PRACTICAL MANUAL
AGRO-3611

Exercise No. 1

Introduction, Aims and Objectives of Practical Crop Production – II, Allotment of Plot and History of plot

Introduction: -

The course of Practical Crop Production – II in Agronomy is introduced in Fourth semester B.Sc. (Agri.) degree, from academic year 2007-08 commonly for all Agricultural Universities of Maharashtra State.

During this semester, each student will be given about 2 R area for raising one Rabi crop from cereal, pulses or oil seed group. The students are expected to work from sowing up to threshing and preparing produce for marketing. The students should also take all biometric observations from germination up to harvesting in the plot. The student's work will be evaluated on the basis of the performance of the students in completing the field operations, observations and maintenance of record, calculations etc. in the journal.

Aims and Objectives: -

1. To get actual practical experience in applying the improved technology for obtaining maximum production
2. To study the operations wise labour requirement and cost of each operation.
3. To study the input requirement for cultivation of allotted crop.
4. To study the constraints encountered for cultivation of crop under given set of field and climatic condition.
5. To study benefit cost ratio.
6. To develop confidence among the students.
7. To develop research attitude in the students.

Allotment of plot

Each student is allotted an area of 2 R for raising Wheat crop. Student should carry out all operations, record observations and do calculations of each operation to be carried out.

History of the allotted plot: -

i) Name of College :

ii) Name of the block and plot No. :

iii) Location of plot :

iv) Area in ha/area :

v) Type of soil :

vi) Depth of soil :

vii) Fertility status of soil :

viii) Degree of slope of Land :

ix) Drainage condition of soil :

x) Source of water supply :

xi) Type of farming (Rainfed / Irrigated) :

xii) Crops suitable :

xiii) Distance from market :

xiv) Market and Transport facilities :

Crop History for last 3 years: -

Sr. No.	Year	Crop grown			Fertilizer applied (NPK kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*

Assignment: -

Draw map of individual plot indicating the dimensions of plot and number of rows of crop sown.

PLAN OF LAYOUT FOR WHEAT

Crop Variety: Block :

Date of Sowing: Plot No :

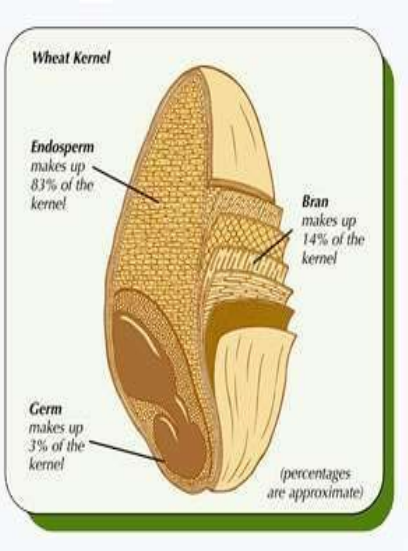
Exercise No. 02

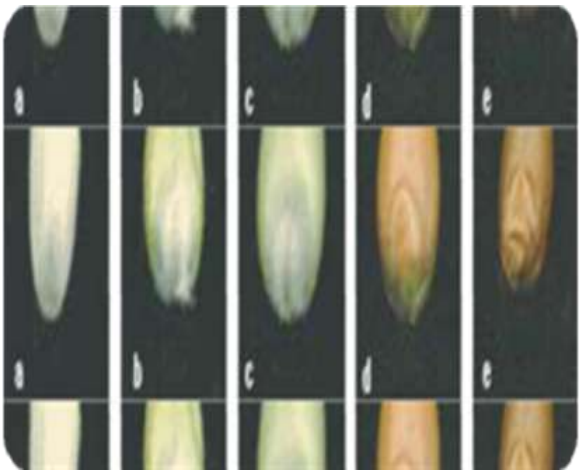
Study of seed production of rabi crops

SEED - Monocot species like wheat have caryopsis (cereal grains) as propagation units.Caryopses are single-seeded fruits in which the testa (seed coat) is fused with the thin pericarp (fruit coat).

Cereal grains have highly developed embryos and in cereal grains the triploid endosperm consists of the starchy endosperm (dead storage tissue) and the aleurone layer (living cells).

Organs of the cereal embryo are: coleoptile (shoot sheath),scutellum, the radicula & the coleorhizae (root sheath).





Kernels at various stages during grain filling:

a) kernel at watery ripe
b) kernel at late milk
c) kernel at soft dough
d) kernel at hard dough showing loss of green color
e) kernel ripe for harvest

Physiological maturity:

When the kernels have attained maximum dry weight it is physically matured.Note the green color is gone from the peduncle and head parts.

Cultural Practices for Seed production of Wheat

Land requirement :

a) Land to be used for seed production of wheat should be:
b) Free of volunteer plants.
c) The field should be well drained,
d) Free of weeds.
e) The soil neither too acidic not too alkaline
Long interval of Crop rotation is desirable

Previous cropping

a) The crop should be planted on a field with a known history to avoid contamination from volunteer plants, noxious weeds and soil-borne diseases that are potentially seed transmitted.
b) A wheat seed crop should never immediately follow wheat, unless the wheat crop in the previous season was of the same variety and of the same or higher generation.
c) Two year rotation for flag smut and seed gall nematode is suggested where applicable.

Isolation requirement

Normally a self-pollinated crop(Clistogamous)

- 1-4 % Cross pollination sometime occurs.
- It is sufficient to isolate seed fields with a strip of 3 meters all around which is planted with a non-cereal crop, or left uncroped.
- In cases where variety is susceptible to diseases caused by Ustilago spp. (eg. loose smut) an isolation distance of 180 meters between seed field and other fields of wheat is recommended
- As per Indian minimum seed certification standards require only 150 m isolation from other wheat fields where in loose smut infection is in excess of 0.1% in the case of foundation seed production and 0.5 % in the case of certified seed production.

Culture practices

Time of Sowing:

1. Long duration varieties like C 306 should be sown during the first fortnight of November.
2. Short and medium duration varieties like Sonalika, HD 1982 should be sown during the second fortnight of November.
3. The optimum time of sowing for wheat is when the mean daily temperature is 23±3°C and for good tillering temperature should range between 16-20°C.

Preparation of Land

1. Deep ploughing with a soil turning plough.
2. Running a harrow before the pre- sowing irrigation.
3. Give a light shallow ploughing or discing after pre-sowing irrigation.
4. Levelling is an important part of seed bed preparation.
5. Keep the seed bed free of weeds.

Source of seed :-Obtain nucleus/breeder's/foudation seed from a source approved by the certification agency.

Seed Rate:- The recommended seed rate for seed crop is 85-100 kg per ha. The seed should be treated with systemic fungicide to control loose smut.

Spacing : The row distance for seed crop should bekept at 22 to 23cm to facilitate rouging and inspection work. For late sown wheat reduce the line spacing to 15-18 cm

Crop Rotation :-Wheat is mainly grown in rotation with rice, sugarcane, arhar (pigeon pea) and sorghum, cotton, pearl millet, cluster bean, sorghum, groundnut,

Method of sowing

- The seed crop is sown in rows with seed drill, or behind the plough in furrows.
- The depth of seeding should be 5 cm.
- Seed drill should be thoroughly cleaned and checked before use.
- Sowing of one variety should be completed before taking up another variety, to avoid mixture.
- If, for any reason, it has to be used for another variety, it should be thoroughly cleaned and checked so that not even a single seed of the previous variety is left.

The recommended doses of fertilizers are:

1) 80 to 120 kg/ha nitrogen,
2) 50 to 60 kg/ha phosphorus
3) 40 kg /ha potash
4) 15 to 20 kg/ha zinc may be given at the seeding time (in case of deficiency).
5) Apply the whole of the phosphoric and Potassic fertilizers and half of nitrogenous fertilizers while sowing, or just before sowing.
6) Apply the remaining half of nitrogenous fertilizer at first irrigation.
7) In rainfed conditions, all the fertilizer should be applied at the time of sowing as basal.

