

1. Traditional Crops



Can you recall?

1. Cereals, oilseed crops and pulses are the important constituents of the traditional farming governing rural economy.
2. Cereals provide staple food for a large proportion of world's population. They are consumed in the form of leavened as well as unleavened flat bread.
3. Oilseed crops have great importance in Indian farming. India contributes 14 percent of world's oil seed area and 8 percent oil seed production in the world.
4. Pulses are rich in proteins and they meet the major share of protein requirements of vegetarian people.
5. Most of the pulses, oil seed crops and cereals are the constituent of crop rotation and mixed cropping with each other.

1.1 WHEAT

Local Name : *Gahu*

Botanical Name : *Triticum* species

Family : Gramineae

Origin : Hard Wheat : Abyssinia

Soft / Bread wheat : North - West India, South West Afghanistan and USSR



Do you know ?

The genus *Triticum* has several species. The species which are commonly cultivated in India are *Triticum aestivum*, *Triticum durum*, *Triticum dicoccum*, *Triticum sphaerococcum* and *Triticum turgidum*. In India *Triticum aestivum* is most common occupying 90% area.

1.1.1 Uses : Wheat is an important staple food crop, mainly consumed in the form of *Chapati*. Wheat grain contains starch, proteins, fats, vitamins and minerals. Among all cereals wheat is a good source of protein. Soft wheat is



Fig. 1.1 Wheat crop



Fig. 1.2 Wheat ears and grain

used for making *Chapati*, bread, cake, biscuit, pastry and other bakery products. Hard wheat is used for preparation of *rawa*, *suji* and *sewai*. Wheat straw is used as fodder as well as thatching and mulching material. It has good bread making quality among all cereals due to gluten content.



Do you know ?

Gluten is a protein (gliadin and glutenin) in wheat dough, a rubbery mass highly essential for manufacturing of bakery products.

1.1.2 Soil : The wheat crop is grown on a wide range of soil conditions. It grows well on soils with reasonable drainage and good water holding capacity. It can be cultivated from light soils to heavy clay soils. Soil should be well drained. The rainfed crop in Maharashtra is generally grown on heavy soils. The optimum range of pH is from 5.5 to 7.5

Try to understand

- Productivity of wheat is higher in Punjab as compared to Maharashtra.
- Note the differences in climatic and soil conditions in both the states.

1.1.3 Climate : It is a temperate crop. It requires cool, dry and clear weather. During early growth stages wheat requires cool climate for proper tillering. Dry sunny weather and cool night favours dew formation, which is essential for growth and development of wheat grains. Optimum temperature range for its growth is 7°C to 21°C and temperature above 25 to 30 °C has adverse effect on growth and yield. Wheat yields well in areas with average annual rainfall of about 750-1600 mm. High humidity is harmful because it favours the spread of fungal diseases like rust and rot. Hot and cloudy, frosty weather is also harmful for germination.



Try this

Collect information regarding different cultivation practices of rainfed and irrigated wheat in your area.

1.1.4 Preparatory tillage : Wheat crop needs a well pulverized but compact seed bed. The practice of land preparation differs with irrigation facilities, soil and climate. For an irrigated crop one deep ploughing with an iron plough is given and is followed by 2 to 3 shallow ploughings by country plough. When wheat follows green manuring crop, the land is prepared by two criss-cross ploughings, followed by 2 harrowings and planking.

For a rainfed crop soil moisture conservation is important. One deep ploughing is given once in three years. Just before sowing, land is given shallow harrowing and light planking. The land which is fallowed during *kharif* season is prepared by 3 to 5 harrowings.

After sowing, 'saras' or flat beds are prepared with the help of '*sara yantra*' or bund former and irrigation channels are opened by ridger.

1.1.5 Sowing season and Time :

Wheat is temperate crop and therefore sown in *rabi* season. Sowing time varies with variety. Tall varieties are sown from last week of October to first week of November. The short durational dwarf varieties are sown in November.



Think about it

Sowing direction : During winter, the direction of sun over India is in south – south east to west – north west. Therefore sowing is done by north – north east or north – south direction. It gives higher yield because it would allow maximum interception (utilization) of sun light and promote vigorous growth.

1.1.6 Sowing

A. Methods :

1. Drilling : One, two or three coultured seed drills are used for sowing wheat in rows at specific distance. The best method is sowing with fertilizer cum seed drill, which places the fertilizer and seed at optimum depth for good germination and uniform crop maturity.

2. Broadcasting : Seed is scattered by hand on the field surface and then mixed in to the soil by working wooden plough or harrow.

B. Spacing : It depends on the factors such as maturity period, tillering habit, time of sowing, fertility status and moisture condition of the field. Early maturing varieties with poor tillering habit are sown at a closer spacing than late maturing and profuse tillering varieties. If sowing is delayed, the spacing should be closer as such crop have reduced growth and less number of tillers. Optimum spacing for irrigated crop is 22.5 cm and for rainfed crop it is about 30cm.

C. Depth of Sowing : It varies with the variety and type of cultivation as follows.

Irrigated crop	: 3 – 5 cm
Rainfed crop	: 8 – 10 cm
Dwarf Variety	: 5 - 6 cm.



Remember this

Wheat seed should be placed in a moist zone for better germination and establishment of seedlings. In high yielding and dwarf varieties seed should be placed only up to 5 cm depth.

D. Seed Rate : Seed rate varies as follows :

Dwarf varieties - 100 to 125 kg / ha

Bold seeded varieties - 125 to 150 kg / ha

Rainfed crop - 75 to 80 kg / ha

1.1.7 Seed treatment :

Fresh harvested seed is dried in sun heat for 2 days to control attack of loose smut. Seed is treated with carboxyl (vitavax) or benlate (Benomyl) @ 1 - 1.25 g / kg seed to control loose smut, foot rot. Seed is also treated with organo mercurial fungicides like agrosan, captan or thirum @ 2 - 3 g / kg seed to control flag smut and foot rot.



Use your brain power

Why it is necessary to – a) use clean seed for sowing. b) use well decomposed FYM / compost.

1.1.8 Varieties : Kalyansona (HDM - 1593), Sonalika (HDM - 1553), Malvika, Sihor, HD - 2189, HD - 4502, HD - 2610, Lok - 1, N - 59, Sharbati, MACS - 2846, MACS - 1967, MACS - 9, NI-5439, etc.

1.1.9 Manures and Fertilisers : Well decomposed FYM / compost is added @ 10 - 15 t / ha at the time of land preparation before last harrowing. Chemical fertilizers are added as follows.

- a. Rainfed : 25 - 50 : 15 - 25 : 25 NPK kg / ha.
- b. Irrigated : 75 - 120 : 40 - 60 : 40 - 60 NPK kg / ha

Allotment - For irrigated crop half dose of N and full dose of P,K are applied at the time of land preparation (basal dose) and remaining half dose of N is applied one month after sowing.

1.1.10 Irrigation : When sown under irrigated condition, wheat requires 5 - 6 irrigations. First presowing irrigation is given and remaining irrigations are given at critical growth stages. If soil is light or sandy, 2 - 3 extra irrigations are given. Following are the critical growth stages at which crop should be irrigated.

