

BARBADOS CHERRY

(*Malpighia glabra* L.)

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1. INTRODUCTION

The Barbados cherry (*Malpighia glabra* L.) belongs to the *Malpighiaceae* family. It is a tropical and subtropical shrub or small tree bearing fruits. A mature tree can bear a briefly exposure to -2.22°C , while young plant are killed if exposed even for a brief period to a temperature below -1.11°C . The rainfall requirement is both medium- and low, and it can tolerate long periods of drought, although without bearing any fruit until rainfall occurring (Morton, 1987). The fruits becomes more delicious by simply stewed with little amount of sugar to modify its acidity. The flavour of the pulp and juice is very pleasant. The fruit can either be dried or frozen which can be used for puree preparation. It juice help

in prevent the darkening of bananas sliced for fruit cups or salads. Other uses are gelatin desserts, punch or sherbet, added as an ascorbic acid supplement to other fruit juices. In Puerto Rico, the juice was dried and powdered commercially for a decade until the cost of production caused the factory to be closed down (Morton 1987). The fruits are the richest known sources of ascorbic acid, 1000 - 4000 mg/100 g of edible part (Moscoso, 1956). The vitamins C of the fruits are being promoted in different forms such as powder, tablets, capsules, juice and syrup.

CONTENTS

1. Introduction	1
2. Domestications	2
3. Taxonomy	2
4. Taxonomy Classification	3
5. Centers of Origin/Centers of Diversity	3
6. Objectives of Crop Improvements	3
7. Cytogenetic	4
8. Inheritance Pattern	4
9. Problem in Breeding	4
10. Botanical Description	4
11. Floral Biology	5
12. Different Species	6
13. Crop Improvement Methods	7
14. Varieties	7
15. Future Thrust	9

2. DOMESTICATION

The fruit to Florida was first reached from Cuba which was carried by Pliny Reasoner as appeared in the catalog of the Royal Palm Nursery for 1887-1888. The seeds of Barbados cherry were brought from Curacao to the United States Department of Agriculture (S.P.I. #44458) by H.M. Curran in 1917. Since then the trees were grown casually in southern and central Florida until after the World War II. This fruit tree has also been distributed to different countries of the world, it was recorded for the first in 1916 that it bore fruit in the Philippines. Before the World War II, trees were also planted in the Rio Piedra Experiment Station, Puerto Rico to control erosion on terraces. Later, thousands of seedlings were distributed for planting in schools to make the easily available of fruits to school children and to increase their vitamins intake. From 1949 onwards, the higher content of vitamin C in this fruit has resulted in creation of interest among the people, leading to plantation of a large number of trees in America. Similarly, plantings were taken place in Jamaica, Venezuela, Guatemala, Ghana, India, the Philippines and Queensland, Australia, and Israel (Morton, 1987).

Trees of Barbados cherry are growing wild as well under cultivation throughout the northeastern Brazil (Taylor, 2005). It has been under cultivation over a period of times in Cuba, Jamaica, Puerto Rico, Florida, Venezuela, Guatemala, Ghana, India, the Philippines, Queensland, Australia, and Israel and as dooryard crop in the Bahamas, Bermuda, and to some extent in Central and South America (Morton, 1987). In India, the tree has been grown in tropical areas such as Tamil Nadu, Kerala and it has also gained popularity in Port Blair and other regions (Singh, 2006).

3. TAXONOMY

The generic name of Barbados cherry was derived in honour of Marcello Malpighi, an Italian physician and botanist in the 17th-century (Quattrocchi, 2000). About 40 years ago, there was confusion about the taxonomic of this crop with the cultivated crop tree *M. emarginata*, which have small insipid fruit and flower structure (IBPGR, 1986). Generally, the cultivated and improved plants is known as *M. puniceifolia* L. while the wild one as *M. glabra* L. However, according to Morton (1987) that *M. Puniceifolia* L. or *M. glabra* L. is the general approved botanical name for the Barbados cherry (Morton, 1987). Later, it is widely accepted that both the taxa belong to *M. glabra* L. (Orwa, *et al.*, 2009).

