

Cross Breeding (Hybridization)

1. Types of cross breeding,
2. Heterosis and design of cross breeding programmes,
3. Hybridization in different fishes.

Definition

- When a plant or animal is bred with a plant or animal from different stock, the process is known as hybridization

NATURAL BREEDING AND ARTIFICIAL BREEDING

Breeding behavior varies in fish from once in life time (Oncorhynchs) to once in a year (many major carps and most other fish) or monthly (Ictalurus) or continually throughout the year (*Cyprinus carpio*) or once in ten to fourteen years (*Anguilla*).

For Indian major carps breeding is seasonal (once in a year) coinciding with rain and flood, which offer greatest opportunity for survival and development of the progeny.

EVENTS IN NATURAL BREEDING AND IN INDUCED BREEDING



Diploid hybrid

Cross between two different species result in diploid hybrid . Which are viable and so find application in fish culture to the new combination traits both inter specific and intra generic hybrid have been achieved in India .

Triploid hybrid

The triploid hybrid by chromosomal manipulation

Which include the following .

1. By inter generic mating between a diploid female of another of one species and triploid male of another species .
2. By subjecting the normally fertilized a involve in artificial in sanitation off egg of one species by sperm of another species to head or cold .
3. By subjected the fertilized a involve in the egg one species with the sperm of another species to action of an antibiotic colchicum with are mitotic inhabitation . The triploid may viable but are sterile however the triploid growth faster than either diploid parent and so find use in fish culture in a monsoon mono sex culture system .

hybridization of two types

- a. Inter specific hybridization
- b. Inter generic hybridization

Types of Hybridization
on the basis of cell type involve in crossing over

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graph TD; A([Types of Hybridization  
on the basis of cell type involve in crossing over]) --> B{{1. Hybridization in sex cell}}; A --> C{{2. Somatic Hybridization}}
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1. Hybridization in sex cell

2. Somatic Hybridization

Types of Hybridization

on the taxonomic relationship of the two parents, hybridization classified into two broad groups.

1. Intervarietal Hybridization

2. Distant Hybridization

INTRASPECIFIC

INTERSPECIFIC

Intra generic

Inter generic

1. Intervarietal Hybridization

- The parents involved in hybridization belong to the same species. In crop improvement programme this type of hybridization is commonly used
- e. g crossing of two varieties of wheat or other crops..

INTERSPECIFIC HYBRIDIZATION

Interspecific reciprocal hybrids were produced among Indian major carp by crossing *Labeo rohita* with *Labeo calbasu*. These hybrids have been shown some traits of interest for aquaculture i.e. hybrid exhibited faster growth than the slow growing parents the *calbasu*.

For :- example

Male

Labeo rohita

Labeo calbasu

Labeo bata

Labeo bata

Labeo calbasu

female

laboe calbasu

labeo rohita

labeo rohita

labeo calbasu

labeo genus

results

rohu calbasu

calbasu rohita

bata calbasu

bata calbasu

calbasu

genius

INTER-GENERIC HYBRIDIZATION

Extensive work has been carried out on inter-generic hybridization among the species or three genera i.e catla labeo and cirrihinus as many as 30 / . inter generic have been produced and evaluated for their positive traits how ever only few of then .these found to posses some positive characteristics which are useful for aquaculture.

For:-example

Male

Catla catla

Catla catla

Laboe rohita

Laboe mrigala

Cirrihinus rewa

Female

Labeo rohita

catla mrigala

catla mrigala

Laboe calbasu

Labeo rohita

Results

Catla rohita

Catla mrigala

Rohu mrigala

Mrigala calbasu

Rewa rohu

2) Distant Hybridization:

- The parents involved belong to the different species of the same genus or of different genera.
- Types
 - I. Intrageneric
 - II. Intergeneric

a)INTRAGENERIC HYBRIDISATION:

- ☐ Crosses are made between two individuals of different species belonging to same genera.
- ☐ such as between bison and cow.
- ☐ It is used to produce resistance varieties from diseases ,frost or drought.

