Practical Manual B. Sc. (Hons.) Agriculture

Crop Production Technology–I (*Kharif crops*)

Course Code: BSAC 301

Course Credits: 2(1-0-1)

Semester/ Year: III/ II

Complied By

Ms. Shagun Gupta

Assistant Professor

Department of Agronomy

School of Agricultural Sciences

SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

Contents

Exercise No.	PARTICULARS	Page No.
1.	Rice nursery preparation.	
2.	Transplanting of rice.	
3.	Sowing of soybean, pigeon pea and mungbean.	
4.	Sowing of maize, groundnut and cotton.	
5.	Effect of seed size on germination andseedling vigour .	
6.	Identification of weeds in kharif seasoncrops.	
7.	Top dressing and foliar feeding ofnutrients.	
8.	Study of yield contributing characters andyield calculation of kharif season crops.	
9.	Study of crop varieties and agronomicexperiments at experimental farm.	
10.	Morphological description of Kharif seasoncrops (rice).	

EXPERIMENT No.1

AIM: To study about

MATERIALS REQUIRED:

1. Fertile, well drained upland field
2. Seeds(presoaked overnight)
3. Rose can
4. Fertilizers(Urea, DAP, MOP)

THEORY:

Wet Bed Method :

Wet nurseries are preferred under irrigated condition.The soil is puddled by two to three runs of puddler or three to four ploughings with local plough. After one or two days of puddling, divide the nursery area into narrow beds of 1.25 metre width and of any convenient length depending upon the slope. This facilitates sowing, weeding, spraying of chemicals and irri-gation operations. Construct the drainage channels 30 centimetre wide in between the seed beds. Apply 225 g urea or 500 g ammonium sulphate and 500 g single super phosphate per 10 square metre. Uniformly broad-cast about two to three handfuls of seed on a square metre of seed bed. Keep the seed beds saturated with water for first five days and then in-crease gradually the level of water up to 5 centimetre as the seedlings grow. Drain the excess water in periods of heavy rains during the first week of sowing. Adopt suitable disease and pest control measures. An application of 50 g of urea per square metre may be made by top dressing in case of nitrogen deficiency symptoms.

Dry Bed Method :

This method is practised in areas where water is not sufficient to grow seedlings in wet nurseries. Plough the field three to four times till the soil is thoroughly pulverised. Prepare beds of the same size as in wet nurseries but 15 centimetre high with channels (30 centimetre wide) between them. Sow the seed in rows 10 centimetre apart in dry or moist condition of soil. Use the same seed rate and fertiliser as in wet nurseries. The sown seeds should be covered immediately with a layer of soil. Special care should be taken for water management in these beds.

Dapog Method :

This method of raising nursery has been introduced from Philippines. It has been adopted by some farmers in Andhra Pradesh raising seedlings. It saves almost half of the time in seedling raising. Th main merit of this method is that less area is needed to raise seedling. Twenty-five to 30 square metres of area is enough to raise seedlings sufficient for planting one hectare. The seedlings are raised faster in the method. In this method, beds could be prepared on an even but slightly raised (4 to 5 centimetre) surface in an open field or on even cement floor. About one

square metre of seed bed should be required for every three kilograms of seed.Cover the soil surface of the seed bed evenly and completely with banana leaves with the protruding midribs removed or preferably with plastic sheets. Carefully lay strips of banana bracts along the edge of the seed bed. Push thin bamboo pegs through the bracts into the soil to keep bracts upright and firm.

PROCEDURE:

Steps followed during raising of seedlings in nursery :

1. Select a fertile, well drained upland field near the source of irrigation.
2. For transplanting one hectare area about 500 square metre nursery should be sufficient for nursery raising.
3. In case of late sowing area can be increased to 750-1000 square metres.
4. Seed should always be true to the variety, healthy, viable, clean and of high germination percentage (80 pe cent or more).
5. Rice seeds required to raise seedlings should be soaked in water am pregerminated. Seeds that are germinated before sowing will start to grow quickly in the field or seedbed.

Signature of Faculty In-charge

EXPERIMENT No.2

AIM: To study about transplanting method in rice cultivation.

MATERIALS REQUIRED:

1. Healthy seedlings of rice (raised from wet nursery)
2. Healthy seedlings of rice (raised from mat nursery)
3. Labour: Men:2,Women: 4
4. A pegged rope(with 20 cm row spacing)
5. Mechanical Rice transplanter

THEORY:

Transplanting: Transplanting is the process of moving a fully germinated seedling (or mature plant) and replanting it in a permanent location for the growing season. Transplanting can be done conventionally as well as mechanically:

1. Conventional Transplanting

Conventional transplanting is the most common practice of rice cultivation in South and South East Asia which is practised in areas where there is fertile soil, abundant rainfall and plentiful supply of labour. Also much of the success in this system depends on the seedlings. If nursery is good and the seedlings are robust and healthy then one can hopefully look for a bumper crop. Twenty one days old 2-3 seedlings/hillare transplanted manually in the puddled field at a depth of 2-3 cm with a spacing of (20 cm × 15 cm). The entire process is done by hand and therefore, it is time consuming, laborious, causes drudgery to labours and also results in high cost of production, however give uniform and adequate plant stand.

