UNIT 12 AGRONOMY OF FIELD CROPS-II

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12.1 INTRODUCTION

In this unit, we shall discuss about crops having diverse use ranging from human consumption to commercial purpose. The sorghum is grown for its grain and fodder, while the groundnut is raised for its seed used for extraction of edible oil. The cotton and tobacco are cultivated for lint and leaves, respectively, which have very high commercial utility. Although these crops are spread all over the country, they are cultivated extensively in peninsular and western regions comprising states of Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat.

Objectives

After studying this unit for tobacco, cotton, sorghum and groundnut; you should be able to

- suggest suitable soils and climate,
- describe seedbed preparation,
- list varieties,
- state seed rate,
- state time and method of sowing,
- mention irrigation requirement and time of irrigation,
- propose nutrient management,
- list stages of crop growth,
- plan weed control,
- discuss pests, diseases and their control, and
- state the harvesting time and expected yield.

12.2 TOBACCO

Tobacco is one of the important cash crops in India grown in an area of 0.4 million hectares with a total annual production of about 560 million kilogram. The country earns about Rs. 500 crores as foreign exchange and Rs. 3000 crores towards excise duty besides providing employment to about 60 lakh people.

*Nicotiana tabacum* and *Nicotiana rustica* are the two cultivated species in India. The *N. tabacum* varieties known as desi types have tall plant with broad leaves and usually pink flower. The *N. rustica* varieties known as ‘vilayati’ and ‘calcutta’ are characterized by short plant with round puckered leaf and yellow flowers.

On the basis of their use different types of tobacco have been identified. The principal types are:

a) Cigarette types
b) Bidi types
c) Cigar and cheroot types
d) Hookah types
e) Chewing and snuff types

Specific varieties in *N. tabacum* have been developed for cigarette, cigar and cheroot, bidi, hookah and snuff tobaccos. The varieties developed in *N. rustica* are used only for chewing, hookah and snuff tobaccos.
12.2.1 Suitable Soils and Climate

Soil

In general tobacco grows best on sandy loam surface soil and a slightly finer sub soil having ample internal drainage, good aeration and high moisture holding capacity, moderate fertility status with pH ranging from 5.5 to 6.0.

Climate

A frost-free growing season of 100 to 120 days with a mean temperature of about 26.7° C and a liberal and well distributed rainfall from 8.8 to 12.5 cm per month are ideal requirements for tobacco crop. The relative humidity may vary from 70 to 80 in the morning to 50 to 60 per cent at mid day.

12.2.2 Seedbed Preparation

Tobacco seeds are small and the emerging seedlings are tiny and delicate and, therefore the seeds are unsuitable for sowing directly in the field. Hence they are sown in small areas or called nurseries or seedbeds and tended carefully till the seedlings attain a particular size before transplanting in the main fields.

Systematic layout of nursery on raised beds with intervening channels helps in quick drainage of rain water. The beds of 1.0-1.2 m wide facilitate hand weeding and watering with rose cans. The beds can be of any convenient length along the slope but generally not more than 10 m.

The nature and intensity of tillage operations in main plots where these seedlings are to be transplanted vary from region to region and depends on soil type. Deep ploughing in summer followed by harrowing in rainy season shows the maximum amount of rainfall. One or two ploughings with 3-4 harrowings prepares the land for transplanting.

12.2.3 Varieties

A large number of varieties have been released for cultivation of tobacco. A few important ones are

For Cigarette Type
- Hema
- Jayasri (MR)
- Godavari special
- McNair 12
- Swarna
- Bhavya

For Bidi Type
- Anand-2
- Anand-119
- GT-4
- PL-5

For Cigar and Cheroot Type
- Bhavani special
- Lanka special
- Krishna
- S-5

For Hookah Type
- DD437
- Sonar Mothihari
- Hemi
- Bitri
Crop Production

For Chewing and Snuff Type

• GC1
  Gandak Bahar
  Maragadham
  Bhagyalakshmi

12.2.4 Seed Rate

Tobacco seeds are tiny and one gram of seed contains 10,000 seeds. A seed rate of 3 kg/ha has been found to be optimum for all types of tobacco under different agro-climatic conditions.

12.2.5 Time and Method of Planting

The time and method of planting depends on soil type, agro-climatic condition and type of tobacco. Since the tobacco seedlings are raised in nursery, about 7 weeks old seedlings are transplanted in main field. The time, spacing and method of planting cigarette tobacco in different soils is furnished below.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Time of Planting</th>
<th>Spacing</th>
<th>Method of Planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black-soil</td>
<td>Mid October to Mid November</td>
<td>70 x 50 cm</td>
<td>Flat planting</td>
</tr>
<tr>
<td>Red soil</td>
<td>Early October</td>
<td>100 x 60 cm</td>
<td>Flat planting followed by ridging</td>
</tr>
<tr>
<td>Coastal soil</td>
<td>Mid October to Mid November</td>
<td>70 x 50 cm</td>
<td>Flat planting followed by ridging</td>
</tr>
</tbody>
</table>

Other types of tobacco have the following requirements:

<table>
<thead>
<tr>
<th>Tobacco Type</th>
<th>Time of Planting</th>
<th>Spacing</th>
<th>Method of Planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bidi type</td>
<td>First fortnight of August</td>
<td>100 x 75 cm</td>
<td>Flat planting</td>
</tr>
<tr>
<td>Cigar and cheroot type</td>
<td>Mid October to Mid November</td>
<td>60 x 45 cm</td>
<td>Ridge planting</td>
</tr>
<tr>
<td>Chewing type</td>
<td>November</td>
<td>75 x 75 cm</td>
<td>Ridge planting</td>
</tr>
</tbody>
</table>

12.2.6 Nutrient Management

The major nutrients essential for growth and development of tobacco plant are nitrogen, phosphorus, potassium, calcium, magnesium and sulphur. The elements equally essential in small quantities are boron, manganese, iron, zinc, molybdenum and copper. Of these, nitrogen, phosphorus and potassium are routinely applied through fertilizer while the rest are applied whenever the deficiency symptoms of these are noticed.

Nitrogen influences the ultimate quality characteristics of tobacco leaf like nitrogen constituents (protein, nitrogen, nicotine etc.) and sugars which determine the taste and strength of smoke. Low nitrogen smoking tobaccos giving mild and pleasant smoke require optimum nitrogen fertilizer while strong tobaccos require higher fertilizer dose of nitrogen. Lower nitrogen supply than required dose leads to thin and pale leaf in addition to low yield, while higher dose of nitrogen more than required leads to thick dark green and trashy leaf though yields are increased. In both the cases the quality and chemical balances are drastically affected leading to off taste and disagreeable smoke.

The potassium requirement of tobacco is relatively high as it plays a vital role in improving the quality and fire holding capacity of tobacco. Potassium deficiency is generally observed in nurseries and field crops raised on light soil.

The recommended nitrogen and potassium dose for different types of tobacco is
### Tobacco Types

<table>
<thead>
<tr>
<th>Tobacco Types</th>
<th>Nitrogen (kg N/ha)</th>
<th>Potassium (kg K₂O/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cigarette type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Heavy soils</td>
<td>30</td>
<td>30-50</td>
</tr>
<tr>
<td>- Light soils</td>
<td>40-60</td>
<td>60-120</td>
</tr>
<tr>
<td>2. Bidi type</td>
<td>180</td>
<td>40</td>
</tr>
<tr>
<td>3. Cheroot type</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>4. Hookah type</td>
<td>112</td>
<td>112</td>
</tr>
<tr>
<td>5. Chewing &amp; snuff type</td>
<td>100</td>
<td>50-100</td>
</tr>
</tbody>
</table>

Although phosphorus is an essential element for tobacco but its requirement is generally low. In India phosphorus deficiency is generally not noticed in tobacco. A maintenance dose of 50-100 kg P₂O₅/ha depending upon the type of tobacco and soil is applied to meet the phosphorus requirement of tobacco.

