Growing grapes, fruits, and vegetables for wineries

Farm to Bottle

Fluffy Fields Vineyard & Winery
2708 21st Street West
Dickinson, ND 58601
701-483-2242
www.fluffyfields.com

REAP Investment Board
Rural Economic Area Partnership

Acknowledgements to:
REAP Investment Board
USDA RDBG
2016 Winery Supply Chain
www.reapmatters.org

United States
Department of
Agriculture

Rural Development

The work that provided the basis for this publication was supported by funding under an award with the U.S. Department of Agriculture Rural Development.
The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

USDA is an equal opportunity provider, employer, and lender.

TABLE OF CONTENTS

Apples

Cultivars: Dakota Gold, State Fair, Zestar, Hazen, Duchess, Goodland, Northern Lights, Prairie Magic, Red Baron Sweet Sixteen, Honeycrisp, Haralred, SnowSweet, Haralson and Wodarz

Planting & Growing

Field Conditions

Sunlight, and plenty of it, is a key to fruit production. Plant where the trees will be in the sun most or all of the day. Early morning sun is particularly important as it dries the dew from the leaves, reducing incidence of diseases.

Growing Conditions

Although apple trees will grow well in a wide range of soil types, a deep soil ranging in texture from a sandy loam to a sandy clay loam is preferred. Apple trees will not thrive in soil that is poorly drained. In areas of poor drainage, roots die resulting in stunted growth and eventual death of the tree. Apple trees also perform poorly on droughty soils where shoot growth can be stunted and fruit size and quality reduced. Most fruit plants, including apples, grow best when the soil pH is near 6.5.

Fertilizers

Spring is the best time to fertilize. Prior to applying fertilizer test soil to measure for pH and identify needed nutrients. Soil fertility can be observed by looking at the glossy tissue from the tip of the branch to the dark scar that encircles the branch to identify new growth. Periodically (about every 3 years) check soil pH. The soil test report will indicate if additional liming is required.

Nitrogen is the most important nutrient needed. Phosphorous and potassium are needed in relatively large amounts, particularly on young trees. After the trees mature, fertilization with phosphorus and potassium will likely not be required. To fertilize apple trees the year they are planted, broadcast over a

2-foot circle 1 cup of 10-10-10 fertilizer about one month after planting. Do not put any fertilizer in the hole before planting. In June following planting, broadcast 1 cup of 10-10-10 fertilizer around the tree. In early spring of the second season (when the tree is 1 year old), broadcast 2 cups of 10-10-10 fertilizer over a 3-foot circle. Repeat again in June.

In succeeding years, follow these guidelines increasing the diameter of the broadcast circle and the amount of fertilizer (10-10-10) by 2 cups per year. After a tree reaches 6 years only nitrogen fertilizer is needed. Use 4 cups of ammonium nitrate per tree for trees 6 to 8 years old and 6 cups for trees 9 years old and older.

Do not apply any fertilizer to severely pruned trees. If growth is excessive, omit fertilizer for a year or two until growth is reduced to a desirable amount (terminal growth on bearing trees averaging 10 to 15 inches per year). Caution: When fertilizing, never dump large amounts in a small area. Root burn may result. Keep fertilizer 6 inches or more away from the trunk. Always broadcast the fertilizer evenly over the recommended area. Once the trees begin to bear, use shoot growth to determine if you need to reduce or supplement the fertilization rates previously suggested. Ten to 15 inches of growth are ideal for bearing trees. If growth is more than this, apply less fertilizer. If growth is less, apply a little extra fertilizer the next season.

Tree guard & mulch

Pest controls

Protect the plant from sunscald which usually occurs in late winter or early spring. Sunscald occurs when absorption of heat by the dark bark activates the growth of cells beneath the bark which may later be killed by colder weather. Sunscald can be prevented by installing white tree guards or painting the southwest sides of the trunk with a white latex water-based paint diluted with at least 50% water. Tree guards can also be beneficial in allowing the plant to grow and protect itself from animals such as rabbits and mice.

A deer fence is recommended. A deer fence should be roughly 8 feet tall.

Example of deer fence

Mulching helps prevent weed growth once the plant is established. A permanent grass cover such as bluegrass, orchard grass or fescue can be planted in orchards or farms. Spray strips with glyphosate to kill weeds within the row. When planting a few trees cultivate a clear diameter of at least 5 to 6 feet around the tree followed by shredded bark mulch.

To control insects and disease follow a good sanitation plan. Collect dropped leaves and fruit. Burn or destroy all pruning, leaves, and fruit to avoid harboring pests. Spraying can be beneficial for producing a high quality fruit if pests are observed. Insect traps monitor codling moths and apple maggots.

Apple Fly Maggot Adult

Codling Moth

Foliar diseases such as scab and rust are most likely to occur during the spring when everything is wet. The critical time to spray is early spring when leaves are still emerging. Prune trees every spring to maximize sunlight and allow air movement to reduce humidity which most fungi need to survive.

Apple Scab

Apple Rust

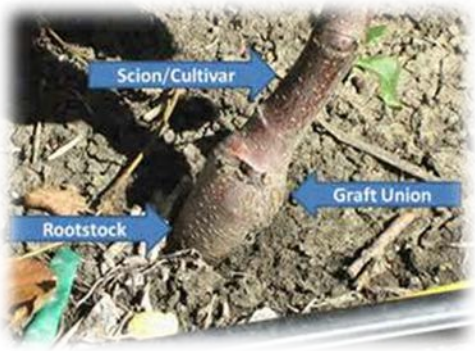
Plant stock

Apple trees can be bought as a partially grown tree or as a seedling. Most nurseries have partially grown trees. Seed catalogs typically have seedlings. Your local NRCS (Natural Resources Conservation Service) will have seedlings available to purchase.

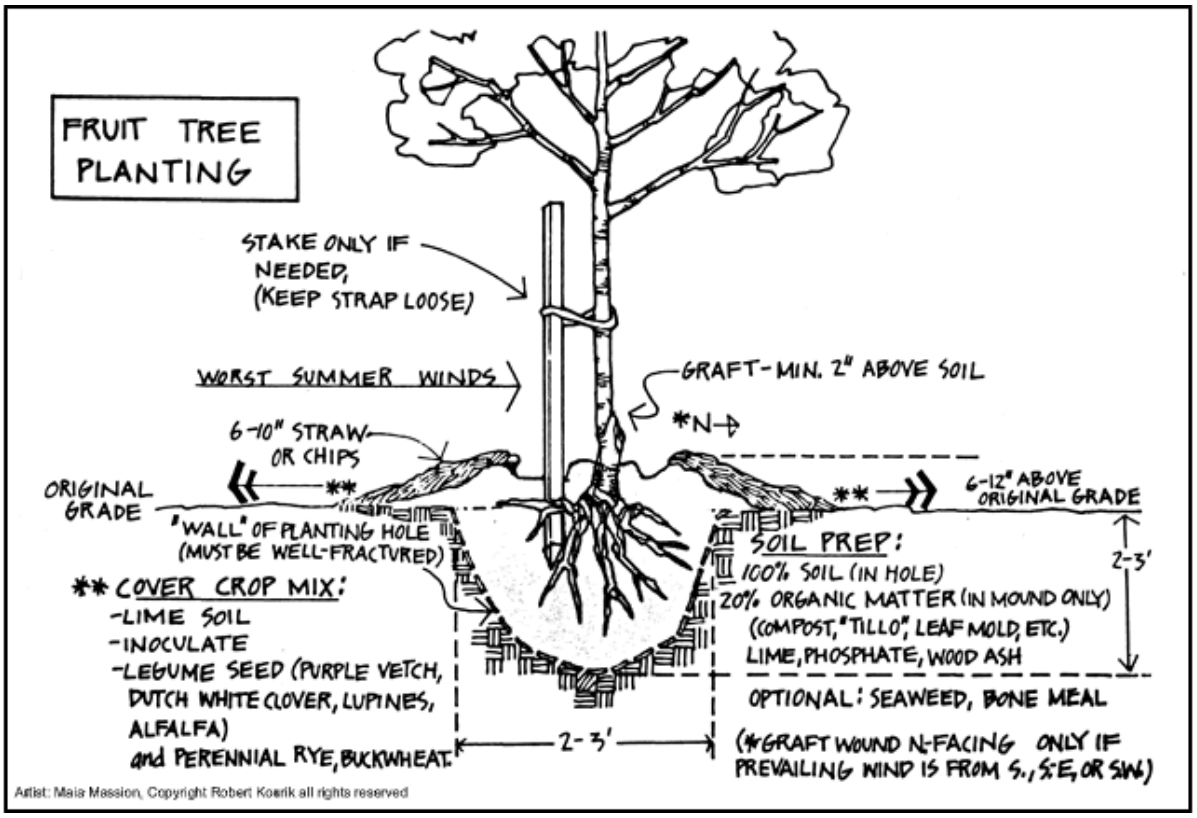
Planting

Plant dormant bare-root trees in early spring. Pre-potted nursery stock can be planted throughout the growing season. To plant bare-root trees, dig a hole larger than the root spread of the tree. This will help avoid root crowding. When planting a graft, locate the graft (a bulge near the union of the root and top) and place it 2 inches above the soil level.

Graft planting



Fill in with soil and tamp firmly, leaving a slight depression around the tree and water thoroughly. The lowest branch should be located on the southwest side to reduce sunscald. Watering is very important at the time of planting, soak the root area thoroughly. Give young trees 3 to 5 gallons of water weekly. An orchard will need irrigation regularly for at least the first two years.



Bare-root tree planting

Staking examples

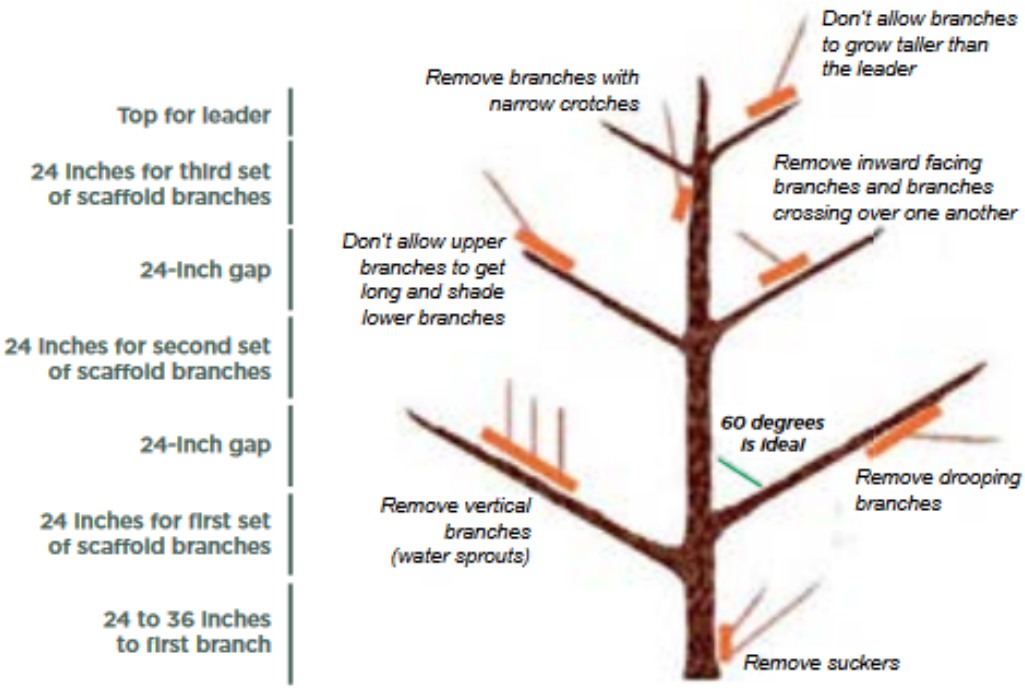
Apple trees require at least two different cultivars to ensure fertilization. Apple trees should be spaced a minimum of 20’ x 20’, preferably 25’ x 25’ for easy cultivation and full tree development. Staking younger trees helps the tree bear fruit earlier and produces higher yields. Staking protects the tree from wind and allows the root system to stabilize.

Growing season

An apple tree is a perennial. Once planted, it can live for many years.

Growing

Little pruning is done when the tree is first planted. For branched trees remove broken branches. Where branches rub against each other remove the less desirable branch. The tree may be trimmed back to 1 foot above its tallest side branch, making sure the top of the “central leader” remains the highest point of the tree. A young tree requires little pruning except to select proper main branches. The first branch should begin about 30 inches from the ground.



Pruning Guidelines

Harvest

Time to germination

Most trees are planted as seedlings. A tree can be started from fruit seeds. Apples take anywhere from 70-80 days at 40-41 degrees F to germinate.

Time to harvest

Standard Apple trees do not produce significant yield in the first five to ten years. Dwarf Apple trees do not produce significant yield in the first five years.

Harvest per season

Apples are harvested annually. The harvest period for apples differs by variety with some beginning mid to late September, and others late September to early October. Harvesting depends on weather throughout the growing season.

Manual harvesting methods

Manual harvesting can be accomplished using baskets or buckets. Ladders and laborers are needed. Crew size will depend on the size of the orchard. Protective clothing should be worn to protect laborers from branch scratches. The rolling picking method will prevent the picker from disturbing the tree, causing the fruit to fall or bruise. With this method, the apple is gently turned upside down on the spur (stem). If the fruit is ready to pick it separates easily. A multiple bin carrier may reduce bruising and allow for easier removal of the fruit from the orchard.

Machine harvesting methods

DBR Conveyor Concepts, LLC introduced the Phil Brown/DBR vacuum system. This system eliminates ladders and prevents major problems such as bruising, efficiency, and picker fatigue. The Pluk-O-Trak Fruit Harvester produced by Oesco, Inc. works by having pickers remove fruit from the tree, and place on a conveyor belt. This harvester also has a bin-trailer that eliminates the need to stop and change out bins once full.

Multiple Bin Carrier

Phil Brown/DBR Vacuum

Pluk-O-Trak Fruit Harvester

Yield per acre

Apple trees do not produce significant yield in the first five to ten years. Thereafter the average apple tree will produce approximately 8 bushels of apples per year. Dwarf apple trees yield begins approximately year 5.

Assuming tree row planting at 10 feet in row spacing at 18 feet between rows the average acre will hold 242 standard trees. Dwarf apple trees will increase to 388 per acre allowing for 7 feet in row spacing and 16 feet between row spacing.

Standard Apple Tree
2,304 Bushels
96,768 Pounds

Dwarf Apple Tree
3104 Bushels
130,368 Pounds

Yield per acre

$96,000 - $130,000 per ACRE!

Prepare for Market

Preparing to store – washing

An apple continues to live and respire after it is picked. Respiration cannot be completely halted. The objective of postharvest cooling is to slow the process and increase storage life.

Even apples stored for a short period need field heat removed as soon as possible. Rapid cooling will not injure the apples.

Preparing to store – packing

Prepare apples to store in perforated plastic bags. Perforations allow the bag to maintain a high relative humidity and prevent moisture build up. DO NOT tightly seal the bags, simply fold over the ends.

Storage – Conditions

Temperature and relative humidity are important for maximum storage life. Apples stored near 32°F with a relative humidity between 90-95% are optimum. Apples stored at 50°F or higher will spoil up to three times faster. Large quantities of apples can be stored in cellars, garage or unheated outbuildings.

The higher the holding temperature, the greater the softening and respiration rate and the sooner the fruit quality become unacceptable. Apples respire and degrade about twice as fast at 4°C as at 0°C. At 15°C apples respire and degrade more than six times faster. Optimum storage temperature for apples depends on variety. All are within the range from -1°C to +4°C (30°F to 39°F).

Apples are susceptible to freezing. Temperatures more than 1 or 2 degrees below freezing should be avoided. Chilling damage in apples is often consistent with internal breakdown. It occurs at temperatures of around 0°C/32°F and is not generally visible from the outside. Upon cutting, parts of the fruit flesh appear brown or moist with a narrow zone of normal tissue immediately beneath the skin.

Apples may suffer freezing injury on the tree, in storage or during transit. Exposure to freezing tends to be more damaging to harvested fruits than to those still on the tree. After freezing, the skin may show irregular areas of brown discoloration. Severely frozen flesh leaks on thawing, becoming soft and brown. After storage, cavities may develop in the affected tissue. Even in the absence of obvious symptoms, fruits exposed to freezing temperatures are weakened and their storage life is shortened. The fruit softens and becomes mealy.

All varieties require a relative humidity from 90 to 95 percent to prevent shrivel. Maintaining humidity within this range reduces weight loss. Humidity near the saturation point (100 percent) encourages bacteria growth and fungi. Some varieties of apples, such as Golden Delicious, can be held in plastic liners to keep the humidity at high levels.

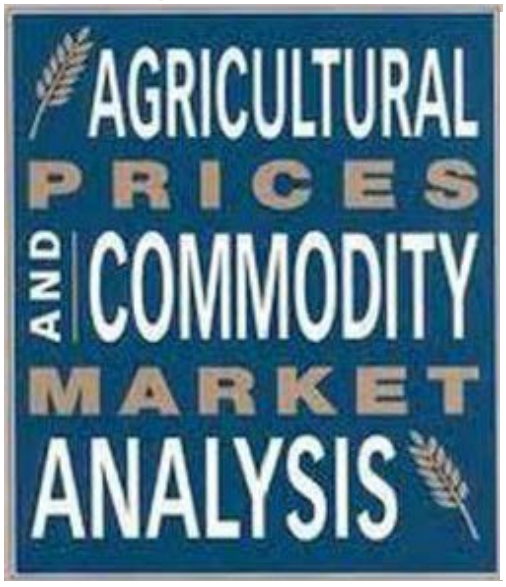
Chilled apples suddenly transferred into warm air are likely to "sweat". Water vapour in the air will condense on the apples. Sweating also occurs when the doors of a cold storage room are opened, allowing warm, moist air to enter. Sweating itself does not harm the fruit, but causes wetting, which encourages the growth of fungi and bacteria. Chilled apples should not warm and re-chill. Chilled apples should be warmed slowly before bringing into the open area.

Storage – length of time
Apples can be stored anywhere between 3-5 months in the right conditions.

Transportation from field
With manual harvesting, apples can be transported from the field with a flatbed vehicle. With the Pluk-O-Trak the bins are on a bin-trailer pulled behind the harvester which allows leaving the field with the bins. The Phil Brown/DBR Conveyor also has a bin-trailer to pull behind the harvester to transport the produce through the field and out of the field.

Transportation to market
Apples are transported by refrigerated truck unless hauled directly from the field to the end user. In some cases, end users pick the product themselves.

Selling



Market price resources
USDA National Retail Report: Specialty Crops.

Market price history
Nationally fresh apples priced at $1.57/lb. In North Dakota prices are $1.00/lb.

Market demand
The average person eats 65 apples per year in some form (raw or processed). Current US population is over 323 Million. In the US alone that's over 21 Billion apples consumed per year.

Delivery considerations:
Apples should maintain temperatures during transportation in temperature controlled (refrigerated) trucks as outlined above in Storage Conditions. Apples should not be transported with other produce such as onions, garlic and potatoes as they will absorb their odor.

Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

Both the Pluk-O-Trak and the Phil Brown/DBR vacuum system help remove the produce from the field. Purchase the bins that work with the correct harvester.

Tools

Apple baskets or buckets are $10 - $15. Fruit picking gloves are $2.00 to $6.00 per pair. Orchard ladders are $180 to over $400 depending on height and composition. Refrigeration truck rental is estimated at $190.00/day and $.20/mile. Refrigeration trailer rental is estimated at $110.00/day and $.05/mile without the semi or driver.

Plant stock

Apple trees are typically sold as bare root seedlings or trees. Seedlings and trees can be purchased from commercial nurseries, Burpee, Gurney's and other seed catalogs. Purchase price ranges based on variety (or cultivar), maturity and quantity. Good quality stock seedlings or trees start at approximately $19.95 plus shipping costs. Seedlings can also be purchased at the local NRCS (National Resource Conservation Service).

Labor

Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Apricot

Cultivars: Harglow, Harcot, Manchurian, Mandan, Moongold, Sungold, Siberial

Planting & Growing

Field Conditions

Apricot prefers well-drained loamy soil with pH between 6 and 7.5. Apricot should be planted 4 to 9 feet deep to allow for adequate drainage and root expansion. Organic matter can be introduced to existing soil to improve soil conditions. Each tree should have a 4-foot area around the base free of grass and weeds. Add a 3 to 4-inch layer of mulch underneath the tree to control weeds, grass and retain moisture.