Field Inspection

The best time to access cultivar purity is after ear-emergence when seed has started to fill. Latter inspection when glume and seed colour can be observed

Irrigation

- Depending on the soil, four to six irrigations may suffice.
- The first irrigation should be given at crown root initiation stage, about 30-35 days after sowing.
- Other irrigations should be given at late tillering, late jointing, flowering, milk and dough stages.
- Two to three extra irrigations may be needed on light soils.
- In case of zero tillage, first irrigation should also be applied similar to conventional tillage.
- Crown root initiation and heading stages are the most critical to moisture stress.

Interculture

- Timely weeding and interculture are essential.
- Weed control by Periodic hoeing and weeding.
- For control of broad-leaved weeds spray 2-4 D at@ 0.5kg active ingredient per hectare in 750 liters of water after 25 to 30 days of sowing.
- For control of Phalaris minor or wild oats make a pre-emergence application of Penda methalin (stomp) @ 1 kg per ha in 750 liters of water or spray Isproturon @ 1 kg per ha in 750 liters of water after 35 days of sowing.

Roguing -Two or three roguings may benecessary

First roguing :- Just ahead of the flowering stage, or during flowering to remove any ff-type plants which are obvious at this state of growth.
Second roguing : Just after flowering is completed, and before the crop starts to turn colour.
Third roguing: should be done after the ear heads turn colour and start to mature.

Harvesting and Threshing

- Soon after maturity, the seed crop should be harvested to avoid shattering and losses due to uncertain weather.
- Most suitable stage is grain moisture of 20-25%.
- Mechanical harvesting is a common practice for seed

▪ production fields.-

Breeder and pre-basic seed are harvested by plot combine and do not constitute many problems.

foundation and certified seeds have to be harvested with commercial combine harvesters.

The most critical factors to be considered are :

- seed moisture content,
- mechanical damage
- cleanliness of equipment.
- For seed crops, dry weather during ripening and
- harvesting is essential.
- Threshing or combine harvesting at 16 to 19 percent moisture content reduces mechanical damage (Thompson, 1979).
- Harvesting may be done by sickle, Combine orreaper, and later the threshing with stationary thresher.
- Threshing should be done promptly.
- Threshing equipment should be cleaned after threshing other wheat varieties.
- The threshing floor must be thoroughly cleaned to prevent mixtures.
- Care must be exercised to ensure that laborers do not mix the harvested certified seed with other wheat on the farm.

Minimum Sample Weight for testing wheat Seeds(ISTA, 2007)

Maximum weight of Seed lot (Kg)	Submitted Sample (g)	Working Sample (g)	Working Sample for Counting of other Species (g)
30,000	1000	120	1000

- **Prescribed Seed standard for seed Certification(ISTA)**

Class of Seed	Off-type	Pollen shading	Object-able plant	Plant head affected by designated disease
Foundation Seed	0.050	-	0.010	0.10
Certified Seed	0.1	-	0.020	0.50

Seed Class	Germination %	Moisture	Pure seed (min)	Inert matter %	Other crop seed (max)	Object-able Weed Seed(max)
Foundation Seed	**85**	**12.0**	**98**	**2**	**10**	**10**
Certified Seed	**85**	**12.0**	**98**	**2**	**20**	**20**

Exercise No. 03

Study of mechanization and Resource conservation in rabi crops

Zero tillage (ZT) technology plays an important role in the sustainable intensification of rice–wheat cropping system and adoption of better-bet management practices, such as timely crop establishment, in India. Nearly two decades ago, ZT was first introduced to help farmers reduce tillage costs and advance the planting time of wheat and other Rabi crops. In successive years, ZT marked the evolution of the concept of conservation agriculture in rice–wheat cropping systems. ZT now offers significant opportunities in cropping system optimization for greater system productivity, especially in the eastern Indo-Gangetic Plains of India. As the majority of farmers in rice–wheat cropping systems still burn the residues of the rice crop to enable their rapid disposal before wheat sowing, recent advances in ZT makes it possible to sow wheat successfully into heavy residues and facilitate the use of residues as mulches for weed suppression and moisture conservation. One example is the Happy Seeder that can seed wheat in heavy residue mulch of up to 8 to 10 t/ha without any adverse effect on crop establishment.

The productivity advantages of ZT wheat result from earlier planting (and thus avoiding terminal heat damage during

the grain filling stage), control of *Phalaris minor,* a major weed of wheat, better nutrient management and water savings.

- Other advantages include improved soil and water conservation, increased use of land through intensification of cropping systems, reduced labor and energy requirements, reduced equipment inventories, reduced wear and tear on tractors and equipment, and greater environmental benefits.
- ZT reverses the loss of soil organic matter that happens in conventional tillage. Improves soil quality and water retaining capacity by adding organic matter. As crop residues decompose, this creates an open soil structure that lets water in more easily, reducing runoff.
- Helps reduce CO2 emissions and mitigate the adverse effect of global warming.
- ZT use leads to reduction in air pollution by minimizing crop residue burning.
- Improves the biological diversity of soil that increases the number of beneficial insects and keeps many insect pests in check.
- Establishing the wheat crop through zero tillage can be undertaken as a business Zero tillage (ZT) can be defined as the placement of seed into the soil by a seed drill without prior land preparation. A common definition of zero tillage (i.e., no-till) specifies that 30 percent of the soil surface should be covered by crop residues at the time of planting. Zero tillage improves the total productivity, meaning the efficiency of labor and capital used.

A tractor-drawn ZT seed-cum-fertilizer drill is the core of the technology, allowing wheat seed to be sown directly into unploughed fields with a single pass of the tractor, often with simultaneous basal fertilizer application, especially phosphorus. It can also be used for planting other crops like lentil, chickpea, mustard, green gram, rice and maize.

A tractor-drawn ZT seed-cum-fertilizer drill

Combine Harvester - Is a machine which harvests the grain crops by comprising the three separate operation activities of harvesting. Those are:

1. Reaping { Harvesting }
2. Threshing
3. Winnowing these 3 operations are combined to form a single process in the combine harvester.

- FUNCTION OF COMBINE HARVESTER Feeding the standing crop to the cutter bar with the help of reel Cutting the crop Feeding the crop to threshing unit Threshing the crop Separating the husk from grains Cleaning the grains Conveying and storing the grain
- BEFORE OPERATING COMBINE HARVESTER Before operating the combine harvester in field we should check the followings in the field: Height of cutting, Moisture content , Crop condition ,Field condition.
- IDEAL REQUIREMENT'S OF A PERFECT COMBINE HARVESTER 1. Less broken grains 2. No grain loss on the ground at the cutter bar end 3. No grain losses at the back end of the harvesting unit 4. No un-thrashed grain 5. Should give clean grains 6. Machine should be capable of operation on crop even with higher moisture content 7. Machine should be capable of working on various crops 8. Easy to operate 9. Easy to maintain 10. Should consume less fuel

Combine Harvester

1.Standing crop 2.Reel 3.Cutter bar 4.Conveyor 5.Threshing drum 6.Sieves 7.Straw walkers 8.Unloader 9.Straw spreader

Exercise No. 04

Study of physical and chemical properties of the allotted Plot to the students

Objects: - 1. To know the physical properties of the soil.
2. To know the chemical properties of the soil.

Introduction: -

Soil is defined as natural body consisted of mineral, organic matter and other living material in which plants grow. It is a natural body developed as a result of pedogenic process that takes place during and after weathering of rocks in which plants and other forms of life are able to grow.

Components of the soil: - Soil is mainly composed of

1. Mineral matter **:-** (45%) obtained from disintegration and decomposition of rocks.
2. Organic matter **:-** (5%) obtained by decay of plant residues and microbial tissue.
3. Water **:-** (20-30%) obtained from rains, snow, dew etc.
4. Air and gasses **:-** (20-30%) obtained partly from the atmosphere and partly as a result of reaction and microbial activities taking place in the soil.
5. Organisms **:-** Two types macro organisms like rodents, worms, insects etc. and micro organisms like bacteria, fungi, actinomycetes etc.

