Plant propagation and breeding in agriculture

Plant propagation is the process by which new plants grow from various sources, including seeds, cuttings, and other plant parts. Plant propagation may refer to both man-made and natural means.

Types of propagation

- Sexual propagation: occurs through the natural growth of viable seeds.
- Asexual propagation: allows for the creation of new plants using cuttings from vegetative parts, like the roots, leaves, and stems.

Selection of planting material

In order for a farmer to reduce the expenses the need to select the planting material that he is sure of.

Characteristics of a good planting material

1. Should be readily available within locality to reduce transport expenses and time wasted in looking for it.
2. It should be pest and disease free to reduce the transmission of such diseases and pest to the seedling.
3. It should be easy to transport i.e. should not be bulky.
4. In case, of seeds should be of uniform size and shape to allow easy mechanization during planting.
5. It should be easy to store so that it can used in future when needed.
6 In case of seed they should have passed the dormancy stage.
7. The planting material should be highly viable to reduce the costs involved in filling up the gaps where they did not germinate.
8. Seeds should be of uniform colour to allow easy sorting and planting.
9. The planting material should be of high proven performance give high returns once planted.
10. Materials should be free from contamination by weeds.
11. Should be free from mechanical damage.
12. In case of seeds, should be large enough.

Seed propagation

This is where seeds of mature plant having desirable qualities are used for planting.

Qualities of good seed lot for planting

- Should be viable
- Should be disease
- Should be free from mechanical damage
- Should be mature
- Should have appropriate size to ensure enough food reserve
- Should be free from contamination
- Should be of desired genetic make up
- Should be plump i.e. well-formed and not wrinkled

Reasons for drying seeds before storage

- To prevent molds and rot: seeds with high moisture rot easily
- Properly dried seed have long shelf life
- To prevent germination before planting
- To reduce pathogenic contaminations
- Maintain seed quality such good color

Advantages of propagation from seeds

1. Seeds are not bulky and therefore are easy to handle and convenient to transport.
2. They can be stored for a long time while retaining viability
3. Seeds are easy to treat against pest and seed bone diseases
4. Minimizes spread of disease from parents to offspring
5. They are cheaper planting materials
6. Seeds are easy to use during machine planting.
7. Seed planting is a quick method of increasing a crop population in a short period.
8. Some crops are difficult to plant from vegetative parts.
9. Plants raised from seeds have a longer life span than those raised by vegetative means.

Disadvantages of propagation from seeds

1. Some seeds are delicate hence difficult to handle during planting.
2. They promote spread of seedling or seed borne disease.
3. Seeds require special field preparation before planting more especially those with small seeds.
4. Some seed may not breed true to type hence disappoint farmers
5. The formation of seeds requires special condition during pollination and fertilization.
6. Due to interference during pollination seeds may be formed but of a high degree of variability.
7. Crops raised from seeds take a longer time to mature.
8. Some plants do not have viable seeds.

Analysis of seed purity

This refers to the process of determining whether the purchased seed or processed seed have contamination such as weed seeds, inert materials, stones, other crop seeds etc.

Percentage purity = $\frac{weight\ of\ pure\ seed}{total\ weight\ of\ seed\ sample}$

Seed treatment

- **Seed dressing** –coating seeds with pesticides e.g. copper Sulphate.
- **Chitting** or encouraging sprouting e.g. in potato seeds.
- **Inoculation**, usually done legumes where seeds are coated with correct bacterial for nodule formation.

  Importance of inoculation
  - Promotes formation of root nodules
  - Increases nitrogen fixation to the soil
  - Minimizes use nitrogenous fertilizers
- **Hot water treatment** against viral diseases e.g. in sugarcane and cassava.
- **Fumigation of seeds** is use of volatile chemicals in seed store to kill pests in the room

Seed viability

It is the ability of a seed to germinate and develop into a healthy seedling under favorable conditions**.**

