

## Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Third Year)

Subject: Botany

Paper Code: BOC-108

Paper Title: Cytogenetics and plant breeding

Unit: Alteration in chromosome number

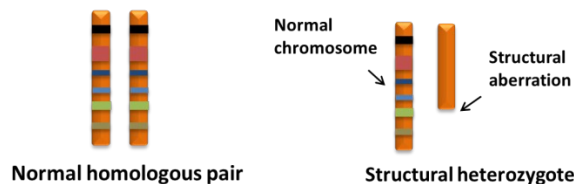
Module Name: Meiosis in structural heterozygotes

Name of the Presenter: Rajendra Shetye

Notes:

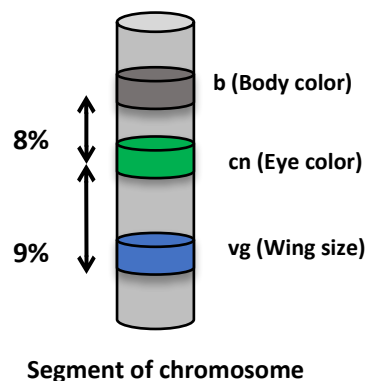
### Structural heterozygote:

Diploid organism which is characterized by a homologous pair containing one normal chromosome and other chromosome with structural aberration is called structural heterozygote.

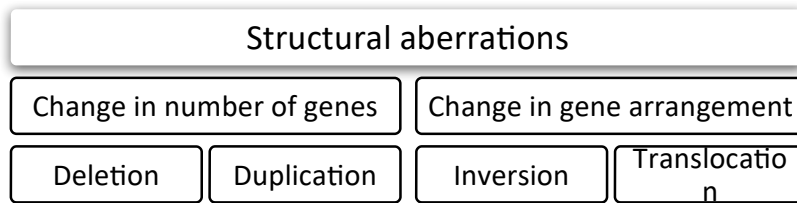


### Structural aberrations:

Every chromosome has characteristic structure due to presence of Specific types, number and sequence of genes. When change occurs in any one of them it is referred as structural aberration.



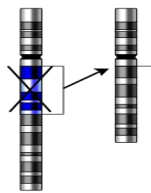
## Types of structural aberrations:



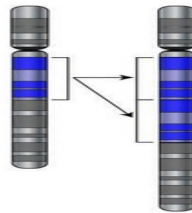
### Aberration due to change in number of genes:

**Deletion** results in loss of part of chromosome.

- Terminal deletion: Terminal segment of chromosome is deleted.
- Intercalary deletion: Interstitial segment of chromosome is deleted.

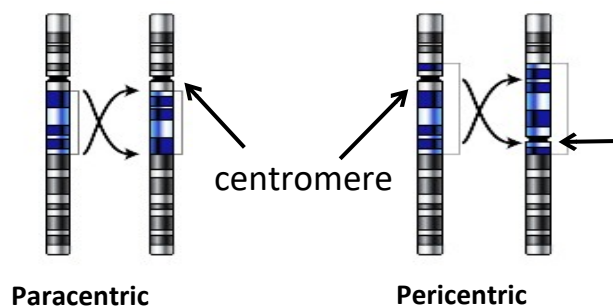


**Duplication:** Presence of part of chromosome in excess of the normal complement.

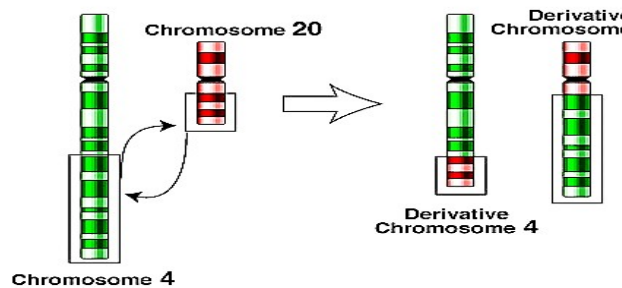


### Aberration due to change in gene arrangements:

**Inversion:** Part of chromosome is detached and reattached in reverse order of genes.



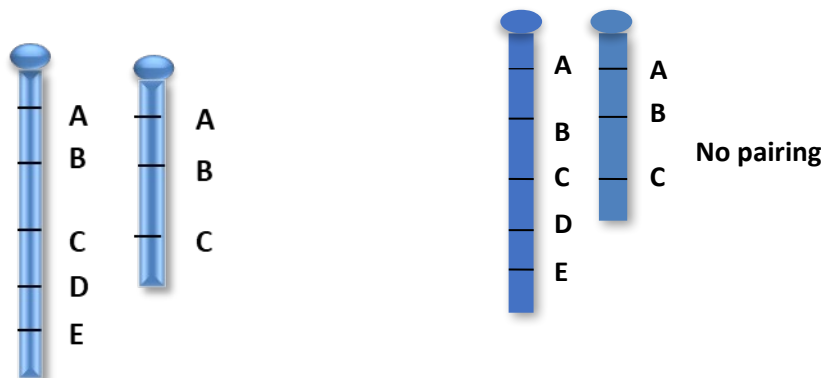
**Translocation:** Part of chromosome is *transferred* to a non-homologous chromosome or exchange of chromosome segments occur between two non-homologous chromosomes called as **reciprocal translocation**.