Beefalo



**Cow
+
Bison**

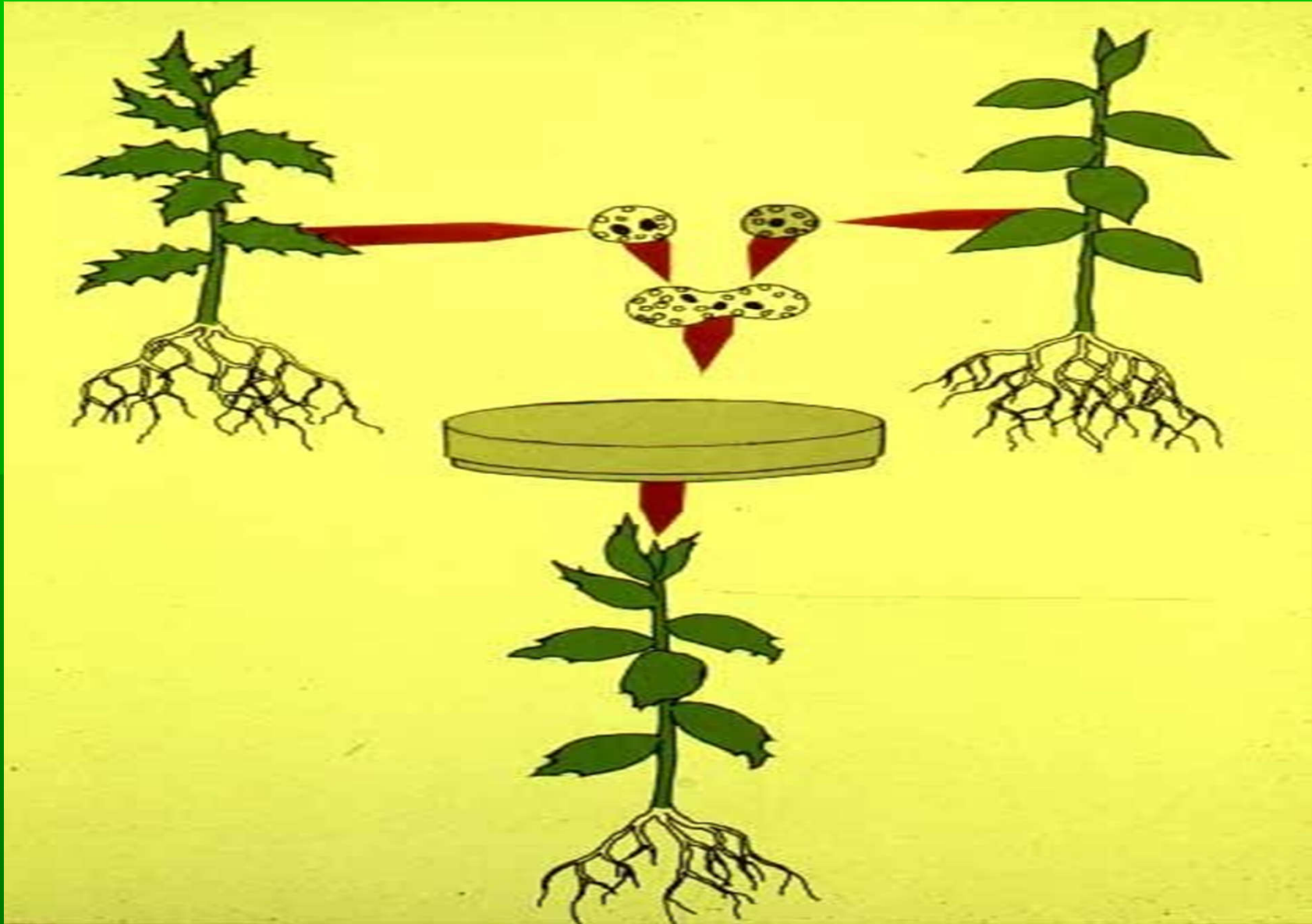
CHARACTERISTICS OF HYBRID

- ☐ The survival rates of hybrids vary in different crosses.
- ☐ The growth rate in hybrids is generally intermediate between the parental species.
- ☐ Hybridization of two species may result in the production of monosex population.
- ☐ Reproductive capacity of the hybrids are affected at various levels.