- i) Crown root initiation
- ii) Tillering
- iii) Jointing
- iv) Flowering
- v) Grain filling

Rainfed wheat crop is grown on residual moisture of soil and dew formed during winter.

1.1.11 Intercultivation : Weed competition is maximum during first 30 - 40 days after sowing. Hoeing or interculturing few days after first and second irrigation is helpful for breaking the crust and removing the weeds. For small field hand tools like 'khurpi' or hand hoe, etc. are used. Thus, two hand weedings and hoeings are required for weed control. Chemical weed control is also recommended. The herbicides like isoproturon, bentazone, metasulfuron are effective.

1.1.12 Crop rotation :

It is not desirable to grow wheat year after year on same piece of land. The common crop rotations are -

1. Mung / udid / soybean (*kharif*) → wheat (*rabi*)
2. Paddy / bajra / jowar / maize (*kharif*) → wheat (*rabi*)
3. Groundnut / sesamum (*kharif*) → wheat

1.1.13 Intercropping : Inercropping of wheat with mustard, potato, gram and pea is the common practice.

1.1.14 Plant Protection

I. Pest

a. White ants (Termites)

Nature of damage : This pest lives hidden underground and feed on developing roots and stem. It causes wilting or drying of plants.

Control measures : Locate the termitoria and destroy it by digging or fumigation. Drilling in soil 5% aldrine or heptachlor @ 65 kg / ha or spraying the crop with chloropyriphos 20 EC is also effective.



Fig. 1.3 Termites

b. Cut worms :

Nature of damage: The caterpillars live hidden under soil during day time and cut plants and feed on them during night hours.

Control measures: Apply 5 % aldrine powder @ 125 kg / ha. before sowing

c. Stem (Pink) borer

Nature of damage: The young larva feed on tender parts of plant and later on bore into the stem and causes death of central shoot locally known as dead heart.



Do this

Visit a nearby wheat field and look insects-pest. Identify them and suggest proper control measures for them.

Control measures: Collect and destroy dead hearts. Spray the crop with quinolphos, chloropyrifos.

d. Rat

Nature of damage: Rats cut the stalks, ears and feed on developing grains. They also carry the grains into the burrows. The damage is equally serious in threshing yard and godowns.



Fig. 1.4 Rat

Control measures -

- Mechanical method : Hunting, trapping, flooding and ultra sonic sound.
- Chemical method : Use of zinc phosphide and selphos tablet is very effective.

II. Diseases

a. Wheat rust: There are three types of rust

1. Yellow or stripe rust :

Symptoms : Small yellow spots forming stripes appear on leaves which later on turn black.



Fig.1.5 Yellow or stripe rust

2. Black or stem rust :

Symptoms: Reddish brown to dark brown spots appear on leaves and stems, later on these spots turn black. Grains are shrivelled and lighter in weight.

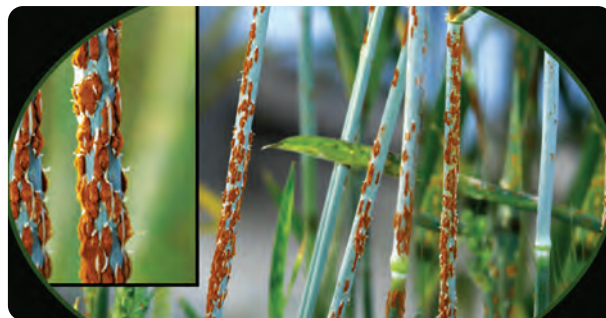


Fig. 1.6 Black or stem rust

3. Brown or leaf rust :

Symptoms : Small, round or oblong orange coloured spots, which later on turn black, appear on the leaves and glumes. These spots appear in clusters or may be irregularly scattered all over the leaf.

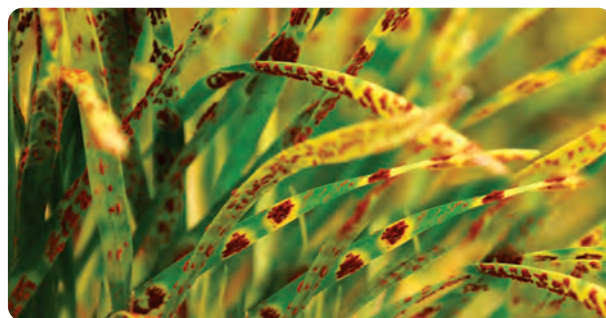


Fig. 1.7 Brown or leaf rust

Control measures :

- For all kinds of rust prominent control measure is to grow resistant variety.
- Spraying the crop 2-3 times with the mancozeb or zineb at an interval of 15 days are effective chemical control measures.

b. Flag smut :

Symptoms : It appears from seedling stage to crop maturity. Gray to grayish black spots appear on the leaves. The infected plants are stunted and bear no grains. Even if grains appear, they are shrivelled and have poor germination ability.



Fig. 1.8 Flag smut

Control measures :

- Seed treatment with organo mercurial compound like agrosan, captan or thirum @ 2.5 to 3g per kg seed.
- Proper crop rotation and early sowing of crop is also effective.

c. Loose smut :

Symptoms : The fungus infect the plants through stigma and establish in developing seed. The grain is replaced by black powdery mass of fungal spores.

Control measures : Sun heat treatment or seed treatment with carboxyl or benlate are the recommended control measures.

d. Foot rot :

Symptoms : In rainfed crop dry soil conditions and temperature around 30°C are conducive for infestation. Specific symptoms are yellowing of foliage followed by death of plant.

Control measures : Growing resistant varieties and seed treatment with organomercurial compound like agrosan, thirum, etc., are the effective control measures.



Try this

Collect information about different varieties, weedicides, insecticides available in the market from nearest *krishi seva kendra*.

1.1.15 Harvesting and yield : This crop is ready for harvesting after 4 – 4.5 months of sowing. The crop is harvested when grain is fully developed, straw become dry and gives peculiar noise with winds and the moisture content in grains is 18 to 22%. Harvesting is



Fig. 1.8 B Combine harvester

done by cutting the plant close to the ground with sharp sickle. Plants are tied in bundles, dried in sunheat and taken to the threshing yard. Threshing is done by trampling the plants under the feet of bullocks or beating them with long wooden sticks or using power thresher. Now a days, mechanical (combine) harvester is used. Grain is dried to about 12% moisture. Then grain is stored in metallic bins, earthen pots, gunny bags and placed in godowns.

1.1.16 Yield Yield varies as follows :

Rainfed - (average yield) 6-9 q/ ha.

Irrigated - 25 - 40 q./ ha.

Mexican varieties : 40 - 50 q / ha

1.2. PADDY (Rice)

Local Name : *Sal, Bhat, Dhan*

Botanical Name : *Oryza sativa*

Family : Gramineae

Origin : South and south east Asia



Fig. 1.9 Paddy crop



Fig. 1.10 Paddy grain

1.2.1 Uses : Rice is the staple food of 60% population of the world. It contains carbohydrates, proteins, fats, minerals and vitamins. Rice bran contains 18 - 20% edible oil. Paddy straw is used as manuring, mulching, padding material as well as thatching material of huts. Husk is used as fuel and for making light weight bricks. Rice bran, paddy husk and stalk used as fodder for cattle. It is also used for packing, ripening of fruits and agronomical

products. Inferior quality of rice, broken rice is used as poultry feed. Rice byproducts like murmura (parched rice), lahi (parched paddy) and poha (beaten rice) are prepared. Rice grain have important place in ceremonies related to birth, marriage, funerals and other religious functions .



