Plant Breeding and Evolutionary Methods

Rakesh Reddy. K[1], Nidhi Dubey[2], Harshal Avinashe[3]
[1] *M.Sc. Student, Dept. of Genetics and Plant Breeding, Lovely Professional University, Phagwara, Punjab*
[2,3] *Assistant Professor, Dept. of Genetics and Plant Breeding, Lovely Professional University, Phagwara, Punjab*

***Abstract* - Why breeding is necessary for development is a generalized question in every agricultural conversation, and it is the time to answer why? Before green revolution being India an agricultural country was not self-sufficient to supply the food, and in worldwide that the time where hidden hunger was seeping slowly into sleeves of every nation and there was drastic change in behaviour of consumers at that time, when the point food is health came into light nutrition, self-sufficient production, supply on demand , economic growth by exporting the raw materials started to play a crucial role in economics of every country and at this time the one and only key which was emerging like a silent storm was plant breeding and biotechnology a broad implementation of these to subjects in production after Dr. Norman E Borlaug and Dr. M. S. Swaminathan the world of plant breeding was on its verge pulling entire nation on its shoulders to make countries self-sufficient from the 1960's this technique in agriculture was on boom by semi-dwarf variety to newest technology smart breeding in plant breeding this is the central concept we are going to concentrate in this review.**

***Index Terms* - Speed breeding (SB), Rapid Generation Advance (RGA), Double Haploids (DH), Marker Assisted Backcrossing (MABC)**

INTRODUCTION

With the continuous increase in the human population and changes in climate conditions have created a significant fear on the global food security. Also increase of new pests and diseases which generate threat to the productivity of agricultural products. The primary aim of a breeder is to create a new genotype which is resistant to major and upcoming pests and pathogens and to alter and develop the current varieties (Pooja et al., 2014) and secondary aim becomes to ensure to create and develop the varieties for the fulfilment of quality demands and reduction of growth period (Forster et al., 2014). For the production of pure lines, and segregation populations they are needs to self-pollinate for several generations where the primary material for every breeding populations are needed to produce in a faster time period and for fixation of genetic material in segregating population needed to self-pollinate for several generations which may takes about seven to eight generations in conventional breeding procedure and a suitable climate needed to be supported for the growth and development of plant populations. Recent change in climatic conditions and time required breeding procedures makes the breeders to search for new technologies and practices for the development of new cultivars. Such procedures include.

RGA (Rapid generation advance)
In rice RGA is breeding method often proved. In this all-plant populations growing in the field followed by growing regular seasons. RGA mentioned as Single seed desenting method (SSD) is a faster and alternate breeding method which is highly used in cereals. It is used in manipulating the plants and condition of growth. When comparing the regular condition crop seasons these are early in flowering and seed setting. Bulk population method is one of the breeding methods of resource saving but not time saving like RGA. Rapid generation advance simplicity of technical, few resources are required, cost is less and speed when compare with normal. Breeding program of IRRI's irrigated applying this method in out sized manner. It reduces the 2years of breeding cycle and decreases the development of variability.

DH (Doubled haploids)
The artificial method of conversion in which the monoploid sets of chromosomes behave like diploids those are known as DH (Doubled haploids). They are reducing the fixation time because complete homozygous lines created immediately. Doubled haploids mainly performed in the laboratories of tissue

culture example like cereal species. It is one of the proved methods like rapid generation advance. By this method many varieties of rice are released.

Shuttle Breeding

Shuttle Breeding is one of the essential modern plant breeding techniques where the crop cycle can be continued even in the offseason by changing the location of the same crop. It also has another benefit for selection as the location is changed from season to season thereby faces many climates, diseases, pests and other environmental conditions. This method was developed by CIMMYT, Mexico and popularized by Dr Norman Borlaug in wheat.

Marker-assisted backcrossing (MABC)

Backcrossing is the most common plant breeding method used to transfer a target gene into commercial or popular varieties. In case of backcrossing, the recipient parent which is used as female has many desirable characters and lack one or few characters which are incorporated. Backcrossing, when used with DNA markers provides a greater efficiency in selection. Marker Assisted Back Crossing (MABC) have a good efficiency in detecting the targeted desirable gene or Quantitative Trait Locus (QTL) and thus enables the essential original characteristics of the recipient variety and upgrade it with desirable characters of the donor. MABC can also be used for Marker Assisted Pyramiding, where many genes or quantitative trait loci are combined in a single recipient. On using DNA markers reduces the time for varietal development which usually takes several years. Using this method, drought tolerant, salinity tolerant and flood tolerant varieties are development in rice. Only on availability of desirable genes or QTL's, this method can be applied.

