Mohanlal Sukhadia University

Department of Botany

B.Sc. II year Paper III

Green Revolution

Images taken from internet.

What is Green Revolution??

The Green Revolution was a period when the productivity of global agriculture increased drastically as a result of new advances.

During this time period, new chemical fertilizers and pesticides were created. The chemical fertilizers made it possible to supply crops with extra nutrients and, therefore, increase yield.

The newly developed pesticides controlled weeds, deterred or kill insects, and prevented diseases, which also resulted in higher productivity.

Images taken from internet.

History and development of Green Revolution

The beginnings of the Green Revolution
are often attributed to Norman Borlaug,
an American scientist interested in agriculture.

Dr. Norman E. Borlaug receives the
Congressional Gold Medal in 2007.

Borlaug, a 1970 Nobel Laureate, was honored for his work in the 'Green Revolution,' saving millions of lives from famine in India, Mexico, and the Middle East

Images taken from internet.

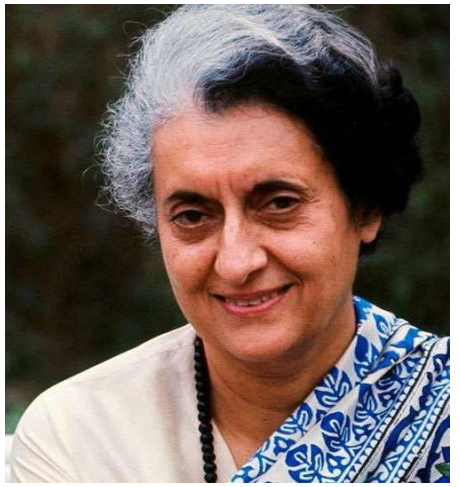
Green Revolution in India

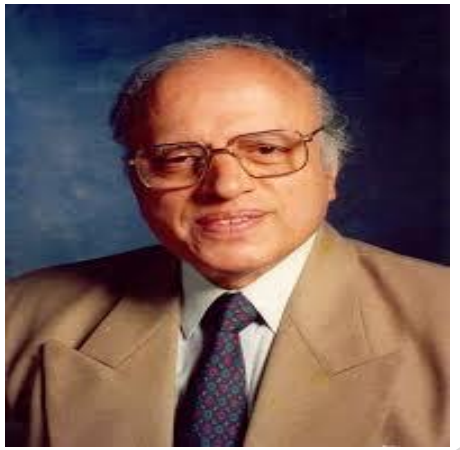
• In 1965 the government of Mrs. Indira Gandhi decided to major steps on agriculture conditions.

• Thus Green Revolution was applied to the period from 1967 to 1978 basically in the parts or Haryana and Punjab.

• At this stage concern was on Wheat and Rice.

• Dr. M S Swaminathan from India led Green Revolution as a Project.





Images taken from internet.

Traditional ways of farming

Images taken from internet.

Methods used in Green Revolution

1. Multiple Cropping System
2. Seeds with superior genetics
3. Proper irrigation system
4. HYV (high yield variety) seeds
5. Pesticides and fertilizers
6. Modern machines
7. Expansion of farming areas

Images taken from internet.

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Effect of Green Revolution

- Increase in production
- Capitalistic farming
- Rural employment
- Import of food grains
- Development of industries
- Economic growth
- Thinking of farmers

Images taken from internet.

Images taken from internet.

Important aspect of Green Revolution

In addition to producing larger quantities of food, the Green Revolution was also beneficial because it made it possible to grow more crops on roughly the same amount of land with a similar amount of effort. This reduced production costs and also resulted in cheaper prices for food in the market.

The ability to grow more food on the same amount of land was also beneficial to the environment because it meant that less forest or natural land needed to be converted to farmland to produce more food.