2. Mechanical Transplanting

When rice is established by transplanting the seedlingsusing self propelled transplanter, it is called mechanical transplanting. In the present investigation, seedlings were raised on mat type nursery and 4-5 seedlings/hill (15 days old) are transplanted at a depth of 2-3 cm with (25 cm × 15 cm) spacingin the main fieldby using CRRI manually operated 4 row rice transplanter. The field is prepared and puddled in the same manner as in conventional transplanting.

PROCEDURE:

The following steps are followed in transplanting:

1. Uproot the seedlings (21 days old in Conventional and 15 days old in mechanical transplanting).
2. Carry the seedlings for transplanting in main field.
3. The seedlings are transplanted manually in the puddled field at a depth of 2-3 cm with a spacing of (20 cm × 15 cm in Conventional transplanting).
4. In mechanical transplanting 4-5 seedlings/hill (15 days old) are transplanted at a depth of 2-3 cm with (25 cm × 15 cm) spacingin the main field by using CRRI manually operated 4 row rice transplanter.

a. Conventional transplanting

Signature of Faculty In-charge

EXPERIMENT No.03

AIM: To studySowing of soybean, pigeon pea and mung bean

MATERIALS REQUIRED:

1. Seeds of soybean**,** pigeon pea and mung bean
2. Fresh rhizobium culture
3. Fungicide: Thiram + Bavistin (1:1 @ 3g/kg of seeds)
4. Seed rate for: Soybean**=** 70-80 kg/ha
   Pigeon pea= 12-15 kg/ha
   Mung bean= 12-15 kg/ha

Procedure:

A. Sowing of soybean

1. To reduce the fungal attack the seed should be treated prior to sowing with fungicides like Thiram at the rate of 4.5 g per kg of seed or with a mixture of Thiram Bavistin 1:1 at the rate of 3 g/kg of seed.
2. Rhizobium culture' is used at the rate of 0.5 kg per 70 kg seed. Moist the seed with water and mix the culture uniformly in shade just before sowing. Always use fresh Rhizobium culture.
3. Soybean is planted from third week of June to first fortnight of July. But July seems to be the best. June planting.requires irrigation before sowing and also June planting takes longer period to mature and very much susceptible to yellow mosaic virus.
4. The sowing should be done in lines 45 to 60 centimetre apart with the help of seed drill or behind the plough. Plant to plant distance should be 4-5 centimetre. The depth of sowing should not be more than 3-4 centimeter.
5. If seed is of 80 per cent germination, 70-80 kg seed per hectare is required. For late planting and for spring crop, seed rate should be 100-120 kg per hectare.

B. Sowing of pigeon pea

1. Treat the seed with Carbendazim (Bavistin) or Thiram at the rate of 3 g per kg of seed before sowing.

2. Pigeon pea should be sown in the first fortnight of June with pre-sowing irrigation, so that the succeeding crop can be sown with the least delay. Late sown crop is more likely to be damaged by frost in northern parts of the country.

3. Early sowing helps in taking a good wheat crop after pigeon pea. Under rainfed conditions sowing could be done with the onset of monsoon in the later part of June or early July.

4. Seed should be own behind the plough or with the help of seed drill at a row spacing of 60-75 centimetre keeping 15-20 centimetre distance from plant to plant.

5. A seed rate of 12-15 kg per hectare is sufficient. In mixed cropping seed rate is adjusted according to the proportion of arhar and companion crops to be grown. In the intercropping seed rate remains same as for pure crop.

C. Sowing of mung bean

1. Before sowing seed should be treated with Thiram or Carbendazim(Bavistin) at the rate of 2.5 g per kg of seed. It is also desirable to treat the seed withsuitable Rhizobium culture as well, if the crop is being taken in the field for the first time or after a long period.

2. In Kharif season, sowing is done with the onset of or, in the second fortnight of June to first fortnight of July. Rabi Moong is sown in Rabi season too in October-November. SummerMoong is grown in summer season too under irrigated conditions. It is sown after the harvest of sugarcane, wheat, potato etc. Sowing is done in the middle of March to middle of April.

4. Seeds of soybean 12-15 kg per hectare should be sown in rows 45 centimetre apart while during Rabi and summer seasons 200 seed per hectare should be sown in rows 30 centimetre apart.

