

## **Applications of Bioinformatics in Crop Improvement:**

Bioinformatics has wide practical applications in genetics and plant breeding

**Some important applications of bioinformatics in plant breeding and genetics are listed below:**

### **1. Varietal Information System:**

Bioinformatics has useful applications in developing varietal information system. Variety refers to a genotype which has been released for commercial cultivation. Various types of varieties are used in plant breeding. The detailed information about various types of varieties can be developed using highly heritable characters. Such information can be used in various ways as given below:

- (i) In DUS testing for varietal identification
- (ii) In grouping of varieties on the basis of various highly heritable characters.
- (iii) In sorting out of cultivars for use in Pre-breeding and traditional breeding.

The information can be stored in the computer memory and be retrieved as and when required.

### **2. PGB Data Base:**

Genetic material of plant which of value as resource for present and future generations of people is referred to as plant genetic resources. It is also known as gene pool, genetic stock and germplasm.

The germplasm is evaluated for several characters such as highly heritable morphological and other characters as given below:

- i) Highly heritable morphological traits, (ii) Yield contributing traits, (iii) Quality characters, (iv) Resistance to biotic and abiotic stresses, (v) Characters of agronomic value.

Bioinformatics is useful in handling of such data in several ways as follows:

- (i) It maintains the data of several locations and several years in a systematic way.
- (ii) It permits addition, deletion and updating of information.
- (iii) It helps in storage and retrieval of data.
- (iv) It also helps in classification of PGR based on various criteria.
- (v) It helps in retrieval of data belonging to specific group such as early maturity, late maturity, dwarf types, tall types, resistant to biotic stresses, resistant to abiotic stresses, genotypes with superior quality, genotypes with marker genes, etc.

### **3. Studies on Genome:**

Genome refers to the basic set of chromosome. In a genome each type of chromosome is represented only once. The study of structure and function of entire genome of an organism is referred to as genomics. It is being developed as a sub discipline of genetics which is devoted to the mapping sequencing and functional analysis of genome. The word genomics was coined by **Thomas Roderick in 1986**.

**The discipline of genomics consists of two groups, viz:**

#### **(i) Structural Genomics:**

It deals with the study of the structure of entire genome of an organism. In other words, it deals with the study of the genetic structure of each chromosome of the basic set of chromosome i.e. genome.

#### **(ii) Functional Genomics:**

It deals with the study of genome function. It deals with transcriptome and proteome. Transcriptome refers to complete set of RNAs transcribed from a genome and proteome refers to complete set of proteins encoded by a genome

**There are three methods of gene mapping:**

- (i) Recombination mapping,
- (ii) Deletion mapping and
- (iii) Molecular mapping.

The last method is widely being used for gene mapping these days. It is computer aided method which is useful in genome mapping. It has been used for genome mapping in various crop plants such as Arabidopsis, rice and maize.

It is a rapid and accurate method of gene mapping. Now computer aided genomic mapping, sequencing and functional analysis studies are being carried out with almost all important field crops. Computer aided programmes have made such studies very simple.

### **4. Studies on Proteomics:**

Proteomics refers to the study of structures and functions of all proteins in an individual. In other words, it deals with the study of entire protein expression in an organism.

**Proteomics is of two types:**

#### **(i) Structural Proteomics:**

It refers to the study of the structures of all proteins found in a living organism.

#### **(ii) Functional Proteomics:**

It deals with functions of all proteins found in a living organism. In fact, proteomics is a new sub-discipline of functional genomics. It is the study of proteomes which refer to complete set of proteins encoded by a genome. A variety of techniques are used for the study of proteomics. Now computer aided programmes are available for the study of proteomics.

### **5. Studies on Metabolomics:**

Metabolomics refers to the study of all metabolic pathways in a living organism. In other words, it is the computer aided information of all metabolic pathways of a living organism.

#### **Main points related to metabolomics are listed below:**

- (i) It deals with the study of all metabolic pathways in a living organism.
- (ii) It is computer based information about metabolic pathways in a living organism.
- (iii) It helps in identification and correction of metabolic disorders in an organism.
- (iv) It helps in selection of individuals with normal metabolic pathways.
- (v) It helps early detection of genetic disorders associated with metabolic pathways.

### **6. Modelling of Plants:**

Bioinformatics plays an important role in modelling of crop plants. Such computer aided studies have already been made in field pea and several other field crops. First the plant model is conceptualized using various plant traits and then efforts are made to develop such model by using appropriate breeding procedures.

First donor sources for these traits are identified from the available germplasm. Then efforts are made to combine these traits in one genotype particularly in a popular variety. Such computer based studies help in developing plant ideotype suitable for machine picking and used in multiple cropping system.

### **7. Pedigree Analysis:**

Computer aided studies are useful in pedigree analysis of various cultivars and hybrids. Information about the parentage of cultivars and hybrids is entered into the computer memory which can be retrieved any time. The list of parents that are common in the pedigree of various cultivars and hybrids can be sorted out easily.

It helps in the pedigree analysis which in turn can be used in planning plant breeding programmes especially in the selection of parents for use in hybridization programmes. Through study of protein structures, it helps in pedigree analysis.

### **8. Biometrical Analysis:**

In plant breeding and genetics, various types of biometrical analyses such as correlation, path coefficient, discriminant function, diallel, partial diallel, triallel, quadriallel, generation means, line x tester, triple test cross, stability parameters,  $D^2$  statistics, metroglyph etc. are carried out.

Computer aided programmes are very much useful in carrying out such biometrical analyses. The information obtained from such biometrical analysis is used in better planning of plant breeding programmes for achieving specific goal.

### **9. Forecasting Models**

Computer aided programmes have wide applications in developing various types of forecasting models especially useful for predicting crop production and productivity and in forecasting incidence of insects and diseases in crop plants. Weather parameters are used in making such predictions. Computer aided remote sensing techniques are used for such predictions.