#### 12.2.7 Irrigation Requirement

Irrigation is necessary for light soils whenever soil water content comes down to 60 per cent of available water. Leaf growth ceases when soil water content comes down to 20 per cent of available water. Usually no irrigation is given when tobacco is grown in black soils during monsoon season. When it is grown as irrigated crop about 6-8 irrigations are required to raise a successful crop. The following irrigation schedule has been found optimum for light soils.

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Stage of Crop</th>
<th>Depth and Method of Irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>15-20 DAT*</td>
<td>20 mm – surface irrigation</td>
</tr>
<tr>
<td>2nd</td>
<td>30-35 DAT</td>
<td>24 mm – surface irrigation</td>
</tr>
<tr>
<td>3rd</td>
<td>40-45 DAT</td>
<td>48 mm – furrow irrigation</td>
</tr>
<tr>
<td>4th</td>
<td>50-55 DAT</td>
<td>48 mm – furrow irrigation</td>
</tr>
<tr>
<td>5th</td>
<td>65-70 DAT</td>
<td>24 mm – alternate furrow method</td>
</tr>
<tr>
<td>6th</td>
<td>80-85 DAT</td>
<td>24 mm – alternate furrow method</td>
</tr>
<tr>
<td>7th</td>
<td>90-100 DAT</td>
<td>24 mm – alternate furrow method</td>
</tr>
<tr>
<td>8th</td>
<td>115-120 DAT</td>
<td>24 mm – alternate furrow method</td>
</tr>
</tbody>
</table>

*Days after transplanting

Water-logging at any stage is harmful to crop, hence care should be taken to prevent water-logging. As chlorides affect burning quality and storability of tobacco, water containing chlorides in excess of 50 ppm should be avoided.

#### 12.2.8 Stages of Crop Growth

The following stages of crop growth have been identified in tobacco.

1) **Nursery stage:** This stage starts from germination to transplanting in main field. It usually lasts upto 7-8 weeks.

2) **Seedling establishment stage:** This is a transition stage from transplanting to establishment in main field. It ranges from 1-2 weeks.

3) **Early growth stage:** This stage heralds the beginning of growth in the main plot after transplanting.

4) **Grand growth stage:** This is the stage when crop attains the peak growth before attaining maturity.

5) **Ripening stage:** This period involves the actual maturity of leaves signaling the readiness of crop for harvest.
The actual length of each stage depends on type of tobacco, variety and cultural practices like topping and desuckering, besides irrigation and fertilizer application.

**Topping and Desuckering**

The operation of topping consists of removal of the terminal bud just before or after the emergence of the flower head. Following topping the axillary buds become active and put forth shoots known as suckers. Removal of these is called desuckering. The objective of topping and desuckering is to divert the nutrients of the plants to the leaves instead of flower and seeds to improve leaf yield and quality of the tobacco. The topping is done manually, while the desuckering is done by spraying chemical like 4% Decanol.

**12.2.9 Weed Control**

Generally depending on location and preparatory tillage a few weeds are noticed in tobacco. Intercultivation or manual weeding with khurpi or hoe between rows reduce the weed problem to a great extent. However when weed menace becomes severe they can be controlled by the use of weedicides. Application of Eptam and Tillan at 3 kg a.i./ha gives good control of weeds.

**12.2.10 Pests, Diseases and their Control**

Tobacco is attacked by many insect pests and diseases both in nursery and main field. These pests and diseases cause considerable damage to seedlings in the nursery and leaf in the transplanted crop reducing yield and quality of crop.

**Pests**

The major pests that infest tobacco and their control measures are as follows:

1) **Leaf eating caterpillar**: Spray 0.05% monocrotophos or chlorpyriphos
2) **Stem borer**: Spray 0.05% quinalphosat 30 and 40 days after germination and 10 and 20 DAT in field.
3) **White fly**: Spray the following insecticides commencing from 4 weeks after germination in the nursery and 10- days after transplanting in the main field at weekly intervals.
   1st spray: Chloropyriphos 0.05%
   2nd spray: Monocrotophos 0.05%
   3rd spray: acephate 0.75%
   4th spray: demeton-S-methyl 0.04%
4) **Ground beetles**: Apply 0.05% endosulfan or 0.03% chlorpyriphos sodium 75 ml/plant at planting.
5) **Green peach aphid**: Give a prophylactic spray in early winter with 0.07% acephate or 0.02% dimethoate.
6) **Bud worm**: Spray 0.01% fenvalerate or 0.1% monocrotophos on the inflorescence in seed plots.
7) **Cigarette beetle**: Fumigate with 1 aluminium phosphide tablet per cubic meter for 96 hours.

**Diseases**

Tobacco is affected by diseases caused by fungi, viruses, bacteria, nematode and mycoplasma. The losses due to these diseases are estimated to range from 5 to 15% depending on their intensity.

1) **Damping off**: A serious fungal disease causing 80-100% death of seedlings under humid conditions. Two sprays of 0.2% metalaxyl (Ridomil M2 72 WP) gives about 95% control.
2) **Anthracnose**: A serious fungal disease during rains and high relative humidity resulting in 100% loss. Two sprays of 0.025% Bavistin 50 WP at weekly interval effectively controls this disease.

3) **Leaf blight**: This disease occurs in both nursery and in main field during wet conditions. Two sprays of 0.2% Metalaxyl is recommended for the effective control of this disease.

4) **Frag-eye spot**: Common in later stage of nursery and transplanted crop. Controlled by spraying 0.025% Bavistin.

5) **Root-knot**: It is caused by nematode and mostly observed in light soils. Application of phenamiphos 5G at the rate of 10g/sq.m. controls this.

6) **Brown spot**: Major disease in West Bengal two sprays of 0.2% Thiram or Mancozeb, first at the onset of the disease and the second 10 days later is recommended.

7) **Powdery mildew**: This disease is more prevalent in Karnataka and Andhra Pradesh. Spraying of 0.05% Carbendazim 50WP offers 85% control of this disease.

8) **Tobacco mosaic virus**: Leaves show marked distortion and plants are stunted. No effective chemicals are available for control of this disease.

**Parasite**

**Orobanche**: This is a complete root parasite on tobacco. Deep ploughing in the summer and crop rotations reduce the orobanche infestation.

### 12.2.11 Harvesting Time and Yield

The sign of maturity and method of harvesting depends on type of tobacco. Generally change in colour of leaves from green to yellowish, thickening of leaves, accumulation of gummy substance on leaves, flowering of plants, brittleness of leaves are the symptoms of maturity. The time required to attain maturity is a varietal trait. It ranges from 80 to 130 days.

Cigarette tobacco is harvested by priming i.e. two or three leaves which have completed their growth and are turning from green to yellowish green or slightly yellow in colour are detached from the plant. Generally it takes about 70-75 days from planting to be ready for the first priming.

Cigar, cheroot, chewing, hookah and bidi tobacco is harvested by stalk-cut method. Here plants are cut close to ground with a sickle and left in the field overnight for wilting. Later on they are collected depending upon processing needed for different types of tobacco.

Yield in tobacco refers to the weight of dry and marketable leaves of various grades pooled together. The yield differs for each type of tobacco as given below.