A) Physical properties of the soil: - The physical properties of soil depend primarily on size. Shape and arrangement of its mineral and soil particles. The important physical properties of the soils are as under.

1) Soil Texture	2) Soil structure	3) Absolute-particle density
4) Bulk density	5) Porosity (Pore space)	6) Soil colour
7) Volume/weight of soil	8) Soil water	9) Soil consistency
10) Soil air	11) Soil temperature	12) Soil organic matter etc.

B) Chemical properties of the soil: -

The chemical properties of soil are important, as they are closely related to the capacity of the soil to supply plant food nutrient's. They are largely govern the fertility of the soil. The important chemical properties of the soils are as under.

1) Soil reaction (Soil pH) 2) Cation and anion exchange capacity (CEC)

3) Soil solution 4) Soil colloids 5) Organic matter

C) Classification of soils according to availability of nutrients and recommended dose of fertilizer.

Sr. No.	Class of soil	Organic carbon (%)	Available NPK (kg/ha)			Dose of nutrients according to nutrient availability
			N	$P_2 0_5$	K_2O	
1	Very low	below 0.20	below 140	below 15	below 120	50% more
2	Low	0.21 – 0.40	140 – 280	16 – 31	121 – 180	25% more
3	Medium	0.41 – 0.60	280 – 420	31 – 50	181 – 240	As per RDF
4	Medium high	0.61 – 0.80	420 – 560	51 – 65	241 – 300	10% less than
5	High	0.81 – 1.00	560 – 700	66 – 80	301 – 360	25% less than
6	Very high	above 1.00	above 700	above 80	above 360	50% less than

D) Formula for calculation of available N, $P_2 O_5$ and K_2O in soil.

1) 1 hectare = 2240784 kg soil (15 cm depth)

$$\text{2) Available N Kg/ha} = \frac{\%\ N\ (g) \times 2240784}{1000}$$

$$\text{3) Available } P_{2os} \text{ Kg/ha} = \frac{\%\ P_{2os}\ (g) \times 2240784}{1000}$$

$$\text{4) Available } K_2O \text{ Kg/ha} = \frac{\%\ K_2O\ (g) \times 2240784}{1000}$$

A) Physical Properties of the allotted plot:

i) Soil Texture 1) Sand % _____ 2) Silt % _____ 3) Clay%_____

ii) Soil Textural class _____

iii) Soil structure _____

iv) True or Absolute sp. Gravity (Particle density) _____

v) Apparent specific gravity (Bulk density) _____

vi) Pore space (Porosity) _____

vii) Soil consistency (Plasticity) _____

viii) Soil colour _____

ix) Soil temperature _____

x) Soil Water _____

1. Maximum water holding capacity: _____

2. Field Capacity: _____

3. Permanent Wilting point: _____

4. Available water capacity: _____

B) Chemical properties / Analysis of the allotted plot –

i) Soil pH :

ii) E.C. of soils :

iii) Organic carbon :

iv) Available N :

v) Available P_2O_5 :

vi) Available K_2o :

vii) $CaCO_3$:

Assignment:-

1. Draw the diagram of equilateral triangle for determination of textural class of Soil
2. Suggest dose of N, P & K for Wheat crop according to available N, $P_2 O_5$ & K_2O of the allotted plot.

Exercise No. 5

Study of package of practices for growing Wheat crop (Timely, Late and Rainfed)

Botanical Name: -*Triticum Spp.* **Family** :-Poaceae

A) Economic importance of Wheat: -

1. It is important staple food in India next to rice.
2. Wheat contains 10 to 12% Protein, 57% Carbohydrate and 2-4 % lysine Wheat Protein is a good source of thiamine, nicotinic acid and other B-Vitamins.
3. It is used in preparation of baked products e.g.. Bread, flakes, cakes and buiscuits etc.
4. Wheat grain is also used in preparation of *Halwa, dalia, sevya, maida, Rava, upma, chapaties* etc.
5. Wheat protein contains characteristic substance 'gluten' which provides spongyness to the bread essential for bakers.

B) Origin and History: -It is originated from South Western Asia (Turkey). Aryan's introduce Wheat in India.

C) Area and distribution: - Wheat is grown all over world over an area of about 215 million ha. with a production of 584 million tones of grain. The important Wheat growing countries are China, India, USSR and USA. India ranks second in area and production of Wheat. Production of India in the year 2006-07 were 73 million tones. Important states growing Wheat are U.P, Punjab, Haryana, M.P., Bihar, Rajasthan and Maharashtra , U.P. stands 1st in area and production of Wheat but productivity was highest in Punjab.

D) Classification: -

Wheat is annual plant which belongs to poaceae family and genus Triticum. Although as many as 18 species of Wheat have been described following four species are economically important and in cultivation.

1. *Triticum aestivum*: -It is also known as soft Wheat or sarbati Wheat or bread Wheat. It is used for preparation of chapaty and bakery products.

2. *Triticum durum*: - It is also known as Hard or Bansi or macaroni Wheat. It is used for preparation of *Suji, Rava, Sevya, Maida* etc.

3. *Triticum dicoccum*: -It is also known as Emmer or khapli Wheat. It is used for preparation of South Indian dish e.g. Uppama. In Western Maharashtra it is used for preparation of "*Kheer*".

4. *Triticum spherococcum*: -It is also known as Indian dwarf Wheat or Club Wheat.

Amongst these four ***Triticum aestivum*** is most important species accounting over 87 per cent of the total Wheat production of India followed by the durum Wheat (about 12%) and dicoccum Wheat (about 1 per cent.)

E) Crop morphology: -Wheat plant can be divided in two distinct parts viz root system and shoot system.

1) Root system: - i) Primary root system or Temporary roots: -

It forms at the time of germination and absorb nutrients for the young seedlings. As the plant growth progresses, the primary root system usually dies and is replaced by the more permanent secondary root system.

ii) Secondary root system or Permanent roots: - It arises at a point above the primary root system at the primary organ of absorption till maturity arises near the soil surface at the time of crown root initiation stage (usually, 21- 25 days after sowing).

2) Shoot system: -

i) Stem: - The stem is round or cylindrical generally hollow except at the node.

ii) Leaves: - Leaf consist of four parts.

a) Leaf sheath: -It is basal part of leaf, it protect the growing point and auxiliary buds from weather.

b) Leaf blade: - It is flattened with parallel veined portion.

c) Ligule: - A membranous portion at the junction of the sheath and blade on the side of the leaf. The continuation of the sheath through the collar is known as ligule.

d) Auricle: - These are lobes of the leaf blade which extend down word on each side at the junction of the blade and sheath.

iii) Inflorescence: -

The flowering portion of the Wheat plant is called ear or head but in botanical language, it is a spike. Spikelets are systematically arranged on the common axis. The central zigzag axis is the rachis. The spikelets are alternate.

Spilelet is composed of flowers called florets. The number of florets in a spikelet may vary from 1-5.

Florets: - The outer covering of a floret is made up of a lemma and a palea.

Kernel: - The typical Wheat kernel is from 3-10 mm in length and 3-5 mm in diameter.

F) Climatic requirement: - It requires cool, moist weather during its major portion of growing period followed by dry warm weather towards maturity. Temperature requirement at various growth stages of Wheat is as follows.

1) Germination- 20 - 25^{0}C 2) Tillering- 16 - 20^{0}C
3) Grain filling- 23 - 25^{0}C 4) Base temp- 5^{0}C

Wheat can be grown effectively where annual rainfall is 700 to 1600 mm. Rains after germination results into seedling blight. Warm and damp climate is not suitable. For maximum number of effective tillers, wheat requires about 55 – 60 days of cool climate during early stages of growth. When cloudy weather is coupled with high temperature then crop suffers from rust disease.

