Practical Manual
on
Practical Crop Production - II (*Rabi* Crops)

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PRACTICAL NO. 1 **DATE:**

SOWING OF *RABI* CEREAL CROPS

1.1 Objectives:

To know the method of sowing of *rabi* cereal crops

1.2 Materials Required:

Certified *rabi* cereal crop seeds, measuring tape, rope, hand tyne, weighing balance etc.

1.3 Steps/Procedure:

a. Check the moisture condition of the field before sowing the seeds.

b. Level the field ploughed and harrowed earlier by spade and also clears all the weeds.

c. As per recommended seed rate, calculate the amount of seed and weigh the seed quantity required for the area before sowing.

d. Then, make furrows or lines having shallow depth with the help of a hand tyne.

e. Drop the seeds along the furrows maintaining the plant to plant distance as specified in the classroom.

f. Cover the seed with light soil and press the furrow lightly after sowing.

1.4 Observations:

Crop	Plot size (sqm)	Seed requirement / plot	Method of sowing	Spacing	Depth of sowing	Remarks (if any)
Wheat						
Barley						

1.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=xIe2EjQNols

https://www.youtube.com/watch?v=bwz7hh-JZPg

Fig. Sowing of wheat seeds

Signature

PRACTICAL NO. 2 **DATE:**

APPLICATION OF FERTILIZER IN *RABI* CEREAL CROPS

2.1 Objectives:

To know about the application of recommended dose of fertilizer for different *rabi* cereal crops

2.2 Materials required:

Field ready for final ploughing/harrowing, crop field at tillering stage/before flowering, fertilizers, micro-nutrient containing fertilizers, weighing balance etc.

2.3 Steps/Procedure:

a. Observe the type of crop, nutrient removal capacity by the crop, growth stage of crop.

b. Compute the amount of fertilizers to apply as per the recommended dose of fertilizer.

c. Weigh out the computed amount of fertilizer and label the individual container properly.

d. Apply nitrogenous fertilizer generally in splits, basal application is done through simply by broadcasting method and top dressing as placement or as foliar application.

e. In split application of nitrogen, first calculate the amount required for each application.

f. Broadcast entire phosphatic and potassic fertilizers before sowing or planting of crops as basal application.

g. Incorporate the fertilizer into the soil with wheel hoe or hand rake.

2.4 Observations:

Crop	**Recommended NPK dose (Kg/ha)**	**Fertilizer requirement / plot**			**Basal dose**	**1st top dressing**	**2nd top dressing**
		N	**P_2O_5**	**K_2O**			
Wheat							
Barley							

2.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=cR4mfajZC7o&t=2s

https://www.youtube.com/watch?v=bKanpftoxiY

https://www.youtube.com/watch?v=3WB6D0sdcAg

Fig. Application of fertilizer

Signature

PRACTICAL NO. 3 **DATE:**

HARVESTING OF *RABI* CEREAL CROPS

3.1 Objective:

To know about the criteria and methods of harvesting of *rabi* cereal crops

3.2 Materials required:

Field with well matured *rabi* cereal crops, harvesting equipment (sickle, hansua etc.), gunny bags or baskets, balance, etc

3.3 Steps:

a) Visit the field of different *rabi* cereal crops at the maturity stage.

b) Check and verify all the criteria for harvesting as discussed in the class from the matured standing crops.

c) Then cut the crop with the help of a sickle or hansua leaving 10-15 cm of the basal part above the ground.

d) Continue the cutting process until your hand is full with the harvested plants.

e) Move to the next row as you finished a handful cutting.

f) Leave the cut crop in the field and exposing it to the sun for drying.

g) Make the bundle of harvested crops and move the cut crop to the threshing location thereafter.

3.4 Observations:

Crop	Criteria for harvesting	Time required for harvesting (days)	Days required after flowering	% panicle matured	% grain matured
Wheat					
Barley					

3.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=JG0gVOt4QJY

https://www.youtube.com/watch?v=R2wFhQJCj_0

Fig. Harvesting of wheat crop

Signature

PRACTICAL NO. 4 **DATE:**

ESTIMATION OF GRAIN YIELD OF *RABI* CEREALS BY NET PLOT METHOD

4.1 Objective:

To study about the grain yield estimation of *rabi* cereals by net plot method

4.2 Materials Required:

Field with well matured *rabi* cereals crops, meter scale, harvesting equipment (sickle, knife, etc.), gunny bags or baskets, balance, etc.

4.3 Steps:

a. Select a plot of 1 m^2 of matured plants with the help of a meter scale.
b. Harvest the plants from selected area cutting with the help of sickle at ground level.
c. Tie the harvested plants in bundles and carry them to the threshing floor.
d. Keep them under the sun for 2-3 days for proper drying to facilitate easy threshing.
e. Then thresh the plants by beating on the bamboo frame or preferably with sticks.
f. Clean the grains and weigh the grain amount with the help of a weighing balance.
g. Convert the grain weight (g/m^2) into grain yields in terms of kg/ha.
h. Dry the straw under sun for 3-4 days and calculate straw yield in kg/ha in similar way.
i. Then calculate the harvest index by using the following formula –

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (Grain yield)}}{\text{Biological yield (Grain yield + Straw yield)}}$$

4.4 Observations:

Crop	Grain weight (g)	Straw weight (g)	Estimated grain yield (kg/ha)	Estimated straw yield (kg/ha)	Harvest index (%)
Wheat					
Barley					

4.5 Conclusion:

Signature

PRACTICAL NO. 5 **DATE:**

SOWING OF *RABI* PULSE CROPS

5.1 Objectives:

To know the method of sowing of *rabi* pulse crop seed

5.2 Materials Required:

Certified *rabi* pulse crop seed, measuring tape, rope, hand tyne, weighing balance etc.

