**Cultivation Process for Grapes**

**INTRODUCTION**

Grape cultivation is one of the most remunerative farming enterprises in India. Famous Indian medicine scholars, Sasruta and Charaka in their medical treatises entitled ‘*Sasruta Samhita’* and *‘Charaka Samhita’,* respectively, written during 1356-1220 BC, mentioned the medicinal properties of grapes. Kautilya in his *‘Arthashastra’* written in the fourth century BC mentioned the type of land suitable for grape cultivation. Native spp. resembling *Vitis lanata*and *Vitis palmata* grow wild in the northwestern Himalayan foothills. Indigenous varieties known as ‘Rangspay’, ‘Shonltu White’ and ‘Shonltu Red’ are grown in Himachal Pradesh even today.

Cultivated grapes are believed to have been introduced into the north of India by the Persian invaders in 1300 AD, from where they were introduced into the south (Daulatabad in Aurangabad district of Maharashtra) during the historic event of changing the capital from Delhi to Daulatabad by King Mohammed-bin-Tughlak. Ibn Batuta, a Moorish traveller who visited Daulatabad in 1430 AD, reported to have seen flourishing vineyards in south India. Grape was also introduced in the south into Salem and Madurai districts of Tamil Nadu by the Christian missionaries around 1832 AD, and into Hyderabad province by HEH, the Nizam of Hyderabad in the early part of the 20th century. From Delhi, Daulatabad, Madurai, Salem and Hyderabad, grape cultivation spread to different parts of the country.

**PRESENT STATUS OF GRAPE CULTIVATION IN THE COUNTRY**

Grape is grown under a variety of soil and climatic conditions in three distinct agro-climatic zones, namely, sub-tropical, hot tropical and mild tropical climatic regions in India.

**Sub-tropical Region:** This region covers the northwestern plains corresponding to 28° and 32° N latitude including Delhi; Meerut district of Uttar Pradesh; Hissar and Jind districts of Haryana; and Bhatinda, Ferozpur, Gurdaspur and Ludhiana districts of Punjab. Vines undergo dormancy and bud break starts in the first week of March while the rains arrive in the first week of June, and therefore, only 90-95 days are available from the initiation of growth to harvest. Consequently, ‘Perlette’ is the only early ripening variety grown in this region. Rain damage is a problem with Thompson Seedless in this region. Single pruning and a single harvest is the accepted practice here.

**Hot Tropical Region:**This region covers Nashik, Sangli, Solapur, Pune, Satara, Latur and Osmanabad districts of Maharashtra; Hyderabad, Ranga Reddy, Mahbubnagar, Anantapur and Medak districts of Andhra Pradesh; and Bijapur, Bagalkot, Belgaum, Gulberga districts of northern Karnataka lying between 15° and 20° N latitude. This is the major viticulture region accounting for 70 percent of the area under grapes in the country. Vines do not undergo dormancy and double pruning and a single harvest is the general practice in this region. Maximum and minimum temperature is 42°C and 8°C, respectively. The major problems in this region are soil and water salinity and drought. Berry growth is impaired and in certain locations pink blush sometimes develops on green berries due to temperatures that drop to a low of 8°C. Thompson Seedless and its clones (Tas-A-Ganesh, Sonaka), Anab-e-Shahi, Sharad Seedless and Flame Seedless are the varieties grown in this region.

**Mild Tropical Region:** An area covered by 10° and 15° N latitude including Bangalore and Kolar districts of Karnataka; Chittoor district of Andhra Pradesh and Coimbatore; and Madurai and Theni districts of Tamil Nadu fall in this region. Maximum temperatures in a year seldom exceed 36°C, while the minimum is about 12°C. Principal varieties are Bangalore Blue (Syn. Isabella), Anab-e-Shahi, Gulabi (Syn. Muscat Hamburg), and Bhokri. Thompson Seedless is grown only with limited success. Except for Thompson Seedless, two crops are harvested in a year.