G) Soil: -Wheat prefers clay loam or loamy textural soils with good drainage and moderate water holding capacity soil pH Requirement for Wheat is 6.5 to 7.5. Information regarding Land preparation, seeds and sowing, Fertilizer management, inter-cultivation, water management, plant protection, harvesting and threshing are discussed in further exercises.

H) Rotations and inter cropping: - a) Crop Rotations:-

i) Soybean -Wheat ii) Paddy - Wheat iii) Maize - Toria - Wheat

b) Intercropping:- Wheat + Mustard (9:1)

I) Varieties: - 1. Varieties of *Triticum aestivum*

Sr. No	Name of Variety	Duration (Days)	Grain Yield (Q/ha.)
i) Timely sown varieties			
1.	AKW 1071 (Purna)	110 – 115	30 – 35
2.	HD 2189	115 – 120	35 – 40
3.	AKAW 3722 (Vimal)	110 – 115	30 – 35
4.	DWR – 164	120	40 – 45
5.	Parbhani 51	120 – 125	38 – 40
6.	HD 2380	110 – 115	30 – 35
7.	Tall varieties: NI 747-19, NI 5643, NIAW-301	115 – 120	15 - 20
ii) Late sown varieties			
1.	AKW 381	90 – 95	35 – 40
2.	HI 977	105	30 – 35
3.	HD 2501	110	35 – 40
4.	NIAW 34	100	40 – 42
5.	DWR 195	110	35 – 40
6.	Kailas	115 – 120	32 – 35
iii) Rainfed varieties			
1.	NI 5439	115	10 – 12
2.	MACS 1967	105-110	8-10
3.	Ajintha	90 – 95	14 – 15

2. Varieties of *Triticum durum*.

a) Tall Varieties: - NI 146, Pusa – 6 , N-59, N-5749

b) Dwarf Varieties: - AKDW- 2997-16, HD-4502, Vijay, MACS- 2846, MACS-2496, MACS – 9, NIDW-15, , Panchvati

3. Varieties of *Triticum dicoccum* :-

NP – 202, DDK-1027, DDK-1009, NP-200

First dicocccum variety in Maharashtra have developed in the year 2008 by Agarkar Research Institute, Pune was **MACS-2971** (Yield : 50 - 52 Q/ha.)

* 3 gene dwarf verities in Wheat: - Heera, Moti, Arjun

* Triticale is cross between Wheat and Rye.

Assignment: -

1. Draw a diagram of Wheat plant and labeled the root and shoot parts.
2. Prepare leaflet on wheat cultivation
3. Explain crown root initiation in wheat.

Exercise No. 6

Preparation of calendar of operation for Wheat

Objects: -

1. To study the various operations required for Wheat crop.
2. To know the labour unit required for various operations to be carried in Wheat crop.
3. To make timely arrangement of inputs and labours for carrying various operations for Wheat crop,
4. To know the cost required for various operations.

Definition: -

It is a statement of work schedule indicating the type of operations to be carri ed out in all farm crops during a specified period,

Method of preparation of calendar of operation: -

1. Prepare a list of crops to be grown in the farm.
2. List out chronologically all operations separately for each crop.
3. Fix up the time limit for each operation for various crops to be done month wise.
4. Fix up the priority of operations cropwise.
5. Estimate the manual and bullock power required for each crop.
6. All operations starting from preparatory tillage to threshing and winnowing for all crops should be included.
7. It should be in a such way that all operations scattered throughout the year and there should not be slack season.

Assignment: -

Problem: - Prepare a calendar of operation for growing wheat on an area of one ha and 2 R.

Calendar of operation for Wheat:

Sr. No.	Month & Weeks No.	Operation to be carried out	Implement required	Labour unit					
				M		F		BP	
				2R	**1 ha**	**2R**	**1 ha**	**2R**	**1 ha**

Exercise No. 7

Study of preparatory, secondary tillage and seedbed preparation for Wheat.

Object: -

1. To know the various operations to be carried out in preparatory tillage operation for making friable and loose seedbed for easy and optimum germination and good growth of wheat.
2. To know the various implements, cost required for carrying preparatory and/secondary tillage operations.

Introduction: -

Tillage is defined as a physical manipulation of soil with suitable tools and implements to result good soil tilth for better germination and subsequent crop growth and yield.

Preparatory tillage: -

It includes proper leveling and mixing of F. Y. M. in the soil, planking and lay out of field for sowing the crop.

Secondary tillage:-

It includes harrowing and mixing of F.Y.M. in the soil, planking and lay out of the field for sowing the crop.

Land preparation for a Wheat: -

Wheat requires well-pulverized firm and fine but Compact seed bed. After the harvest of *kharif* crop the field should be deep ploughed with the help of M. B. Plough followed by 2 to 3 harrowing. The stubbles and residues of previous crop be collected and burnt off and make field clean. Planking is done after each harrowing to level the seedbed. Before last harrowing apply 10 to 15 t of FYM/ha.

Preparation of sara or broad bed: -

For irrigated Wheat, field is divided into no. of strips called as sara or broad furrow with the help of sara yantra. Width of sara should be 2 to 4 m, however, length depends upon slope and type of soil. (6 to 8 m).

On shallow and medium soil the length of sara should be less. On leveled and deep clay soils the length may be more. These strips are divided into flat beds by preparing furrows across the sara with the help of ridger, which may serve as irrigation channels. The bunds of the saras are mended with manual labour with the spade.

Observations to be recorded: -

Sr No.	Operation carried out	Date of Operation	Labour used **M F BP**	Implement used	Area covered (m^2)
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					

Calculations: -

i. Calculate total labour unit required per plot for preparatory tillage.

ii. Calculate labour unit required per ha. for seedbed preparation.

iii. Calculate total cost required for seedbed preparation.

a. Per plot

b. Per ha.

Exercise No. 8

Sowing and seed treatment of Wheat

Objectives: -

1. To know the various seed treatments to be carried out in Wheat.
2. To know the cost of seed treatment to Wheat.

Introduction: -

Seed treatment is defined as a process of treatment of seed with various substances i.e. water, fungicides, growth regulators, nutrient solutions or any other physical treatment before sowing the seed for various purposes or objectives.

Objectives of seed treatment: -

i. Preventive control measure against pest & diseases-
ii. Breaking of seed dormancy
iii. Convenience in sowing
iv. Quicker germination
v. For N fixation
vi. Enhancing crop growth

Seed treatments to Wheat Seed: -

1 Thiram @ 3g/kg seed to control fungal diseases.
2 Vitavax @ 2g/kg seed or solar heat treatment to control loose smut.
3 Azotobactor @ 25g/kg seed to fix atmospheric nitrogen asymbiotically.

Procedure for seed inoculation with Azotobactor: -

Prepare a Jaggery solution by adding 125 of Jaggery in 1.25 litre of water. Boil the solution, cool it and add 250 g. Azotobactor culture in Jaggery solution. Stir it properly and pour on the 10 kg seed. Treat the seed thoroughly and dry under shade before sowing.

Observation and Calculations: -

i) Calculate the required quantity of seed.
   i. Per plot …… ii. Per ha. ……
ii) Calculate required quantity of thirum / Azotobactor.
   i. Per Plot …… ii. Per ha ……
iii) Calculate labour unit required / plot
   a. Labour required for treating the seed / plot
   b. Time required to treating the seed / plot

i) Calculate labour units required / ha

ii) Calculate cost of thiram required

i. Per Plot …… ii. Per ha ……

iii) Calculation total cost required for seed

i. Per Plot …… ii. Per ha……

Sowing of Wheat: -

a) Sowing time: -

Rainfed - 15 – 30th October.
Timely sown irrigated Wheat - 01 – 15th November.
Late sown irrigated Wheat - 15 Nov. to 15th December.