Growing Conditions

Apricot needs a period of cold, called chill hours, to produce fruit. Chill hours are when the tree is subjected to temperatures of 45^{o} F or lower. Most apricot trees require between 700 and1000 chill hours or 4 to 6 weeks annually. Apricot trees prefer full sun.

Fertilizers

Apply fertilizer in spring. Fertilize periodically throughout the summer to ensure strong growth. Add 1 to 2 pounds urea mixed with water during the first spring watering followed by applications of a quarter to half pound monthly during the summer on young trees.

Spider Mite Infestation

Pest controls

Spider mites are tiny and look like sprinkles of cayenne pepper. Mites gather on the underside of leaves or feed on the buds or fruit. Mites suck out vital juices in young leaves and cause deformed or stunted growth. This reduces fruit yield. Mites can cause bronzing, or silvering of the fruit which may result in deformed or ruined fruit. Spray the fruit tree with a forceful stream of water to remove spider mites. Spider mites like hot, dry climates. A well-watered tree will detour mites. Rabbits and other rodents may chew on the lower portion of the tree during winter months. Netting or fencing can help detour these pests.

Diseases

Bacterial cankers may be considered the biggest problem associated with apricot trees. Bacterial cankers cause the formation of dark, sunken sores at the base of buds and randomly along the trunk and limbs. Gum may weep through these wounds as the tree emerges from dormancy in the spring or the tree could die. Once a tree is infected there is little that can be done. Some growers have found success with high doses of copper fungicide applied at the leaf drop. Powdery mildew infections start as white fuzzy patches on the lower surfaces of new leaves. As it progresses it affects fruit and young tree shoots. Powdery mildew fungus is common during warm, dry summers. Powdery mildew rarely causes enough damage to stone fruit trees such as apricots to require a fungicide.

Bacterial Canker excreting "gum"

Powdery Mildew

Plant stock

Apricot is usually planted as root stock or as 1 to 2 year old trees. Apricot is available from nurseries.

Planting

Dig a whole twice as big as the root ball. Set the tree in the hole gently spreading the roots. Fill the hole halfway with soil. Add water and completely drain. Fill the remaining hole with soil. Tamp down soil and water again. Trickle water each week for an hour. This will ensure that roots receive a deep watering. Water the tree twice weekly once fruit starts producing.

Avoid planting apricot trees near eggplant, tomatoes, peppers, potatoes, raspberries and strawberries. These crops can be a source of verticillium wilt.

Growing season

In the spring thin fruits to about 4 to 6 inches apart to ensure that the remaining fruit will develop. Prune dead or diseased branches from the tree in the fall. Apricot trees are self-pollinating and tend to produce earlier than most other fruit trees. Pink or white flowers bloom in the early spring followed by fruit in May. Protect apricot blossoms from frost damage. A standard size apricot tree will produce three to four bushels of fruit each year.

Growing

Prune shoots or suckers that grow out of the branches and roots. Since fruit is produced in second year prune lightly the first 2 years. Prune branches crossing or rubbing and those growing straight up the center of the tree. Prune in late summer the second year after fruiting is over. Prune into a vase shape with an open middle. This improves air flow and for allows even sunlight. Thin a heavy apricot crop to ensure that the fruit isn't small when at maturity. This will promote uniform ripening. Fruit that has been thinned usually ripens quicker.

Harvest

Time to germination

Apricot trees can be grown from pits (seeds). One option involves soaking the seed in water for a minimum of 24 hours. This allows the seed to properly hydrate. Fill a container with a mixture of peat moss and sand placing the seeds at one inch depth in the soil and refrigerate for 30 days. This method works well if the temperature is not ready for outdoor planting. Keep the soil from drying out to encourage germination. Plant outdoors once sprouted, after risk of freezing. Plant seeds 2 inches deep. Another method is directly planting the seed in the fall when the temperatures go below 40 degrees for at least 30 days. Plant seeds in about 2 inches of fertile soil that receives plenty of sunlight. Encourage sprouting by watering the seed after 3 to 4 weeks. Continue watering as the plant continues to grow.

Time to harvest

Apricots do not produce fruit until the 3rd or 4th year after planting. Apricots can ripen on or off the tree. Apricots do not become sweeter if they ripen off the tree. For the best flavor it is recommended to let the fruit ripen on the tree. Apricots are ready to be harvested when the background color of the skin turns from green to yellow and the fruit has started to soften but is still firm.

Harvest per season

Apricots can be harvested once per season, although fruit may be harvested over a period of a couple of weeks.

Manual harvesting methods

Apricots should be picked when slightly firm to avoid injury. If the fruit is too soft it can result in bruising during packaging or shipping. Ripe fruit should easily be picked from trees. A tarp may be strung up closer to the branches to catch fruit if shaking the trees.

Yield per acre

109 trees per acre
4 – 5 bushel per plant
50 pounds per bushel
21,800 to 27,250 pounds of fruit per acre
$3.00 to $4.00 per pound

$65,400 - $109,000 per ACRE!

Prepare for Market

Preparing to store – packing

Pack apricots by placing in a single layer to prevent bruising or other damage while they ripen.

Storage – Conditions

The best way to store apricots is a single layer to minimize damage from the weight of stacking the fruit as they may continue to ripen. Temperature should be maintained around 31 to 32° F for long term storage with a relative humidity of 90-91%. Do not store apricots with any other fruit that give off a higher amount of ethylene. This will cause apricots to age faster and can increase the possibility of fungus growth.

Prepare apricots for freezing by halving apricots and removing pits. Peel and slice apricots. If apricots are not peeled heat in boiling water 30 second to keep skins from toughening during freezing. Cool in cold water and drain. Lay out on a flat surface, freeze. Place frozen apricots in fruit bags or containers.

Storage – length of time

Apricots can be kept for a short period at room temperature. Apricots will last 1 to 3 weeks in the refrigerator. Apricots can be frozen for up to a year.

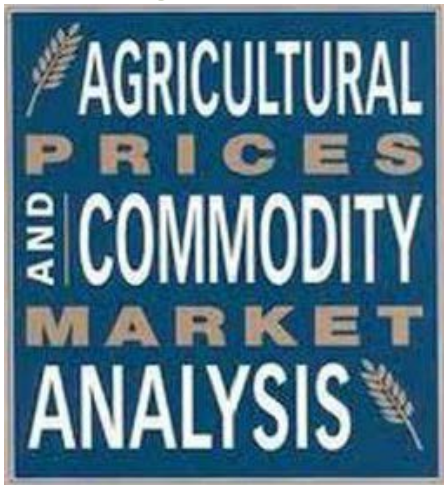
Transportation from field

Transport flats or baskets of apricots from fields with a trailer and tractor.

Transportation to market

Transport apricots in a refrigerated truck.

Selling



Market price
Fresh apricots sell for $3.00 to $4.00 pound.

Market price resources
Agricultural Marketing Resource Center

Market price history
Apricot prices peaked in 1986 and 1996. Apricot prices have held steady since about 2004. Fresh apricot prices are more volatile than processed apricot prices.

Market demand
Demand for fresh apricots remains steady since 2006. Demand for dried apricots has seen an increase over the same time period. Fresh apricots have remained steady since 2006, while dried apricots have seen an increase. Per capita consumption of apricots ranges from .9 to 1.6 pounds.




Delivery considerations
Refrigerated delivery will preserve freshness. Apricots should not be stacked on top one another to avoid damage or bruising.

Investment

Land
Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

Harvest will require a trailer and something to pull it.

Tools

Baskets or buckets are $10 - $15. Fruit picking gloves are $2.00 to $6.00 per pair. Orchard ladders are $180 to over $400 depending on height and composition. Tarps start at $10.00 depending on size and mil thickness. A fruit picker tool starts at about $20.00 depending on style. Some pickers have bags to catch fruit, some have baskets as shown.

Plant stock

Apricot trees start at $16.00 per tree depending on size and variety.

Labor

Manual picking is known to be labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Aronia Berry

Scientific Name:
Photinia melanocarpa

Cultivars:
Autumn Magic, Iraqis Beauty
McKenzie, Viking, Nero, etc.

Planting & Growing

Field Conditions

Aronia adapts well to a wide range of soil drainage classes from poorly drained to excessively well-drained, but do best in a well-drained soil. Guidelines for apples are often used for Aronia as they have a close botanical relationship. Iron deficiencies have been observed in commercial planting where the soil type leans to Loess, where the pH is often greater than 7.2. The optimum pH is slightly acidic ranging from 6-6.5, but will tolerate a pH range of 5-8.5. The plant can tolerate full sun or partial shade, though full sun is recommended in commercial growing to allow uniform ripening. Reduce the weed population before planting any perennial crop through the appropriate use of a cover crop or fallowing the ground.

Growing Conditions

Aronia grow best in well drained soils. Aronia prefer soil that is slightly acidic ranging from 6 to 6.5 but will also tolerate a pH range from 5 to 8.5. Aronia tolerates full or partial sun, but full sun is recommended for commercial growing to allow uniform ripening.

Fertilizers

Fertilizers can be applied after a soil test done identifies nutrients needed through fertilization. Too much Nitrogen can be detrimental to the anthocyanin content of the berry. Fertilizer isn't required for the plant to grow but adding fertilizer will boost yields. Aronia Berry Services of Northeast Iowa recommends using fish emulsion fertilizer.

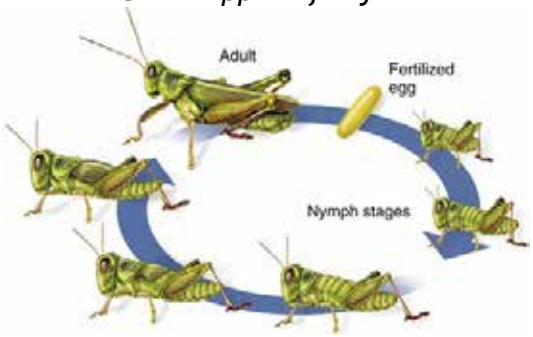
Pest controls

Wildlife including deer, birds, rabbits, and small rodents are the usual problem. A deer fence is essential for new plantings to prevent browning; the plant gives off a natural chemical to deter deer but in itself is not sufficient. Birds usually do not bother the plant until the berry is nearly ripe. Bird damage is typically minimal. The use of netting is optional. Aronia is in the same family as apples; as such they potentially share a lot of the same pests. Pests could include: apple maggot, brown marmorated stink bug, grasshoppers, and Japanese beetles. Scouting for pests is necessary as they may not be problematic in all regions. There are few insecticides available for these pests making controlling them limited. Products include: Actara, Assail, Avaunt, Entrust, and Sevin. ***Labels differ from state to state always make sure to read the label and contact your local extension agent for assistance.***

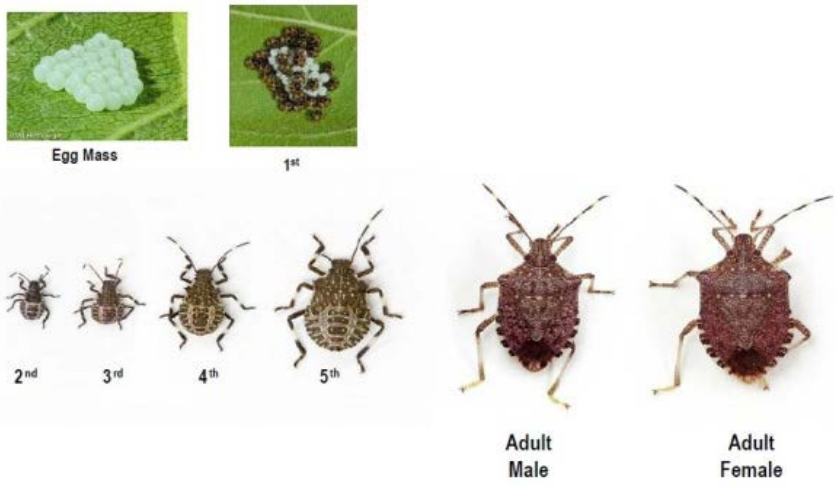
Example of deer fence

Apple Maggot life cycle

Grasshopper life cycle



Stink Bug life cycle



Diseases

Observed diseases include cedar-quince (or hawthorn) rust and cedar-apple rust. Healthy Aronia plants seem to be very tolerant against disease. Yield will not be affected although lesions may appear on the leaves. Plants may be susceptible to fire blight but reported cases are very rare.

Weed Control plays an important part in disease management. Add mulch around the base of the plants to help control weeds and conserve soil moisture. Controlling weeds with a weed eater or mowing should be done with care to not damage the canes which makes the plant more susceptible to diseases. Controlling weeds, especially during establishment is crucial to establishing a good stand.

Fire blight on Aronia berries

Cedar Quince Rust

Plant stock

The crop is planted via a plug. A new growth cutting is taken from an established plant. The cutting is about an inch and a quarter in length and placed in a hormone solution until the tap root has calloused over after which they are transplanted into a different setting which is roughly 2 inches by 4 inches. The plug remains there until planted that same fall or following spring. When planted in the same fall as harvested from an earlier spring cutting the plan can reach 10-20 inches tall. Plants are usually cut down to 12 inches before planting.

Planting

Spacing differs based on whether you plan to manually or mechanically harvest the crop. For hand harvest, plugs may be spaced as close as eight feet on center and six to eight feet within the row. To facilitate hand harvesting row spacing of 10 to 14 feet is recommended. This allows for a vehicle between the rows to remove produce from the field. For mechanical harvest a minimum of ten feet from the center is recommended with row spacing 12-14 feet on center.

Growing season

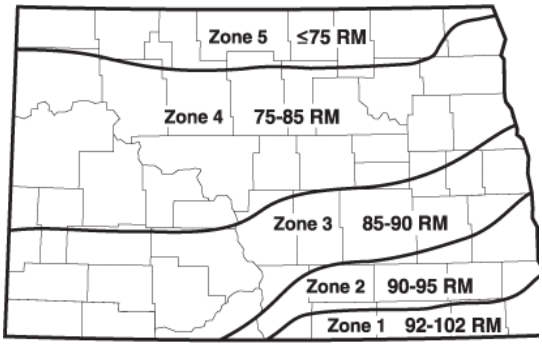
Aronia is a perennial, deciduous woody shrub that can have up to 40 or more stems at maturity. Aronia has a cold period or a rest period before flowering. Not much is known about the cold or rest period.

Growing

Aronia is a perennial, and can survive for several decades. Two years after planting the aronia shrub can produce at least two pounds of berries per bush when planted at eight feet in-row. By the third year production is about three to five pounds. Production levels off at 15-20 pounds of fruit by the fifth or sixth year. Pruning is required to keep the bush at a manageable size and to maintain yields. Pruning also helps with mechanical harvest. As the canes age they become less productive, for maximum yield and plant longevity remove canes that become larger than 1 inch in diameter. Aronia should be pruned during late winter or early spring before buds break. Alternatively, the plant should be cut back to the ground every 10 years and reestablished This will force the plant out of production for several years as it reestablishes itself. This is not recommended for commercial plantings as ten year old canes are usually too large to fit through mechanical harvesters.

Time to germination

Most Aronia is planted from a plug. Seedling starts require a period of stratification from 90-120 days in cold temperatures (34-41 degrees Fahrenheit) and moist.



Zones 3 – 8

Time to harvest

Aronia berries are pea sized, violet-black and hang in clusters of up to 12 berries. Aronia berries are harvested late August to early September. Fruit hangs well on the plant and allows a broad harvest of 4-6 weeks.

Harvest per season

The plant produces two crops spanning two seasons. Current year berries are harvested in the current season with second year buds developing for the following year's berries.

Manual harvesting methods

Aronia berries can be hand-picked. Berries grow in cluster with each group of berries taken from the stem. Berries can be picked as a cluster or individually. Berries picked in clusters will need to be de-stemmed later. Manual harvest is very labor intensive and recommended only for small crops with few plants.

Machine harvesting methods

Aronia Berry machine harvesting can be accomplished using a blueberry picker. Oxbo International Corporation has a line of blueberry harvesters that include self-propelled and tow-behind models. Oxbo International equipment is manufactured in the United States at locations in New York, Wisconsin, and Washington. Weremczuk Agromachines has developed half and a full row Aronia harvesters. Manufactured in Poland, Weremczuk Agromachines are available through Aronia Berry Services of Northeast Iowa. Both are currently being used in the Midwest. They use rapid agitation of slow-spinning fingers to remove fruit from canes. They do not de-stem fruit.

Oxbo 8000 Blueberry Harvester

Weremczuk Agromachines

Weremczuk Agromachines Joanna 4

Oxbo 930 Blueberry Harvester

Yield per acre

One acre
700 plants
20 pounds per plant
14,000 pounds of fruit per acre

$14,000 - $20,300 per ACRE!

Prepare for Market

Preparing to store – washing

Once fruit has been through the de-stemmer they are put into a water bath followed by a sanitizer solution. Berries are allowed to dry and frozen.

Preparing to store – packing

Fruit can be stored in any type of sealed container. Plastic containers and plastic bags are examples.

Storage – Conditions

Best stored frozen in a walk in freezer or home deep freezer depending on quantity.

Storage – length of time

Frozen berries can be stored for years until used.

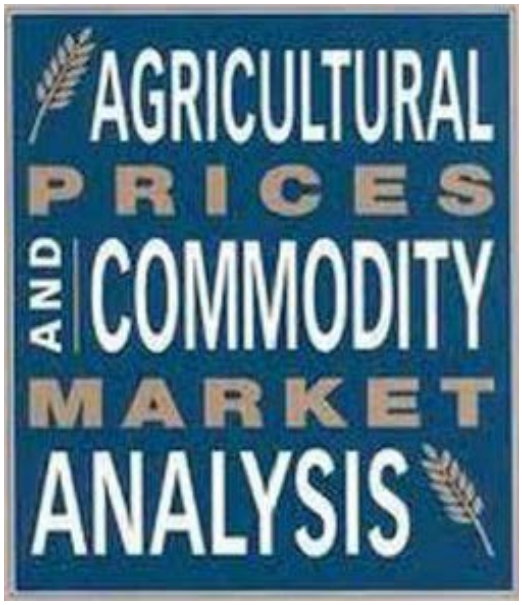
Transportation from field

Manual harvesting berries can be transported from the field with a flatbed vehicle. Mechanical harvesting fruit is dispersed from the harvester onto small fruit totes holding up to 40 pounds of berries. Totes are stacked on pallets, roughly 40 totes per pallet. Pallets are transported in a refrigerated truck and stored temporarily until washed and frozen. Large fruit totes measure 4' x 4' that hold between 900-1100 pounds of fruit are an option for large producers.

Transportation to market

Typically berries are transported by refrigerated truck unless hauled directly from the field to the end user. In some cases, end users go to growers and pick the product themselves.

Selling



Market price
Iowa State Extension lists the 2016 market at $1.00 to $1.45 per pound. Prices reported by members of the North Dakota Grape and Wine Association in 2017 ranged from $2.25 to $2.75 per pound.

Market price resources
Typically growers/buyers work out a buy/sell agreement or a broker negotiates price. Prices are typically set in December for the following growing season. Price may fluctuate based on berry quality.

Market price history
No publically reported market price is available.

Market demand
Aronia berry is overtaking the acai berry. Aronia berry is growing very popular; however, no publically reported trends in market demand are available.

Delivery considerations
As berries are frozen for storage a refrigerated truck is recommended.

Investment

Land
Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

Self-propelled and pull behind blueberry or Aronia harvesters. Manufacturers include Oxbo International and Weremczuk Agromachines. Refrigeration truck rental is estimated at $190/day and $.20/mile, refrigeration trailer rental is estimated at $110/day and $.05/mile without semi or driver.

Tools

For Manual harvest: fruit totes, gloves, pruners or scissors to remove the berries from the plant and ladders depending on how tall the plants are. Refrigeration truck rental is estimated at $190.00/day and $.20/mile, refrigeration trailer rental is estimated at $110.00/day and $.05/mile without semi or driver. Fruit totes price out at approximately $30.00 and higher depending on size. Fruit picking gloves range from $2.00 to $6.00 per pair. Berry pruners range from $25.00 to $50.00 with extended pruners priced from $65.00 and higher.

Fruit totes

Extended Pruners

Plant stock

Plugs can be purchased from Aronia Berry Services of Northeast Iowa, Burpee, Gurney's and other seed catalogs. Likely price per plug is $16.95.

Labor

No information is available on labor estimates for manual Aronia berries. Manual picking is known to be labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Carrots

Variety: Bolero, Nantesa Superior and Thumberline.

