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Breeding Strategies for Improving Protein Quality in Maize

(*Sourabh Kumar[1] and Dayanand[2])

[1]Department of Genetics and Plant Breeding, CPCA, SDAU, Dantiwada, Gujarat, India
[2]Department of Genetics and Plant Breeding, PAU, Ludhiana, Punjab, India
* 99sourabhkumar@gmail.com

After wheat and rice, maize (*Zea mays* L.) is the third major cereal crop in the world and it is used for both livestock feed and human consumption. Due to high genetic yield potential, it is known as the queen of cereal crops. It is a highly cross-pollinated crop. 15% of the world's protein and 19% of the calories derived from maize food crops. Particularly in developing countries, millions of people in the world, derive a part of their protein and daily calorie requirements from maize. In developed nations 78% of total maize production is used for livestock feed. One-third of the world's population, especially in developing and underdeveloped nations of Sub-Saharan Africa and South-east Asia, cereals are the only source of nutrition. In Africa, maize accounts for 17% to 60% of the total protein supply per day of individuals who are more susceptible to risk of protein or essential amino acid deficiencies. From this risk mostly affected pregnant women, lactating mothers, and young children. To alleviate malnutrition, protein content in maize can be increased (close to double the quantity of protein in normal maize) in the endosperm of maize.

Breeding Methods

(a) Recurrent selection
(b) Heterosis breeding
(c) Marker assisted back crossing

(a) Recurrent selection:

Recurrent selection is used to improve the frequency of desirable alleles for a character in a breeding population. Term coined by Hull (1954), procedure described by Jenkins (1940). Recurrent selection originally developed as method of breeding in cross pollinated species. The goal of recurrent selection is to improve the mean performance of a populations of plants. Recurrent selection are four types….

(1) simple recurrent selection,
(2) recurrent selection for general combining ability,
(3) recurrent selection for specific combining ability and
(4) reciprocal recurrent selection.

In recurrent selection for GCA use broad genetic base tester but in recurrent selection for SCA use narrow genetic base tester. In reciprocal recurrent selection improve the two population in single time, in reciprocal recurrent selection both populations used as tester for each other.

(b) Heterosis breeding:

Superiority of f1 over both its parents in terms of yield or some other characters known as heterosis. Term heterosis given by Shull (1914). when inbred lines are used as parents, cross-

pollinated species show heterosis. In many cases hybrids show improved quality, which may or may not be accompanied by higher yields. Types of heterosis….

(a) Average heterosis or Relative heterosis
(b) Heterobeltiosis
(c) Economic heterosis

superiority of f_1 over the mid parent known as average heterosis, over better parent known as heterobeltiosis, over best commercial variety of the crop known as economic heterosis. Economic heterosis is the only estimate of heterosis, that's of practical value.

(c) Marker Assisted Backcrossing:

Marker-assisted backcrossing is routinely implemented in breeding programs for gene introgression. There is a need of marker-assisted selection because of following reasons.

(1) Each backcross generation needs to be selfed to identify the recessive gene and a minimum of six backcross generations are required to recover satisfactory levels of recurrent parent genome.

(2) Rigorous biochemical tests to ensure enhanced lysine and tryptophan levels in the selected materials in each breeding generation require

Both foreground MAS and background MAS can be efficiently utilized for selecting target locus moreover assuring maximum recovery of the recurrent parent. MAS used for development of parental lines and developed hybrid in less than half the time required through conventional breeding.

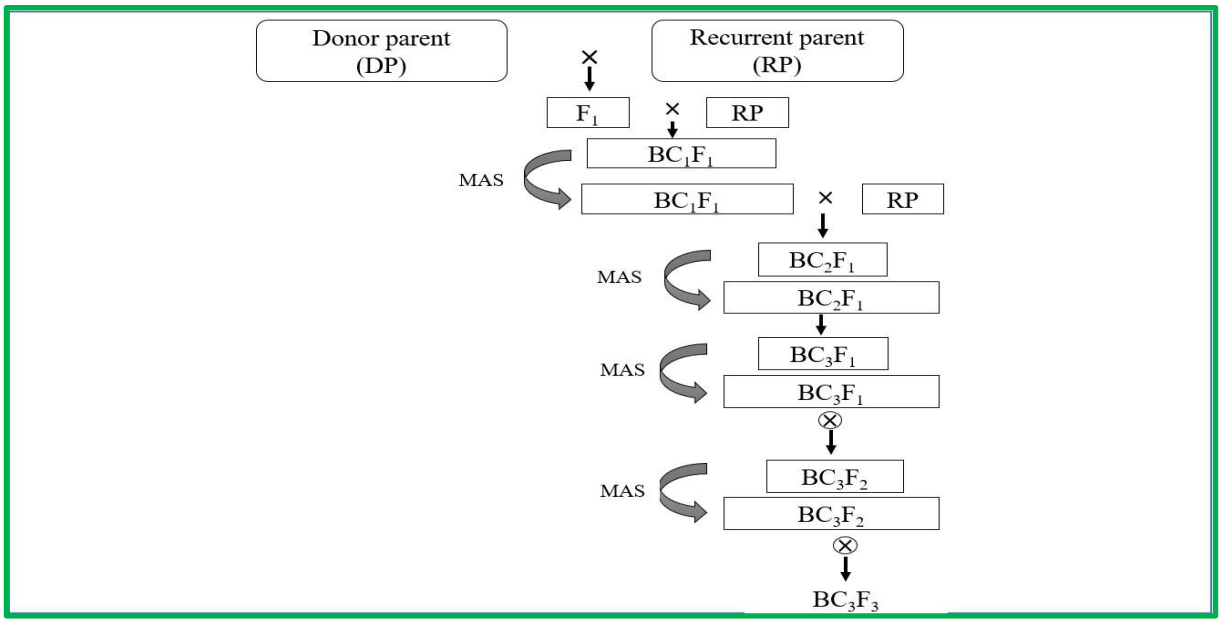

Fig 1: Marker Assisted Selection

Phenotypic recurrent selection in maize was not able to increase protein quality, as reasonable rates as compare to heterosis breeding and marker assisted backcrossing. Marker assisted backcrossing convert the normal maize inbred into quality protein maize. In recurrent selection and marker assisted backcrossing reduced the yield as compare to heterosis breeding. Marker assisted backcrossing and heterosis breeding increase protein quality as well as protein content. Where a large proportion of maize is produced by small-scale farmers, there is a need to raise the adoption rate of quality protein maize especially in developing countries who use the grain mainly for their own consumption or store the seed for the following growing season.