<table>
<thead>
<tr>
<th>Type</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cigarette</td>
<td>935</td>
</tr>
<tr>
<td>Bidi</td>
<td>1445</td>
</tr>
<tr>
<td>Cigar and cheroot</td>
<td>1100</td>
</tr>
<tr>
<td>Hookah</td>
<td>1167</td>
</tr>
<tr>
<td>Chewing</td>
<td>1200</td>
</tr>
<tr>
<td>Snuff</td>
<td>1596</td>
</tr>
</tbody>
</table>
i) What is the optimum seed rate of tobacco?

iv) How many irrigations are required for tobacco under irrigated conditions?

v) What is the objective of topping and desuckering in tobacco?

vi) Name three pests and three diseases of tobacco.

vii) Name the methods of harvesting in tobacco.

12.3  COTTON

Cotton is the major supplier of raw material for the textile industry. India produces about 160 lakh bales (1 bale = 170 kg) of cotton from an area of 83 lakh hectare. In India it is grown under diverse agroclimatic conditions extending from sub-Himalayan region in Punjab in north to Kanyakumari in south and from arid Gujarat in west to high rainfall hilly eastern state of Manipur. The major cotton growing states are Maharashtra, Rajasthan, Tamil Nadu and Haryana. There are four cultivated species of cotton viz.,

Gossypium arboreum  
Gossypium herbaceum  
Gossypium hirsutum  
Gossypium barbadense

These species show distinct differences in morphology. The G. arboreum and G. herbaceum are commonly called old world, Asiatic or desi cotton. G. hirsutum and G. barbadense are known as new world cottons or American cotton. All the four cultivated species are grown in India on a commercial scale along with both interspecific and intraspecific hybrid cotton.

12.3.1 Suitable Soils and Climate

Deep soils of 60 cm or more with a pH of 5.5 to 8.5 are ideal for cotton growing. Soils having good drainage are suitable as cotton is susceptible to water-logging.

Cotton is a tropical and subtropical crop. It requires a minimum temperature of 15°C for germination with a temperature range of 21°C – 27°C for optimum vegetative growth. Although it can tolerate 43°C. Warm days and cool nights during reproductive phase are helpful to good ball and fibre developments. A rainfall of 50 cm well distributes over is sufficient for rainfed crop. Good sunshine during boll maturation and a frostless period of 180-200 days are the requirements for rainy crop.

12.3.2 Seedbed Preparation

When cotton is to be grown under irrigated conditions after wheat, in northern states of India. 1 or 2 ploughings after a heavy irrigations followed by levelling by wooden plank prepares the soil for sowing of cotton. In black soil areas of central and southern India, 3 or 4 harrowings with blade harrow after pre-monsoon rains followed by planking prepares good seedbed for sowing cotton. In the red lateritic soils of southern India, 2 to 3 light ploughings or harrowings are necessary for rainy season cotton.

12.3.3 Varieties

In India maximum area is covered by hybrids (40%), followed by G. hirsutum (36%), G. arboreum (16%), G. herbacum (8%) and G. barbadense (0.2%). The important hybrids and varieties suitable for different states are listed in table.
12.3.4 Seed Rate

The optimum seed rate depends on type of cotton and spacing followed. The most common seed rate for different types of cotton is

Desi cottons : 10-15 kg/ha
American cottons : 18-20 kg/ha
Hybrids : 2-3 kg/ha

12.3.5 Time and Method of Sowing

Sowing is done by either drilling with the help of 2 or 3 tyned drills in rows or by dibbling. Dibbling is the most common practice in most of the regions. Three to six seeds are dibbled per hill by making a small holes in the soil. The seeds are then covered either by soil or by mixture of soil and farm yard manure. For ridge planting, 22-25 cm high ridges are made according to the spacing between the rows and seeds are dibbled on one side of ridge at 5 to 7.5 cm below the top of the ridge. In widely spaced hybrids, to reduce the seedling mortality and save the cost on seeds, seedlings are raised in polythene bags for 15-35 days and then transplanted in main field after removing polythene packets. In general a spacing of 60 cm × 30 cm for American varieties and 60 cm × 15 cm for desi varieties is optimum, with a seedling depth of 5 to 6 cm.

The optimum time of sowing varies from zone to zone due to variations in climate, soil, varieties and cultivation practices. The optimum time of sowing for different zones is as follows:
12.3.6 Nutrient Management

Cotton is a very exhaustive crop needing higher quantities of nutrients for better growth and higher yield. The fertilizer dose depends on the variety, yield potential, season, irrigation facility and initial fertility status of soil. The requirement of nutrients vary from region to region. Application of 80-100 kg nitrogen, 30 kg $P_{2}O_{5}$ in Punjab, Haryana and northern Rajasthan; and application of 100-120 kg nitrogen, 40-80 kg $P_{2}O_{5}$ under irrigated conditions and 40-60 kg nitrogen and 40-80 kg $P_{2}O_{5}$ per hectare under rainfed conditions in central region consisting of Madhya Pradesh, Gujarat and Maharashtra, are optimum. Hybrid cotton requires about 120-150 kg nitrogen, 60-75 kg $P_{2}O_{5}$ and 60 kg $K_{2}O$ application. It is necessary to apply 50 per cent of nitrogen and whole of phosphorus and potassium at sowing and remaining 50 per cent nitrogen at flowering period.

12.3.7 Irrigation Requirement

Irrigation requirement depends upon the frequency and intensity of rains. One pre-sowing irrigation and one 3-4 weeks after germination gives good crop stand. Normally 6-8 irrigations are needed with a total 600-700 mm water during crop period. As cotton is sensitive to water-logging proper drainage should be provided to remove excess water from field. Free flooding under flatbed sowing and furrow irrigation under the ridge planting are ideal.

12.3.8 Stages of Crop Growth

The important stages of crop growth observed in cotton are

1) Seedling stage – germination upto 60 DAS
2) Commencement of sympodial branching – 60 to 70 DAS
3) Flowering – 90 to 10 DAS
4) Boll formation stage – 125-130 DAS
5) Boll opening – 140 DAS
6) Maturity – 160 DAS

These stages may slightly vary with type and variety of cotton, season and cultivation practices.
12.3.9 Weed Control

As cotton is wide spaced crop, a large number of weeds emerge in the vacant space between plants before the crop covers the area through vegetative growth. Thus cotton is vulnerable to weed competition specially during the initial stages of crop growth i.e. initial 50-60 days. Mechanical control of weeds through intercultivation or hand weeding gives satisfactory control of weeds. Chemically weeds can be put under check by pre-emergence application of basalin @ 0.75-1.5 kg a.i./ha or post-emergence application of diuron @ 0.5-0.75 kg a.i./ha.

12.3.10 Pests, Diseases and their Control

The common insect pests and diseases noticed in cotton and their chemical control is as follows:

**Insect Pests**

The jassids, aphids, white flys, thrips, boll worms and leaf minor are observed in cotton at various stages of cotton. These may be controlled by spraying dimethoate or phosphomidon @ 0.3 kg a.i./ha at 15 days interval or soil application of phorate or aldicarb @ 1 kg a.i./ha or spray endosulfan or carbaryl @ 1 kg a.i./ha or monocrotophos @ 0.6 kg a.i./ha at 15 days interval.

**Diseases**

1) **Bacterial blight**: Seed treatment with ceresan or thiram @ 2-3 g/kg seed or by spraying agrimycine (0.02%) + copper oxychloride (0.25%) at 15 days interval.

2) **Fusavium wilt**: Seed treatment with ceresan or thiram @ 2-3 g/kg seed.

