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Reversion of Autopolyploids into Diploids

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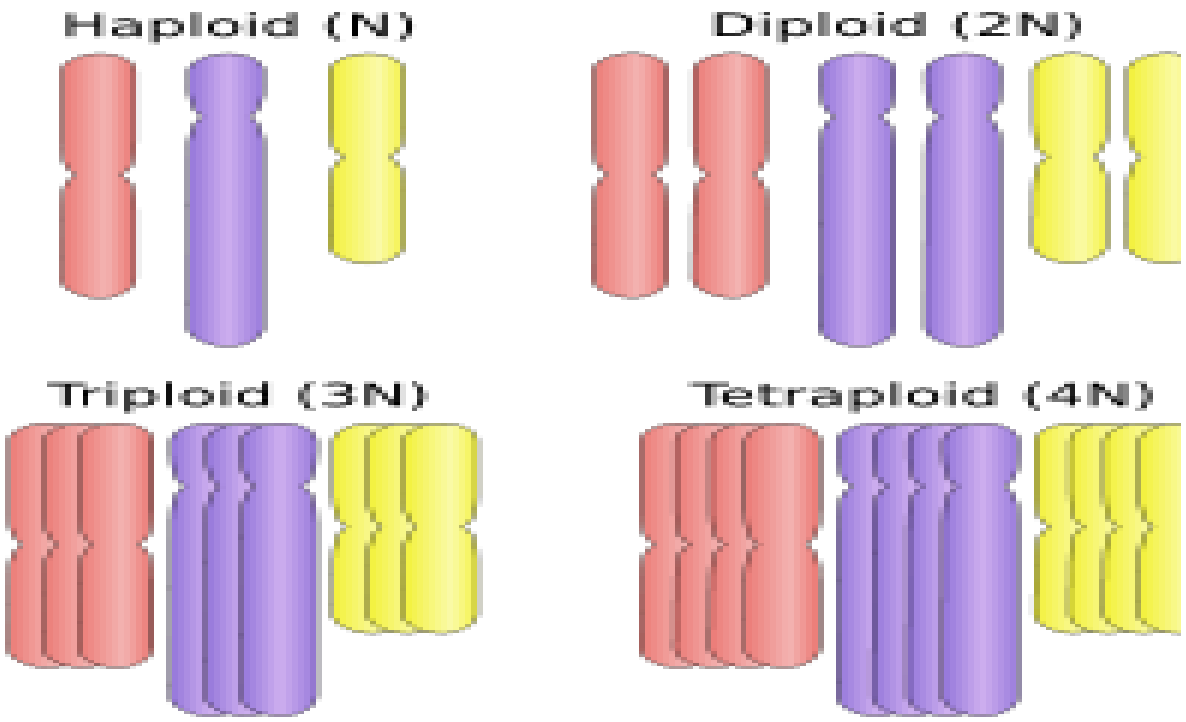
SUMMARY

Reversions are genetic alterations that reverse the effect of mutations. Some revertants are due to compensatory changes in genes different from the one with the original mutation. Reversion occurs when the effects of one mutation are counteracted by a second mutation. Sometimes these reversion takes place naturally where as some reversion are created with different methods like haploidization, Pollen and ovule culture, Haploid parthenogenesis and haploid apogamy, Natural/artificial crossing, Colchicine treatment, Unequal distribution of chromosomes, Multipolar orientation of spindles for research purpose which is explained in this article

INTRODUCTION

Ploidy refers to the number of sets of homologous chromosomes in the genome of a cell or an organism. Each set is designated by n. Thus, the term diploidy would refer to a state of being diploid, that is having two sets of the chromosomes (and therefore two copies of genes), especially in somatic cells. Autopolyploidy refers to a type of polyploidy in which the chromosome complement consists of more than two copies of homologous chromosomes.



Reversion of autopolyploid to diploid can be achieved by following methods

- HAPLOIDIZATION
- POLLEN AND OVULE CULTURE
- HAPLOID PARTHENOGENESIS AND HAPLOID APOGAMY
- NATURAL/ARTIFICIAL CROSSING
- COLCHICINE TREATMENT
- UNEQUAL DITRIBUTION OF CHROMOSOMES
- MULTIPOLAR ORIENTATION OF SPINDLES

Haploidization

- In nature autotetraploids are derived by chromosome doubling of diploid parents

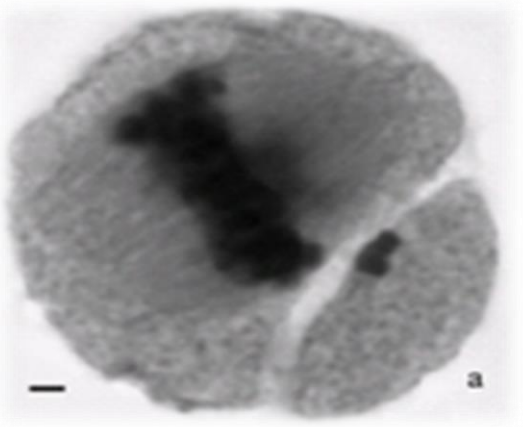
- It is also shown that autopolyploids also gives rise to fertile diploids through the process called haploidization (de Wet, 1971)
- In 1963, Kimber and Riley have recorded self-fertile haploids derived from polyploids *Bromus inermis* (2n=56) and *Parthenium argeniatum* (2n=72)
- In 1970, de Wet and Harlan had obtained fertile haploids from three tetraploid species of *Dichanthium*, *Sorghum controversum* (2n=40) and *S. halapense* (2n=40)

