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A review: Breeding in chilli

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Abstract

Breeding for disease resistance has been an area that has attracted the most attention. Resistant varieties represent one of the greatest triumphs of modern agriculture and have undoubtedly contributed in stabilizing food and fiber yield across the globe. Now-a-days, breeding methods is used as an additional tool by the plant breeders. As this methods became more perfect and better known, the plant breeders can increasingly add it to their arsenal to accomplish the common objectives of the crop improvement.

Keywords: Chilli, breeding methods

Introduction

The chilli (*Capsicum* spp.) pepper is an important condiment of high commercial value and also medicinal values containing antioxidant properties, anti-cancerous and many other properties capsicum belongs to the family Solanaceae possessing 10 species. Chilli (*Capsicum annuum* L.) is one of the most cultivated vegetable spice crops in tropical and subtropical climates. India is the largest consumer and exporter of chillies in the international markets and exports dry chilli, chilli powder and oleoresins to over 90 countries. The production of chilli in India is dominated by Andhra Pradesh. It is grown in several parts of India has a larger area; its productivity is very low as compared to other countries. Hence, there is an urgent need to produce and identify new varieties combining with high level of disease resistance, besides increased yield and capsaicin content in chilli.

Origin and Taxonomy

Capsicum originated in the New World tropics and sub-tropics. Mexico is the centre of diversity for *C. annuum*. There are five major cultivated species in the genus *Capsicum*. These five species are:

Capsicum annuum

C. frutescens

C. chinense

C. pendulum

C. pubescens

Germplasm Sources

Asian Vegetable Research and Development Centre (AVRDC), Shahua, Tainan, Taiwan
Centre for Genetic Resources, Wageningen, the Netherlands
Central Institute of Genetic and Germplasm, Gatersleben, Germany
National Bureau of plant Genetic Resources, New Delhi, India
Indian Institute of Vegetable Research, Varanasi, India

Flower Structure and Pollination

The flowers of chilli are pentamerous. Stamens are 5 and alternate with petals. Large fruited cultivars may have 5 to 7 corolla. Crosses can made any time in day but morning hours are preferable.

It is of tenly cross pollinated crop, natural crossing take about 16.5%. Fruits normally matured in about 45 days after pollination. Anthesis – 6 to 9 AM. Anther dehiscence – 9 to 11 AM. Receptivity of stigma was the highest at the day of anthesis.

Breeding Objectives

Earliness

- Desirable fruit shape and size, fruit shape, wrinkleness, fruit colour, seed content and pungency in Indian context
- Superior fruit quality i.e., pleasing flavor, high sugar/acid ratio, high pigment content and vitamin C in bell pepper and high capsaicin, a fat soluble, flavourless, odourless and colourless compound
- High oleoresin in chilli
- Resistance to diseases i.e., fruit rot, cercospora leaf spot, powdery mildew, bacterial leaf spot, phytophthora root rot, root knot, common leaf-curl virus.
- Resistance/tolerance to insects i.e., thrips, mite, aphid, fruit borer
- Resistance/ tolerance to abiotic stresses i.e., heat, water stress, salinity
- Rejuvenation ability after winter in hot pepper in north India
- High yield
- Colour retention in dry Chillies on drying

Breeding Methods

Mass Selection

Here a large number of plants having similar phenotype are selected and their seeds are mixed together to constitute a new variety. Thus the population obtained-from selected plants will be more uniform than the original population. However they are genotypically different. It was used to improve landraces or open-pollinated cultivars of peppers. In this approach, characters with high heritabilities are easily fixed and a reasonable level of variability is also maintained.

Merits of Mass Selection

1. Varieties developed will be having more adaptability since each plant is genotypically not similar. They have buffering action against abnormal environment.
2. Time taken for release of a variety is less.
3. The genetic variability present in the original population is maintained.

Demerits

1. Compared to pure line variety they may not be uniform
2. In the absence of progeny test we are not sure whether the superiority of selected plant is due to environment or genotype. By farmers
3. May not be as uniform as that of a pureline variety and certification is difficult.

2. Pureline Selection

This method is applicable to landraces/local cultivars being grown by farmers. In this method, initial seed stock is space planted and superior plants are selected and harvested separately. Next year, individual plant progenies are grown and progeny showing superior performance and devoid of genetic variability. Several chilli varieties in India have been developed by this method. These varieties are: G 1, G 2, G 3, G 4, NP 6A, K 1, Co 1, Musalwadi, Sindur, Patna Red, Pant C1.