*Vinifera* varieties susceptible to mildew suffer losses due to unprecedented rains during flowering and fruit set in both hot and mild tropical regions.

Area and production of different varieties of grapes in India is as follows:

|  |  |  |
| --- | --- | --- |
| **Variety** | **Area (ha)** | **Production (t)** |
| Anab-e-Shahi (white, seeded) | 3,000 | 135,000 |
| Bangalore Blue Syn. Isabella (black, seeded) | 4,500 | 180,000 |
| Bhokri (white, seeded) | 500 | 15,000 |
| Flame Seedless (red, seedless) | 500 | 10,000 |
| Gulabi Syn. Muscat Hamburg (purple, seeded) | 1,000 | 30,000 |
| Perlette (white, seedless) | 1,500 | 60,000 |
| Sharad Seedless - A mutant of Kishmish Chorni (black, seedless) | 1,000 | 20,000 |
| Thomson Seedless and its mutants (white, seedless) | 22,000 | 550,000 |
| **Total** | **34,000** | **1,000,000** |

Approximately 85 percent of the total production, irrespective of the variety, is consumed fresh. About 120,000 tonnes of Thompson Seedless and its mutants, namely, Tas-A-Ganesh, Sonaka and Manik Chaman are dried for raisins. Some 20,000 tonnes of Bangalore Blue are crushed to make juice, and 10,000 tonnes of Bangalore Blue, Cabernet Sauvignon, Chenin Blanc, Chardonnay, Merlot, Pinot Noir and Uni Blanc are crushed to process into wine.

**PRODUCTION OF PLANTING MATERIAL**

Vines are raised on their own roots in India. Due to the non-prevalence of Phylloxera or nematodes, rootstocks are not employed, but in recent years, the ‘Dogridge’ rootstock is being employed to combat soil and water salinity problems.

**Multiplication on Own Roots**

Grapes are multiplied exclusively by the rooting of hardwood cuttings. No Government agency is involved in the multiplication and supply of rooted cuttings. Growers themselves obtain the hardwood cuttings from elite vineyards and raise their own nurseries. Well matured canes obtained in September/October are selected. Cuttings of 4 nodes each with a thickness of 8 to 10 mm are made from the selected canes. The fresh cuttings are soaked in running water for 24 hours to leach out the water-soluble rooting inhibitors. The basal parts of cuttings are then dipped in a 2,000 ppm strong IBA solution for five minutes before planting. It is also a practice to plant the cuttings *in situ*when three to four cuttings prepared and treated as above are planted at each spot in the main field. Soil drenching with chlorophyriphos 0.1 percent is a practice to safeguard the cuttings against termite damage.

**Raising on Rootstocks**

Hardwood cuttings of the ‘Dogridge’ rootstock are subjected to rooting, preferably in polybags of 15 x 25 cm. Rooted cuttings of this rootstock are planted in the main field during February-March. The desired scion variety is then grafted/budded on the rootstocks in the field by wedge grafting/chip budding. Wedge grafting is more common and the best time for the operation is September-October, while June-July is the suitable time for chip budding.

**ESTABLISHMENT OF VINEYARDS**

**Land Preparation and Vine Establishment**

The land is tilled and laid into plots of 120 m x 180 m separated by 3 m wide roads. Land within a plot is levelled perfectly to have a gradient of less than 1 percent in any direction to ensure uniform discharge of water through the emitters of drip irrigation systems.

Trenches of 75 cm width, 75 cm depth and 118 m length in a north-south direction with a gap of 3 m between trenches are opened with heavy machinery. They are closed with topsoil, up to a height of 45 cm after 15 days exposure to sun. The remaining gap is filled with a mixture of soil, cattle manure, single superphosphate, sulphate of potash and micro-nutrients. Usually, 50 kg of cattle manure, 2.5 kg of superphosphate, 0.5 kg of sulphate of potash and 50 g each of ZnSO4 and FeSO4are added to the soil for every running meter length of the trench.

