**Concept of Cellular Totipotency :-**

A cell with the capacity to form an entire organism. Human development begins when a sperm fertilizes an egg and creates a single totipotent cell. In the first hours after fertilization, this cell divides into identical totipotent cells. Approximately four days after fertilization and after several cycles of cell division, these totipotent cells begin to specialize.

Totipotent is as opposed to pluripotent and multipotent. Totipotent cells have total potential. They specialize into pluripotent cells that can give rise to most, but not all, of the tissues necessary for fetal development. Pluripotent cells undergo further specialization into multipotent cells that are committed to give rise to cells that have a particular function. For example, multipotent blood stem cells give rise to the red cells, white cells and platelets in the blood.

**Callus culture :-**

Callus varies considerably in appearance and texture, ranging from hard nodular cell masses to friable soft ones. They maybe white or creamish, orange, green either in whole or part as a result of chloroplast development. The shape of individual cells within the callus mass ranges from the near spherical or markedly elongated.

A typical unorganized plant callus initiated from a new explants or piece of previously initiated calli has three stages of development. The induction of cell division.

A period of active cell division during which differentiated cells lose specialized features they may have acquired and become de-differentiated.

Cell division usually occurs in the outer layer of the explants. Period when cell division slows down on ceases and when within the callus, there is increasing cellular differentiate Callus culturing is performed in the dark while light can be encourage the differentiation of the callus. At the time of long term culture, the culture may loss the requirement for cytokinin and auxins. Manipulation of the auxins to cytokinin ratio in the medium can leads to the development of shoots, roots or somatic embryos from which the plant can be subsequently produced.
Callus culture is useful for many purposes.

1. Callus is the starting material for the suspension culture which cells are separated.
2. It helps in the production of secondary plant products.
3. It is useful for the synthesis of starting compounds that are subsequently modified to yield the desired product.
4. It is the starting materials for vegetative propagation of plants.

Based on the availability of the various invitro techniques, the dramatic increase in their application to various problems in basic biology, agriculture, horticulture, and forestry. The applications can divide conveniently into five broad areas:

1. Cell behavior.
2. Plant modification.
3. Germplasm storage and pathogen free plants.
5. Product formation.
6. Improved varities.

**Suspension Culture.**

The cultivation of cells suspended in the medium rather than adhering to a surface. Suspension culture is common for microorganisms but less so for the culture of the cells of most multicellular organisms. When referring to mammalian cells, suspension culture is used for the maintenance of cell types, which do not adhere, including some types of blood cells, or in order to have cells express characteristics, which are not seen in the adherent form. Sometimes it is necessary to prevent adhesion by choosing a hydrophobic surface, which does not encourage cell adhesion. The absence of serum components from the medium will also help to prevent adhesion.

Cell suspension is prepared by transferring a fragment of callus (about 500 mg) to the liquid medium (500 ml) and agitating them aseptically to make the cells free in medium. It is difficult to have suspension of single cell. However, the suspension includes single cell, cell aggregates (varied number of cells), residual inoculums and dead cells (Dodd’s and Roberts, 1985). King (1980) has described that a good suspension consists of a high proportion of single cells than small cluster of cells. It is more difficult to have a good suspension than to find optimum environmental factors for cell separation.
Biofortification :-

To increase the nutritional value of crops and plants through breeding, a process is used which is called as biofortification. The breeding can be of two types, either conventional or traditional and through genetic engineering methods. The crops produced through biofortification method are always rich in nutrients like iron, zinc and Vitamin A. Usually when plants are produced through traditional breeding, they have the nutrients which are present in them naturally but plants of biofortification are very rich in nutrients. Before the arrival of this technique, it was difficult for the farmers to buy transgenic seeds, but now they can produce plants full of nutrients. These nutrients can be helpful in reducing the disease rate in humans.

Method of Biofortification:-

Plant breeding takes place through two methods:

1) Traditional Breeding:-
In this type of breeding, seeds are selected which are the source of producing crops rich in nutrients. Such seeds are bred with those varieties which are responsible for giving high yield of crops. The result will be the production of crops with high yield and highly rich in nutrients. Although the nutrients should be high in the crops but it should be considered that the nutrients should not affect the human health in a negative sense. Crops produced through biofortification also give poor to eat food rich with nutrients.

2) Breeding by Genetic Engineering:-
By using the methods of genetic engineering, a gene which contains the nutrients is inserted in the seed. This seed is when bred with the high yield quality crop; the result will be production of crops rich in micronutrients. Golden rice was produced using this method. They are very rich in nutrients. This rice is rich in beta-carotene which is the most essential nutrient for the children. It provides vitamin A to the children. Children who are partially blind, they can use this type of rice to fulfill the need of Vitamin A.

Biofortification and crops:-
Golden Rice:

Golden rice was produced using the method of biofortification. They are very rich in nutrients. This rice is rich in beta-carotene which is the most essential nutrient for the children. It provides vitamin A to the children. Children who are partially blind, they can use this type of rice to fulfill the need of Vitamin A. golden rice is also important in providing nutrients to those children who are suffering from malnutrition. This product is exported to the poor countries especially African countries to support the food needs.

Sorghum:

Sorghum is also a cereal crop like rice, maize, barley and wheat. This crop is very poor in providing enough nutrients necessary for the body. If the sorghum crop is produced with the help of conventional breeding, it does not result in providing good amount of nutrients that is why scientists used genetic engineering methods to grow this crop. Lysine fortification is a technique which was used for this purpose and the crop produced as a result was very rich in nutrients and also useful economically.

Issues of Biofortification:

There are people who oppose the genetic engineering methods used in biofortification because they think that the crop might be rich in nutrients but it may not be acceptable by the immune system of the human body. For example golden rice is the example of genetically modified food. Biofortification is a not very vast that is why some people think that this technique is the source of producing nutrients in only some crops and sometimes nutrients exceed the limit of requirement.

Besides macroscopic plants and animals, microbes are the major components of biological systems on this earth. You have studied about the diversity of living organisms in Class XI. Do you remember which Kingdoms among the living organisms contain micro-organisms? Which are the ones that are only microscopic? Microbes are present everywhere – in soil, water, air, inside our bodies and that of other animals and plants. They are present
even at sites where no other life-form could possibly exist—sites such as
deep inside the geysers (thermal vents) where the temperature may be as
high as 1000°C, deep in the soil, under the layers of snow several metres
thick, and in highly acidic environments. Microbes are diverse—protozoa,
bacteria, fungi and microscopic plants viruses, viroids and also prions that
are proteinacious infectious agents. Some of the microbes are shown in
Figures
Microbes like bacteria and many fungi can be grown on nutritive media to form colonies (Figure) that can be seen with the naked eyes. Such cultures are useful in studies on micro-organisms.