Seed longevity

It is the period of time that seeds remain viable

Germination

It is the development of a seed into a seedling

Physiological processes that take place during seed germination

- **Imbibition** is the uptake of water by diffusion due to presence of solid particles or colloids in the seed causing the seed to swell.
- **Activation of hydrolytic enzymes** following uptake of water.
- **Hydrolysis** of storage food material into soluble products by hydrolytic enzymes
- **Translocation/transport** of soluble products (glucose and amino acids) from endosperm (storage area) to the actively growing centres of the embryo.
- **Synthesis** of enzymes, nucleic acids, structural proteins
- **Respiration** to provide energy for cellular activities
- **Cell division, elongation and differentiation** lead to immergence of a seedling from a seed. measures

Measures to increase the ability of seeds germination

- Proper drying of seeds before storage reduce moisture content and risks of pests and diseases
- Harvesting mature seeds
- Controlling oxygen supply during storage of seeds
- Maintaining proper temperature
- Treatment of seeds to avoid pest and diseases
- Proper seed bed preparation especially for small seeds
- Soaking seeds in growth stimulants
- Soaking seeds in water overnight before planting to soften their testa.
- Prechilling of seeds with hard coats to ease entry of water and air.
- Avoid prolonged storage of seeds.

Methods to determine the viability of seeds

- **Germination Test**: Place a specific number of seeds (e.g., 100) on a moist paper towel, fold it, and place it in a plastic bag. Keep it in a warm place and check after a few days to see how many seeds have sprouted.
- **Water Test:** Place seeds in a container of water. Viable seeds will sink, while non-viable seeds will float.
- **Excised Embryo Test**: This involves removing the embryo from the seed and placing it in a nutrient solution to see if it grows.
- **Chemical Test**: Some seeds can be tested using chemicals that react with living tissues, indicating viability.
    - Viable seeds soaked in 0.1% tetrazolium salt solution and left for 24 hours will have their embryo stained red.
    - Viable seeds decolorize warm potassium permanganate solution
- The **electrical conductivity test** measures the leachate's conductivity when seeds are soaked in water, providing an indirect assessment of seed viability.

Seed dormancy

Seed dormancy is the **inability of a viable seed to germinate under conditions favorable for germination**.

Causes of seed dormancy

- **Seed coats impermeable to water**: dormancy remains until the testa layer decay by soil.
- **Seed coat impermeable to oxygen**: but later seeds become more permeable to oxygen so that it germinates afterwards.
- **Mechanically resistant seed coat**: In certain **seeds of weeds have hard seed coats** that prevent the expansion of embryo.
- **Immaturity of the embryo** that do not germinate until allowed time to mature.
- **Due to the effect of germination inhibitors** such as abscisic acid that prevent germination of seed.
- **Low temperature:** In certain plants the seeds **remain dormant after harvest because they require low temperature for germination.** The seeds germinate in the spring season.
- **Light sensitive seeds:** some seeds require light to germinate and will not germinate in its absence

Methods of breaking dormancy

- **By soaking the seeds** in growth stimulating hormone
- **By pre-chilling** i.e. seeds are exposed to very low temperature for a short time before planting in normal conditions
- **Soaking seeds in cold water** overnight before planting in normal condition
- **Scarification / mechanical removal of testa**
- **Heat treatment:** seeds are soaked in hot water at about 800C for 3 – 5 minutes before planting
- **Exposure to light:** some seeds need to be exposed to light in order to germinate.

Advantages of seed dormancy

- Seed are able to withstand adverse external conditions such as very cold or very dry weather.
- It allows seed and fruits to disperse
- Prevents death of entire population in bad times since all seeds do not germinate at ago
- Prevents pre-harvest germination

- Facilitate proper storage of seed.

Methods of planting seeds

(a) Broad casting

This is the scattering of seeds all over the field in random manner. It is usually used for seeds which are very small that cannot easily put in holes

Advantage of planting seeds by broadcasting

- It quick
- Easy and simple
- Requires less labour
- Minimize soil erosion due to good crop cover
- Best for small seeds such as millet and simsim

Disadvantages of planting seeds by broadcasting

- Cannot be mechanized
- Difficult to weed
- Uneven distribution of seedlings
- Some seeds are eaten by birds

(b) Row planting

Here seeds are planted in holes, drills or furrows that are in rows/lines

Advantages of row planting of seeds

- Uses fewer seeds
- Gives optimum plant population
- Planting can be mechanized
- Promote uniform germination
- Easy to weed
- Plant get enough space

Disadvantages of row planting of seeds

- Requires a lot of labour
- Tedious
- Requires skill
- Not suitable for small seeds

Nursery bed

A nursery bed is a small portion of land prepared for raising seedlings before transplanting.
A seed bed is a piece of land which has been prepared and ready to receive the planting materials where they can grow up.