3) **Root rot**: Seed treatment with Brassicol @ 5g/kg seed.

4) **Anthracnose**: Seed treatment with ceresan or Agrosan @ 2.5 g/kg seed or by spraying Blitax @ 2 kg/ha in 1000 litre water.

5) **Alternaria leaf spot**: Spray 50% copper oxy-chloride.

6) **Myrothecium leaf spot**: Spray 50%.copper oxy-chloride.

12.3.11 Harvesting Time and Yield

The harvesting time of cotton depends on sowing time, variety and its maturity period. Bolls normally reach the full size in 20-25 days after flowering and further take 25-35 days for full development of the seed and fibres. Then maturation takes place another 25-30 days. Cotton is harvested by picking seed cotton from the individual bolls which open over a long period of 2 to 3 months. The crop is harvested in 3 to 4 or even more pickings when sufficient number of well opened bolls are available. The number of pickings and quantity available per picking varies according to the maturation habit of the variety and other seasonal conditions and management. Usually synchronous bearing varieties require few pickings. In developed countries cotton is mostly picked by mechanised pickers.

An yield of 15-20 quintals of seed cotton per hectare may be obtained when high yielding varieties or hybrids are grown with improved package of practices.

**SAQ 2**

i) Name the cultivated species of cotton.

ii) Write optimum seed rate for different types of cotton.

iii) Mention two important methods of sowing in cotton.

iv) a) What is the total water requirement in cotton?

   b) Mention methods of irrigation in cotton.

v) Name three important pests and diseases of cotton.

vi) How cotton is harvested?
12.4 SORGHUM

In India, sorghum ranks third in area and production after rice and wheat with 15 million hectares area and 12 million tonnes of grain production. Sorghum grains constitute staple food for millions of people. Its fodder and straw is fed to animals providing milk, draft power and meat. Its cultivation in the country is concentrated in the Deccan plateau where it is completely dependent on rains. The major states growing sorghum are Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Rajasthan and Gujarat.

12.4.1 Suitable Soils and Climate

Soils with clay loam or loam texture having good water retention capacity are best suited for sorghum cultivation. It can be grown on soils with a pH range of 6.0-8.5 as it tolerates considerable salinity and alkalinity.

Sorghum is adopted to tropical, subtropical and temperate climate. The optimum temperature for photosynthesis is 30 to 36°C. It does not tolerate frost. Sorghum can be grown successfully in areas having an average annual rainfall between 60 and 100 cm.

12.4.2 Seedbed Preparation

Sorghum requires a well prepared seed bed. Soil should be fine as seed size is small. A cloddy seed bed leads to uneven crop stand. A well prepared seed bed with fine soil could be made by ploughing up to a depth of 25 centimeters followed by harrowing and land levelling. The seed bed should be free from weeds and stubbles of the previous crop. Deep tillage using mould board plough is particularly advantageous on red soils and shallow to medium deep soils. It mixes bottom clay with top layers which improves soil moisture holding capacity.

12.4.3 Varieties

As a result of the efforts under comprehensive coordinated sorghum improvement project initiated by Indian Council of Agricultural Research during the year 1962, a large number of coordinated sorghum hybrids (CSH) and coordinated sorghum varieties (CSV or SPU) are developed and released. These are of shorter duration, input responsive and mostly photo period sensitive. The important hybrids and varieties are

i) For kharif i.e. rainy season

<table>
<thead>
<tr>
<th>Hybrids</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSH1</td>
<td>CSV 1</td>
</tr>
<tr>
<td>CSH2</td>
<td>CSV 2</td>
</tr>
<tr>
<td>CSH3</td>
<td>CSV 5</td>
</tr>
<tr>
<td>CSH5</td>
<td>CSV 9</td>
</tr>
<tr>
<td>CSH9</td>
<td>CSV 10</td>
</tr>
<tr>
<td>CSH10</td>
<td>SPV 346</td>
</tr>
<tr>
<td>CSH11</td>
<td>SB 105</td>
</tr>
<tr>
<td>CSH 14</td>
<td>CSV 13</td>
</tr>
<tr>
<td>CSH 15</td>
<td>CSV 14</td>
</tr>
<tr>
<td>DS4.3</td>
<td>CSV 15</td>
</tr>
<tr>
<td></td>
<td>SB 2415</td>
</tr>
<tr>
<td></td>
<td>DSV-3</td>
</tr>
</tbody>
</table>

ii) For rabi i.e. winter season

<table>
<thead>
<tr>
<th>Hybrids</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSH 7R</td>
<td>CSV 8R</td>
</tr>
<tr>
<td>CSH 7R</td>
<td>M 35-J</td>
</tr>
<tr>
<td>CSH 8R</td>
<td>CSV 7R</td>
</tr>
<tr>
<td>CSH 12R</td>
<td>Annigeri-1</td>
</tr>
<tr>
<td>CSH 13R</td>
<td>Mulathi</td>
</tr>
<tr>
<td></td>
<td>DSV4</td>
</tr>
</tbody>
</table>
12.4.4 Seed Rate

A plant population of 1.5 lakh per hectare is required to realise the maximum grain yield potential. An approximate rate of 12-15 kg per hectare is sufficient to attain the required plant density. A row spacing of 45 cm and plant to plant spacing of 10-12 cm ensures the optimum plant density.

12.4.5 Time and Method of Sowing

Sorghum is grown in all the three seasons viz., kharif (rains), rabi (winter) and summer. The time of sowing in different seasons is as follows:

<table>
<thead>
<tr>
<th>Season</th>
<th>Sowing Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kharif (Rainy season)</td>
<td>First week of July</td>
</tr>
<tr>
<td>Rabi (Winter season)</td>
<td>Mid September to mid October</td>
</tr>
<tr>
<td>Summer</td>
<td>Mid January to Mid February</td>
</tr>
</tbody>
</table>

Sowing of sorghum is mainly done on flat seedbeds in lines using a seed drill or draw tube fixed behind plough at a depth of 2-5 cm.

12.4.6 Nutrient Management

Sorghum is a heavy feeder on plant nutrients. A grain sorghum crop yielding 50-60 quintals per hectare removes about 130-180 kg nitrogen, 50-65 kg P₂O₅ and 100-130 kg K₂O. It is thus obvious to fertilize the crop to supplement the availability of nutrients from the soil. The quantity of nutrients depends on the soil fertility status, season, soil moisture and crop species used. In general hybrids respond to higher doses of nutrients as compared to varieties. Application of about 80-100 kg nitrogen for hybrids and 60-80 kg nitrogen for varieties per hectare during kharif; and 90 kg nitrogen for hybrids and 60 kg nitrogen for varieties per hectare during rabi is found to be optimum. Application of fertilizer in two splits i.e. 50 per cent at sowing and 50 per cent at knee high stage gives higher response in terms of grain yield. In addition to nitrogen, application of 50 kg P₂O₅ and 30-40 kg K₂O per hectare at the time of sowing results in enhanced yield in many areas.

12.4.7 Irrigation Requirement

Sorghum is commonly cultivated as a rainfed or dryland crop. However, when it is grown under irrigated conditions, 4-5 irrigations are necessary to bring the crop to maturity. The irrigation is needed at the following critical stages of the crop.

1) Germination at the time of sowing
2) Flower primordial initiation (25-30 days after sowing)
3) Flag-leaf stage (50-55 days after sowing)
4) Flowering (60-70 days after sowing)
5) Grain filling stage (80-90 days after sowing)

The total water requirement of sorghum is about 50 to 60 cm during rainy (kharif) and 60 to 70 cm during summer.