Planting & Growing

Field Conditions

Carrots prefer a sandy soil with a neutral pH. The optimum pH for carrots is between 6 and 6.5. Soil should be stone free and tilled deep so that carrots have room to expand. Soil should be well drained and loose (fluffy) to prevent the carrots from forking or stunting. To prepare a good seed bed till the soil deep and smooth the surface. Carrots will not grow well in acidic soils. Obtain soil samples to test for pH levels before planting.

Growing Conditions

Carrots are a good late season crop that tolerates frost well. Plant carrot seeds outside 3 to 5 weeks before the last spring frost date. Plant seeds roughly 3 to 4 inches apart with rows at least a foot apart. Gently mulch to help retain moisture, speed germination and protect the roots from sunlight. Carrots taste much better after a couple of frosts. Following the first hard frost in the fall cover the carrot rows with an 18 inch layer of shredded leaves to preserve them for later harvesting. Carrots are grown best in cool weather; they can be planted in early spring and left in the ground until fall.

Fertilizers

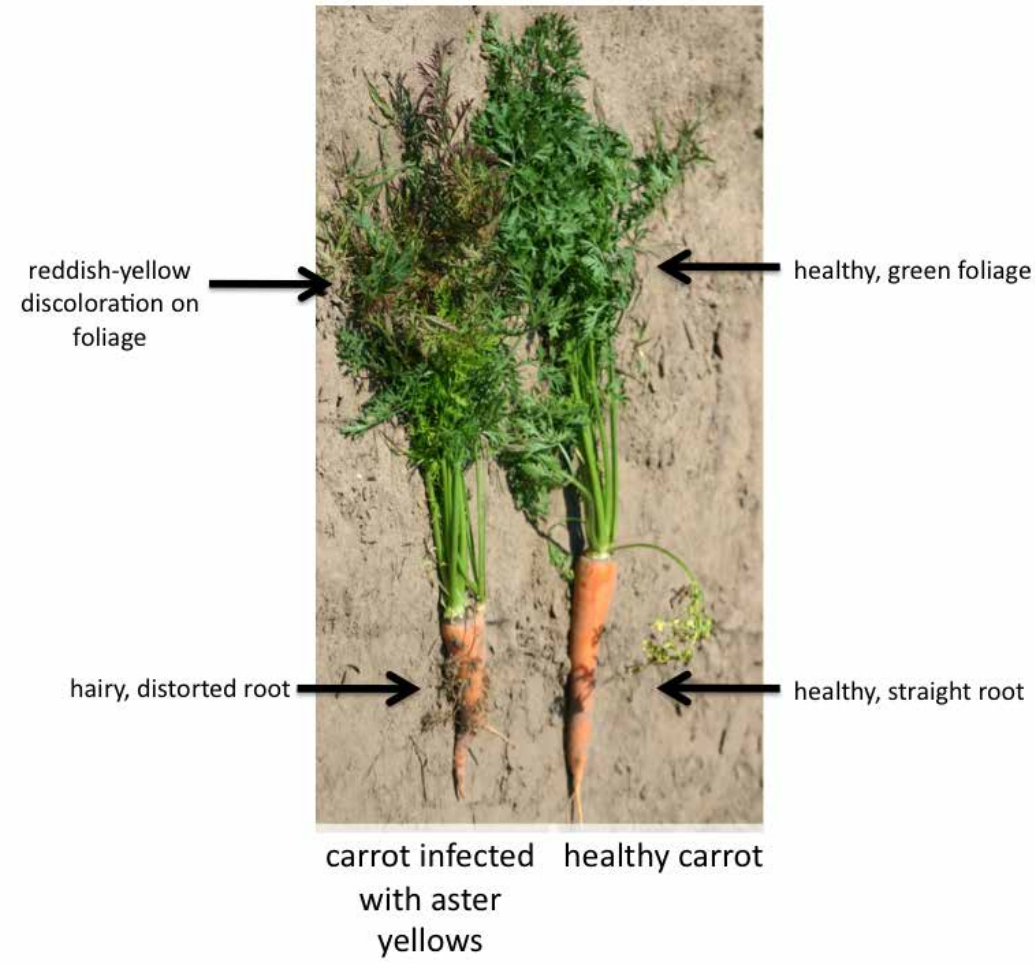
Fertilize within 5 to 6 weeks of sowing. Adding fertilizer to early or fresh manure to the soil can cause the crop to grow forks. Nitrogen requirements for carrots are typically 3/4 to 1 cup of urea for every 100 feet. Prior to applying fertilizer test soil to measure for pH and identify needed nutrients. If needed, apply half during seed bed preparation and side dress the rest during mid-season. You can improve soil conditions to by adding well-rotted manure or compost. DO NOT use fresh manure. DO NOT use weed and feed type fertilizers as they can kill the carrots.

Pest control

Carrots are tolerant to most pests and diseases. Some troublesome pests are wireworms, flea beetles, carrot root flies and aster yellow disease. Flea beetles will chew small round holes in the leaves, spread disease and destroy the crop when they are very young. Carrot root flies are maggots that will chew on the roots and can destroy the crop. A soil insecticide can be used at planting time to minimize carrot root flies. Aster yellow disease will cause shortened and discolored carrots tops with hairy roots. Keep carrots weeded as pests spread aster yellow disease by feeding from plant to plant. A good control plan for aster yellow disease is leafhoppers. Aster yellow disease can survive the winter.

Large lesions caused by flea bettle larvae

Wireworms



Plant stock
Carrots are biennials. Left in the ground the tops will flower and produce seeds the second year. Carrots are best planted from seed each year. Carrots can be seeded directly into the soil. Carrot seed can be purchased in bulk from seed companies such as Gurneys or Burpee. Carrot seeds are available at many other local suppliers such as Walmart, grocery stores, hardware stores and other variety stores. Your local hardware store might also carry seeds.

Planting
Carrots can be planted as early as April 15th. Plants should be thinned once they reach at least one inch tall. Plants should be thinned so they stand at least 2-3 inches apart. Snip plants with scissors instead of pulling them out to prevent damage to other roots. Water at least one inch per week.

Growing season
Carrots will grow through the entire planting season. Carrots planted in early spring can be left in the ground until after first frost in the fall.

Growing
Carrots like at least one inch of water each week. Water is important for good production. Soak the soil to promote healthy root development. Watering once a week is usually enough unless the carrots are planted in sandy soil where more frequent watering may be needed.

Harvest

Time to germination
Germination will begin as soon as the soil remains at 50°F for at least 10 days. At a higher temperature carrots could take up to 30 days to germinate.

Time to harvest
Carrots usually mature after about 2 ½ months. Carrots are ready for harvest when they reach ½-3/4 inch in diameter at the top or when desired maturity is reached. Carrots can stay underground for a longer period of time. The best flavor is usually found after the first few light frosts. Harvesting on a cool day is favorable over a warm day to avoid the roots from getting to hot.

Harvest per season
Typically there is one harvest per season. Harvest can continue through the season, once plants are at a desired size as you can keep carrots in the ground if the temperature is right up until the first frost of the year. Carrots can stay in the ground right up to until the ground becomes completely frozen.

Manual harvesting methods

Manual harvesting is very labor intensive. Manual harvesting requires a lot of bending and stooping. Tools needed to harvest carrots are minimal - gloves, a hand trowel to loosen the soil if needed and buckets or crates. Knee pads may be helpful. A trailer pulled by a 4-wheeler or tractor may be needed for larger harvests.

Machine harvesting methods

There are different types of harvesters on the market. The harvester needed will depend on the size of the operation. Garvesters by Asa Lift (Grimme), Dewulf, and Simon are available in self-propelled, tractor-trailed or tractor-mounted versions and will accommodate from one to six rows. Harvesters can be equipped with hoppers or an elevator for crates and big bags. The two m*ost* commonly used harvesters for carrots are: top lifting, and share lifting.

Top lifting

Top lifting harvesters are used to harvest carrots grown on ridges. The machine grabs the green tops of the carrots. The carrots are then fed into the machine where the tops are cut off and the soil is removed. Carrots are then conveyed to the hopper or elevator.

Share lifting

Share lifting harvesters are used to harvest carrots that are grown in beds. With share lifting harvesting the green top is removed before being lifted from the soil. Carrots are removed from underneath the soil and are placed on sieve chains. Sieve chains help remove excess soil. Carrots are then placed directly into crates.

Yield per acre

12,500 pounds per acre
$28.50/cwt
$.74 - $1.00/pound

$3,500 - $12,500 per ACRE!

Prepare for Market

Preparing to store – washing

Twist off carrot tops at roughly ¼ to ½ inch above the root shoulder. Scrub off dirt under cold running water. Allow to dry and seal in an airtight plastic bag. Refrigerate.

Preparing to store – packing

Carrots can be stored in tubs of moist sand for winter use. Carrots can be stored with dirt still on them or washed and allowed to briefly air dry before storing. One of the more popular ways to store carrots is to store them in large bins or crates that are lined with plastic sheets. The crates should be lined to allow for air circulation. Air should enter from the base and exit in a passive way via the top. This helps keep an ideal humidity of 98% and helps prevent mold or rotting. For example, loosely place roots in a food-grade 5 gallon bucket, drill a few holes in the bottom (3/8 or so in diameter) and in the lid of the bucket. This allows for proper ventilation while keeping humidity in check.

Storage – Conditions

Leave mature carrots stored in the soil as long as the ground doesn't freeze. Carrots can be stored for months, providing the stored roots are mature and have little damage; proper temperature and humidity are maintained. Preferred temperatures are 32-38 degrees F with a relative humidity of 98%.

Storage – length of time

When carrots are properly stored they can hold for a couple months.

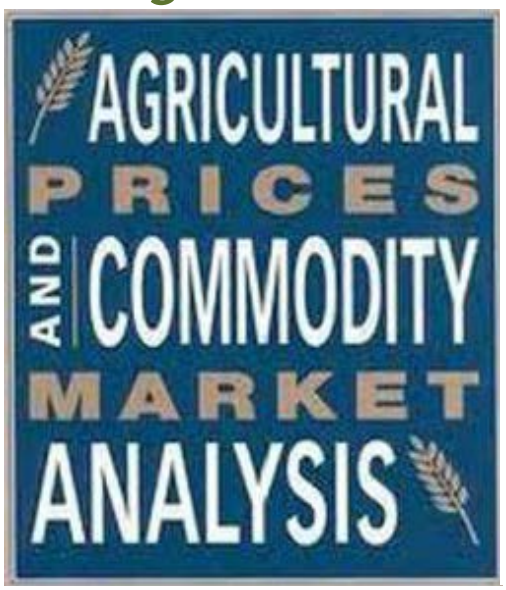
Transportation from field

With manual harvest a tractor and trailer can be used to remove the crates from the field. With mechanical harvest a larger hopper or elevator on the harvesting equipment may be used.

Transportation to market

A refrigerated truck that can keep the crop at the optimum storage temperature and humidity is recommended for transportation. There are four grades of carrots: US Extra No. 1, US No. 1, US No. 1 Jumbo, and US No. 2. Typically carrots are shipped in standard container, table cartons, table poly bags or poly jumbo cartons.

Selling



Market price

Supply and demand drive the general price for carrots. Consumption form is also a factor in determining market price (fresh, canned, or frozen). The average price for fresh carrots is $28.50 per cwt. Average retail price for raw whole carrots per pound is $0.74. In North Dakota, fresh carrot prices are $1.00 per pound.

Market price resources

US Department of Agriculture Economic Research Service - Fruit and Vegetable Prices. 2017 North Dakota Winery and Vineyard survey.

Market price history

No current publically reported market price is available.

Market demand

Demand for fresh carrots has held steady for the past 20 years with personal consumption at about 1.5 to 1.6 pounds of carrots annually.




Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

Machine harvesting can be done with a top lifter or share lifter harvesting machine. Asa Life (Grimme), Dewulf and Simon are industry recognized manufacturers of carrot harvesting equipment.

Ada Lift (Grimme) Carrot Harvester

Dewulf Carrot Harvester

Simon Carrot Harvester

Tools

Crates or containers for manual removal from the field and storage until processed for shipping. Crates start at approximately $30 depending on size and composition. Heavy duty work gloves range from $2.00 to $6.00 per pair. Foam kneeling pads range from $2.50 to over $20.00 depending on thickness and size. A trailer and 4-wheeler or flatbed truck is needed for manual harvesting to remove crates or containers from the field.

Plant stock

Carrot seed can be purchased in bulk quantity from a seed supplier. Seed catalogs will feature many varieties. Seed suppliers include Gurneys, Burpees, Abott & Cobb, Bejo Seeds, Breeders Seeds, Harris Seeds, Sakata, Bulk Seed Store and even Amazon. Bulk seeds start at $16.00/pound.

Labor

Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Currants & Gooseberries

Cultivars
Red Currant: Red Lake, Jonkheer van Tets, Rovada, Tatran

Black Currant: Ben Alder, Ben Lomond, Ben Sarek, Titania

White Currant: Blanka, White Imperial, Primus, Pink Champagne

Gooseberry: Porman, Oregon Champion, Hinnonmaki Red, Pixwell, Captivator

Planting & Growing

Field Conditions

Currants grow best planted on a northern slope with protection from direct sunlight. Another option is to plant currants along the side of a building or any shady structure. Avoid soil with poor air circulation which can increase the chances of powdery mildew. Sloping grounds also help prevent powdery mildew. Rich, well drained soils that have a high moisture holding capacity are preferred. Avoid sandy soils which do not hold moisture well. Adding organic matter to the soil such as compost, peat, or manure is beneficial to improve soils. This is especially important if soil is somewhat sandy.

Growing Conditions

Currants tolerate partial shade and prefer a cool, moist growing area. The ideal pH for currants is around 6.5. Currants like morning sun, followed by part shade in the afternoon and a lot of air circulation. Current leaves are easily sun burned. Plants do not tolerate soil temperatures exceeding 85^{o} F.

Fertilizers

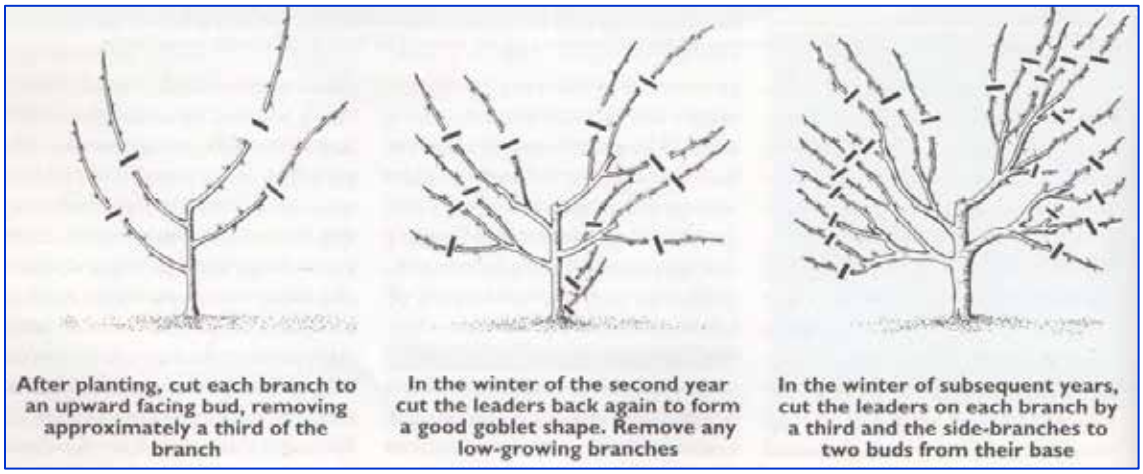
Currants feed heavily on nitrogen. To give currants a head start work manure into the soil. Annual top-dressing of composted manure is also beneficial. If plants are not vigorous lightly broadcast .25 to .5 pound of 10-10-10 fertilizer per plant. Avoid fertilizers that contain a muriate of potash (potassium chloride). Prior to applying fertilizer test soil to measure for needed nutrients.

Mulching

Mulching helps keep soil cool in the summer. Currants prosper in cooler soils. Mulch also helps retain moisture. Spread mulch around current plants to a depth of two to three inches. Replenish yearly as needed. Mulch options include: straw, lawn rakings, composted manure, compost, wood chips, or similar materials. Grass clippings make excellent mulch for currants. If using fresh straw or sawdust apply nitrogen fertilizer as these types of high-carbon mulches can tie up nitrogen as they decompose.

Pruning

The best time to prune currants is when the plant is dormant, typically late winter or early spring. Remove branches that lie along the ground and branches that are diseased or broken. Fruit is usually found on the strongest spurs of two or three-year-old wood. After the first year of growth remove all but six or eight of the most vigorous shoots. After the second year of growth leave four or five of the best one-year-old cane shoots and up to three or four two-year-old canes. By the third-year prune currants so that roughly three or four canes of each age class remain. At the end of the fourth year the oldest set of canes should be removed to allow new canes to grow. This rotating system of pruning allows the currants to remain productive.



After planting, cut each branch to an upward facing bud, removing approximately a third of the branch

In the winter of the second year cut the leaders back again to form a good goblet shape. Remove any low-growing branches

In the winter of subsequent years, cut the leaders on each branch by a third and the side-branches to two buds from their base

Pest controls

Currant aphids are the most common pest to affect currants. Currant aphids are tiny, soft-bodied insects that feed on the bottom of young leaves. Currant borers are moth larvae that burrow into the pith of currant canes. Infested canes do not die in the fall result in sickly spring growth. The adult currant borer typically appears in June and will lay eggs in leaf axils. To prevent the next generation of pests remove infected canes before June 1st. Destroy these infected canes to ensure to kill off larvae, eggs, or adult pests. Proper pruning helps minimize currant borer infestation. Currant stem girdlers are immature sawflies that eat around, or girdle the tips off of new shoots. To control currant stem girdlers, cut off affected tips in May or June to about three to four inches below the girdle. If left until later in the season cut affected tips to about 8 inches below the girdle.

Currant Aphid

Currant Aphid Damage

Adult Currant Borer

Currant Borer Larvae

Currant Stem Girdler

Powdery mildew affected currants

Anthracnose leaf spot on currant leaf

Diseases

Powdery mildew is a fungal disease. Powdery mildew is a powdery white growth usually appearing on the surface of leaves, shoots, and branch tips. Fungus can affect the berries. Powdery mildew thrives in warm, humid conditions with poor air flow. Prune infected branches and shoot tips in early spring. Horticultural oils may help prevent the spread of powdery mildew. Anthracnose and leaf spot can problematic in wet and humid years. Symptoms include brown spots, yellowing of leaves, and young stems with early defoliation. To prevent, destroy affected leaves and apply mulch after leaf drops.

Plant stock

Purchase strong, well-rooted plants from a nursery. Select one or two year old vigorous stock. Numerous nurseries carry currants. Nurseries include Awald Farms, Harvest Nursery, Honeyberry USA, Indiana Berry and Plant Co, LLC. Honeyberry USA is the closest nursery located in Minnesota. All forms of currants are deciduous shrubs and grow very fast under optimum conditions. The plant is a multiple-stemmed clump, can grow up to five feet tall and five feet wide. Annual growth is a single flush in spring where roots are superficial, fine, and easily damaged.

Planting

Plant the currants in early fall or very early spring before plants start to grow. Before planting stock remove damaged roots and head back the tops to about six to ten inches. Keep roots damp. Set the plant into prepared soil slightly deeper than their depth at the nursery. Firmly stamp the soil around the roots. Spacing is important and each cultivar has different spacing recommendations. At purchase planting instructions should provide specific cultivar spacing recommendations. As a rule currants should be planted three to five feet apart in row and eight to ten feet apart between rows.

Growing season

Depending on the cultivar, fruits ripen between 70 to 100 days after blossom.

Harvest

Time to germination

Plants are usually planted when they are one or two years old. If germinating from seeds it is important to enhance germination with scarification. Germinate with stratification at 28 degrees F to 35 degrees F for up to 60 days without scarification.

Time to harvest

To determine if currants are ripe monitor the color and flavor of the fruits as they develop. Another method to determine ripeness is to squeeze the fruit to determine to check for softening. Cool picked fruit quickly by placing in covered containers or closed bags to help maintain humidity levels and prevent drying when storing fruit in refrigerators. Expect first harvest after the third year. Harvest may last two to three weeks as currants remain useable for some time after they ripen on the bush. Picked berries should be immediately removed from direct sunlight and stored in a cool area until are processed.

Harvest per season
Currant plants hold onto their fruit very well. If fruit is to be stored pick dry. To avoid damaging fruit, pick the whole strig by its stem, making sure not to damage the spur. Currants will produce one harvest each season.

