Received: 17 Jul 2023 | Revised: 29 Nov 2023 | Accepted: 30 Nov 2023

Electronic Journal of Plant Breeding

Research Note

Genetic variability studies in F_3 generation of mundu chilli (*Capsicum annuum* L.) for growth, yield and quality

Gadha Sreekumar[1*], G. J. Janavi[2], K. Nageswari[1], K. Venkatesan[3], C. Muthiah[4] and M. Madhan Mohan[5]

[1]Vegetable Science, HC & RI, TNAU, Periyakulam, Tamil Nadu, India
[2] Post harvest Technology, HC & RI, Periyakulam, TNAU, Tamil Nadu, India
[3]Floriculture and Landscaping Architecture, HC & RI, Periyakulam, TNAU, Tamil Nadu, India
[4]Plant Protection Technology, HC & RI, TNAU, Periyakulam, Tamil Nadu, India
[5]Agricultural Research Station, Vaigai Dam, TNAU, TamilNadu, India
***E-Mail:** gadharajee@gmail.com

Abstract
A study was conducted on 16 growth, yield and quality characteristics in the F_3 population derived from the *Mundu Chilli* cross PKM CA 32 x PKM CA 20, encompassing genetic variability, heritability and genetic advancement. The progenies in the population were assessed using 16 parameters, encompassing on aspects such as growth, yield, and quality. The success of varietal improvement relies on the genetic variability in existing material. Assessing the nature and extent of variability in the germplasm stock is a crucial step for effective breeding methods. The study found significant levels of genetic diversity in every trait examined in each progenies in the cross. High GCV and PCV were observed for yield of fruits per plant (both dry and ripe), oleoresin and capsaicin, suggesting greater variability and high heritability estimates with considerable genetic advancement as percentage of mean indicating these traits could increase the fruit yield and quality.

Keywords: Genetic variability, growth, heritability, quality, *mundu* chilli, yield

Chilli belongs to Solanaceae family, which is known for its fiery unique pungent taste and commonly used spice cum vegetable. Scientifically, chilli is known as *Capsicum annuum* L. with chromosome number 2n=24, having its origin in South and Central America (Amare, 2013). The Capsicum genus, varying from mild to intense spiciness, comprises of more than 25 species. However, only five of which are grown and domesticated: *C. annuum* L., *C. frutescens, C. chinense* L., *C. pubescens* L., *and C. baccatum* (Costa *et al.,* 2009). Out of these five, *C. annuum* L. is the predominant globally grown species, specifically for hot and sweet pepper (Moscone *et al.,* 2006). Despite chillies being commonly grown as an annual crop, under the right climatic circumstances, they may also be grown as a perennial shrub.

An indigenous round or oblong kind of chilli known as *Ramnad Mundu* is farmed in Tamil Nadu, India, as a rainfed crop. The *ramnad mundu chilli* fruit has a diameter of 5.70 to 10.20 cm and a length of 1.55 to 2.80 cm, with a thick pericarp ranging from 0.25 to 0.32 mm. Majority of *mundu chilli* is raised as rainfed crop in the coastal saline region of Tamil Nadu, specifically in the districts of Tuticorin, Ramanathapuram and Viruthunagar. These areas display soils with moderate to high alkalinity, with a pH ranging from 7.5 to 9.0, and experience an annual rainfall of 460 mm. Owing to its mild pungency, the *mundu chilli* is ideally utilized as a spice with capsaicin content ranging from 0.26 to 0.38%, ASTA colour value (70.95 units) and high oleoresin content (13%). It's resilience against salt and drought, coupled with its higher selling price compared

to the samba type, makes it a favourite amongst farmers for cultivation in rainfed areas. However, the *mundu chilli* has a low yield in Tamil Nadu, registering only 1.2 t/ha (Anonymous, 2022). Yield is the most complex quantitative attribute, regulated by several genes and it is also highly influenced by environments. Therefore, choosing superiorgenotypes only on the basis of yield may not be successful. Therefore, to effectively make a selection, it is vital to distinguish between genetic and total variability so that the breeder may choose an appropriate breeding strategy. Studies on variability cannot provide much assistance in improving yield, since it depends on a lot of component features. Therefore, understanding the genetic relationships between the qualities that affect yield is essential to develop a solid selection strategy for increasing yield by indirect selection of component traits. The current study was conducted to explore the relationship between traits in *mundu chilli* crosses.