Genomic selection (GS)

Genomic selection is a recently emerged unique method where whole genome based molecular breeding strategies are used. It is the complementary method to Marker Assisted Selection in which assumptions are based on a vast number of DNA markers instead of focusing on specific or few genes or quantitative trait loci. This method can be used to reduce the breeding cycles and thus reduce time taken for development of variety. It is an accurate method to select complex traits like yield by shortening the breeding cycle and increase the genetic gain within no time. Even though it is a precise breeding method, it is of high cost and many development countries cannot implement this method for its cost effectiveness. Many changes must be made to make it cost effective before implementation.

Mutation breeding

It is a process of exposing the plant material (mostly seeds) to radiations or chemicals to create mutants with desired characters to bred with other cultivars. Normally, mutation breeding takes 7-9 years as compared with 10-15 years in a standard plant inbreeding method. A collaboration of FAO and IAEA has developed over 3000 mutant cultivars from 200 crop species (http://mvgs.iaea.org). Mutation breeding using random mutation induction is considered as a conventional breeding method and it is not regulated (Forster et al., 2014).

Speed breeding

Speed breeding methods involve in decreasing the crop duration, crop life cycle by growing the plants in a completely controlled environmental conditions like maintaining optimal temperatures required by the plants and thus increasing the photosynthetic active radiation (PAR). The concept of speed breeding was initially from the efforts of NASA-ALP to grow crops in space, within an enclosed chamber of control environment and an extended photoperiod. Breeding is a technique where the main aim is to exploit the genetic variances which are available in a distant population of species. For the exploitation of such genetic variability crossing procedure becomes mandatory. The first report on the use of 24 hr light growing systems has been that published by NASA-ALS program (Rowell et al., 1999). The process involved in a plant's response to continuous light exposure causes adverse effects viz., foliar chlorosis, reduced or limited plant growth and productivity. A plant response to constant light exposure will be depend upon various factors including optimum temperature, relative humidity, CO level, light intensity, duration of light and some other minor characters like mineral nutrients. Use of continuous light by exposing light to plants can decrease the generation cycles for many plants (Sysoeva et al. 2010), but for some species it can also cause an injury like in brinjal and tomato (Velez-Ramirez et al., 2011).

By using this speed breeding procedure, a breeder can create and develop the cultivars for the global needs.

Applications of speed breeding

To decrease the generations cycles

In wheat and barley crops by using of embryo culture and proper management of irrigation practices, duration and intensity of light with an appropriate control of temperature can produces up to 8 generations of wheat in a year and 9 generations of barley in a year (Zheng et al., 2013). By using this procedure, we can develop a population of recombinant inbreed lines (Li et al. 2010; Ma et al. 2010) and near isogenic lines (Ma et al. 2011). In pea 6.9 generations per year can be achieved (Ochatt et al.,2002), in soyabean about five cycles is possible with the help of embryo rescue method (Roumet and Morin 1997) and with the use of induction of stress can increase the number of generations in crops like oat, triticale (Liu et al., 2016), pea (Ribalta et al., 2014), canola (Yao et al., 2016). With the use of controlled environment conditions and SSD methods we can reduce the flower development time in groundnut (Connor et al., 2013) and Amaranthus (Stetter et al., 2016) which is used in the crossing programmes and in variety development. Using the method of grafting in cassava will induces the flowering (Ceballos et al., 2017).

Towards gene pyramiding

In barley with the implementation of speed breeding, with the use rapid trait introgression technique into modified backcross strategy to barley cultivar named Scarlett produced an introgression lines (ILs) in period of two years (Hickey et al., 2016) and with the use of RGA system in controlled environment in SSD process can decrease the time to produce RILs. In wheat with the help of speed breeding production of rust resistance (Hickey et al., 2012; Riaz et al., 2016), yellow spot (Dinglasan et al., 2016) and development of better root angle (Richard et al.,2015) and grain dormancy (Hickey et al., 2010) are developed.

CONCULSION

As from the above context it is clear that plant breeding from convectional to molecular technology and markers to smart breeding new techniques are needed for the development of production of the present population in a minimal level where time plays key role in production that minimum time and more production make our country and world healthy and self-sufficient respectively. In this current situation of increasing population, climate changes and newly emerging of pests, pathogen and diseases where speed breeding can help to decrease the crop duration which helps in feeding the nations and helps to create a resistant cultivar.

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