**Planting Season**

The best season for planting the rooted cuttings of cultivated varieties in the main field is September-October whereas for rootstocks it is February-March.

**Spacing**

Spacing generally varies with the varieties and soil fertility. For vigorous varieties it is 6 m x 3 m or 4 m x 3 m and 3 m x 3 m or 3 m x 2 m for less vigorous varieties.

**CARE AND MANAGEMENT OF VINEYARDS**

**Training of Vines**

Many training systems are in vogue in India, but the most popular are Bower, Telephone and Flat Roof Gable systems.

**Bower System:** Owing to the high productive potential, bower was a very popular system of training in the past. It is highly suited for vigorous varieties like Anab-e-Shahi, Bangalore Blue and Gulabi. But in varieties like Thompson Seedless and Tas-A-Ganesh where vine vigour and excessive foliage density affects the productivity adversely, this system is not popular.

**Telephone System:** T-trellis is used in this system of training. With three top wires and ‘T’ shaped supports, the trellis looks like a telephone pole and wires and hence the name.

This system is followed for moderately vigorous varieties like Thompson Seedless and other seedless cultivars in about 25-30 percent of the vineyard area in Maharashtra. Yields in this system are less than the bower. In very hot and dry places, sunburn of the berries and of the arms are experienced in summer.

**Flat Roof Gable System:** Combining the advantage of bower and the extended Y systems and eliminating their disadvantages, an inter-connected Y trellis forming a flat roof gable is being adopted. This system is particularly followed for vigorous vines (vines grafted on rootstocks). The bunches are protected from direct sunlight and well exposed to sprays of pesticides. The clusters hang within the reach of the worker of an average height. Owing to these advantages, this system is gaining popularity among the growers in Maharashtra, Andhra Pradesh and Karnataka.

**Pruning of Vines**

Three distinct pruning practices are in vogue in relation to cropping in the three grape growing regions of the country. In the sub-tropical region, vines are pruned only once in December and the crop is harvested once. Half of the canes are pruned to renewal spurs and the rest to fruiting canes (3-4 nodes for Perlette).

In hot tropical regions, vines are pruned twice but only one crop is harvested. All canes in a vine are pruned back to single node spurs in March-May to develop canes and the canes are forward pruned in October-November for fruiting. The number of nodes retained on a cane varies with the variety and cane thickness. There is no scope to prune earlier than October and later than November due to unfavourable weather conditions.

In the mild tropical region, vines are pruned twice and the crop is harvested twice. In varieties like Gulabi and Bangalore Blue, which are fairly resistant to rain damage and in which fruit bud differentiation is not impaired by cloudy weather and rains, pruning is done at any time of the year. As a result, five crops are harvested every two years.

**Application of Manure and Fertilizers**

As vineyard soils are either sandy loams or heavy clays, the usage of organic manure has assumed high importance in India. A standard dose of 500:500:1000 kg of N, P2O5 and K2O per hectare is followed in light sandy soils, while 660:880:660 kg are applied for heavy clay soils. The annual dose is fixed based on the petiole analysis carried out at 45 days after spur pruning. While 40 percent of the annual dose is given through organic sources, 60 percent is given as inorganic fertilizer. Calcium ammonium nitrate is usually not used. Sulphate of potash is the only source of potash used in place of muriate, particularly in heavy clay soils. Recently application of soluble fertilizers through drip irrigation is picking up. 40 percent of N, 50 percent of P2O5 and 33 percent of K2O of the annual dose is given during the growth season and the rest in the fruiting season.

**Weeding**

Weeds between the rows of vines are removed mechanically by tractor drawn implements. Within the rows, weeds are manually hoed and removed. Sometimes the post-emergent weedicides, mainly glyphosate at about 2.0 kg/ha or paraquat at about 7.5 kg/ha is sprayed in fully grown vineyards.