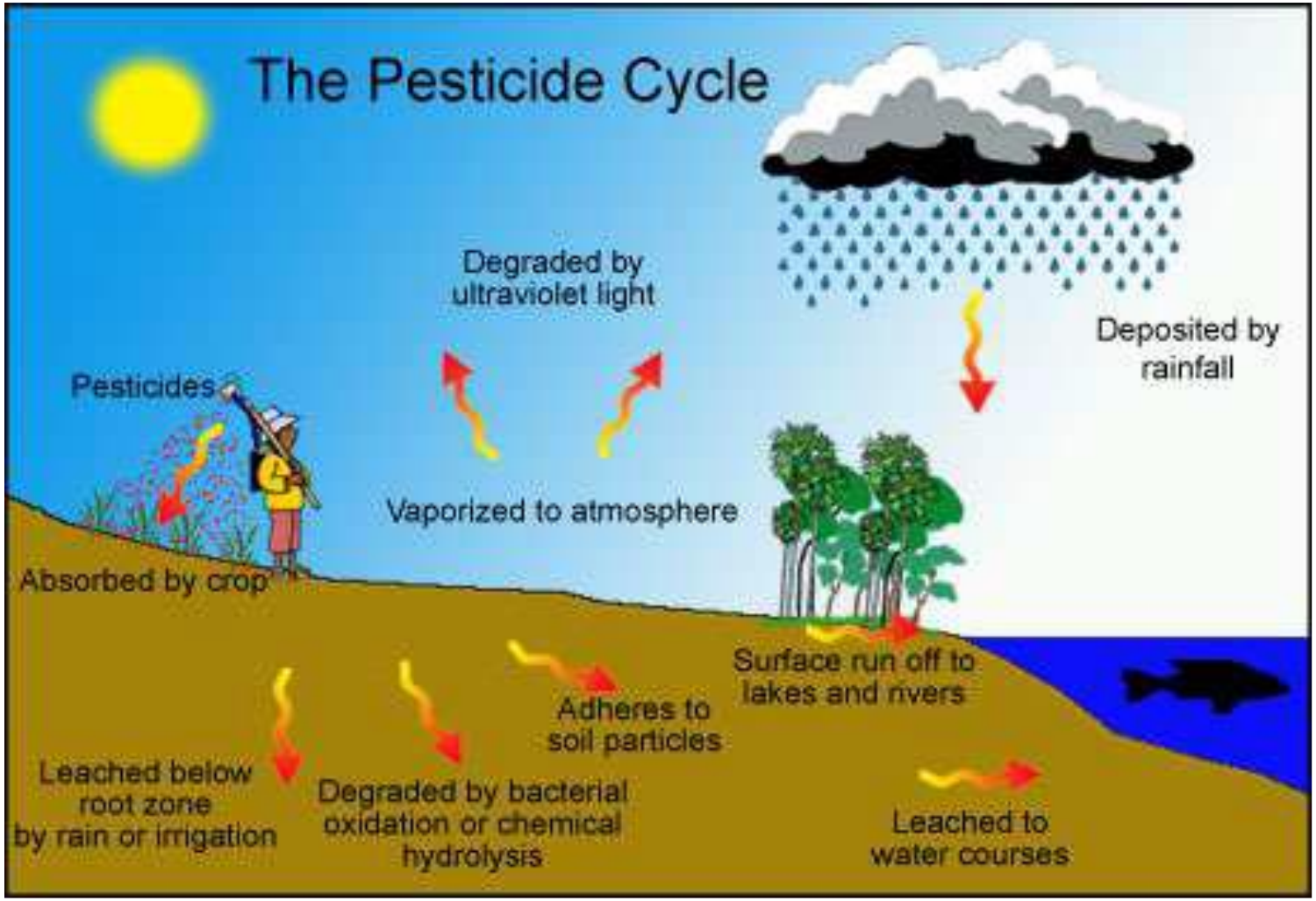
Images taken from internet.

Issues regarding Green Revolution

- Pollution and erosion of soil
- Pollution of water
- Unemployment among uneducated farmers
- Deadly disease
- Harmful for farmers
- Consumption may be adverse

Images taken from internet.