The fruit of the Barbados cherry resemble the European cherry. The common names of this fruit crop are the Antilles cherry, Puerto Rican cherry, West Indian cherry, native cherry, health tree, garden cherry and French cherry. It is also known with different names in different dialects such as *acerola*, *cereza*, *cerezacolorada*, *cereza de la sabana*, or *grosellain* Spanish; in French as *cerisier*, *cerise de St. Domingue*; in Portuguese as *cerejeira*; in Venezuela as *semeruco*, or *cemeruco*; in the Netherlands Antilles as *shimarucu*; in the Philippines as *malpi*.

4. TAXONOMY CLASSIFICATION

Kingdom Plantae: Plants

Subkingdom Tracheobionta: Vascular plants

Superdivision Spermatophyta: Seed plants

Division Magnoliophyta; Flowering plants

Class Magnoliopsida: Dicotyledons

Subclass: Rosidae

Order: Polygalales

Family: Malpighiaceae – Barbados Cherry family

Genus: *Malpighia* L. – malpighia

Species: *glabra*

5. CENTERS OF ORIGIN/CENTERS OF DIVERSITY

Barbados cherry is native to American tropics including the Lesser Antilles from St. Croix to Trinidad, also Curacao and Margarita and neighboring northern South America as far south as Brazil (Morton, 1987; Janick and Paull, 2008). Today it has become naturalized in Cuba, Jamaica and Puerto Rico after cultivation over a period of times, and is commonly grown as dooryards crop in the Bahamas, Bermuda, and to some extent in Central and South America (Morton, 1987). The plants are spreading all over the world, however, its maximum distribution was noticed in Central America and the West Indies (Nakasone *et al.*, 1968).

6. OBJECTIVES OF CROP IMPROVEMENTS

- i. To develop high ascorbic content varieties.
- ii. To develop a high yielding varieties.
- iii. To reduce acidity content of the fruits.
- iv. To develop varieties resistant and tolerant to nematode such root-knot nematode (*Meloidogyne incognita* var. *acrita*) and burrowing nematode (*Radopholussimilis*) which are one of the major factors responsible for decline of its cultivation.
- v. To develop varieties resistant to insects such as Caribbean fruit fly (*Anastrepha suspense*), fruit worm (*Anthonomusflorus*), aphid (*Aphis spiraecola*), Hesperid caterpillar (*Ephyriadesarcas*), blue chrysolimid of acerola (*Leucoceralaevicollis*).
- vi. To develop varieties resistant to diseases such as anthracnose (*Colletotrichum gloeosporioides*), and leaf spot (*Cercospora bunchosiae*).

7. CYTOGENETIC

A very little information is available on chromosome of this species. Most of the species of the genus *Malpighia* are diploids, *i.e.* $2n = 20$. The chromosome of Barbados cherry are small about 1.71 to 2.56 μm and are metacentric, except chromosome 2 which was classified as sub-metacentric (Mondin *et al.*, 2010).

8. INHERITANCE PATTERN

No attempt has been carried out to study the genetics and inheritance patterns of the commercial traits in this crop.

9. PROBLEM IN BREEDING

Very little work has been carried out in Barbados cherry, however certain behaviours of the plants may cause hindrance in breeding programme such as bisexual flowers, self- and cross-incompatibility and low seed content. In addition, fruit setting are also affected by seasons in Barbados cherry. Absence of rain may cause little or no fruits during the season.

10. BOTANICAL DESCRIPTION

10.1. Tree

Barbados cherry is evergreen bushy shrub or small tree attaining up to 5 - 6 m height. It is more or less erect or spreading and drooping, minutely hairy branches.

10.2. Leaf

Leaves are elliptic, oblong, obovate, or narrowly oblanceolate and little wavy. Leaf length is 2-7 cm and breadth is 9.5-40 mm. Leaf shape is obtuse or rounded at the apex, acute or cuneate at the base. Leaf when very young is having white, silky and irritating hairs. Mature leaf is hairless, dark green and glossy.