**Reciprocal translocation**

**Meiosis in structural heterozygote with terminal deletion:**

Homologous pair has one normal chromosome and other deficient homologue with terminal chromosome segment missing. During meiosis –I at zygotene stage, the chromosomes pair precisely gene by gene all along the homologous region but In deficient region, the normal chromosome does not show any pairing



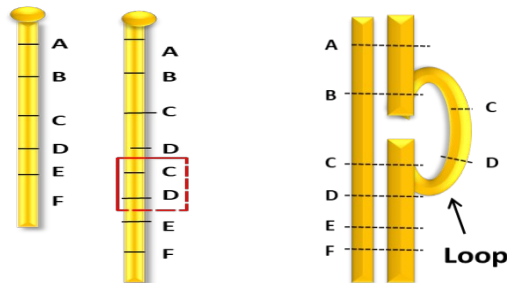
**Meiosis in structural heterozygote with intercalary deletion:**

Homologous pair has one normal chromosome and other deficient homologue with in between chromosome segment missing. During meiosis –I at zygotene stage, at the point of intercalary deficiency a **buckling (loop)** develops in the normal homologue. It is, therefore, known as **buckling effect**. Such a configuration is called **deficiency loop or compensation loop**.



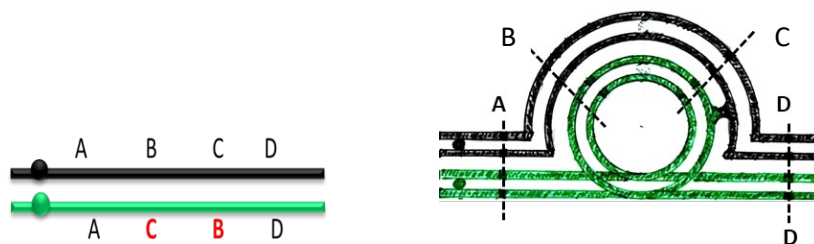
### Meiosis in structural heterozygote with duplication:

Homologous pair has one normal chromosome and other homologue has additional chromosomal part. During meiosis –I at zygotene stage , the chromosome bearing duplicated segment **forms a loop to maximize the juxtaposition** of homologous region.

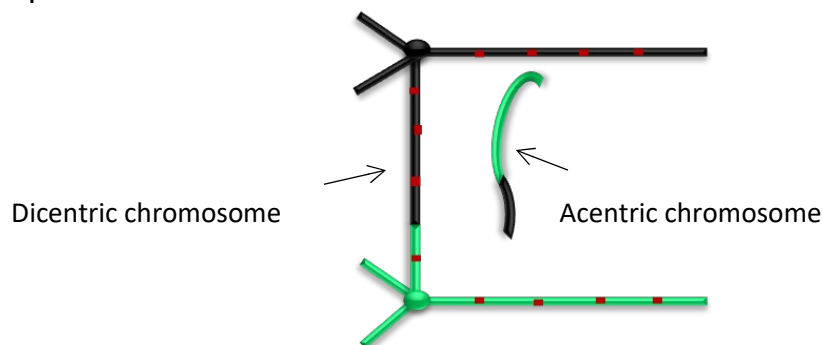


### Meiosis in Paracentric inversion heterozygote:

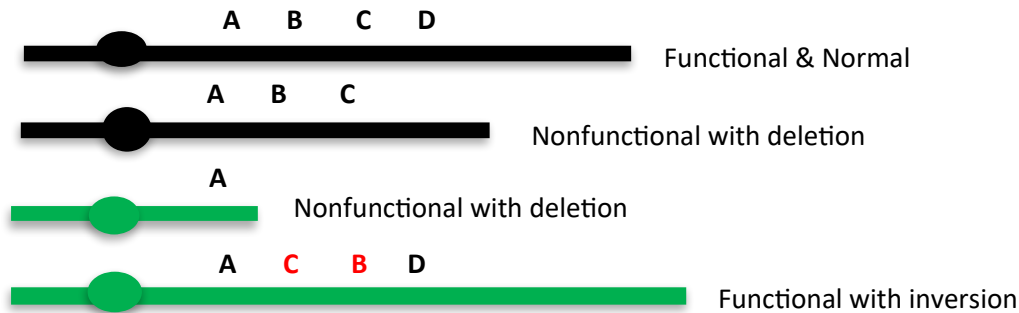
Paracentric inversion heterozygote has one normal chromosome and its homologue has some part of chromosome with inverted genes sequence. **But centromere is not included in inverted sequence.** In Prophase-I **during synapsis** inverted loop is formed in chromosome with inversion **to maximize the juxtaposition** of homologous region.