PROBLEMS OF HYBRIDIZATION

- ☐ It is beneficial if done with care and caution.
- ☐ Uncontrolled hybridization may cause economic loss.
- ☐ It requires a lot of experiments to find out an useful hybrid.
- ☐ Some hybrids are cultured on a commercial scale.

SOMATIC HYBRIDIZATION



Development of hybrid plants through the fusion of somatic protoplasts of two different plant species/varieties is called somatic hybridization

Somatic hybridization technique

1. isolation of protoplast



2. Fusion of the protoplasts of desired species/varieties



3. Identification and Selection of somatic hybrid cells

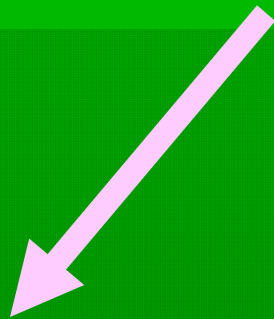


4. Culture of the hybrid cells

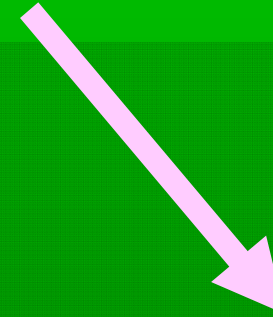


5. Regeneration of hybrid plants

1.Isolation of Protoplast
(Separation of **protoplasts** from plant tissue)