10.3. Fruit

Fruits are produced in the leaf axils either singly or in 2 – 3 number. Fruits are oblate to round and 3-lobed. Fruit diameter is 1 – 3 cm and weighing 3 – 5 g. The fruit resemble the true cherry but it is a three-carpellate drupe, bright-red and orange-colored, peel is thin and glossy. Fruit is very juicy. Pulp is soft with a pleasant, tart flavor and acid to sub-acid (Orwa, 2009). Approximately it takes 3 weeks from floral anthesis to maturity of the fruits (Nakasone *et al.*, 1968).

10.4. Seed

Seeds are 3 in number, small, rounded, each having 2 large and 1 small fluted wings looking like 3 triangular, yellowish, leathery-coated, corrugated inedible ‘stones’.

11. FLORAL BIOLOGY

11.1. Flowering

Flowers usually appear after periods of rainfall or irrigation, thus flowering may occur any time during the year depending on local rainfall and climate pattern. Flowering may last a year-round (Anonymous, 2014a). Flowering and fruit set occur almost continuously from April through November in Florida, and fruits mature in approximately 30 days (Stahl *et al.*, 1955, Ledon, 1958).

11.2. Flowers

Flowers are borne in sessile or short-peduncle axillary cymes in cluster of 3 – 5 flowers on new terminal and on lateral spurs (Nakasone *et al.*, 1968). Flowers are bisexual, 1 – 2 cm in diameter. There are five pink or lavender, and fringed petals. Flowers consist of calyx with 6-10 large sessile glands, 5 petals, fringed, slender-clawed or spoon-shaped, 10 stamens and filaments united below (Orwa, 2009).

11.3. Anthesis, dehiscence of anthers, stigma receptivity

Flower anthesis and pollen dehiscence occurred early in the morning, with 98% of flowers starting to open between 4.00 and 5.00 h and only 1% of them opening between 5.00 and 8.00 h (Freitas *et al.*, 1999). Anther dehiscence started at 6.00 h and continued throughout the day, with most (72%) occurring between 7.00 and 10.00 h. Flowers lasted only one day. Stigmas were already receptive at 6.00 h when anthers started to dehisce to release fresh pollen (Freitas *et al.*, 1999).

11.4. Pollination

The main agents for pollination in Barbados cherry are bees. This was evidenced by a significant increase in fruit-set through maintenance of bee hives in Florida (Morton, 1987). In Hawaii, the pollination taking place through wind and insects is very little, and the inadequate population of insects resulted in often production of seedless fruits (Morton, 1987). The flowers of the members of the family *Malpighiaceae* have oil glands which are collected by certain species of the Anthophoridae family, such as *Centris*. *Centris* is known to be one of the most important groups of pollinators of Tropical America. The main species of *Centris* group observed in flowers of Barbados cherry are *Centris dirrhoda* (Raw, 1979), *Centris fuscata*, *C. aenea* and *C. sponosa* (Melo *et al.*, 1997) and *Centris flavifrons* (Magalhães and Oliveira, 1998). The population of the species varies with location, for example, *Centris aenea* was the most abundant (42.6%) in Bahia (Castro, 1998), while, *Centris (Hemisiella) tarsata* was the most abundant (71.4%) visitor of flowers in the semi-arid ecosystem of Caatinga (Castro, 2002). The self- and cross-incompatibility in Barbados cherry have been reported (Orwa, 2009).

In addition to pollinators, seasons of fruiting also affecting fruit setting in Barbados cherry. In Florida, the Bahamas, Puerto Rico and Hawaii there may be a spring crop which ripened in May, followed by small crops off and on until December. However, when there is no rain in the season then there will be no fruits until December and then followed by a heavy crop. While in Zanzibar, the fruiting season is during the months of December and January. The fruit set can be increased through application of growth regulators such IBA (100 ppm) and PCA (50 ppm). The duration between flowering and fruit maturity is about 22 days.