Remember this

Central Rice Research Institute located at Cuttak in odisha. Rice Research Station is located at Karjat in Maharashtra. India ranks first in area as well as production in the world. In Maharashtra, major rice growing regions are Konkan and Vidarbha. There are 23 species of rice out of which only 2 are cultivated.

1.2.3 Soil : In India major paddy growing areas have alluvial soils. In Maharashtra, paddy is grown in a variety of soils. It is grown on khar land in coastal saline region. Its cultivation is restricted to lateritic soils in south konkan and basalt soils in maval and ghat region. The soil pH should be 5.5 to 7. It prefers acidic condition.



Do you know ?

- Rice contributes 27% of cereal grains production in the world.
- Unhusked grain (seed) and the growing crop is called as paddy.
- Seed is husked or hulled, milled and polished to produce white rice.

1.2.3 Climate : Rice is grown under wide range of climatic conditions. Though it is mainly a tropical crop, its cultivation is also done in sub-tropical and temperate regions. The rice growth is optimum at temperatures between 20° to 37° C. In both tropics and temperate regions the level of solar radiation decides rice productivity. Rainfed rice cultivation is limited to areas receiving an annual rainfall more than 1000 mm.

1.2.4 Methods of cultivation : Different methods of paddy cultivation are as stated below

1. Dry cultivation
2. Semi-dry cultivation
3. Wet cultivation
4. Intensive or Japanese method of cultivation

1. Dry cultivation : This method is followed in regions which do not have irrigation facilities and where rainfall is inadequate and uncertain.

In this method fields are ploughed immediately after the harvest of previous crop or after summer showers. Seed is sown to a greater depth by dibbling behind plough or drilling. Drilling in lines help in proper establishment of plants and also facilitates inter cultivation.

2. Semi-dry cultivation : This is so called because some part of life cycle of crop passes under dry and some under wet condition.

The rain water is impounded when crop is about 1 $\frac{1}{2}$ to 2 month old and when water gets accumulated to a depth of 10-15 cm, by the end of July the field is worked by giving shallow ploughings. This methods helps in suppressing the weed growth and thinning as well as inter culturing. In short in this system the crop thrives on moisture available in bunded fields.

3. Wet cultivation : In this system land is ploughed thoroughly and puddled with 3-5 cm standing water in the field. The seedlings are raised in nursery and later on transplanted in puddled field. When it is not possible to raise seedlings in time, in such cases seeds are soaked in water for sprouting. The sprouted seeds are then broadcasted directly in the puddled field. Transplanting method has various advantages as follows.

- Plant population is more uniform and seed rate required is comparatively less than the other methods.
- Farmer gets sufficient time for land preparation.
- Weeds are burried at the time of puddling and get controlled.
- Losses due to pest and diseases are minimized by adequate control measures in the nurseries.

- Nurseries when grown in advance facilitates timely transplanting.

4. Intensive or Japanese method of cultivation : This method is followed in the areas of assured water supply and where farmer can adopt plant protection practices and can apply heavy doses of fertilizers for inducing crop production. The following are the specific features of this method:

- Seedlings are grown in raised beds.
- Seed rate needed is less.
- The crop is manured heavily.
- 3 to 4 seedlings are transplanted at each spot in a row.
- It facilitates interculturing operations.



Observe and Discuss

- The differences in various methods of paddy cultivation.
- Which method is suitable to your area?

1.2.5 Preparatory tillage : This is different for dry and wet cultivation method. In dry management system land is prepared in the same manner as for other cereal crops. In wet system land is flooded and prepared in submerged soil. In both systems the chief cultivation practices are the summer ploughing after the receipt of rains and repeated harrowing. Compost or F.Y.M. is also added before last harrowing. Perfect levelling is essential in both the systems.

1.2.6 Sowing :

A. Season and time :

The main cropping seasons in India are as stated below :

Season	Sowing time
Aus or Autumn paddy	May to June
Aman or winter paddy	July to August
Boro or spring paddy	December to January
Summer paddy	February to March

B. Seed rate :

It differs with the methods of sowing as follows:

1. Transplanting- 25 to 40 kg/ha.
2. Dibbling- 50 to 60 kg/ha.

3. Drilling - 60 to 70 kg/ha.

4. Broadcasting- 80 to 100 kg/ha.

1.2.7 Seed selection and seed treatment :

Seed should be selected from high yielding varieties. It should be clean and viable. It should be soaked in 1% KCl solution for 12 hours to improve the germination and vigour potential. The seed is also dipped in 3% brine solution for selection of healthy seed followed by treatment with the solution of cuprasan, perenox or cupravit for 10-15 minutes. This will prevent the attack of blast and blight disease. The attack of bacterial leaf blight can be prevented by treating paddy seed with mixed solution of streptomycin and wettable ceresan followed by hot water treatment at 52° C to 54° C for half an hour.

1.2.8 Nursery :

1. Wet nursery :

The land for nursery is ploughed twice during summer season and is then puddled by giving 3 to 4 ploughings in 5 to 6 cm standing water. Well decomposed compost or F.Y.M is added at the rate of 10 tonnes per hectare or green leaf manure may also be added at the rate of 8 to 10 tonnes per hectare. After puddling, the field is levelled and divided into small beds of one meter width and suitable length. Half metre wide channels are used to facilitate drainage. Sprouted seeds are then broadcasted in the field. Based on seed size, the seed rate may be 350 to 450 kg for raising one hectare nursery. The seedlings obtained from one hectare nursery are sufficient for planting 10 to 12 hectare of land. The specific dose of fertilizer is given depending upon the fertility status.

2. Dry nursery :

It is followed in the regions of non assured water supply. The land is prepared by 4 to 5 ploughings and some cross ploughings. Well decomposed F.Y.M is added and raised beds are prepared. The raised beds are 1 to 1.5 metre wide, 8 to 10 cm high and of any convenient length. Drainage is provided by opening 30 cm wide channels. Sowing is done during second week of June and seed is covered with thin layer of soil or compost. The seed rate needed

for growing one hectare nursery is about 250 to 400 kg and it will give rise to sufficient seedlings for planting 10 to 12 hectares of land. The seedlings obtained are hardy and establish early after transplanting.



Try this

- Visit a nearby paddy field and observe the technique of nursery management.
- Strike the differences among the different types of nurseries.

3. Dapog nursery :

This is followed in areas of adequate water supply. Nursery is prepared on concrete floor or on raised beds of soil covered with polythene paper or banana leaves. Pre-germinated seed are used for sowing. In this method seedlings become ready for transplanting in 14 to 16 days after sowing. Nursery of 30 to 40 sq.m. is sufficient for raising seedling for planting 1 hectare land.

1.2.9 Transplanting :

Time of transplanting is based on the factors such as availability of water for planting, maturity period of the variety, etc. The varieties having maturity period of 120, 135 and 150 days are transplanted after about 21, 25 and 30 days respectively.

