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## **UNIT 4 GRAPE (*VITIS VINIFERA* L.)**

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## 4.0 OBJECTIVES

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After going through this unit, you will be in a position to:

- explain the background and uses of grapes,

- discuss status of area and production of grapes in the world and country,
- describe the soil, climatic and nutritional requirement,
- identify the seedless and seeded cultivars/hybrids,
- describe the planting, propagation and training methods, and
- describe various pests-diseases and physiological disorders.

## 4.1 INTRODUCTION

Grape (*Vitis vinifera* L.) is the most important and widely grown deciduous fruit crop on every continent. Grapes are being grown commercially in the tropics. The history of grape culture is as old as that of human civilization. The grape is believed to be introduced in India by the invaders from Iran and Afghanistan about 1300 AD.

Grape belongs to the **family Vitaecae**. Grape originated in Asia Minor, in the region between South of Black and Caspian seas. The family contains 12 genera and 600 species. It is considered as a sophisticated fruit from the very old times to prepare drink, wines and medicine. In European countries, it is mainly cultivated for making wines. Ripe fruits are supposed to be the best table fruit and are very easily digestible. Fruits contain a large proportion of sugars and minerals. The grape juice is a nourishing thirst quencher a stimulant to the kidneys and a laxative.



## 4.2 AREA AND PRODUCTION

The grape is grown in all the tropical countries of the world *viz.* India, Indonesia, Philippines, Thailand, Taiwan, South China, Australia, Brazil, Columbia, Mexico, Kenya, West Indies, Nigeria, Zimbabwe etc. with an annual production of 7,501,872 tonnes. In India, 90 % of grapes are being produced in the tropical region of the peninsular states i.e. Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu. The area and production of grape in the major growing states of the country is given in Table -1: The annual production of the grape in the country is 1677.1 thousand mt from an area of 64.4 thousand ha. Approximately 71 per cent of world grape production is used for wine, 27 per cent as fresh fruit and 2 per cent as dried fruit.

**Table 1 :** Statewise area, production and productivity in total of Grape during 2017-18.

Sl. No.	State	Area (000 ha.)	Production (000 mt.)	Productivity ha/mt
1	Maharashtra	105.50	2286.44	21.68
2	Karnataka	26.61	524.20	19.70
3	Mizoram	2.45	18.00	7.35
4	Tamil Nadu	2.16	58.93	27.28
5	Andhra Pradesh	0.80	15.92	19.70

6	Punjab	0.29	8.23	28.38
7	Telangana	0.35	5.27	15.06
8	Madhya Pradesh	0.09	1.28	14.22
9	Jammu & Kashmir	0.33	0.89	2.70
10	Other	0.35	0.94	2.67
	<b>Total</b>	<b>138.91</b>	<b>2920.09</b>	<b>158.94</b>

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### 4.3 SOIL

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Grapevine has a strong root system and can be grown in a wide range of soils from gravelly loam to heavy clays, from very shallow to very deep. However, the best suited soil is well drained sandy loam containing good amount of organic matter. The soils having low fertility status can be made suitable with the application of heavy amount of well decomposed farmyard manure and addition of other nutrients. High lands with good drainage and free sunshine are suited for grapes. The soil should have also moderate water holding capacity and porosity. Free drainage is essential for areas which experience heavy rainfall during the early spring, the season for initiation of root growth after winter dormancy. Grape thrives well under soil pH levels of 6.5 - 7.5. Grape is moderately tolerant to salinity and alkalinity, but excessive lime is harmful.

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### 4.4 CLIMATE

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The grape is sub-tropical fruit. However, it can be grown in temperate and tropical climate zones. The climatic factors for grape cultivation may be classified as sunlight, temperature, rainfall, humidity, wind flow etc. The grapes require long, warm to hot dry summers at fruiting time and cool winters at resting time. Under humid summer conditions, vines do not grow well as they are susceptible to diseases. Grapes can tolerate high humidity better in cool regions than in warmer areas. Bright sunny days help in the development of sugar in the berries. However, at a very high temperature the skin becomes thicker. The distribution of rain, rather than the total rainfall is most important. Rainfall should not coincide with the fresh growth after pruning or during fruit ripening. Rains or cloudy weather during blooming and fruit ripening may result in poor berry set and poor quality of fruit. Rains at ripening may cause considerable damage to the crop by berry splitting and bunch rotting. High humidity and rains results in disease problems for vine and fruit. Frost, if occurs in spring, may damage the sprouting buds. Similarly, hails during the fruiting season may spoil the whole crop.

The vines remain dormant during winter in North India, while in South and West India, the grapevine takes no rest, grows throughout the year, yield two crops.

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### 4.5 COMMERCIAL VARIETIES

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There are about 10,000 named and well described cultivars of grapes throughout the world, although there are a number of synonyms for the same cultivar in different regions. In India, more than 1,000 cultivars are now grown

in different experimental stations, most of them being introduced from other countries. Apart from these introductions, certain varieties developed as a result of selection or hybridization has been released for cultivation. You will find a description of some of the important cultivars given below:

## **4.5.1 Seedless Cultivars**

### **4.5.1.1 Beauty Seedless**

The vine is medium in vigour. Berries bluish black, spherical, small size, fairly sweet, flavour poor. It is esteemed for its productivity, earliness and suitability for processing into juice. Although it has poor keeping quality, it has proved acceptable to the trade as a table grape and is preferred next to perlette in North India. It can be trained to head system and is highly to moderately susceptible to diseases. It gives high yield in Northern states of the country.