Advantages of raising seedlings in a nursery bed

- Many seedlings can be prepared in small area
- Make it easy to carry out routine management.
- Provide the best conditions for growth i.e. fine tilth.
- Allows transplanting of healthy and vigorous seedlings
- Preparing seedling is source of income/employment

Factors to consider when selecting a site for a nursery bed

- Source of water for irrigation

- Gentle slope to minimize soil erosin and flooding
- Security to protect from thieves, bird and animals
- Nursery bed should be sheltered from strong wind that would destroy seedling
- Nursery bed should point in north-south direction to expose the seedlings to adequate sunlight.

Nursery management

- Watering in the morning and afternoon
- Weeding
- Pricking out/remove of weak and unhealthy seeding and planting them in another nursery bed
- Providing a shade
- Mulching when necessary
- Pest control by applying the recommended pesticides
- Hardening off or gradual reduction of shade and watering before transplanting
- Disease control
-

Vegetative propagation

This is the reproduction of plants from plants part that are not associated with reproductive organs.

Advantages of vegetative propagation

- The offspring is similar to the parent in all ways hence preserve good mother characters.
- Offspring grows faster and mature early.
- Offspring are strong and hardly compare with seedling obtain from seeds.
- Vegetative propagation is the best way for propagating plants with no viable seeds.
- Daughter plants obtain food from their parents until they are sufficiently strong hence increasing chances of survival.
- Multiplication of the plant population is faster
- Over comes the problem of prolonged dormancy in some seeds
- Less risk of seedling disease
- Doesn't require much care
- Does not require pollinating agents

Disadvantages of vegetative propagation

- It may cause overcrowding due to the ability to establish quickly and grow fast.
- It may cause overcrowding due to the ability to establish quickly and grow fast.
- The planting materials are quite bulky and therefore difficult to handle store and transport.
- Due to their high moisture content vegetative materials are difficult to store.
- Some vegetative methods of propagation are complex and hence need a lot of skill to execute.
- A small hectare can be covered during planting as compared to seed propagation.

Methods of vegetative propagation

1. Layering - Mainly used in passion fruits.
2. Grafting - Used in most fruits like citrus, avocado, mangoes etc.
3. Budding - Can be used in fruits also like citrus.
4. Tissue culture- group of cells are developed into a new plant or plants

5 Use of storage structures

a. Bulbs - Used in onions and garlic.
b. Bulbils - Used in sisal
c. Suckers - Used in banana and pineapple
d. Rhizomes. - Used in ginger
e. Runners - Used in strawberry
f. Corms - Used in cocoyam
g. Splits - Used in pyrethrums
h. Stem tubers - Used in Irish potatoes.
i Cutting - Used in cassava sweet potato, clonal coffee.

GRAFTING

This is where two different stems are united in woody plants of the same species. The upper part of the union is called a scion while the lower part is called a stock.

PRINCIPLES OF GRAFTING

For successful grafting, there are about five principles which must be adhered to;

- Compatibility – The scion and stock must be related or close to facilitate sexual hybridization.
- The scion and the stock should be disease free.
- Use suitable equipment or tool for grafting
- Scion should have a bud
- Both scion and stock should be woody
- Both scion and stock should be from quality plant
- Graft quickly
- Cambial alignment – The cambium of the scion and root stock should be aligned for the union form.

- Timing of the grafting operation – Grafting must be done at a time when the root stock is in a proper physiological state.
- Avoiding desiccation – After grafting operation make sure that all the surface is sealed off using wax or grafting tape around the joining
- Pressure – Apply a pressure after aligning the cambium of the root stock and scion such that the xylem stays in contact.