The seedlings are pulled, tied in bundles and left in water for a night before planting. At each spot 3 to 4 seedling are transplanted. The planting distance for early, medium and late maturing varieties may be 15×15 cm, 20×15 cm and 20×20 cm, respectively. In case of late planting due to paucity of irrigation water, aged seedlings are preferred to younger ones. Nowadays mechanical transplanters are used for paddy transplanting.



Fig. 1.11 A) Mechanical paddy transplanting



Fig. 1.11 B Manual paddy transplanting

1.2.10 Varieties : The popular varieties are Indrayani, Basmati, IR-8, IR-20, IR-22, IR-36, HRI-120, Sahyadri, sakoli-6, pusa basmati, Ambemohar-157, Ambemohar-159, Krishna, Ratna, Sabarmati, Karjat-3, Karjat-7, Phule Samruddhi, Indrayani, etc.

1.2.11 Manures and Fertilizers : The recommended doses and application depends upon types of variety.

Farm yard manure or compost is added at the rate of 12.5 tonnes/ha, as one of the pre sowing cultivation operations. The nutrient requirement of paddy is as follows .

Varieties	N	P	K	
Local improved	25 to 50	25 to 50	25	kg/ha.
High yielding	100	50	25	kg/ha.

All the quantity of 'P' and 'K' is applied at the time of sowing. Nitrogen is given in two split doses. About $\frac{3}{4}$ th amount is applied as basal dose and remaining $\frac{1}{4}$ th sometime during the period of internode elongation. Nitrogen should be given preferably through ammonium sulphate.

1.2.12 Irrigation : The paddy is semiaquatic plant and require more water than other crops.

A lowland paddy crop requires more water than upland crops as land submergence is followed for them. The average water requirement of rice is 1240 mm. The period from primordia initiation to heading is most sensitive to water requirement.

1.2.13 Inter cultivation :

The problem of weed is critical in direct seeded crops from 15 to 30 days and in

transplanted rice from 30 to 45 days. The crop should be inter cultured by using rice rotary weeder. This helps in weeding, stirring and aerating the soil. Inter culturing should be repeated 3 to 4 times at an interval of 15 days. The recommended herbicides are almix, bensulfuron, oryzaline, etc.

1.2.14 Intercropping : Paddy can be intercropped with the crops like green gram, sesamum, black gram, groundnut, etc.

1.2.15 Crop rotation : In tracts possessing irrigation facilities rice is followed by cash crops like sugarcane, potato, wheat or pulses like gram, pea, green gram, black gram, etc.

1.2.16 Plant protection :

I. Pest

a. Yellow stem borer

Nature of damage Larvae bore into the stem to feed and cut the central shoot at the base causing dead hearts.

Control measures Collection and destruction of dead hearts and use of resistant varieties are recommended for the control of stem borer.

b. Swarming caterpillar

Nature of damage Caterpillars appear in big groups and they eat younger plants.



Fig. 1.12 Swarming caterpillar

Control measures Destruction of stubbles of previous crop and use of 3% carbofuron or 5% quinolphos at the rate of 15 kg/ha is effective.

c. Rice bug

Nature of damage It sucks the juice from the developing grains during milk stage.



Fig. 1.13 Rice bug

Control measures Spraying the crop with chloropyriphos 20 EC is the effective control measure.

d. Rice hispa :

Nature of damage Beetles feed on chlorophyll of leaf lamina, producing white streaks.

Control measures The recommended control measure is to spray the crop with chloropyriphos 20 EC or malathion 50 EC.

e. Paddy gall fly :

Nature of damage Maggots enter the stem and attack the base of growing point and produces silvery shoot. Affected tillers do not produce any panicle.



Fig. 1.14 Paddy gall fly

Control measures: Burning grass and wild rice or applying 10% thimet granules at the rate of 10 kg per ha. after 10 and 20 days of transplanting are recommended.

Among the other insects - pest which affect paddy are grass hopper, jassids, etc. Rats and crabs also cause damage by eating plant parts.



Try this

- List out pest and diseases of paddy which are common in your area.
- Prepare a chart of pest and diseases of paddy with their control measures.
- Whether Integrated Pest and Disease Management is possible in paddy?

II. Diseases

a. Paddy Blast :

Symptoms Spindle shaped brown to reddish brown spots appear on the leaves. The spots on stem and grains are darker. There is rotting of neck resulting in dropping of ears.



Fig. 1.15 Paddy blast

Control measures :

- i. Grow resistant varieties.
- ii. Treat the seed with cupravit, perenox or cuprasan.
- iii. Spray the crop with benlate @ 150g/ ha in 250 Lites of water. 2 to 3 sprays are required.

b. Sheath blight :

Symptoms : Greenish gray and oval spots appear predominantly on leaf sheath. Later on these spots turn grayish white with brown margin.



Fig. 1.16 Sheath blight



Remember this

Upland paddy (rice) refers to paddy grown on both flat and sloping fields that are prepared and seeded under dryland conditions. It is also called as rainfed paddy. Paddy grown on flat land with controlled irrigation is known as lowland paddy(rice) it is also known as irrigated paddy .

Control measures :

- i. Grow resistant varieties.
- ii. Treat the seed with perenox, cupravit or Cuprosan @ 2 g/ kg seed.

c. Foot rot/stem rot :

Symptoms : Small irregular black spots appear on leaf sheath. The affected plants remain stunted and fail to tiller. Roots become reddish brown and rot. Grains are shrivelled.



Fig. 1.17 Foot rot

Control measures

- i. Use disease resistant varieties.
- ii. Treat the seed with perenox, cupravit or cuprasan @ 2g/ kg seed.

d. Bacterial leaf blight :

Symptoms Water soaked translucent streaks appear on leaves which later on turn yellow to white in colour. The leaves dry up.



Fig. 1.18 Bacterial leaf blight

Control measures

- Treat the seed with the mixed solution of streptocycline and wettable ceresan followed by hot water treatment.
- Spray the crop with streptocycline or agrimycin.

e. Grassy smut :

Symptoms : The symptoms are characterized by stunting of plants, excessive tillering and erect growth habit. The leaves are green or pale yellow.



Fig. 1.19 Grassy smut

Control measures

Use of resistant varieties is the effective control measure for preventing the attack of grassy smut.

1.2.17 Harvesting and threshing :

The paddy should be harvested when the moisture content of the grain is about 20 to 25%. At this stage ears are nearly ripe and straw is still slightly green. Timely harvesting prevents the loss of yield due to grain shedding. Usually majority of the grains in ears of high yielding varieties ripe 35 to 40 days after full emergence of ear.

The crop is harvested by cutting the plants with a sickle near to the ground level. The plants are left in the field to dry for 1 or 2 days or they are tied in bundles and dried for 2 to 3 days. The drying is continued till the moisture content in grain is reduced to 12 to 13%. The crop is threshed by beating the plants with sticks or under the feet of bullocks. Small sized paddle threshers are also in use. Nowadays mechanical harvesters are available.

1.2.18 Yield :

It varies from 40 to 50 quintals per hectare for early varieties and 60 to 70 quintals per hectare for late varieties.



Do you know ?