### **4.5.1.2 Thompson Seedless**

It is originated in Asia minor. It is a table and raisin cultivar, which ripens uniformly in the middle of June in North and February to April in South. The vine is vigorous in growth and bears in 16 months after planting. Bunch is medium large, long, conical to cylindrical, shouldered and compact. Berries small, elongated yellowish green to golden yellow in colour. Eating and keeping qualities are excellent. It is commercially grown in all the grape growing areas of the world.

### **4.5.1.3 Pusa Seedless**

It is a selection made at the IARI, New Delhi from unknown origin, but it resembles Thompson Seedless in many characters. The vine is vigorous and medium yielder. Berries greenish white, slightly more elongated, pulp very sweet, keeping quality is good. Apart from table purpose, good raisins can also be prepared.

### **4.5.1.4 Perlette**

A hybrid between “Scolokertekhiralynoje” x “Sultanina Marble” which was developed by Dr. H. P. Olmo at University of California, USA. It perform well in North and Western India. It is one of the earliest maturing cultivar, which bears heavily. Bunches small to medium, long, conical, compact with medium-sized, spherical, whitish green translucent berries, flesh soft, muscat - flavoured, TSS 18-20 per cent, good keeping quality.

### **4.5.1.5 Delight**

This cultivar is a sister seedling of perlette. This very early ripening cultivar has been found to perform well in Punjab and Haryana. The bunch is medium in size, compact, conical and attractive with green, small and almost round berries having muscat-like flavour. It has good eating and shipping quality.

### **4.5.1.6 Himrod**

A recent introduction to India, but performing well in Punjab, Haryana and Uttar Pradesh. Vine is vigorous and heavy yielder. Bunches are attractive,

medium large, shouldered and well filled with yellow-green berries of excellent quality. The skin is thick and tough. This cultivar is reported to be resistant to a number of pests and diseases.

Some other well known seedless grape cultivars are Kishmish Beli, Kishmish Churni, Seedless White Round.

### 4.5.2 Seeded Cultivars

#### 4.5.2.1 Anab-e-Shahi

It was introduced in Hyderabad from the middle east in 1890 and was extensively grown in Andhra Pradesh and Karnataka, but it is being replaced by “Thompson Seedless” due to seedlessness and superior fruit quality. The bunch is medium to large in size, and are moderately compact. The berry is oval in shape. It is amber in colour. Keeping quality is good. It is resistant to cercospora and fruit rot. The vine bears in 20 to 24 months after planting. It has been acclaimed as one of the most productive cultivar grown in India and yielded over 30/tons/acre/year.

#### 4.5.2.2 Bangalore Blue

Bangalore blue is an important cultivar of Karnataka where it gives more than one crop in a year. This variety is supposed to be a **hybrid of vinifera and labrusca species**. It does well on bower and kniffin systems of training. The taste is very acidic and flavor foxy. Apart from its use for table purpose, it is being used for juice and wine. Bunches are small, well filled with small to medium sized berries. It is susceptible to cracking and rotting during rains.



#### 4.5.2.3 Bhokri

It is one of the leading cultivar of Tamil Nadu and Maharashtra. It is a vigorous and high yielding cultivar with large, compact, usually shouldered bunches. **It does well on bower as well as on trellis systems of training.** The berries are green, medium in size, oval with soft pulp. Ripening is late but uniform, however, berries crack with rain and its keeping quality is poor.

#### 4.5.2.4 Black Champa

A selection made from introductions at IIHR, Bangalore, suitable for table, juice and red dessert wine purposes. The vines are vigorous in growth and high yielding. Bunches are small, well filled with small to medium berries, spherical in shape and black in colour, quality excellent with 25-27 per cent TSS. Its keeping quality is also good, but it tends to crack and rot during rains.

#### 4.5.2.5 Gulabi

It is also known as Karachi, Paneer Draksha and Muscat. It resembles Muscat Hamburg of Australia. The vine is medium in vigour and yields high. Bunches are small and loose with deep purple, spherical and small sized berries. The berry skin is thick and shipping quality is good. The fruit ripens early and uniformly with Muscat flavour.

#### 4.5.2.6 Cheema Sahebi

This is vigorous growing, high yielding variety was selected by Dr. G. S. Cheema from the open pollinated seedlings of “Pandhari Sahebi”. Earlier it was known as Selection-7, mainly grown in Maharashtra. Bunches are large, conical, shouldered with medium to large, oval, pale coloured berries. This late ripening cultivar has good shipping quality.

#### 4.5.2.7 Cardinal

This very early red table grape was evolved as a result of crossing between Tokay and Ribier which is performing well in the irrigated regions of North India. The vine is medium in vigour. Clusters are attractive, medium to large, loose and conical with large, bright red and spherical berries. The colour changes to reddish black as ripening proceeds.

### 4.5.3 Hybrids

#### 4.5.3.1 Arkavati

It is cross of “Black Champa” x “Thompson Seedless”. The vines are vigorously growing. The bunch is long conical to cylindrical, berries medium, spherical to ellipsoidal, yellowish green. Berries are almost seedless. This hybrid is suitable for raisin making. Juice percentage is 70-74.

#### 4.5.3.2 Arka Kanchan

A hybrid between “Anab-e-Shahi” x “Queen of the Vineyard”. The vines are vigorously growing. The bunch is medium to large, conical, berries large, golden yellow, ellipsoidal to obovoid. It is a seeded hybrid. Juice percentage is about 60-65.