Delayed sowing causes reduction in yield.

b) Method of sowing: - Drilling with the help of two bowl seed drill or seed cum ferti drill.

c) Seed rate: -

1. Rainfed Wheat - 75 – 80 kg/ha.
2. Timely sown irrigated Wheat- 100 to 125 kg/ha.
3. Late sown irrigated Wheat - 125 to 150 kg/ha.

d) Depth of sowing: -

1. Rainfed Wheat (Tall varieties) - 8 – 10 cm.
2. Irrigated Wheat - 4 – 5 cm.

Mexican dwarf varieties of wheat should be sown at shallow depth because of short coleoptile length.

e) Spacing: -

i) Rainfed and timely sown irrigated Wheat - 22.5 cm bet^{n} row to row.
II) Late sown irrigated Wheat - 15 – 18cm bet^{n} row to row.

f) Plant population / ha: - 18 – 20 lacs/ha.

g) **Sowing direction:-** North-South

Observations and calculations: -

1. Date of sowing :-
2. Method of sowing :-
3. Row to row spacing :-
4. Variety :-
5. No. of rows per plot :-

Labour unit (Sowing)

i) No. of labour engaged / plot

ii) Time required for sowing / plot

8) Calculate labour unit required / plot

9) Calculate labour unit required / ha

10) Calculate time required / ha

a. Cost of seed + cost labour unit

11) Calculate sowing cost including labour cost / ha

Assignment: -

Calculate the seed required for your plot area if the seed rate is 100 kg/ha.

Exercise No. 9

Study of Integrated Nutrient management of Wheat.

Objects: -

1. To know the nutrient requirement of Wheat.
2. To know the method and time of application of nutrients to Wheat crop.
3. To know the labour unit cost and cost of nutrients requirement.

Nutrient management of Wheat: -

Apply 10 to 15 t of FYM or compost before last harrowing. NPK dose for Wheat is as follows.

1. Rainfed Wheat	-	40 : 20 : 20 kg NPK/ha.
2. Timely sown irrigated Wheat	-	120 : 60 : 60 kg NPK/ha.
3. Late sown irrigated Wheat	-	80 : 40 : 40 kg NPK/ha.
4. Under limited irrigation	-	60 : 30 : 00 kg NPK/ha.
5. For Tall Niphad varieties	-	75 : 50 : 50 kg NPK/ha.

For rainfed Wheat full dose of NPK should be applied at the time of sowing. However, under irrigated condition half dose of nitrogen and full dose of P & K should be applied at the time of sowing with the help of two bowl seed drill. Remaining half dose of nitrogen should be broadcasted at the time of first irrigation i.e. 18 – 21 DAS.

For Integrated Nutrient management of Wheat the seed should be inoculated with Azatobactor and PSB 250g per 10 to 12 kg of seed.

Observations and calculations: -

i) Calculate quantity of fertilizer required (Basal dose)

a) Per plot - Urea_____ SSP_____MOP_____

b) Per ha - Urea_____ SSP_____MOP_____

II) Calculate quantity of fertilizer required for top dressing

a) Per plot - Urea_____

b) Per ha - Urea_____

III) Calculate cost of fertilizer application

a) Per plot - _____

b) Per ha - _____

Calculation for fertilizer for wheat crop on the basis of soil test report.

Available N = 190, P2O5 = 14 kg, K = 500 kg

Sr. No	Nutrient	Formula	Nutrient required for 45 Q/ha yield on the basis of soil test report.
1.	N Kg/ha through fertilizer.	(7.54 x Expt. yield q/ha)	(0.74 x available N kg/ha) N-199 kg. Urea- 432 kg.
2.	P_2O_5 kg/ha through phosphatic fertilizer	(1.90 x Expt. Yield q/ha)	(2.88 x available P_2O_5 kg/ha) P_2O_5 - 45kg, SSP-280 kg
3.	K2 kg/ha through Potosh fertilizer	(2.49 x Expt. Yield q/ha)	(0.22 x available K_2O kg/ha) K-2kg, MOP-5kg

Assignment: -

1. Calculate quantity of Urea, SSP and MOP for Wheat crop grown on 2 R area.
2. Calculate quantity of 18:18:10, Urea and MOP for late sown irrigated Wheat grown on 1 ha area
3. Calculate dose fertilizer for your plot on the basis of soil test report.

Exercise No. 10

Study of water management to Wheat

Objects: -

1. To know the water requirement of Wheat.
2. To know the critical growth stages of Wheat for irrigation.

Management of irrigation water is most important in Wheat. Adequate soil moisture is required for normal development of Wheat plant at all the stages of growth.

Irrigation Layout: -

For irrigated Wheat, after the seedbed preparation, saras (Broad bed) are prepared dividing the field in the number of strips with the help of "sara yantra". The width of sara should be 2 to 4 m. The length depends upon and type of soil. (Generally, 6 to 8 m.)

Water requirement: - 45 to 50 cm

Irrigation scheduling: -

Based on different approaches for irrigation scheduling recommendations for Wheat are as follows.

1) Soil moisture depletion Approach: - Generally Wheat is irrigated at 50 to 75 per cent depletion of soil moisture.

2) Climatological approach: - In this approach, a known amount of water (IW) is applied when cumulative pan evaporation (CPE) reaches a pre-determined level. The amount of water given at each irrigation ranges from 4 to 6 cm. according to soil type. Generally, irrigation is scheduled at 0.75 to 0.8 ratio with 5 cm of irrigation water.

3) Critical growth stage approach: - Critical growth stages of Wheat are crown root initiation, maximum tillering, late jointing, flowering, milk stage and dough stage. If irrigation is applied at every critical growth stage, maximum yield can be achieved.

Irrigation and water management to Wheat: -

For normal growth and development, Wheat requires about six irrigations, excluding pre-sowing irrigation. Depth of each irrigation should be 6 cm. The scheduling of irrigation based on critical growth stages is as follows.

Sr. No.	Growth Stage	Days after sowing
1.	Crown root initiation	16 to 20
2.	Maximum tillering	30 to 35
3.	Late jointing	45 to 50
4.	Flowering	65 to 70
5.	Milk stage	80 to 85
6.	Dough stage	95 to 100

If the quantity of irrigation water is limiting factor, it should be managed as under.

1. Only one irrigation - 21 DAS
2. Two irrigations - 21 and 65 DAS
3. Three irrigations - 21, 42 and 63 DAS
4. Four irrigations - 21, 42, 63 and 84 DAS

Observations: -

1. Variety :
2. Date of sowing :
3. Critical growth stages :
4. Date of irrigations :
5. Water measuring device used :
6. Area to be irrigated :
7. Time required in (hrs.) :
8. Discharge / second (lit) :
9. Total water required (lit.) :

Assignment: -

1 Identify critical growth stages of Wheat, draw diagrams and labeled.

2. Calculate cost of each irrigation and total irrigations for 1 hectare and for 2 R area.

Exercise No. 11

Title: - Determination of germination/emergence percentage of Wheat.

Objects: - 1. To know the germination percentage of seed.
2. Adjust seed rate for maintaining optimum plant population per hectare.

Germination is the development of seedling from the seed embryo which is able to produce a normal plant under favorable conditions. Plant population per hectare is the most important production factor for obtaining higher yield. For this purpose grower must know the germination percentage of seed which is being used for sowing. Seed rate can be adjusted according germination percentage for obtaining optimum plant population.

Types of germination: -

i) Epigeal: - In which cotyledons come above the soil surface and generally become green and photosynthetic.

ii) Hypogeal: - In which cotyledons do not come above the soil surface.

Methods of testing seed germination.

1. Paper method: -

The paper should be soak in water for 2 - 4 hours to moisten it evenly and to remove water soluble toxic substances. If present, paper may be used for seed germination in one of the several ways listed below:

a) TP (Top of paper)
b) BP (Between paper)
c) PP (Pleated paper)

When seeds are germinated in paper first count may be taken after 4 days. Final count may be taken after 12 days. If seedlings are weak then the germination period may be prolonged. By taking final count germination percentage may be calculated.

$$\text{Germination \%} = \frac{\text{Actual no. of germinated seed}}{\text{No. of seed put for germination}} \times 100$$

***2.* Petri-dish method*:* -**

Two blotters or filter papers are placed on the bottom of the Petri-dish and they are soaked with water. Number of blotters can be increased or decreased according to the need of water by seed during germination and size of the seed. A convenient number of seeds, ranging from 10-20, depending upon their size are placed on the surface of water-soaked blotters in the Petri-dish. The kind of seed, date and time of seed soaking are written on the glass-over of Petri-dish with the help of a glass marking pencil. Usually, the germination percentage is calculated and reported on the basis of the results of germination of about 100 to 200 seeds.