5. Sowing can be done behind the local plough or with the help of seed drill.

Signature of Faculty In-charge

EXPERIMENT No.04

AIM: To study Sowing of maize, groundnut and cotton

MATERIALS REQUIRED:

1. Seeds of maize, groundnut and cotton
2. Fresh rhizobium culture
3. Conc. Sulphuric acid
5. Fungicide: Thiram , Bavistin or Captan (3g or 5 g/kg of seeds)
6. Seed rate for:Maize**:** Hybrid: 20-25 kg/ha
   Composite- 18-20
   Groundnut = 80-100 kg/haCotton:
   American cotton:15-25 kg/ha

Desi cotton: 10-18 kg/ha

7. Solution for treating cotton seed: 5 g Emisan, 1 g streptocycline, 1 g succinic acid in 10 litres of water.

PROCEDURE:

A. Sowing of Maize

1. Seed should be treated-with Bavistin or Derosal or Agrozim at the rate of 3gikg of seed.

2.One seed should be planted at every 20-25 centimetre in rows 60 centimetre apart. Sow the seed 3-5 centimetre deep.

3. Ten to twenty per cent more seeds than the desired plant population would be normally required to compensate for various field losses.

4. Seed rate: Hybrids :20-25 kg per

hectareComposites :18-20 kg per hectare

B. Sowing of Groundnut

1. Treat the selected kernels with 5 g of Thiram or Captan per g of kernels so as to check various seed and soil borne diseases,

2. Seed are inoculated with proper strain of Rhizobium culture particularly in those places where groundnut is to be grown for the first time.

3. Sow the crop with the advent of monsoon in the last week of June or in the first week of

July. Complete the sowing as early as possible as delayed sowing causes progressive reduction in the yield.

4. Where irrigation facilities are available, sow groundnut around 20th June or 10-12 days before the onset of monsoon with a pre-sowing irrigation.

5. Sowing of rabi crops In southern part of the country where groundnut is sown in Rabi season also, should be sown in the month 01 November and December

6. In bunch types, the row to row distance is kept 30-40 cm and in spreads ing types 45i-60 centimetre. For this, 80-100 kg of seeds per hectare would be enough for bunch types and 60a80 kg for spreading types.

7. Plant to plant distance would be 15 and 20 centimetre for bunch and spreading types respectively.

C. Sowing of Cotton

1. Seed should be treated before sowing. Soak the seed thoroughly for 2 hours in the solution of 5 g Emisan, 1 g streptocycline, 1 g succinic acid in 10 litres of water at the rate of 6-8 kg delinted seed.
2. A seed rate of 15 to 25 kg per hectare in case of American cottons and 10-18 kg per hectare in case of desicottons is recommended.
3. A spacing of 60 centimetre between rows and 45 centi-metre between plants for American cottons and a spacing of 60 centime-tre between rows and 30 centimetre between plants for local cottons is desirable. There is wide spacing in case of hybrid cottons in all the regions.
4. The plant population should be between 50,000 to 80,000 plants per hectare.

Signature of Faculty In-charge

EXPERIMENT No. 05

AIM: - To study effect of seed size on seed germination and seedling vigour.

THEORY: -

1. Seed size is an important physical indicator of seed quality that affects vegetation growth andyield.
2. Genetic variation is the cause for variation in seed between varieties.
3. Based on the size of the seeds,they are classified as very large, large, medium, small and verysmall.
4. Generally, seed germination is controlled by many internal and external factors. Seed size is oneof them. It influences the germination, growth and biomass of the seeding.
5. Generally, bigger seed germinates quicker and would take lesser time when compared to that ofsmaller.
6. Sowing of mixed seed of a species may result in non-uniform density of seedlings which maylead to heterogeneity in the vigour and size of the seedlings.
7. Many studies have seen that bigger sized seeds recorded quick and highest seed germination(79%); followed by medium (59%) and small (22%).
8. Higher and quicker germination in bigger sized seeds could be due to presence of higher amountof carbohydrates and other nutrients than in medium and small sized seeds.
9. Besides germination and seedling vigour, bigger sized seed showed significantly higher seedlingheight, root length as compared to medium and smaller seeds.
10. So, it is suggested to use higher seeds to get higher and quicker seed germination and earlyseedling growth.
11. Experiments were conducted on:-
    a) *M. Suriga (tree spp.)*
    b) *Pongamia pinnata*
    c) *Vateria indica*
12. The influence of seed size or seed germination and seedlings vigour was higher in *M. suriga*.

Table 5.1. Effect of seed size on seed germination and seedling vigour

Seed size	Seed germination(%)	Seedling height(cm)	Root length(cm)
Big	**79**	**12.4**	**9.06**
Medium	**59**	**10.3**	**7.56**
Small	**22**	**7.1**	**5.36**

Signature of Faculty In-charge

EXPERIMENT No.06

AIM: To study identification of weeds in kharif season crops

MATERIALS REQUIRED:

1. Specimen of kharif weeds from crop field

THEORY:

Kharif Annuals / Kharif Weeds:

They appear with the onset of monsoon (June, July) and complete their life cycle when rainy season is over (Oct or Nov) E.g Cock's comb, dudhi, math, chimanchara , parthenium etc.

