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Polyploidy Breeding in Vegetable Crops

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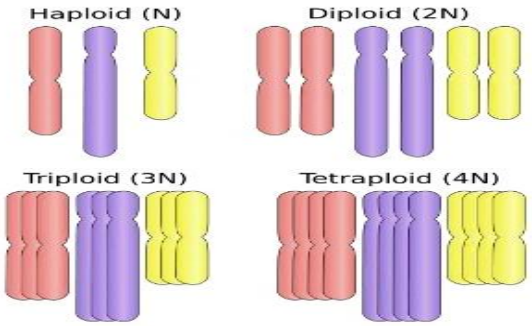
Introduction

A polyploid organism or individual is one with more than two basic or monoploid sets of chromosomes. In angiosperms, it typically varies from 35% to 70%. It is responsible for developing species with greater size, vigour, and disease resistance as well as increasing genetic diversity.



Features of polyploids

- Polyploid cells are larger than diploid cells.
- Polyploids have larger guard cells and fewer stomata than diploids.
- They have larger and thicker leaves, larger flowers and fruits.
- Shows Gigas effect

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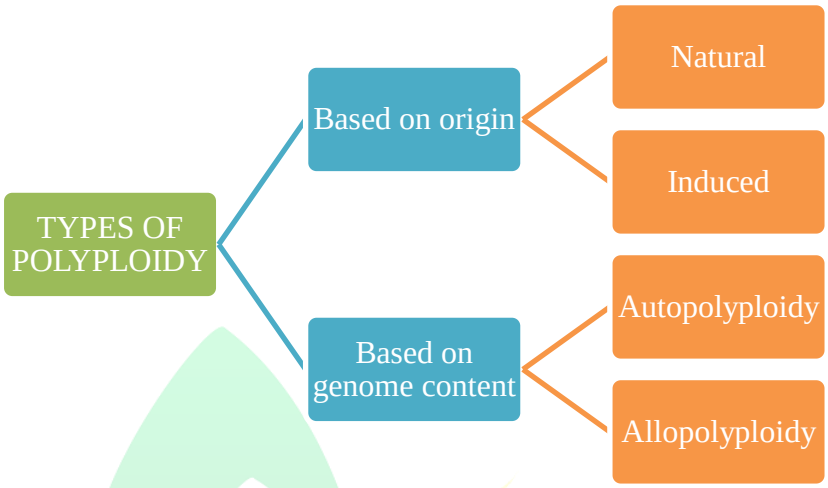
Types of polyploidy



I. Based on origin

A. **Natural -** Produced as a result of unreduced gamete production or a mutation in the gene that codes for the protein that forms the spindle during cell division.

B. **Induced -** Colchicineat the concentration of 0.01-0.5% (or other chemicals like acenapthanechloralhydrate, sulphanilamide, ethylmercury chloride, colchamine, oryzalin, trifluralinetc) dissolves the spindle fiber during cell division and results in chromosome doubling.

II. BASED ON GENOME CONTENT

A. **Auto polyploidy-** Autopolyploidy is the condition in which an individual possesses more than two full sets of chromosomes from a single genome. It is also known as autoploidy.

B. **Allopolyploidy-** Allopolyploidy is the condition in which an individual possesses two or more genomes contributed from different parental species in their ancestral lineage. It is also known as alloploids.

Examples of some polyploidy crops with their origin, formation process, ploidy level and chromosome number

Common name	**Origin**	**Formation Process**	**Ploidy level and chromosome number**
Potato	Natural	Autopolyploidy	4x = 48
Sweet potato	Natural	Autopolyploidy	6x = 90

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Triploid sugarbeet	Synthetic	Autopolyploidy	3x = 27
Triploid watermelon	Synthetic	Autopolyploidy	3x = 33
Leek	Natural	Autopolyploidy	4x = 32
Yam	Natural	Autopolyploidy	3x = 60; 4x = 80
Triploid cassava ‘SreeHarsha’	Synthetic	Autopolyploidy	3x = 54

List of Polyploid varieties and its features

PusaJyoti	Palak	Tetraploid, with very large, thick, tender, succulent dark green leaves that regenerate quickly, yielding 50 t/ha.
ArkaMadhura	Watermelon	Triploid seedless, TSS 13-14%, longer shelf life and transport quality, suitable for year round production under protected conditions, yields 50-60 t/ha
PusaBedana	Watermelon	Seedless triploid hybrid with aborted embryos and rudimentary seeds.
Shonima	Watermelon	Seedless triploid hybrid, red in colour
Swarna	Watermelon	Seedless triploid hybrid, yellow in colour
Sugar baby	Watermelon	Seedless triploid hybrid, fruits are slightly small in size,round shape and deep pink flesh. Average weight is 4-5kg.
SreeHarsha	Tapioca	Developed from triploid (OP-4 (2x) × H-2304 (4x), high starch content of 38-41 %, maturity- 300 days with yield 35-40 t/ha.
SreeApoorva	Tapioca	Released in the year 2013 from triploid progeny of local diploid variety Ambakkadan with the induced tetraploid of sreesahya, tubers are big sized, long cylindrical with brown skin and white flesh. It is suitable for starch extraction as well as culinary purpose, Starch content 33.3 %, maturity- 300 days with yield 37.60 t/ha.

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SreeAthulya	Tapioca	Released in the year 2013 from triploid progeny of local diploid clone OP-4 and induced tertraploid of "SreeVisakham", starch content 35 %, maturity-300 days with yield 40-50 t/ha.

Merits and demerits of polyploidy breeding

Merits

- Enlargement and Increased Vigor
- Creation of Sterile Triploids
- Restoring Fertility in Hybrids
- Overcoming Barriers in Hybridization
- Enhancing Pest Resistance and Stress Tolerance

Demerits

- Inbreeding in polyploids
- Effect of polyploidy on sterility
- Polyploidy affects inheritance and population genetics

Conclusion

Plants that are polyploid have broadergenomic and genetic diversity. Polyploidy plant can use toproduce early variety, seedless fruits, sterile line, productive crops, resistance and medicinal plants. Breeding for polyploidy can be a useful strategy in the development of novel crop species. It can be highly beneficial to farmers as larger fruits or other parts tend to fetch more yield and price. Furthermore, the fact that many of the most important crop species are polyploid has demonstrated that polyploidy is also important for humans.

Reference

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