#### 4.5.3.3 Arka Shyam

A cross of “Bangalore Blue” x “Black Champa”. The vines are moderately vigorous. The bunch is medium, cylindrical. Berries are medium large, shinning black, spherical to obovoid, seeded, juice 60-72 per cent, yield potential is high.

#### 4.5.3.4 Arka Hans

It is developed by crossing “Bangalore Blue” x “Anab-e-Shahi”. The vines are vigorous. Bunch is well filled, cylindrical. Berries medium large, yellowish green, spherical to ellipsoidal. It is a seeded hybrid. Juice content is 68-70 per cent. Unlike “Anab-e-Shahi” it also produces fruits on head system of training.

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## 4.6 LAYOUT AND PLANTING

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### 4.6.1 Layout of Orchard and Preparation of Land

While selecting a site for planting a vineyard, the factors like vicinity to the market, road, railway station, storage facility, processing industry etc. need special consideration. The grape is highly perishable fruit and cannot be stored long or transported to distant markets. A proper layout of a vineyard is very important, because any mistake done cannot be corrected afterwards. It is advisable to prepare a sketch plan on a graph paper indicating the plants, rows, pillars, channels etc. Wind breaks should be planted to protect the vines from hot desiccating winds that blow over the plains of North India during May - June.

### 4.6.2 Planting

Planting should not be taken up unless the layout and bower erection are complete. On well cultivated and weed free land the pits are dug 75 - 100 cm<sup>3</sup> in size. While digging the pits, the top half depth soil is separately heaped which will be utilized later for filling the pits. The pits are allowed to remain open and subject to weathering for 3 - 4 weeks. The pits are then filled with 1:1 mixture of top soil and farmyard or organic manure, 3 kg bon-meal, 5 kg neem cake, 1-3 kg super phosphate and 500 g sulphate of potash may also be added. 30 g Aldrin (5 %) is also thoroughly mixed with the soil as protection against termites. The soil is then allowed to settle by giving irrigation.

Time of planting will depend on the prevailing weather conditions. Under semi tropical conditions where winter rainfall or easy irrigation is available, planting may be done during October - January. But under subtropical and temperate climates, the planting starts from January - February. One year old rooted cutting are planted. In the middle of the pit a hole is made to spread the roots and soil is pressed firmly and gently. The vines are irrigated lightly right after planting. In order to ensure better establishment healthy, disease free, plants are planted and top of the plant is pruned leaving 2-3 buds. A basin is prepared around each newly planted vine which is connected with irrigation channel. As the plants starts growing, they can be trained on any of the training systems.

The spacing varies with the cultivars. The commonly followed spacing is 4.5 x 4.5 m for "Anab-e-Shahi", 7.2 x 3.6 m for "Bangalore Blue" and 3.0 x 3.0 m for "Thompson Seedless" or "Pusa Seedless".

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## 4.7 PROPAGATION

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Grapevines are propagated by Asexual method of propagation and sexual method of propagation. Asexual method of propagation is also known as vegetative method of propagation and it take place by stem cuttings, layering, budding and grafting. Sexual method of propagation is by seeds.

### 4.7.1 Asexual Method of Propagation

It is commercial method of grape propagation on large scale. It take place by:



#### 4.7.1.1 Cutting

The grape is mainly propagated by stem cuttings. Hard wood cuttings give higher success than semi hard and soft wood cuttings under ordinary conditions. The stem cuttings are made from one year old wood (canes), at the time of pruning, when the vines are dormant. After discarding the very basal portion of stem, about 20-30 cm long, medium thickness cuttings are prepared by giving lower end is cut immediately below a bud, while the upper cut at 0.75 to 2.0 cm above the bud. It is essential that each cutting should have at least 3 to 4 buds. It is always advisable, to select high yielding, disease and pest free vines for preparing cuttings. Cuttings are prepared, in well prepared nursery beds, at 30 cm distance between cuttings and 100 cm between rows. Cuttings are planted bit deep in the soil, in such a way that one bud is left above the ground. Rooting success in cuttings may go upto 95 per cent or so, under favourable conditions. Rooted cuttings are ready for planting in 90 days.

#### 4.7.1.2 Layering

Grape cultivars, which are difficult to root on cuttings can be propagated by simple, trench and mound layering.

#### 4.7.1.3 Grafting and Budding

These methods are also quite common in grapevine propagation, when the benefits of a particular rootstock are wanted to be exploited. Bench grafting is widely used in grapes. Scions are grafted on either rooted or unrooted cuttings by whip grafting method, which is usually done in late winter or early spring. T-budding and chip budding, are also popular in grapes.

#### 4.7.1.4 Rootstock

In India, normally the vines grow well on their own roots. However, for some problems, such as phylloxera, nematodes, salinity etc. suitable rootstocks should be selected. The following rootstocks are generally used for grafting or budding:

- i) **St. George** : A variety of *V. rupestris*, vigorous, phylloxera-resistant, drought tolerant, suitable for shallow non-irrigated soils, susceptible to rootknot nematode.
- ii) **Ganzin No.1** : Highly productive, phylloxera-resistant, suitable for fertile, irrigated soils, susceptible to rootknot nematode.
- iii) **Harmony** : A cross between “Dog Ridge” seedling and a “1613” seedling. Vigorous, resistant to phylloxera and nematode. Cuttings root easily.
- iv) **Freedom** : A sister seedling of “Harmony”, very vigorous, resistant to phylloxera and nematode, cuttings root easily and uniformly. It is recommended where high vigour is desired.
- v) **Dog Ridge and Salt Creek** : Closely related varieties of *V. champini*, resistant to phylloxera and rootknot nematode, extremely vigorous, suitable for low fertility and sandy soils, cuttings are difficult to root.

