

SHORT NOTES

LINKAGE

Tendency of the gene situated on the same chromosome remain together and transmitted together in the same gamete in parental combination is called linkage or in other words linkage is a modification of Mendal's law of independent assortment.

The clear demonstration of Mendalian dihybrid ratio (9:3:3:1) and law of independent assortment was reported by Betson and Punnet (1906) in sweet pea and the result obtained by them was contrary (unfavourable) to the Mendal's independent assortment. Betson and Punnet found that when two genes, such as "A" "B" come from same parent (AA BB and aabb), they tend to remain together in successive generation and in the gametes production but when the same two gametes come from different from parents (AA bb and BB aa), they tend to remain separate in the progeny and gametes. They called these two phenomenon Coupling and Repulsion respectively.

To summarised the above result alleles coming from the same parent tend to enters the same gametes and to be inherited together (genetic

coupling). Similarly in same genes coming from two different parents tends to enter different gametes and to be inherited separately and independently (repulsion). Morgan (1910) working on *Drosophila* and found that coupling and repulsion are the two aspects of single phenomenon which to be called linkage.

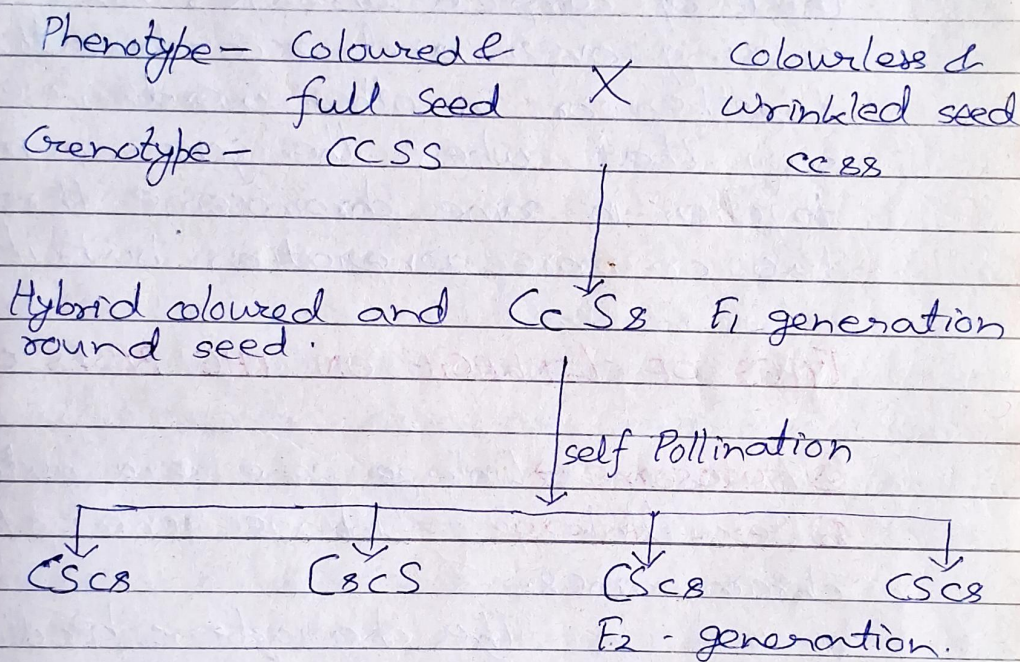
Morgan and Castle (1906) formulated chromosomal theory of linkage to explain the above phenomenon. According to them —

- 1) Genes that show linkage are situated on the same chromosome.
- 2) Genes are arranged in a linear fashion in the chromosome.
- 3) The genes which are closely located show strong linkage where as they are widely separated and more changes to get separated by crossing over.
- 4) Linkage gene remains in their original combination during inheritance.

TYPES OF LINKAGE IN PLANT

① Incomplete linkage or Partial linkage — When the genes on the same chromosome do not remain together for two or more generation and where crossing over takes place. The first plant in which linkage and crossing over ~~was~~ was studied

is maize plant by Hutchinson (1911). In maize plant coloured and round seeded are dominant over colourless and wrinkled (shrunken) seeds respectively. Hutchinson crossed these two maize plant bearing coloured and wrinkled (shrunken) seeds respectively. Hutchinson round seed with colourless and shrunken seeds as give below in the chart.



Here in F_2 generation 4 types of progeny were found,

- | | |
|--|------------------------------|
| <p>Ⓐ Coloured and full seed.</p> <p>Ⓑ Colourless and shrunken seed</p> <p>Ⓒ Coloured and shrunken seed</p> <p>Ⓓ Colourless and full seed</p> | <p>} 96.4%</p> <p>} 3.6%</p> |
|--|------------------------------|

But on the basis of

independent assortment and the expected ratio is the four types of progeny is 1:1:1:1 or 50% parental and rest 50% recombinant but in above example 96.4% gametes linked together and recombined only 3.6%.

③ Complete or perfect linkage → Morgan (1919) found in male *Drosophila* cell that of complete linkage, there is no crossing over and recombination together or in other words, we can say that when the genes remain together in same chromosome through two or more generation but it is more

TYPES OF LINKAGE ON THE BASIS OF CELL

- ① Autosomal linkage → Linkage gene are autosomal.
- ② Sex-linkage → Linkage gene of sex chromosomes.

The characters produced by inheritance, such genes are called sex-linked characters. The inheritance of such character is called sex-linked inheritance as for example - haemophilia, colour blindness etc.

FACTORS AFFECT THE LINKAGE

- 1) Distance → Greater the difference between genes is less in the linkage.

If the genes are closely associated, linkage is strong.

2) **Age** → With the increase of age of an organism chances of crossing over decreases and linkage increases.

3) **Temperature** → With the increasing of temperature linkage increases but excess temperature is harmful and linkage decreases.

4) **X-rays** → With the effect of x-rays crossing over increases so linkage decreases.

IMPORTANCE OF ROLE OF LINKAGE →

① The idea of linkage is utilized in the improvement of plant through hybridization and selection programme. It also helps in bringing desirable characters together.

② Linkage may some time be used as or acts as a marker between quantitative and qualitative genes.

③ Linkage may create protoplasm or destroyed protoplasm where poor character gene is linked to good character gene than it is very difficult to separate them.

④ It checks the appearance of new combination.

⑤ It helps to hold the potential characters together.