5.3 Steps/Procedure:

a. Check the moisture condition of the field before sowing the seeds.
b. Level the field ploughed and harrowed earlier by spade and remove all the weeds.
c. Calculate the amount of seed and weigh the seed quantity required for the area before sowing as per recommended seed rate.
d. Make furrows or lines having shallow depth with the help of a hand tyne.
e. Drop the seeds along the furrows maintaining the plant to plant distance.
f. Cover the seed with light soil and press the furrow lightly after sowing.

5.4 Observations:

Crop	**Plot size (sqm)**	**Seed requirement / plot**	**Depth of sowing**	**Spacing**	**Depth of sowing**	**Remarks (if any)**
Chickpea						
Pea						
Lentil						
Lathyrus						

5.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=xIe2EjQNols

https://www.youtube.com/watch?v=bwz7hh-JZPg

https://www.youtube.com/watch?v=PXcVJTuJNoc

Fig. Sowing of pulse crop seeds

Signature

PRACTICAL NO. 6 **DATE:**

BASAL APPLICATION OF FERTILIZER IN *RABI* PULSE CROPS

6.1 Objectives:

To know about basal application of recommended fertilizer dose in different *rabi* pulse crops

6.2 Materials required:

Fields ready for final ploughing/harrowing, fertilizers, micro-nutrient containing fertilizers, container, weighing balance etc.

6.3 Steps/Procedure:

a. Compute the amount of fertilizers to apply as per the recommended dose of fertilizer.
b. Weigh out the computed amount of fertilizer and label the individual container properly.
c. Apply entire quantity of N, P and K fertilizers before sowing or planting of crops.
d. Pick up a handful of each fertilizer one by one with the fingers slightly separated; throw the fertilizers with a horizontal movement of your hand. The width of area covered by one throw is usually 3 meter.
e. Use only one stroke for each handful.
f. Move forward at a constant speed as you throw.
g. When your hand is empty take another handful of fertilizers and broadcast it as evenly as possible.
h. If wind is blowing broadcast crosswise keeping your hand low.
i. Do the last harrowing/ploughing thoroughly to incorporate the fertilizers into the soil.
j. If it is not possible to pass through the harrow, use a wooden plank or hand rake to work the soil.

6.4 Observations:

Crop	**Recommended NPK dose (Kg/ha)**	**Nutrient requirement as basal dose / plot**			**Remarks (If any)**
		N	**P_2O_5**	**K_2O**	
Chickpea					
Pea					
Lentil					

6.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=cR4mfajZC7o&t=2s

https://www.youtube.com/watch?v=bKanpftoxiY

https://www.youtube.com/watch?v=3WB6D0sdcAg

Fig. Application of fertilizer

Fig. Bio-fertilizer

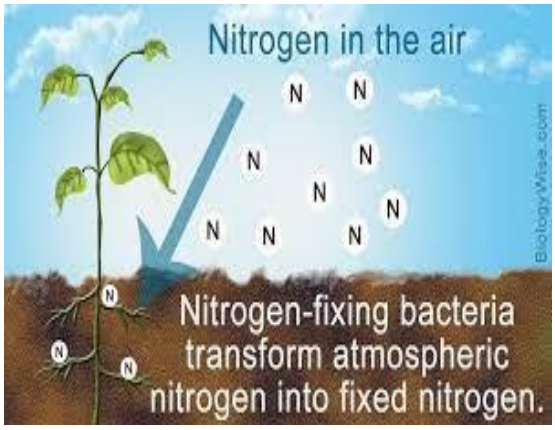


Fig. Atmospheric N fixation

Signature

PRACTICAL NO. 7 **DATE:**

HARVESTING OF *RABI* PULSE CROPS

7.1 Objective:

To know about the criteria and methods of harvesting of *rabi* pulse crops

7.2 Materials required:

Field with well matured *rabi* pulse crops, harvesting equipment (sickle, hansua etc.), gunny bags or baskets, balance, etc

7.3 Steps:

a. Visit the field of different *rabi* pulse crops at the maturity stage.

b. Check and verify all the criteria for harvesting as discussed in the class from the matured standing crops.

c. Then cut the crop with the help of a sickle or hansua.

d. Continue the cutting process until your hand is full with the harvested plants.

e. Move to the next row as you finished a handful cutting.

f. Leave the cut crop in the field and exposing it to the sun for drying.

g. Make the bundle of harvested crops and move the cut crop to the threshing location thereafter.

7.4 Observations:

Crop	Criteria for harvesting	Time required for harvesting (days)	Days required after flowering	% pod matured
Chickpea				
Pea				
Lentil				

7.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=JG0gVOt4QJY

https://www.youtube.com/watch?v=R2wFhQJCj_0

Fig. Harvesting of pulse crops

Signature

PRACTICAL NO. 8 **DATE:**

YIELD ESTIMATION OF *RABI* PULSES ON THE BASIS OF NET PLOT METHOD

8.1 Objective:

To study about the seed yield estimation of *rabi* pulses by net plot method

8.2 Materials Required:

Field with well matured *rabi* pulses crops, meter scale, harvesting equipment (sickle, knife, etc.), gunny bags or baskets, balance, etc.