Rice is stored as unhusked rice (paddy) or milled rice. Before storing, it should be confirmed that the moisture content in grain is up to 12-13%. The moist paddy would lead to grain discolouration, bad odour and bitter taste and this should be avoided. For small scale home storage, sacks, metal or wooden containers are used. For large scale storage, special storage rooms with proper fumigation facility are useful.

1.3 GROUNDNUT

Local name: *Bhuimung*

Botanical Name: *Arachis hypogaea*

Family: leguminosae

Origin: South America (Brazil)



Fig. 1.21 Groundnut pods



Fig. 1.20 Groundnut crop



Do you know ?

The name groundnut is derived from Greek word *Arachis* means legume and *hypogaea* means below ground with reference to formation of pods in to the soil.

1.3.1 Uses :

Groundnut is predominant among oilseed crops grown in India. Its oil content varies from 45 to 55%. Refined oil and vegetable ghee are used as cooking medium. Kernels are rich in protein and vitamins-A, B, B₂. Kernels are eaten as raw, roasted or sweetened. Oil is also used for the manufacture of soaps, cosmetics, toilet requisites, etc. Groundnut cake is used as cattle feed as well as manure. Groundnut is also consumed in the form of confectionery products. Vines are fed to the livestock.

1.3.2 Soil :

Groundnut prefers loam and sandy loam soils. Well drained light sandy loams with ample calcium and moderate organic matter are most suitable. It is acid tolerant crop with pH range of 5 to 5.5. Heavy and stiff clay soils are not suitable as such soils become hard during dry climate and affect the pod formation and also create problems in harvesting.

1.3.3. Climate :

Groundnut is usually cultivated in tropical and subtropical regions. It performs well in temperatures ranging from 24° to 33°C. It can not withstand frost and drought conditions. It can be grown well in places receiving an annual rainfall of about 500 mm to 1250 mm and up to 1600 mm with good drainage facility.

1.3.4 Preparatory tillage :

Groundnut requires deep, loose and fine seed bed. Land is prepared by giving one deep ploughing and 2-3 harrowing. Medium deep soils are ploughed twice followed by several harrowing till the monsoon rains are received.



Remember this

Groundnut is also known as peanut, monkey-nut and *moong fali*.

1.3.5 Sowing

a. Season and time :

In Maharashtra *kharif* crop is sown from last week of June to first week of July. During summer season the time of sowing is January to February.

b. Sowing methods and spacing : It depends on the type of variety grown. The erect varieties are either dibbled at 25×15cm distance or drilled with four coultered seed drill in rows 25 to 30 cm apart. Semi spreading varieties are dibbled at 45 ×15 cm distance and spreading at 60 ×15cm distance.

c. Seed rate :

It depends on the test weight of seed, spacing and type of variety. It is as follows.

- Erect varieties-100 to 120 kg/ha.
- Semi-spreading - 80 to 100 kg/ha.
- Spreading varieties 60 to 80 kg/ha.

1.3.6 Seed selection :

Only healthy kernels from high yielding varieties should be selected. Broken and decoated kernels should be avoided. Yellow or black coloured (diseased) and kernels damaged by insects, should not be taken for sowing.

1.3.7 Seed treatment :

The attack of root grub is prevented by treating the seed with chloropyriphos 20 EC at the rate of 6 ml/ kg seed.

Treatment of 1 percent organo-mercurial. Fungicide like agrosan or thirum 2g/kg seed is given for controlling collar rot and root rot disease.

Treatment of *rhizobium* culture is done @ 250g/10 kg seed to increase nitrogen fixation.

1.3.8 Crop rotation :

Groundnut is rotated with cotton, jowar, bajra, gram and paddy. It is also rotated with garden crops like potato, chilli, garlic, ginger, onion and turmeric.

1.3.9 Intercropping :

Jowar, bajra and maize are important cereal crops which are grown as intercrop with groundnut. Long durational crops like cotton, pigeon pea and short durational like sesamum, sunflower, green gram etc., are also grown as an intercrop with groundnut.

1.3.10 Varieties :

Erect (Bunchy) : S.B.-11, AK-12-24, Kopargaon No.3, TMV-2, TMV-7, TMV-9, TMV-11, JL-24, ICGS-37, ICGS-44, JL-220, Konkan Gaurav, etc.

Semi spreading : Kopargaon No-1, AK-8-11, TMV-6, TMV-8, TMV-10, ISGS -5 ICGV-86325, etc.

Spreading : Karad 4-11, TMV-1, TMV-3, TMV-4, CSMG-84-1, TAG-24, TAG-303.



Remember this

- In India, research on groundnut improvement was started during 1980-81 through the All India Co-ordinated Research Project on oil seeds.
- Now a days, National Research Centre of Groundnut, Junaghad in Gujarat is co-ordinating the groundnut improvement programme in the country.

1.3.11 Manures and Fertilizers : The doses differ with method of cultivation as follows :

For rainfed crop well decomposed farm yard manure or compost is added @ 10 tones/ha. About 10 kg nitrogen and 20 kg phosphorus per ha. is also added as basal dose.

For irrigated crop F.Y.M or compost is added @ 12.5 tones/ha. About 20 kg nitrogen and 40 kg phosphorus is added per ha. as a basal dose.

1.3.12 Irrigation :

Average water requirement ranges between 450 to 650 mm. For a *kharif* crop there are only one or two occasions during which crop needs irrigation on account of long dry spell. A good summer crop can be grown with 8 to 10 irrigation turns. The most critical stages of growth for irrigation are flowering, pod formation and maturity during which adequate supply of water is a key factor for obtaining good yields.

1.3.13 Intercultivation : In groundnut weed infestation is highest up to 35 days from sowing. The crop is generally given one hand weeding and two hoeings till pegging begins. Herbicides such as fulchloralin, alachlor are effective for weed control.

1.3.14 Plant protection :

I. Pest

a. Aphid :

Nature of damage : Aphid sucks the sap from leaves and other tender plant parts. In case of heavy attack plants become chlorotic and leaves curl.



Fig. 1.22 Aphid

Control measures :

Spraying the crop with phosphamidon is the recommended control measure for aphid.

b. Root grub :

Nature of damage : Grub feeds on rootlet and nodules and destroy entire root leading to death of plant.



Fig. 1.23 Root grub

Control measures :

Seed treatment with chloropyrriphos 20 EC or soil application of carbofuron granules found effective against root grub.

c. Leaf roller :

Nature of damage : The caterpillar rolls the leaves and remains feeding on green tissues.



Fig. 1.24 Leaf roller

Control measures :

Chloropyrifos 20 EC or profenophos 50 EC are effective in controlling leaf roller.

II. Diseases :

a. Leaf spot (Tikka) :

Symptoms : Circular to irregular dark spots surrounded by yellow ring appear on the leaves. In the case of late spot the lower surface of the spots is carbon black in colour.