These stocks are recommended for rasi and wine grape vineyards in sandy soils.

### 4.7.2 Sexual Method of Propagation/by Seed

This method generally used to breed new varieties / hybrids by cross pollination. Fresh seeds harvested from the ripen fruits develop by cross pollination. These Freshly harvested seeds are stratified at a temperature between 0.5 to 4°C for about 12 weeks to break dormancy and to get higher and uniform germination.

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#### Check Your Progress Exercise 1

**Note:** a) Space is given below for the answer.

b) Compare your answer with that given at the end of the unit.

1. What are different uses of grapes ?

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2. What are the main hybrids of grapes ?

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3. Which is the best method of propagation of grapes ?

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## 4.8 NUTRITIONAL REQUIREMENTS

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The grapevine removes an appreciable quantity of nutrients, from the soil. It has been estimated that an average crop of grape removes from the soil 40-60 kg N, 10-15 kg P and 50-70 kg K per hectare. To maintain the soil fertility for consistent yield, it becomes necessary to replenish these nutrients in the form of manures and fertilizers, which may be applied annually to the soil, in addition to that already applied to the pits before planting.

The fertilizer requirement, of a vineyard is influenced by several factors, such as the fertility status and other characteristics of the soil, plant age, vigour and yield potential, climate of the place and the vineyard management. Therefore, the recommendations made for a region, may not hold good for another region, with different climatic conditions. In general, for 3 to 5 year old vines, application of 500 kg N + 125 kg P<sub>2</sub>O<sub>5</sub> + 750 kg K<sub>2</sub>O/ha/year has

been suggested. For vines above five years of age, application of 500 kg N + 500 kg P<sub>2</sub>O<sub>5</sub> + 1000 K<sub>2</sub>O/ha/year has been suggested. These recommendations are for a vine population of 750/ha (4.5 m x 3 m). The fertilizers are to be applied in split doses - after April pruning, 60 per cent N, 50 per cent P and after October pruning 40 per cent N, 50 per cent P and 50 per cent K should be applied, the rest 50 per cent should be applied at fruit set. For younger plants, the above mentioned doses are to be reduced in proportion of age. The FYM may be applied in January at the time of pruning. Half of the nitrogen and potash, and the entire amount of phosphorous, should be applied immediately after pruning in February. The remaining half of nitrogen and potash are to be applied, just after berry set.

The grapevine has a deep, widespread root system. The active feeding zone has been found in the range of 30 - 40 cm deep. Therefore, at the initial stage, the vine mainly absorbs nutrients applied in the pits before planting. In the subsequent years, fertilizers are applied at a distance of 30 cm from the trunk and 15 cm deep, which is properly mixed. Fertilizers can be applied through foliar application, which is quite efficient and rapid, since the fertilizers are absorbed by the leaves quite rapidly and efficiently. The micronutrients are mostly applied by this method.

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## 4.9 CULTURAL PRACTICES

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The following cultural practices are essential for grape orchard.

### 4.9.1 Irrigation

Grape is a drought tolerant fruit crop, as compared to other fruit crops. However, for profitable production, there should be arrangements for adequate supply of water to the vineyard as and when, it is needed. Grapevine should be irrigated after pruning and fertilization. Early vegetative period after transplanting, requires copious watering for adequate and fast vegetative growth, particularly during the dry and warm period. But the plants will require judicious irrigation once they enter bearing stage. It is very essential to irrigate grapevine at an interval of 5 - 7 days until the berries attain pea size and thereafter irrigation is given at 10 days interval till maturity. It is advisable not to irrigate grapevine 25 - 30 days before harvesting of berries as during this stage quality will be affected adversely. Excessive moisture at this stage can cause splitting of berries and subsequent rotting. Irrigation to vines after harvest is as important as during the active growth period. In order, to maintain sufficient moisture in the soil, irrigation should be applied up to October at an appropriate interval depending upon the distribution of rains.

### 4.9.2 Weed Control

Weed control in vineyard is as important as manuring or irrigation, since weeds compete with grapes for nutrients, moisture and light besides acting as a secondary host for many pests and diseases. Weeds may be controlled by cultivation around and between growing plants. Spring is the best time for cultivation. Now-a-days, two pre-emergence herbicides namely Simazine and Diuron, are being used to control annual weeds in vineyards. 2,4 - D can also be used in controlling the weeds.

### 4.9.3 Intercropping

Actually no intercrop should be sown in vineyards as it comes into bearing one year after planting and commercial crops starts after 2 - 3 years of planting. Apart from this, the distance between vines is 3 x 3 meters and as such much space is not left between the plants for growing of intercrops. Another factor is that almost entire plantations are trained on bower system of training. This structure with the spread of grapevines on it causes partial to complete shading in the 3<sup>rd</sup> year. Also the grapevine is a shallow rooted crop, therefore, root injury is quite possible in case of deep ploughing. But now-a-days intercrops like radish, cucurbits, okra, brinjal, cabbage and potato can be grown for the first two to three year after planting the vine yards.