8.3 Steps:

a. Select a plot of 1 m^2 of matured plants with the help of a meter scale.
b. Harvest the plants from the selected area cutting with the help of sickle at the ground level.
c. Tie the harvested plants in bundles and carry them to the threshing floor.
d. Keep them under the sun for 2-3 days for proper drying to facilitate easy threshing.
e. Then thresh the plants by beating on the bamboo frame or preferably with sticks.
f. Clean the seeds and weigh the seed amount with the help of a weighing balance.
g. Convert the seed weight into grain yields in terms of kg/ha.
h. Dry the stover under the sun for 3-4 days and calculate the stover yield in kg/ha in similar way.
i. Then calculate the harvest index by using the following formula –

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (Seed yield)}}{\text{Biological yield (Seed yield + Stover yield)}}$$

8.4 Observations:

Crop	**Seed weight (g)**	**Stover weight (g)**	**Estimated seed yield (kg/ha)**	**Estimated stover yield (kg/ha)**	**Harvest index (%)**
Chickpea					
Pea					
Lentil					

8.5 Conclusion:

Signature

PRACTICAL NO. 9 **DATE:**

SOWING OF *RABI* OILSEED CROPS

9.1 Objectives:

To know the method of sowing of *rabi* oilseed crop seeds

9.2 Materials Required:

Certified *rabi* oilseed crop seeds, measuring tape, rope, hand tyne, weighing balance etc.

9.3 Steps/Procedure:

a. Check the moisture condition of the field before sowing the seeds.
b. Level the field ploughed and harrowed earlier by spade and remove all the weeds.
c. Calculate the amount of seed and weigh the seed quantity required for the area before sowing as per recommended seed rate.
d. Make furrows or lines having shallow depth with the help of a hand tyne.
e. Drop the seeds along the furrows maintaining the plant to plant distance.
f. Cover the seed with light soil and press the furrow lightly after sowing.

9.4 Observations:

Crop	Plot size (sqm)	Seed requirement / plot	Method of sowing	Spacing	Depth of sowing	Remarks (if any)
Mustard						
Sunflower						
Safflower						

9.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=eMAtDZqbWN4

https://www.youtube.com/watch?v=lCv90-7-mYo

https://www.youtube.com/watch?v=6FdsW0gOjX8

Signature

PRACTICAL NO. 10 **DATE:**

FERTILIZER APPLICATION IN *RABI* SEASON OILSEED CROPS

10.1 Objectives:

To know about application of recommended fertilizer dose in different *rabi* oilseed crops

10.2 Materials required:

Fields ready for final ploughing/harrowing, fertilizers, micro-nutrient containing fertilizers, container, weighing balance etc.

10.3 Steps/Procedure:

a. Observe the type of crop, nutrient removal capacity by the crop, growth stage of crop.

b. Compute the amount of fertilizers to apply as per the recommended dose of fertilizer.

c. Weigh out the computed amount of fertilizer and label the individual container properly.

d. Apply nitrogenous fertilizer generally in splits, basal application is done through simply by broadcasting method and top dressing as placement or as foliar application.

e. In split application of nitrogen, first calculate the amount required for each application.

f. Broadcast entire phosphatic and potassic fertilizers before sowing or planting of crops as basal application.

g. Incorporate the fertilizer into the soil with wheel hoe or hand rake.

10.4 Observations:

Crop	**Recommended NPK dose (Kg/ha)**	**Fertilizer requirement / plot**			**Basal dose**	**1st top dressing**	**2nd top dressing**
		N	**P_2O_5**	**K_2O**			
Mustard							
Sunflower							
Safflower							

10.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=cR4mfajZC7o&t=2s

https://www.youtube.com/watch?v=bKanpftoxiY

https://www.youtube.com/watch?v=3WB6D0sdcAg

Fig. Application of fertilizer

Signature

PRACTICAL NO. 11 **DATE:**

HARVESTING OF *RABI* OILSEED CROPS

11.1 Objective:

To know about the criteria and methods of harvesting of *rabi* oilseed crops

11.2 Materials required:

Field with well matured *rabi* oilseed crops, harvesting equipment (sickle, hansua etc.), gunny bags or baskets, balance, etc

11.3 Steps:

a. Visit the field of different *rabi* oilseed crops at the maturity stage.

b. Check and verify all the criteria for harvesting as discussed in the class from the matured standing crops.

c. Then cut the crop with the help of a sickle or hansua.

d. Continue the cutting process until your hand is full with the harvested plants.

e. Move to the next row as you finished a handful cutting.

f. Leave the cut crop in the field and exposing it to the sun for drying.

g. Make the bundle of harvested crops and move the cut crop to the threshing location thereafter.

11.4 Observations:

Crop	Criteria for harvesting	Time required for harvesting (days)	Days required after flowering	% seed matured
Mustard				
Sunflower				
Safflower				

11.5 Conclusion:

Video link:

https://www.youtube.com/watch?v=JG0gVOt4QJY

https://www.youtube.com/watch?v=R2wFhQJCj_0

Fig. Sunflower at maturity

Fig. Harvesting of mustard

Signature

PRACTICAL NO. 12 **DATE:**

YIELD ESTIMATION OF *RABI* OILSEEDS ON THE BASIS OF NET PLOT METHOD

12.1 Objective:

To study about the seed yield estimation of *rabi* oilseeds by net plot method

12.2 Materials Required:

Field with well matured *rabi* oilseeds crops, meter scale, harvesting equipment (sickle, knife, etc.), gunny bags or baskets, balance, etc.

