



CRANBERRY PRODUCTION IN WISCONSIN

Cranberries are a native species to Wisconsin. Commercial cranberry production in Wisconsin began near Berlin in about 1860. Early marshes were developed simply by digging ditches around stands of native vines and encouraging their growth. These early cranberry pioneers faced hazards of frost, insects, weeds, diseases and fires, most of which are now manageable.

During the early 1890s, the center of the Wisconsin cranberry industry shifted to the Cranmoor area, just west of Wisconsin Rapids. Later developments were made in the Black River Falls, Warrens, and Tomah areas, followed by marshes in northern Wisconsin, primarily around Manitowish Waters, Eagle River, Spooner, and Hayward. Cranberries are Wisconsin's leading fruit crop both in terms of acreage and value. Cranberries are currently (1996) produced on about 13,600 acres in 19 of Wisconsin's 72 counties. The greatest acreage is in Wood and Jackson Counties. Farm gate value is about \$75 million.

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 buds along the stem. Runners grow horizontally. In very vigorous beds runners may 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 the open and grow. The buds must survive through Wisconsin winters in order to produce a crop the following year. Critical times for the crop are when the buds form in the late summer and when they open and begin to grow the following spring.

Wisconsin cranberries flower in late June and early July. The blossom period lasts for three or four weeks depending on the weather. Pollen is transferred from flower to flower by wild bees, wind, 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. The berries are small and green at first, taking between 75 and 100 days from flowering for the fruit to mature and turn their attractive dark red color. Cranberries can be eaten fresh, and possess a distinct, crisp, tart flavor.

Site Selection

A good site for cranberries has an acidic soil with soil pH between 4.0 and 5.5 and a large supply of available water and sand. Either organic or sand soils are suitable for cranberry production. The water table should be near the soil surface so that a minimal amount of overburden will have to be excavated.

Soil pH is very important. Cranberries require an acid soil to survive. If a potential site does not have an appropriate pH it is usually not commercially feasible to adjust the pH more than a few tenths.

There must be an adequate supply of water to provide for frost protection, replacing evapotranspiration, harvest and winter flooding. If possible the water source should have a pH less than 6.0. One estimate of cranberry water needs is 6 acre-feet per year per acre of planted vines. Water sources include lakes, rivers and reservoirs. Reservoirs are built to stockpile water so an ample supply is available for peak use times. An adequate and accessible supply of sand is also important. Sand is used in initial bed construction to provide a base to plant the vines into. Once the vines are established a thin layer of sand is spread on the ice every few years and sand must be available for this practice.

Traditionally cranberry marshes have been developed in woodland 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 marshes must obtain permits before some types of maintenance is done as well.

Site Preparation

Once a suitable site has been located site preparation can begin. The overlying soil 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 formed that are about 150 feet wide by 600 or more feet long. Removing exposed soil reduces later weed and disease problems. The beds are leveled with the use of a laser so there are no low spots for water to collect. Beds are designed to flow water from an inlet bulkhead to an outlet bulkhead in the opposite end.

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 the topsoil is spread on the sides of the dikes and seeded to grass to hold the soil in place and prevent erosion.



A sprinkler system including pumps, mainlines and laterals with sprinkler heads is established before vines are planted. The sprinkler system is to replace water lost through evaporation as well as to protect against frost.

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

Cultivar Selection

Cranberries are seldom commercially produced today from their original native or wild vines. Virtually all vines planted in new marshes today are hybrids produced by crossing native vine types. The predominant cultivar in 1996 is Stevens. It is a midseason cultivar with large berries and good color.

Production of Stevens is quite stable from year to year. Ben Lear is another popular cultivar. Ben Lear is an early coloring cultivar with quite large berries. Ben Lear is more sensitive to management practices, and can have variable yields if not managed carefully. Other popular cultivars include Searles, Pilgrim, and McFarlin. It is advisable to include more than one cultivar in a marsh plan to spread out the harvest season and reduce the risks associated with a 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 remain for many years.

Planting

Once the bed is prepared for planting, cranberry cuttings are spread on the sand at the rate of about two tones of vines per acre. Once the vines are spread, they are pushed into the sand with a straight dull disk. The vines are then sprinkled with water through the irrigation system. After a few weeks the cuttings produce roots and new vine growth begins.

The vines grow slowly at first, but once a good root system is established they will 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 seven years before a new bed is in full production.

Mineral Nutrition

Cranberries are unusual in utilizing nitrogen only 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 may receive slightly more than this, and older beds on peat soils may receive much less than this. Nitrogen is applied in frequent light applications so that the roots have a good chance of intercepting and absorbing the fertilizer.

Cranberries show no yield response to potassium fertilizers, so potassium fertilizer is rarely needed. Some phosphate fertilizers are applied to cranberries to assure an adequate supply of phosphorus in the soil solution. Secondary and micronutrients are rarely needed by cranberries.

The nutrient status of cranberry vines can best be determined by tissue testing in August. Samples of new growth are collected across each bed and sent to a plant analysis lab for testing. The results are compared to standards and adjustments made whether minerals are low, adequate or high. Additions of fertilizer can be adjusted upwards or downwards based on tissue test results.

Pest Management

Cranberries have many pests, which, if not controlled, will reduce yields and fruit quality. Many cranberry growers are following the principals 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. The life cycles of weeds, diseases, and insects are studied to determine when they are most susceptible to control. Models of pest development in relation to temperature have been developed to assist growers in predicting pest outbreaks. Using these principles, pesticide applications have been significantly reduced in the past few years. Computer software has been developed to assist growers to apply these models and interpret the results.

