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Doubled Haploid (DH) Technology in Crop Improvement

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A doubled haploid is a genotype formed when haploid cells undergo chromosome doubling. Artificial production of doubled haploid is important in plant breeding. Haploid cells are produced from pollen or egg cell or from other cells of the gametophyte, then by induced or spontaneous chromosome doubling, a doubled haploid cell is produced which can be grown into a doubled haploid plant. It is a very efficient tool to produce completely homozygous lines from heterozygous donor plants in a single step. Haploid plants were first discovered in devil's weed (*Datura stramonium*) by **AD Bergner** in 1921.

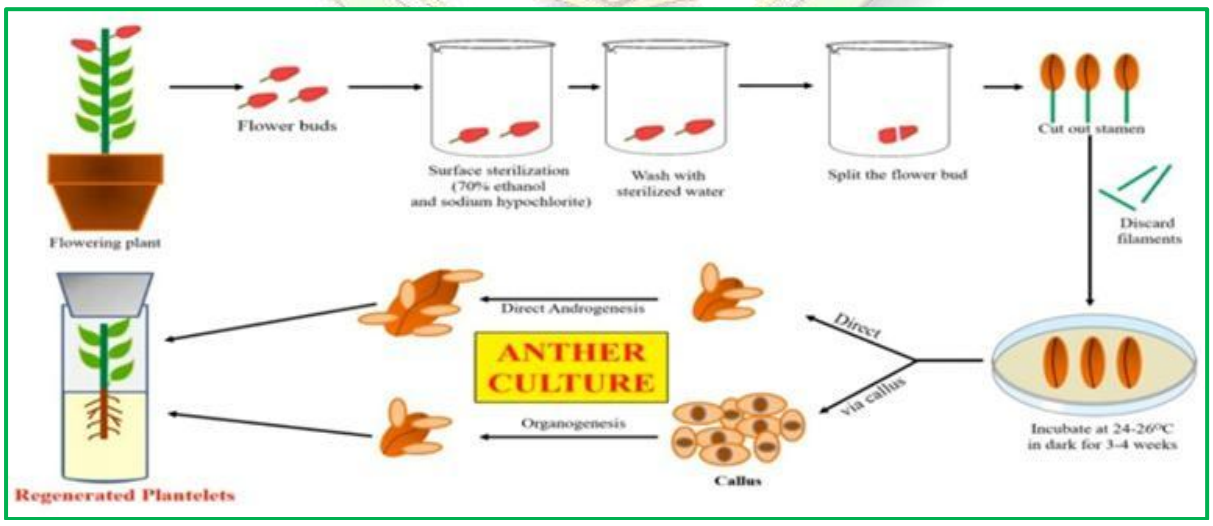
Needs

- Development of homozygous lines
- Fixation of heterosis
- Mutation studies and easy to induce mutation
- Cytogenetical research
- Induction of genetic variability at haploid level

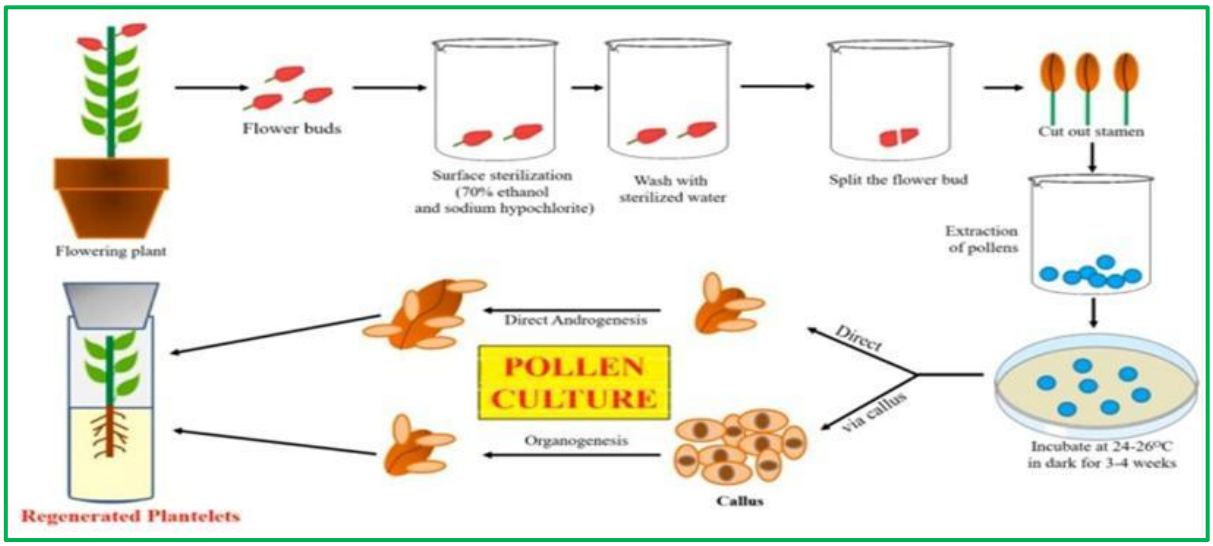
Methods to Induce Doubled Haploids

1. **Haploids from male gametes**

a. **Anther culture:** It is the technique in which anthers containing microspores or immature pollen grain are cultured on a nutrient medium for the purpose of generating haploid plant.

