**AGC 212 NOTE**

**CROP IMPROVEMENT**

**Mendel’s Work in Genetics**

Gregor Mendel (1822-1884) carried out the first quantitative studies on inheritance. He published the results of his work in1867. These laid down the basic laws of genetics. Mendel’s conclusions about inheritance were based on his hybridization experiments in which he considered either one pair of contrasting characters or two pairs of contrasting characters involving cross between

plants with these characters. The cross involving only one pair of contrasting character is called **monohybridization** and the related experiment is called **monohybrid experiment** or monohybrid cross. Likewise, the cross involving two pairs of contrasting characters is called **dihybridization** and the related experiment is referred to as **dihybrid** experiment or cross experiment.

**Mendelian Laws**

From the results of his experiments, Mendel came to certain conclusions which are referred to as the principles of Mendelian Inheritance or Mendel’s Laws of Heredity. Mendel’s two important laws are:

 The Law of Segregation (of genes), and

 The Law of Independent Assortment (genes).

**Law of Segregation**

This is Mendel’s first law of heredity. It states that:

 the hereditary characters of an organism are determined by genes (called ‘ factors’ by Mendel) which are discrete unchanging units of inheritance;

 a gene for a character may have alternative forms (alleles) which express the character in different ways;

 in a diploid organism , each character is controlled by two copies of each gene which may be identical alleles (homozygous) or different alleles (heterozygous);

 if a diploid organism has two different alleles (heterozygous) fora character, one allele may be dominant, dictating the expression of the character to the complete exclusion of other (the recessive

allele);

**Law of Independent Assortment**

This is Mendel’s second law.

this law state that alleles on different chromosomes assort independently during meiosis (gamete formation). Or this law states that each pair of contrasting characteristics (genes) behaves or segregates independently of those of any other pair.

When two hereditary units of a pair are unlike, the one which functions and produces its character or effect is called **dominant** while the other which remains undeveloped or unexpressed is called **recessive.**

**Crop Improvement**

Crop improvement has been in progress since primitive man first exercised a choice in selecting seed from wild plants for growing under cultivation. The greatest advances were made before the dawn of civilization. However, not until the last century, when some knowledge of genetics was acquired, did crop breeding become a science with the outcome of breeding methods reasonably predictable.

**objectives of crop improvement**

The objectives or crop breeding is, to correct these deficiencies while developing new cultivars with higher yield capabilities.

Improvements of the following characteristics are considered the objectives of crop breeding:

i. to produced crops that are resistant to common diseases and pest

ii. to produce crops that are resistant to adverse weather condition such as drought, cold, heat and salt

iii. to produce crops that have adaptation to variable photoperiods

iv. to produce crops with adaptation to heavy grazing or frequent cuttings

v. crops with enhanced market quality e.g. higher content of fiber, of protein, sugar, starch, or other extractives; better processing quality for textiles, foods, beverages, and drugs, and better colour

vi. seed quality e.g. higher or lower seed-setting tendency, greater longevity, high viability, larger size and non-shattering

vii. growth habit e.g. more erect or prostrate stems, more or less tillering or branching, more uniform flowering and maturity, more uniform height, longer life, and better ratio of tops to roots

viii. harvesting quality e.g. stronger, shorter, or taller stalks, erect stalks and heads, non-shattering qualities, easier processing and freedom from irritating awns

ix. productive capacity e.g. greater vigour, higher fertility and faster recovery after cutting

x. feeding quality of fodder e.g. palatability, leafiness, hull percentage, nutritive value and texture.

**Methods of Crop Improvement**

There are three general methods of crop improvements namely:

i. Introduction

ii. Selection

iii. Hybridization.

**1. Introduction**

This is the act of importing crop variety from other countries to be used as foundation stock in breeding programme. Crop introduction from other countries may be of superior productivity and they often provide better foundation stock for breeding. Foreign varieties may possess resistance to some diseases or insects pests or may have some useful characteristics that can be transferred to adapted varies by hybridization. Collection of exotic and domestic wild and cultivated species and strains of various crop plants are being screened for disease and insect resistance, and other characteristics that might be useful in breeding.

**2. Selection**

Mass selection is a quick method of purifying or improving mixed or un-adapted crop varieties. It is done by selecting a large number of plants of the desired characteristics and then increasing the progeny. It serves to eliminate undesirable types.

**i. Pure-line or pedigree selection**

Pure-line pedigree selection or individual plant selection consists of growing individual progenies of each selected plant so that their performances can be observed, compared and recorded. Only a few superior strains among the numerous original selections are saved for advanced testing.

Pure-line selection offers a quick means of segregating desired types from mixed varieties.

**3. Hybridization**

Hybridization is the only effective means of combining the desirable characters of two crop varieties. The first step in breeding by hybridization is to choose parents that can supply the important character or characters that a good standard variety lacks. It is important to have in mind definite characteristics. The seeds that develops from the cross-pollinated flowers, when planted,

produce plants of the first filial of F1 generation. These plants should be all alike, only the dominant and mutual recessive characters being expressed.

In the second F2 generation, the plants break up or segregate into all possible combinations of the dominant and recessive characters of the two parents. Plants of the types desired are selected, these and several subsequent generations are handled as previously described under selection methods. Reselection continues thereafter until the desired strains are uniform usually for three to six generations.