**Supplementary Irrigation**

Since grapes are grown in areas where the evapotranspiration exceeds the precipitation, irrigation is essential. Less than 10 percent of the vineyard areas are surface irrigated, while the rest is irrigated by drip systems. Water requirement is calculated based on the pan evaporation using 0.8 as the crop factor. Water is applied at different rates at different stages of vine growth and berry development.

**Pests and their Management**

The important pests of grapes in India are, flea beetles, thrips, mealy bugs and leaf hoppers.

**Flea beetles:** The adult beetles scrape the sprouting buds and eat them up completely after each pruning. Damaged buds fail to sprout. Insecticides like carbaryl at 0.15 percent, quinolphos at 0.05 percent, dichlorvas at 0.1 percent or phosalone at 0.05 percent are sprayed from the fourth day until the emergence of leaves.

**Thrips:** Thrips attack the ovaries of flowers and newly set berries and suck sap from them. The affected berries develop a corky layer and become brown on maturity. Scab formation on the berry surface is also due to thrip damage to the ovaries/young berries. Such berries are not suitable for marketing. Thrips are effectively controlled by spraying phosphamidon at 0.05 percent, carbaryl at 0.125 percent, phosalone at 0.05 percent or malathion at 0.05 percent. Prophylactic sprays of insecticides against thrips are given once in five days from the initiation of bloom to berry set.

**Mealy Bugs:** Mealy bugs are the most serious and problematic pests of grapes in India. Nymphs and adults suck sap from the tender shoots resulting in crinkling and stunting of the new shoots. They excrete honey on leaves and berries and sooty mold develops on the honey. Mealy bug infected bunches are unfit for marketing. Yield losses can be up to 50 percent due to mealy bug damage. Mealy bugs are hard-to-kill insects and the package of practices for their control in India is as follows:

i) Avoid spraying broad-spectrum insecticides particularly synthetic pyrethroids.

ii) Spray only dichlorvas at 0.1 percent mixed with neem oil 0.2 percent or tridemorph at 0.1 percent.

iii) Release *cryptolaemus montrozieri* beetles at 8,000-10,000 per hectare when the berries start softening. It is better to release a mixed population of grubs and adults rather than only adults.

**Leaf hoppers:** This pest has assumed serious proportions in all grape growing regions of India in recent years. The adults and young nymphs of hoppers suck sap exclusively from the lower side of the leaves. Carbaryl at 0.15 percent, fenitrothion at 0.04 percent, phosalone at 0.05 percent or quinalphos at 0.05 percent are sprayed to control this pest. A mixture of quinalphos at 0.05 percent and phosalone at 0.05 percent is more effective on the nymphs while tridemorph at 0.1 percent only is effective on the adults.

**Diseases and their Management**

The important grape diseases are anthracnose, downy mildew, powdery mildew and bacterial leaf spot. In recent years, *Alternaria* is also becoming a serious pathogen.

Anthracnose is prevalent in all grape growing regions of the country. The disease is characterized by small light brown or greyish black lesions on tender shoots, young leaves, flowers and young berries. Bordeaux mixture at 0.8 percent, copper oxychloride at 0.25 percent or carbendazim at 0.1 percent are used to control this disease.

Downy mildew is the most devastating disease of grapes in the tropical region of the country. The disease mainly appears on the leaves, but also attacks the flower clusters and young fruits. The losses are very high when it attacks the clusters before fruit set. Entire clusters decay, dry and drop down. Properly neutralized Bordeaux mixture at 1 percent, copper oxychloride at 0.2 percent, Mancozeb at 0.2 percent, metalaxyl (Ridomil Mz at 0.2 percent) or Phosethyl-Al (aliettle at 0.2 percent) are used against this disease.