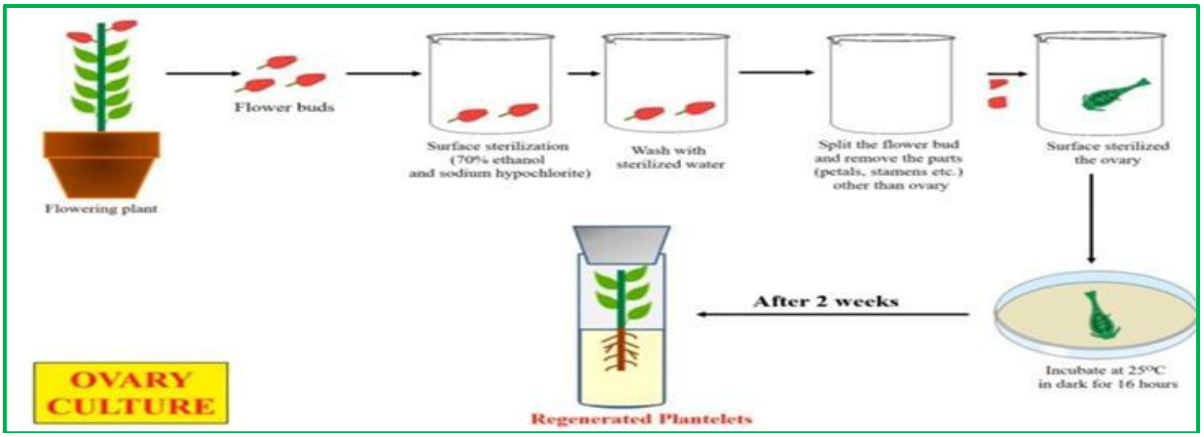


b) Pollen or Microspore culture: Pollen or microspore culture is an in vitro technique by which the pollen grains, preferably at the uni-nucleated stage, are squeezed out aseptically from the intact anther and then cultured on nutrient medium for the purpose of generating haploid plant.

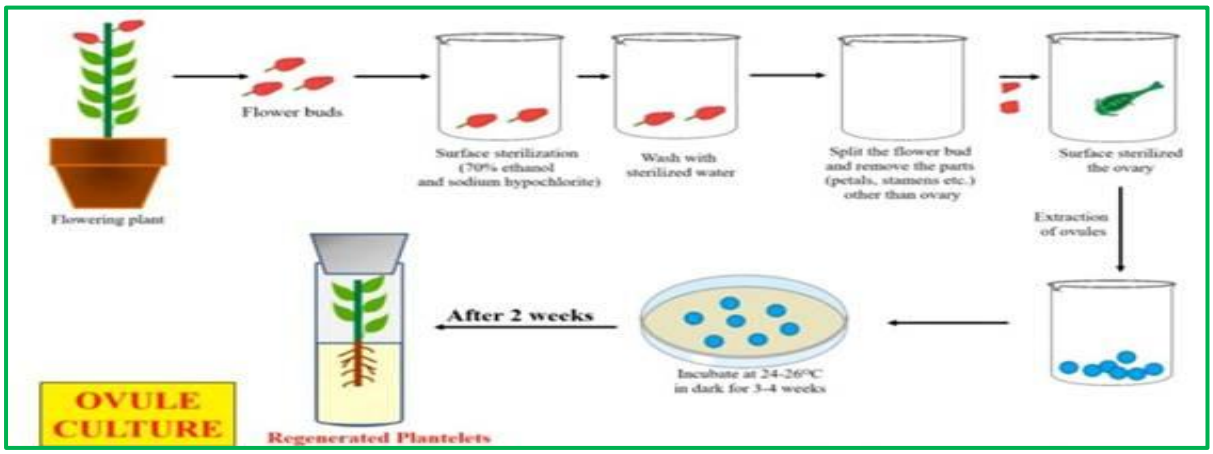


2. Haploids from female gametes

a) **Ovary slice culture:** Ovary culture is a technique of culture of ovaries isolated either from pollinated or un-pollinated flowers.



b) **Ovule culture or megaspore culture:** Ovule culture is an experimental system by which ovules are aseptically isolated from the ovary and are grown aseptically on chemically defined nutrient medium under controlled conditions.



Advantages of DH

- Development of complete homozygous line in 2-3 generation.
- Perfect fulfillment with DUS criteria for variety protection.
- Higher frequency of desirable homozygous plant.

Disadvantages of DH

Frequency of haploid production is very low.
Highly unpredictable.

Uses of DH

- Development of purelines
- Development of cultivars
- Development of hybrids as parents
- Construction of genetic maps
- Gene tagging / location genes
- Identification of moleculars markers for trait selection

Achievement

Varieties developed through doubled haploid technology:

Crop	Method followed	Varieties	Country
Rice	Anther culture	Tanfeng 1, Tan Fong 1, Hua Yu 1, Hua 03, Xin Xiu, Xhongua 8, Ta Be 78, Guan 18	China
Rice	Anther culture	Parag 401 (ACR 401)	MH, India
Rice	Anther culture	CR Dhan 80	CRRI, India
Wheat	Anther culture	Hua Pei 1, Lung Hua 1, Jinghua 1, Yunhua 1, Yunhua 2	China
Tobacco	Anther culture	Tan Yu 1, Tan Yu 2, Tan Yu 3	China

Pest and disease resistance lines developed using doubled haploid technique:

Crop & line	Resistence to	Reference
Barley- Mingo Q- 21681	Barley yellow mosaic virus Stem rust, leaf rust and PM	Stoffenson *et al.*, 1995
Tobacco- Tan yu 3	Necrotic strain of potato virus	Witherspoon *et al.*, 1991