A total of 250 F_3 chilli plants obtained from the cross PKM CA 32 × PKM CA 20 were evaluated for growth, quality and yield. The genotypes were raised in unreplicated plots at the Western Block farm, Department of Vegetable Science in Horticultural College and Research Institute, Periyakulam during 2021-22. All the recommended agronomic practices were followed for better crop establishment and stand. Observations were recorded on 11 yield contributing characters namely, height of the plant (cm), primary branches / plant, fruit length (cm),days to 50% flowering, single fresh fruit weight (g), number of fruits / plant, ripe fruit yield / plant (g), dry fruit yield / plant (g), the number of seeds / fruit, single fresh fruit weight (g), thousand seed weight (g). Observations were also recorded on quality features like capsaicin content (%), oleoresin (%), ascorbic acid (mg per 100g), colour value (ASTA), and proline (µg per g). Calculations of the Genotypic Coefficient of Variation (GCV) and Phenotypic Coefficient of Variation (PCV) were computed using the formulas put forth by Burton & De Vane (1953). The Genetic Advance (GA) and broad sense heritability were estimated using the formulas suggested by Johnson *et al.* (1955) and Allard (1960), respectively.

The estimates of mean, range, GCV, PCV, heritability in broad sense and genetic advance are presented in **Table 1**. Wide range of variation was observed for all the traits among the F3 progenies of the cross, suggesting the existence of scope for selection. Similar results were reported by Gupta *et al.* (2009) and Warshamana *et al.* (2008) in chilli. The PCV was high for fruit girth (20.82), capsaicin content (27.60), and oleoresin content (24.39) and it was moderate for plant height (14.76), length of the fruit (15.61), number of primary branches (15.77) per plant, number of fruits (13.74) per plant, days to fifty percent flowering (14.52), ripe fruit yield (19.34) per plant, dry fruit yield / plant (19.69), single fresh fruit weight (14.28), thousand seed weight (19.36), number of seeds / fruit (13.28), colour value (18.47), ascorbic acid (15.82) and proline (15.55). Most of the traits exhibit a broad range of variance, which would provide more options for the development of desirable types.

The GCV was high for capsaicin (23.43) and oleoresin content (21.17) and moderate for number of primary branches / plant (11.59), fruit girth (15.32), ripe fruit yield / plant (11.15), dry fruit yield / plant (11.79), thousand seed weight (14.53) and colour value (10.32) indicating diversity for these traits. For most of the traits, GCV registered lower values than PCV (**Table 1**), displaying a compelling linkage between the phenotype and environment. This has been strongly supported by the research findings of Gupta *et al.* (2009) and Singh *et al.* (2005). Minimum GCV was observed for parameters *viz*., plant height (6.66), days to attain 50% flowering (9.47), count of fruits / plant (5.28), length of the fruit (7.49), weight of a single fresh fruit (6.43), seed count / fruit (4.80), ascorbic acid level (8.78) and proline content (6.29). For the improvement of these attributes, simple selection would be effective. These findings significantly align with the observations of Singh *et al.* (2005) and Samadia (2007) in chilli.