1. ***Echinochloa colona***
   Common name : Junglerice
   Family: Poaceae (Graminae) - Grass Family

   a. *E. colona* is a cosmopolitan weed common in crops (mainly rice, maize and vegetables), gardens, roadsides, disturbed sites, waste areas and pastures.
   b. It also grows along waterways, on the margins of lakes and ponds, in swamps and wetlands, and in other damp habitats. It has the potential to invade natural areas and completely outcompete native vegetation.

Echinochloa colona

2. ***Echinochloa crusgalli***

Common name : Common barnyardgrass
Family: Poaceae (Graminae) - Grass Family

a. *Echinochloa crusgalli* is the most widespread weed of rice throughout South and Southeast Asia.

b. It is an annual grass, robust and tufted, erect or decumbent, often rooting and branching at nodes, near the base of the plant.
c. It can grow up to 1 m high. The whole of the plant is glabrous and green slightly bluish. The leaves 1.5cm wide has frequently their margin slightly wavy.
d. The inflorescences erect spread out over the last leaves, there are green or purpled-tinged having 5 to 50cm long. The absence of ligule and the numerous inflorescences that are spreading, ascending, or branched are distinguishing characteristics of *E. crusgalli*.

Echinochloa crusgalli

3. ***Setaria glauca***
Common Name: yellow foxtail, golden foxtail, wild millet
Family Name: Poaceae (Graminae) - Grass Family

a. It is an annual weed, reproducing by seed

b. Culms are upright, usually flat, hairless, tiller to form clump, frequently with red base

c. Leaves blades are flat, sometimes "v"-shaped, frequently twisted, conspicuous midrib, long fine hairs above at base, rolled in bud; auricles absent; ligule fringe of hairs; sheaths open and overlapped, hairless, flattened.

d. Panicles are cylindrical, dense, upright; spikelet with 5 or more bristles, bristle turn yellow when mature.

Setaria glauca

4. *Cyperus rotundus* L.

Common Name: Purple nutsedge
Habitats: Roadsides, sandy fields and cultivated ground.
Family: Cyperaceae

a. *Cyperus rotundus* is a perennial growing to 0.6 m (2ft) by 1 m (3ft 3in).
b. It is in flower from Mar to July.
c. The flowers are hermaphrodite (have both male and female organs)Suitable for: light (sandy) and medium (loamy) soils.
d. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers moist or wet soil.
e. Nut Grass is used to treat digestive disorders, menstrual irregularity and nausea. It also promotes liver detoxification and healing.

Cyperus rotundus

5. *Commelina benghalensis*

Common Name: **wandering jew**

Family: Commelinaceae

a. *C. benghalensis* belongs to a family with 500-600 species with distinct characteristics.

b. It has creeping stems which assume an ascending position, are 15-40 cm long, branched and rooting at the nodes.

c. The leaves are ovate or elliptical, acuminate, 3-7 cm long, 1-2.5 cm wide with a base narrowed into a petiole. The flowers are subtended by bracts with their edges fused to a length of about 10 mm to form a flattened funnel-shaped , 1.5 cm long and wide.

d. Flowers have three lilac blue petals 3-4 mm long, the lower rather smaller than the two laterals and occasionally white.

e. The fruit consists of a pear-shaped capsule with five seeds and the capsule open when mature(dehiscent).

f. Seeds which sometimes appear sugar-coated are 2 mm long, ribbed-rough and greyish brown in colour.

g. *C. benghalensis* produces white underground rhizomes with reduced leaves and closed modified flowers which produce subterranean seeds. These seeds are fewer but remain viable longer than the aerial ones.

h. The species is distinguished from others by the blue flowers, the short flower stalk .

i. *C. benghalensis* is a weed of the tropics and subtropics.

Commelina benghalensis

Signature of Faculty In-charge

EXPERIMENT No. 07

AIM: - To study top dressing and foliar feeding of nutrient.

MATERIAL REQUIRED: -
Fertilizers, sprayers.

THEORY: -

Top Dressing

1. Spreading or broadcasting of fertilizers in the standing crop (after emergence of crop) is known as top dressing.
2. Generally NO_3-N fertilizers are top dressed to the closely spaced crops like wheat, paddy. Eg: Sodium Nitrate, Ammonium Nitrate and Urea, so as to supply N in readily available form to the growing plants.
3. The term side dressing refers to the fertilizers placed beside the row of the crop (widely spaced) like maize of cotton.