### 4.9.4 Training and Pruning

#### 4.9.4.1 Training

Training is one of the most important and regular post planting operations in grapevines, to induce proper shape, desired growth and fruiting, with respect to quantity and quality. Initial training consists of removal of undesired shoots for development of straight and healthy trunk, pinching and tying to encourage bushy crown or vigorous framework, as well as dispersed canes, and bending the canes for bud differentiation. By nature, a grapevine is a robust climber but it can be trained to any fashion. Although there are numerous forms of training system, but in India, the most widely adapted systems are head, kniffin, trellis and bower. A brief description of the systems is given below:

- i) **Head System :** This is the least expensive method of training of grapes, and is considered most suitable for less vigorous cultivars. Single shoot is allowed to grow along support, other shoots are removed. It diverts all the energies of the vine into one single shoot which will form the permanent trunk. The shoot is tied loosely to the support with a piece of jute. When the vine is about one metre in height, it is cut back to produce side shoots. Two lateral branches are encouraged to grow and the plant is topped again at 1.3 metre height and two more lateral branches are allowed to grow. Thus four lateral branches are allowed to grow in all directions, and all other shoots are removed. Fruiting canes develop on these laterals. After 3 - 4 years, the vine becomes a dwarf bush and does not need any support.
- ii) **Bower System :** This system is also known as arbour, pergola or pandal. It is very expensive and very popular in North as well as in South India. The vines are spread over a criss-cross network of wires, usually 2 - 2.5 metres above the ground, supported by pillars (made of concrete, iron or stone) and arms of angle iron. The holes are drilled in the angle iron at a distance of 60 cm to create a criss-cross network of wires. The vine is allowed to grow as single stem. All lateral branches are removed. As soon as the main shoot reaches the bower, it is pinched so that lateral branches form. Two strong lateral branches are allowed to grow as primary arms. From these, secondary arms are allowed to develop at 50 - 60 cm apart. On secondary arms, tertiary arms are allowed to develop at 15 - 20 cm apart. These tertiary arms are pruned to 2 - 3 buds in the following

season. The new shoots arising from those spurs will provide the fruiting. The vigorous varieties like “Anab-e-Shahi” and “Bhokri” are most suitable for this system.

**iii) Kniffin System :** The kniffin system, as developed by Mr. William Kniffin of New York in 1850, is a four cane system. This system is not as popular or common as bower system in India. In this system, a trellis of two wires is strung from vertical posts. The lower wire is placed one meter above the ground and the upper wire half a meter above the lower wire. The single stemmed vine is allowed to grow forming two arms either side of the trunk at lower wire and two arms at upper wire. The pruning of a kniffin vine consists in cutting back, the canes to 6 - 8 buds. The bearing shoots are allowed to hang freely, no tying being necessary. The main trunk is tied to each wire and the canes are tied along the wires. “Thompson Seedless” “Bhokri” and “Kandhari” cultivars are suitable for kniffin system of training.

**iv) Telephone Trellis System :** This is also known as Overhead trellis system. This system is sometimes considered better than Kniffin system where the lower arms are less productive. This system is an improvement over bower system in respect of ventilation and light penetration. It is relatively less expensive than bower, but more expensive than kniffin system. However, this is not very popular with the grape growers in India. In this system, the vines are allowed to grow straight up to a height of 1.5 - 1.6 m and then trained on overhead 3 - 4 wires (45 - 60 cm apart) fixed to cross angle arms supported by vertical pillar or post. The usual spacing for each vine is 3 x 3 m.

While training the vines by any of the above systems, it should be kept in mind that the vine should develop the whole structure (primary, secondary and tertiary branches) slowly over a period of several years, otherwise the arms become unproductive and will produce fruiting wood at the apical ends only.

#### 4.9.4.2 Pruning

Pruning refers to the judicious removal of any plant part to establish and maintain a desired vine shape, to increase productivity, to distribute proper amount of bearing wood over the vine, to regulate the crop for maintaining the vitality of the vine for consistent productivity and to facilitate various cultural operations. Training determines the form, while pruning affects the functioning of the vine. It is done to concentrate the activity of the vine in the parts left after pruning, and to induce sprouting of the fruit buds located in the middle portion of the canes, which otherwise could not sprout.

The pruning of grapes consists of thinning out and heading back. All matures current season's canes are pruned to a certain level depending upon the bearing zone of the variety e.g. “Anab-e-Shahi” and “Bhokri” are pruned to 5 bud level, “Thompson Seedless” to 10 buds, “Bangalore Blue” to 4 buds and “Gulabi” to 9 buds. Normally, more number of buds is retained on thicker canes and less on thinner ones. All over crowded, diseased and damaged canes are completely thinned out. The extent of thinning out or the number

of fruiting spurs/cane to be retained after pruning largely depends on the health and vigor of the vine, the system of training, space provided for each vine, fertility of the soil and desired fruit quality.

Pruning is normally done once in North India during the month of January, but in South India, pruning is done twice a year, once in summer and again in winter. Grapevines in South and Western India grow continuously without any dormancy. Summer pruning is done during March - April in Andhra Pradesh, Karnataka and Maharashtra and in June in Tamil Nadu. This is called back or growth pruning. The winter pruning is done in September - October in Southern states except Tamil Nadu where it is done in December.