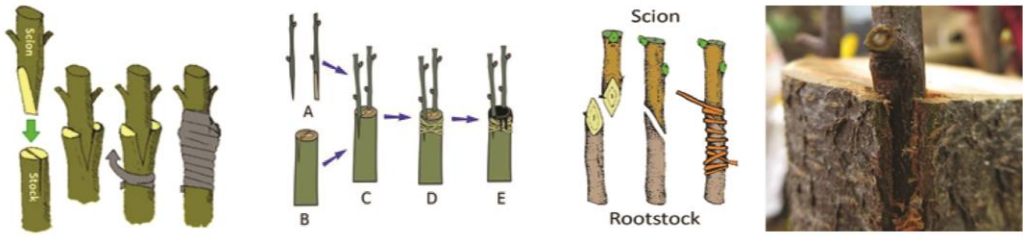
Advantages/reasons for grafting plants

1. It changes the tree top from being undesirable to desirable
2. It makes it possible to grow more than one fruit or flower in the same plant.
3. Root stocks with desirable character like disease resistance, problem of water logging are used which may be beneficial to the scion and farmer.
4. It helps to propagate clones that cannot be propagated by any means.
5. Can be used to repair damaged trees e.g. bridge grafting
6. It helps propagating special plants form e.g. seedless oranges.
7. Helps in change variety for more especially when the acid
8. Virus indexing – Plants having viral infection with no signs will show signs when grafted.

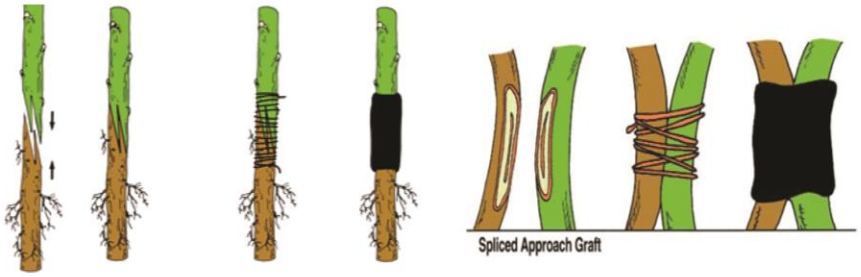
Disadvantages/limitation of grafting

1. Incompatibility – this failure of grafted material to survive due to a difference in genetic constitution.
2. Certain undesirable characteristic of the stock are transferred to offspring
3. Requires a lot of skills and experience for successful grafting to occur.
4. Requires a lot of time for tangible results to be got.
5. Absence of genetic variation
6. Apply to plant of the same species only
7. Leads to premature againg

Types of grafting



1.Top Wedge graft 2. Cleft Grafting 3. Splice grafting 4. Bark grafting

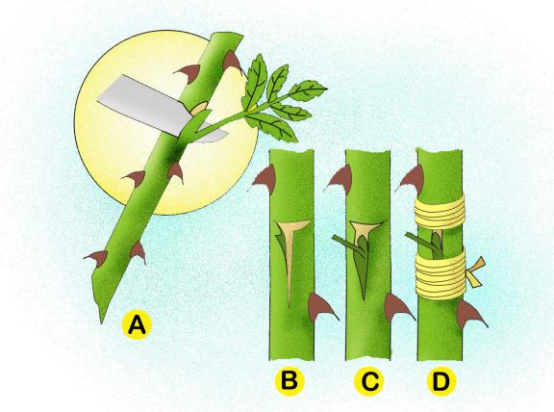


5. Whip and tongue grafting 6. Approach grafting

1. **Top Wedge: a** cut surface of the scion forms a wedge that is inserted into a vertical slit on the root stock that has been slash.
2. **Cleft Grafting / Top working grafting: t**his involves grafting a scion into a canopy of a relatively large established tree.
3. **Splice grafting**: a long slanting cut is made in both scion and root stock which is later tied together.
4. **Bark grafting**: a bark grafting is a plant made by slitting the back of the stock and inserting the scion beneath it. It is often used to regenerate an adult tree that has stopped being productive and to replace its structural branches. The cambium of the scion must line up as closely as possible with the cambium of the stock for a good graft union
5. **Whip and tongue grafting**: this is done if the root stock and scion have the same dimensions. A stanty cut is made at the base of the scion top of the root stock. The two are fitted together and waxed
6. **Approach grafting**: Here both the scion and stock remain attached to another plant until a secure union has been formed.
7. **Bridge grafting**: This is used in repairing damage free plant normally woody trunks of valuable established trees.

Budding

This type of vegetative propagation the bud or scion is united with a seedling or a mature tree.