Failures of green revolution



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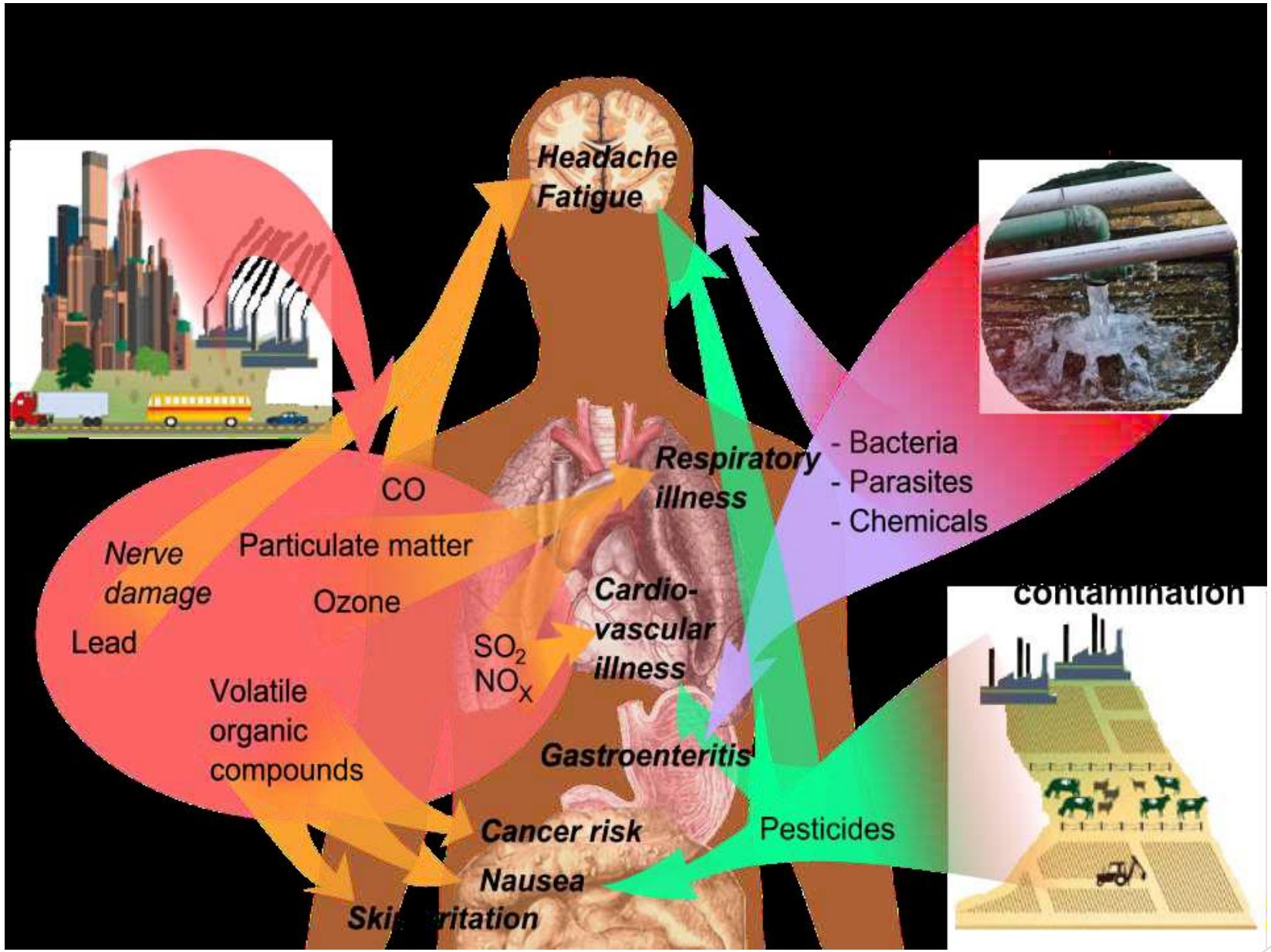


Images taken from internet.

