

Success Stories in Agriculture Biotechnology

Neetu Choudhary

Ph.D (Ag) Entomology, Swami Keshwanand Rajasthan Agricultural University Bikaner.

*Corresponding Author: Choudharyneetu502@gmail.com

Department's support has led to the development of improved varieties of crop plants through marker assisted backcross breeding. In cereals fourteen varieties have been released (Maize- 2, Rice- 8 and Wheat-4) with enhanced nutritional content, resistance to pathogens and tolerance to abiotic stresses. Of these 14 varieties, 6 have reached farmers field (Maize- 1, Rice- 4 and Wheat-1). In addition, one variety of soybean and two rose varieties have been released.

Table 1: Varieties developed from different crops and their traits

Crop	Variety developed	Trait
Maize	HQPM1 (improved) and Vivek QPM 9	Pro-vitamin A rich variety
	Pusa HM4 improved, Pusa HM9 improved, Pusa HMS improved	High lysine and tryptophan
Rice	Pusa Basmati 1728, Pusa Basmati 1718, CARI Dhan 6, CARI Dhan 7	Bacterial blight resistant
	Improved White Ponni.	Drought tolerant and heat resistant
	Mushk Budji (improved)	Blast resistant variety
	HPR2143 (improved)	Blast and bacterial leaf blight resistant
	DRR Dhan -50	Two-in-one flood and drought tolerant
	Swarna- sub 1, IR64- sub 1, Samba-Mahsuri- sub 1, Ranjit-Sub1, Bahadur-Sub1 & CR_Dhan 802	Submergence tolerance variety
Wheat	Unnat PBW343 and Unnat 347	Resistance against leaf and stripe rust
	HI 8737 -Pusa Anmol, HI 8759 -Pusa Tejas	High Yield and quality
Pearl millet	TNBG 0608053 & TNBG 0608207	High grain yield and high beta carotene content
Soybean	CO3 (Soybean I) & JSS 35 (Soybean M) Improved	Phytophthora and Powdery mildew resistance
	NRC127	Kunitz trypsin inhibitor free
Tomato	Punjab Chuhara (improved)	Leaf curl virus, late blight & root knot nematode (Mi) resistance
Grape	H90.24 and H98.23	Downy mildew resistance with bold berries and loose bunches
Rose	Pusa Mahak	Fragrant
	Pusa Aaradhana	Thornless

(Source: National Institute for Plant Biotechnology)

Pusa jai kisan

Among oilseed crops, rapeseed mustard occupies a prominent position in India accounting nearly 6 million hectares. Pusa Jai Kisan has been developed through tissue culture technique called somaclonal variation. A popular commercially released variety, Varuna (Type59) was used as a donor parent for generating somaclonal variation.

Rice blast resistance gene pi54

Rice is one of the important crops cultivated and consumed throughout the world. At NRCPB mapped and cloned a dominant blast resistance gene Pi54 which provides resistance to several isolates of *Magnaporthe Oryzae*. Using marker assisted selection, NRCPB along with Division of Genetics, IARI and Department of Agricultural Biotechnology, Palampur has transferred blast resistant gene in BPT and in Pusa Basmati-1. The Pi54 gene is being transferred in many rice varieties by using MAS.

Mustard hybrids

Brassica juncea is the most important oil seed crop of northern India. Inter varietal crosses show 30-60% heterosis for yield. Hence development of hybrid could lead to increased production and productivity. The crop is ideally suited for hybrid production as it is amenable to cross pollination.

Maize improvement

In maize breeding programs, the maintenance of inbred line genetic purity and conformation of the genetic identity of genotypes are important quality control functions. Molecular markers can be improved for various purposes, including quality control genotyping, germplasm characterization, selection marker of parental combination. Using MABC, introgressed five QTLs associated with yield components and flowering in maize from donor parents in a drought susceptible recurrent parent.

Wheat genome decoded

India was part of a strong partnership in decoding the wheat genome in which 15 countries joined to complete this huge task of decoding 17000million bases. Indian scientists participated in decoding chromosomes 2ABread wheat, with an estimated world harvest of more than 550 million tons, is one of the most important food crops in the world. The analysis of the wheat genome, in which India played a crucial role, will give breeders the tools required to select traits for healthy yield.

Marker assisted selection in bean breeding

A molecular marker for resistance to bean golden yellow mosaic virus (BGYMV) is one of the earliest and most used examples of marker use in breeding of common bean. A SCAR marker named

SR2 based on a co- dominant RAPD marker was identified for the bgm-1 resistance gene. Gene stacking for several foliar diseases was facilitated by using molecular markers, four genes conferring resistance to angular leaf spot, bean common mosaic to improve the durability of resistance.

Bt brinjal

Brinjal is an important vegetable crop of India. It is a good source of vitamin and minerals, especially iron. Using biotechnological tools NRCPB has developed transgenic brinjal with a *Bt* gene (*cry1Fa1*), which is very effective against Brinjal shoot and fruit borer.

Potato improvement

A significant number of qualitative genes have been mapped on the potato genetic linkage map, and diagnostic markers for MAS exist. Many important traits are governed by multiple Agriculture Biotechnology Success stories e QTL with small effects and unknown epistatic effects. International Potato Center (CIP) use marker associated with a resistance gene to the virus.

Supporting soil health improvement through biotech interventions

DBT supported biotechnological interventions to improve soil fertility and biological health for high crop productivity. Vermicompost fortified with ABM's (*Acinetobacter*, *Bacillus megaterium*, *Mycorrhiza*) increased 15% yield compared to chemical fertilizers. Use of farm waste for vermicomposting focused to improve soil health benefitted.

Herbicide resistance crop

One of the most common herbicides is glyphosate which is available commercially as Roundup and Tumbleweed Glycophosphate acts by inhibiting an amino acid biosynthetic enzyme called 5-enolpyruvylshikimate-3-phosphate synthase. Resistant plants have been produced by increasing synthesis of EPSPS by incorporating extra copies of gene, such as in crop plant as in soya.

Cattle genomics: improving indigenous livestock

India has the largest repertoire of cattle in the world Indian cattle population is highly heterogenous .69% of Indian cows are owned by the poor. The Department has initiated Phase-I of CATTLE GENOMIC PROGRAMME at National Institute of Animal Biotechnology, Hyderabad. Whole genomic sequencing of five important milch breeds of cattle has been initiated will help in identifying pure elite animal of a particular cattle breed in its early age and also for conservation of breed with economically important traits.

Conclusion

Biotechnology could contribute into existing crop improvement programs; Biotechnology could increase agricultural productivity beyond what is possible with conventional breeding technique alone. Appropriate biotechnologies could raise the revenues in agricultural production which is still the dominant source of income and employment for the rural poor in large part of the world.

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