Principles of Inheritance and Variation

TRY YOURSELF   ANSWERS

1. Reciprocal cross is a cross in which the male and female parents used in an earlier cross are reversed *e.g.*, a cross made between male violet flower plant and female white flower plants are further crossed as female violet flower plant and male white flower plant.

2. Mendel used pea plants because:

(i) It has short life cycle therefore, offsprings can be produced quickly.

(ii) Pea plant has many distinct varieties and the flowers are bisexual.

3. Checker board method was firstly used by Reginald. C. Punnett in 1927. It is a graphical representation to indicate all possible union of gametes during fertilisation and to calculate the probability of all possible genotypes of offsprings in a genetic cross. The possible gametes are written on two sides, usually the top row and left columns. All possible combination of gametes during fertilisation are represented in boxes below the squares, which generates a square output form.

4. Emasculation is the process of removing anthers from bisexual flowers without affecting the female reproductive part (pistil), which is used in various plant hybridisation techniques. Emasculation ensures that only cross pollination takes place and self pollination does not occur. Thus, it helps in cross breeding of plants.

5. Mendel's work was rediscovered by three European scientists: Huge de Vries, Carl Correns and Erich von Tschermak while working independently.

6. A plant heterozygous for one character and homozygous for other could be AaBB or Aabb. In both the cases, it will produce two types of gametes, *i.e.*, AB, aB or Ab, ab.

7. Main reasons for the success of Gregor Mendel were as follows:

(i) Mendel did his experiments on pure breeding varieties of pea, *i.e.* homozygous dominant and homozygous recessive varieties.

(ii) The traits studied by Mendel did not show linkage, incomplete dominance or co-dominance.

(iii) Mendel worked on clearly contrasting characters such as flower colour (purple or white) and plant height (tall or dwarf).

(iv) Mendel studied all characters one by one, however his predecessors studied all characters simultaneously.

(v) Mendel repeated his experiments and studied the characters upto three or more generations and also performed reciprocal crosses to validate his results.

(vi) Mendel did control cross breeding experiments where he avoided contamination from foreign pollen grains, however in nature, self breeding takes place.

(vii) Mendel took a large sample size. He recorded all the data of every cross and statistically analysed the data.

8. Crossing over is the exchange of genetic material between non-sister chromatids of homologous chromosomes during meiosis, which results in new allelic combinations in the daughter cells. Here, the non parental combinations occurs due to the exchange of genetic material between non-sister chromatids of homologous chromosomes during meiosis.

9. Linkage is defined as a relationship or an association between genes. There are two types of linkage *viz*. complete linkage and incomplete linkage.

Complete linkage refers to the completely linked genes. It includes complete inherited sets without any recombination whereas incomplete linkage is opposite and may include recombination.

In case of completely linked genes, these genes are located at a close distance from each other whereas in incomplete they are at distance.

10. A sex chromosome is a type of chromosome that participates in sex determination. Humans and most other mammals have two sex chromosomes, the X and the Y.

11. In birds, the sex is determined by two chromosomes *viz*. Z and W. The females produce two different types of gametes (ZW) and males produce single type of gametes (ZZ).

12. Base analogue mutagens are chemicals that mimic bases to such an extent that they can be incorporated into DNA in place of one of the normal bases. Examples of base analogs include 5-bromouracil, 2-aminopurine, 6-mercaptopurine and acycloguanosine, etc. Since 5-bromouracil can pair with either adenine or guanine, it also affects base pairing during DNA replication, which leads to mutations.

13. Genomic mutations are chromosomal mutations involving change in chromosome number. The genomic mutations are of two types *viz*. polyploidy and aneuploidy.

14. In paracentric inversion, the inverted segment does not include centromere and in pericentric inversion, the inverted segments include centromere. In paracentric inversion,

centromere is located outside the inversion loop whereas in pericentric inversion, centromere is located inside the inversion loop.

15. The non-sexual (somatic) characters linked with sex chromosomes are called sex linked traits and the inheritance of such characters is called sex linked inheritance. The concept of sex-linked inheritance was introduced by T. H. Morgan in 1910, while working on *Drosophila melanogaster*. The genes for sex linked characters occur in both segments of X and Y chromosomes.

X-linked inheritance means that the gene causing the trait or the disorder is located on the X chromosome. Females have two X chromosomes; males have one X and one Y. Genes on the X chromosome can be recessive or dominant. Their expression in females and males is not the same. Genes on the Y chromosome do not exactly pair up with the genes on the X chromosome. X-linked recessive genes are expressed in females only if there are two copies of the gene (one on each X chromosome). However, for males, there needs to be only one copy of an X-linked recessive gene in order for the trait or disorder to be expressed. For example, a woman can carry a recessive gene on one of the X chromosomes unknowingly, and pass it on to a son, who will express the trait.

16. The sex influenced traits are the autosomal traits. Their expression depends on the sex hormones of the individual, therefore, these are called sex-influenced traits. *e.g.*, baldness in man, length of index finger.