Conclusion

Green Revolution has done a lot of positive things, saving the lives of millions peoples and exponentially increasing the yield of food crops.

But environmental degradation makes the Green Revolution an overall inefficient, short-term solution to the problem of food insecurity.

So, more sustainable and environmental friendly system of cultivation needs to be practiced.

The world needs green Revolution, which promises to feed a growing world population sustainably – without compromising the needs of future generations

Images taken from internet.

Need for second green revolution

India has tremendous export potential in agriculture in present era of globalization .

In second Green Revolution emphasis should be
laid on

1. Non food grains

(Non-food crops include Oilseeds (groundnut, linseed, rapeseed and mustard, Niger seed), Fibre crops (cotton, jute and Mesta), sugarcane, tobacco, Plantation crops (tea, coffee and rubber), Condiments)

2. Improving global market opportunities
3. Improving rural infrastructure
4. Improving rural roads and electrifications

Images taken from internet.

GERMPLASM AND ITS CONSERVATION

Images taken from internet.

INTRODUCTION

- A germ is a collection of genetic resources for an organism. For plants, the germplasm may be stored as a seed collection (even a large seed bank) or for trees in a nursery. Animal as well as plant genetics may be stored in a gene bank or cryo-bank.

- Germplasm is a living tissues from which new plants can be grown. It can be a seed or another plant part-a leaf, a piece of stem, pollen or even just a few cells that can be turned into the whole plant.

- It contains the information for a species genetic make up, a valuable natural resources of plant diversity.

Images taken from internet.

GERMPLASM IN AGRICULTURAL PURPOSE

- Agricultural benefits from uniformity among crop plants within a variety, which ensures consistent yield and make management easier.

- However, genetic uniformity leaves crops especially vulnerable and to new pests and stresses.

- Genetic diversity of germplasm gives plant breeders the sustained ability to develop new high yielding , high quality varieties that can resist constantly evolving pests , diseases and environmental stresses.

Images taken from internet.

- Sexually compatible wild species and landraces – ancestral varieties of crop species are the key to genetic diversity, but the amount of land where plants grow wild continues to shrink and many plant species are disappearing.

- That’s why the plant science community has developed conservation system to evaluate, catalogue and distribute germplasm for people all over the world to use.

Images taken from internet.

GERMPLASM BIOLOGICAL TECHNOLOGY

Images taken from internet.

GERMPLASM CONSERVATION CONTENT:

History

Definition

Way of conservation

Cryopreservation

Advantages and

Disadvantages

Images taken from internet.

HISTORY ABOUT GERMPLASM

Even since primitive man learned the art of learning and realized the economic utility of plants, he started saving selected seeds or vegetative propagules from one season to next. Conservation was taught and decreed in part of India and China as far back as (700 B.C).
The concept of physical basis of heredity expressed by the 19th century Biologist August Weisamann. According to his theory, germplasm, which is independent from all other cells of the Body (somatoplasm) is essential element of germ cells(eggs and sperm) and is the heredity material that is passed from generation to generation.

Images taken from internet.

Weisamann first proposed this theory in 1883, it was later published in (1892; The Germplasm: A Theory of Heredity). Bajaj 1995 and Staristky 1997 reported that some of the valuable gene pools might be lost unless coordinated efforts are made towards the conservation of genetic stock all over the world. Realizing the danger of genetic resources the U.N Conferences on Human Environment held in Stockholm in 1972, recommended conservation of the habitat that are rich in genetic diversity.

Images taken from internet.

WHAT IS GERMPLASM CONSERVATION?

Plant germplasm is the genetic sources material used by the plant breeders to develop new cultivars.
They may include:

- Seeds

Other plant propagules are:

- Leaf
- Stem
- Pollen
- Cultured cells

Which can be grown into mature plant?
Germplasm provide the raw material(genes) which the breeder used to develop commercial crop varieties.