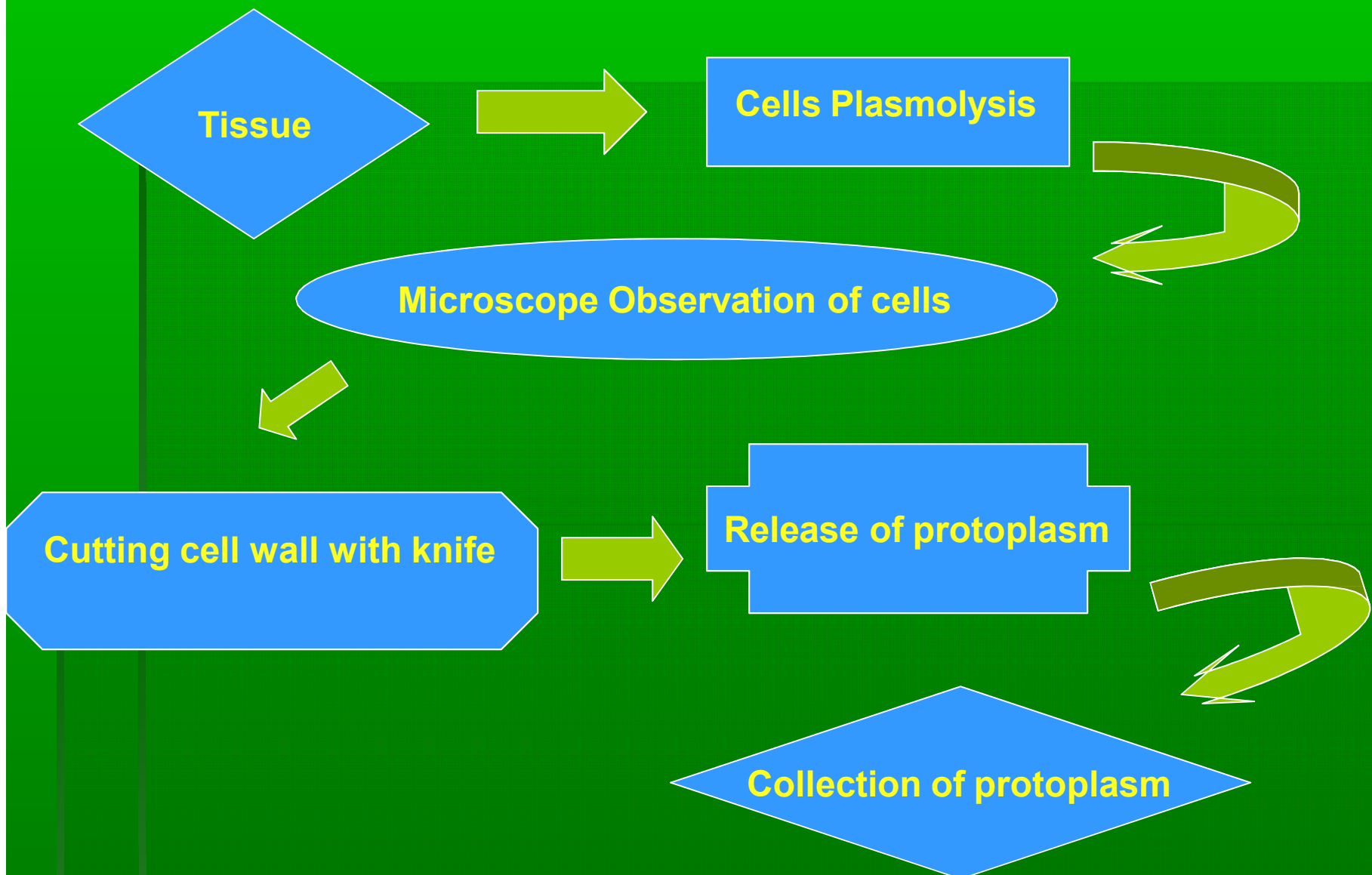


1. Mechanical Method



2. Enzymatic Method

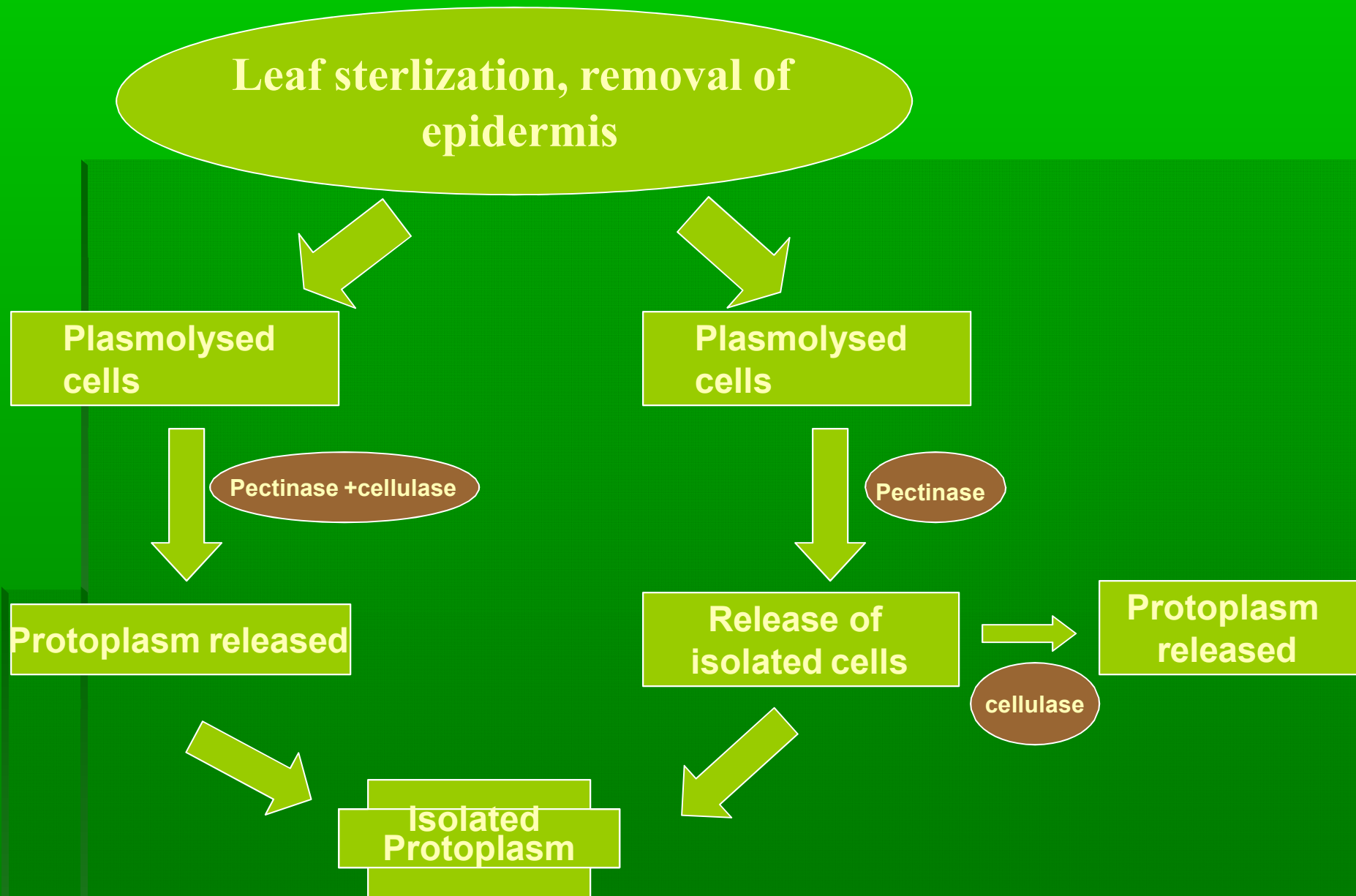
1. Mechanical Method



1. Mechanical Method

- ☐ Used for vacuolated cells like onion bulb scale, radish etc.
- ☐ Low yield of protoplast
- ☐ Laborious and tedious process
- ☐ Low protoplast viability

Enzymatic Method



Enzymatic Method

- ❑ Used for variety of tissues and organs including leaves, petioles, fruits, roots, stem, shoot apices, embryo microspores
- ❑ Mesophyll tissue - most suitable source
- ❑ High yield of protoplast
- ❑ Easy to perform
- ❑ More protoplast viability

2. Protoplast Fusion (Fusion of protoplasts of two different genomes)

1. Spontaneous Fusion

Intraspecific

Intergeneric

2. Induced Fusion

Chemofusion

Mechanical
Fusion

Electrofusion

1. Spontaneous Fusion

- Protoplast fuse spontaneously during isolation process mainly due to physical contact

- a) Intraspecific produce homokaryones

- b) Intergeneric have no importance

2. Induced Fusion

a) Chemofusion- fusion induced by chemicals

- Types of fusogens
 - PEG
 - NaNO_3
 - Ca^{2+} ions
 - Polyvinyl alcohol

Induced Fusion

b) Mechanical Fusion

Physical fusion of protoplasts under microscope by using micromanipulator and perfusion micropipette

c) Electrofusion

Fusion induced by electrical stimulation

4. Identification and Selection of somatic hybrid cells

- ☐ Hybrid identification- Based on difference between the parental cells and hybrid cell