Powdery mildew is prevalent in all the grape growing regions. It is next in importance to downy mildew in its devastating severity. The disease is characterized by the presence of white powdery (ash like) coating in patches on both sides of the leaves, young shoots and immature berries. Powdery mildew is controlled easily by wettable Sulphur formulations. A wide range of fungicides, namely, Calaxin at 0.07 percent, Karathane EC at 0.04 percent, Myclobutanil (Systhane at 0.05 percent), Triademifon (Bayleton at 0.1 percent) and Penconazol (Topas at 0.025 percent) are used to control this disease.

Bacteria infects leaves, shoots and berries. The symptoms appear as minute water soaked spots on the lower surface of the leaves, especially along the main and lateral veins. Mostly these spots coalesce and form larger patches. Severely infected leaves give a blighted appearance. Streptocyclin at 500 ppm is used as a prophylactic spray, while Bordeaux mixture at 0.8 percent or copper oxychloride at 0.15 percent is used to check its spread.

**Physiological Disorders**

Physiological disorders associated with high temperature and low atmospheric humidity in the hot tropical region are dead arm and trunk splitting. Salinity injury is common in Maharashtra and north Karnataka. Other physiological disorders are cane immaturity, water berries, cluster tip wilting, shot berries, uneven ripening and post-harvest berry drop. The eco-physiological disorders are ‘*coulure’*, blossom-end rot, pink berry syndrome, berry cracking and rotting.

**Quality Improvement**

**Shoot and Cluster Thinning:** Only one or two clusters are retained per cane depending upon the density of the latter. Irrespective of the number of clusters, only the apical two or three shoots are retained. In vines trained to the flat roof gable, individual shoot length is encouraged rather than the total canopy size for preventing sunburn of the berries.

**Production of Loose Clusters:** Pre-bloom GA sprays of 10 ppm and 15 ppm are given respectively on the 11th to 14th day after bud break for cluster elongation. Rachides of the clusters are trimmed to retain 8-10, depending on the number of leaves available per cluster. Clusters are dipped in GA solution of 30-40 ppm when 10-20 percent of the flowers open in each cluster for berry thinning.

**Increasing Berry Size:** Manual means are used to supplement chemical thinning to ensure adequate berry thinning and improve the quality of grapes. Approximately 90-120 berries are retained per cluster depending upon the number of leaves available to nourish it at 8-10 berries per every leaf depending on its size. Clusters are dipped in GA solution of 40-50 ppm concentration once at 3-4 mm size of the berries and again at 7-8 mm size. When berry diameter is to be increased to more than 16 mm, clusters are dipped in a mixture of 10 ppm BA + 25 ppm GA or 2 ppm CPPU + 25 ppm GA or 1 ppm brassinosteroid + 25 ppm GA instead of GA alone at these two stages.

In addition to the treatment with growth regulators, berry size and crispiness are increased by girdling. The width and depth of girdling are 1-1.5 mm. Girdling is done at 4-5 mm diameter of the berries.

**Increasing the TSS Content:** Berry thinning and cluster thinning to maintain adequate leaf/fruit ratio (5 cm2), while girdling will ensure a TSS content of 20°B.

**HARVESTING AND YIELDS**

Approximately one million tonnes of grapes are harvested annually in India. Grape is harvested almost all the year round. If not all the varieties, one or more varieties are always available at any given time of the year. Period of harvest and yield of different varieties is given below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Variety** | **Yield (t/ha)** | | **Period of Harvest** |
| **Average** | **Potential** |
| Anab-e-Shahi | 45 | 90 | February-May, July, November-December |
| Bangalore Blue | 40 | 60 | January-March, June-December |
| Bhokri | 30 | 50 | November-December, June-July |
| Gulabi | 30 | 50 | January-March, June-December |
| Perlette | 40 | 50 | June |
| Thompson Seedless and other seedless varieties | 25 | 50 | January-April |

However, the major proportion of produce, mainly of Anab-e-Shahi, Thompson Seedless and its clones, is harvested during March-April from the hot tropical region, which contributes more than 70 percent of the total harvest.