Images taken from internet.

NEED FOR CONSERVATION OF GERMPLASM

- Loss of genetic diversity among plant species.

- Human dependence on plant species for food and many different uses. E.g. basic food crops, building materials, oils, lubricants, rubber and other latexes, resins, waxes, perfumes, dyes fibers and medicines.

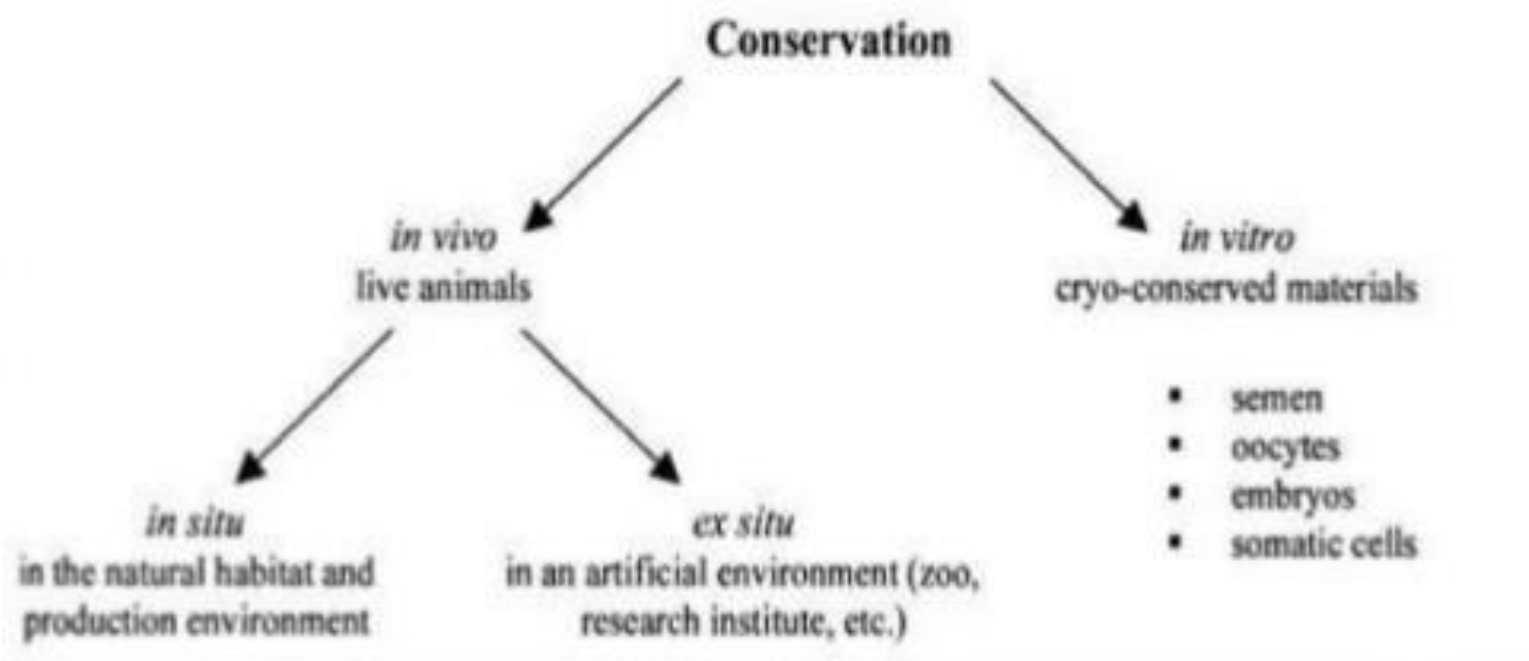
- Species extinction and many other are threatened and endangered-deforestation.

- Great diversity of plants is needed to keep the various natural ecosystems functioning stable interactions between species.

