

BLUEBERRY STORAGE



PRE AND POST-HARVEST STORAGE

TABLE OF CONTENTS

Growing conditions-climate.....	2
Varieties.....	3
Harvest time.....	4
Harvest method.....	5
Sorting and packing.....	6
Post-harvest storage.....	7
Controlled Atmosphere (CA) -Ethylene.....	8

References:

Keith Thompson :Fruit and vegetables Harvesting

NC State Extension Publications:Authors:

Mike Boyette
Philip Morris Professor
Biological & Agricultural Engineering
Ed Estes
Professor Emeritus
Agricultural & Resource Economics
C. M. Mainland
Bill Cline
Specialist (Blueberries, Muscadine Grapes)
Plant Pathology

TOP BLUEBERRY PRODUCING COUNTRIES



Growing Conditions

All blueberry varieties thrive in acidic soil. For the northern varieties, a pH range of 4.5 to 5.5 is what you should aim for. When growing southern and warm climate types, the soil can be slightly closer to neutral with a range of 5.5 to 6.0. Soil amendments at planting time and mulches that increase the acidity levels in the soil include pine needles, leaf mold, pine bark and peat moss. As demonstrated in the table blue berries grow worldwide and is also worldwide consumed.

Consumption of blue berries grow very fast last years, fruits are considered as a superfood, so good for your health, The global production give the opportunity for year around availability.

Climate

Blueberries are typically grown in humid, northern climates that have winter chills, mild summers and low-pH or acidic soils, conditions that limit their range. But many new varieties are available for lower chill areas, very warm areas, as well as coastal areas.



Varieties

Within each type of blueberry there are a variety of different cultivars bred for specific growth habit, leaf color and berry type. We have a broad range of varieties from the past, this will not change always very fast because a plantation can produce for many years. But due to the bigger demand from the consumers there is a huge production increase worldwide and different new varieties come on the market. Also with new and better properties like bigger berries, better taste, resistance against diseases and possibilities to grow in different climate zones



Varieties for Cold Climates

Northern highbush (*Vaccinium corymbosum*) and northern low-bush blueberries (*Vaccinium angustifolium*) are cold-hardy and require winter chilling hours in order to produce fruit. The highbush variety is hardy in U.S. Department of Agriculture plant hardiness zones 3 through 7 while the low-bush variety is hardy in zones 2 through

7. Highbush blueberries produce larger fruit than the low-bush type, making them more desirable in the home garden and for commercial growing.

Varieties for Mild Climates

Rabbiteye (*Vaccinium ashei*) and southern highbush (*Vaccinium corymbosum*) varieties don't need the winter chilling hours required by the northern varieties, making them ideal for mild southern climates. Rabbiteye is a wild southern native that produces well in mild climates. Horticulturalists developed the southern highbush by crossing northern highbush varieties with the wild rabbiteye types. Hardiness varies depending on the cultivated variety for both rabbit eye and southern highbush, but they are generally hardy in zones 6 through 10.

Harvest time

Blueberries of the highbush type (*Vaccinium corymbosum* L.) and the rabbiteye type (*Vaccinium ashei*) are grown in several parts of the world. More than 90 percent of the blueberries produced commercially are of the highbush type. Harvesting of highbush blueberries begins in the Northern Hemisphere is starting in late May and often continues through up to augustJune. In the southern hemisphere the harvest is starting already in December in specific countries (Peru, Chile). Rabbiteye varieties ripen in late June, and harvesting continues into August. Blueberries, even those growing on the same bush, do not all ripen at the same time. Under normal growing conditions, blueberries ripen over a period of three to four weeks. Ripe blueberries should have a completely uniform blue color.

Depending upon the crop and the weather conditions, blueberry fields may be harvested as many as four times in intervals of five to seven days. Harvesting more frequently may not make efficient use of labor, whereas less frequent harvesting may result in a high percentage of overripe fruit.



Harvest method

Manual Harvesting

Rules for Blueberry Pickers

1. Keep your hands clean. Remember that you are handling a food product. The law requires you to wash your hands after each visit to the rest station.
2. Pick all the ripe blueberries on the bush before moving on to the next bush.
3. Harvest only well-ripened fruit. Leave immature fruit for the next harvest.
4. Place your hand under the clusters to avoid dropping the berries.
5. Avoid overfilling your hands; do not squeeze or roll the fruit.
6. Do not put trash or cull berries into the container.
7. Never allow harvested fruit to remain in the sun.
8. Place harvested blueberries always directly in the shadow or better in the cooling.



Mechanical Harvesting

Rules for Minimizing Damage to Fruit by Mechanical Harvesting

1. Harvest only dry fruit in the coolest part of the day.
2. Minimize the drop heights on the machine and pad the impact surfaces.
3. Eliminate as much vibration as possible.
4. Limit the depth of harvested fruit in the field containers to 10-12 cm (4 or 5 inches).
5. Handle and dump field containers very gently.
6. Cool the fruit as soon as possible after harvest.

