N D Negi* and S K Upadhyay

Blueberry: A future super fruit

Blueberries are being grown widely in USA, Canada, Europe, Australia, New Zealand and South Africa for its attractive and nutritive fruits. In India its commercial production has not been reported until now but it can be grown in areas having acidic soils with winters cool enough to meet out chilling requirements. Recently few plants were introduced in the Department of Horticulture, CSKHPKV, Palampur, Himachal Pradesh and these plants have shown adaptation to this climate. Generally, blueberry is a deciduous bush that grows upto 6-12 feet in height with fibrous roots which lacks roots hairs. The roots have mycorrhizal association and continuous supply of inorganic fertilizer reduces the mycorrhizal population. The commercial production of bush starts after 6 years and time of flowering is early spring. However, fruits ripen in the month of April-May depending upon varieties and climatic conditions prevailing in that region. Fruits contain various vitamins, antioxidants, minerals and fibre. The calorific value of this berry is very low i.e. 100 g of fresh fruit can provide just 57 calories. Among fruits, blueberries are highest supplier of antioxidants, mainly obtained from anthocyanin compound (chlorogenic acid, tannins, myricetin, quercetin and kaempferol) and other flavonoids such as β-carotene, lutein and zea-xanthin, etc. The oxygen radical absorbing capacity (ORAC) of this berry is also very high, which helps to get rid off of harmful free radicals from the body and thus protects the body against aging, cancers and various degenerative diseases.

BLUEBERRY (*Vaccinium* spp.; Ericaceae) is a potential berry fruit for acidic soils; the genus includes some 450 species worldwide, just handful are of economic significance. There are several types of blueberries like: lowbush (*Vaccinium angustifolium*), highbush (*Vaccinium corymbosum* L.) and bilberry or forest blueberry (*Vaccinium myrtillus*) etc. Highbush blueberry is suitable for cultivation and most widely cultivated, other species of minor importance are *V. ashei* R. the rabbiteye blueberry, which is native to the South Eastern United States, and the low chill southern highbush, derived from northern highbush types crossed with several species such as *V. darrowi* and *V. ashei* R. have proven suitable in warm climates with low winter chill.

The cultivated (highbush) blueberry is a bush generally grows up to 6 to 12 feet height with simple, elliptic to ovate deciduous leaves. The leaves are slightly waxy above with pubescence at least on the veins beneath. The trunk may be single or multiple, sometimes numerous suckers arise near main trunk.

The USA is the leading blueberry producer due to its ideal growing climate with abundant land while Chile is main supplier of off-season blueberry in world. Other countries in the Southern hemisphere are Australia, New Zealand and South Africa. According to FAO, the annual production of blueberries in world is 3, 11, 959 MT from 72, 306 ha area. In Europe, blueberries are being grown in Germany, the Netherlands, Poland, Italy and Hungary.

a. Dormant blueberry plant after pruning; b. blueberry flower; c. bearing blueberry plant

Besides these countries many growers in France, Austria, and Italy are growing it on commercial scale. Even in Belgium and Norway, some very promising trials with special methods of blueberry cultivation (heated greenhouse production) resulted in a limited commercial production which is very successful. Its commercial cultivation has not been reported in India but, in Himachal Pradesh at C.S.K.H.P.K.V, Palampur blueberry was introduced in 2007-08 and have shown adaptive to this climate since the soil here is slight acidic and climate during winter remains cool enough to meet out chilling requirement up to some extent.

Uses

Blueberries are eaten raw, dried, boiled, and baked in a wide variety of culinary purposes.

Nutritional and medicinal properties

Blueberries are rich source of carbohydrates, vitamins, anthocyanins and several minerals, it contains high amount of iron. The berries also supply bioactive compounds with high antioxidant activity abundantly. The main bioactive compounds are flavanoids (flavonols, anthocyanins and others) and some phenolic acids. Thus blueberry improves immune system, improves eyesight, lowers down cholesterol level, prevents cancer, controls diabetes, improves blood circulation, protects skin against UV radiation and slows down Alzheimer and other age-related diseases/disorders. There are also reports that dried berries and tea made from leaves are sold in health food shops as a proven remedy for gastrointestinal complaints as well as for the secondary treatment of diabetes. It has higher capacity to absorb free oxygen radicals therefore, known to slowdown aging process and old age ailments and cancers, etc.

