LINKAGE IN GENETICS



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- Importance of linkage

Introduction

- Mendel's low of segregation states that when two or more than two factor are considered together ,these factor show independent and random assorted during distribution of gametes.
- During meiosis in F1 generation progeny (AaBb) maternal and paternal factor are independent assorted into gametes.
- Four types of gametes (AB, Ab, aB & ab) will be produce equal proportion (1:1:1:1).



- Dihybrid F2 ratio of 9:3:3:1 and test cross ratio (1:1:1:1) are actully based on the low independent assortment.
- This assortments of characters is based on independent assortment of non homologous chromosomes ; these will be located on seperated non homologous chromosome.



- Some time if more than two genes are locate on same chromosome, independent assortment does not takes place, instead the would be inherited together in a group.
- Genes present on same chromosomes and inherited together are called as linked gene and the process is called as linkage. "
- The principle of linkage was 1st discovered by Bateson and Punnet in 1906 in sweet pea (Lathyrus odoratus).
- Total number of linkage group in an organism is equal to the number of homologous chromosomes (pair of chromosomes).
- Linkage group Human beings 23
 Drosophila 04
 Sweet pea 07

Definition

According to Morgan (1910) he define linkage as -

"The tendency of gene present on the same chromosome, to remain in the original combination and enter together same gamete".

Theory of linkage

- 1. Coupling and repulsion theory of linkage
- 2. Chromosomal theory of linkage
- 1. Coupling and repulsion theory of linkage this theory was proposed by W. Bateson & R. C. Punnet (1906), after the study of pea plant
- He take two varieties of pea plant -
- ^{1.} Plant with purple flower 'P' and long pollen (L).
- **II.** Plant with red flower 'p' and round pollen(l).

Here purple flower 'P' & long pollen 'L' are dominant and red flower 'p' & round pollen 'l' are recessive.

When a cross is made b/w purple flower long pollen "PPLL" and red flower round pollen "ppll".F1 gen.... Only "PpLI" produce..



When f1 hybrid were test cross with double recessive red & round (homozygous) they failed to produce expected ratio 1:1:1:1ratio
 These usually produce four combination in ratio 7:1:1:7.



- Above test cross show the parental combination are seven time more than the non parental combination.
- Bateson & punnet suggest " the alleles coming from the same parent tend to enter same gamet and to be inherited together . This is called genetic coupling.

Cont...

In same way " the genes or alleles coming from two different parents tend to enter different gametes and to be inherited independentlly". This is called genetic repulsion.



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2. Chromosomal theory propose by Morgan and Castle in 1910 According to this theory –

1. Gene which is locate on the same chromosome show linkage.

- 2. The linked genes are locate same chromosome in a linear sequence with a definite and constant order in its arrangement.
- 3. The strength of linkage depends upon the distance b/w gene.

 $D \approx 1/S \text{ or } S \approx 1/D$

Here D = distance b/t gene , S = Strength of linkage D = K. 1/S

K = constant known as linkage4. Cis – arrangement & trans arrangement of genes



Types of linkage

- 1. Complete linkage
- 2. Incomplete linkage
- 1. **Complete linkage** In a complete linkage two or more character are inherited together and these character are appear in two or more generations. Ex. Drosophila (male)





2. Incomplete linkage – this type of linkage found many plant and animals.

Here chromosomes break accidently either in one or several places.



Important of linkage

- 1. Linkage help to know the characters of parents.
- 2. It helps to know the probability of origin of new characters in off springs.
- 3. It helps in the control of many characters of organisms by controlling inheritance of linkage groups.

THANK YOU FOR YOUR ATTENTION