3. Pedigree Method

This method involves selection of superior plants in the segregating generations following hybridization between superior cultivars along with maintenance of pedigree method. Selection of superior parental cultivar is crucial step. Such chilli cultivars are Andhra Jyoti, Pusa Jawala, Pusa Sadabahar, X235, K2, Pant c1, Punjab lal, Jawahar 218, Agnirekha.

Bell paper- Spartan Garnet, Spartan Emerald, Sonnette.

4. Back-cross Method

This is normally used to transfer single gene few genes from primitive cultivars/wild forms to leading cultivars. In some cases even BC2 families may be routed through pedigree method instead of following a routine back crossing programme which needs 5-6 back crosses with recurrent parent. The typical examples are dominant L genes for TMV, recessive pvr, TEV resistance genes and various BLS resistance genes. Cultivars include Yolo Wonder R, Tabasco Green Leaf and Mississippi Nemaheart.

5. Heterosis Breeding

F₁ hybrids of Bell paper popular in USA and Europe and gaining popularity in India after the initiation of research and seed production work in vegetable by a large no. of private sector seed companies. F₁ hybrid is Bharat developed by Indo-American, hybrid seed, Bangalore.

6. Mutation Breeding

Both chemical and Physical mutagenic agents like EMS, DMS, gamma rays, X-rays, were used in India. But so far only one variety MDU-1 has been developed at the college of Agriculture and Research Institute, Madurai by treating the seeds of K-1 by gamma rays 30kr. Possesses compact plant type and determinate growth habit with fruits borne in clusters of 4 to 9 at nodes against single fruit borne at nodes in K-1 or K-2.

Biotechnology

1. Molecular Markers

A variety of molecular markers have been used in pepper. Different molecular markers vary in their strengths and weakness, therefore, each molecular markers and how it has been used in capsicum research is described below:

2. Isozymes

The use of isozymes in pepper research has focused predominantly on measuring genetic variability, and clarifying systematic and phylogenetic relationship in the genus. Isozymes have been used to examine systematic relationships of *Capsicum cardenasii*, *C. eximium*, *C. tovarii* and *C. pubescens*. Analysis of the isozyme data indicated that *C. pubescens* clustered more distantly to *C. cardenasii* and *C. eximium* than those two did to one another, but that *C. pubescens* was more closely related to *C. eximium* than to *C. cardenasii*.

3. RFLPs

Restriction Fragment Length Polymorphisms (RFLPs) utilize restriction enzymes that cut genomic DNA at specific sites. The cut DNA fragments are separated by electrophoresis then transferred and immobilized on to nitrocellulose paper. In capsicum research, RFLPs have been used for genetic mapping.

4. RAPDs

Randomly Amplified Polymorphic DNA (RAPD) utilize the polymerase chain reaction (PCR). RAPDs have been used in Capsicum research to study genetic diversity, linkage and to provide additional molecular markers for mapping.

5. Genetic Transformation

Genetic engineering in pepper is dependent upon a reliable means of transformation and tissue culture regeneration. It has been possible to produce cucumber mosaic virus resistance in chilli plantlet by integrating genes. Genetic transformation has been very difficult to achieve in pepper. This is largely due to the difficulty in regenerating plants from transformed cells. Therefore, the utilization of cloned genes in pepper has been difficult and lagged behind other crop plants. There have been reports on successful regeneration of pepper from somatic embryos and also successful transformation of this plant with several genes.

Achievements

a) Selection (Purline selection)

G-1, G-2, G-3, G-4 (Bhagyalakshmi), NP-46-A, K-1, Co 1, Seema, Musalwadi, Sankeshwar 31, Malkapuri, yellow, Patna Rod, Co2.

b) Pedigree method (Hybridisation)

1. Pusa Jawala = NP46A x Puri Red.
2. Punjab lal = Perrinial x long Red
3. K 2 = K1 x Sattar Samba
4. Pant C-1 = NP 46A x Kandhari
5. Pant C-2 = NP 46A x Kandhari
6. Jawahar 218 = Kalipeeth x Pusa Jwala
7. Andhra Jyoti = G2 x Bihar variety
8. Pusa Sadabahar = Pusa Jwala x IC-31339

Important Varieties with Characteristics

1. MDU-1: Mutant variety, cluster bearing.
2. NP 46A: Dwarf plants with spreading habits, less seedld.
3. Pusa Sadabahar: Belongs to *C. futescens*, perrinial nature, leaf resistance.
4. Punjab lal - Suitabel for colour extraction.
5. Jwalamukhi - for high density planting.
6. Bhaskar - Yellow another, resistant to thrips and mites.
7. Pusa Jwala - NP46-A x puri red fruits are long thin, red colour and curved at tip used for green chilli.
8. Arka Lohit - Tolerant to powdery mildow.
9. Arka Abir - For colour exfaction.
10. Pant C-1 - NP46A x Suryamukhi Khandhari, high level of pungency, suitable for both dry and green chilli. Resistant to little leaf.