- Aesthetic value of natural ecosystems and diversity of plant species.

Images taken from internet.

MODE OF CONSERVATION



Images taken from internet.

IN SITU CONSERVATION

- In situ conservation is on- site conservation or conservation of natural resources in a natural population of plants such as forests genetic resources in natural population of tree species.

- It is the process of protecting an endangered plant in its natural habitat either by protecting or cleaning up the habitat itself or by defending the species from predators.

- It is applied to conservation of agriculture biodiversity in agro ecosystem by farmers, especially those using unconventional farming practice.

Images taken from internet.

EX SITU CONSERVATION

Images taken from internet.

Ex situ conservation means literally," off-site conservation ". It is the process of protecting an endangered species of plants or animal outside of its natural habitat; for example, by removing part of the population from a threatened habitat and placing it in a new location, which may be a wide area or within the care of humans.

Images taken from internet.

EX SITU CONSERVATION CAN BE CARRIED OUT BY SEVERAL METHODS

- Seed gene bank
- In vitro storage
- DNA storage
- Pollen storage
- Field gene bank
- Botanical gardens

Images taken from internet.

There are three main approaches for the *In vitro* conservation of germplasm

- CRYOPRESERVATION
- COLD STORAGE
- LOW –PRESSURE AND LOW OXYGEN - STORAGE

Images taken from internet.

IN VITRO CONSERVATION OF GERMPLASM..

Images taken from internet.

CRYOPRESERVATION

Cryopreservation (Greek, krayos-frost) literally mean in the frozen state. The principle involved in cryopreservation to bring the plant cells and tissue cultures to a zero metabolism or non-dividing state by reducing the temperature in the presences of cryopreservation.

CRYOPRESERVATION broadly means the storage of germplasm at very low temperature.

- Over solid carbon dioxide (at 79°C)
- Low temperature deep freezer (at -80°C
- In liquid nitrogen (at -196°C).

Images taken from internet.

MECHANISM OF CRYOPRESERVATION

The technique of freeze preservation is based on the transfer of water present in the cells from a liquid to solid state. Due to the presence of salts and organic molecules in the cells, the cell water requires much more lower temperature to freeze (even up to -68°C) compared to the freezing point of pure water (around 0°C). When stored at low temperature, the metabolic processes and biological deteriorations in the cells/tissues almost come to standstill.

Images taken from internet.

TECHNIQUE OF CRYOPRESERVATION

The cryopreservation of plant cell culture followed the regeneration of plants broadly involves the following stages.

- Development of sterile tissue culture.
- Addition of cryoprotectant and pretreatment.
- Freezing
- Storage
- Thawing
- Reculture
- Measurement of survival/viability
- Plant regeneration

Images taken from internet.

1.DEVELOPMENT OF STERILE TISSUE CULTURE

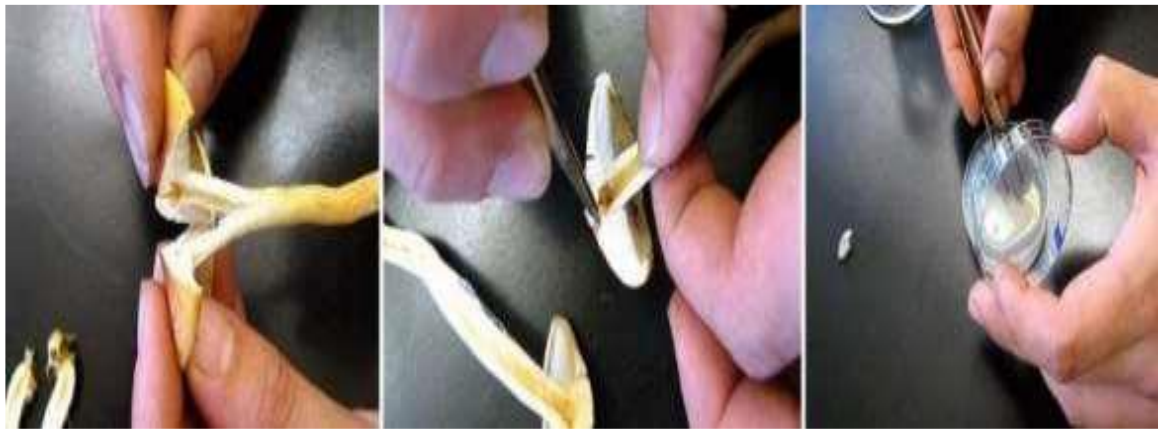
The selection of plant species and the tissue with particular references to the morphological and physiological characters largely influences the ability of the explants to survive in cryopreservation. Any tissue from a plant can be used for cryopreservation e.g. meristems, embryos, endosperm, ovules, seeds, culture plants.