12.4.8 Stages of Crop Growth

Vanderlip and Reeves (1972) identified the following growth stages in sorghum

<table>
<thead>
<tr>
<th>Growth Stage</th>
<th>Approximate Days</th>
<th>Identification Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Emergence. Coleophie visible at soil surface</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>Collar of third leaf visible</td>
</tr>
</tbody>
</table>
Growing point differentiation (PI). Approximately 8 leaf stage.

- Final leaf visible in whorl
- Boot panicle extended into flag leaf sheath
- Half bloom. Half of plants at some stages of bloom
- Soft dough
- Hard dough
- Physiological maturity, maximum dry matter accumulation

Although cultivar, temperature and photoperiod affect the duration of growth stages, the same general pattern is found in early, medium and late maturity types.

From physiological maturity sorghum takes 3 to 4 weeks to attain seed moisture level of 10 to 15% at which it is ready for harvest. Crop can be harvested any time after physiological maturity.

### 12.4.9 Weed Control

The sorghum seedlings are relatively small and weak to compete with weeds in the early stages. Therefore it is necessary to control weeds at the beginning of the crop growth. Frequent intercultivation or hand weeding control the weeds effectively. Chemically weeds can be controlled by pre-emergence application of atrazine @ 0.25-0.50 kg a.i./ha.

### 12.4.10 Pests, Diseases and their Control

#### Insect Pests

Sorghum is damage by a large number of insect pests. The tissue bores, leaf eating pests and sucking insects are major confronted groups. The important insect pests and their chemical control is given below:

<table>
<thead>
<tr>
<th>Insect</th>
<th>Stage of Damage</th>
<th>Control Measure (Chemical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Shortfly</td>
<td>Seedling</td>
<td>Seed treatment with carbofuran @ 1 kg per 100 kg seed.</td>
</tr>
<tr>
<td>2. Stemborer</td>
<td>Seedling to flowering</td>
<td>Application of carbofuran 3G @ 7.5 kg/ha at 25 and 35 flowering days after emergence.</td>
</tr>
<tr>
<td>3. Armyworm</td>
<td>Early vegetative growth to maturity</td>
<td>Spray endosulfan 3SC @ 2 ml per litre solution upon noticing the pest</td>
</tr>
<tr>
<td>4. Grasshopper</td>
<td>-do-</td>
<td>-do-</td>
</tr>
<tr>
<td>5. Aphid</td>
<td>-do-</td>
<td>-do-</td>
</tr>
<tr>
<td>6. Shoot bug</td>
<td>Vegetative stage</td>
<td>-do-</td>
</tr>
<tr>
<td>7. Ear head midge</td>
<td>Panicle emergence to maturity</td>
<td>Dust malathion 5% or endosulfan 4% @ 25 kg/ha</td>
</tr>
<tr>
<td>8. Earhead caterpillar</td>
<td>-do-</td>
<td>-do-</td>
</tr>
<tr>
<td>9. Ear head bug</td>
<td>-do-</td>
<td>-do-</td>
</tr>
</tbody>
</table>

#### Diseases

Sorghum is attacked by several diseases from seedling stage to harvest. Many of these diseases are severe and are major constraint in successful cultivation of sorghum crop.
<table>
<thead>
<tr>
<th>Diseases</th>
<th>Control Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dowing mildew</td>
<td>Spry 0.2% Dithane M-45 four times from 7th day of planting at a weekly interval</td>
</tr>
<tr>
<td>2. Dust</td>
<td>Spray 0.2% Dithane M-45 or Bavistin</td>
</tr>
<tr>
<td>3. Grey leaf spot</td>
<td>Spray Bitox or Roural 2000 ppm solution</td>
</tr>
<tr>
<td>4. Smuts Viz. Grain smut</td>
<td>Seed treatment with thiram or cerean @ 2 to 4 g per kg seed</td>
</tr>
<tr>
<td>Head smut</td>
<td></td>
</tr>
<tr>
<td>Lung smut</td>
<td></td>
</tr>
<tr>
<td>Loose smut</td>
<td></td>
</tr>
<tr>
<td>5. Ergot or sugary</td>
<td>Spray mancozeb on inflorescence three times. 1st spray at emergence disease of earhead followed by subsequent sprays at 5 days interval.</td>
</tr>
<tr>
<td>6. Grain molds</td>
<td>Spray 0.2 % thiram or captan solution.</td>
</tr>
<tr>
<td>7. Charcoal rot</td>
<td>Spray fungicide like Risolex</td>
</tr>
</tbody>
</table>

**Parasites**

**Striga**: The genus striga commonly known as 'witch weed' is a serious root parasite noticed in sorghum. The seeds of striga germinate with stimulation from the sorghum roots and later on draw carbohydrates, minerals and water from the host reducing the vigour of the crop and yield. Post-emergence application of 2,4-D and paraquat at the rate of 1 to 2 kg/ha effectively controls this root parasite.

**12.4.11 Harvesting Time and Yield**

The high yielding hybrids and varieties mature in about 100-120 days after sowing. The crop is harvested for grain when grains mature and become hard. The earheads are cut and separated in one lot from the standing crop. The stalks are cut later at convenient time. When crop is late maturing and tall, it is cut and spread uniformly over the field for drying. The ears are separated from the stalks after 3 to 4 days and threshed. The straw is tied into small bundles and heaped after it dries up. The earheads removed from the stalks are dried in threshing yard and threshing is done either by beating them with sticks or by trampling them under bullocks’ feet. Mechanical threshing is also done by power operated threshers. Clean grains are separated from glumes and chaff by winnowing.

The grain yield of improved varieties under optimum growing conditions ranges between 25-35 quintals/ha and that of fodder between 12-15 tonnes/ha. The yield potential of different sorghum types is as follows:

<table>
<thead>
<tr>
<th>Local desi sorghum</th>
<th>10-15 q/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved varieties released by different states</td>
<td>20-30 q/ha</td>
</tr>
<tr>
<td>High yielding varieties e.g. CSV 4</td>
<td>28-36 q/ha</td>
</tr>
<tr>
<td>Hybrids e.g. CSH 5</td>
<td>40-50 q/ha</td>
</tr>
</tbody>
</table>

**SAQ 3**

i) Mention the major uses of sorghum.

ii) Name two hybrids and two varieties for kharif and rabi sowing of sorghum.

iii) Expand CSH and CSV in relation to sorghum.

iv) What is the optimum seed rate for grain sorghum?

v) Write critical stages for irrigation in sorghum under irrigated conditions.

vi) Mention two insect pests and two diseases affecting sorghum.

vii) Name root parasite noticed in sorghum.
viii) What is the yield potential of local varieties, high yielding varieties and hybrids in sorghum?

12.5 GROUNDNUT

In India groundnut is grown in 8.0 million hectares with a total production of 7.2 million tonnes. The main groundnut growing states are Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra which together account for about 80% of the area and 91% of the production of the crop.

Based on the carriage of lateral branches cultivated varieties of groundnut, three habit forms have been identified. viz. Bunch type, semi-spreading type and spreading type.

Bunch Type

The main stem becomes in distinguishable from the lateral branches.

Spreading Types

They have erect and conspicuous main stem with lateral branches which may be erect or prostrate.

Semi-spreading Types

These are inter-mediate of the bunch and spreading forms in the character.

12.5.1 Suitable Soils and Climate

Ideal soil for groundnut production is a well drained, light coloured, loose, friable, sandy loam well supplied with calcium and a moderate amount of organic matter. Soils with higher clay content coupled with high sodium and higher pH of 8.0 are not suitable for groundnut. High yields are obtained on soils with a slightly acidic reaction (pH 6.0 to 6.4).