Manual harvesting methods
The easiest way to harvest currents and gooseberries is to cut whole stems and remove the berries from the stems. This also serves the dual purpose of pruning the plants during harvest. Currants and gooseberries can also be harvested off the stem like any other berry. Berries should be carefully removed into shallow baskets to prevent bruising. Currants and gooseberries are known to stain hands during picking, protective gloves are recommended.

Machine harvesting methods
Weremczuk manufacturers the Victor Z harvesting system with V-shakers used for harvesting currants and gooseberries. Harvester accessories include attachments to pick up small bushes, rollers for unloading, 1110 lb. totes, working lights, and a roof.

Yield per acre
Yields vary with general estimates three to ten pounds harvested from a single bush. An acre of currants will accommodate 700 – 1,700 plants depending on spacing and plant size. Yield per acre ranges from 2,100 pounds to 17,000 pounds. Gooseberries and black currents tend towards the lower end of the price range followed by respective increases with black currents and white currents. North Dakota wineries purchased black currents in 2016 at market prices ranging from $2.00 to $4.00 per pound.

Yield per acre

2,100 - 17,000 pounds per acre

$4,200 - $61,200 per ACRE!

Prepare for Market

Preparing to store – cleaning
Currants and gooseberries are delicate. Do not rinse under water. Dip in cool water to rinse then drain. Spread a clean, dry terry cloth towel on a slanted surface with one end propped up. Gently roll currants down the towel. Allow to fully dry before freezing or storing.

Preparing to store

To freeze currants and gooseberries arrange dry, fresh berries in one layer and place in a freezer. When frozen, transfer berries to freezer bags or containers. Properly frozen currants and gooseberries will last for up to two years.

To dry currants and gooseberries cover a flat with cheesecloth or light muslin. Spread berries on the cloth; place the tray in the sun to dry for approximately 2 days turning once or twice. Set the tray in a warm, dry place and let stand until leathery to the touch. Store dried berries in a cool, dry place.

Package unprocessed currants and gooseberries in paperboard cartons, wooden boxes, or bags; corrugated or millboard cartons to transport on pallets.

Preparing currants on a flat sheet to freeze

Gooseberries drying on cheese cloth

Storage – Conditions

Containers for storing currants and gooseberries should be no deeper than 4 inches to keep the berries fresh. Currants and gooseberries can be frozen in plastic containers or bags. Currants and gooseberries can be dried and stored in plastic containers or bags.

Storage – length of time

Currants and gooseberries can be stored covered in refrigeration for five to seven days. Frozen currants and gooseberries can be stored up to 12 months at a temperature range from 39^{o} F to 68^{o} F with relative humidity of 60-70% or 12 months at 44^{o} F with a relative humidity of 50-60%. Store dried currants and gooseberries up to one year.

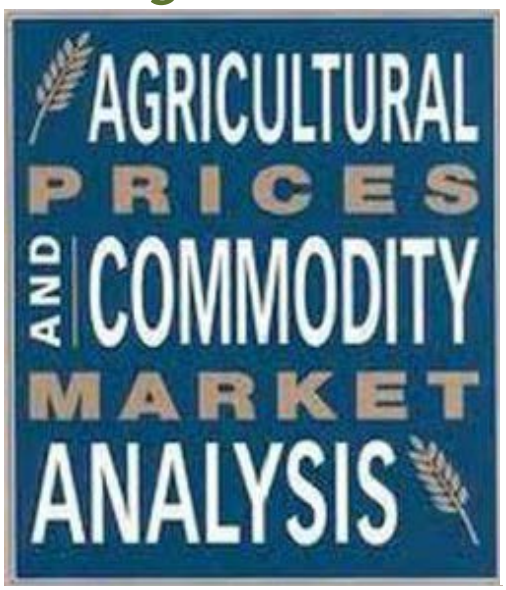
Transportation from field

With manual harvest a tractor and trailer to follow behind the pickers helps transport the produce from the field. With mechanical harvesting the harvesters typically have pull behind trailers that allow removal from the field.

Transportation to market

Can be transported by ship, truck, or railroad, it is very important to have cool, dry, and good ventilation.

Selling



Market price

Current market price for currents and gooseberries is $2.00 - $3.60 per pound for retail marketing. No wholesale prices are available.

Market price resources

2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey. University of Kentucky. USDA.

Market price history

No current market price history is available.

Market demand

Research indicates white, red and black currants, as well as gooseberries, have excellent potential at local markets. Gooseberries have the greatest potential for fresh market sales. Gooseberries are relatively easy to grow and local supply can quickly be exhausted by customer demand. Preserving berries for sale during off-season may also be a way of diversifying agriculture.

Delivery considerations

Packages are sensitive to impact damage. Carefully packaging will help protect the fruit during transport. Cargo should be stowed and secured during transport to minimize shifting or slippage and damage. When berries are frozen a refrigerated truck with freezer is recommended. Fresh market delivery should be in a refrigerated truck.

Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

The Victor Z harvester adjusts several types of berry bushes planted in espaliers without supports such as currents and gooseberries. Minimum between row spacing is 14 feet. The Victor Z harvesting system shakes the fruit off of the bush. Options include a pull behind model which requires a tractor, or as a full row harvester. Harvesting equipment used for blueberries and Aronia berries are also adaptable to currants and gooseberries.

Tools

Manual harvest requires gloves and containers to catch and store the berries until removed from the field. Gloves range from $2.00 to $6.00 per pair. Containers typically start at around $30.00 each. Step ladders may be helpful for taller bushes. Commercial fiberglass step ladders start at about $100.

Plant stock

Nursery plant stock currant bushes will start at $9.00 and up depending on size and cultivar. As with market prices, black currant bushes are typically more affordable than red currant bushes followed by white currant bushes being the most expensive. Nursery plant stock gooseberry bushes will start at $7.50 and up depending on size and cultivar.

Labor

Manual picking is known to be labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

It is estimated that it will take approximately 10 hours for production and 40 hours for harvest on a 1/5 acre parcel. This does not include processing.

Grapes

Cultivars:
Aspen Glow, Baltica, Bluebell, Brianna, ES 12-6-18, ES 5-4-71, ES 6-16-30, ES 8-20-43, Frontenac, Frontenac Gris, Frontenac Blanc, St. Croix, King of the North, LaCrescent, Louise Swenson, Marquette, MN 1131, MN 1200, Petite Amie, Prairie Star, Sabrevois, St. Pepin, Somerset Seedless, Valiant

Planting & Growing

Field Conditions

Grapes prefer soil that is slightly acidic to neutral with a pH range from 5.5 to 7.0. Imbalanced soils can be corrected by adding lime to increase the pH or sulfur to reduce the pH. A sandy loam is the best type of soil for grapes as it drains well yet still holds moisture. Sandy loam soils also have large amounts of organic matter which is important for grape production. Silt loams and clay loams also work well permitting they drain well. Soil can be improved by adding different types of organic matter to make the soil better suited for growing grapes. For example, heavy clay and silty soils will benefit from vegetable and manure compost while sandy soils can benefit from composted organic materials such as peat moss and humus.

Growing Conditions

Grapes like full sun. If full sun is not available, select a site where the grapes will enjoy morning sun. A small amount of afternoon shade is okay. Grapes also grow well on south facing hills.

Fertilizers

Do not fertilize first year grapes unless needed due to soil conditions. Always tests soil before applying any type of fertilizer. In the second year, a light fertilizer can be applied.

Pest controls

Animals that bother grapes are birds, deer, and rabbits. To protect grapes from wildlife install a deer fence with chicken wire around it to protect from rabbits and deer. A bird net will protect the grapes from birds. Wildlife can be harmful to the grape stand.

Deer fence around grapevines

Bird netting on grapevines

Aphids

Troublesome insects for grapes are aphids. Aphids can be found on young shoots and the underside of young leaves. Aphids are usually dark brown in color. Aphids usually do not pose a large threat to grapevines, only grapes. Japanese beetles are also known to be problematic for grapes. Japanese beetles are rarely observed in North Dakota due to climate conditions.

Black rot on grape
How a fungus overwinters

Powdery mildew

***Mycelium**: vegetative part of a fungus usually consists of a network of fine white filaments.*

Diseases

Black rot fungus can cause significant damage to grape production. Frontenac, Frontenac Gris, and Marquette are somewhat resistant. Black rot can affect the entire plant but the most significant losses happen when berries get infected. Young leaves are susceptible to infection as they unfold but once mature are usually hardy enough to resist the infection. Berries are susceptible to infection immediately prior to bloom through four weeks after bloom. Controls to prevent black rot are to make sure debris is cleaned up yearly. This reduces the chance of the fungus overwintering. Pruning is crucial as it allows air to flow throughout the plant which promotes leaf drying. Fungi prefer moist areas. Powdery mildew can appear on leaves at chlorotic spots on the upper leaf surfaces. Signs of the pathogen appear soon after as a white, webby mycelium on the lower leaf surface. Season long control is important as this pathogen emerges early in the spring.

Plant stock

Select vigorous 1-year-old plants. Nurseries may hold back weaker 1-year-old plants to continue growth then release for sale as 2-year-old stock. Obtain certified virus free stock when possible. Most nurseries have this option. Recommend networking with other grape growers in North Dakota for recommendations on nurseries before purchasing grape vines.

NORTH DAKOTA GRAPE & WINE ASSOCIATION

http://www.ndgwa.org/

Planting

Plant dormant, bare-root grape vines in early spring. Construct a trellis before planting, as grape vines will need to be trained on a vertical support. A trellis must be sturdy as grape vines become very heavy as they grow. A trellis also helps cut back the risk of disease. Install the trellis that can allow for a mesh net above and around the vines to protect the fruit from birds. Before planting grape vines soak the roots in water for two to three hours. Space vines six to ten feet apart. Each vine should be planted in a hole 12 inches deep and 12 inches wide. Fill the hole with four inches of topsoil, and trim off broken roots. Set the vine into the hole and cover with 6 inches of topsoil. Tamp and tamp down and fill the hole with soil. Do not tamp down. Prune the top of the vine back to two or three buds when planting. Water vines well at the time of planting. Mulch can be useful to hold moisture around the base of the vines.

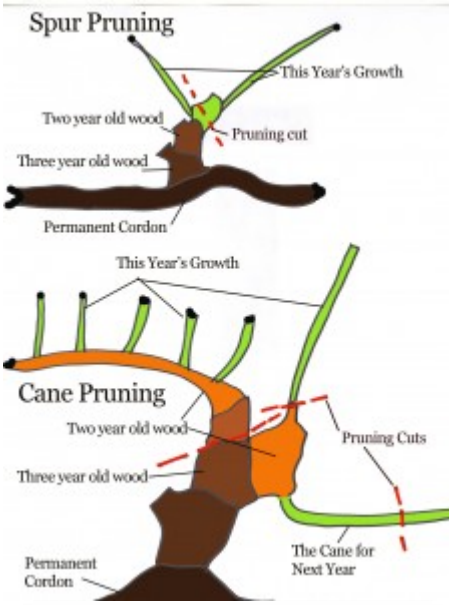
Examples of functional & ornamental grape trellis

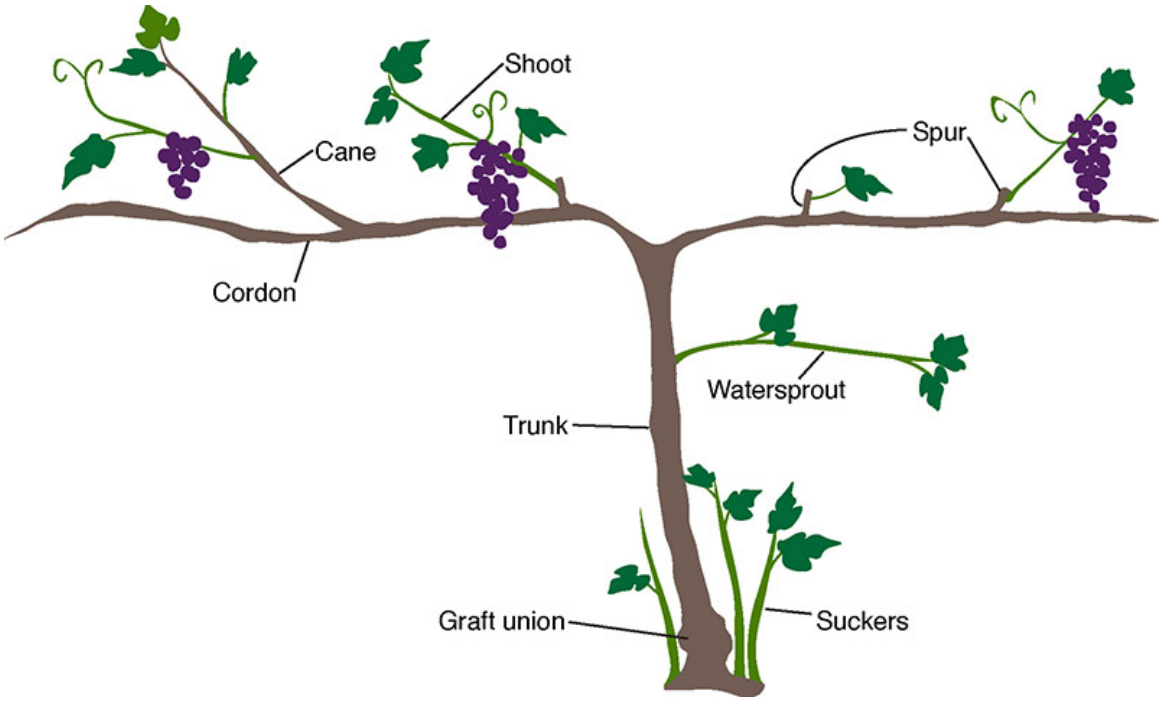
Growing season

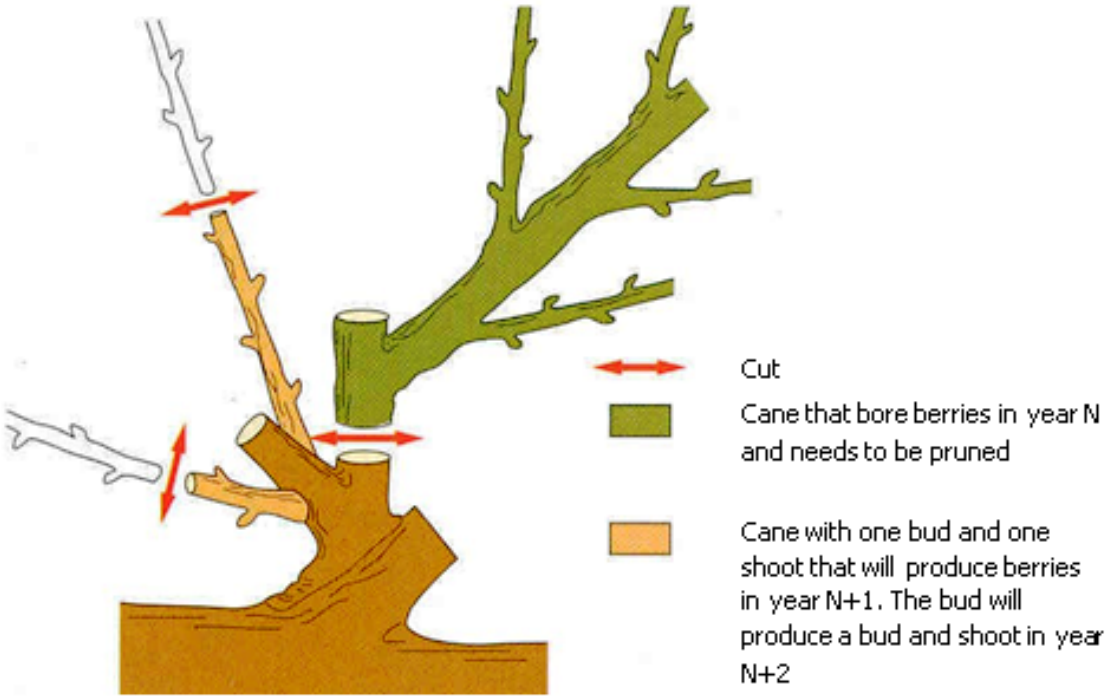
Allow a few seasons for vines to grow strong and mature before the plant produces fruit. Fruit laden vines are very heavy and canes can break without a strong enough plant to support the fruit.

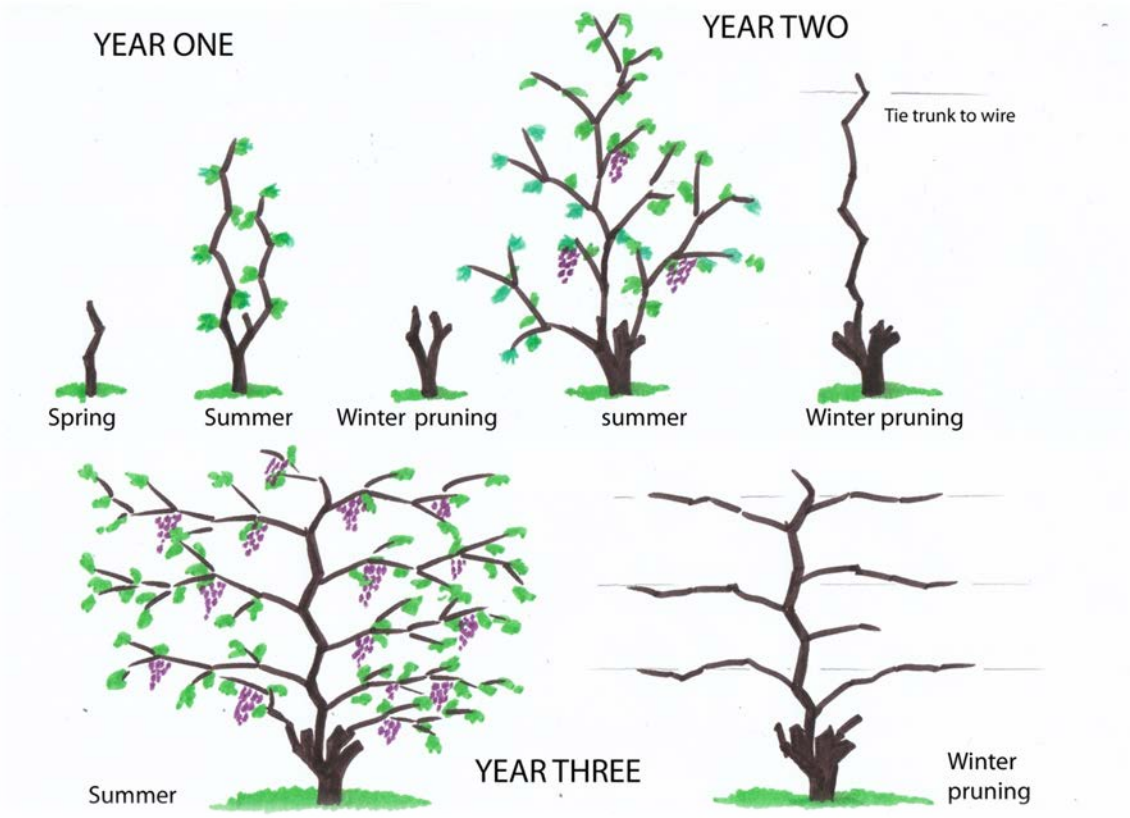
Growing

Pruning is important to keep vines healthy and ensure canes produce fruit each season. Prune annually when vines are dormant, usually in March or April when buds start to swell and you can assess if overwinter damage is observed. Remove up to 90% of growth from the previous season. This encourages a higher quality grape. Increased pruning will increase fruit production. In the first year cut back all buds except two or three. Select a few strong canes and cut back the rest ensuring the remaining canes are fastened to the support structure. In the second year prune back all of the canes leaving a few buds on each arm. Remove flower clusters as they form. Harsh winter weather can cause injury or even kill vines. Grapevines usually regrow from low on the trunk. Pruning may need to be limited for a year while you determine how much of the vine has died. Grapevines have a large root system and regrow quickly.






Cut
Cane that bore berries in year N and needs to be pruned
Cane with one bud and one shoot that will produce berries in year N+1. The bud will produce a bud and shoot in year N+2


YEAR ONE
YEAR TWO
Tie trunk to wire
Spring
Summer
Winter pruning
summer
Winter pruning
Summer
YEAR THREE
Winter pruning

Harvest

Time to harvest

During the first couple of years vines should not be allowed to produce fruit. The plant needs the first few years to strengthen its root system to build strength to hold the weight of the fruit. Once the vines are grown and begin bearing fruit some of the foliage can be pinched back to allow for more sunlight. This will help ripen fruit on the vine. Make sure flavor content is at the desired level before picking. Grapes will not continue to ripen after picked. Grapes are ready to harvest when they are rich in color, juicy, full of flavor, are easily crushed and plump. Sampling different clusters is a good way to see which grape are ripe and which grapes need more time on the vine.