12.3 Steps:

a. Select a plot of 1 m^2 of matured plants with the help of a meter scale.
b. Harvest the plants from selected area cutting with the help of sickle at ground level.
c. Tie the harvested plants in bundles and carry them to the threshing floor.
d. Keep them under the sun for 2-3 days for proper drying to facilitate easy threshing.
e. Then thresh the plants by beating on the bamboo frame or with sticks.
f. Clean the grains and weigh the grain amount with the help of a weighing balance.
g. Convert the seed weight into seed yields in terms of kg/ha.
h. Dry the stover under sun for 3-4 days and calculate stover yield in kg/ha.
i. Then calculate the harvest index by using the following formula –

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (Seed yield)}}{\text{Biological yield (Seed yield + Stover yield)}}$$

12.4 Observations:

Crop	Seed weight (g)	Stover weight (g)	Estimated seed yield (kg/ha)	Estimated stover yield (kg/ha)	Harvest index (%)
Mustard					
Sunflower					
Safflower					

12.5 Conclusion:

Signature

PRACTICAL NO. 13 **DATE:**

WEED CONTROL IN *RABI* SEASON CROPS

13.1 Objective:

To know the methods of weed control in *rabi* season crops

13.2 Materials required:

Hand hoe, nirani, mechanical weeder (wheel hoe), knapsack sprayer, herbicide, measuring cylinder, container, water etc.

13.3 Steps/Procedure:

Weeding by hand with nirani:

a. It is difficult to grasp the weeds at 2-3 leaf stage. Uproot them by a combing and stirring action with fingers held slightly apart.

b. If weeds are of 10 cm height or more, pull them by hand or uproot by using nirani.

c. Do not step on the crop plant.

d. Put uprooted weeds on the bunds.

e. Observe the re-germination of weeds in the field. If necessary do it again about 2 weeks after the first weeding.

Weeding with wheel hoe:

a. Check the condition of field. Soil should be soft and does not affect much resistance.

b. Adjust spaces between the tynes of wheel hoe according to row spacing of the crops.

c. Push the wheel hoe forward between the rows to avoid touching crop plant and injuring the plants.

d. Insert tynes to a depth of about 2.5 cm.

e. When using a wheel hoe one should avoid hitting crop plants.

Application of herbicide:

a. Weigh correct amount of herbicide required to apply and calculate the number of sprayer loads along with quantity of water required for each sprayer.

b. Use clean water and pour 1/4th amount of required water into the container. Container should contain more than the sprayer tank.

c. Never place herbicide ahead of the water because the wettable powder tends to float and many emulsifiable concentrates are acidic.

d. Add the herbicide to the water container. For wettable powder thoroughly mix it with a small amount of water before pouring it into the water container. This makes dispersion of the powder in a larger amount.

e. Mix the herbicide with stick not by your hand.

f. Add remaining water to complete dilution and pour the herbicide solution in the spray tank.

g. Check the pressure in spray tank and other parts.

h. Start spraying over weedy area in field keeping nozzle of sprayer downward.

i. Shake the spray can frequently to keep wettable powder or emulsifiable concentrate in suspension and maintaining a constant pressure within sprayer.

j. Move forward with a constant speed until you complete the practice for whole area.

13.4 Precautions:

a. Make sure that material being applied will not affect neighbouring crops.

b. Check wind direction to prevent injury to other susceptible crops from the drift.

c. When spraying in windy weather, spray downward as this will cause slightly less drift than spraying upwind or cross wind, and will reduce widespread drift.

d. Do not smoke during spraying.

e. Properly dispose of the excess chemical.

f. Wash your hand thoroughly with soap and clean the spray tank as well.

13.5 Observations:

Sl. No.	Crop	Weed observed	Chemical Management	Biological managements
1				
2				
3				
4				
5				

13.6 Conclusion:

Video link:

https://www.youtube.com/watch?v=UmNUErtv4KE

https://www.youtube.com/watch?v=vHEzTTitk-s

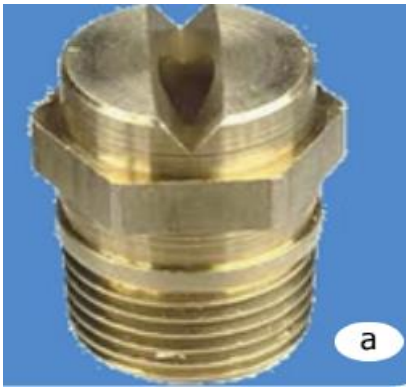
https://www.youtube.com/watch?v=U_aqvhZve6o

Different types of sprayers and nozzles used for herbicide application

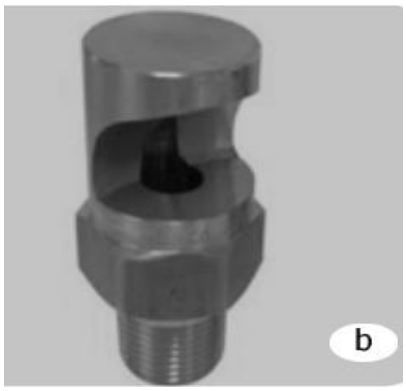
Knapsack sprayer

Power sprayer

Foot sprayer



Flat fan nozzle



Flood jet nozzle

Spray nozzle hood

Signature

PRACTICAL NO. 14 **DATE:**

DIRECT SOWING OF TRUE POTATO SEED (TPS) FOR PRODUCTION OF TUBERS

14.1 Objective:

To know about the methods of sowing of true potato seed (TPS) for production of tubers

14.2 Materials required:

Tillage implements and tools (spade, hand hoe, rake etc.), ladder/plank, measuring tape, weighing balance, seeds, manures and fertilizers, gunny bags or rice straw etc.

