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B.Sc HONS Part-III Paper-VI

Topic:- Linkage and crossing over.

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Q. Give an account of linkage and crossing over with suitable examples.

Ans. Introduction : It is now universely agreed that gene which are located on the chromosomes are the hereditary character.

The number of gene in a cell is more than the number of chromosomes. It is, therefore, evident a single chromosomes carries several genes. The genes on the same chromosome remain tied to one another & are said to be linked. They tend to be transmitted to the offspring. But some time usually during reduction diction, a pair of homologous chromosome exchange segment and so also the genes located on that particular part of chromosome T.H. Morgan 1911 designated this phenomenon of the separation of the chromosome and

also the genes located on that part, as crossing over & the phenomenon of no separation of genes located on that part of the chromosome known as linkag

Linkage and Crossing Over : The phenomenon of linkage and crossi over best illustrated by taking the example of drosophila. It is the normal f have grey body and long wings but a race has been found with successi mutation having black body & vestigeal wing.

When these two varieties are crossed. in Fl generation all individenc are grey bodies and long winged. This indicates that the grey body and lo wing character are dominant over black body and vestigeal wing.

Hence, We can indicate :

Grey body–G	Long wing–L
Black body–g	Vestigeal wing–l

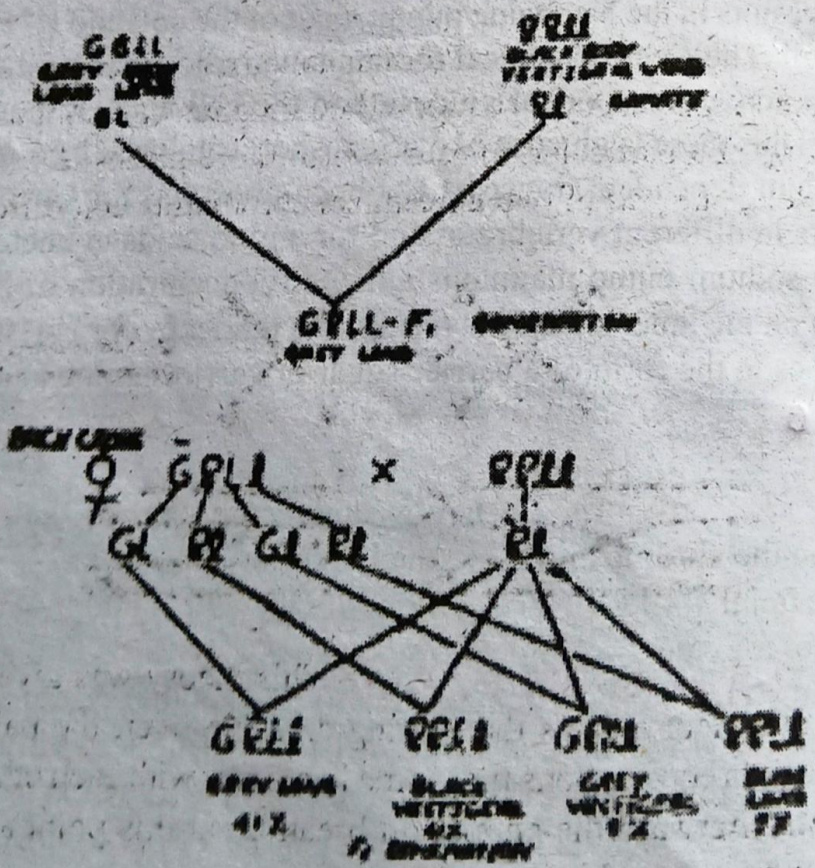
The gametic constitution of grey body and long wings individuals wou be GGILL and black body and vestigeal wing individuals would be GGILL

When the gametes of the two parents combine in the Fl generation the produce hybrid having genotype GgIl. This hybrid (female) of Fl may produ four types of garnets.

GI, GL } Both due to linkange

GL, gl } Both due to crossing over

In above experiment, it has been found that the former two types of game are in high percentage. 41% each which the crossed over gamets 9% each.



When these P_2 female is back crossed with pure double recombine male (ggll). The male will produce only one type of garnets (gl). This would remelt in the formation of four type of individuals.

Ggll
Ggll } 41% due to linkage

Ggll
ggll } 9% due to crossing over

Sometimes there is no crossing over, only two of individuals are formed each being 50%.

Thus Morgan and his co-workes recognised two types of linkage.