Harvest per season

One harvest each year usually occurring in late summer or in the early fall.

Manual harvesting methods

To harvest grapes, clip full clusters off of the vine with a pruning shears or a heavy-duty scissors. Handle grape clusters carefully. Remove injured or undesirable berries. Cool the harvested grapes as soon as they are picked. Grapes are typically packed into 30 pound boxes, also called lugs. Grape clusters are consolidated into ½ ton bins or two-ton bins on tractors that follow the picking crew down the rows.

Machine harvesting methods

Most commercial harvesters utilize pivotal strikers or trunk shakers to remove fruit from the vine. Pivotal strikers use flexible, horizontal rods that strike the canopy and knock the fruit loose. Trunk shakers use rails that move back and forth to shake the upper trunk of the plant and the cordon. A cordon is a plant trained to grow flat as a single horizontal shoot or two diverging horizontal shoots in a single line. It is estimated that mechanical harvesting can reduce labor costs up to 75%.

Oxbo 3016 XL Pivot striker

Trunk shaker

Yield per acre
6,920 pounds per acre
$.60 - $1.00/pound

$4,100 - $6,900 per ACRE!

Prepare for Market

Preparing to store – washing

To extend the shelf life of grapes, do not wash grapes until they are ready to use. To prepare for freezing take off the stems, wash grapes carefully under cool running water. Remove grapes that are broken or show signs of decay. Rinse for 30 to 60 seconds. Pat dry.

Preparing to store – packing

Grapes should not be rinsed off before storage. Extra moisture from washing will speed up the decay process. If grapes are to be frozen place in a single layer on a cookie tray and put in the freezer. Once grapes are frozen, transfer to airtight containers or heavy-duty freezer bags and return to freezer.

Storage – Conditions

Do not store grapes with other fruits or vegetables as grapes can absorb odor from other fruits and vegetables. Store grapes in cardboard boxes or crates lined with clean, dry straw. Sawdust also works well. Keep clusters separate. Storing grapes in a refrigerator where temperature and humidity can be regulated is preferred over storage in a cellar where temperature and humidity can fluctuate. When storing in a refrigerator cover grapes loosely with plastic to reduce moisture loss. Grapes can be stored in a refrigerated place for up to two weeks. Frozen grapes, properly stored, will maintain their quality for about 10 to 12 months, and remain useable beyond that time.

Transportation from field

How you harvest will determine how you remove grapes from the field. With manual harvesting a tractor and trailer is preferred to follow pickers. With mechanical harvesting it will depend on the harvester. Self-propelled harvesters will store the fruit and allow you to leave the field with harvested grapes on the machine.

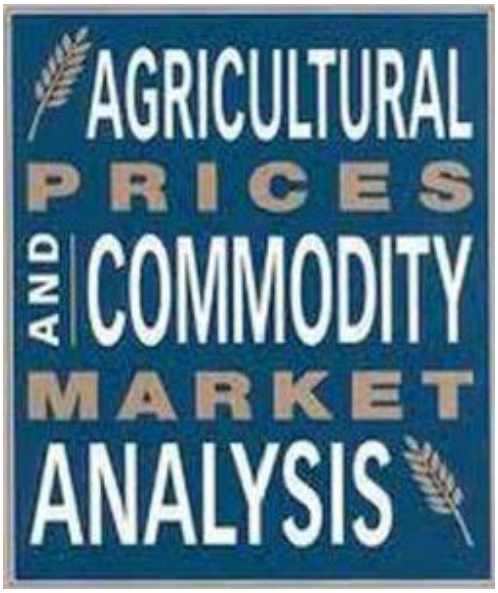
Transportation to market

Grapes can be transported to market via truck, railroad, ship or aircraft. Grapes should be shipped in a refrigerated container or truck with fresh air supply or controlled atmosphere. Grapes are highly sensitive due to their relatively think skins and must be handled with care. Required refrigeration temperatures must be maintained even during cargo handling and transfer. In damp weather (rain, snow, grapes must be protected from moisture to avoid premature spoilage. Grapes should be segregated from other fruits or vegetables to avoid absorbing their odors. Exact transport temperatures may vary depending on the variety. Grapes with high sugar content may be maintained slightly below freezing. Grapes with low sugar content require temperatures above freezing. To avoid shriveling relative humidity should be approximately 90-95%.

Selling

Market price

North Dakota wineries paid prices from $.60 to $1.00 per pound in 2016.



Cultivar/Variety	*Price*
Brianna	$.60/pound
Edelweiss	$.60/pound
Foch/Millet	$1.00/pound
Frontenac	$.60 - $1.00/pound
Frontenac Gris	$.80 - $1.00/pound
King of the North	$.70/pound
LaCrescent	$.60 - $.70/pound
Marquette	$.85 - $1.00/pound
Petite Amie	$.60/pound
Prairie Star	$.70/pound
Riesling	$.60/pound
St. Pepin	$.60/pound
Steriox	$.60/pound

Market price resources

Market prices were obtained through a recently completed 2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey. 40% of North Dakota's wineries and 37.5% of North Dakota's vineyards participated in the survey.

Market price history
No market price history is available for North Dakota grapes. California grapes saw a rise in market price of 25% for red wine grapes and 15% for white wine grapes in prior years.

Market demand
40% of North Dakota's wineries participated in the 2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey. Of those participating wineries over 69,000 pounds of grapes were purchased for wine production in 2016. Of these same survey participants over 53,600 bottles of wine were produced in 2016. Production for 2017 – 2019 is estimated at over 89,000 bottles annually by the same survey participants. Total bottles produced include grape, fruit and vegetable wines.

Delivery considerations
Almost without exception North Dakota wineries are interested in entering into advanced contracts with grape growers. Survey participants identified the following characteristics of a desired advanced contract partner: Ripe fruit, clean fruit, delivery to the winery, delivery based on wine production schedule, adequate quantities (no small quantities), consistency, reliability, fair prices for both seller/buyer, and industry involved supplier

Investment

Land
Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment
Oxbo Corporation, American Grape Harvesters, New Holland, Pellenc America and Plantra Incorporated offer complete lines of American manufactured grape harvesters. Grape harvesters include self-propelled or pull behind models. Grape harvesters allow for row spacing and desired pick system.

Tools

Manual harvest requires pruning shears or a heavy-duty scissors to cut grape clusters from the vines. Baskets to pick grapes that are then transferred to containers used to carry grapes to and from the field. Containers used for storage should be no deeper than 4 inches. Gloves and ladders may be helpful. Gloves range from $2.00 to $6.00 per pair. A heavy duty fiberglass step ladder will cost approximately $150.00. A professional quality pruning shears will start at about $50.00 and a heavy duty scissors at $30.00.

Plant stock

Grape vines should be purchased as hardy and vigorous one-year-old plants from respectable nurseries. If possible, ensure vines are tested and virus free.

Labor

Annual pruning and manual picking are known to be labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.




Juneberries

Cultivars:
Alpina, Atlaglow, Forestburg, Gardener, Green, Honeywood, JB-30, Martin, Northline, Paleface, Pembina, Smokey, Thiessen, Regent, Williams

Planting & Growing

Field Conditions

Juneberries can be grown on a wide range of well-drained soil. Sandy loams are ideal with a pH range of 5.5 to 7.5. Juneberries benefit if planted on a slight slope, especially a Northeast slope. Avoid cold pockets as the spring flowers could be lost due to frost.

Growing Conditions

Irrigation during establishment and fruiting will increase a successful harvest. Once fruit is established trickle irrigation is the most efficient. In dry years, increase irrigation to insure plant establishment and fruit production. Juneberries prefer full sun to partial shade.

Fertilizers

Juneberries need little fertilizer. Prior to applying fertilizer test soil to identify needed nutrients. If new growth is weak apply a handful or two of a complete fertilizer (5% nitrogen, 10% potash and 10% phosphate) to the area beneath the dripline of the bush in early spring before new growth begin.

Pest Controls

Juneberries are susceptible to Fabraea leaf spot, powdery mildew, fire blight, and cedar-serviceberry rust. These tend to be minor as most cultivars have a slight resistance to them. The main insect pest for this area is the leaf miner, plum curculio, and the pear slug sawfly.

Fabraea Leaf Spot

Powdery Mildew

Cedar Serviceberry Rust

Fire Blight

Pear Slug Sawfly

Pear Slug Sawfly Larvae

Leaf Miner Life cycle

The biggest concern with Juneberry production is birds as they will completely strip the plant of their fruit. Use netting to keep birds out. Screens and netting are nearly 100% effective in fruit protection. Mice, rabbits, and deer can also cause harm. Control weeds with non-chemical means as there are no herbicides currently registered for commercial fruit production. Weed control methods such as mulch, shallow cultivation or hand weeding have been proven to be beneficial. Deep cultivation can cause root damage and allow suckers to develop. If the crop is irrigated, grasses can be planted between rows.

Bird Netting

Plant stock

US nurseries supply juneberries for ornamental use, not fruit production. Successful propagation includes: plant division, tissue culture and root cuttings. Hardwood cuttings are difficult to root but softwood cuttings, if taken at the correct growth stage, are easier to root. Propagate from seeds that have been subjected to cold stratification; however up to a third of the plant will differ from the parent. Healthy plants 1 to 2 feet tall are best for transplanting.

Planting

Transplant vigorous young Juneberry bushes when they are between 12 to 24 inches tall, taking care with fibrous roots. Set plants two to three inches deeper than they grow in the propagation bed. Encourage suckering for maximum yield. Planting depth should be twice as wide as the root ball of the plant and as deep as previously potted.

Growing season

Plants usually blooms in early spring (Late April to mid-May), with fruit forming 6-8 weeks later in late May or early June. Fruit ripens up to 38 days after petal fall. Juneberries will begin to bear fruit 2 to 4 years after transplanting; with significant yields after 6 to 8 years and maximum yields at 12 to 15 years. Well maintained plantings can be productive from 30 to 50 years.

Growing

Irrigation in the beginning is crucial for establishment. Juneberry bushes can grow as high as 18 feet in ideal conditions. Juneberries require regular pruning usually during late winter or early spring. Flowers develop on older growth; vigorous new growth yields produce good quality fruit. Remove weak, diseased, and low-spreading branches. Propagation can be done by suckers, by dividing crowns, or with root cuttings or seeds.

Harvest

Time to germination

Seeds are the most economical way of propagation. Seedlings will differ from the parent plant in size and fruit characteristics. Seedlings grow slowly and require 2 to 4 years before transplant. If sowing seeds directly in the soil make do in late summer. Roughly 25% of seeds will germinate the following spring.

With root cuttings take a piece of root the diameter and length of a pencil in the fall and refrigerate for two months to satisfy dormancy requirements. The cuttings may be taken in early spring when plants are still dormant. Promote sprouting by pretreating root cuttings in poly bags filled with moist peat moss and store in the dark for 3 weeks at 70°F. Shoots will appear in 2 to 4 weeks at which time the root pieces can be put in a seedling flat, covered with a non-soil medium and placed in a greenhouse. Allow to grow for an additional 2 weeks, removing the cuttings to a moist bed to root. Keep root pieces moist and shaded until new shoots have developed (several inches long and thick for their length). Suckers can be dug in early spring when the plants are dormant and prune the tops back to about two inches above the roots. Plant the suckers in shaded rows or in a shady spot and keep moist. Crown division can be taken from plants that are 5 years or older and can provide anywhere from 10 to 25 divisions. Transplant the divisions into sandy soil which then stimulates the development of well rooted side shoots.

Root Cutting

Suckers

Time to harvest

The earliest possible fruit production is within 2 years if not planting seeds. With seeds expect 2 to 4 years before the seedling will be large enough to transplant plus another 2 years before fruit is produced. A general rule for harvesting is to wait until at least two-thirds of the fruit are fully ripe to begin harvest. Harvest the fruit in early morning when the fruit is dry and cool. When harvesting pick into shallow containers no deeper than 6 inches, to avoid damage. Refrigerate the fruit quickly to prevent spoilage.

Harvest per season

Harvest once per season.

Manual harvesting methods

The fruit can be hand-picked fresh for market. A hand-held mechanical shaker, or a fruit rake can also be used.

Fruit Rake

Handheld mechanical shaker

Machine harvesting methods

Hand held mechanical shakers can be used for larger scale operations. Over the row harvesters are available for larger scale producers. Consult the manufacturer before planting to ensure plant spacing and field layout accommodates equipment. Machine-harvested fruit requires additional cleaning and sorting before fresh or processing markets. Both the Littau Harvester Company's over-the-row harvester and the Oxbo 8000 Blueberry harvester have shown promise in trials harvesting juneberries.

Littau Over-the-row Harvester

Oxbo 8000 Blueberry Harvester

Yield per acre

A mature plant may yield anywhere from 10 to 15 pounds of fruit per shrub. Juneberries should be planted with in row spacing 2.5 feet and between row spacing of 6 feet for manual harvest. Manufacturer specifications for mechanical harvesting will determine between row harvest spacing. A typical acre will hold 1200 to 1400 Juneberry shrubs at full maturity.

Yield per acre

10 – 15 pounds/shrub
1200 – 1400 shrubs/acre
12,000 – 21,000 pounds/acre
$5.00/pound

$60,000 - $105,000 per ACRE!

Prepare for Market

Preparing to store – washing

Gently remove dirt by rinsing Juneberries under cool water in a colander. After washing spread the fruit out and allow to fully dry. Allow drying or Juneberries will clump together when frozen. Wait to wash berries after they thaw for use. Washing beforehand can result in tough skin.

Preparing to store – packing

Pack in plastic container, large freezer bags or vacuum seal. Flash freeze and store in low temperature freezers. For home production the berries can be frozen successfully in a home freezer.

Storage – Conditions

Fruit should be stored in low temperature freezers.

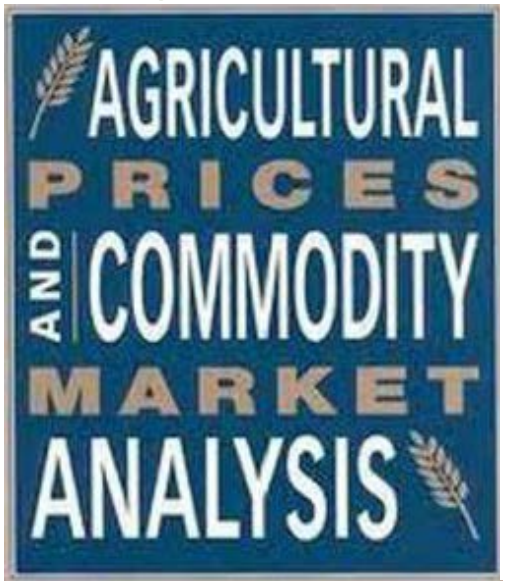
Storage – length of time

Flash frozen berries can be stored for 2 years.

Transportation from field
Berries must be picked in shallow containers (no more than 6 inches deep) to prevent damage to the fruit. The berries must be refrigerated soon after being picked. A flatbed trailer or cart can be used to quickly remove berries from the field.

Transportation to market
Ship cold. Can be shipped with other fruits.

Selling



Market price
2017 market price for juneberries is $5.00/pound. Juneberries compare to blueberries with a current market price of $4.73/pound (University of Kentucky).

Market price resources
University of Kentucky and USDA National Retail Report: Specialty Crops. Juneberry prices compare to blueberries.

Market price history
No publically reported market price is available.

Market demand
Fresh berries are used to produce jams, syrups, juices, pies, rolls, wine, and sweetbreads. Berries are also be dried and sold similar to raisins. Most people are generally unfamiliar with juneberries. Most commercial juneberries are grown in Canada, where reports indicate a growing interest in juneberries including: fresh market, commercial processing, and freezing industries.

Delivery considerations
Berries are frozen for storage. A refrigerated truck with freezer is recommended. Fresh market delivery should be in a refrigerated truck.

Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

Harvest will require a trailer and something to pull it. For larger production an over the row harvester may be required. Littau Harvester Company's over-the-row harvester and the Oxbo 8000 Blueberry harvester show promise in trials harvesting juneberries.

Tools

Shallow containers cost $10 - $25 depending on size and composition (wood, bamboo, composite). Fruit picking gloves are $2.00 to $6.00 per pair. Orchard ladders range in price from approximately $180 up to over $400 depending on height and composition (wood, aluminum, composite). Refrigeration truck rental is estimated at $190.00/day and $.20/mile, refrigeration trailer rental is estimated at $110.00/day and $.05/mile without semi or driver. Handheld mechanical tree shakers are not manufactured specifically for Juneberries, although Olive or nut shakers may work. Mechanical tree shakers price out upwards of $50,000 and more depending on size, age and condition.

Plant stock

Local nurseries or seed catalogs may have available plant stock, but usually do not stock for starting a large operation. They are more suited for ornamental shrubs than fruit production. A recommended option for purchasing Juneberry plant stock is to purchase directly from farms that are already producing Juneberries commercially. Some nurseries with stock are Aubin Nurseries, Boughen Nurseries, Foothills Greenhouse, or Jeffries Nurseries in Manitoba; Jarvis Blushke, Honeywood Lilies and Nursery, and J. Boughens Wholesale Nursery in Saskatchewan.

Labor

Labor needed for a mature 1/5 acre planting is approximately 8 to 12 hours for production, 60-80 hours for harvest and 10-15 hours for packing and grading. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Pears

Cultivars: Orient, Carrick, Waite, Kieffer, Magness, Moonglow, Ure, Starking Delicious, Dawn, Anjou, Spalding, Warren, Golden Spice

Planting & Growing

Field Conditions
Pear trees grow best in fertile sandy, well drained, loam soil a pH of 6 to 6.5.

Growing Conditions
Pears prefer full sun and need air circulation in the winter and early spring.

Fertilizers
Do not directly apply fertilizer when first planting a pear tree. Test soil to measure for pH and identify needed nutrients. Apply compost and aged manure before planting if needed. Ammonium nitrate can be added after the pear tree is established, typically after one year.

Pest controls
Aphids feed on pear leaves and cause curling. Aphids also feed on young shoots which can cause stunted growth. Damage is usually minor compared to when aphids feed on the fruit. Aphids produce a substance called honeydew which gives the pears a darker appearance and a black fungus can grow from the honeydew. Aphids are usually a rare find in pear orchards. If identified in small amounts other insects will usually eat them.

Pear Aphids

Pear Psylla

Pear Blister Mites and Rust Mites are invisible to the naked eye and are common on unsprayed trees. Mites are found feeding on developing fruit caused depressed russeted spots that look like blisters on the pears.

Identify mites or mite damage during the dormant season, just before bloom. Seek professional help for chemicals that can provide control. Pear psylla is one of the most serious pests for pears as they are resistant to most insecticides. Pear psylla is usually found on European varieties where they cause loss of crop, affect tree vigor and result in loss of trees. Pear psyllas produce honeydew that allows a black sooty mold to grow on the fruit. Pear psyllas produce a toxin which when injected into the tree cause portions of the leaves to blacken. Pear psylla cause severe plant damage. For control introduce other insects such as green or brown lacewings. A natural population of moths will eat pear psylla. Pear psylla is resistant to most insecticides. Monitoring pear trees is the best defense. Application of one or two dormant spray oils may reduce population during overwintering.

Pear Mite Blister

Rust mites

Diseases

Fire blight disease threatens pears. Fire blight can be controlled through variety selection, limiting use of nitrogen fertilizer, summer pruning and spraying for the disease if observed. During summer pruning remove fire blight-infected spurs and shoots a week or two after petal fall. Prune the trees 6 inches beyond the visible infection. After pruning remove and destroy pruning debris to prevent spread.

Fire Blight

Powdery mildew overwinters in leaf buds and flower buds. Infections on the leaf underside cause chlorotic patches or spots on the upper side of leaves. Infected leaves crinkle or curl. Affected blossoms will be covered with the fungus. The tree may have less fruit or the fruit may appear stunted. Powdery mildew can usually be controlled with applications of fungicides.

Powdery Mildew

Plant stock

Plant self-sterile pear trees of different varieties and same-time bloomers. Buy one year old grafted whips about 5 feet tall, ½ to ¾ inches thick with smooth even bark.

