

UW-Madison Steenbock Library Reference Page  
<http://www.library.wisc.edu/guides/agnic/cranberry/cranhome.html>

UW-Madison Dept. of Horticulture Cranberry Page  
<http://www.hort.wisc.edu/cran/>

Wisconsin Cranberry Discovery Center  
<http://discovercranberries.com>

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All photos taken by Dr. T. Roper, unless otherwise indicated.

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