14.3 Steps/Procedure:

a) Know the size of land (medium high or high) allotted for seed sowing.

b) Prepare the land fine and friable.

c) Make seedbed of 15 cm high, 1 m wide with a convenient length.

d) Apply required amount of manures and fertilizers at the time of final land preparation.

e) Take required amount of seeds after weighing on a balance.

f) Make furrow of 0.5 cm deep at 15 cm interval across the length of seedbed.

g) Sow 2 to 3 seeds per hole at 10 cm interval and cover it with well dried cow dung powder.

h) Thereafter, cover bed with wet gunny bags or rice straw for 5 to 7 days after sowing.

14.4 Precautions to be taken:

a) Check the condition of seedbed (it should have fine tilth before sowing of seed).

b) Sowing must be completed within first fortnight of November.

c) Check germination percentage of seed before sowing.

d) Nursery bed should be shaded between 10 am to 5 pm for first 2 weeks.

14.5 Observations:

Area (sqm)	Seed required (g)	Manure and fertilizer applied	Other management practices followed (if any)

14.6 Conclusion:

Video link:

https://www.youtube.com/watch?v=3x74CQc9OcA

https://www.youtube.com/watch?v=0WLgQrlV1XQ

https://www.youtube.com/watch?v=ZYqodjhKK20

Fig. Sowing of true potato seeds

Signature

PRACTICAL NO. 15 **DATE:**

PRACTICE OF PLANTING OF POTATO TUBERS

15.1 Objective:

To know about the steps of planting of potato tubers in main field

15.2 Materials required:

Well prepared land, good quality potato tubers, manures and fertilizers, tyne, rope, peg etc.

15.3 Steps/Procedure:

a. Prepare the main field with repeated ploughing followed by levelling.
b. Apply recommended dose of fertilizers during the final land preparation and mix it thoroughly with soil.
c. Calculate the amount of seed tubers as per recommended seed rate and treat the seed tubers by dipping in the fungicide solution before planting.
d. Fix pegs and connect those with rope for demarcation to draw furrows.
e. Make ridges and furrows with the help of a hand tyne.
f. Drop the seed tubers along the furrows maintaining plant to plant distance and at desired depth.
g. Cover furrows with soil over seed tubers and press the furrow lightly after sowing.

15.4 Precautions to be taken:

a. Seed tubers should be free from any disease infection.
b. It must be a well sprouted tuber and should be 30-40 g each in weight.
c. Treat the seed with fungicide solution before sowing in field.
d. Field should not have excess moisture during planting time.

15.5 Observations:

Area (ha)	Recommended dose of NPK (Kg/ha)	Fertilizer applied	Seed required (g)	Spacing (cm)	Depth of planting (cm)

15.6 Conclusion:

Video link:

https://www.youtube.com/watch?v=K4XfsiyhXaQ

https://www.youtube.com/watch?v=6SvNmvpGfIM

Fig. Planting of potato tubers

Signature

PRACTICAL NO. 16 **DATE:**

POST-PLANTING MANAGEMENT IN POTATO CROP FIELD

16.1 Objective:

To learn about the different post planting management practices (inter-cultural operations, irrigation, top dressing of fertilizers, pesticide application, harvesting etc.) in potato crop

16.2 Materials required:

Well established potato crop field, sources of irrigation, fertilizers, pesticides, spade, khurpi, nirani etc.

16.3 Steps/Procedure:

After planting of tubers in the field following management practices to be done –

Irrigation water application:

a. Apply 2 light irrigations to the crop within first 2 weeks of planting at 5-7 days interval.
b. Thereafter, irrigate the crop through furrows at an interval of 7-10 days at least for 4-5 times.
c. Stop the irrigation water application to the crops about 12-14 days before harvesting.

Weeding and earthing up:

a. Clean all the weeds from the crop field manually with the help of nirani at 21 days after planting (DAP).
b. Then follow the earthing up covering about first 2-3 nodes of the seedlings.
c. Repeat the weeding and earthing up operations at 42 DAP.

Top dressing of fertilizers:

a. Apply 1/3rd of nitrogenous fertilizer (40 kg N/ha) at 21 DAP as first top dressing in between the rows of the crops.
b. 2nd top dressing of 40 kg N/ha is to be given at 42 DAP again following the weeding and earthing up operations.

Plant protection measures and dehaulming:

a. Spraying of appropriate insecticides and fungicides to be made to check the infestation of various insect and disease pests as found in the crop field.

b. Dehaulming operation should be followed to the plants before 25 days of harvesting to avoid the aphid infestation and to reduce the yield loss due to higher transpiration.

Harvesting:

a. Crop usually matures within 110-115 days of planting.
b. Dig out the matured tubers of potato with the help of spade or khurpi.