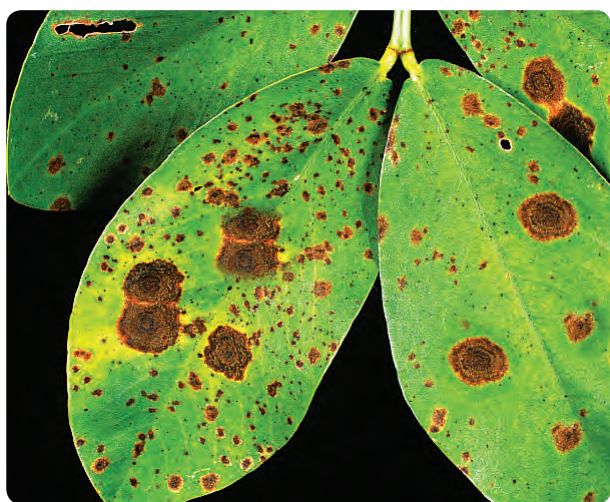


Fig. 1.25 Leaf spot

Control measures :

The control measures include use of resistant varieties, proper crop rotation and dusting the crop with sulphur @ 15 to 25 kg/ha.

b. Collar rot :

Symptoms : Attack of this disease is common in light sandy soils. Attack on seed soon after sowing results into pre-emergence rotting of seed.

The symptoms in emerging seedling are yellowing and drying either of entire seedling or its branches.



Fig. 1.26 Collar rot

Control measures :

The most effective preventive control measures are to grow resistant varieties and to treat the seed with organo-mercurial fungicides like agrosan or mancozeb or thirum @ 2 to 4 g/ kg seed.

c. Root rot :

Symptoms : Symptoms are characterized by reddish brown discolouration of the stem and collapsing of plants.



Fig. 1.27 a Root rot

Control measures :

Proper crop rotation practices and seed treatment with agrosan, thirum or mancozeb, etc. are beneficial in controlling root rot disease.

1.3.15 Harvesting :

The time of harvesting is determined on the basis of the following signs of maturity:

1. Yellowing of top leaves and drying and falling of older leaves.
2. Blackening of inner side of the shell.
3. Hardening of pods.
4. Turning of kernel to its normal size and colour.
5. Crop age- It differs with the types of varieties. The erect, semi spreading and spreading types mature in 100, 120 and 150 days respectively.

After ascertaining the maturity by above criteria, harvesting is done by pulling the vine from the soil with pods in erect and semi spreading varieties. The pods are then separated from vines. In the case of spreading types the harvesting is done by ploughing the field and then searching the pods in the soil. The pods are dried to 10 percent moisture content and stored.



Fig. 1.27 b Groundnut sheller (Hand operated)

1.3.16 Yield :

Under irrigated conditions the average pod yield is about 30 q/ha. Under rainfed conditions the pod yield of erect, semi-spreading and spreading varieties is 8 to 10, 10 to 12 and 15 to 17 q/ha. respectively.



Do you know ?

Groundnut is stored preferably in the form of unshelled pods. Pods are stored mostly in gunny bags and also in earthen pots, mud bins or baskets. Before storage, pods are dried to safe moisture limit (10%) otherwise there may be possibility of development of poisonous moulds. During storage pod should be inspected frequently to see that there is no incidence of any pest and disease.

1.4 SOYBEAN

Botanical Name: *Glycine max*

Origin: Asia (China)

Family: Leguminosae



Fig. 1.28 Soybean crop and grain



Fig. 1.29 Soybean pods

1.4.1 Uses :

Soybean is an important oil seed as well as pulse crop. Average oil content is about 20 percent. It is also rich in protein content 41%. It is used for the manufacture of soaps, paints, plastics, condles, etc. It is used in the form of baked and green beans, flour, candies, cocoa, cooking oil, vegetable milk, etc. It is used as animal feed in the form of hay, pasture, oil,

milk, etc. Being leguminous crop it helps in fixation of atmospheric nitrogen.



Remember this

- Soybean accounts for 50 per cent of oil seed production in the world.
- In India cultivation of soybean on commercial scale was started 1970's onward.

1.4.2 Soil :

Soybean is grown on wide range of soils. In Maharashtra it is usually grown on light to sandy loam soils. In heavy soils crop makes excessive vegetative growth. The soil should be well drained. Optimum range of pH is from 6 to 6.5. Crop is sensitive to water logging particularly during early stages of its growth.

1.4.3 Climate :

Soybean is a tropical crop. However, it is also grown in subtropical and temperate regions. Soybean can thrive low and very high temperature but optimum range of temperature for its growth is 20 to 35° C. It does well in areas receiving an annual rainfall of about 600 to 1000 mm.

1.4.4 Preparatory tillage :

On light to medium type of soil one deep ploughing is given to a depth of 15 to 17 cm and is followed by clod crushing and 2 to 3 harrowings. On heavy soils repeated harrowings only are given to prepare the land for soybean.

1.4.5 Sowing

a. Season and time :

In India soybean is grown as *khari*f and *rabi* crop. *Khari*f crop is sown in the month June to July. When grown as *rabi* crop, it is sown during October to November.

b. Sowing method and spacing :

Soybean is usually drilled but sometimes it may also be dibbled on ridge. The distance between two rows is about 45 to 60 cm and plant to plant distance may be 5 cm. It should be sown to a depth of about 3 to 5 cm.

c. Seed rate:

The seed rate for soybean varies with spacing and test weight. The average seed rate is about 65 to 75 kg/ha.

1.4.6 Seed treatment :



Fig. 1.30 Seed treatment

In order to prevent the attack of fungal diseases, the seed is treated with thirum @ 3g/kg seed or carbendazim 2g/kg seed. Soybean being a leguminous crop, its seed is treated with *rhizobium* culture for increased nitrogen fixation through increased nodulation on roots.

1.4.7 Intercropping :

Soybean is grown as an intercrop with the cereals like jowar, maize and bajra. It is also intercropped with groundnut and pigeon pea.



Fig. 1.31 Intercropping

1.4.8 Varieties :

Brag, Clark, Punjab-1, Soybean no. 4 J.S. 335, D.S. 228 (Phule kalyani), MACS-13, MACS-57, MACS-58 MACS-124, etc. are the important varieties.

1.4.9 Manures and Fertilizers

Well decomposed farm yard manure is added at the rate of 15 cart loads per hectare. In addition to that 20 to 25kg nitrogen and 50 kg phosphorus per hectare are added. Depending on soil test values 20 to 40 kg potash may also be given, if required. Nitrogen, phosphorus and potassium are given as basal doses.

1.4.10 Irrigation :

In Maharashtra soybean is grown as a rainfed *kharif* crop. However, in the case of long dry spell it needs two irrigations, particularly at the stage of flowering and pod formation. The water requirement varies between 450 to 750 mm.



Remember this

- Soybean being leguminous crop is able to fix atmospheric nitrogen through *Rhizobium*.
- Plant starts to fix atmospheric nitrogen about four weeks after sowing.

1.4.11 Intercultivation :

The weed competition is more during first two months after sowing. Normally weed control is done by hoeing or by using herbicides. Under the situation of small land holding two hand weeding are sufficient for controlling weeds. Herbicides such as fluchloralin, alachlor, etc., can be used for weed control.

1.4.12 Crop rotation :

Soybean is rotated with wheat, potato, etc.

1.4.13 Intercropping :

Soybean is intercropped with maize, cotton, jawar, groundnut, bajri, etc.