3) Sand method: -

Sand is used as substrate for testing seed for germination. Sand is to be put in a metalytic or plastic boxes. Then moist the sand and put seeds uniformly in a moist sand cover the seed with moist sand having 1-2 cm layer. Then required amount of water to be added to the sand boxes daily till germination takes place. Then normal seedlings should be counted and calculate germination percentage.

Emergence percentage: -

Emergence percentage is calculated after sowing the seeds in the field when germination completely takes place. After sowing the when complete germination take place than number of plants emerged in the plot are to be counted physically. Then on the basis of theoretical plant population and actual emerged seedlings, emergence percent is to be calculated.

Observations and calculations: -

1. Date of sowing
2. Date of observation
3. Plot size
    a) Length of plot row
    b) Spacing between two rows
    c) Spacing between two plants
    d) No. of lines/plot:
4. Calculate theoretical plant population/plot (A) _____
5. Actually No. of seedling emerged-/Plot (B) _____
6. Calculate emergence % {(B/A) x 100} _____

Exercise No. 12

Study of growth and yield contributing attributes in Wheat.

Objects: -

1. To study various growth stages of Wheat crop.
2. To study growth and yield attributes of Wheat.

Growth stages of Wheat: -

Different growth stages of Wheat are as follows

1. Germination and emergence
2. Seedling
3. Crown root initiation.
4. Tillering.
5. Jointing
6. Flag leaf stage / Boot leaf stage
7. Boot stage.
8. Flowering
9. Milk stage
10. Dough stage
11. Maturity

Plant growth observations in Wheat: -

i) Growth contributing characters: -It includes plant height (cm), No. of tillers/plant, No. of leaves/plant etc.

ii) Yield contributing characters: - It includes, No. of earheads per metre row length, No. of spikelets per earhead, length of earhead, No. of grains per earhead, test weight (1000 grains weight), yield / plant (Grain & straw yield) etc.

Procedure for recording observations: -

Growth observations should be taken at fixed periodic interval i-e. at 30, 60, 90 DAS and at harvest. Select 5 plants randomly from a plot label these selected plants and record periodic observations.

Growth observations of Wheat crop: -

Plant No.	Plant height (cm)				No. of leaves/ plant				No. of tillers/plant			
	30	60	90	At Harvest	30	60	90	At Harvest	30	60	90	At Harvest
1												
2												
3												
4												
5												
Total												
Mean												

Observations of yield contributing characters: -

Plant No.	Length of earhead (cm)	No. of spikelets/earhead	No. of grains/spikelet	No. of grains/earhead	Yield (g)	
					Grain	Straw
1						
2						
3						
4						
5						
Total						
Mean						

Other observations: -

i) Date of emergence :

ii) Date of seedling stage :

iii) Date of Max. tillering :

iv) Date of boot stage :

v) Date of 50% flowering :

vi) Date of harvesting :

vii) Grain yield/plot (kg) :

viii) Grain yield/ha (kg) :

ix) Straw yield /plot (kg) :

x) Straw yield/ha (kg) :

xi) Grain to straw ratio :

Assignment: Define all the growth stages of wheat.

Exercise No. 13

Study of interculturing and weed management in Wheat

Objects: -

1 To Know the method, cost of interculturing required to Wheat crop.

Inter cultivation in Wheat: -

1) Hoeing: - In Wheat, only one hoeing with hand hoe or slit blade hoe is recommended at 15 DAS.

2) Weeding :- Critical crop weed competition period in Wheat is 30 to 40 DAS. Hand weeding should be followed at 20 and 40 DAS. For effective control of weeds following herbicides are recommended for wheat crop.

Name of Herbicide	Application Rate kg. (a.i/ha)	Time of application	Weeds controlled
1. Isoproturon	1.0 Kg	Pre-emergence or post-emergence at 25 – 30 DAS	Broad and narrow leaved weeds
2. 2 4 – D	1.0 to 1.25 Kg	Post-emergence at 25-30 DAS	Broad leaved weeds

Note: - 1) Use 700 lit. of water per ha. for soil application and 500 lit of water for foliar spray.
2) Select only one herbicide

Weeds Observed in Wheat crop: -

a) Monocot weeds: -

Phasalis minor is considered as mimicry weed in Wheat. Besider this following monocot weeds are observed in Wheat.

1) Wild oat - *Avena fatua*
2) Lavala / Nagarmotha - *Cyperus rotundus*
3) Haryali - *Cynodon dactylon*

b) Dicot weeds observed in Wheat: -

1) Bathua - *Chenopodium album*
2) Krisha neel - *Anagallis alba*
3) Senji - *Melilotus alba*
4) Chandvel - *Convonvulus arvensis*

5) Piwala Dhotra	-	*Argemone mexicana*
6) Ghol	-	*Portulaca Oleraceae*
7) Congress Weed	-	*Parthenium hysterophorus*
8) Badi dudhi	-	*Euphorbia hirta*
9) Math (chawali)	-	*Amaranthus viridis*
10) Ankri	-	*Vicia sativa*

Observations and calculations: -

1. Identify and list the weeds observed in your plot.
2. Calculate the labour required for weeding / plot & per ha.
3. Calculate total cost of weeding per plot & per ha.

Exercise No. 14

Title: - Study of Integrated insect, pest and diseases management in wheat

Object: - 1) To identify and control the various diseases and pest in Wheat.

Insect pests: -

Wheat is affected by a number of insect, pest and rodents.

1) Stem borer:

Attack of stem borer is observed in Wheat at heading stage.

Control measure: - 1) Uproot affected plants & burnt it.

2) Spray Carbaryl 50% @ 40g/10lit. of water

2) Termites: -

Termites damage the crop soon after sowing and sometimes near maturity. Infestation is heavy under unirrigated condition and in the fields where undecomposed FYM is applied before sowing.

Control measure: -

Mix 5% Aldrin dust @ 25kg/ha at the time of last harrowing before sowing.

3) Brown Wheat mites, Aphids and Jassids: -

These leaf sucking inseds results into discolouration of leaves.

Control measure: - 1. Rogor @ 10g/10lit of Water.

Rodents: -

Field Rats: -

They cause heavy loss to Wheat crop and do considerable damage to the harvested crops lying in stacks in the field.

Control measure: -

1) Use poison bait to control rats (50 parts Wheat or maize floor + 1 part Zinc phosphide + little edible oil) OR

Fumigate the burrows of rats in the morning time with aluminum phosphide @ 1 tablet of 0.5g per small burrow or 3.0g per large burrow.

Diseases of Wheat: -

1) Rusts: -

a) Brown Rust : *Puccinia recondita tritici*

b) Yellow Rust : *Puccinia striiformis*

c) Black Rust : *Puccinia graminis tritici*

Control measure: -

1) Grow resistant varieties viz. HD 2733, HD-2428.
2) Avoid late sowing of long duration varieties.
3) Spray Zineb or Mancozeb (Dithane M-45) @ 25g 1 lit of water.

2) Loose smut: -*Ustilago nuda tritici*.

Control measure: -1) Solar heat treatment or seed treatment with vitavax @ 2g/kg seed before sowing.

3) Karnal Bunt: - *Neovassia indica*

C.M. 1) Seed treatment with Agrosan GN @ 2.5g/kg seed.

2) Avoid excessive irrigation particularly during flowering of Wheat.

4) Alternaria leaf blight: - ***Alternaria triticina***

C.M. 1) Seed treatment with vitavax @ 2.5g/kg seed.

2) Applying adequate fertilizer and irrigation.

3) Spraying Zineb or Dithane M-45 @ 25g/ 10 lit of water.