References

1. Patil N, Meshram LD, Nandanwar RS. Induced quantitative variation in economic characters by chemical mutagens in chilli (*Capsicum annum* L.). *J Soils and Crops* 1997;7(1):15-18.
2. Sri Devi, Mullainthan L. Physical and chemical mutagenesis for improvement of chilli (*Capsicum annum* L.). *world applied sciences journal* 2011;15(1):108-113.
3. Tembhurne V, Rao SK. Heterosis and Combining Ability in CMS Based Hybrid Chilli (*Capsicum annum* L.). *Journal of Agricultural Science* 2012;4:10.
4. Prasath, Ponnuswami V. Breeding for extractable colour and pungency in capsicum- a review. *Veg. Sci* 2008;35(1):1-9.

5. Hari Har Ram. Vegetable Breeding Principles and practices 2012, 381-407.
6. Kannagara KN, Kumara GAIP, Illangakoon IMNS, Ekanayaka EMNTM. Development of high performing green chilli (*Capsicum annum* L.) breeding line through
7. hybridization and selection. *Annals of Sri Lanka Department of Agriculture* 2013;15:51-58
8. Koon Subramanyam, Kondeti Subramanyam, Pinnamaneni Rajasekhar, Chirra Srinivasa Reddy. Assessment of Genetic Relationships among South Indian Chilli (*Capsicum annum* L.) Cultivars Using RAPD and ISSR Markers. *The Asian and Australasian Journal of Plant Science and Biotechnology*©2012 Global Science Books 2012.
9. Dhamayanthi KPM, Reddy VRK. Breeding derivatives with desirable traits using chilli (*Capsicum annum* L.) stocks and popular varieties. *Journal of Spices and Aromatic Crops* 2003;12(2):107-112.
10. Susheela K. Evaluation of screening methods for anthracnose disease in chilli. *Pest Management in Horticultural Ecosystems* 2012;18(2):188-193.
11. Reddy MK, Shrivastava A, Kumar S, Kumar R, Chawda N, Ebert AW, *et al.* Chilli (*Capsicum annum* L.) Breeding in India. *SABRAO Journal of Breeding and Genetics* 2010;46(2):160-173
12. Patel MP, Patel AR, Patel JB, Patel JA. Heterosis for green fruit yield and its components in chilli (*Capsicum annum* var. longicum (D.G) Sendt) over environments. *Electronic Journal of Plant Breeding* 2010;1(6):1443-1453.
13. Navneet Kaur, Jagtar Singh Dhiman, Daljit Singh Khurana. Physiological and Biochemical Traits Analysis of *Capsicum annum* L. Germplasm for resistance to *Colletotrichum capsici*. *cell & Plant Sci.* 2011;2(3):12-21.
14. Nyla Jabeen, Bushra Mirza. Ethyl Metahane Sulfonate enhances genetic variability in *Capsicum annum*. *Asian j. of plant Sci* 2002;1(4):425-428
15. Dhall RK. Breeding for quality traits in chilli: A review *J Res Punjab agric Univ* 2008;45(3-4):156-60.
16. Samuel Tilahun, Pandiyan Paramaguru, Kandhasamy Rajamani. Capsaicin and ascorbic acid variability in chilli and paprika Cultuvars as revealed by HPLC analysis. *J Plant Breed. Genet* 2013;1(02):85-89.
17. Satya Prakash, Singh SJ. Insect transmitted viruses of peppers: A review. *Veg. Sci* 2006;33(2):109-116.
18. Shairul Rizdiyandi Omar, Osumanu Haruna Ahmed, Shaharudin Saamin, Nik Muhamad Ab. Majid. Gamma Radiosensitivity study on chili (*Capsicum annum*). *American Journal of Applied Sciences* 2008;5(2):67-70.
19. Kothari SL, Joshi A, Kachhwaha S, Ochoa-Alejo N. Chilli Peppers: A review on tissue culture and transgenesis. *Biotechnology Advances* 2010;28:35-48.
20. Thamburaj S, Narendra Singh. *Vegetables, Tubercrops and spices* 2010, 49-75.
21. Thul ST, Lal RK, Shasany AK, Darokar MP, Gupta AK, Gupta MM, *et al.* Estimation of phenotypic divergence in a collection of *Capsicum* species for yield-related traits. *Euphytica* 2008.