Hybrid Selection

(Several markers are used)

- **Genetic complementation**
- **Phytotoxins**
- **Specific amino acid**
- **Auxin autotrophy**
- **Antibiotics**
- **Auxotrophic and metabolic mutants**
- **Chromosomal analysis**
- **Herbicides**

5. Culture of the hybrid cells

Hybrid cells are cultured on suitable medium provided with the appropriate culture conditions.

6. Regeneration of hybrid plants

- ☐ Plants are induced to regenerate from hybrid cell
- ☐ These hybrid plants must be at least partially fertile, in addition to having some useful property, to be of any use in breeding schemes.

Advantages of somatic hybridization

- Production of novel interspecific and intergeneric hybrid
 - Pomato (Hybrid of potato and tomato)
- Production of fertile diploids and polyploids from sexually sterile haploids, triploids and aneuploids
- Transfer gene for disease resistance, abiotic stress resistance, herbicide resistance and many other quality characters

Advantages of somatic hybridization

- Production of heterozygous lines in the single species which cannot be propagated
- Studies on the fate of plasma genes
- Production of unique hybrids of nucleus and cytoplasm

Limitations of Somatic hybridization

- ☐ Poor regeneration of hybrids
- ☐ Non-viability of fused products
- ☐ Not successful in all.
- ☐ Production of unfavorable hybrids
- ☐ Lack of an efficient method for selection of hybrids
- ☐ No confirmation of expression of particular trait in somatic hybrids