### 4.9.5 Girdling

Girdling is also known as ringing, is an old practice which consists of removing a complete ring of bark from any part of the vine (trunk, arm fruiting cane or spur). Girdling the trunk affects the entire vine, whereas girdling a cane affects only part of the cane above the girdle. Girdling interrupt the normal movement of food materials so that the level of carbohydrates and plant hormones increase the parts above the wound. The time of girdling varies depending upon the objective of girdling. To improve the set of berries, girdling should be done a week before bloom, while to increase berry size, it should be done just after berry set. Good care in cultivation, particularly in manuring and irrigation, has to be taken for girdled vines. Over cropping of girdled vines is to be avoided, which may be achieved by proper pruning and thinning.

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## 4.10 INSECT-PESTS AND DISEASES

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### 4.10.1 Insect-pests

#### 4.10.1.1 Grapevine Thrips (*Rhipiphorothrips cruentatus* Hood)

Small grey to greenish insects, suck sap from the mature leaves, and form small colonies on the leaves. The thrips infested leaves exhibit brown irregular necrotic areas with dots of dipper colour. Thus the gross photosynthetic areas are reduced and the vines become weak. Tender shoots and fruits also be affected and growth may be checked and leaves wither and fall from the vines due to thrips under severe attack.

Application of systematic insecticides like Rogor or Metasystox (0.1 %) at pre-bloom and at post fruit set period is advised. Some tolerant varieties like “Thompson Seedless”, “Pusa Seedless” etc may be selected in thrip prone areas.

#### 4.10.1.2 Flea Beetle (*Scelodanta strigicolles*)

This pest incidence is noticed immediately after pruning and most prevalent in October. The adults and nymphs feed on sprouting buds and new growth by cutting holes and scrapping the leaf surface.

The insect is controlled by the application of Malathion (50 EC) 500 ml or Carbaryl (50 WP) 1.5 kg dissolved in 500 litre of water is recommended.

#### 4.10.1.3 Mealy Bug (*Pseudococcus carymbaties*)

These soft bodied insects are polyphagous in their feeding habit. They suck sap from all plant parts during various stages of their development, particularly during flowering, the excreta of the insect falling on honey dew favours the growth of shooty moulds, affecting photosynthesis and weakening the infected plants.

Foliar spray of Dichlorovos (0.15 %) plus fish oil rosin soap (2.5 %) or Phosphomidon (0.03 %) is effective to control the insects.

#### 4.10.1.4 Grape Leaf Roller (*Sylepta lunalis* Guence)

It is a serious insect of grapevine during August-September. A female lays 100 to 150 eggs, usually on ventral surface of leaves. On hatching, the young caterpillars feed on the epidermis of leaves and skeletonise the same. Later, these caterpillars roll the leaves and feed within. Pupation takes place within rolled leaves. Generally each leaf roll contains only one caterpillar. The activity of the pest is accelerated with the onset of monsoon and continues till October.

In the initial stage of attack, remove the rolled up leaves and destroy the same with larvae pupae within. Dust 1 per cent Parathion 20-25 kg/ha. Spray Malathion 50 EC at 0.05 per cent (one part of Malathion 50 EC in 1000 parts water)

#### 4.10.1.5 Chaffer beetles (*Adoratus* spp.)

It occurs mostly during the monsoon season. The beetles come out at night and feed voraciously on young shoots and leaves leaving only the vines.

Remove the weeds from the vineyards. Stomach poisons are most effective to control the beetles. Spray with Monocrotophos at 0.05 per cent is effective. Dusting of leaves at 2-3 times at an interval of fortnight with 10 per cent Aldrin is also effective.

#### 4.10.1.6 Nematodes

Grapevines are harmed by several types of nematodes viz. root nematode (*Meloidogyne* sp.), reniform (*Rotylenohus* sp.), dagger nematode (*Xiphinema* sp.), spiral nematode (*Helicotylenchulus* sp.) and stunt nematode (*Tylenchorhynchus* sp.). Nematodes damage the vines by direct infestation and by transmitting curling virus. Nematode is a serious problem under heavy soil having near neutral pH. Nematode attack causes yellowing of leaves, defoliation and loss of yield up to 30 per cent.

Resistant varieties may be used as rootstock. Nematicides like DBCP @ 33.69 litres per hectare should be added into the soil. Even soil application of 6 kg of Carbofuran controls the root knot nematodes.

#### 4.10.1.7 Scales

At least thirteen species of scale insects attack grapes. The scale insects suck sap from the shoots which dry up. Leaves turn yellow and growth stops.

Remove of loose bark after pruning and spraying with 0.2 per cent Malathion is suggested. The spray may be repeated.

#### 4.10.1.8 Birds

Number of birds causes a considerable damage to grapes. They eat berries and damage them. Damaged berries rot quickly.

Cover the vines with nylon net. Produce high sound by beating tins/drums, also use crackers.

#### 4.10.2 Diseases

##### 4.10.2.1 Anthracnose (*Elsinoe ampelina*)

This disease is caused due to fungus. All plants parts are affected and cankers are produced on the shoots, stem, leaf veins and berries. Dark spots are seen on shoots, and they enlarge into sunken cankers. As cankers coalesce, stems are girdled or killed. On foliage the spots are grey with dark or purple border. With time affected leaves become shot holed and tattered. Slightly sunken brown spots, sometimes with grey centres develop on immature berries. Later, affected berries dry and wrinkle. Monsoon and low temperature are very favourable for this disease.

To control the disease remove all the affected parts *viz.* mummified berry clusters, tendrils, canes, old loose bark and burn them. Spray the vines with 0.2 per cent Copper oxychloride. Spray the vineyards with 0.2 per cent Benlate or Bavistin after leaf emergence. The spray may be repeated four times at an interval of 15 days during the rainy season.