16.4 Observations:

Water requirement and time of application	**Top dressing of nitrogenous fertilizer**		**Plant protection measures**	
	1st	**2nd**	**Insect pest control**	**Disease pest control**

16.5 Conclusion:

Signature

PRACTICAL NO. 17 **DATE:**

YIELD ESTIMATION OF POTATO TUBER BY YIELD COMPONENT METHOD

17.1 Objective:

To study about the yield estimation of potato tuber by yield component method.

17.2 Materials Required:

Field with well matured potato crops, meter scale, harvesting equipment (spade, khurpi, etc.), gunny bags or baskets, balance, etc.

17.3 Steps:

a) Select a unit area with the help of a meter scale from the matured potato crop field at least from 5 places.
b) Then count the total number of plants from the selected 1 m^2 area.
c) Dig out the potato tuber with the help of spade or khurpi.
d) Count the number of tuber at least from 10 plants and calculate the number of tuber per plant simply by doing the average.
e) Take at least 10 tubers from the selected 1 m^2 area and measure the weight with the help of a weighing balance.
f) Calculate the average weight of tuber simply by dividing the total weight by 10.
g) Calculate the tuber yield of potato on the basis of the following formula.

$$\text{Yield (t/ha)} = \frac{10000 \times \text{No. of plants/m}^2 \times \text{Avg. number of tubers/plant} \times \text{Avg. weight of tuber (g)}}{1000 \times 1000}$$

17.4 Calculation:

Estimate the yield of potato tuber with the following data given-

No. of plants/m^2 = 6

Average number of tubers/plant = 14

Average weight of tuber (g) = 36

$$\text{Yield (t/ha)} = \frac{10000 \times 6 \times 14 \times 36}{1000 \times 1000}$$

$$= 30.24$$

Therefore, the estimated tuber yield of potato is 30.24 t/ha.

Problem 1:

Calculate the tuber yield of potato with the following data given-

Spacing = 45 cm x 30 cm

Average number of tubers/plant = 14

Average weight of tuber (g) = 36

17.5 Conclusion:

Signature

PRACTICAL NO. 18 **DATE:**

QUALITY SEED PRODUCTION

18.1 Objective:

To study about the quality seed production of rabi crops

18.2 What is Seed?

A seed is a small embryonic plant enclosed in a covering called the seed coat, usually with some stored food. It is the product of the ripened ovule of gymnosperm and angiosperm plants which occurs after fertilization and some growth within the mother plant.

18.3 Types of seed:

i. **Nuclear seed:** This is the hundred percent genetically pure seed with physical purity and produced by the original breeder/Institute /State Agriculture University (SAU) from basic nucleus seed stock. A pedigree certificate is issued by the producing breeder.

ii. **Breeder seed**: The progeny of nucleus seed multiplied in large area as per indent of Department of Agriculture and Cooperation (DAC), Ministry of Agriculture, Government of India, under supervision of plant breeder / institute / SAUs and monitored by a committee consisting of the representatives of state seed certification agency, national / state seed corporations, ICAR nominee and concerned breeder. A golden colour certificate is issued by seed certification agency for this category of seed.

iii. **Foundation seed**: The progeny of breeder seed produced by recognized seed producing agencies in public and private sector, under supervision of seed certification agencies in such a way that its quality is maintained according to prescribed field and seed standards. A white colour certificate is issued for foundation seed by seed certification agencies.

iv. **Registered seed:** Registered seed shall be the progeny of foundation seed that is so handled as to maintain its genetic identity and purity according to standard specified for the particular crop being certified. A purple colour certificate is issued for this category of seed.

v. **Certified seed:** It is the progeny of foundation seed produced by registered seed growers under supervision of seed certification agencies to maintain the seed quality as per minimum seed certification standards. A blue colour certificate is issued by seed certification agency for this category of seed.

vi. **Truthfully Labeled (TL) Seed:** One more class of seeds is truthfully labeled seeds. This type of seeds does not come under the purview of the Department of Seed Certification. This kind of seeds is tested only for its physical purity and germination. By this method, any farmer can produce seeds and market it as truthfully labeled seeds. Labeling is compulsory but certification is voluntary

18.4 Characteristics of Good Quality Seeds

a. Seed Health

Seeds with good germination capacity and seed vigour are considered as quality seeds. Seeds should be devoid of insect damage and infestation by any microbes like bacteria and fungi.

b. Physical Purity of Seeds

The physical purity of the seeds should be maintained at 96-98% and the seeds should be of uniform size and shape without any damage. The seeds should be devoid of inert matter like dust, stones, seeds of other crop varieties, broken seeds, weed seeds, etc. After harvest, seeds should be separated from chaffy seeds and insect or disease affected seeds in order to maintain the physical purity of the seeds.

c. Genetic Purity

Genetic purity of the seed should be maintained in order to ensure the quality of the seeds. The traditional and inherent characteristics of the seed should be maintained from generation to generation and is referred as genetic purity. The characteristics of the progeny should exactly resemble its mother plant.

d. Moisture Content of the Seeds

Seeds with high moisture content will lose its germination vigour and viability soon. Hence, it is necessary to maintain correct moisture content of the seeds in order to ensure the good germination capacity and viability. It is also essential to protect the seeds from pest infestation and attack by diseases. Seeds should be stored at a safe moisture level of 9 – 13%. Moisture content of the seeds is measured directly using digital moisture meter.