12. DIFFERENT SPECIES

The genus *Malpighia* is one of the 55 genera in the family Malpighiaceae and its contains about 45 species of shrubs or small trees (Nakasone *et al.*, 1968; Janick and Paull, 2008). According to Ledin (1956) that only *M. glabra* and *M. Mexicana* have large edible fruits. *M. emarginata* is also known to be cultivated due to its sweet and juicy fruits, which are very rich in vitamin C (Johnson, 2003). *M. coccigera* L. and *M. urens* L. are also cultivated in South-East Asia (Orwa, 2009). While *M. puniceifolia* is present as far north as Florida and Texas.

Other species are given below:

1. *Malpighia aquifolia* L.
2. *Malpighia cauliflora* Proctor & Vivaldi (Jamaica)
3. *Malpighia coccigera* L. – Singapore holly (Caribbean)
4. *Malpighia cubensis* Kunth – *palo bronco de hojapequeña* (Cuba)
5. *Malpighia emarginata* DC. – Barbados cherry, acerola *Malpighiafucata* Ker Gawl. (Puerto Rico)
6. *Malpighia glabra*
7. *Malpighia harrisii* Small (Jamaica)
8. *Malpighia mexicana* A.Juss.
9. *Malpighia obtusifolia* Proctor (Jamaica)
10. *Malpighia polytricha* A.Juss.
11. *Malpighia proctorii* Vivaldi (Jamaica)
12. *Malpighia setosa* Spreng. – bristly stinging bush (The Bahamas, Hispaniola, Puerto Rico)
13. *Malpighia suberosa* Small
14. *Malpighia urens* L. – cowhage (Caribbean)

Confused and approved generic name of species (Anon., 2010, 2014)

Sl. No.	Correct generic name	Previous generic name
1	<i>M. argentea</i> Jacq.	<i>Bunchosia argentea</i> (Jacq.) DC.
2	<i>M. armeniaca</i> Cav.	<i>Bunchosia armeniaca</i> (Cav.) DC.
3	<i>M. glandulifera</i> Jacq.	<i>Bunchosia glandulifera</i> (Jacq.) Kunth
4	<i>M. glandulosa</i> Cav.	<i>Bunchosia glandulosa</i> (Cav.) DC.
5	<i>M. altissima</i> Aubl.	<i>Byrsonima altissima</i> (Aubl.) DC.
6	<i>M. crassifolia</i> L.	<i>Byrsonima crassifolia</i> (L.) Kunth
7	<i>M. densa</i> Poir.	<i>Byrsonima densa</i> (Poir.) DC.
8	<i>M. spicata</i> Cav.	<i>Byrsonima spicata</i> (Cav.) DC.
9	<i>M. reticulata</i> Poir.	<i>Heteropterys multiflora</i> (DC.) Hochr.

13. CROP IMPROVEMENT METHODS

There has been a great interest generated among the horticulturist and food industrialists to commercialize the crop following discovery of high ascorbic acid content in the fruits of Barbados cherry (Asenjo and De Guzman, 1946). In Hawaii the first commercial orchard was established in 1956 which composed largely of unselected seedlings and inferior clones. There was a wide variation among the seedling population for characters such as fruit and ascorbic acid content (Arostegui *et al.*, 1954; Jackson and Pennock, 1958; Ledin, 1956). And to feed the infant industry of Barbados cherry, a selection and testing program was initiated and continued (Nakasone *et al.*, 1968). So far only selection has been attempted which led to the released of several varieties.

14. VARIETIES

The varieties of Barbados cherry are grouped as sweet and sour varieties based on ascorbic acid content. The ascorbic acid content of sour type was higher than that of sweet type. In addition, sour type is more preferred for processing such as juices and purees (Nakasone *et al.*, 1968).

14.1. Sweet Varieties**14.1.1. Manoa Sweet**

This is a high yielder variety, a selection made from B-17 seedlings. Trees are upright, spreading, open type of growth, vigorous, produce multiple leaders and attain a height about 15 feet. Fruits are orange red when fully ripe, sweet and good flavored. (Nakasone *et al.*, 1968).