1.4.14 Plant protection :

I. Pest

Stem borer causes serious damage by tunneling the stem and side branches. It can be controlled by spraying the crop with chloropyrifos 20 EC.

Pod borer is controlled by using chloropyrifos 20 EC.

The other insects-pest which also found to attack soybean are hairy caterpillar, white flies and aphids and should be checked by suitable control measure.

II. Diseases :

a. Bacterial blight :

Symptoms : Reddish-brown spots with yellow margin appear on the leaves and also on pod.



Fig. 1.32 Bacterial blight

Control measure :

Use of resistant varieties and seed treatment with organo-mercurial fungicides like cerasan are the effective control measures.

b. Mosaic :

Symptoms : It is the virus disease causing mottling and curling of leaves. Petioles and internodes are shortened, especially early infection results in to stunted plant growth.



Fig. 1.33 Mosaic

Control measures :

The control measures include spraying the crop with profenophos 50 EC to control vector which spreads virus or using healthy seeds for sowing.

c. Leaf spot :

Symptoms : Reddish brown spots appear on upper surface of the leaves. Spots also appear on all other plant parts except roots. Infestation is severe during November-December months.



Fig. 1.34 Leaf spot

Control measures :

Seed treatment with thirum or carbendazim and spraying the crop with mancozeb, etc., are the recommended control measures for leaf spot.

d. Downy mildew :

Symptoms : Small chlorotic spots which later on become grayish-dark brown appear on upper surface of leaves. Lower side of leaves show whitish downy growth.



Fig. 1.35 Downy mildew

Control measures :

Seed treatment with thirum or carbendazim and growing resistant varieties are the effective control measures.

1.4.15 Harvesting : Soybean matures in 90 to 120 days. It is harvested when leaves turn yellow and start drooping. The pods also turn yellow and dry. Pods when pressed by hand cracks. At harvesting time, the moisture content in the grain should be 15 to 17%. Harvesting is done either by pulling the plants or cutting



Think about it

Whether Integrated Pest and Disease Management is possible in soybean?

them near the ground level. The plants are heaped and dried for 2-3 days. Threshing is done by beating the produce with sticks or by using threshing machines. The produce is then winnowed, dried and stored. Nowadays combined harvester is also used for soybean harvesting.



Remember this

For safe storage of soybean the moisture content in the grain should be brought to 11 percent by drying. Moisture proof gunny bags or seed bins are used for storage. Proper pest and disease control measures should be taken during the period of storage.

1.4.16 Yield :

1. Pure rainfed crop - 10 to 15 q/ha.
2. Mixed crop - 3 to 4 q/ha.
3. Irrigated crop (pure) - 35 to 40 q/ha.



Do you know ?

- 1) Indian Central Oilseeds Committee (ICOC) was established in 1947 to increase oilseed production
- 2) Oilseeds Development Corporation (ODC) replaced ICOC in 1966
- 3) All India Co-ordinated Research Project on Oilseeds(AICRPO) was set up in 1967
- 4) Technology Mission on Oilseed(TMO) was established in 1986

1. 5. GRAM

Synonym: *Harbhara, Chana, Bengal gram, Chick pea*

Botanical Name : *Cicer arietinum*

Family : Leguminosae

Origin : South – West Asia



Fig. 1.36 Gram crop



Fig. 1.37 Gram grain



Try this

Obtain the information of varieties of deshi, kabuli gram suitable under rainfed, irrigated conditions. Point out the difference between the growth characteristics of deshi and kabuli varieties.

1.5.1 Uses : Gram is important *rabi* pulse crop in India. It contains carbohydrates (62%), protein (21%) and vitamins A and E. Tender leaves of young gram crops used as vegetable. It is consumed in the form of splits (*dal*), flour (*besan*), cooked grain, salted or unsalted grain. It is also used for preparation of sweet

product like *puranpoli, laddu, mysorepak*, etc. Malic acid and oxalic acids (*Amb*) collected from green leaves have medicinal value for intestinal disorders. Grains as well as husk are used as horse feed. Germinated grains are recommended to cure scurvy disease.

1.5.2 Soil : Gram is fertility restorative crop. It is grown on variety of soil ranging from light to heavy black, mixed red, alluvial soil with well drained condition. Sandy loam to clay loam is most suitable soil. Optimum range of pH is 6 to 7.5. Water logging, saline and alkaline conditions are harmful.

1.5.3 Climate : It is grown in cool and dry climate. It is best grown in areas receiving low to moderate rainfall (400 - 700 mm) and mild cold climate. The average temperature required is from 25^o to 30^oC. If temperature goes below 5^oC and above 30^oC it affects pod setting and seed development. Excessive rainfall after sowing or at flowering and severe cold cause great harm. Cloudy weather and frost conditions during flowering reduce flowering and seed settings.

1.5.4 Preparatory tillage : Gram is a hardy crop. It can be grown on clodded or rough seed bed. One deep ploughing is given after harvest of *Kharif* crop by iron plough. One to two harrowings are given to prepare seed bed. For moisture conservation planking is done.

1.5.5 Sowing

a. Season and Time : It is usually grown in *rabi* season. The optimum time of sowing is from 15th October to 15th November.

b. Sowing method and Spacing : Gram is sown by drilling, dibbling or plough furrow method. Generally sown by drilling method. Sowing in plough furrow behind *deshi* plough is practiced if there is inadequate moisture in the soil. Optimum row spacing for different varieties is as follows :

Deshi type : 30 × 10 cm

Kabuli Type : 45 × 10 cm

c. Seed rate :

1. Deshi (varieties) : 65 to 70 kg / ha.
2. kabuli varieties : 80 to 90 kg / ha.

1.5.6 Seed treatment : Seed is treated with carbendazim (bavistin) or thirum + bavistin @ 2 to 3 g / kg seed to control wilt disease. Gram seed is also treated with rhizobium culture just before sowing @ 250 g / 10 kg seeds for efficient nitrogen fixation through increased nodulation on roots.



Think about it

Why seed of leguminous crop is treated with *rhizobium* culture?

1.5.7 Varieties : N-31, N-59, Chafa, Warangal, Vijay, Vikas (Phule G-1), Vishvas (Phule G-5), Digvijay, BDN – 9 – 3.

Kabuli Types: Virat, Vihar, PKV kabuli – 2, Sadabahar, Sweta (ICCV-2).

1.5.8 Manures and Fertilizers : 12 – 15 cart loads FYM or compost per ha. is mixed in soil at the time of land preparation. The dose of nutrients for rainfed crop is 10 : 40 : 20 NPK kg / ha. and for irrigated crop is 20 : 60 : 40 NPK kg / ha.

1.5.9 Irrigation : Generally gram crop is grown as rainfed crop on residual soil moisture. Depending upon the soil type, the water requirement is 300 to 400 mm. If irrigation facility is available it is given at sowing, branching, flowering and pod filling time for light soils. Pod formation is the most critical stage for irrigation.

1.5.10 Intercultivation : First 4 to 5 weeks are critical from weed control point of view. Use of pre emergence herbicides followed by one hand weeding and one hoeing at 15 days interval is found to be effective for controlling weeds. Herbicides used are bentazon, pendimethalin etc.