Groundnut is essentially a tropical and subtropical crop. The plants grow well in an area where the temperature is from 21.0-26.6°C. The low temperature lowers the oil content in seed. The groundnut grow well in an area receiving annual rainfall of 50-125 cm. Rainfall during pod maturity is detrimental to crops as physiologically mature pods start germinating inside the pod before harvesting. The plant cannot withstand long and severe drought or water-logging.

12.5.2 Seedbed Preparation

A seedbed with good friable soil is necessary for the good germination of seed and optimum plant population. The type of tillage operation depends on the soil type and quality of rainfall received. Two ploughings followed by harrowings at appropriate intervals depending upon soil condition prepare good seed bed. Groundnut requires a loose and fine soil for easy penetration of pegs and avoid loss of nuts during harvesting. If the soil is cloddy one heavy planking before sowing smoothen the soil surface by breaking clods.

12.5.3 Varieties

Selection of a suitable variety for a particular area depends on soil type, rainfall distribution, season, market preference and resistance to pests and diseases of the area. Spreading types are suitable under rainfed conditions where the rainy season is longer. Bunch type are better for rainy season and under irrigated conditions. Bunch types are also preferred in clayey soils, where harvesting is a problem. Semi-spreading types are also grown in areas where spreading types are grown. Some of the important varieties for different areas are:
<table>
<thead>
<tr>
<th>State</th>
<th>Bunch</th>
<th>Spreading</th>
<th>Semi-spreading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gujarat</td>
<td>Junagadh-11</td>
<td>GAUG-10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GAUG-1</td>
<td>A-4-334</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IGGS-4A</td>
<td>Somnath</td>
<td></td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>TMV-2</td>
<td>TMV-3</td>
<td>ICGS-76</td>
</tr>
<tr>
<td></td>
<td>Kadi-2</td>
<td>Kadiri-71-1</td>
<td>Kadi-3</td>
</tr>
<tr>
<td></td>
<td>ICGV-86590</td>
<td></td>
<td>Girnar-1</td>
</tr>
<tr>
<td></td>
<td>ICGS-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>TMV-2</td>
<td>TMV-1</td>
<td>TMV-6</td>
</tr>
<tr>
<td></td>
<td>CO-2</td>
<td>Girnar-1</td>
<td>TMV-10</td>
</tr>
<tr>
<td></td>
<td>Polachi-1</td>
<td>TMV-4</td>
<td>TMV8</td>
</tr>
<tr>
<td>Karnataka</td>
<td>S-206</td>
<td>S-230</td>
<td>HG-10</td>
</tr>
<tr>
<td></td>
<td>DH-330</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HG-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maharashtra</td>
<td>Spanish Improd</td>
<td>Karad-4-11</td>
<td>AK-8-10</td>
</tr>
<tr>
<td></td>
<td>Kopergoan 3</td>
<td></td>
<td>Kopergaon-1</td>
</tr>
<tr>
<td></td>
<td>JL-24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>Jyothi</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gangapur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>Type-32</td>
<td>Type 25</td>
<td>Type-64</td>
</tr>
<tr>
<td></td>
<td>Faizpur-1-5</td>
<td>Type-28</td>
<td></td>
</tr>
<tr>
<td>Rajasthan</td>
<td>ICGS1</td>
<td>RS1</td>
<td>RSB-87</td>
</tr>
<tr>
<td>Punjab</td>
<td>SG-84</td>
<td>Punjab-1</td>
<td>M-197</td>
</tr>
<tr>
<td>Orissa</td>
<td>Kissan Jawan</td>
<td>TMV-3</td>
<td></td>
</tr>
</tbody>
</table>

**12.5.4 Seed Rate**

The seed rate depends on the seed weight, inter and intra row spacing. On an average the following seed rate has been found to be optimum.

For bunch type : 100 to 125 kg/ha

For semi-spreading and spreading type : 85 to 100 kg/ha

**12.5.5 Time and Method of Sowing**

Groundnut is grown in all the three seasons viz. Kharif (rainy season), rabi (post rainy season) and summer in India. The time of sowing for kharif season starts with the onset of monsoon from June. The sowing for the rabi season starts from September. The summer sowing begins from January and lasts up to May.

There are three important methods of sowing the groundnut

1) Using seed drill
2) Dropping seed in the furrow formed by the plough
3) By dibbling (manually)

Sowing by using seed drill is the most common method. Here the row spacing and depth of seeding are maintained uniformly throughout the sowing area. The depth of sowing should be 5 to 7 cm in the red soils and 4 to 5 cm in black soils. The optimum spacing for bunch type varieties is 30 × 10 cm and for other types it is 30 × 15 cm. It is essential to cover the seeds after sowing to prevent seed damage by birds and other animals.

**12.5.6 Nutrient Management**

Groundnut crop requires considerable quantity of nutrients for higher yield. For every tonne of unshelled nuts and two tonnes of haulm produced by a groundnut crop about 63 kg nitrogen, 11 kg phosphorus (P₂O₅) and 46 kg potassium (K₂O), 27 kg calcium (CaO) and 14 kg magnesium (MgO) are removed. It is therefore necessary to meet the part of nutrients’ requirement through inorganic fertilizers. The quantity of nitrogen to be applied depends upon the fertility status of the soil, plant population, rainfall etc. The dose of nitrogen recommended varies from 10-20 kg/ha for the rainfed crop and 20-40 kg/ha for
the irrigated crop. The nitrogen is usually applied at the time of sowing or 3-4 days prior to sowing and incorporated into the soil. The quantity of phosphorus to be applied depends upon the soil phosphorus status, plant population, rainfall distribution etc. The quantity of phosphorus recommended ranges from 20-80 kg P₂O₅/ha. Single super phosphate is the best source of supply of phosphorus as it contains calcium and sulphur along with phosphorus, which are needed for the groundnut. Since most of the soils are rich in potassium, response to potassium application is noticed only if the available K₂O in soil is <150 kg/ha. A dose of 40 kg K₂O/ha under rainfed and 50 kg K₂O/ha under irrigated conditions is recommended. Localized application of phosphorus and potassium in a band in seed rows 5 cm below the seed is desirable. Application of about half tonne of gypsum at flowering takes care of the calcium and sulphur requirement of the crop.

### 12.5.7 Irrigation Requirement

Groundnut crop requires about 400 to 450 mm of water with a minimum of 8 to 9 irrigation. The critical stages for irrigation in groundnut are:

1. Flowering
2. Peg formation, and
3. Pod development

Regular irrigations are necessary to reduce high percentages of immature and shrivelled pods. However, irrigation at the maturity stage should be avoided as it results germination of mature seeds within the pods reducing the quality and yield.

Irrigation schedule for bunch type varieties in sandy loam soils is given below:

<table>
<thead>
<tr>
<th>Period</th>
<th>No. of Irrigations</th>
<th>Water Required (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30 DAS</td>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td>31-65 DAS</td>
<td>4</td>
<td>200</td>
</tr>
<tr>
<td>66-90 DAS</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>450</td>
</tr>
</tbody>
</table>

*DAS: Days after sowing*

Free flooding and border strip method of irrigation during early stages and furrow method of irrigation during later stages of crop is ideal.