Planting

Plan to grow at least two different varieties of pear trees. This is crucial for the trees to pollinate. Plant compatible varieties. Standard sized trees should be spaced 20-25 feet apart, while dwarf varieties can be spaced 12-15 feet apart. When planting container-grown trees remove the plant from the pot

and remove any circling roots by laying the root ball on its side. Use a shears to cut through roots. Dig a hole a few inches deeper and wider than the spread of the roots. Set the tree top on a small mound of soil in the middle of the hole. Spread the roots away from the trunk without excessively bending them. Do not add fertilizer or topsoil to the hole.

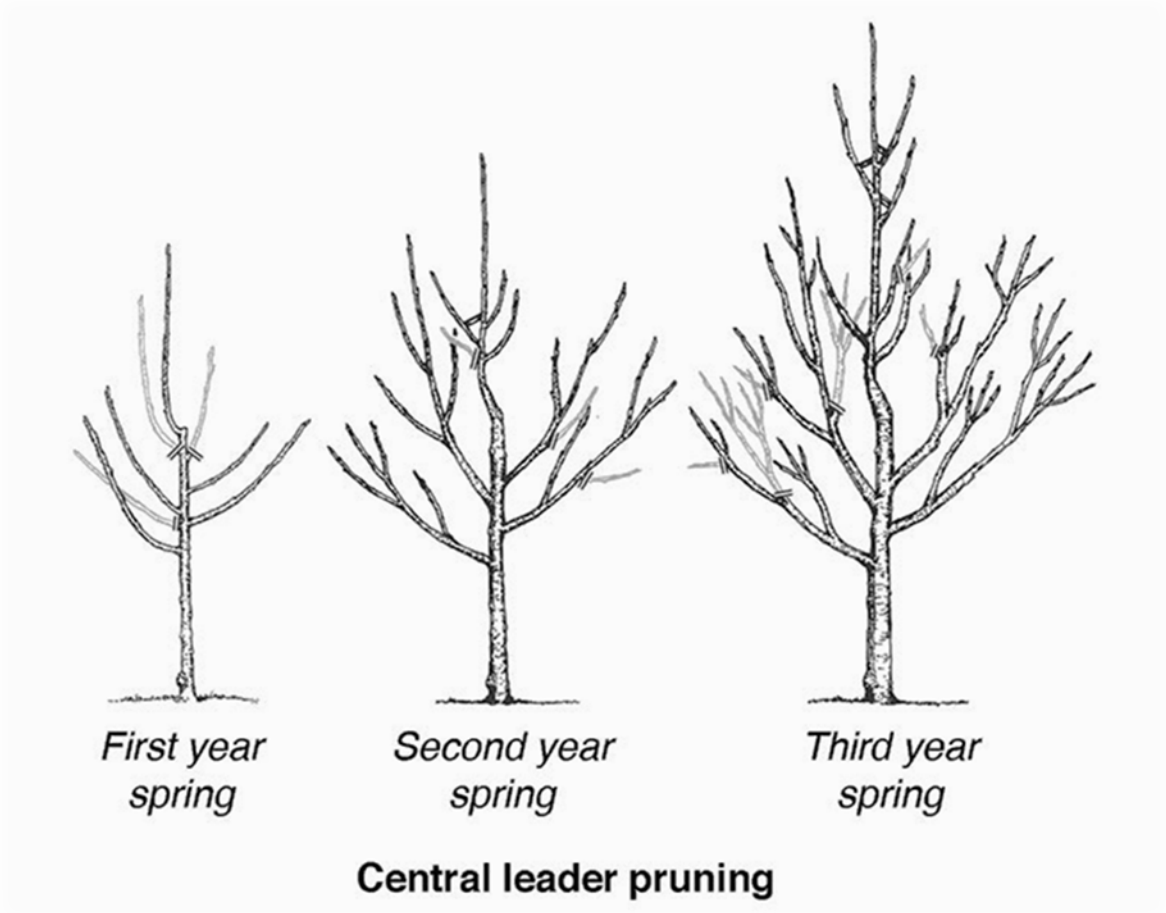
Growing season

Pears grow annually. Once planted pears continue to grow every year. The growth cycle includes a dormant season, flowering season, fruiting, and harvest season. During the dormant season conditions help determine the kind of fruit harvest in the upcoming year. Pear trees require roughly 600-900 chill hours, below 45° F. Fruit harvest will be better with more hours at 45° F. The dormant season is also the best time to prune pear trees. Flowering season is usually during spring and is the ideal time to add fertilizer. Prior to applying fertilizer test soil to identify needed nutrients. Too much or too little fertilizer can hurt the plant.

Fruiting season is during summer. Protect trees from excessive water loss during dry summer months. Drip irrigation or sprinklers work very well. Harvest occurs in the fall. Harvest depends on variety type. After harvest fertilize and water trees as in the spring. Remove any fruit or leaves ground debris to help prevent spread of diseases or pests.

Growing

Water the young trees well during dry periods to help establish the root system. Apply a small amount of fertilizer early in the year. Add about 1/8 pound of ammonium nitrate per tree multiplied by the number of years the tree has been in the soil. Use less fertilizer with fertile soil. If the leaves are pale green or yellowish during the summer add more fertilizer the following spring. If trees grow more than 12 inches in a year cut back on fertilizer. Prune dwarf trees to a central leader system. Prune standard trees to a central leader system or a modified leader system which is easier to maintain. The central leader system features a central trunk with branches that spiral out every 5-8 inches. Make sure no branch is directly above another. Training for each system begins in early summer of the first year during which time shoots within 18 inches of the ground should be removed. The result should resemble a Christmas tree. Use spreaders to help shape the branches of the tree outward instead of upward. When branches are small push the branches away from the main trunk with clothespins. For bigger branches use wooden slates with a “V” shape notched in each end. Prune trees regularly, generally very lightly. Thin the fruit out as well leaving roughly 6 inches between each cluster of fruit per branch. After the trees are established water regularly.



Harvest

Time to germination

Pears are not planted via seed nor do they grow by their own root systems. Pears are grafted onto rootstock which allows pears to grow like a tree.

Time to harvest

Harvest pears when they are mature but still hard to the touch. Pears will ripen at room temperature. Pick pears when the fruit has a slight yellow blush but is still green. Pears need to be cooled to ripen properly. The longer they are chilled the faster they will ripen once at room temperature. Optimum temperature is 30^{o} F. Pears will not freeze at this temperature as the pear's sugar acts like antifreeze.

Harvest per season

You Harvest once a year. Pears, like apples can be a longer harvest. Pears are harvested between August and November.

Manual harvesting methods
Gently twist the pears free. Fruit firmness can be measured with hand picking. Gently place the pears in a bin or crate using care not to drop and damage or bruise the fruit. Use a ladder for hard to reach pears. Immediately place pears in cold storage with a preferred temperature of 31-35° F.

Machine harvesting methods
Most commercial pear orchards hand pick to ensure fruit is properly ripened.

Yield per acre

218 – 242 trees per acre
150 – 250 pounds per tree
54,500 – 60,600 pounds per acre
$1.43 per pound

$56,800 - $86,500 ACRE!

Prepare for Market

Preparing to store – packing
Carefully place pears in cartons or bins to prevent bruising or damaging.

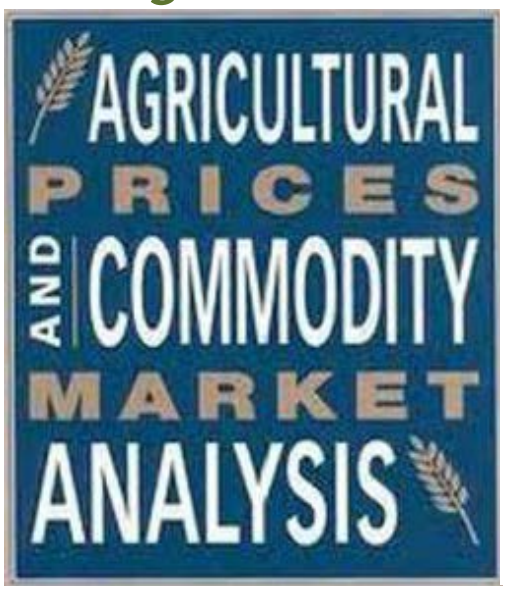
Storage – Conditions
Store the pears in a refrigerated room with temperatures at 30-35° F. This is the optimum temperature for cooling pears down and allows them to quickly ripen at room temperature.

Storage – length of time
Pears can keep in containers in a cool, dark place at 40° F for 1 to 2 months. Pears can be refrigerated for a week. Pears picked before first blush can be stored up to 3 months.

Transportation from field
Use tractors or ATVs to pull trailers holding bins or crates to remove the fruit from the field. Use a trailer or small vehicle that will fit between rows.

Transportation to market
As pears need to be held at 30 to 35° F a refrigerated truck will prevent pears from ripening.

Selling



Market price resources
USDA National Retail Report: Specialty Crops.

Market price
Pears sell at about $1.43 per pound.

Market price history
Market prices have remained steady since 2015.

Market demand
Pears are the number two produced fruit in the US.




Delivery considerations
Pears should be kept chilled until they are ready to be ripened. Pears should be refrigerated at 30 to 35° F until ripening.

Investment

Land
Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Tools

Pear baskets or buckets are $10 - $15. Fruit picking gloves are $2.00 to $6.00 per pair. Orchard ladders are $180 to over $400 depending on height and composition. Refrigeration truck rental is estimated at $190.00/day and $.20/mile. Refrigeration trailer rental is estimated at $110.00/day and $.05/mile without the semi or driver.

Labor

Manual picking is known to be labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.






Notes

Plums

Cultivars: Bavay's Gage, Big Blue, Howard Miracle, Methley, Pembina, LaCrescent, Pipestone, Seneca, Stanley, Toka, Underwood

Planting & Growing

Field Conditions
Plums grow best in well drained, moderately fertile, loamy soil with full sun.

Growing Conditions
Avoid planting plums in low areas where frost may settle as frost can damage the tree. Plant trees in a sheltered position in south or west facing spots out of the wind. This will allow the tree to set fruit.

Fertilizers
Do not fertilize plum trees until after they have set a crop. Once the plum tree is established fruit production will require some fertilizer. With a decent fruit set fertilize with 1 pound of calcium nitrate per tree or 1 ½ pounds of 10-10-10 fertilizer. Cut back nitrogen in the fall and winter to avoid new growth.

Pest controls
Plum maggots, Plum moths and Plum Sawfly tunnel through fruit making them inedible. To prevent insects and their larva spray deltamethrin or lambda cyhalothrin in mid-June. Apply a second application three weeks later. Wasps are attracted to the fruit's high sugar content. Harvest as soon as fruit ripens to avoid wasp damage. Do not leave debris or over-ripe fruit on the ground.

Plum Maggot

Plum Sawfly

Plum Moth

Plum Maggot damage

Brown Rot

Bacterial Cankers

Diseases

Brown rot is a fungal disease that causes brown spreading rot in fruit. Occasionally white pustules of fungi appear on the surface. Brown rot is usually worse in wet summers and when there is minimal air flow. Remove and destroy all rotten fruit when first noticed. This will help prevent brown rot. Bacterial cankers can cause sunken, dead areas of bark often accompanied by gummy ooze that can kill off entire branches. To avoid bacterial cankers keep up with pruning and ensure debris does not build up around the plum tree. If cankers have appeared prune back to healthy wood and paint the wood with wound paint to protect the wound from re-infection.

Plant stock

Planting stock usually consists of 3-6-foot-tall trees with a diameter of 3/8-3/4 inch trunk. A vigorous hardy tree is preferred.

Planting

For container-grown trees, remove the plant from its pot and remove all circling roots by laying the root ball on its side. Cut through the roots. For grafted trees, keep the graft union at least 1 inch above the soil line. Dig a hole that is a few inches deeper and wider than the spread of roots. Set the tree on top of a small mound of soil, be sure to spread the roots away from the trunk without excessively bending them. Space standard-sized trees 20-25 feet apart, and dwarf trees 15-20 feet apart.

Growing season

Plum trees begin producing fruit in about four years depending on variety.

Growing

Plum tree varieties may require cross-pollination to produce fruit. Some varieties can produce fruit on their own. To prevent the branches from breaking under the weight of the tree, thin plum trees. Prune back broken branches back to undamaged wood. Cut back to a natural fork to avoid leaving stubs. To promote growth, water young trees heavily every week during the first growing season. Water trees into mid-October to store moisture for winter. Rake up debris in the fall. This lowers the risk of diseases or pests overwintering. Prune in early spring or mid-summer to avoid infection. The best time to prune is spring for young trees and mid-summer for more established trees. To prevent winter injury consider a tree wrap or guard around the lower trunk, especially for a young plum tree.

Harvest

Time to germination

Most plum trees are planted as 3 to 6 foot tree stock. Plum trees can be germinated from plum pits. To germinate from a plum pit wash the pit in lukewarm water with a soft scrub brush to remove pulp. The pit (seed) needs a chilling period for germination at a temperature between 33 to 41° F. The pit should germinate in about 10-12 weeks. One method to accomplish stratification is to wrap the pit in a moist paper towel and keep the pit inside a plastic bag placed in the refrigerator for 6-8 weeks. Look for sprouts periodically as it could sprout earlier. Once sprouted remove and plant the pit in a container with well-drained soil consisting of part vermiculite and part potting soil. Plant the pit at about 2 inches deep. Keep the pot in a cool bright area. Keep the soil moist. After danger of frost, transplant the plant outside mixing compost in the soil. Plant at 2 inches and tamp the soil around the plant. Another method is to plant the pit directly into the soil in the fall or winter. Plant the pit about 3 inches into the soil and make sure to mark the planting. Leave the plant over the winter months and watch for sprouting.

Time to harvest

Check plums for ripeness by applying gentle pressure with your fingers. If the skin of the fruit feels soft it is ready to be picked. Plums should easily come off the tree with a light twist. Plums can be harvested slightly early when they are still firm and stored in a cool place to fully ripen.

Harvest per season

Plums are usually harvested in August and September.

Manual harvesting methods

Plums should easily come off the tree with a slight twist. Branches can bend safely to bring the fruit closer for harvest. Manual harvest is recommended as not all the fruit is ready to harvest at the same time. Place harvested plums gently in containers to avoid bruising which may cause the fruit to rot. Once harvested quickly transport plums to refrigerate or freeze for later use.

Yield per acre

81 trees per acre
82,000 plums per acre
14,462 pounds per acre

$23,100 - $28,900 per ACRE!

Prepare for Market

Preparing to store – packing

Plums bruise easily. Packaging should ensure that plums are stored with the least potential for bruising. Damaged fruit will leak juice and pulp which can attract insects, dirt and damage adjacent fruit. Boxes or pallets should have adequate stacking strength.

Storage – Conditions

Plums can be stored in a refrigerator. Plums can also be stored by freezing them or dehydrating them. Dried plums are prunes. To freeze plums, wash and let dry. Slice plums into wedges and remove the pits. Lay the wedges on a flat sheet to freeze the plum wedges. Place frozen plums in a food storage bag or bin.

Storage – length of time

Plums do not store well for very long. Plums continue to ripen after picking. Plums should be stored at room temperature, away from sunlight and heat until they give softly to the touch and have a sweet aroma. Once ripe, refrigerate plums as necessary to prevent spoiling. Refrigerated plums may last anywhere from 2 to 4 weeks. Cold temperatures may change the texture and taste of plums. Frozen plums will keep for several months up to a year. Freeze plums at their peak flavor and ripeness as under ripe plums lose flavor when thawed.

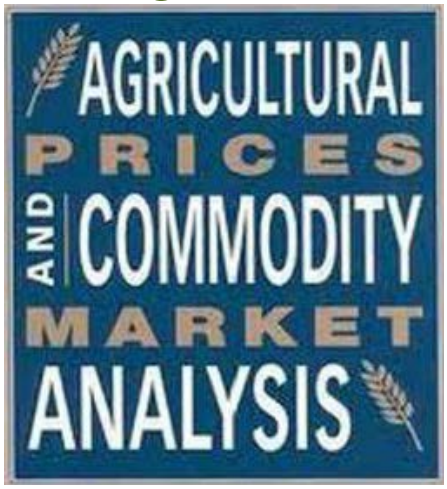
Transportation from field

Transport flats or baskets of plums from fields with a trailer and tractor.

Transportation to market

Plums do not store well for very long. Transport plums in a refrigerated truck to ensure plums do not prematurely ripen.

Selling



Market price

In 2016 North Dakota wineries paid $1.60 to $2.00 per pound for plums.

Market price resources

2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey.

Market price history

Market price history remains steady.

Market demand

Prunes are higher in demand than fresh plums. Fresh plums are seasonal. North Dakota wineries reported purchasing 1,100 pounds of plums in 2016. Market demand for plums dropped in the early 2000's recovering somewhat due to increased promotion of the health benefits of plums and prunes. Per capita consumption of prunes and plums is between .5 and 1.0.



Delivery considerations

Plums ripen quickly. Plums should be delivered right before they ripen. If possible deliver early to ripen at their final destination.

Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

Harvest will require a trailer and something to pull it.

Tools

Plum baskets or buckets are $10 - $15. Fruit picking gloves are $2.00 to $6.00 per pair. Orchard ladders are $180 to over $400 depending on height and composition. Refrigeration truck rental is estimated at $190.00/day and $.20/mile. Refrigeration trailer rental is estimated at $110.00/day and $.05/mile without the semi or driver.

Labor

Manual picking is known to be labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.




Pumpkins

Cultivars: Magician, Magic Lantern, Apollo, Hannibal, Gladiator, Aladdin, Solid Gold, Growers Giant

Planting & Growing

Field Conditions

Vines can spread from 50 to 100 square feet. Pumpkins require a lot of room to grow. Pumpkins like the soil to be warm. Pumpkins like full sun to light shade. Allow enough room for the plants so the vines can grow out. Pumpkins are big feeders and prefer rich, well-drained soil, but not too soggy.

Growing Conditions

Pumpkins require a lot of food and long growing period, usually 75 to 100 frost free days. Late May planting in northern locations is the best option. Wait for threat of the last frost has passed and the soil is warm so the seedlings will not be injured or die. Soil should be at least 60° F at least three inches beneath the surface. Pumpkins need a constant supply of water throughout the growing season. Compost and aged manure mixed in the soil before planting is beneficial for pumpkins. The optimum soil pH should be between 5.8 and 6.6 with minimum soil compaction.

Fertilizers

Perform Soil testing annually to determine nutrients needed. Without soil testing the recommended N-P-K application rates are 80-150-150 broadcasted or 40-75-75 banded. If soil calcium levels are low or low to medium and no lime applications have been applied gypsum should be applied in rows where seeds will be planted. Gypsum adds calcium to the soil without affecting pH.

Pest controls

Cucumber beetles and squash bugs attack seedlings, vines in both mature and immature fruit. Populations are usually high in late summer. Watch for infestations as there can be damage to the flesh of the pumpkin making them less likely to store well.

Cucumber Beetles

Winged aphids usually bring in viruses, while wingless aphids usually live on the leaves causing damage there. The squash vine borer is a problematic pest to any vined plant. Observed symptoms are plant wilt. Wilting may only occur in strong sun at first. Holes will be seen near the base of the plant filled with moist greenish or orange sawdust like material called Frass.

Squash Bug

Winged Aphid

Wingless Aphid

Squash Vine Borer

Diseases

Powdery Mildew causes a white powdery mold growth on the surface of leaves. This growth can kill the leaves and interfere with proper ripening.

Powdery Mildew

Frass

Plant stock

Pumpkins grow best when planted directly in soil as seeds. Pumpkins can be started inside then transplanted outdoors. Most seeds can be bought through seed catalogs such as Burpee or Gurneys, Walmart, Amazon, home improvement and farm supply stores.

Planting

Drip irrigation allows fertilizer application throughout the growing season and ensures plants get adequate moisture. Pumpkins are generally planted in single rows at 30-40 inches between plants and 8-12 feet between rows. When planted using this spacing an acre will produce 1600 to 2800 plants. Honey bee hives are beneficial for pollination. One hive per acre is recommended. In areas of short growing season start seeds indoors in peat pots about 2-4 weeks before the last spring frost. Harden off the plant before transplanting. Pumpkins will germinate faster when planted in pumpkin mounds. Pumpkin mounds or pumpkin hills are the size of a small baseball pitcher mounds. Pumpkin mounds help support drainage and aid pest control.

Growing season

Pumpkin growing degree days (GDD) range from 75-120 days. In northern climates select a variety with a shorter GDD as frost and cold weather can damage pumpkin crops.