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 means of managing weeds include pulling weeds by hand or mowing off the tops of weeds to allow light to the cranberry vines. Once the vines completely cover the soil surface the vines will shade out many 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 to use preemergent herbicides that prevent weeds from germinating, and the second is to use postemergent herbicides to kill weeds once they are growing. Most growers use a combination of the two approaches.

Insect Management

Cranberries are susceptible to a number of insect pests. Some insects attack the fruit, while others damage the vines. In either case, damage reduces the economic returns of the marsh. The two most significant insect pests of cranberries in Wisconsin are the Black Headed Fireworm and Cranberry Fruitworm. Other significant pests include Cranberry Girdler, Tipworm, Sparganothis Fruitworm and some general spanworms. However, these pests are not economically significant on every marsh every year. Growers monitor insect populations within the marsh using pheromone traps and by sweep netting. They count the number of insects caught and use these numbers along with a knowledge of insect life cycles to estimate whether economic injury to their crop is likely. If significant damage is imminent, an approved insecticide is applied. 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 one is Cottonball disease. Although Cottonball disease is not widespread, when it does occur it can cause substantial losses. Preharvest 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.

Because the 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. Root rot problems are best managed by improving drainage where the rots occur.

Harvest

Cranberries can be either dry or wet harvested. However, in Wisconsin even when dry harvesting, the beds are flooded with a few inches of water to cushion fruit and reduce bruising. Dry harvesters rake the berries from the vines with an action similar to a comb. Dry harvested fruit is usually sold for fresh use. For wet harvesting, beds are flooded with eight to ten inches of water. A machine with a beater on the front is driven through the bed to remove the berries from the vines. The berries then float to the water's surface. The floating berries are corralled into a corner and conveyed out of the bed to a waiting truck. Wet harvested berries usually are used for processing.

After harvest, fruit for fresh use is dried in boxes with slatted bottoms and stored in heavily insulated or mechanically refrigerated buildings. Berries for processing are delivered to a receiving station where they are graded, cleaned and then frozen for later use.

Water Management and Frost Protection

Water is essential for cranberry culture in Wisconsin. Water is used for spring reflow, sprinkler or flood frost protection, irrigation, harvest and winter protection. Many growers utilize water from lakes, rivers, streams, reservoirs and other surface water impoundments. Groundwater is generally not used for cranberry culture.

Modern cranberry marshes are completely sprinkle irrigated. Sprinkler systems may be buried under the surface of the beds, or placed on the surface and removed before the harvest. There are advantages and disadvantages to both approaches. Sprinkler systems must be designed to provide even, thorough coverage across the beds.

Although the cranberries are wetland plants, they do not grow under water or in standing water. Excellent drainage is essential, as is application. Cranberry beds are ringed by drainage ditches to allow water to drain from 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.

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 the cranberry vines through the sprinklers. As the liquid water changes to ice, heat is released. This heat, called the heat of fusion, is sufficient to protect the vines if the air temperatures do not go too low. Liquid water must be present on the vines at all times or the temperature will quickly drop and the vines or fruit 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 color in late August, the plant has already begun its preparation for winter dormancy. By December, the dormant vines are flooded with water that quickly freezes into a solid covering of ice. The ice protects the cranberries from extreme cold and fluctuating temperatures as well as preventing the winter winds from drying out the vines.

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 helps control weed, insect and disease pests. It is easy to sand in the winter when the vines are covered with ice. Dump trucks are driven onto the ice over the beds and about one-half to one inch layer of sand 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 aid runner and upright development.

Marketing

Potential cranberry growers should have 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 70% of the cranberry acreage in Wisconsin. Other producers operate independently and sell their fruit to other processors and handlers. Most of the cranberry crop is sold for processing. Only about 5% of the total crop is sold for fresh fruit and fresh fruit requires additional management skill.

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 get and read a copy of this market order. Wisconsin growers also assess themselves to provide funds for research and generic promotion for the industry.

Economics

Depending on what equipment is needed and on the initial cost of the land, the cost of establishing a cranberry marsh is estimated to be between \$20,000 and \$30,000 per acre. This includes vines, bed construction and leveling, dike and bulkhead development, reservoir construction, and wells and pumps. Additional investments may include heavy equipment and storage buildings for the equipment, and housing for the marsh manager and workers.

In addition a grower requires additional, sizable capital for operating expenses for annual production costs. Production costs are estimated (199) at \$6300 per acre or roughly \$46 per barrel per year. These numbers do not include a return to the owner.

In 1991, the farm gate value of Wisconsin's cranberry crop was about \$78 million. When ancillary services are included, the total impact of the industry on Wisconsin's economy is about \$154 million. The industry provides employment directly or indirectly for about 5,800 citizens.

In addition to the 15,000 acres of planted vines, cranberry growers also own and manage 120,000 acres of other land giving a ration of roughly 10 acres of support lands per acre of planted vines. Much of this acreage is prime habitat for wildlife. Much of the wetlands and woodlands are inaccessible, providing undisturbed sites for birds and animals for nesting, rearing young and feeding.

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 a good fiber content. These traits are important in today's health conscious values. The popularity of cranberries is increasing as people discover how versatile this tart, dark red, native fruit can be.

T.R. Roper is Assistant Professor and Extension Horticulturist, University of Wisconsin-Madison

T.D. Planer is Associate Professor, Cooperative Extension, University of Wisconsin-Extension, Wood County

This publication was produced with funds provided through the Wisconsin Cranberry Board, Inc.

Published October 1996