Colchicine ($C_{22}H_{25}NO_6$) Treatment

- High frequency of reversion following colchicine induced polyploidy were found in *Tabernaemontana divaricate (CREPE JASMINE).*
- On intermittent treatment of 0.2% colchicine for 6 hours resulted in c-mitosis which continued till cells with 12n, 15n, 16n, 19n and extremely high chromosome number, which could not be counted, were produced.
- This is because, the cells at diploid state can divide faster than the polyploid ones due their reduced complexity.
- Further division in such high ploidy cells was not possible, so neighbouring diploid cells forms the growing point bringing about total reversion.

Unequal Distribution of Chromosomes

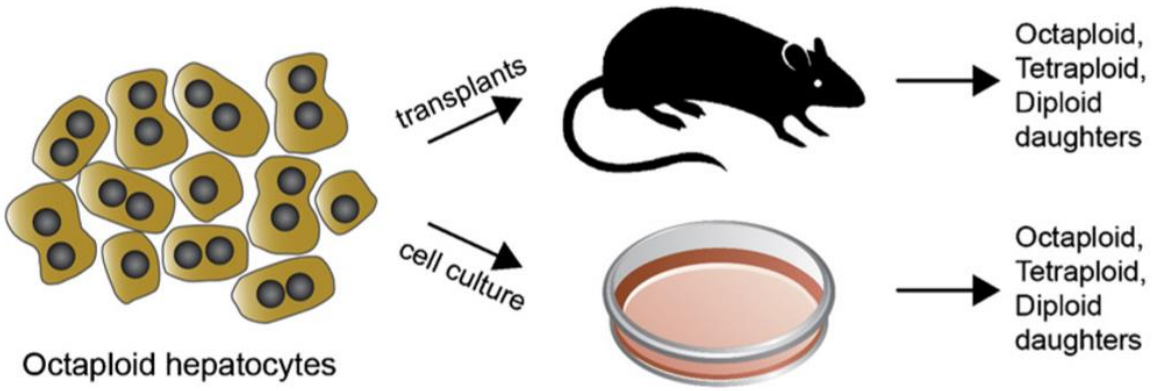
- Non-disjunction of autopolyploids during meiosis results in the unequal distribution of chromosomes among gametes
- It leads to the production of monoploid gametes, which on fusion gives rise to diploid individuals



Unequal Distribution of Chromosomes

Multipolar Orientation of Spindles

- In the hepatocyte cells of liver, diploid cells are formed from polyploid cells. **(Duncan, 2013).**
- Usually, the dividing diploid cells contains two centrosomes only, whereas the polyploid hepatocytes have supernumerary centrosomes.



- Eg., dividing tetraploid hepatocytes have typically four centrosomes.
- In pre-metaphase or metaphase, the four centrosomes orients along three or four distinct poles, forming multipolar spindle
- These multipolar spindles cause unequal division of chromosomes which is followed by cytokinesis to form diploid daughter cells

Natural/Artificial Crossing

- During gamete formation in triploids, the chromosome number in gametes vary from x to 2x with chromosome numbers approaching x and 2x being more frequent than the intermediates.
- The fusion of two such gametes with x number of chromosomes may result in fertile diploids.
- Due to this high frequency of gametes with x number of chromosomes, it is highly possible to get fertile diploids from Datura autotriploids.

Pollen and Ovule Culture

Pollen Culture

- One of the most popular methods for producing haploids is through culturing of pollen on artificial medium.
- Initial reports for successful production of haploids through anther culture in Datura was given by Guha and Maheshwari in 1967.
- Haploids has been reported in as many as 153 species belonging to 23 families of angiosperms.
- By using pollen culture techniques in autotetraploids, diploid offsprings can be produced

Ovule Culture

- Haploids have also been successfully produced from cultured female gametophytes.
- First achieved with some gymnosperms like *Zamia, Ephedra* and some *Cycads.*
- Recently haploids had been produced from ovule culture in plants like barley, wheat and tobacco.
- The difficulty in production of haploids from ovule culture when compared to anther culture culture is due to the differences in growth patterns in *invitro* development of unfertilized female and male gametophytes.

Haploid Parthenogenesis and Haploid Apogamy

Haploid Parthenogenesis

- Development of embryo without fertilization from haploid egg cells is termed as haploid parthenogenesis.

Haploid Apogamy

- Development of embryo other cells of normal haploid embryo sac such as synergids or antipodal cells is termed as haploid apogamy
- These are non-recurrent in case of diploid species but when haploid parthenogenesis and haploid apogamy occurs in autotetraploids it may give rise to fertile diploid organisms

CONCLUSIONS

There is significance of polyploidy reversal in evolution. Evolution at diploid level is efficient than the polyploids due to its selective advantage in mutation. Haploidy unmasks accumulated mutations, and makes available new gene combinations for selection to act upon when the occasion arises.

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