### 12.5.8 Stages of Crop Growth

The common stages of crop growth observed in bunch and spreading types are as follows:

<table>
<thead>
<tr>
<th>Crop Growth Stage</th>
<th>Bunch Type</th>
<th>Spreading Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seedling emergence</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Commencement of flowering</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>Peg elongation and entering into soil</td>
<td>30</td>
<td>38</td>
</tr>
<tr>
<td>Commencement of pod development</td>
<td>35</td>
<td>43</td>
</tr>
<tr>
<td>Commencement of pod maturity</td>
<td>83</td>
<td>88</td>
</tr>
<tr>
<td>Completion of pod maturity</td>
<td>105</td>
<td>135</td>
</tr>
<tr>
<td>Period of maximum vegetative growth</td>
<td>15 DAF/38-53 DAS</td>
<td>8-43 DAF/59-74 DAF/63-81 DAF in two peaks</td>
</tr>
<tr>
<td>Period of maximum flowering</td>
<td>20-30 DAF/45-53 DAS</td>
<td>35-45 DAF/63-73 DAF</td>
</tr>
<tr>
<td>Duration of flowering</td>
<td>20-36 DAF/</td>
<td>31-80 DAF</td>
</tr>
</tbody>
</table>

*D - Duration (days)*
*DAS - Days after sowing*
*DAF - Days after flowering*
*DD - Days after peg penetration into the soil*
12.5.9 Weed Control

Weed problem is very severe in the initial stages of growth in groundnut crop as seedlings emerge 7-10 days after sowing. Mechanical removal through intercultivation or hand weeding at 20-25 DAS and 40-50 DAS reduce the weed influence on crop yield drastically. Pre-plant application of fluchloralin @ 0.5-1.0 kg a.i./ha about 10 days prior to sowing or pre-emergence application of alachlor or nitrofen @ 1.5 kg a.i./ha control the weeds effectively.

12.5.10 Pests, Diseases and their Control

In general insect pests cause 10-20% reduction in crop yields. The important insect pests and their chemical control are as follows:

Foliage Pests

Leaf miner, hairy caterpillar, aphids, thrips and jassids are the major foliage pests noticed and they can be controlled by spraying Dimethoate 30EC @ 1 ml/litre water solution or Endosulfan 35EC @ 2 ml/litre water solution.

Underground Pests

Termites and white grub are the important underground pests in groundnut. These can be controlled by soil application of 10% carbaryl @ 20 kg/ha or 5% Fenitox @ 12 to 15 kg/ha.

The groundnut is affected by root rot, collar rot, stem rot, dry wilt and yellow mould diseases caused by soil borne pathogens. They can be controlled by seed treatment with captan/thiram/dithane M-45 at the rate of 3g/kg seeds before sowing. The foliar diseases like leaf spot, rust etc. may be controlled by spraying 0.2% Dithane M-45 or Dithane 2.78 2 or 3 times at 10-15 days interval from 40 DAS. The incidence of viral diseases like bud necrosis, rossette, mosaic etc., may be reduced by spraying Metasystox @ 1 ml/litre of water to control virus carrying insects from spreading the disease.

12.5.11 Harvesting Time and Yield

The right time for harvesting can be judged by uprooting few plants randomly in the field and examining the pods for maturity. The yellowing of leaves and development of dark tint colour inside the shell indicates the readiness of the crop for harvesting. Adequate moisture in the soil should be ensured before harvesting to facilitate easy pulling of plants and reducing the pod detachment from plants inside soil. The bunch and semi-spreading varieties are manually harvested by uprooting the plants while in spreading types are harvested by digging or ploughing or blade harrowing. The pods are stripped from the plants after the harvest and dried for 7-10 days to bring down the moisture content to around 5 per cent.

The average pod yield of spreading and semi-spreading types under rainfed conditions is about 12-14 q/ha and that of bunch type is 8-10 q/ha. The crop grown under irrigated condition, may yield upto 40 q/ha. The seed yield will be about 70-75 per cent of the pod yield by weight.

SAQ 4

i) Name three plant types noticed in groundnut.

ii) Why rainfall is detrimental at pod maturity stage?

iii) Mention the factors influencing selection of variety for a particular area.

iv) What is the optimum seed rate for groundnut?

v) Why seed covering is important after sowing in groundnut?

vi) What are the critical stages of crop growth for irrigation in groundnut under assured irrigation facility?

vii) Mention two underground insect pests in groundnut.

viii) What is the method of harvesting in groundnut?
12.6 SUMMARY

This unit covers the important agronomic practices for successful cultivation of tobacco, cotton, sorghum and groundnut.

The tobacco crop is best suited for cultivation in sandy loam soil having good drainage with pH of around 6.0. It requires a mean temperature of 26°C and a mean rainfall of about 10 cm per month during growing period. As the seeds are small, seedlings should be raised in nursery and transplanted in main field. Selection of suitable type of tobacco and variety is important to realize higher yield in a given area. A seed rate of 3 kg/ha nursery is sufficient. Tobacco is grown mainly during kharif with transplanting time varying from August to November depending upon the type of tobacco. Appropriate dose of fertilizer to supply nutrients and 6-8 irrigation are necessary to raise a good crop. As crop is affected by many pests and diseases both in nursery and main field, necessary preventive and protective measures should be followed. Tobacco crop is harvested mainly by priming method in cigarette type and by stalk cut method in other types of tobacco. The leaf yield varies with type of tobacco and cultivation practices.

Cotton is the main source of textile fiber in India. It is grown in variety of soils ranging from sandy loam to clay loam from light black soil to lateritic soils. It requires a climate of warm days and cool night and well distributed rainfall of 50 cm. Suitable type and variety of cotton are available for all major cotton growing areas. The seed rate too varies with type of cotton. The optimum time of sowing varies from May to August depending upon the onset of monsoon and area of cultivation. It is a heavy feeder of nutrients thus requires about 100-150 kg nitrogen, 40-80 kg P2O5 and 40-60 kg K2O per hectare depending on soil fertility status. Under irrigated condition, about 6-8 irrigations totaling to 600-700 mm given at critical stages result in higher yield. Cotton is vulnerable to many pests and diseases, hence spraying of systemic insecticides like monocrotophos to control insect pests and seed treatment with fungicides like ceresan at recommended rate is necessary to ward off adverse effect of these. Crop will be ready for harvest by 140-160 DAS depending upon duration of variety. It is harvested by picking the dry seed-cotton from opened bolls. As cotton exhibits non-synchronous maturity, it needs 3-4 pickings to complete harvesting. The yield varies with type of cotton, variety and cultivation practices.

Sorghum is one of the major staple food crops in India. It is best suited for cultivation in clay loam to loam textured soil with good water holding capacity and a pH range of 6.0-8.5. It is grown in sub-tropical condition with moderate temperature and average rainfall of 60-100 cm in India. There are a good number of hybrids and varieties released by co-ordinated sorghum improvement project suitable for both kharif and rabi seasons for all sorghum growing areas. It is sown in July during kharif and around October during rabi seasons. A seed rate of 12-15 kg per hectare with a plant density of 1.5 lakh per hectare is optimum. When it is grown as irrigated crop about 4-5 irrigations are required at critical stages of crop growth. Application of 60-100 kg nitrogen, 50-60 kg P2O5 and 30-40 kg K2O per hectare for hybrids help realizing maximum yield potential. Pre-emergence spray of atrazine @ 0.25-0.50 kg a.i./ha keeps the crop field free of weeds. Since the crop is susceptible to many insect pests and diseases seed treatment with thiram, corbofuron etc. and spraying of insecticide like endosulfon and fungicide like dithane-M-45 at recommended dose when incidence of insect pests and diseases are anticipated will reduce the losses due to these. The crop matures in about 100-120 days depending upon varieties and season. The harvesting is done by cutting the mature and dry ear heads and threshed to separate the grains. The grain yield is low in desi sorghum with 10-15 q/ha while hybrids yield upto 50 q/ha with optimum cultivation practices.