PRECAUTION: -

1. Care must be taken in top dressing that the fertilizers is not applied when the leaves are wet as it may burn or scratch the leaves.

Foliar Feeding

1. Foliar feeding is an effective method for correcting soil deficiencies and overcoming the soil's inability to transfer nutrients to the plant under low moisture conditions.
2. Foliar Fertilization is the most efficient way to increase yield and plant health. Tests have shown that foliar feeding can increases yields from 12% to 25% when compared to conventional fertilization.
3. When fertilizers are foliar applied, more that 90% of the fertilizer is utilized by the plant. When a similar amount is applied to the soil, only 10 percent of it is utilized. In the sandy loam, foliar applied fertilizers are up to 20 times more effective when compared to soil applied fertilizers.

The effectiveness of foliar applied nutrients is determined by

(1) The condition of the leaf surface, in particular the waxy cuticle. The cuticle is only partially permeable to water and dissolved nutrients and, as a result, it can limit nutrient uptake.

(2) The length of time the nutrient remains dissolved in the solution on the leaf's surface.

(3) Diffusion, the movement of elements from a high concentration to a low concentration. For diffusion to occur, the nutrient must dissolve, and

(4) The type of formulation. Water-soluble formulations generally work better for foliar applications as they are more easily absorbed when compared to insoluble solutions.

PRECAUTIONs:

1. Use a sprayer that produces a fine mist.
2. Nozzles should be turned to the back of the sprayers so the flow of material approaches the plant at a 90 degree angle to float on the plants

Signature of Faculty In-charge

EXPERIMENT No.08

AIM: To study the yield contributing characters and yield estimation.

Post- harvest studies

A. Yield attributing characters

1 Number of Panicles m^{-2}

Procedure:

Two randomly selected spots, previously used for counting the number of total tillers were also used for counting panicles/m^2 by running 1 m row length in randomly selected two spots of transplanted and drum seeded rice while 50 cm^2 quadrate in case of broadcasted crop. Then the values were converted to per m^2.

2. Panicle length(cm)

Procedure:

The length of ten randomly selected panicles from each plot at maturity were measured in cm by using metre scale from neck-node to the tip of the apical grains and were averaged for recording mean panicle length.

3. Number of total grains/panicle

Procedure:

Ten panicles selected for measuring the panicle length were used for knowing the total number of grains per panicle. Total number of filled grains were also counted.

4.Number of filled grains /panicle

Procedure:

The grains from ten randomly selected panicles were separated and cleaned. Sound and bold grains were counted and averaged for recording mean filled grains/ panicle.

5 .1000 grain weight

Procedure:

One thousand cleaned dried seeds were counted randomly from the yield of each plot and weighed by using a digital electronic balance to determine the test weight.

B. Yield Estimation

1. Grain yield

Procedure:

Each plot was marked for net plot size to remove the border effect, the net plot was harvested, threshed and cleaned. After complete sun drying the grain weight of each net plot was measured on physical top balance and converted to quintals per hectare. The results were expressed on 14 % moisture basis.

2.Straw yield

Procedure:

After threshing, the cleaned grain yield was deducted from the bundle weight for obtaining straw yield of each net plot area and converted to quintals per hectare.

3.Harvest index (HI)

Procedure:

Harvest index for each plot was calculated from the economic yield and biological yield by using expression as suggested by Singh and Stoskoph (1971).The economic yield indicates grain yield whereas, the biological yield represents the total yield (grain + straw) of the plot.

Harvest index (HI) was calculated by the following formula:

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (grain + straw) (kg/ha)}} \times 100$$

Signature of Faculty In-charge

EXPERIMENT No.09

AIM: To study of crop varieties (Pigeon pea) and agronomic experiments at experimental farm.

THEORY:

1. **Pusa-855 :** Plants of Pusa-855 are medium tall (190 cm) and semi-spreading having indeterminate branching. The variety matures in 140-150 days. Seeds are brown, round and bold (9.3 g/1000 seeds). Being bold seeded, the recovery of Dal is better, besides better cooking quality. The variety has been found moderately resistant to diseases like sterility mosaic virus, phytophthora stem blight and wilt. Yield potential is 22-25 quintals per hectare.
2. **Amar:** This variety matures in 260-270 days. It is suitable for growing in whole Uttar Pradesh. This variety is resistant to sterility mosaic and wilt diseases. Yield potential is 25-30 quintals per hectare.
3. **Narendra Arhar-1:** This variety matures in 260-270 days. It is suitable for growing in Uttar Pradesh. This variety is resistant to wilt and sterility mosaic diseases. Yield potential is 25-30 quintals per hectare.
4. **Azad:** This variety matures in 260-270 days. It is also suitable to grow in Uttar Pradesh. The variety is resistant to sterility mosaic and wilt diseases. Yield potential is 25-30 quintals per hectare.
5. **ICPL-151:** This variety matures in 260-270 days. It is suitable for growing in plains of Uttar Pradesh. Wheat can be planted timely in the same field after harvest of this variety. Yield potential is 18-20 quintals per hectare.