2. ADDITION OF CRYOPROTECTANT

Cryoprotectant are the compound that can prevent the damage caused to cells by freezing or thawing. There are several cryoprotectant which include: (DMSO, GLYCEROL, ETHYLENE, PROPYLENE, SUCROSE, MANNOSE, GLUCOSE)

Images taken from internet.

Development of tissue culture



Cryoprotectant

Images taken from internet.

3. FREEZING

The sensitivity of the cells to low temperature is visible and largely depends on the plant species. Four different types of freezing are used.

- Slow freezing method
- Rapid freezing method
- Stepwise freezing method
- ✓ Dry freezing method

4. STORAGE

Maintenance of the frozen cultures at the specific temperature is as important as freezing. In general, the frozen cells/tissues are kept for storage at temperature in the range of -72 to-196°C. Storage is ideally done in liquid nitrogen refrigerator at 150°C in the vapour phase, or at -196°C in the liquid phase.

Images taken from internet.

LOOK OF STORAGE TECHNIQUE!

Images taken from internet.

5.THAWING

Thawing is usually carried out by plunging the frozen sample in ampoules into the warm water (temp 35-45°C) bath with vigorous swirling. By this approach, rapid thawing (at the rate of 500-750 °C min^{-1}) occurs, and this protects the cell from the damaging effects ice crystal formation. As the thawing occurs (ice completely melts) the ampoules are quickly transferred to a water bath at temperature 20-25°C. This transfer is necessary since the cells get damaged if left for long in warm (35-45°C) water bath.

Images taken from internet.

6. RECULTURE

In general thawed germplasm is washed several times to remove cryo-protectant. The material is then cultured in a fresh media.

7. PLANT REGENERATION

The ultimate purpose of cryopreservation of germplasm is to regenerate the desired plant. For appropriate plant growth and regeneration, the cryopreserved cell/tissue have to be carefully nursed and grown. Addition of certain growth promoting substances, besides maintenance of appropriate environmental conditions often necessary for successful plant regeneration.

Images taken from internet.

APPLICATION OF GERMPLASM CONSERVATION

 Plant materials (cell/tissue) of several species can be cryopreserved and maintained for several years and used as and when needed.

 Cryopreservation is an ideal method for long term conservation of cell culture which produces secondary metabolites e.g. medicines.

 Disease (pathogen) free plant material can be frozen and propagated whenever required.

➢ Recalcitrant seeds can be maintained for long.

 Conservation of somaclonal and gametoclonal variation in culture.

 Plant material from endangered species can be conserved.

 Cryopreservation is a good method for the selection of cold resistant mutant cell lines which could develop into frost resistant plant.

Images taken from internet.

LIMITATION OF GERMPLASM

- The expensive equipment needed to provide controlled and variable rates of cooling/warming temperatures can however be a limitation in the application of in vitro technology for large scale germplasm conservation.

- Formation of ice crystal inside the cell should be prevented as they cause injury to the cell.

- Sometimes certain solutes from the cell leak out during freezing.

- Cryoprotectant also effect the viability of cells.

Images taken from internet.