Groundnut is an important oil seed crop grown in India. Loose, sandy loam soils having moderate organic matter and calcium content with good drainage are best suited for groundnut cultivation. It grows well under 21-26°C temperature with annual rainfall of 50-125 cm. Good seed bed preparation is pre-requisite as pods are developed under ground along with root system. Many improved varieties are available for different groundnut growing areas. A seed rate of 90-120 kg per hectare depending upon the groundnut type and variety will be sufficient. It is grown in all the three season viz., kharif, rabi and summer in India. Sowing is usually done by using seed-drill with a spacing of 30 cm between rows and 10-15 cm between plants in rows at a depth of 4-7 cm depending on soil type. A dose of 20-40 kg nitrogen, 20-40 kg P2O5, 40 kg K2O and 0.5 tonne of gypsum per hectare will be required to meet the nutrient requirement of groundnut crop. When grown in the late season, groundnuts are susceptible to pod borer, and hence measures should be adopted to minimize the damage. The harvest is done when 85% of the groundnuts are ready to harvest.
as irrigated crop it requires about 8-9 irrigations. As weeds cause severe damage, pre-emergence application weedicide like alachlor @ 1.5 kg a.i./ha control the weeds in the field. Further spray of systemic insecticides like endosulfan reduce the insect damage. Where underground insect pests are menace, application of carbaryl or phorate granules is also needed. Seed treatment with fungicides like capton prevents the seed borne diseases. Groundnut is harvested by uprooting the plants and stripping the pods from plants. The yield depends on groundnut type and variety and cultivation practices.

12.7 KEY WORDS

Drainage : The process of discharge of water from an area of soil by sheet or stream flow (surface drainage) and the removal of excess water from within the soil by downward flow through the soil (internal drainage).

Fungicide : A chemical used to prevent the emergence or control or kill the disease causing fungus.

Harvesting : The process of collecting the economic portion from crop at maturity or at the stage required.

Hybrid : A plant resulting from a cross between parents that are genetically unlike.

Insecticide : A chemical used to prevent or control or kill the insect pests.

Irrigation : The artificial application of water to the land in order to grow the crop or improve the crop yield.

Nursery : A portion of land where seeds of crops are allowed to germinate and grow. These plants are removed after some time and transplanted on the main field.

Season : The part of the year during which cultivation of a crop is possible.

Seed bed : A prepared area in which seed is sown.

Seed Rate : The quantity of seed used or to be used per unit land for sowing or planting purpose. Seed rate is usually expressed in terms of kg/ha.

Soil Fertility : The ability of soil to provide plant nutrients in proper amounts and in the proper balance for the growth of specified plants under the suitable environment.

Soil pH : Indication of degree of acidity or alkalinity. The pH scale of 0-14 expresses intensity of acidity or alkalinity. The pH value of 7.0 is neither acid or alkali. The pH value < 7.0 indicate acidity with intensity increasing as the number decreases and pH > 7.0 indicate alkalinity with its intensity increasing as the number increases.

Sowing : It is an art of placing seeds in the soil to have germination in the field. A perfect sowing gives correct amount of seed per unit area, correct depth at which seed is placed in the soil and correct spacing between row to row and plant to plant.

Spacing : The distance between plants in the standing crop.

Spraying : A liquid, solution or suspension of matter such as fungicide, insecticide etc. made available in the form of fine drops; applied to a surface or body by means of a jet of air of stream forced from the minute openings of a sprayer.

Transplanting : The act of removing the plants from one place to another with the object of growing it permanently at a new location.
Crop Production Variety: A population of crop plants having many characteristics in common.

Water-logging: A condition of land where the ground water stands at level that is detrimental to plant growth. It may result from excessive irrigation or seepage coupled with inadequate drainage.

Weedicide: A chemical used to kill the weeds.

Yield: The usable portion of a crop that has a market value.

12.8 ANSWERS TO SAQs

SAQ 1
i) a) Cigarette type
   b) Bidi type
   c) Cigar and cheroot type
   d) Hookah type
   e) Chewing and snuff type

ii) Since tobacco seeds are small and the emerging seedlings are tiny and delicate, they are raised in nursery and transplanted to main field.

iii) About 3 kg per hectare of nursery

iv) Under irrigated conditions 6-8 light irrigations are required for tobacco.

v) The topping and desucking is done in tobacco to divert the nutrients of the plants to the leaves instead of flowers and seeds. It improves leaf yield and quality of the tobacco.

vi) Pests: 1) Leaf eating caterpillar
   2) White fly
   3) Green peach aphid

Diseases: 1) Damping off
   2) Brown spot
   3) Tobacco mosaic virus

vii) i) Priming
    ii) Stalk cut method

SAQ 2
i) 1) Gossypium arboreum L.
   2) Gossypium herbaceum L.
   3) Gossypium hirsutum L.
   4) Gossypium barbadense L.
   The first two are called desi cotton and the last two are called American cotton

ii) Desi cottons: 10-15 kg/ha
    American cottons: 18-20 kg/ha
    Hybrids: 2-3 kg/ha

iii) i) Drilling using seed drill
     ii) Dibbling

iv) About 600-700 mm water spread over 6-8 irrigations is required for cotton under irrigated condition.
v) a) Free flooding under flatbed sowing  
   b) Furrow irrigation under ridge planting  

vi) Pests:  1) Jassids  
  2) White flies  
  3) Boll worms  

Diseases: 1) Bacterial blight  
           2) Fusarium wilt  
           3) Leaf spot  

vii) Cotton is harvested by picking seed cotton from the individual bolls which are open. The number of pickings and quantity per picking depends on maturity habit, season and management practices.  

SAQ 3  

i) Grain: Human food  
   Stover: Fodder for animals  

ii) Season Hybrids Varieties  
    Kharif CSH 4 CSV 10  
    CSH 9 DSV 3  
    Rabi CSH 13 RM-35-1  
    RSH 7R CSV 8R  

iii) CSH: Coordinated sorghum hybrid  
     CSV: Coordinated sorghum variety  

iv) 12-15 kg/ha  

v) 1) Germination – at the time of sowing  
    2) Flower primordial initiation – 25-30 days after sowing  
    3) Flag leaf stage – 50-55 days after sowing  
    4) Flowering – 60-70 days after sowing  
    5) Grain filling stage – 80-90 days after sowing  

vi) Insect pests:  1) Shootfly  
                   2) Arhead midge  

Diseases:  1) Downey mildew  
            2) Ergot or sugary disease  

vii) Striga  

viii) Local varieties: 10-15 q/ha  
      High yielding varieties: 28-36 q/ha  
      Hybrids: 40-50 q/ha  

SAQ 4  

i) a) Bunch type  
   b) Spreading type  
   c) Semi-spreading types  

ii) Rainfall during pod maturity results in germination of physiologically mature seeds inside pods before harvest and reduce the final yield.
Crop Production

iii) a) Soil type
   b) Rainfall distribution
   c) Season
   d) Management practices
   e) Market preference

iv) Bunch type: 100-125 kg/ha
   Spreading and semi-spreading type: 85-100 kg/ha

v) The uncovered and exposed seed are damaged by birds and other animals, which results in gapy crop stand.

vi) a) Flowering
    b) Peg formation
    c) Pod development

vii) a) Termites
    b) White grubs

viii) Groundnut is harvested by uprooting the mature plants either manually or by running plough or blade harrow and then stripping the pods from plant.