Agronomic experiments at experimental farm:

1. Effect of rice residue management on growth, yield attributes and yield of grain and straw of wheat and soil health.

The experiment was conducted in rice-wheat sequence during 2007-08 and 2008-09 in Birsa Agricultural University Farm, Kanke, Ranchi to assess the effect of rice residue management on growth, yield attributes and yield of grain and straw of wheat and soil health. The trial was laid out in randomized block design with three replications having nine treatment combinations. The various rice residue and nitrogen management systems significantly affect the plant height and number effective spike m^{-2}, number of grain ear $head^{-1}$ were maximum with rice residue incorporation or rice residue retention 25% additional N+recommended NPK over sowing of wheat without incorporation of rice residue and recommended NPK and rice residue incorporation+recommended NPK at wheat sowing during both the years. Among the yield attributes and yield viz. number of effective tillers m-2, length of ear head, and number of grains ear $head^{-1}$, grain and straw yield were also recorded maximum with the same treatment. Nitrogen uptake by grain

and straw influenced significantly by rice residue and nutrient management practices during both the years. Highest nitrogen uptake by grain and straw was recorded under the treatment when rice residue incorporated with 25% additional N+recommended NPK against sowing of wheat without incorporation of rice residue+recommended NPK and rice residueincorporation+recommended NPK.

Signature of Faculty In-charge

EXPERIMENT No.10

AIM: To study morphological description of Kharif season crop(rice).

MATERIALS REQUIRED:

1. Specimen of rice crop (at vegetative and reproductive stage)

BOTANICAL DESCRIPTION

The rice plant (*Oryza sativa* L.) is a member of Gramineae family. The common cultivated rice plant is an annual which usually grows to a height of half a metre to two metres but there are certain varieties that grow much taller (6-9 metres). Some deep water rice varieties grow with the gradual rise of the flood water level. Rice plant can be divided into two main parts namely root system and shoot system.

Root System

When a rice grain germinates in a well drained, upland soil the sheath (coleorhiza) emerges. If it germinates in submerged low lands, the coleoptile emerges ahead of the coleorhiza. The primary, embryonic root (radicle) comes out through the coleorhiza shortly after it appears. This is followed by two or more secondary roots, all of which develop lateral roots. The embryonic roots later die and are replaced by secondary adventitious roots produced from the underground nodes of the culm .

Shoot System

Collectively applies to all plant parts visible above the ground level. It is mainly composed of calms, leaves and inflorescence (panicle).

CULM : The culm or stem is made up of a series of nodes and internodes. The rice calms are usually hollow except at the nodes. Each node bears a leaf and a bud. Under favourable conditions buds near ground level grow into tillers. The primary tillers give rise to secondary tillers which give rise to tertiary tillers.

LEAVES: The leaves of rice are sessile in nature. They are borne at an angle, on culm in two ranks along the stem, one at each node. The leaf blade is attached to the node by leaf sheath. The rice leaf is similar to that of wheat, but is usually distinguished from it by the length of the ligule. In the rice, ligule is very prominent, usually more than one centimetre. The leaf number is more on a primary tiller than on the secondary and tertiary tillers.

PANICLE : The rice inflorescence known as panicle is a group of spikelets borne on the uppermost node of the culm. The primary panicle branch is divided into secondary and sometimes tertiary branches. These bear the spikelets.

SPIKELET:

The individual spikelet consist of found two outer glumes. All the parts found above the 'outer glumes' are collectively called floret. It consists of a hard covering the two sections of which are known as lemma and palea (the glumes) and the complete flower is between them. The lemma and palea together are known as the "hull". The rice flower contains six functioning stamens(male organ) and a pistil (female organ). At the base of the flower are two transparent structures