##### 4.10.2.2 Powdery Mildew (*Uncinula necator*)

This disease is favoured by cool weather. The disease develops more abundantly in shade or diffused light than in bright light. The fungus may attack leaves, tender shoots and fruits. Whitish patches of cobweb like growth are first noticed on the surface of green parts of the vine, which later become greyish powdery in appearance, due to presence of numerous spores. Severely affected leaves become distorted and discoloured which ultimately drop off. Infected berries don't ripen properly, become hard and develop cracks. Infected flowers do not set fruits.

Spraying of Wettable sulphur (0.2 %) or dusting of Sulphur at an interval of 5-7 days before the infection occurs. Spraying with 0.1 per cent Karathane has been also found effective in controlling powdery mildew.

##### 4.10.2.3 Downy Mildew (*Plasmopara viticola*)

It is a disease of grapes in peninsular India and all varieties of vinifera grapes are susceptible. Cool humid weather favours the spread of downy mildew. The fungus infects leaves, flowers and young berries. Light yellow translucent spots appear on the upper leaf surface. Later on, white patches of mould develop on the lower surface of the leaf. Severely affected leaves finally dry and drop from the vine. Succulent shoots, petioles and tendrils have a water soaked appearance. In severe cases, flower and young fruits are also affected and killed, which drop off. At later stages the berries wither, turn brown, and then shrivel and shatter easily from the bunch.



Spraying of 1.0 per cent Bordeaux mixture (4:4:100) at an interval of 6-7 days is recommended. Other fungicides like Zineb, Mancozeb and Captan also has been proved effective.

#### **4.10.2.4 Black Rot (*Guignardia bidwellii*)**

Black rot is most prevalent in areas having hot, moist weather during the growing season. Black rot may attack all green parts of the vine and is particularly destructive to the fruit. It produces reddish brown irregular spots on the foliage. On the shoots, tendrils, clusters, stems, petioles, it produces small, elliptical dark coloured cankers. The affected berries shrivel and dry and become hard.

Bordeaux mixture has been found effective in controlling black rot.

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## **4.11 PHYSIOLOGICAL DISORDERS**

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The physiological disorders which are quite common are:

### **4.11.1 Flower Bud, Flower and Berry Drop**

This problem is quite serious in North India. Flower bud, flower and subsequent berries drops and makes the bunches loose and such bunches fetch low price. Reduction in yield due to flower bud, flower and fruit drop may be considerable. The factors responsible for this disorder are high temperature, heavy rains, improper fertilization, water stress, heavy crop load, endogenous auxin deficiency at a particular stage of berry development etc. Control measures to this problem include making 0.5 cm wide girdle on the trunk about 10 days before full bloom, judicious application of fertilizers especially nitrogen, dipping the bunches in NAA containing formulations or spraying with NAA and regular and uniform irrigation.

### **4.11.2 Bud Failure or Poor Bud Burst**

It is a common phenomenon in “Thompson Seedless” in peninsular India, after October pruning. Absence of chilling temperature is considered to be the primary reason for this disorder. Even on a mature cane, 40 per cent buds may fail to sprout. Fruit bud differentiation is also poor. Good cultural practices may lessen the severity of the problem.

### **4.11.3 Bunch Wilting**

This disorder mostly occurring at ripening stage is quite common in South, as well as in North India. The main symptoms are shriveling of rachis and drying of berries, at the tip of the bunch. This disorder is attributed to moisture stress condition, coupled with high temperature. This malady can be checked by accelerating sugar translocation to bunch. Spraying of 0.2 per cent Boric acid has been proved effective in reducing bunch wilting.

### **4.11.4 Blossom-end Rot**

A black sunken spot develops at the blossom end of the berry, which later on spreads with water soaked region around it. Defective calcium nutrition and

assimilation appear to be the cause for it. Spray of 1.0 per cent calcium nitrate may correct this disorder.

#### **4.11.5 Interveinal Chlorosis**

Occurrence of interveinal chlorosis is quite common in grapes, when the area between veins become yellowish. In severe cases, the leaf tips dry up. It is mainly due to deficiency of magnesium, zinc or iron. It can be corrected by spraying the vines with 0.2 per cent  $MgSO_4$ ,  $ZnSO_4$  and  $FeSO_4$ . Two to three sprayings at an interval of 20-30 days are recommended. Magnesium deficiency is aggravated by excessive application of potassium. High salinity may also cause marginal and interveinal chlorosis.

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### **4.12 HARVESTING**

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Grape is a non-climacteric fruit. Therefore, harvesting is only done when berries are fully ripe on the vine. Grapes after harvesting do not improve in their quality. The best stage of development of harvesting of table grapes are attractiveness in appearance and eating quality, good shipping and keeping quality and availability, when prices are favourable. There are many harvesting indices such as berry size, pH, sugar-acid ratio etc. In general, ripening is indicated by an increase in sugars, a decrease in acidity and the development of colour, texture and aroma characteristic of a variety. Moreover, as the berries mature, the cluster stem changes from green to brown, straw or yellow colour. The most accepted criterion for maturity, however, is the brix-acid ratio, characteristic of a variety.