18.5 Factors Influencing Seed Production

During seed multiplication, certain guidelines should be followed - otherwise the quality of the seeds will be affected. These includes -

a. Site / Land Selection
b. Field Preparation
c. Selection of Species and Seed Source
d. Seed Selection
e. Seed testing for seed germination, vigour and dormancy
f. Sowing Season
g. Planting Density
h. Weed Management
i. Pest and Disease Management
j. Intercultural Technologies

18.6 Conclusion:


QUALITY SEED PRODUCTION IN A FLOW CHART
Variety Development
Parent Seed Multiplication
Field Selection
Planting Equipment Sanitation
Isolation
Roguing
Field Inspection
Certification
Harvesting Equipment Sanitation
Harvesting
Separate Seed Storage
Testing and Grading
Bagging and Tagging
Commercial Farmer
Food Processor

Signature

PRACTICAL NO. 19 **DATE:**

FARM MECHANIZATION IN INDIA

19.1 Objectives:

To know the status of farm mechanization in India

19.2 Farm Mechanization:

Mechanization of agriculture and farming process connotes application of machine power to work on land, usually performed by bullocks, horses and other draught animals or by human labour. It (mechanization) chiefly consists in either replacing, or assisting or doing away with both the animal and human labour in farming by mechanical power wherever possible. Mechanization may be either partial or complete. It is partial when only a part of the farm work is done by machine. When animal or human labour is completely dispensed with by power supplying machines, it is termed as complete. Farm mechanization is a term used in a very broad sense. It not only includes the use of machines, whether mobile or immobile, small or large, run by power and used for tillage operations, harvesting and thrashing but also includes power lifts for irrigation, trucks for haulage of farm produce, processing machines, dairy appliances for cream separating, butter making, oil pressing, cotton ginning, rice hulling, and even various electrical home appliances like radios, irons, washing machines, vacuum cleaners and hot plates.

19.3 Forms of farm mechanization:

Mechanization in agriculture has two forms.

a) **Mobile mechanization**: It attempts to replace animal power on which agriculture has been based for very many centuries.

b) **Stationary types of mechanization:** It aims at reducing the drudgery of certain operations which have to be performed either by human labour or by a combined effort of human beings and animals.

19.4 Status of farm mechanization industry in India

Equipment manufacturers	No. of units
Agricultural tractors	22
Power Tillers	5
Irrigation pumps	600
Plant protection Equipments	300
Combine Harvesters	48
Reapers	60

Threshers	6000
Seed Drills & planters	2500
Diesel oil Engines	200
Plough, Cultivators, Harrows	5000
Chaff cutters	50
Rural Artisans	>1 Mn

19.5 Benefits of Mechanization in Agriculture:

- **It increases production:** Mechanization increases the rapidity and speed of work with which farming operations can be performed.
- **It increases efficiency and per man productivity:** Mechanization raises the efficiency of labour and enhances the farm production per worker. By its nature it reduces the quantum of labour needed to produce a unit of output.
- **Mechanization increases the yield of land per unit of area:** Increase in the yield of crops, due to mechanization of farms, has been traced from 40 to 50 per cent in the case of maize; 15 to 20 per cent in Bajra and Paddy; 30 to 40 per cent in Jowar, Groundnut and Wheat.
- **Mechanization results in lower cost of work:** It is found that the cost of production and the yields can be adjusted properly if mechanization is resorted to.
- **It contracts the demand for work animals for ploughing water lifting, harvesting, transport:** In actual operation, costs amount to little when machines are idle, whereas the cost of maintenance of draught animals remains the same during both periods of working and idleness, because animals have to be fed whether they are doing work or not. It is advantageous to use tractors when a great deal of work has to be done in a short time.
- **It brings in other improvements in agricultural technique:** In its improvements in the sphere of irrigation, helps in improving land reclamation and the prevention of soil erosion. Besides mechanical fertilization, contour bunding and terracing are done by mechanical methods with the help of self-propelled graders and terraces.
- **It leads to commercial agriculture:** Mechanisation results in a shift from ‘subsistence farming’ to ‘commercial agriculture. This shift occurs mainly due to the need for more land and capital to be associated with farmer in order to reap the full technological benefits.
- **It solves the problem of labour shortage:** In countries where human labour falls short of requirements in agriculture, use of machines can replace human and animal power.

- **It releases manpower for non-agricultural purposes:** Since the mechanisation of agriculture results in the employment of lesser number of persons on farms, surplus manpower may be available for other economic activities.

19.6 Scope of Farm Mechanization of Agriculture in India:

- Reclamation of lands infested with deep-rooted weeds and grasses like Kams, hariali, and doob by deep ploughing with the help of tractor driven implements.
- Land improvements by land levelling and grading with the help of bulldozers and other heavy machines.
- Construction of dams and reservoirs, soil and water conservation works such as contouring, terracing, bunding to check the menace of soil erosion.
- Jungle clearance and opening up virgin lands for cultivation.
- Deep ploughing, chiselling, more draining, and other operations like lifting water from great depths in the wells.
- Making roads on the farms, hauling farm produce, for processing of farm produce such as rice hulling, oil extraction, sugar cane crushing and decorticating of the groundnuts, plant protection measures like spraying, dusting and fumigation.
- Large co-operative or collective farms.
- For ploughing of clayey soils, that are difficult to handle when the time for preparation between crops, or after heavy monsoon rains and before sowing, is too short for effective results by bullock driven implements.
- Intensive and extensive cultivation in sparsely populated areas and
- Big farmer's holding of more than 30 acres of land.