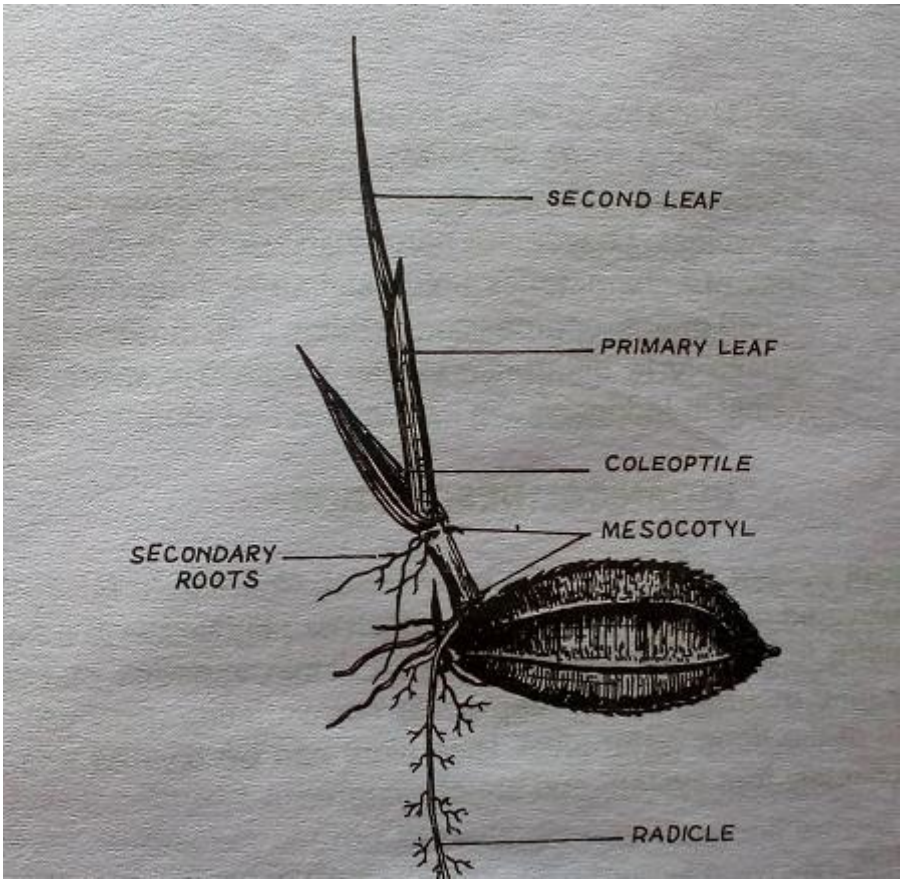

Fig.10.1.Components parts of a rice germinating seedling

known as lodicules' . Rice is a self pollinated crop. When rice flower becomes ready to bloom, the lodicules become turgid and push the lemma and palea apart, thus allowing the stamens to emerge outside the open floret. Rupturing of the anthers then leads to the shedding of pollen grains. After the pollen grains are shed on stigma the lemma and palea close.

GRAIN (Caryopsis): Rice grain develops after pollination and fertilisation are completed. The grain is tightly enclosed by the lemma and palea. The dehulled rice grain is known as brown rice as brownish pericarp covers it. The pericarp is the outermost layer which envelopes the caryopsis and is removed when rice is milled and polished. The embryo lies at the ventral side of the spikele4 next to the lemma. Adjacent to the embryo is a dot like structure the hilum. The embryo contains the plumule and radicle. The plumule is enclosed by a sheath known as coleoptile and the radicle by the coleorhiza. The rest of the caryopsis is occupied by the starchy endosperm