Growing
Thin to 2 to 3 plants per hill when plants are 2 to 3 inches tall by snipping off unwanted plants. Do not disturb the roots of the remaining plants. In rows thin plants to one plant every 18 to 36 inches. Pumpkins need a lot of water. Water the plants thoroughly at least 1 inch per week. Water the plants deeply during fruiting. Try to keep foliage and pumpkins dry unless it is a sunny day. Excess dampness might encourage faster rot. Install mulch around the plants to hold in moisture, suppress weeds and discourage pests. Poor light, too much fertilizer, poor weather at blooming and reduced pollination affect fruiting.

Harvest

Time to germination
Pumpkin plants take 7 to 10 days to emerge from the ground. If nothing sprouts after 10 days replant.

Time to harvest
Hand harvest pumpkins at their mature stage of color and size. A pumpkin is ready to harvest when the rind feels hard and the pumpkin sounds hollow. Press into the pumpkin's skin. If the skin resists puncture the pumpkin is ripe.

Harvest per season
Fruits can be pollinated at different times throughout the growing season potentially resulting in multiple harvests during one growing season.

Manual harvesting methods
To harvest you can cut the fruit off the vine with a sharp knife or a pruner, be sure not to cut too close to the pumpkin, a good length is 3-4 inches this will also increase the length of how long the pumpkin will keep. Handle the fruit very carefully as they bruise very easily. After harvested pumpkins should be allowed to cure in the sun for about a week, this allows the skin to toughen and then should be stored in a cool, dry room.

Machine harvesting methods
A "pumpkin plow" is a V-shaped front-mount blade that moves pumpkins into windrows. The harvester runs down the rows where a large wheel fitted with sharp spikes pokes into the pumpkins, lifting them up to be dumped into a wagon hopper. Another machine harvesting option is an attachment to the front of a tractor that spreads the pumpkins which are then vacuumed up with a pull behind attachment.

Yield per acre

1600 – 2800 plants per acre
6 -18 pounds per pumpkin
$.11 per pound

$1,000 - $5,500 ACRE!

Prepare for Market

Preparing to store – washing

Pumpkins usually do not require washing. Most dirt can be brushed off.

Preparing to store – packing

Stabilizing pumpkins on quarter filled sand bags, soft Styrofoam or foam to allow the pumpkin to form to the base. This will prevent the pumpkins from rolling and bruising during transportation. Pumpkins can be packaged in shallow stackable crates.

Storage – Conditions

Store pumpkins in a cool, dry area to extend the shelf life of the crop and prevent shrinking. Pumpkins will stay nice looking for anywhere from 2 to 3 months if stored at a relative humidity of 50-70% and temperatures of 50-55^{o} F. The area should be a well-ventilated.

Storage – length of time

Pumpkins can store well between 2 and 3 months.

Transportation from field

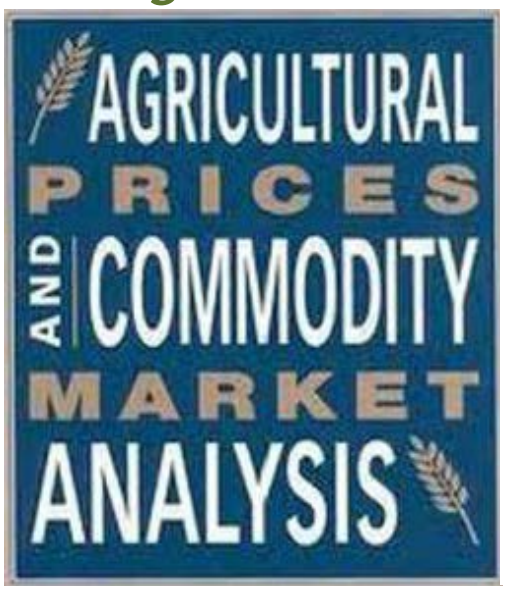
For manual harvesting use a tractor and flatbed trailer to transport the pumpkins.

With machine harvesting pumpkins will be picked into an attached rear trailer connected to the tractor. Once pumpkins are harvested they can be removed directly from the field.

Transportation to market

Transportation to market will require a truck and trailer. A large load storied in crates will require a forklift or other mechanism to easily lift the crates on and off of the trailer. Manual packing and unpacking is another option however may result in bruising.

Selling



Market price resources

USDA National Retail Report: Specialty Crops.

Market price

Pumpkins have a market price of $.11 a pound as a food commodity. Pumpkin prices will be higher for seasonal decorative purposes. Prices of $3.00 to $10.00 for decorative purposes are observed.

Market price history

Market prices increased slightly from 2011 to 2015. Market prices remain relatively steadv.

Market demand

Pumpkins are usually in high demand anywhere from late August through October. Pumpkin sales rose 34% between 2009 and 2014 in part due to an increase in use for pumpkin fruit and spices in food and drinks.

Delivery considerations

Pumpkin travel well if packed securely. Cool, dry conditions are needed. Pumpkins do not need to be refrigerated.

Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

For manual harvest a flatbed trailer and a tractor to remove the pumpkins from the field are needed. For mechanical harvest attachments to a tractor remove row and mound planted pumpkins.

Tools

Manual harvest requires gloves, pruning shears and a sharp knife. Gloves average $2.00 to $6.00 per pair. Pruning shears cost $20 - $50 as does a good sharp knife with replacement blades. Some type of a field lift may be needed for extremely large pumpkins.

Plant stock

Bulk pumpkin seeds start at about $18.00 per pound. For smaller quantities, pumpkin seeds can be bought in 25 seed packages for about $2.00 a pack.

Labor

Manual picking is labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Raspberries

Purple cultivar: Royalty

Red cultivars: Autumn Bliss, Boyne, Autumn Britten, Caroline, Encore, Festival, Heritage, Killarney, Latham, Nova, Prelude, Polana, Summit

Black cultivars: Black Hawk, Bristol

Planting & Growing

Field Conditions

Raspberries grow on any soil type but prefer soil that is slightly acidic to neutral with a pH level around 6. Prepare soil with compost or aged manure a couple weeks before planting.

Growing Conditions

Raspberries prefer full sunlight. Mulching helps the ground stays moist near the plants. Raspberries love water. Make sure raspberries get at least one inch of water per week. The roots of raspberry plants shoot up canes. Pruning back shoots allow the remaining canes to produce more berries. Red raspberries have a bushy growth habit and grow well on a garden fence or trellis. Black and purple raspberries need more space and are best grown as a thicket with a mowed perimeter. High tunnels will extend the growing season.

Fertilizers

Raspberry plants are heavy feeders and need fertilizer. Composted manure is a good source of nutrients and can be incorporated into the soil prior to planting. Composted manure can also be added to established plants.

Pest controls

Cane Borers present the greatest pest threat to healthy raspberries plants. Cane Borers usually lay their eggs in first-year canes of raspberry plants. Once hatched cane borers cause severe damage to the canes. The damage is usually minor but can lower fruit production.

Rabbits can cause damage to raspberry canes in winter. Rabbits and some dogs will eat the fruit from raspberry bushes. A simple chicken wire fence will help prevent any damage.

Male Spotted-Wing Drosophila

The spotted-wing drosophila will burrow through berries making the fruit soft and unappealing. Females may lay eggs which could cause fruit to rot. Keep the ground around the plants free of debris will help prevent the spotted-wing drosophila from causing damage.

Japanese beetles chew on the leaves of raspberry plants causing the leaves to look like lace. The best way to eliminate Japanese beetles is to take a bucket of soapy water and flick the beetles into the water.

Diseases

Cane diseases can reduce or destroy a crop in summer-bearing raspberries. The most common cane diseases in red raspberries are cane blight and spur blight. The most common disease for black raspberries is anthracnose. Spur blight is both a leaf and a cane disease. Spur blight can cause the edges of leaves to yellow and die. Spur blight stands out as a chocolate brown or purple spot right below where leaves attach. Cane blight infections start where a wound might have occurred on the canes. The infection causes cankers that start out as reddish-brown streaks on the bark. Anthracnose cane can be identified by sunken pits in the bark. The spots are usually white to pale tan or occasionally a purple red.

Improving air flow through the raspberry patches can help avoid cane diseases, along with making sure no debris builds up under and around patches. Gray mold can affect the fruit, canes, blossoms, and stems. Gray mold is most common on fall-bearing raspberries, in dense patches, or patches that have little air movement. The best way to prevent gray mold is to reduce free water on leaves or blossoms, if raspberries are planted in a location with full sun and good air movement this can help reduce the chances of gray mold.

Japanese Beetle Damage

Spur Blight Infection

Anthracnose Lesions

Gray mold

Plant stock

Raspberries bear two ways. Summer-bearers bear one crop each season in the summertime and ever-bearers which bear two crops, one in the summer and one in fall. Tissue-cultured plantlets or nursery-matured stock of cultivars appropriate to the site should be purchased from a reputable nursery. Healthy, mature raspberry plants can also be divided.

Raspberries come in two basic types: red and black. Yellow raspberries are a mutation of red or black raspberries, and purple raspberries are a cross between red and black raspberries. Red raspberries have chilling requirements that limit their production to cooler regions of the United States. An estimated 75 percent of all domestically grown raspberries are of the red variety, and most of these are processed.

Planting

Raspberries start best when planted in early spring. Raspberries should be planted a distance from wild growing berries to decrease the risk of spreading pests and diseases. Before planting soak raspberry roots for an hour or two. Dig a hole roomy enough to allow the roots to spread spacing plants about 3 feet apart in row and 8 feet between rows. After planting cut back canes leaving 8 to10 inches. Both summer-bearing and ever-bearing cultivars readily produce new shoots from the roots (called “suckering”). New plantings are established by taking advantage of the plants’ ability to produce suckers. Depending on the variety a trellis or a fence or fence may be used to support plants. Do at planting time to avoid disturbing growth as the raspberry is maturing.

Growing season

Raspberry plants will grow canes in the early spring after first plant. In following year plants will start producing fruit. Certain varieties will produce fruit anywhere from 16 to18 months after planting. Raspberries are considered “high stakes” crops. Raspberry plantings should fruit for at least five years and occasionally produce for more than ten years.

Growing

Summer-bearers produce berries on two-year-old canes while one year old canes grow next to them. Older canes usually have brown stems while the younger canes are typically green. Prune older canes once they have finished

fruiting for the year, typically in the fall. Leave about 6 of the thickest, strongest and if green, canes. Keep plants contained in a 19-inch-wide space. Without pruning, raspberry plants will become thickets. Cut off sideways growing canes. Ever-bearers require less pruning as they are mowed down to the ground in fall after picking. If the raspberry patch is small use a pruning shears. Pick up any debris around plants as diseases and pests can overwinter.

Harvest

Time to harvest

All varieties of raspberries will produce fruit in their second season. Some ever-bearers will produce very small fruit the first fall after planting. In early summer raspberries will ripen over a period of 2 weeks. Berries will need to be picked every couple of days. Harvesting early in the day while temperatures are cool and then precooling the fruit before shipment significantly extends shelf life.

Harvest per season

Raspberry plant variety will determine harvest. Summer-bearers only have one harvest while ever-bearers have two harvests during one season.

Manual harvesting methods

Manually harvest raspberries to select ripe berries. All berries do not ripen and are not ready to be picked at the same time. Pick raspberries on a sunny day when the raspberries are dry. A ripe raspberry will leave the vine easily. Do not tug on the fruit too hard. Raspberries are very delicate. Try not to place all berries in one container to avoid squishing the berries. Production of a good crop from year to year requires careful management.

Yield per acre

At maturity (about four years old), plants should produce about 5,000 pounds of fruit per acre.

$7,500 - $30,000 per ACRE!

Prepare for Market

Preparing to store – washing

For short term storage (refrigeration), washing raspberries help prevent spoilage. Give the raspberries a 30-second hot water bath at 125° F or a quick, acidic dip in one part vinegar, three parts water solution to keep them fresher for longer. Heat or vinegar destroys any bacteria or mold spores present, effectively prolonging the shelf life by several days. Simply rinsing them with cool water prior to storage should be avoided, as moisture encourages decay.

Preparing to store – packing

If harvested at the proper time and handled carefully, raspberries will remain in good condition for several days. Because the fruit is fragile, it should be picked and packed directly into containers without further sorting. Cool berries to remove field heat and improve shelf life. Berries that will be frozen can be packed into labeled freezer bags.

Storage – Conditions

Raspberries can be frozen for later use. Give the raspberries a quick rinse in cold water and dry thoroughly on paper towels, then freeze in a single layer on a tray. Once frozen, seal the raspberries in an airtight storage container or bag. Fresh frozen raspberries are best used within 10 to 12 months.

Storage – length of time

Frozen raspberries can be stored anywhere from 10-12 months, while refrigerated raspberries only last 2-3 days.

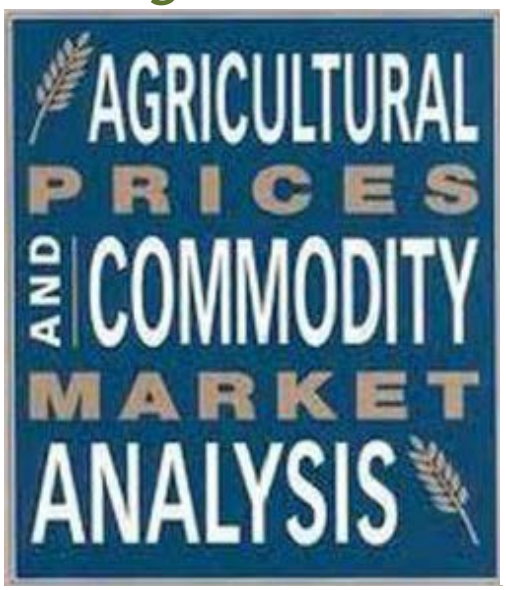
Transportation from field

Berries are typically picked directly into shallow flats, baskets or containers. A cart or trailer being pulled by a tractor or ATV can remove the crop from the field with ease. Stack flats carefully to not damage raspberries.

Transportation to market

When transporting fresh produce a refrigerated truck will help prevent spoilage. Raspberries have a short refrigeration life and will need to be transported quickly after harvest. Fresh Raspberry fruit is not sensitive to chilling temperatures and should be stored as cold as possible without freezing. Frozen raspberries can be transported in a controlled refrigeration truck or packed with dry ice. Raspberries typically will not absorb odors from other fruits during shipping or storage.

Selling



Market price

Market prices for raspberries range from $1.50 per pound to $6.00 per pound. Price variance is primarily attributed to variety. In 2016 North Dakota wineries paid $4.00 per pound for raspberries.

Market price resources

Agricultural Marketing Resource Center, USDA Agricultural Marketing Service and 2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey

Market price history

Market price history remains steady.

Market demand

Fresh raspberries are usually high in demand during the summer months. Demand for raspberries is usually excellent and high prices can be obtained. North Dakota wineries participating in the 2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey reported purchasing 800 pounds of fresh raspberries in 2016. Winemakers expressed interest in purchasing more fresh raspberries.




Delivery considerations

Fresh-market raspberries are usually sold in half-pint clamshells (hinged plastic containers). Six basic marketing alternatives are available to raspberry growers: wholesale markets, cooperatives, local retailers, roadside stands, you-pick operations, and processing firms. Because raspberries are so perishable, they are well suited to marketing channels where a short period of time is spent in the “pipeline” from the producer to the consumer, such as roadside stands and you pick operations. Fresh raspberries should be carefully delivered as they are easily squashed and can reduce the quality of the fruit. When

selling raspberries through a wholesales either the grower or a shipper will take the crop to the market. Marketing cooperatives generally use a daily pooled cost and price, which spreads price fluctuations over all participating producers. Local retailers expect high-quality raspberries and may require minimum available quantities at their demand. Roadside stands and you-pick operations provide opportunities to receive higher-than-wholesale prices for fruit and will include additional expenses for advertising, building and maintaining a facility, and customer service. You-pick operations save on harvest costs, but some of the crop will not be harvested.

Depending on location, processors may or may not be a marketing option. Traditional processors are less likely to contract with small-acreage growers, and, historically, processing prices have been more volatile than fresh-market prices. There is an increased interest in locally produced raspberries for use in fruit wines, which provides an additional an outlet for excess fruit. Fruit can also be frozen for later use in locally produced value-added processed products.

Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Equipment

Trailer to remove the berries from the field, along with a tractor or another type of vehicle to pull the trailer.

Tools

Fruit picking baskets cost $10 - $25 depending on size and composition. Fruit picking gloves are $2.00 to $6.00 per pair.

Plant stock

Raspberry plants cost $5.00 and up per plant depending on size and variety.

Labor

Manual picking is known to be labor intensive. Raspberries are very delicate and workers require supervision. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Rhubarb

Cultivars: Canada Red, Crimson Cherry, German Wine, Macdonald, Raspberry Red, Riverside Giant, Sunrise, Valentine, Victoria

Planting & Growing

Field Conditions

Before planting remove all perennial weeds. Rhubarb thrives in well-drained fertile soil with full sunlight. Mulching with a heavy layer of straw and cow manure can help provide extra nutrients while retaining moisture and controlling weed growth.

Growing Conditions

Along with full sunlight rhubarb does best when average temperatures fall between 40° F in the winter and below 75° F in the summer. Water rhubarb plants well during the summer as they need a lot of moisture. Remove seed stalk as soon as they appear.

Fertilizers

When planting rhubarb mix in compost, rotted manure or other fill high in organic matter. Rhubarb feeds heavily on the soil and needs extra organic matter. Do not add chemical fertilizer when planting rhubarb or in the first year of growth as it can kill the plant. After the first spring frost, apply a light sprinkling of high-nitrogen fertilizer such as 25-3-3 or 10-6-4 when the ground thaws. This is important so the fertilizer will go directly in the ground and not harm the roots.

Pest controls

Insects usually do not bother weed free rhubarb.

Diseases

Rhubarb disease is uncommon. If disease is present it will most likely be fungus. Fungus usually occurs when rhubarb is planted in soil that does not drain well. When fungus is observed mix soil with organic matter and sand to help with drainage. Funguses that can affect rhubarb include Ascochyta leaf

Ascochyta Leaf Spot

spot. Ascochyta leaf spot appears as small, green-yellow irregular spots on the upper leaf surface. Spots later develop a white center surrounded by a reddish margin. The infected spots turn brown, die, and fall out producing a hole. Aschochyta leaf spot does not affect the stalk. Ramularia leaf spot appears as small red dots that enlarge to form circular lesions. Larger spots can become white to tan with purplish halos. Stalk infections can later develop. Stalk infection is usually the key symptom of a ramularia infection. Botrytis can cause leaf, stalk, and crown rot. Botrytis usually appears when the rhubarb crop doesn't receive proper air circulation and has high humidity. Root and Crown Rot is rhubarb that doesn't seem to be thriving. When rhubarb plants suffer from this fungus and bacteria leaves may turn yellow to red and collapse. When viewed, the crowns may exhibit a black-brown decay or black-brown holes. To prevent Root and Crown Rot make sure soil is well-drained; remove and destroy any part of the plant that seems sick. Anthracnose Stalk Rot usually occurs during unusually wet spring or if plants are under some type of environmental stress. Early indications are wilted leaves and water soaked lesions. To prevent Anthracnose Stalk Rot clean up litter around the stalks.

Ramularia Leaf Spot

Root and Crown Rot

Plant stock

Rhubarb plants can be started from seed or plant stock. Mature rhubarb plants can be divided to start another rhubarb plant. Rhubarb seeds and plants are available at most nurseries, Walmart, Amazon and other general product stores.

Planting

Dig a bushel basket size hole. Space plants four feet apart and plant roots roughly one to two inches below the surface soil.

Growing season

After the first year harvest will depend on the number of stalks on the plant. Rhubarb can live up to 20 years without having to replace the rhubarb plant.

Growing

Rhubarb is a perennial vegetable although it is used as a fruit. Only use the stalk as leaves are poisonous. Rhubarb is easy to grow. Rhubarb needs cool weather to thrive. Plant one-year old rhubarb crowns in early spring as soon as the ground thaws. Fall planting should be done when rhubarb roots are dormant. Every three to four years split the rhubarb roots. Split the plant when dormant, typically early spring or fall. After harvest the stems may die back. In the fall cut back old rhubarb stalks to leave the buds exposed to cold winter weather. Remove all plant debris. After the ground freezes cover rhubarb with two to four inches of mulch, preferably well-rotted compost. This conserves moisture, adds nitrogen to the soil and gives rhubarb a good start for the next growing season. In the spring remove rhubarb flowers as they appear. This helps direct the plants energy into growing stems versus seeding out. In the summer water rhubarb thoroughly, especially during dry periods.