1.5.11 Nipping : Nipping in gram is also called as topping. Tips are nipped off or tips of the young branches are removed is called as topping. It is done when the crop is at grand growth stage or 10 - 15 cm height or 3 - 4 weeks after sowing. It increases number of branches per plant. young shoots are used for vegetable purpose.



Internet my friend

Collect information about *dal* mills used in Maharashtra.

1.5.12 Collection of malic acid (*Amb*) : When plants are 40-60 days old the leaves secrete acid i. e., malic acid and oxalic acid locally known as '*Amb*'. These acids dissolve in dew which accumulates on leaf tips. These acids can be collected by running a cotton cloth on the crop, early in the morning and squeezing it in bucket. It contains 90-95% malic acid and 5-10% oxalic acid. These acids believe to have medicinal value against intestinal disorders. Near about 5-7 lit. of malic acid can be collected from 1 ha. area of gram.

1.5.13 Crop rotation and Intercropping : cereal crops, vegetables in *kharif* are followed by gram in *rabi* season. Gram is mostly grown as sole or pure crop. It is grown as inter crop with wheat, *rabi* jowar, safflower, linseed, mustard, sugarcane, etc.

1.5.14 Plant Protection :

I. Pest

a. Gram pod borer

Nature of damage Initially larvae bores into the buds and flowers results in shedding of buds, flowers. After formation of pods it bores into them and feed on developing seeds.



Fig. 1.38 Gram pod borer

Control measures :

Recommended control measures are deep ploughing, use of light or pheromone traps and dusting the crop with malathion 5 % or carbaryl 5 % or phosalone 4 % @20 - 25 kg / ha. Spraying of chloropyriphos 2 ml / lit. or cypermethrin, neemseed kernel extract 5 % or NPV is also practiced.

b. Cut Worm :

Nature of damages : Caterpillar remain hidden during day time and cuts the plant or its branches during night hours.



Fig. 1.39 Cut worm

Control measures :

Prophenophos 50 EC or dichlorovas 70 EC are effectively used against this pest.

II. Diseases :

Wilt

Symptoms It is a fungal disease. It attacks root system, results in decomposition of roots, stunted growth with pale yellow leaves, dropping of leaves. The affected plants, uprooted easily and later on withers and dies.



Fig. 1.40 Wilt

Control measures : Follow clean cultivation, crop rotation, grow disease resistant varieties. Treat the seed with thirum or captan or bavistin @ 2 - 3 g/ kg or *trichoderma* @ 6 g + 1 g vitavax / kg spray copper sulphate or bordeaux mixture.



Remember this

Pulse crops belong to the family leguminosae. The term pulse is an alternative term used for edible seed of leguminous crop. It is derived from latin word *puls* meaning thick soup. Split cotyledons of dry legume seed is boiled in water , softened, macerated and used as soup. Pulses are useful both as food and fodder besides as green manure crops.

1.5.15 Harvesting : Crop matures in about $3\frac{1}{2}$ - 4 months after sowing. At maturity leaves turn yellow and the plant dry. Harvesting is done by cutting the plants close to the ground with sickle or by pulling the plants. Plants are dried for one week under sun heat. Threshing is done by trampling under the feet of bullocks or by beating with long sticks or by threshing machine. The seed is cleaned by winnowing and stored in gunny bags, godowns or in the form of splits.

1.5.16 Yield :

Rainfed crop : 5 - 6 q/ha.

Irrigated crop : 10 - 12 q/ha.

The proportion of grain to chaff is 1 : 1.75 or 1 : 2 by weight.



Do you know ?

The success of gram and other leguminous crops in nitrogen deficient soils is due to presence of nodules on its roots. These nodules contain *Rhizobium* bacteria, which fixes atmospheric nitrogen into the soil .The nodulation and nitrogen fixation depends on different factors such as temperature, proportion of Na, Ca, Mo, Mn, etc.The nodulation can be increased by inoculation of seed with specific *Rhizobium* culture.



Exercise



Q.1 Answer the following questions.

A. Select the appropriate alternative and complete the following statements.

- Botanical name of gram is
 - Triticum* species
 - Arachis hypogaea*
 - Cicer arietinum*
 - Oryza sativa*
- Tikka is the important disease of crop.
 - Paddy
 - Gram
 - Wheat
 - Groundnut
- Indrayani is the variety ofcrop.
 - Paddy
 - Groundnut
 - Soybean
 - Wheat
- Gram leaves contains..... acid.
 - HCN
 - Carbonic
 - acetic
 - malic
- Gall fly is the important pest of crop.
 - Wheat
 - Cotton
 - Paddy
 - Groundnut

B. Make the pairs.

Group A

- Wheat
- Groundnut
- Soyabean

Group B

- Arachis hypogaea*
- Cicer arietinum*
- Oryza sativa*
- Triticum aestivum*
- Glycine max*

C. Find the odd one out.

- Chafa / Kalyansona / Brag / Gluten
- Pod borer / Tikka / Gall fly / Stem borer
- Termites / Wilt / Rust / Mosaic
- Groundnut / Wheat / Paddy

D. Write True or false.

- Oil content in groundnut seed varies from 45 – 55 %.
- Sonalika is the important variety of paddy crop.
- Soybean contain about 41 % protein and 20 % oil.
- Gram is most important kharif crop in India.
- Wheat has a good bread making quality among all cereals.

Q.2 Answer in brief.

- Write short notes on collection of acid (*amb*) in gram
- Name any four varieties of rice.
- Write in brief about tikka disease of groundnut .
- Write intensive method of paddy cultivation.
- How nipping / topping is carried out in gram?

Q.3 Answer the following questions.

- Give information on seed selection and seed treatment in paddy.
- Write the uses of paddy
- Write about seed rate and seed treatment in soybean.
- Write in short about dapog nursery.
- Complete the following chart :

Sr. no	Crops	Botanical name	Variety	Seed rate kg/ha.
1	Paddy	.....	.....	.....
2	Wheat	<i>Triticum</i> species	.....	100 - 125
3	Gram	.....	Chafa	.....



Q.4 Answer the following questions.

1. Write information about wet nursery in paddy.
2. List out the diseases of soybean.
3. How groundnut is harvested?
4. Write the uses of wheat.
5. Write the symptoms and control measures of paddy blast.

Q.5 Answer the following questions in detail.

1. Describe the wheat crop on following points :
 - a. Soil
 - b. Sowing methods
 - c. Harvesting
2. Complete the following table.

Sr. No.	Crops	Botanical name	Seed rate kg/ha.	Varieties
1	Gram	.....	.....	.....
2	Ground nut	.....	.....	.....
3	Paddy	.....	.....	.....
4	Wheat	.....	.....	.....

Q. 6 Answer the following questions in detail.

1. Provide the information of groundnut crop on following aspects
 - a. Climate
 - b. Preparatory tillage
 - c. List of varieties
 - d. List of pest.
2. Give information on following points regarding cultivation of Paddy crop :
 - a. List of varieties
 - b. manuring
 - c. Economic uses
 - d. List of diseases

**Activity**

Complete the following table with information from your surrounding.

Sr. No.	Crop plants	Varieties	Sowing Method	Season	Pest and disease
1	Wheat				
2	Paddy				
3	Groundnut				
4	Soybean				
5	Gram				