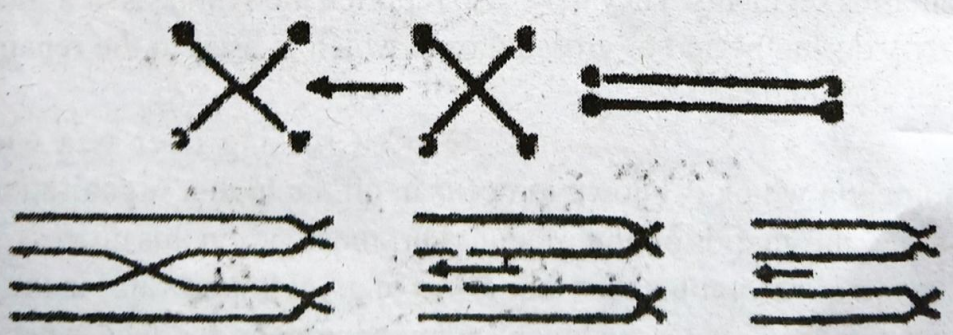
(a) Complete linkage (b) Incomplete linkage.

Complete Linkage : The phenomenon in which parental combination of characters appears together for two or more generation is known as complete linkage. In this type of linkage genes are closely associated and tend to transmitted together. The gene for bent wing (b^+) and seven bristis (Sun of the 4th chromosome mutart of Dresophila exhibit complete linkage.

Incomplete Linkage : In this type of linkage genes remain widely located on the chromosome and have chance of separation by crossing over; this is exhibited by grey body and long wing as shown above.

Theory of Crossing Over : To explain the actual mechanism of crossing over produced by various workers of these, the more important theories are follows :

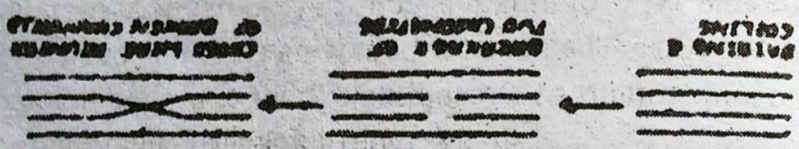
1. Muller's Theory : This theory was. produced by Muller (1919) and account to this theory. The pair of homologous or analogous chromatids first break up at a particular point in two or more pieces. As soon as breakage is complete, the part of two unidentical chromatids unit different combination.



2. Sere Brovsky's Theory : This theory was given by Sere Borvsky's and this theory states that during crossing over, the pair of Homologous or analogous chromotions first come in contact with each other and cross at certain point. Afterward the chromatid break up at this point and their broken parts recombine in different combination.

3. Darlington's Theory : C. D. Darlington (1935) produced probable and easy pypothesis of mechanism or crossing over which is known as "breakage and recention theory". He postulated that the homologous chromosomes are inter twisted during the four strand stage of meiosis. The twisting exerts strain on the chromatids.

If the stress are greater enough one or more chromatid of the homologous will be broken at one or more points. If more than one chromatid break, there is possibility that the broken chromatid of one chromosome will unite with broken end of different chromatids forming ahiama. If the union takes place between sister chromatids part (i.e. paternal to paternal & maternal to maternal) no genetic consequence is anticipated. However, if the break and reunion occur between non-sister chromatid (i.e., paternal to maternal and vice = versa) recombinants would resent. This hypothesis represents the best up to date explanation to account for the formation of recombinants.



Darlington Breakage & Reunion Theory : Preciously it was thought that the mechanical stress produces the breaks before the combination but scientist believe that some enzymes are involved in the process of breakage or reunion. The idea that some enzymatic process bring about breakage and rejoining of DNA strandly was first put forward by Howard & Handery and Boyle (1964).

Sterm and **Hotia** (1969) are of opinion that two enzymes, endonuclease and ligase bring about crossing over. The enzyme endonuclease helps in breathing of the chromatids while the ligase helps in the reunion of the chromatids segments. They have also reported the synthesis of a small amount of DNA during period of crossing over which is used in the repairing of the broken chromatids.

Significance of Crossing Over : Crossing over is a wide spread phenomenon which is known to occur in all the higher organisation between non-sister chromatids of homologous chromosomes in this process, lead to the production of recombinants. Hence, it is of great importa'nce in the evolution. The phenomenon of crossing over is of paramount importance in plant breeding because new varities with valuable characters can be evolved by eliminating undesirable genes through this process. Suddenly of crossing over much helpful in mapping the gene at the chromosome.

Linkange reduces the possibility of variability in garnets unless crossing over occurs.