The productivity of grapes in India is very high, particularly in the Hyderabad region. Yields as high as 100 t/ha in Anab-e-Shahi and 75 t/ha in Thompson Seedless were recorded in this region. However, quality of grapes is usually poor as a result of high yields.

**7. MARKETING**

More than 80 percent of the total production is consumed as table grapes in India, and more than 70 percent of the total production is harvested in March-April, but the cold storage facilities are inadequate. Therefore, market gluts and fall of prices of grapes in March-April are common. Approximately, 2.5 percent (22,000 t) of fresh grapes are exported to the Middle East and European countries. The rest of the produce is marketed within the country. Grapes are exported through three different agencies viz., Grower Exporters, Growers’ Cooperatives and the Trader exporters. These agencies have established their own facilities for pre-cooling and cold storage in the vicinity of major production sites.

**POTENTIAL FOR GRAPE PRODUCTION DEVELOPMENT**

India has the distinction of achieving the highest productivity in grapes in the world, with an average yield of 30 t/ha.

a) Sustaining productivity and minimizing risks in grape cultivation is possible because of the availability of a variety of agro-climatic regions suitable for grape cultivation for table, raisin and wine grapes.

b) Technologies to achieve high productivity are currently available.

c) Scope for double cropping in certain regions and harvesting round the year in certain varieties is practically feasible.

d) Technologies to produce export quality grapes and quality raisins are available.

**CONSTRAINTS IN GRAPE PRODUCTION DEVELOPMENT**

Although grape cultivation is considered as highly remunerative, the area under grapes is confined to only 34,000 hectares due to the following constraints.

a) Heavy initial investment for establishing a vineyard.

b) High recurring costs in vineyard management.

c) Narrow variety base and lack of diversity in utilization of the germplasm available in grape growing countries.

d) High risk of losing the crop due to unprecedented changes in weather.

e) Soil and water salinity in Maharashtra and drought in the hot tropical areas.

f) Short period available for ripening in the north.

g) Very low proportion of export quality grapes.

h) Wine is not a popular drink at present.

i) Marketing problems in table grapes.

**GOVERNMENT POLICIES AND PLANS FOR RESEARCH AND DEVELOPMENT OF GRAPES**

The Government of India is supporting the grape industry of the country in the following ways:

a) Encourage and support the farmers for establishing the vineyards and installing drip irrigation systems by providing soft loans and subsidies.

b) Provide research support to sustain the productivity of grapes under adverse situations.

c) Promote and support the export of fresh grapes by training the growers and providing soft loans and subsidies for pre-cooling and cold storage facilities.

Research on grapes is carried out by the Indian Council for Agricultural Research (ICAR) Institutes and State Agricultural Universities at different centres under the All India Coordinated Research Project on Grapes. The National Research Centre for Grapes (ICAR) located at Pune, Maharashtra is the focal point for conducting and coordinating the research activities on grapes throughout the country.

**CONCLUSIONS**

Grape is cultivated over an area of 34,000 hectares with an annual production of 1,000,000 tonnes. Although, the returns per unit area of land are very high with grape cultivation, the area under grapes is not expanding fast owing to the high initial cost of establishing the vineyards and high recurring cost of production. The risk of losing a crop due to unprecedented changes in weather is also very high. Since the highest productivity in grapes has been achieved, efforts are needed to extend grape cultivation to newer areas. Soil and water salinity and drought are the impediments in this direction, for which suitable rootstocks are to be identified.

There is a need to diversify the uses of grapes. Currently more than 80 percent of the produce is used for table purposes. The major bulk of the produce is harvested in March-April, but as cold storage facilities are currently inadequate there are frequent market gluts. Diversification of uses as wine/juice and export of table grapes can ease the marketing problems. Maintenance of quality of table grapes by crop regulation is the priority consideration to increase exports. For the survival of the grape industry in India, the produce should be quality and cost competitive. Future efforts are to be concentrated in this direction.