Harvest

Time to germination

Rhubarb grown from seed takes up to two years longer to produce stalks than a rhubarb plant planted as a crown. If starting from seed it will take two to three weeks for seeds to germinate. Start seedling rhubarb indoors. When plants are four to six weeks and about 3 to 4" tall begin to "harden off" the plants or slowly get them used to being outdoors.

Time to harvest

Do not harvest any stalks during the first growing year after planted to allow plants to become established. Rhubarb stalks can be harvested when they are 12 to 18 inches long.

Harvest

After three years the growth period for rhubarb is eight to ten weeks. Rhubarb can be harvested numerous times during the growing season. When plant stalks become thin stop harvesting as the rhubarb plant needs nutrient food.

Manual harvesting methods

Grab the base of the stalk and pull away from the plant with a gentle twist. Rhubarb usually breaks away easily. If this doesn't work cut the stalk at the base. Always discard leaves. Leave at least two stalks on the plant to continue production.

Machine harvesting methods

No machine harvesting equipment has been identified.

Yield per acre

1,200 plants per acre
10 pounds per plant
12,000 pounds per acre
$.85 - $1.25 per pound

$10,200 - $15,000 per ACRE!

Prepare for Market

Preparing to store – washing

Trim off leaves. Wash stems. Allow to dry. Bag and freeze. Rhubarb can be cut in small pieces before washing or before freezing if desired.




Preparing to store – packing

For small quantities, rhubarb can be frozen in air tight bags. For large quantities, pack unwashed stalks in crates. Stake crates for air circulation. Moisture loss is prevented by lining crates with perforated polyethylene film. Rhubarb is often packaged in 20-lb cartons or 1-lb film bags in cartons containing 10 bags each.

Storage – Conditions

Fresh rhubarb and fresh rhubarb cut into 1-inch pieces and packaged in 1-lb perforated polyethylene bags can be stored 2-4 weeks at 32° F and high relative humidity. Rhubarb can be hydro-cooled or air-cooled when the temperature of the stalks reach 32 to 33° F within a day of harvest.

Storage – length of time

Fresh refrigerated rhubarb can be stored up to 4 weeks. Frozen rhubarb can be stored up to 12 months.

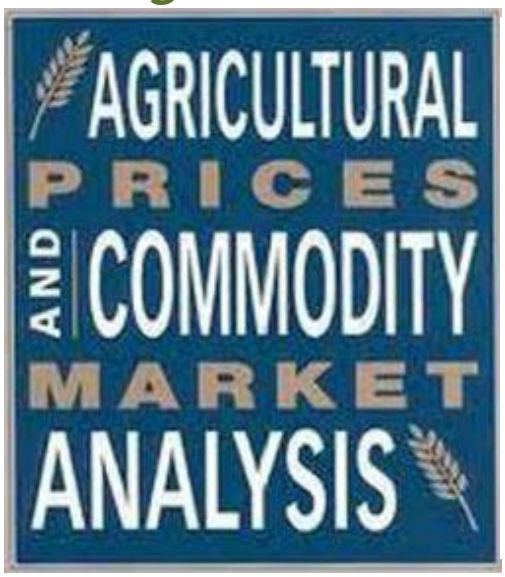
Transportation from field

Rhubarb stalks can be collected in baskets, buckets, boxes or crates then removed from the field manually or on a flatbed trailer.

Transportation to market

Rhubarb should be transported in cool conditions to ensure the stalks do not wilt. For larger quantities a refrigerated truck is recommended.

Selling



Market price

North Dakota wineries paid between $.85 and $1.25 per pound for rhubarb in 2016.

Market price resources

2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey

Market demand

North Dakota wineries purchased over 5000 pounds of rhubarb in 2016. Rhubarb can be bought year-round, but the highest demand for it is from January to July.

Investment

Land

Average Rental Rate (Dollars/Acre) Cropland
Dunn: $35.30/acre
Billings: $34.70/acre
Golden Valley: $28.30/acre
Stark: $43.40/acre
Slope: $39.80/acre
Hettinger: $43.10/acre
Bowman: $36.10/acre
Adams: $36.20/acre

Labor

Manual picking is known to be labor intensive. Job Service North Dakota reports wages for Occupation Code 2092 Farm Workers, Laborers, Crop, Nursery and Greenhouse at a 2016 median wage of $12.82/hour and Occupation Code 2091 Agricultural Equipment Operators at a 2016 median wage of $17.32/hour.

Planting manual labor is approximately 30 hours per acre. Hand weeding is estimated at 5 hours per acre. Harvesting is estimated at $.10 per pound equivalent.

Definitions

Anthocyanin is a water-soluble pigment that produces blue, violet, and red colors in plants.

Broadcast is a method of scattering fertilizer by hand or machine.

Cover crop is planted to prevent soil erosion and provide humus. Cover crops are grasses, legumes (beans), and forbs (turnips) planted for erosion control, improving the soil (structure, moisture, and nutrient content), suppressing weeds, increasing soil biota and provide habitat for beneficial insects. Cover crops add nitrogen and other nutrients to the soil so fertilizers is not needed.

Crown Division is to divide the roots to get separate plants.

Cultivar is the most basic classification category of cultivated plants. Typically refers to an assemblage of plants selected for desirable characteristics that are maintained during propagation.

Desiccant is substances that induces or sustains a state of dryness (desiccation) in commonly encountered pre-packaged desiccants are solids that absorb water. Desiccants for specialized purposes may be in forms other than solid and may work through other principles such as chemical bonding.

Dripline area of a bush or any plant is along the ground below the foliage.

Fabraea leaf spot, also known as leaf blight and black spot, is caused by the fungus Fabraea maculata. This disease usually appears late in the growing season but can occasionally develop in late May and early June. Symptoms first appear as brown to black spots on the leaves. Heavily infected leaves often yellow and drop prematurely. Severe defoliation can reduce tree vigor and yield, especially if trees are defoliated several years in a row. Lesions on fruit appear similar to those on leaves but become slightly sunken as fruit expand. Severely infected fruit may crack. Once established in a tree or a planting, this disease is difficult to control. Spores of the fungus are easily spread by rain and wind. Removal of all fallen leaves during the dormant season reduces potential for new infection.

Fallow ground is cultivated land allowed to lie idle during the growing season; the tilling of land without sowing for a season; crop land or any land plowed and left unseeded for a growing season or more.

Field Office Technical Guide is the primary scientific guides for the NRCS (National Resource Conservation Service). The Guide contains technical information about soil, water, air and related plant and animal resources. Technical guides are localized and apply specifically to the geographic area for which they are prepared.

Fire blight is a contagious disease affecting apples, pears, and some other flowering plants. Under optimal conditions, it can destroy an entire orchard.

Fish emulsion is a fertilizer emulsion produced from the fluid remains of fish processed for fish oil and fish meal industrially. Fish emulsion is naturally derived and is considered an organic fertilizer appropriate for use in organic horticulture. Fish emulsion adds micronutrients.

Fish fertilizer is a fertilizer with lower concentrations of nutrients. An example is Alaska Fertilizer 5-1-1 which has 5% nitrogen, 1% phosphorus and 1% potassium along with other minerals such as calcium, sulfur, magnesium, and sodium. Plants can't absorb calcium without magnesium. Fish fertilizer washes away easily. A two week spray cycle is recommended.

Foliar is of or relating to leaves.

Frass is insect waste.

Glyphosate is a broad spectrum systemic herbicide and crop desiccant. It is used to kill weeds, especially annual broadleaf weeds and grasses that compete with crops.

Hardwood cutting is a cutting from a mature branch to produce a new plant.

Inflorescence is the area of development and arrangement of flowers on an axis or fruit cluster.

Leaf miner is the larva of an insect that lives in and eats the leaf tissue of plants. Leaf-mining insects are moths, sawflies (a type of wasp) and flies, though some beetles exhibit this behavior.

Muriate is a type of chloride, often added to fertilizers.

pH is a figure expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, lower values are more acid, and higher values more alkaline.

Pear slug sawfly is a pest that eats leaves of cherry, pear, and plum trees, leaving behind a skeleton of veins.

Plant division is taking a piece of plant off the parent plant to grow a new plant.

Potash: is an alkaline potassium compound. Potassium carbonate. (KCl)

Plum curculio is a true weevil native to the regions east of the Rocky Mountains in the United States and Canada. It is notorious for destroying fruits if left uncontrolled.

Powdery mildew is a fungal disease that affects a wide range of plants. Powdery mildew diseases are caused by many different species of fungi. Powdery mildew is one of the easier plant diseases to identify as its symptoms are quite distinctive. Infected plants display white powdery spots on the leaves and stems. The lower leaves are the most affected but mildew can appear on any above-ground part of the plant. As the disease progresses the spots get larger and denser as large numbers of asexual spores are formed. The mildew may spread up and down the length of the plant.

Powdery mildew grows well in environments with high humidity and moderate temperatures. It is important to be aware of powdery mildew and its management as the resulting disease can significantly reduce crop yield.

Propagation is to cause an organism to multiply by any process of natural reproduction from the parent stock, the technique of taking a section off the parent plant to grow a new plant.

Raceme is a simple inflorescence in which flowers are produced.

Root cutting takes pieces of the root off the parent plant to grow a new plant.

Sandy loam is a soil type consisting of less than 7% clay, less than 50% silt, and between 43% and 50% sand.

Scarification is weakening, opening, or altering the coat of the seed to encourage germination.

Softwood cuttings are cuttings from semi-ripe growths

Soil type chart

Spur is a short stout twig that bears the fruit buds.

Stratification is the period in which a seed lays dormant in a colder environment allowing for germination to happen.

Strig is the fruiting raceme of the common currant.

Suckers are a root growth that eventually pops through the soil to produce another plant, it is a mechanism used to find an optimal growing area. Suckers can be both beneficial and harmful depending on the growing point.

Sunscald is a winter time injury to tree trunks, caused by the sun.

Tissue culture is taking tissue samples to produce a new plant.

Top-dressing is an application of manure or fertilizer to the surface layer of soil.

Trickle irrigation is a form of irrigation that saves water and fertilizer by allowing water to drip slowly to the roots of many different plants either onto the soil surface or directly onto the root zone.

How-to Guide 

Fish emulsion application

Fish emulsion is a fertilizer produced from fluid remains of fish processed for fish oil and fish meal added with water to create slurry. Fish emulsion can be purchased commercially. Fish emulsion is applied using a hand pump sprayer. Fish emulsion is applied foliar (to the leaves). Recommended application is every two weeks.

Good Agricultural Practices and Good Handling Practices

Good Agricultural Practices (GAP) and Good Handling Practices (GHP) are voluntary programs that you may wish to consider for your operation. The idea behind these programs is to ensure a safer food system by reducing the chances for foodborne illnesses resulting from contaminated products reaching consumers. Also, several major food distribution chains are beginning to require GAP- and GHP-certified products from their producers. These programs set standards for worker hygiene, use of manure, and water supply quality. These practices require an inspection from a designated third party, and there are fees associated with the inspection. Prior to an inspection, you will need to develop and implement a food safety plan and designate someone in your operation to oversee this plan. You will need to have any water supply used by your workers or for crop irrigation and pesticide application checked at least twice each year. A checklist of the questions to be asked during the inspection can be found at www.ams.usda.gov/fv/gapghp.htm. For more information about GAPs and GHPs, contact your local extension office or your state's Department of Agriculture.

pH testing

Test soil pH at home by purchasing kits. To test pH is to contact your local NRSC (Natural Resources Conservation Service) office for assistance with soil testing or kits.
https://www.nrcs.usda.gov
https://www.nrcs.usda.gov/wps/portal/nrcs/site/nd/home/
701-225-5113

NDSU (North Dakota State University) has a soil testing lab. Their website provides detailed instructions on collecting and submitting a sample for testing.
https://www.ndsu.edu/soils/services/soil_testing_lab/
NDSU.STL@ndsu.edu
701-231-8942

AGVISE Laboratories provides a complete line of agricultural testing services and technical support to the United States and Canada. Agvise is a leader in the area of soil testing and plant analysis.
www.agvise.com
701-587-6010

Pruning

Penn State Pruning Resources, 4 excellent publications
http://www.pawinegrape.com/index.php?page=vinticulture

Pruning Grapevines: An Overview, ISU *eXtension* (multiple resources)
http://www.extension.org/pages/31140/pruning-grape-vines:-an-overview

Spring Pruning of Grapevines, 3 pp. North Dakota State University Extension
https://www.ag.ndsu.edu/carringtonrec/documents/northernhardyfruitevaluationprojectrd/docs2015/spring-pruning-of-grapes

Pruning backyard grapevines in the 1st - 3rd years, Ohio State University Extension Fact Sheet http://ohioline.osu.edu/factsheet/HYG-1429-2004

Pruning Videos

Pruning Basics: Spur Pruning, 10-29-10 – Oregon State University, 3:00 min.:
http://www.youtube.com/watch?v=lSMLIZpH7so

Spur Pruning Grapevines, 2-8-10 - Oregon State University, 7:10 min.:
http://www.youtube.com/watch?v=um9p1eiGiwI

Cane Pruning Instruction, 2-2-10 – Oregon State University, 7:23 min.:
http://www.youtube.com/watch?v=mfd2V5DFDo0

Structure of Spur and Cane Pruned Grapevines, 10-29-10, Oregon State University, 6:16 min.: http://www.youtube.com/watch?v=pCs03Mc2HKM

Pruning Grape & Exploring Other Fruits in the Orchard, 9-23-10 – Oklahoma State University, 9:32 min.: http://www.youtube.com/watch?v=xXFumo_8rE4

How to Prune Grape Vines, 7-14-09 – Michael James Jr, 3:51 min.: http://www.youtube.com/watch?v=_vk-Fj0pnP8

Grape Vine Pruning in Late Winter & Early Spring, 4-1-10 – Gurneys, 3:11 min.: http://www.youtube.com/watch?v=i0Z8I2WCLNk&NR=1 3

Proper Methods of Pruning Your Grapevine, Lon Rombough, 5:12 min.: http://vimeo.com/10984172

Pruning Grapes on a High Cordon Trellis Part 1, 3-6-09 – OSU Extension, 3:31 min.: http://www.youtube.com/watch?v=-ZvaReI5vr4&NR=1

Pruning Grapes on a High Cordon Trellis Part 2, 3-6-09 – OSU Extension, 7:02 min.: http://www.youtube.com/watch?v=AEat6g7j_gg&feature=related

Cane & Spur Pruning, UC Davis Farm Advisor, 2-26-09, 9:16 min: http://www.youtube.com/watch?v=23jHTybtCms

Vineyard Pruning Tools, ISU Extension, 3-17-11, 8:53 min.: http://www.youtube.com/watch?v=MUzWnsTN1a8

Grapevine Pruning with Vaughn Hammond, Univ. of Nebraska Extension, 3:08 min,: http://www.youtube.com/watch?v=VE5Aw9Wn5F4

Pruning Grape Vines in Minnesota, UMN Extension, 8:04 min., 2010: http://www.extension.umn.edu/food/small-farms/crops/pruning-grape-vines-in-minnesota/

Pruning Grape Vines, Growing Organic, 4:00 min.: http://www.youtube.com/watch?v=d1cq5VvHFb4

Winter bud damage assessment, 12-20-13 – Grape Doctor, 8:18 min.: http://www.youtube.com/watch?v=rMav5zmGagg

Trellis Design & Construction & Pruning Fundamentals Prior to Your Frist Cut, 11-20-14, Northern Grapes Project, 1:04 hr.: https://www.youtube.com/watch?v=k88CbR1FDXI&feature=youtu.be

Cleaning, lubricating and sharpening hand pruners, 5-18-14, Spruced Up Tree Care, 6:51 min.: https://www.youtube.com/watch?v=kkwZYYjbaO8

Pruning Grape Vines (spur & cane), CA Extension, 18:14 min.: http://vimeo.com/3341415

Grape Pruning Videos from Tom Zabadal at Michigan State University

Grape Video 20 Pruning Grapevines, 8:46 min.
https://www.youtube.com/watch?v=T-7bC8t7_XQ&index=6&list=UUZ7llYhkcOS5eBIS9nMy4LA

Grape Video 21 – The Basic Skills of Pruning Grape Vines, 58:58 min.:
https://www.youtube.com/watch?v=biM6G7gG6as

Grape Video 22 – Pruning Grapevines, The Renewal Zone, 14:52 min.:
https://www.youtube.com/watch?v=HBHApvOj8rc

Grape Video 23 - Pruning Severity: How Much to Leave on a Grapevine, 24:53 min.: https://www.youtube.com/watch?v=sO4MG8-Rl58

Grape Video 24 - Layering a Pruning Technique for Replacing or Renewing Grapevines, 21.03 min.: https://www.youtube.com/watch?v=PLhcSqN9E0c

Grape Video 25 – Pruning Grapevines Before and After Planting, 28:32 min.:
https://www.youtube.com/watch?v=TDGEDEbycqA

Grape Video 26 – Pruning Grapevines Before the Second Growing Season, 36:58 min.: https://www.youtube.com/watch?v=a7CYcSvWhcM

Grape Video 27 – Pruning Grapevines When they are Approaching Full Size,12:40 min.: https://www.youtube.com/watch?v=4hDB_DOoYcc

Grape Video 28 – Pruning Mature Grapevines, the Basic Steps, 35:45 min.:
https://www.youtube.com/watch?v=PZbePV9nw-0

Grape Video 29 - Pruning Equipment for the Manual Pruning of Grapevines, 23:32 min.: https://www.youtube.com/watch?v=x1smxo26C0U

Resources

Apple Orchards
Penn State Tree Fruit Production Guide
http://extension.psu.edu/plants/tree-fruit/tfpg/extension_publication_file

Field Office Technical Guide – Natural Resource Conservation Service
https://efotg.sc.egov.usda.gov/treemenuFS.aspx

Marketing
Agricultural Alternatives: Fruit and Vegetable Marketing for Small-scale and Part-time Growers Agricultural Alternatives: Developing a Roadside Market.

Midwest Fruit Pest Management Guide
https://ag.purdue.edu/hla/Hort/Documents/ID-465.pdf

Midwest Grape Production Guide
http://www.oardc.ohio-state.edu/fruitpathology/Bulletins/mw_grape_12aug05%20S.pdf

Natural Resource Conservation Service
http://www.nrcs.usda.gov

North Dakota local NRCS service centers
https://www.nrcs.usda.gov/wps/portal/nrcs/main/nd/contact/local/

Starting a Community Orchard in North Dakota
Tom.kalb@ndsu.edu

State of the Wine Industry 2017
https://www.svb.com/uploadedFiles/Content/Trends_and_Insights/Reports/Wine_Report/2017-wine-report.pdf

The Northlands Winter Greenhouse Manual
http://www.farrms.org/

Tree planting calculator
https://www.treeplantation.com/tree-spacing-calculator.html

Wine Grower News
http://www.extension.iastate.edu/Wine

Farm to Bottle: Growing Grapes, Fruits and Vegetables for Wineries was developed by Reap Investment Fund, Inc. with funding from a USDA Rural Business Development Grant in 2017. This publication has been prepared to provide readers with information that is concise and easy to understand. A free PDF download is available online at http://reapmatters.org/farm-to-bottle-event/.

Reap Investment Fund, Inc. and USDA Rural Development do not endorse commercial products or companies referenced in this publication even though reference may be to tradenames, trademarks or service names. Reference in this publication to any specific commercial product, process, or service, or corporation name is for general informational purposes only and does not constitute an endorsement, recommendation or certification of any kind.

Information presented from the 2017 USDA Wine to Bottle/NDGWA Winery/Vineyard survey represent actual responses from participating wineries and nurseries. Data has not been adjusted to reflect assumptions based on a 40% survey participation rate of North Dakota wineries and 37.5% participation rate of North Dakota vineyards.

Written by: Ray Ann Kilen
R Kilen Consulting, LLC

Contact information:
Ray Ann Kilen
R. Kilen Consulting
5 Patterson Lake Drive
Dickinson, ND 58601
701-290-8036
rkilen@ndsupernet.com

March 2017

REAP Investment Board

Rural Economic Area Partnership

A free PDF download is available online at
http://reapmatters.org/farm-to-bottle-event/

USDA United States Department of Agriculture

Rural Development

The work that provided the basis for this publication was supported by funding under an award with the U.S. Department of Agriculture Rural Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

USDA is an equal opportunity provider, employer, and lender.