However, additional true breeding plants of the desired recombination would be obtained in later generations from segregating F2 lines.

**SOWING AND PLANTING PRACTICES**

**Definition**

**Germination of seeds**

The process of germination involves the growth of the miniature plant (embryo) contained within the seed into a larger plant. The main function of the endosperm, where present, is to supply food materials to the growing embryo.

**i. Conditions necessary for germination**

1. Water must be available so that when it is imbibed by the seed, metabolic processes within the seeds are enhanced

2. Oxygen should be present for aerobic respiration to occur so as to supply energy for germination process

3. There should be an appropriate temperature.

**ii. Types of germination**

**epigeal germination.** The seedlings of groundnuts, melon, cowpea, onion, okro, and castor are all epigeal.

**hypogeal germination.** Rice, maize, guinea corn, rubber and broad bean seedlings are all examples of hypogeal germination.

**Seed Dormancy**

When a living seed fails to germinate even when provided with the normal conditions necessary for germination, such a seed is said to be dormant.

**i. Causes of seed dormancy**

1. Presence of an impermeable testa that may prevent intake of water and probably oxygen.

2. The presence of growth inhibitors in the seed.

3. Alternatively, it may be caused by the need for cold treatment or for exposure to certain photoperiods before the seed can germinate.

4. The embryo is still immature and has not yet reached its full development at the time of harvest.

5. Very high temperatures during seed maturity may induce dormancy in some species.

**ii. Measures of overcoming seed dormancy**

**a. After ripening treatment**

One type of primary dormancy is characterised by immature embryos. Although the seeds are shed by the plant, the embryo must continue tovdevelop before germination will occur. Problems of immature embryos will be overcome if the seeds receive appropriate after ripening treatment. Often high temperatures are required for after-ripening of certain palm seed require 38°C to 40°C for three months.

**b. Stratification**

Seeds of many plants require moist chilling conditions for a period of time to render them capable of germination. This process is called **stratification**. Chilling is usually 0°C- 10°C for 7 to 180 days. For example, apple seeds require up to 60 days in moist medium at 3°C to 5°C to overcome dormancy.

**c. Scarification**

Seeds of some plant species have a very hard covering that may prevent them from germination unless treated. Hard seed covering can prevent absorption of water and gaseous exchange or may physically prevent the embryo from growing and emerging through the seed coat. It is therefore necessary to make these covering weaker or pervious to water and gases through the process of **scarification.**

**iii. Methods of seeds scarifications**

a. Seeds can be scarified by soaking them in concentrated sulpuric acid for a period ranging from few minutes to an hour or more.

b. A hot water soak is another method of scarifying seeds, first

heating water to boiling point add seeds and remove them when the water is cool 12-24 hours later.

c. Dry heat can be used to rupture seed coats of some species.

d. Mechanical scarifier can be used to scratch the seed coats. When scarified seed deteriorate rapidly, they should be planted immediately.

e. Aging brings about slow natural deterioration of the seed coat in dry storage. In an experiment with alfalfa, one half of the impermeable seeds germinated after one and half years while all

germinated after eleven years in storage.

f. Alternate freezing and thawing sometimes stimulates germination of hard seeds of alfalfa and sweet clover.

g. The germination of hard seeds of alfalfa or clover can also be achieved by exposure for 1 to 1.5 seconds or less to infrared rays of 1180 millimicrons wave length or by exposure to a few seconds to high frequency electric energy.

**Sowing and Planting Practices**

**i. Time of Sowing or Planting**

Several factors influence the time of sowing or planting. They are:

a. rainfall

b. temperature

c. day length

d. occurrence of diseases and pests

e. marketing

f. cropping system

g. availability of labour and equipment.

**ii. Methods of Seed Planting**

Planting of field crops is generally carried out by any of the following

methods of planting:

a. Broadcasting

b. Drilling

c. Precision planting

d. Transplanting.

**a. Broadcasting**

This is a deliberate random scattering of seeds on the field or prepared seed bed. There is no specific or definite inter or intra-row spacing of crops observed. Crops commonly planted by this method include rice, wheat, sesame and some vegetables.

**b. Drilling method**

In this method, seeds are placed in shallow furrows created with disc or hoe and then buried. The spacing between plants may not be regulated. Many field crops are planted using this method.

**c. Precision planting**

Cereal crops such as maize, sorghum and millet are planted with a definite inter and intra row spacing to achieve a precise plant density. This method ensures maximum productivity and high yield of crops.

**d. Transplanting**

Some crops are first raised in the nursery and later transplanted into the permanent field where they mature and complete their growth cycle. Seeds of tobacco, tomato, pepper, and many vegetables are first raised in the nursery before transferred to the field. Rice and sorghum are also

transplanted in some instances. Transplanting has the advantage of reducing wastages of seeds and offers farmers the chance to transplant only healthy and vigorous seedling for best results.

**v. Number of seeds per stand**

The number of seeds sown per stand depends on the expected percentage germination of the seed and number of plants desired per stand. The expected percentage germination is ascertained by prior germination tests and if low, the number of seeds sown per stand is commensurately increased. Sometimes the number of seeds sown on each stand is kept deliberately high, so that the number of plants appearing on each stand is higher than the desired number. When the

seedlings are well established, the extra plants are removed, leaving just the desired number per stand. This procedure of removing excess emerged seedlings is referred to as **thinning.**