D II / Hons. (ZOOLOGY) Paper III rd Gr-B.

Lecture No - 21.

By.

Dr. (Mrs). Prabhavati
Asso. Prof.
Marwari college. Darbhanga.
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Prabhachy-91@gmail.com.

MULTIPLE ALLELES

The word allele is a general term to denote the alternative forms of a gene or contrasting gene pair that denote the alternative form of a gene is called allele. Mendel and his followers used the term allele or allelomorph to denote the alternative form of normal gene. It means the genes for tall and dwarf Pea plants are alleles. The former (tall) is normal allele or wild and the later mutant allele. A gene can mutate several times producing several alternative expressions. Such genes are called Multiple alleles.

Definition :- Multiple allele can be defined as a set of three four or more genes or alleles which have arisen as a result of mutation of normal gene & which occupy the same locus in the homologous chromosomes.

Characters of Multiple Alleles :-

1. The study of multiple alleles may be done in Population.
2. Multiple alleles are situated on homologous chromosomes at the same locus.
3. Crossing over doesnot occur in multiple alleles.
4. Multiple alleles influence one or the same character only.
5. Multiple alleles never show Complementation with each other. By Complementation test the allelic and non-allelic genes may be differentiated well. The production of wild type phenotype is known as complementation test.

⑥ The Wild type (normal) allele is nearly always dominant while the other mutant alleles in series may show dominance or there may be an intermediate phenotypic effect.

⑦ When any 2 of the multiple alleles are crossed, the phenotype is a mutant type and not the wild type.

⑧ Further F_2 generation from such crosses show typical monohybrid ratio for the concerned characters.

Examples of Multiple Alleles :—

Multiple Alleles in Drosophila (Wings of Drosophila).

In Drosophila wings are normally long. There occured two mutations at the same locus in different flies, one causing vestigial (reduced) wings and other mutation causing antlered (less developed) wings. Both vestigial and antlered are alleles of the normal gene and also of each other and are recessive to the normal gene.

Vestigial is represented by the symbol vg and antlered wing by vg^a. The normal allele is represented by symbol +. Thus there are three races of Drosophila

i) Long ++ (+/+)
ii) Vestigial vgvg (vg/vg).
iii) Antlered $vg^a vg^a$ (vg^a/vg^a)

Long winged Drosophila × Vestigial winged Drosophila
+/+ ↓ vg/vg
F1 vg/+ (Long winged) × vg^+ (Selfing)
F2 +/+ vg/+ vg/+ (3 Long winged) | vg/vg (1 Vestigial winged)

Long winged fly × Antlered winged fly
+/+ × vg^a/vg^a
F1 vg^a/+ Long winged × vg^a/+ (Selfing)
F2 +/+, vg^a/+, vg^a/+ (3 long winged fly) | vg^a/vg^a (1 antlered winged fly)

A cross between a long winged fly & another vestigial winged or antlered winged fly.

When a fly with vestigial wing is crossed with antlered winged fly, the F_1 hybrids are intermediate in wing length showing that none of the mutated genes is dominant over the other. This hybrid is sometimes said as the vestigial antlered compound and contains two mutated genes at the same locus. They show Mendelian segregation and recombination.

Vestigial winged fly × Antlered winged fly.

Vg/Vg × Vg^a/Vg^a

F_1 Vg/Vg^a (Intermediate) × Vg/Vg^a (selfing)

F_2 Vg/Vg (1 Vestigial) | Vg/Vg^a Vg/Vg^a (2 intermediate) | Vg^a/Vg^a (Antlered) 1

A cross between a vestigial and antlered winged fly. Besides the vestigial and altered wing, there are several other mutations occuring at the same locus and resulting in nicked wings, strap wings or no wings etc. These are all multiple alleles.

Close linkage versus Allelism:— These mutant genes (vestigial and antlered) are not allelic located at different loci in place of locating at same locus in different chromosomes so closely linked that there is no crossing over between them, the mutant genes will suppress the expression of adjacent normal allele to certain extent.

These closely linked genes are called Pseudoalleles and this suppression is result of Position effect.

Another example of multiple alleles is the eye colour in Drosophila. The normal colour of eye is red. Mutation change this colour to white. Other mutations at white locus took place changing the red eye colour to various lighter shades like cherry, apricot, eosin, creamy, ivory, blood etc are also visible and are due to multiple alleles.

Example - 2, Coat colour in Rabbit:-

The colour of the skin in rabbits is influenced by a series of multiple alleles. The normal colour of the skin is brown. Besides it there are white races called albino and Himalayan ass the mutant races. The Himalayan is similar to albino but has darker nose, ear, feet and tail. The mutant genes albino (a) and Himalayan (a^h) occupy the same locus & are allelic. Both albino and Himalayan are recessive to their normal allele (+).

A cross between an albino and Himalayan produces a Himalayan in F_1 and not intermediate as is usual in the case of other multiple alleles.

Albino a/a × Himalayan a^h/a^h

↓

F_1 a/a^h (Himalayan)

a^h/a × a^h/a selfing.

F_2 a^h/a^h : a^h/a : a^h/a : a/a

Himalyan — Albino.

Representing a cross between Albino & Himalayan Races of Rabbit

Example - 3 - Self sterility in Plants:-

Kolreuter (1764) reported self sterility in Plants tobacco (Nicotiana longiflora). is controlled by four genes designated as S_1, S_2, S_3 & S_4 Several other S alleles were found. The hybrids S_1/S_2 or S_1/S_3 or S_3/S_4 are self ~~sterile~~ sterile because Pollen grains from these varieties did not develop, but Pollens of S_1/S_2 were effective & capable of fertilization with S_3/S_4. 37 members of multiple series cause self. Compatibility in evening Primrose, Oenothera & about 41 are found in red colour.

To be continued.