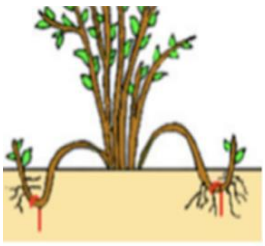


TYPES OF BUDDING

1. **T-budding:** a t-Shaped cut is made on the back of the root stock and a bud is made on the back of the root stock and the bud fitted in
2. **Patch budding:** a rectangular piece of bud is cut of the root stock. A matching piece of bark with a bud is cut from the bud wood and matched into the prepared root stock.
3. **Top budding: b**uds from young plants are inserted at desired location on the stock and after setting the original branches are cut.

LAYERING

This involves inducing a part of plant usually a branch to produce roots while still attached to the mother plant.



TYPES OF LAYERING.

1. **SIMPLE LAYERING**

This involves bending a stem and covering it with soil to produce roots.

2. **TIP LAYERING**

The whole shoot is bent and covered in the soil

3. **COMPOUND LAYERING (SERPENTINE)**

This is achieved by bending a stem several times and sometimes at a point of covering.

4. **MOUNT / STOOL LAYERING.**

A stem is cut just above the ground and the under shoot starts

5. TRENCH LAYERING

Here a trench is dug near the plant and a branch is layed on the trench to facilitate root development.

6. AIR / MACOTTING LAYERING.

The bark of a tree is open at a point and a wet mass is placed around the ring bar to keep it open. This stimulates root to develop at that point.

Tissue culture

It is the development of organisms or organs from cells and tissues under sterile conditions and nutrient media

Advantages of tissue culture

- A large number of plants can be grown in a short period of time
- Healthy plants can be grown from diseased plants
- Plants without seeds can be multiplied
- Produces genetically uniform crops
- Requires small space to raise many plantlets
- Plantlets are not bulky and easy to transport
- Method can be used to produce useful chemicals for medicine

Disadvantages of tissue culture

- Requires all skills
- Since clones are identical can easily be wiped out by environmental disasters.
- expensive

Crop breeding / improvement

This is a process of changing crops genetically to suit man's needs of food, easy harvesting etc.

Or

It's a directed adjustment of crop plants to fit specific environment and production practices.

Germplasm is the genetic material that can be used to perpetuate a species or population. It is only has reproductive value, but through genetic manipulation (plant breeding), germplasm can be improved for better performance of the crop. Germplasm provides materials (parents) used to initiate breeding.

Aims of crop breeding / improvement

- To increase crop yields so as to save the problem of hunger and food shortage.
- To increase the nutrient content of the crop product to solve nutrient deficiency in consumers.
- Produce better size and colour of fruits / seeds that can attract consumers.
- To reduce the gestation period of a crop so as to solve food shortage.
- Conferring disease and pest resistance in crop.
- Production of crops that can tolerate adverse environmental conditions like drought, low soil fertility, high temperature.
- To change growth characteristics of a plant in order to suit harvesting spraying and weeding.
- to improve on the short life of the sowed crop production
- To improve on seed viability character in plants so that there is no wastage of seeds during planting.
- Improving the taste and flavour of certain crop products.
- To produce crop products that is easy to prepare as food for consumers.

Methods of crop breeding/improvement

They include

- Selection
- Introduction
- hybridization

Selection

It is a process of picking from a number of individuals with desirable characteristics to be parents of future generation. Selection can be natural or artificial but artificial selection is most important.

- **Natural selection: Here** crops or animals that are better suited to the environment survive and produce more offspring for the next generation while the less suitable dies off.
- **Artificial selection**: A farmer selectively breeds animals and crops with desirable traits.

Methods of in crop selection

(a) Pure line selection: in this method a single good looking plant is chosen and its offspring used to develop a new variety. It is a passive process since it eliminates variations instead of creating it. It is used to improve self-fertilized plants

Procedure of conducting pure line selection

- A large number of good looking plants with desirable qualities are identified.
- Seeds are collected from the plants from those with desirable qualities and kept separately
- The seeds from each plant are planted separately on isolated fields to prevent mix ups.
- The performance of the seeds from each plants and best performing plants noted.
- The seeds of the best performing plant are selected and identified as new variety.