Crossing over in inverted region produces a **dicentric chromosome**. In anaphase-I it forms a bridge from one pole to other pole. This bridge breaks randomly along its length resulting in fragments with duplication and /or deletion. An acentric fragment is also formed which usually fails to move to either pole.

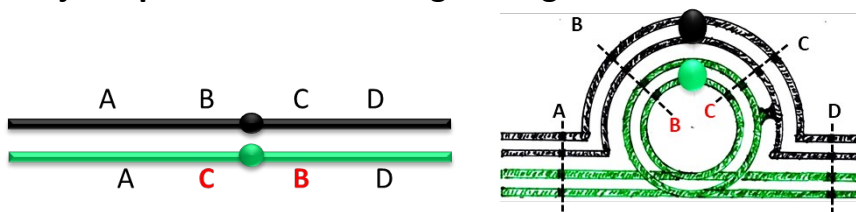


At the end of meiosis half of the gametes formed are nonfunctional. 1/4 functional with normal chromosome. 1/4 with inverted chromosome

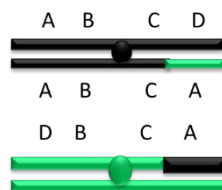


**Meiosis in heterozygote with Pericentric inversion:**

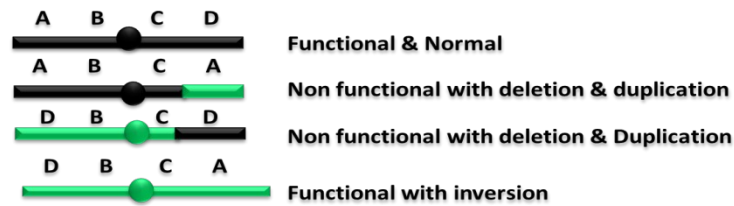
Pericentric inversion heterozygote has one normal chromosome and its homologue has some part of chromosome with inverted genes sequence. And **centromere is included in inverted sequence**. In Prophase-I during **synapsis** inverted loop is formed in chromosome with inversion **to maximize the juxtaposition** of homologous region.



Crossing over in inverted region **results in deletions and duplications**. It also produces **acrocentric** chromosomes. Anaphase -I appears normal, but 2 chromatids of each chromosome usually have unequal arms depending upon where crossing over occurs.

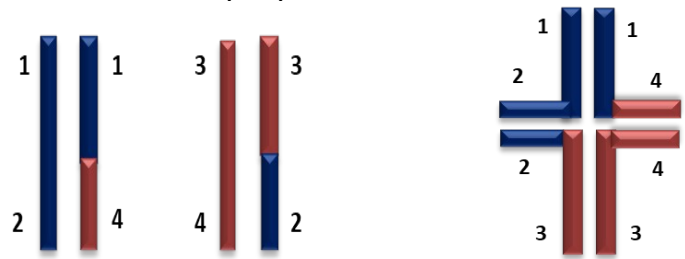


At the end of meiosis half of the gametes formed are nonfunctional. 1/4 functional with normal chromosome. 1/4 with inverted chromosome.



**Meiosis in structural heterozygote with reciprocal translocation:**

Considerable degree of meiotic irregularity is seen. In prophase-I **during synapsis characteristic configurations of chromosome pairing is observed** in order to affect pairing of all homologous chromosomes. Typically, a **cross shaped configuration** is seen in prophase-I. It reduces cross over frequency



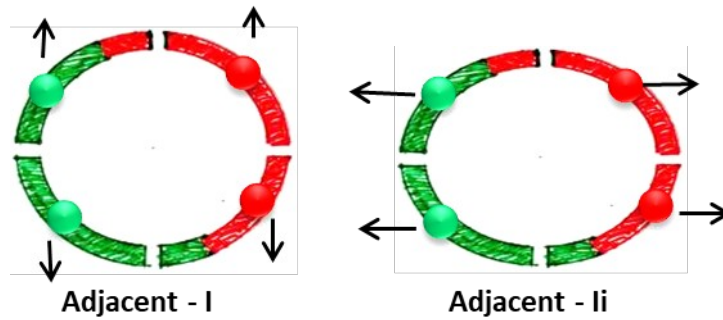
Later this structure opens into either a ring or a figure of 8 structure. In case of 8 figure configuration, in anaphase –I both normal chromosomes move to one pole and both translocation chromosomes move to another pole. This is called **alternate segregation/disjunction**. 2 kinds gametes are formed 50% normal and 50% with translocation.



In ring type configuration, one normal & one translocated chromosome move to same pole and their counterparts move to opposite pole. This is called **adjacent segregation**.

**Adjacent-I:** adjacent chromosomes having non-homologous centromeres move to same pole.

**Adjacent-II:** adjacent chromosomes having homologous centromeres move to same pole.



Adjacent I and Adjacent II will form gametes, which would carry duplications or deficiencies and as a result would be **nonfunctional** or sterile. Therefore, in a plant having a translocation in heterozygous condition, there will be considerable pollen sterility.