14.1.2. *Tropical Ruby*

A good yielder variety selected from B-17 seedlings. Trees growth resembles Manoa Sweet with multiple leader production and requiring certain amount of training to obtain single trunk tree. It grows up to a height of about 15 feet without pruning. Fruit characteristics are similar to those of other sweet varieties type.

14.1.3. *Hawaiian Queen*

It is a selection from B-17 seedlings. Trees growth habit is upright, spreading, and open. Trees can be trained to a single trunk with minimum afford compared to other sweet varieties. Fruits are resembles to those of other sweet varieties.

14.2. Sour Varieties

14.2.1. *J.H. Beaumont*

3B-21 was christened as J.H. Beaumont after the late Dr. John H. Beaumont. It was a clone obtained from seeds. It a compact, low, densely branch growth habit and can easily be trained to a single trunk tree. Both fruit and ascorbic acid production are good. Fruits are large with orange-red color when fully ripe.

14.2.2. *C.F. Rehnborg*

This is a high yielding cultivar named after Mr. Carl F. Rehnborg. It was derived from the Miami seeds germinated in Hawaii. Trees have a compact, densely branch growth type and can be easily trained to a single trunk tree. Fruits are large, orange – red colour, turning dark red when fully ripe with low ascorbic acid content.

14.2.3. *F. Haley*

This cultivar was named after the late Mr. Frederick Haley, Sr., the first person to introduce the acerola into Hawaii in large quantities for commercial purposes. It was also derived from Miami seeds. Trees can be easily maintained to a single stem and it has an upright growth habits with branches are mostly of short laterals and are not so spreading. Fruits are medium sized, turning purplish-red when on full maturity. This variety has a wide adaptability especially in the drier areas.

14.2.4. *Red Jumbo*

It is a selection made from the Miami seedlings. Trees are of single stem with compact growth and well branches, dense foliage and low growing habits. Flowering period extended to January and February and fruit setting percentage and bearing is very high indicating prolific flowering. Fruits are large (9.3 g/fruit), attractive colour turning cherry red to purplish-red upon full maturity.

14.2.5. Florida Sweet

This cultivar was evolved through selection in Florida. Trees are upright growth habit, large fruits, thick peel, apple-like, semi-sweet flavor, and high yield (Morton, 1987).

In Puerto Rica, the first promising selections identified were ‘A-1’ and ‘B-17’ based on fruit size, yield and vitamin C content. Another variety identified was ‘B-15’ which was superior over ‘A-1’ and ‘B-17’ for ascorbic acid content and yield.

The USDA is maintaining seven accessions of *Malpighia glabra* as field plantings in GRIN and locally as given below.

Primary ID	Names
HMAL 1	‘Manoa Sweet’
HMAL 2	‘Hawaiian Queen’
HMAL 3	‘Tropical Ruby’
HMAL 4	‘Maunawili’
HMAL 5	‘F. Haley’
HMAL 6	‘C. F. Rehnborg’
HMAL 7	‘Red Jumbo’

Source: USDA (2014)

15. FUTURE THRUST

The global production of Barbados cherry is very low as compared to other fruit crops. Concerted efforts are required to enhance its cultivation and production potential through crop improvement and participatory technology development with all the stake holders. There is a need to popularize the crops in its suitable location in various part of the world. There is a need to develop and refine technology for higher productivity of the crop. Barbados cherry is the potential sources of Vitamin C. It should be properly utilized by developing advance postharvest technology. Rapid genetic improvement can be achieved by using combination of conventional and biotechnological approaches. Several challenges exist in the improvement of this crops, however, through proper approaches, challenges can be converted into benefits of human being concerning the crop being one of the richest sources of Vitamin C.

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BARBADOS CHERRY (*Malpighia glabra* L.)



Flower of Barbados cherry



Fruits in the Barbados cherry plant



Fruits of Barbados cherry