(b) Mass selection

Seeds are collected from many good looking plants and mixed together. It used for breeding self-pollinated plants species (Dioecious plants)

Procedure of conducting mass selection

- Seeds from many plants with desirable characteristics are collected and mixed together.
- The seeds are planted on the same field and the result seeds from these crops are selected and marked as a new variety

Advantages of mass selection

- It simple
- fast
- cheap
- the cultivar is phenotypically fairly uniform even though it is a mixture of pure lines hence genetically broad based, adaptable and stable

Disadvantages of mass selection

- requires a uniform environment to achieve optimal results
- Phenotypic uniformity is less than that of pure line selection
- Desired qualities are a mixture of heterozygous and homozygous individuals thus a possibility of recessive traits in future generations.

(c) Pedigree selection

It a breeding method in which the breeder keeps records of the ancestry of the cultivar.

Hybridization is used to generate genetic variability

Procedure of pedigree selection

(i) The homologous parents of desirable qualities are identified and crossed.

(ii) Seeds (F1) from superior plants are selected, identifies, planted separately and records kept.

(iii) Procedure (ii) is repeated several time until cultivar of desired quality are produced.

Advantages of pedigree selection

- Record keeping provides a catalog of genetic information of the cultivar unavailable from other methods
- Selection is based not only on phenotype but also on genotype (progeny row) making it an effective method for selecting superior lines from among segregating plants.
- Using the records, the breeder is able to advance only the progeny lines in which plants that carry the genes for target traits occur.
- High degree of genetic purity is produced in cultivar

Disadvantage of pedigree selection

- Record keeping is slow, tedious and expensive
- The method is not suitable for species in which individual plants are difficult to isolate and characterize
- Pedigree selection is a lengthy process requiring 10 – 12 years or more to complete
- The method is more suitable for qualitative than quantitative breeding
- Selection in F2 (early generation testing) on the basis of quantitative traits such as yield may not be effective.

Introduction

This involves improvement of plants by introducing crops from their centers of origin or supposed centers of origins to other areas where they can survive and adapt to the environmental conditions. The introduced crops may be in form of planting material or pollen from suitable varieties for conducting artificial pollination.

Forms of introduction

- Direct for good economic use e.g. rubber and cocoa can be introduced and grown without any modification
- Can be used for selection of suitable crop cultivation
- Can be used for hybridization or other breeding programs.

Problems of crop introduction

- The introduction of plants needs other aspects of the environment for success such as pollinators.
- The introduced plant may not be adapted to the local environment
- Pests and diseases may be introduced with the new crops
- Requires a lot of research on climate and soil conditions before introducing a new crop.

Hybridization

It is the crossing of pure lines to produce a hybrid. Or it is the crossing of different varieties or species of plants to produce hybrids. It is mainly used in breeding for disease resistance.

Pure line cultivar are produced for species that are highly self-pollinated.

Hybrid cultivar are produced by crossing inbred lines that have been evaluated for their ability to produce hybrids with superior vigor above those of the parents

Procedure of hybridization

- Plants with desirable qualities are identified
- Seeds from the identified plants are collected and selfed to obtain homozygosity i.e. pure lines. This is only done in cross pollinated plants; self – pollinated plants are already homozygous due to natural selfing.
- Seeds of pure lines are then selected and planted.
- The male parts of the plant from one group and female parts from another group are removed before flowers are mature which allows cross pollination between the different groups.
- Seeds are then collected after maturity and sown.
- The offspring of F1 are tested at various research stations to find out the suitability to various environments.
- If found suitable, the seeds are multiplied, identified and released to the farmers.

Questions

1. (a) What is genetic engineering? (02marks)
   Genetic engineering refers to the artificial manipulation of DNA to alter an organism's characteristics in a particular way.
   (b) Explain three benefits of genetic engineering in agriculture (03marks)

   - Faster growing plants and animals.
   - More nutritious food.
   - Tastier food.
   - Drought-resistant plants that require fewer environmental resources (such as water and fertilizer)
   - Pest and disease resistant crops and animals
   - Increased supply of food with reduced cost and longer shelf life.
   - Increased medicinal content

   (c) Outline five challenges of genetic engineering in agriculture. (05marks)

   - Loss of nutritional value of foods
   - Low rate of seed germination
   - Produce cause allergies and diseases
   - It can lead to more birth defects.
   - Immune suppression
   - Antibiotic resistance

- Environmental concerns

2. (a) Give the meaning and one benefit of the following as used in crop breeding (06marks)

(i) Polyploidy

Polyploidy is a condition in which an organism's cells have more than two complete sets of chromosomes.