19.7 Some Suggestions for Progress of Farm Mechanisation in Indian Agriculture:

There are practical difficulties in the way of introduction of the machines on the farms. Some of these can be removed by following ways.

a) The Government should provide credit facilities to those farmers who are willing to purchase the machinery individually.

b) Joint farming societies may be developed to serve as machinery cooperatives in the different States.

c) Machine Stations of the type of MTS may be developed in different parts to give the tractors and servicing facilities to the cultivators on subsidized rates.

d) Cheaper types of small machines suitable for Indian conditions should be evolved. These would help the labourer to perform his task more efficiently rather than displace him.

e) Private big farmers should be induced to adopt mechanisation for the use of more efficient equipment is one of the principal ways by which productivity per man and per acre, and hence living standards can be raised.

19.8 Conclusion:

Signature

PRACTICAL NO. 20 **DATE:**

NATURAL RESOURCE CONSERVATION

20.1 Objective:

To study about the natural resource conservation methodology**.**

20.2 Natural Resources

A resource is any natural or artificial substance or energy which can be used for the benefits of mankind. Natural resources are those which exist in the environment naturally, that is, they are not created by humans. They are soil, water, sunlight, animals, plants etc. Natural resources, especially water and soil, are essential for the function and structure of agricultural production systems and for the overall social and environmental sustainability.

20.3 Need for Conservation of Natural Resources

Due to overpopulation and human negligence we started to over-exploit our resources. If this continues, there will no resources left for our future generation. The needs to conserve the resources are-

- ✓ To support life by supporting ecological balance
- ✓ To ensure that the future generations will be able to access the resources
- ✓ To preserve the biodiversity
- ✓ To make sure human race survives.

20.4 Conservation of natural resources in India

The Government of India has undertaken many measures for the conservation of the resources. These includes-

- ✓ Regulations and reforms for proper housing and infrastructure development to avoid land acquisition problems
- ✓ Mass media public service messages to educate the people on the importance of conservation of resources
- ✓ Increase the wildlife and forest reserves in the country
- ✓ Schemes to do a proper inventory of the resources and monitor changes in the environment
- ✓ Various projects and schemes that promote conservation of resources

20.5 Conservation of natural resources

Natural Resources	Methods of conservation
Soil	
Water	
Bio-diversity	

20.6 Conclusion:

Signature

PRACTICAL NO. 21 **DATE:**

PREPARATION OF BALANCE SHEET INCLUDING COST OF CULTIVATION, GROSS RETURN, NET RETURN AND RETURN PER RUPEE INVESTMENT

21.1 Objective

To study the economics (an important component of all agricultural experiment) of different *kharif* season crops

21.2 Materials Required

Notebook and ball point pen or pencil

21.3 Calculation:

Problem 1. Calculate the cost of cultivation, net return, gross return and return per rupee invested of 1ha rice.

Cost of cultivation of rice (Rs ha^{-1})

Sl. No.	Item	Quantity required	Cost/Unit (Rs.)	Total cost (Rs.)
1	Land preparation (Tractor/Power tiller/Bullock)	12 hours 4 MD	500/hour 300/MD	6000 1200
2	Seed cost	30 kg	60/kg	1800
3	Nursery cost	4 MD	300/MD	1200
4	Transplanting	15 MD	300/MD	4500
5	Manure Application cost	10 Tons 4 MD	500/ Tons 300/MD	5000 1200
6	Fertilizer (60:30:30) Urea SSP MoP Application cost	 132 187.5 50 6 MD	 5.52 Rs./kg. 7.24 Rs./kg. 15.70 Rs./kg. 300/MD	 729 1958 785 1800
7	Insecticides/Pesticides Chlorpyrifos+ Cypermethrin (hamla) Application cost	 1 lit. 2 MD	 666/ lit. 300/MD	 666 600
8	Inter cultural operations (Weeding)	10 MD	300/MD	3000

9	Harvesting Threshing Cleaning and storage	22 MD 15 MD 8 MD	300/MD	13500
Cost of cultivation (Rs. ha^{-1})				43938

Gross return (Rs. ha^{-1})

Gross return was calculated by multiplying yield to selling price.

Grain/seed yield per ha = 3500 Kg

Straw/ Stover yield per ha = 5000 Kg

Selling Price

Grain/ Seed @ Rs 15 per Kg

Straw @ Rs 3 per Kg

- **Gross return= Yield × Selling price**

  = Rs. [(3500 × 15) + (5000 × 3)] = Rs. 67500

Net returns (Rs. ha^{-1})

The net return per hectare was worked out by deducting the cost of cultivation from the gross return and expressed in rupees per hectare.

- **Net return= Gross return- cost of cultivation**

  = Rs. (67500- 43938)

  = Rs. 23562

Benefit cost ratio

The benefit: cost (B: C) ratio is the ratio of net returns to total cost of cultivation/ production

$$\text{Benefit cost ratio} = \frac{\text{Net return}}{\text{Cost of cultivation}}$$

=23562/43938

= 0.54

Return per rupee invested

$$\frac{\text{Gross return}}{}$$

$$\text{Return per rupee invested} = \frac{\text{Gross income}}{\text{Cost of cultivation}}$$

$$= 67500/43938$$

$$= 1.54$$

21.4 Conclusion:

Signature

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