Assignment:

1. Identify diseases and pests in your plot. Write their nature of damage.

Exercise No. 15

Study of crop maturity signs and harvesting of Wheat.

Objects: -

i) To know the maturity and proper time of harvesting of wheat crop.

ii) To know the method of harvesting of wheat crop.

iii) To know the labour cost required for harvesting of wheat crop.

Introduction: A) Maturity sings: -

The maturity period in Wheat varies from variety to variety.

Early Varieties - 90 – 95 days

Medium duration - 105 – 110 days

Long duration - 120 to 130 days

Signs of maturity in Wheat are as follows.

1) Leaves and stem turn yellow and becomes fairly dry.

2) Moisture content in grains 25 – 30 %

To avoid loss in yield, crop should be harvested before it is dead ripe. Delay in harvesting may result in damage by rats, birds, insects, shattering and lodging. Timely harvesting ensures optimum grain quality and consumer acceptance.

B) Harvesting: - Harvesting of Wheat normally done with sickles by hand. The crop is cut at about 15 cm from the ground level. It is tied into bundles and allowed to dry for 4 to 5 days.

Observation: -

1) Date of harvesting :

2) Age of crop at harvesting :

3) Labour required per plot for harvesting :

4) Time required per plot for harvesting :

5) Weight of plants immediately after harvest (W1) :

6) Weight of harvested produce after drying (W2) :

7) Loss in moisture (W1-W2) :

8) Calculate the loss of moisture % :

Calculations: -

1)Labour unit/plot for harvesting- 2) Labour unit/ha harvesting-

3) Cost of harvesting/plot- 4) Cost of harvesting/ha-

Assignment: -Identity signs of maturity on your plot.

Exercise No. 16

Threshing, drying, winnowing, storage and preparation of produce for marketing of Wheat

Objective:

i) To know the method of threshing of wheat crop.

ii) To know the labour cost required for threshing and marketing of wheat crop

Threshing in Wheat: -

It can be threshed by trampling under bullock feet or by tractor Now-a-days power thresher are used for threshing. In mechanized farming combine harvester cum thresher can be used which can do harvesting, threshing and winnowing of Wheat crop in single operation. Threshing be done with mechanical thresher having either wire loop cylinder or rasp bar cylinder. (550-600 RPM)

Harvest index:

It is the ratio of economic yield to total biomass production.

$$H.\ I. = \frac{\text{Economic Yield}}{\text{Biological Yield}} \times 100$$

Winnowing: -

It is process of separating grains from the threshed material or bhoosa using natural or artificial wind. When threshing machines are used, winnowing is done simultaneously with threshing.

Drying and storage: -

After winnowing, seed are dried in the sun up to moisture percentage of 10 to 12% for safe storage seeds are dried under sunlight to bring moisture content in grains up to 12%.

Preparation of produce for marketing:

Before marketing or storing the grains are dried in bright sunshine. Again cleaning and grading is adopted. The produce is filled in gunny bags or bins and then stored in rat proof godown.

Observation & Calculation: -

1) Date of threshing

2) Method of threshing

3) Time required for threshing per plot

4) Time required for threshing per ha

5) Labour required for threshing and cleaning/plot

6) Labour required for threshing and cleaning/ha

7) Grain yield per-plot

8) Cost of threshing/cleaning/plot

9) Cost of threshing / cleaning/ha

Assignments:

Calculate harvest index of wheat from following data.

1. Grain Yield : Per plot _____ Per ha. _____
2. Straw Yield: Per plot _____ Per ha. _____

2. How value addition can be done in wheat after harvesting.

3. What are the cares are to be taken while storing and marketing of wheat.

Exercise No. 17

Study of cost of cultivation of Wheat and working out net returns per student

Objectives: -

i. To study the cost per unit area required for various operations

ii. To study the total cost of cultivation per plot and per ha.

iii. To study the cost of production per unit of produce of Wheat

iv. To study the benefit cost ratio of Wheat

v. To study the cost of various inputs required for Wheat

Introduction: -

Cost of cultivation is a total expenditure incurred to any crop till the produce sold in the market. It is calculated by taking into consideration all the tillage operations. Following are the terms required for finding out the expenditure for production of crop.

1. **Preparatory tillage: -** Charges required for all essential preparatory tillage operations like, ploughing, harrowing, clod crushing, Leveling etc.

2. Manures & fertilizers: - Cost required for purchase of manures, fertilizer & its applications is taken into account.

3. Seeds and sowing:- Cost of seed & its sowing & material required for seed treatment.

4. Irrigation:- Irrigation charges depend upon season & duration of the crop and source of irrigation Number of irrigation's given are taken into consideration and charges incurred on it are calculated.

5. After tillage: - Expenditure required for after tillage operations like hoeing, weeding, plant protection measures and any other special operation carried after sowing are included under this item.

6. Harvesting & preparing for market: - This includes the charges required for harvesting of crop, threshing, cleaning drying & preparing it to market.

7. Marketing charges: - Generally, marketing charges are calculated 50 paise per 100 kg of produce & by product if any while calculating marketing charges. Labour required for grading the produce, transporting to market, charged by municipality and *hamali* charges are also included under this item.

8. Supervision charges: - These are calculated 10% on the total cost of production i.e. from preparatory tillage up to marketing of produce.

9. Interest on capital: - It is based on the half life period of the crop. It is calculate (a) 16% depending on that half period of crop.

10. Rent of land: - It depends upon the crop i.e. unirrigated of irrigated. It varies from Rs. 60 to 250 per ha for unirrated to irrigated respectively.

11. hire charges for application & depreciation charges: - It involves the higher charges of appliances such as implements, tools, sprayers dusters etc. required throughout period of crop.

COST OF CULTIVATION OF IRRIGATION WHEAT:

Sr. No.	Operation	Labour required			Cost (Rs.)	
		M	W	BP	Per plot	Per ha.
I	**Preparatory**					
	a) ploughing (1)					
	b) Harrowing (1)					
	c) Cold crushing (1)					
	d) Harrowing (2)					
	e) Collection of stubbles					
	f) Planking					
	Total					
II	**Seed and sowing**					
	a) Cost of seed @ Rs. 16 /kg					
	b) Sowing with two bowled seed drill					
	c) Covering the seed					
	d) Preparation of Saras, water channel					
	Total					
III	**Manure and fertilizers**					
	a) Cost of F.Y.M. 5t @ Rs. 300/t					
	b) Transport of F.Y.M.					
	c) Spreading of F.Y.M.					
	d) Cost of Urea					
	e) Cost of S.S.P					
	f) Cost of M.O.P. s					
	g) Top dressing of Urea					
	Total					

IV	**After care**					
	a) Gap filling					
	b) Hoeing (2)					
	c) Weeding					
	d) Irrigation (6)					
	e) Irrigation charges @ Rs. 100/irrigation for 6 irrigation					
	Total					
V	**Plant protection**					
	a) Seed treatment of thirum @ 3 g/kg for Thiram cost @ Rs. 17/100g packet					
	b) Treating seed with thium					
	C) Spraying (2) cost of dithane M – 45 – 2kg @ Rs. 110/500 g.					
	d) Labour charges for Spraying (2)					
	e) Foliar spray of Urea (2%)					
	Total					
VI	**Harvesting**					
	a) Cutting the plants & trying the bundles					
	b) Threshing with machine @ Rs. 50/q					
	c) Drying, cleaning, bagging					
	Total					
VII	**Marketing**					
	a) Grading (sieving) and transport					
	b) Octroi and other charges					

ABSTRACT

Sr. No.	Item of expenditure	Cost/plot (Rs.)	Cost/ha (Rs.)
1.	Preparatory tillage		
2.	Seeds and sowing		
3.	Manures and fertilizers		
4.	After care		
5.	Plant protection		
6.	Harvesting		
7.	Marketing		
	Total Cost of production (1 to 7)		
8.	Supervision charges (on basis of cost of production)		
9.	Interest on working capital @ 15% for ½ the life period of crop i.e. 60 days		
10.	Hired charges on implements and appliances		
11.	Land rent and taxes		
	Cost of cultivation (A) – (1 to 11)		
12.	**Yields (q)**		
	i) Grain - @ Rs. 850/q		
	ii) Bhusa @ Rs. 100/q		
	Total income (Receipt) = (B)		
13.	**Cost per (qts)** = Total Cost (A) / Yield (Main Produce)		
14.	**Net profit (C) =**		
15.	**B:C ratio =** Profit (C) / Cost (A)		

Exercise No 18

Study of post harvest technology of wheat

Objectives: -

i. To study the processing, cleaning, grading and packing procedure.

ii. To study the value addition technology.

iii. To study the cost of Wheat as per gradation.