Climate and Soil

It requires relatively cold climate with 150 to 1200 hours of chill units to break dormancy. Too cold temperature is detrimental and will kill blueberry shoot and flower buds, so growing areas should be frost free.

Being fibrous and shallow root system, soil type, relative humidity and soil *p*H are important factors therefore, should be kept in mind while planning for its cultivation. It grows well in soils having high water table and should have drained and aerated soils as well. Water logged soil is detrimental and may cause root infestation by various root rot pathogens. Conversely, the very dry area is also undesirable since it may lead to drought stress as it is a shallow rooted bush. It is highly acid loving bush so the ideal soil pH for its cultivation ranges between 4.2 to 4.8 but pH below 6.0 is also suitable for production.

Propagation

Commercially propagated through cuttings (hardwood, semi-hardwood and softwood), but suckers, tissue culture and sexual propagation is also possible. However, the seedling growth is very poor if propagated through seeds. The rooting can be increased by IBA application.

Development of fibrous roots on cuttings

Stages of leaf development (highbush blueberry)

1/16 to 3/16 inch (1 to 5 mm) of green leaf tissue visible; leaves still rolled up (January)

1/4 to 1/2 inch (6 to 13 mm) of green leaf tissue visible; leaves starting to unfold (February)

Shoot expanding and leaves enlarging (March)

Different stages of flower bud development

Buds closed completely, no visible swelling (November)

Buds swells, scales separating and visible swelling (December)

Bud scales separated, tips of flower visible (December-January)

Individual flowers disting-uishable (January)

Different stages of fruit growth

Berries are expanding; fruit may vary from small to large pea-size in the same cluster (March)

Berries are changing from green to pink to blue, the oldest, largest fruit in clusters begin to change colour from green to pink to blue. Fruit begins to soften. Cell division has stopped and fruit growth is by cell expansion (March-April)

First crop of berries is ripe and ready for harvest (April-May)

Planting

Plants are planted in dormant season i.e. December to March with planting distance of 1 × 3 m plant to plant and row to row. The plants should be planted in raised beds if the area experiences heavy rainfall coupled with heavy soils so as to avoid water logging.

Varieties

Aurora, Austin, Alapaha, Bluecrop, Bluegold, Bluejay, Blueray, Bright Blue, Chandler, Darrow, Draper, Duke, Earliblue, Elliott, Gulf Coast, Hardyblue, Jersey, Jewel, Legacy, Liberty, Misty, Northland, Patriot, Reka, Rubel, Spartan, Sharpblue, and Toro.

Berries are picked several times as they ripen. There may be 2 to 5 pickings. Berries may be hand- or machine harvested (May-June)

Harvested blueberry

After harvest, the blueberry plant stores reserves and sets buds for next year's growth until leaf fall. The leaves change colour as nutrients are mobilized back into shoots for growth next spring (September-October)

Mulching

Mulching is very essential operation in blueberry production, since it has shallow and fibrous root system. Further, mulching is also advisable to conserve the soil moisture and to check weed population. The mulching material can be: dried grass, straw, shredded leaves, peat, wood chips, sawdust and pine bark, etc.

Manures and fertilizers

Blueberries are not very demanding in soil fertility and fertile soil supplemented with fertigation can give good production. The organic mulches not only add organic matter in the soil but also improve status of soil fertility. The roots of blueberry lack root hairs so they depend on soil microorganisms (mycorrhizae) to help break down nutrients and mediate uptake into the roots.