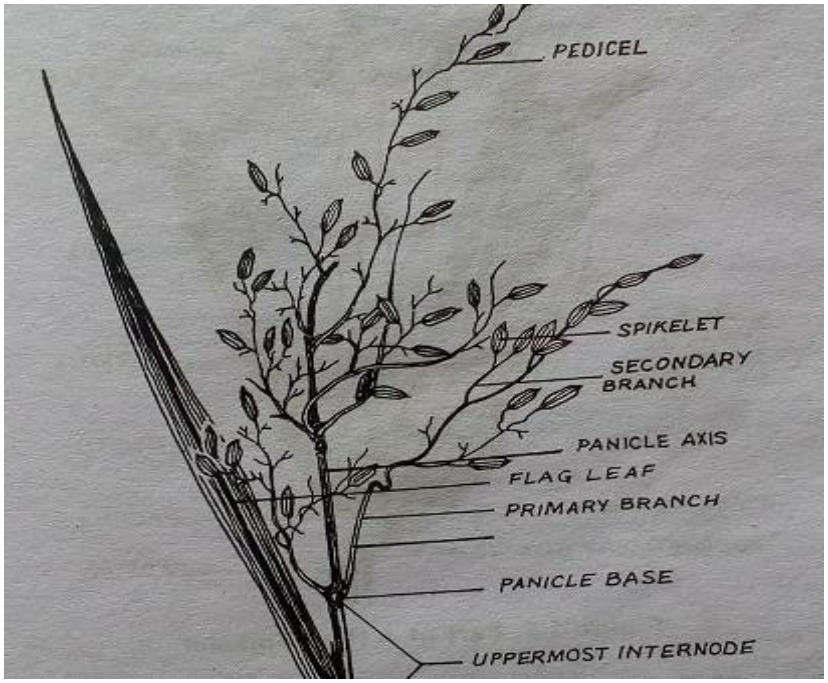

Fig.10.2.Components part of a rice panicle

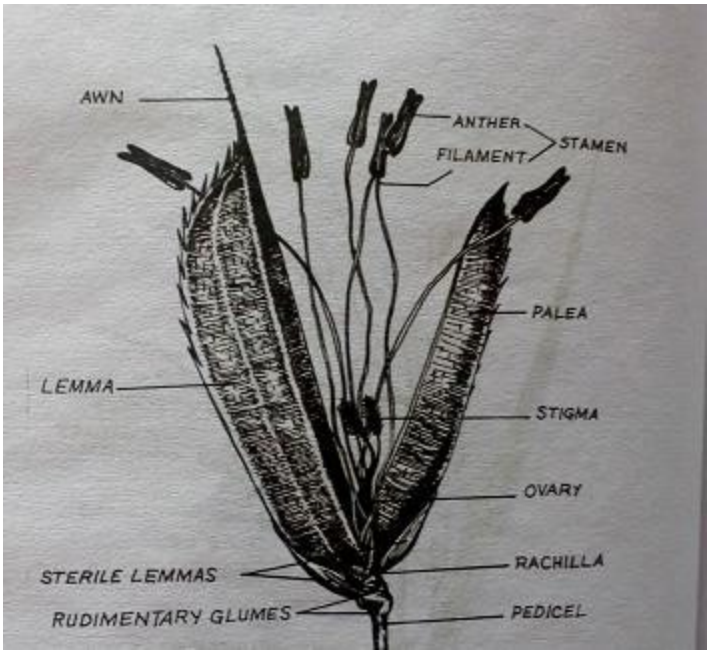

Fig.10.3. Part of a rice spikelet

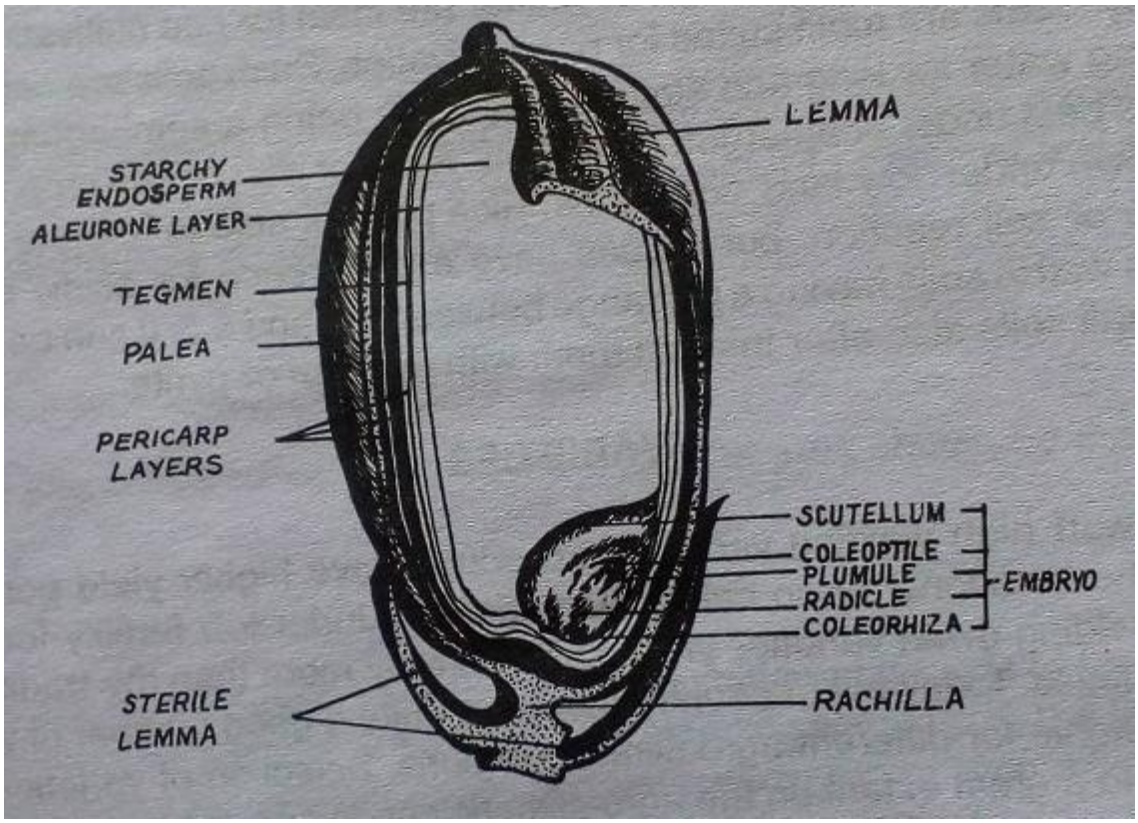

Fig.10.4. Structure of a rice grain

Signature of Faculty In-charge