Processing

- After a seed crop has been harvested, the seed, if necessary, has to be dried and cleaned.
- For wheat seed cleaning, mainly screens, indented cylinders and air screen cleaner are used
- Screens separate based on the width and thickness; a width (or diameter) separation is obtained by round screens, while for thickness separation oblong screens are used
- Indented cylinders carry out length separation; the indents (cells or pockets) in the cylinder will, depending on their size, lift the seeds, which fit in the indents.
- Air separates seeds according to their behavior in an air stream (seed density) . The most important characteristic is the weight; light particles (dust, chaff, glumes or empty or partly filled seeds) will be lifted, whereas the heavier seed will fall down through the air stream.

Pre-cleaner- It has one air channel to remove light material, one top scalping screen toremove large particles and one bottom grading screen to remove small particles.

Dryer- If wheat seed is above 11 to 12 percent moisture, it is dried before it goes into bulk storage or processing.

Air-screen cleaner

- This is the basic cleaner, usually with two air channels and, preferably, four screens.
- The first air channel removes dust and light materials as the seed falls from the feed hopper.
- The second air channel removes light seed and materials after the seed passes through the last screen.
- Screen configurations vary considerably, one or two top or scalping screens remove particles larger than the good seed, and one or
- two bottom or grading screens remove particles smaller than the goodseed.
- Because the average size of wheat seed varies according to the growing conditions, standard screen sizes cannot be
- recommended..
- In general size of Screen aperture for all wheat variety is:

Length separator

- A length separator is almost always used to clean wheat seed. By using the proper machine configuration, shorter or longer undesirable materials (such as broken grains, weed seeds, oat, barley, etc.) are removed. Broken grains and weed seeds, which are shorter than the good seed, are removed by using cylinders with smaller indents.
- Larger impurities can be removed by using a cylinder with indents that lift all good seed, but contaminants (wild oats, oats or barley grains and unthreshed glumes) remain in the cylinder.

Gravity separator

- The gravity separator classifies a seed mixture mainly according to density or specific gravity. It can be used to remove unthreshed glumes and soil particles, which have similar sizes to wheat but different weights.
- Another application is the removal of weevil-infested grains from the seed lot and upgrading seed (in order to improve germination).
- Furthermore, wild oats and some barley may be removed from the wheat seed lots.

Treater

- Wheat seed should, if necessary, be treated with the appropriate fungicide to protect the seed and seedling after planting.
- Insecticides are sometimes applied to protect seed in storage and in the soil.
- Treatments may be applied to protect the seedlings or adult plants against pathogens carried on or in the seed.

Dryer

- In humid and hot climates, seeds may be sealed in vapour- tight plastic bags to maintain viability over longerperiods.
- In such cases, wheat seed moisture content must be below 9 percent, preferably not over 8.5 percent. Usually, a dehumidified, closed-circuit dryer is used after the seed treatment is applied.

Bagger-weigher

- The final step is to weigh the proper amount of seed intothe proper kind of bag.
- Wheat seed bags should be of a size that fits local farmer needs (seed rates and field size).

Storage of wheat

- Seed should be harvested when it reaches harvest maturity, dried to a safe moisture content (if necessary), stored under favourable conditions and protected from damage and pests until it can be planted.
- Immature or damaged seed cannot survive long storage periods.
- Mechanical injury to seed during harvest or handling makes it more susceptible to deterioration in storage.
- seed should be properly dried before going into storage and protected from moisture and high relative humidity.
- Fungi *(Aspergillus* and *Penicillium)* cause damage to stored seed if seed moisture is high.
- High storage temperature has a damaging effect on seed. Stores should be designed so that low temperatures are maintained;
- In general, stored wheat seed should be kept at moisture content levels below 12 percent and relative humidity should not exceed 50 to 60 percent. The cleaned, bagged seed should be stored in a dry, insect and rodent proof warehouse.
- Effective rodent control (traps and poison) is essential in all seed stores.
- A complete programme of exclusion ,
- sanitation and control should be used;

Insects should be controlled by a combination of insecticides and fumigants. Use safest fumigants (e.g. Phostoxin) because some fumigants (e.g. methyl bromide

Assignments: Visit to Wheat processing plant and take a observations and write in this exercise.

Exercise No. 19

Summary report of practical crop production - II

Objects: - To know the procedure of writing of summary report of a given experimental crops.

Each student should write a summary report of Agronomical field work done in wheat crop in course No. 248 on the following points.

1. **Soil** of a given plot.

2. Climatic conditions: - Season report of *rabi* on various climatalogical parameters like temperature, humidity rainfall, rainy days distribution pattern of rainfall (Appendix I). The student should also compare *rabi* season with last 10 years data of various climatic parameters.

3. Effect of weather on wheat crop: - Mention the effect of various climatic parameters on germination, growth and yield of Wheat crop.

4. **Constrains** experienced while doing the various operations Management, availability of various inputs in raising the Wheat crop & suggest ways to over come the constraints.

5. **Profit of Wheat crop: -** Give logical reasons for profit or loss.

Assignments: - Write in detail summery report of wheat crop which you have studied in this course.(Attach separate page if needed)

Exercise No. 20

-Study of weekly weather record for Rabi season.

Weekly weather record for Mean maximum and minimum temperature, Rainfall, number of rainy days and humidity during Year ……. At College of Agril. ……

Month	Met Week No.	Temperature ^{0}C		Rainfall (mm)	Humidity %	
		Max.	Min.		Morning (0730 hrs)	Evening (1430 hrs)

INDEX

Practical Crop Production - II (Rabi Crops) Credit - 0 + 1

Ex. No.	Title of the Exercise	Page No.	Date	Sign.	Remarks
1.	Introduction, aims and objectives of practical crop production - II, allotment of plot and its history.				
2.	Study of seed production of rabi crops				
3.	Study of mechanization and Resource conservation in rabi crops				
4.	Study of physical and chemical properties of the allotted plot to the students.				
5.	Study of package of practices for growing Wheat crop (timely, late and rainfed)				
6.	Preparation of calendar of operation for Wheat.				
7.	Study of preparatory, secondary tillage and seed bed preparation for Wheat.				
8.	Sowing and seed treatment of Wheat.				
9.	Study of integrated nutrient management of Wheat.				
10.	Study of water management to Wheat.				
11.	Determination of germination/emergence count of Wheat				
12.	Study of growth and yield contributing attributes in Wheat.				
13.	Study of interculturing and weed management in Wheat.				
14.	Study of integrated insect pest and diseases management in Wheat.				
15.	Study of crop maturity signs, harvesting of wheat				
16.	Threshing, drying, winnowing, storage and preparation of produce for marketing of Wheat.				
17.	Study of cost of cultivation and working out net returns per student.				
18.	Study of post harvest technology of wheat				
19.	Summary report of Practical Crop Production - II				
20.	Study of weekly weather record for *Rabi* season.				

Certificate

This is to certify that Shri./Ku. _____

Enroll. No. _____ has completed practical of Course No. Agro – 3611 (N) (Practical Crop Production - II (Rabi Crops) as per the syllabus of B. Sc. Agri. (Hons.) second year fourth semester in the laboratory of College as prescribed by M. C. A. E. R., Pune

Date:- Course Teacher