Pruning

The bush is trained either in multi-stem or single stem, initially the vegetative growth is encouraged by removing flower buds from canes. To keep balance between fruits to shoot ratio in proper proportion, pruning should be done regularly. Young bush produces many canes during initial years as bushes become older, the new cane emergence decreases which ultimately hampers their production. Canes which are injured or broken infested with disease and insects are removed, and after 7-8 years heavy pruning is required to encourage new canes and to revitalise vegetative growth. Therefore, it is very important to prune the bush every year to encourage new growth. It starts bearing after three years and production declines after eighth year so bushes should be pruned heavily to encourage new growth.

Season/time of pruning

Dormant season is the best time to prune blueberries but early spring pruning helps growers to identify winter injured woods easily and remove them in areas where winters are prolong and cool.

Flowering and fruiting

Blueberries start bearing after three years and it bears flowers on one year old shoots/canes axillary at each node. The flowers are white or pink-tinged small and closed initially, urn-shaped with 5 petals, and occur 8 to 10 per cluster. Blueberry starts flowering in February-March and fruit ripens in April-May about 62 days after flowering. The frequency of flowering is sporadic and berries are small roundish ¼ - ½" blue-black with tiny brown coloured seeds. Although, highbush blueberry (*V. corymbosum*) is self- fertile, but cross-pollination increases fruit set and results in larger berries with more seeds, and bees are the main pollinator.

Harvesting and yield

It takes about 45-65 days to ripen after flowering; fruits are harvested when colour of fruits turn purple. The harvesting is done manually by plucking individual fruits when the colour of fruit turns pinkish blue.

a. Berries ready for harvesting; b. manual harvesting; c. harvested berries

The mechanical harvesting is widely practised in most of the blueberry growing countries and average yield of this berry is about 2-10 kg/bush. The harvested berries are either consumed fresh or dried, boiled, and baked in a wide variety of culinary purposes.

Diseases

Many fungal, bacterial and viral diseases have been reported to be associated with blueberry production, which causes huge losses to the growers. Generally, blueberry diseases have been categorised in different groups depending on their nature of damage and plant parts affected, viz. leaves, flower, stem, twigs, root and fruit diseases. Whereas, in water logging condition fungal pathogens *Phytophthora* and *Pythium* cause root rot and plants may die so it is advisable to grow them on raised bed and water logging condition should be avoided.

Insect and pests

Several insect and pests also infest the blueberry resulting in economic loss to the growers. Almost all parts of the plant are damaged by several insects, the most important insects damaging buds and leaves are; blueberry bud mite (*Acalitus vaccanii* Kiefer); cut worms; span worms and winter moths, etc. The insects which damage flowers and fruits are; cranberry weevil, cranberry fruit worm, cherry fruit worm, blueberry maggot, plum curculio, green fruit worms and scarab beetles, etc. Similarly, pests infesting leaves and shoots; leaf rollers, orange tortrix, leaf miner, blueberry aphid, blueberry stemgall wasp, etc.

SUMMARY

Blueberries are increasing in popularity and are emerging as one of the most important small fruit crop in the world. The identification of antioxidant properties in blueberry fruit along with other health benefits has helped increase consumer demand. In most of the blueberry growing countries it is being grown on both small and large scale, on large scale most of the farms are mechanised in USA and Europe. It has been reported that blueberries have relatively less problem as compared to other crops so, once the plantation is established the maintenance cost is low. In India its production can be tried where soil is slight acidic and climate during winter remains cool enough to meet the chilling requirements. However, the southern blueberry cultivars which require relatively less chilling hours can also be tried in other parts of the country, provided availability of enough planting stock with technical knowledge to the growers. The initial studies at the Department of Horticulture, CSKHPKV, Palampur have shown quite encouraging results and the Department is working on its propagation and development of production technology.

For further interaction, please write to:
N D Negi, Department of Horticulture, CSKHPKV, Palampur, Himachal Pradesh, 176 062. Corresponding author *e-mail:* nanak_negi@yahoo.co.in

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For assistance contact:

Business Manager
Directorate of Knowledge Management in Agriculture (DKMA)
Indian Council of Agricultural Research
Krishi Anusandhan Bhavan, Pusa, New Delhi 110 012
Telefax: 011-2584 3657; *E-mail:* bmicar@gmail.com