Benefits of polyploidy

- increased sized of plant
- reduced fertility
- high resistance to harsh climate
- increased yield
- increased resistance to diseases

(ii) Hybridization

Hybridization or cross breeding refers to the process of producing offspring by mating two parents from different varieties or species.

Benefits of hybridization in agriculture

Produces varieties that are

- disease resistant crops
- high yielding
- drought resistance

(iii) Back crossing

This is a cross between hybrids in F1 generation with one of the parents or an organism genetically equivalent to the parents.

Benefit of back crossing

Back crossing is mainly aimed at increasing the genetic contribution of one particular parent to the off spring.

(b) Describe the procedure of mass selection in crop improvement. (06marks)

- Seeds from many plants with desirable characteristics are collected and mixed together.
- The seeds are planted on the same field and the result seeds from these crops are selected and marked as a new variety.

(c) Outline the husbandry practices a farmer should adopt to obtain high maize yields. (08marks)

- Till the field remove weeds and improve on the soil aeration
- Timely planting at the beginning of the season
- Plant high yield, drought and disease resistant maize seeds
- Maintain proper spacing
- Apply fertilizers

- Keep the field free of weeds
- Spray pests and disease
- Practice crop rotation to maintain soil fertility.

3. (a) Give four reasons for drying seeds before storage. (04marks)
   - To prevent molds and rot: seeds with high moisture rot easily
   - Properly dried seed have long shelf life
   - To prevent germination before planting
   - To reduce pathogenic contaminations
   - Maintain seed quality such good color

   (b) Outline the physiological changes that take place during seed germination. (04marks)
   - Hydrolysis of storage food material into soluble products
   - Translocation of soluble products from storage area to the actively growing centres.
   - Synthesis of enzymes, nucleic acids, structural proteins
   - Respiration to provide energy for cellular activities
   - Glucose and amino acids are translocated from the storage centres (endosperm or cotyledon) of the seed to the growing regions of the embryo.
   - Cell division, elongation and differentiation leads to immergence of a seedling from a seed.

   (c) Give the importance of air and temperature in the process of germination. (02marks)
   - Air (oxygen) is required for respiration
   - Optimum temperature activates enzymes

4. (a) What are the benefits of irrigation in Agriculture? (08marks)
   - Provides water and reduce water stress of plants and increases crop yields
   - Cools soil.
   - Increases amount of cultivable land
   - Reduces wind erosion
   - Improves the quality of agricultural produce e.g. plumpness of seeds and fruits
   - Provides food security
   - Control some pests such as aphid that are more serious in dry weather
   - Control weeds for instance in rice fields by flooding
   - Soften soil to cultivation
   - Enable timely planting
   - It can help dilute toxins in the soil

   (b) Explain the problems that may result from irrigation
   - Promotes water borne diseases
   - Leads to soil erosion
   - Causes leaching
   - Reduces soil aeration
   - Leads to accumulation of salts in the soil causing soil salinity

- Make soil heavy for cultivation
- May cause death of microorganism due to poor aeration
- Cause denitrification due to poor aeration

5. (a) Give six consideration that should be made by a farmer when selecting and preparing seeds for planting. (06marks)

- Should be viable
- Should be disease
- Should be free from mechanical damage
- Should be mature
- Should have appropriate size to ensure enough food reserve
- Should be free from contamination
- Should be of desired genetic make up
- Should be plump i.e. well-formed and not wrinkled

(b) Four advantages of planting crops on ridges. (04marks)

- Improved weed control: ridges reduce weed density
- Warmer soil temperature: the ridges warm up sooner because the residue from the previous crop settle between them
- Better soil moisture
- Better aeration
- Erosion control: ridges act like mini terraces, reducing soil erosion
- Reduced herbicide costs due to the effective weed control
- Controlled traffic patterns: this system helps in managing traffic patterns, reducing soil compaction

Thanks
Dr. Bbosa Science