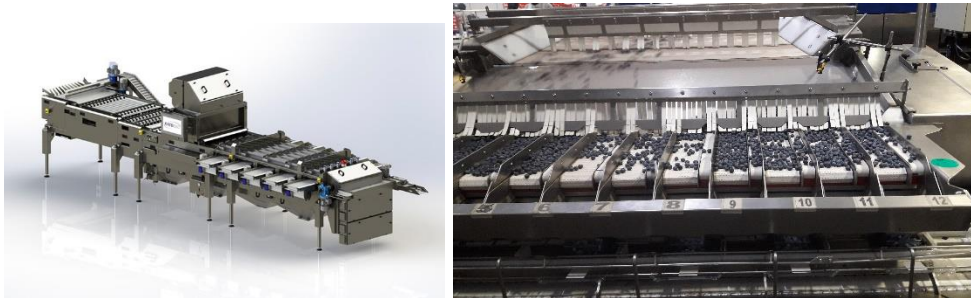


Sorting and packing

Sorting harvested blueberries intended for the fresh market is time consuming, expensive, and damaging to the fruit. Therefore, this practice is generally not recommended. The best time to remove defective berries is during manual harvesting, thus minimizing handling. For machine-harvested blueberries, there may be no alternative but to remove trash and defects on a grading line. When a grading line must be used, it should be operated in such a way as to minimize mechanical damage.

Whether blueberries are mechanically or manually harvested, every effort should be made to keep the percentage of defective fruit to an absolute minimum. Seriously defective fruit may include those with insect damage, broken skin, decay or mold, attached stems, fruit remaining in clusters, and fruit that is overripe, underripe, shriveled, or off-color.

For sorting especially new technologies are developed for distribution center's and packing houses. The use of sorting machines with NIR and camera technology to detect ripening and defects are more and more used worldwide.



Blueberries sorting and packing equipment.

Post-harvest storage

The fruit is classified as climacteric. Ethylene production was $0.5\text{--}2 \mu\text{l kg}^{-1} \text{h}^{-1}$ for northern highbush and $10 \mu\text{l kg}^{-1} \text{h}^{-1}$ for rabbiteye and stimulation of *Botrytis cinerea* growth can occur on blueberries in the presence of ethylene.









Berries stored at $4.4 \text{ }^{\circ}\text{C}$ or above gradually developed a tough texture. The cultivar Bluecrop stored at $12 \text{ }^{\circ}\text{C}$ had high scores for taste, aroma, bitter flavor and flavor intensity and had a high percentage TA. Fruits stored at 4°C scored high for sweet taste, colour (more blue), acidic taste, blueberry flavor, firmness, crispness and juiciness.

Their shelf life in simulated room temperature of $20 \text{ }^{\circ}\text{C}$ and 60% r.h. was shown to be only 1-2 days.

Refrigerated storage recommendations include:

Normally the best storage temperature is – 0.5 °C to 0 °C to keep the fruits free from diseases and a good taste. Generally a high humidity is necessary is recommended (90-95%).

Storage disorders

Fruit orientation	Examples of postharvest blueberries diseases detected using pattern recognition techniques in visible images			
	Control	Shriveled	Fungally decayed	Mechanically damaged
Stem end				
Calyx end				

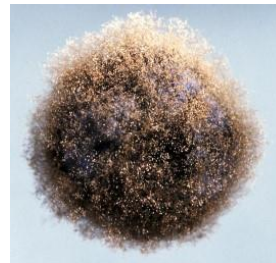
Fungal disorders blue berries



Colletotrichum
(anthracnose)



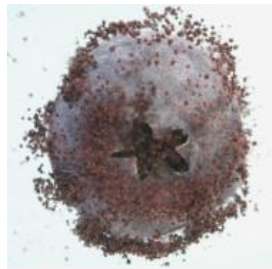
Alternaria



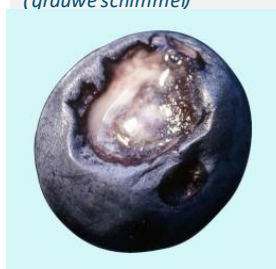
Botrytis
(grauwe schimmel)



Phomopsis



Aspergillus



Aureobasidium (gist)

Controlled Atmosphere (CA)

The storage of fresh blueberries for 7–14 days at 2 °C in an atmosphere in 15% CO₂ delayed their decay by 3 days after they had been returned to ambient temperature compared to storage in air at the same temperature (Ceponis and Cappellini 1983). Nowadays the necessity to store the fruits is sometimes less important because of global availability from the different countries and climate zones. Different conditions are recommended for CA. General 5–10 % O₂ and 5–10% CO₂. Higher CO₂ led generally to early softening for some cultivars. This will differ from country to country and also varieties need sometimes another condition. But with optimal preparations and conditions blue berries have a maximum storage life of up to 8 weeks.

Like for red currants CA storage can be realized in plastic covers with CA measurement and control system, Storex BV has the ability to install such systems and has many references worldwide.

But also small CA cooling rooms are used for prolonged storage.

Ethylene

Ethylene plays an important role in fruit softening and sucrose metabolism of blueberry at 20 °C, and there may be a link between sucrose metabolism and fruit softening.