The cluster or bunch should be removed from the vine by cutting with a sharp knife near its attachment to the cane. The harvesting should be done during the cool hours of the day i.e. early morning or late evening. A properly maintained vineyard usually starts yielding after three years in North India. A yield of 15-20 tonnes/ha was taken from fully grown orchard and even yielded upto 60 tonnes/ha, in a well maintained vineyard of “Anab-e-Shahi” in South India.

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### **4.13 STORAGE**

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After harvesting, and before packing and storing, undesirable berries viz. loose, diseased, overripe, dried, cracked, injured etc. are removed from bunches by hand. Any portion of bunch found undesirable it is trimmed otherwise it will spoil other bunch in the lot. Under ordinary conditions grapes can easily be stored for 4-5 days. This duration can be increased to 40-45 days, if they are stored under cold storage conditions. Further storage life of grapes is prolonged in cold storage with the use of sulphur dioxide releasing paper impregnated with potassium bisulphate, which is kept at the top of the box. The  $SO_2$  is released from papers in cold storage (36-38°F) and 85 per cent relative humidity. The grapes stored under such treatment are kept for 60 days or so but the cold stored grapes should be consumed within 24 hours after removal from cold storage, otherwise they get spoiled, if kept under ordinary conditions.

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## 4.14 PACKAGING

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The place of packing the type of container and the arrangements of bunches in the container, play an important role in marketing of grapes and retention of quality. After sorting of bunches and berries from the bunch, the healthy bunches are graded and ready for packing. Table grapes should be packed at a place that makes possible minimum handlings and limited exposure to high temperature. Packing may be done in the vineyards or in a specially equipped packing shed. In India, grapes are harvested in baskets and brought to packing sheds, trimmed carefully and packed in bamboo basket (8-20 kg), wooden boxes (4 kg), and more recently in corrugated fibre board cartons (4 and 2 kg). Fibre board cartons of 4 kg capacity have become more popular and are used widely in recent years.

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## 4.15 TRANSPORTATION

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In India, grapes are mostly transported to a 500 km by road. To the distant markets it is mostly sent by rail. Now-a-days, consignment is also dispatched by air to retain quality and to fetch good price. Export to foreign countries is done by air only. However, due to lack of refrigerated transport and slow movement, the loss during transit is huge and 25-30 per cent of the consignment may suffer damages and ultimately may be lost.

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### Check Your Progress Exercise 2

**Note :** a) Space is given below for the answer.

b) Compare your answer with that given at the end of the unit.

1. Define trellis system of training in grapes.

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2. In which regions of the country grapes are pruned once and twice in a year ?

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3. Define bunch wilting in grapes.

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## 4.16 LET US SUM UP

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In this unit, we have studied about the grape cultivation, its uses, history, propagation method, pruning and cutting, training system and various physiological disorder in grape cultivation pests and diseases, harvesting and storage. Grape is a subtropical crop, however it can be grown in tropical and dry temperate zone of Ladakh region. Maharashtra has the largest production areas of grapes in the country. Well drained sandy loam soil is good for its cultivation. Pruning should be practiced when the vines become dormant. Being a non-climacteric fruit, grapes should be harvested when the berries are fully ripe.

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## 4.17 KEY WORDS

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- Girdling** : Removing a complete ring of bark from any part of the vine.
- Kniffin** : A system of training grapevine, in which a trellis of two wires is strung from vertical posts in which the lower wire is placed one meter above the ground and the upper wire half a meter above the lower wire.
- Bower** : A system of training grapevine in which the vine is pinched off after reaching the wire network and two vigorous shoots in opposite direction are selected as primary arms.

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## 4.18 FURTHER REFERENCES

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## 4.19 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress Exercise 1

1. Ripe grape fruits are mostly consumed as table purpose which is very easily digestible. Owing to their taste, nutrient content, composition and low caloric output, grapes are refreshing fruits. It is used as fresh fruit, for making rasin and juices. The grape juice is a nourishing thirst quencher, a stimulant to the kidneys and a laxative. In European countries grape is cultivated for making wines.
2. The main hybrids of grapes are “Arkavati”, “Arka Kanchan”, “Arka Shyam” and “Arka Hans”.

3. Grape is mainly propagated by stem cuttings known as Asexual method of propagation. Hard wood cuttings, give higher success than semi hard and soft wood cuttings, under ordinary conditions. The stem cuttings are taken from one year old wood at the time of pruning, when the vines are dormant. Cuttings are prepared by giving a slanting cut at the lower end, immediately below a bud, while the upper cut at 0.75 to 2.0 cm above the bud. It is essential that each cutting should have at least 3 to 4 buds.

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### Check Your Progress Exercise 2

1. This is also known as Overhead trellis system. In this system, the vines are allowed to grow straight up to a height of 1.5-1.6 m and then trained on overhead 3-4 wires (45-60 cm apart) fixed to cross angle arms supported by vertical pillar or post. The usual spacing for each vine is 3 x 3 m. It is considered better than Kniffin system, where the lower arms are less productive, and is an improvement over bower system in respect of ventilation and light penetration. It is relatively less expensive than bower, but more expensive than kniffin system.
2. In North India, the grapes are pruned once in a year i.e. during the month of January, but in South India, it is pruned twice a year, once in summer and again in winter.
3. In grapes bunch wilting occurs at ripening stage, and the main symptoms are shriveling of rachis and drying of berries at the tip of the bunch. This disorder is attributed to moisture stress condition coupled with high temperature. This malady can be checked by accerlating sugar translocation to bunch. Spraying of 0.2 per cent boric acid has been proved effective in reducing bunch wilting.