Breeders consider heritability as a parameter of utmost importance since the value shows reliably a genotype may be identified *via* the manifestation of its phenotypic characteristics (**Table 1**). Johnson *et al.* (1955) emphasized that heritability estimates in combination with GA were more significant for evaluating the actual impact of selection. Most of the traits under the study were shown to have medium broad sense heritability. High heritability and high GA as percent of mean was exhibited in capsaicin and oleoresin content. The traits *viz*., days to 50% flowering, number of primary branches / plant, ripe fruit yield / plant, dryfruit yield / plant, colour value and ascorbic acid exhibited medium GA coupled with medium heritability. This indicates that, the above traits are influenced by addictive gene action. Similar high heritability for the traits were reported by Verma*et al.* (2004) and Samadia (2007).

Based on the performance of *mundu chilli* progenies of the cross PKM CA 32 x PKM CA 20 in the current study, attributes such as capsaicin and oleoresin content exhibited high heritability and substantial genetic advance over the mean. This is likely attributable to the influence of additive genes, suggesting their suitability for selection. However, for traits like days to 50% flowering, number of primary branches per plant, ripe fruit yield per plant, dryfruit yield per plant, colour value and ascorbic acid, both additive and non-additive gene actions were indicated, suggesting a moderate genetic advance. The combination of high heritability and genetic advance provides a more dependable index of selection value. Further enhancement of these traits may be achieved through progeny selection in the succeeding generations which can exploit the additive gene effect.

Table 1. Genetic variability components for prime characters of F3 generation of *Mundu Chilli*PKM CA 32 x PKM CA 20

S.No.	Characters	Mean	Range		Co-efficient of variation		h^2	GA (% mean)
			Min.	Max.	PCV	GCV		
1	Height of plant (cm)	74.24	62.40	90.88	14.76	6.66	20.30	6.19
2	Primary branches/ plant	7.52	5.58	9.17	15.77	11.59	54.00	17.55
3	Days to 50% flowering	55.15	43.33	67.67	14.52	9.47	42.60	12.74
4	Number of fruits/ plant	68.21	55.46	81.51	13.74	5.28	14.70	4.17
5	Fruit length (cm)	2.24	1.78	2.78	15.61	7.49	23.00	7.40
6	Fruit girth (cm)	7.90	4.88	10.02	20.82	15.32	54.20	23.23
7	Ripe fruit yield/ plant (g)	373.01	290.96	478.44	19.34	11.15	33.20	13.25
8	Dry fruit yield/ plant (g)	76.49	58.54	99.08	19.69	11.79	35.90	14.55
9	Single fresh fruit weight (g)	6.24	5.19	7.56	14.28	6.43	20.30	5.97
10	Thousand seed weight (g)	5.65	4.22	7.42	19.36	14.53	56.30	22.47
11	Number of seeds/ fruit	129.36	108.58	148.69	13.28	4.80	13.00	3.57
12	Capsaicin content (%)	0.29	0.16	0.45	27.60	23.43	72.10	40.98
13	Colour value (ASTA)	61.15	43.80	75.57	18.47	10.32	31.20	11.87
14	Oleoresin content (%)	9.19	6.20	13.94	24.39	21.17	75.30	37.84
15	Ascorbic acid (mg/ 100g)	119.86	92.08	141.59	15.82	8.78	30.80	10.04
16	Proline (µg/ g)	310.20	257.53	376.12	15.55	6.29	16.30	5.23

REFERENCES

Allard, R. W. 1960. Principles of Plant Breeding. John Wiley and Sons, Inc. New York.

Anonymous, 2022. Horticulture and Plantation Crops, Ministry of Agriculture, Govt. of TamilNadu.

Burton, G. W. and DeVane, E. H. 1953. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron. J.,* **45**: 478–481. [Cross Ref]

Costa, L. V., Lopes, R., Lopes, M. T. G., de Figueiredo, A. F., Barros, W. S. and Alves, S. R. M. 2009. Cross compatibility of domesticated hot pepper and cultivated sweet pepper. *Crop Breeding and Applied Biotechnology*, **9**: 37-44. [Cross Ref]

Gupta, A. M., Singh, D. and Kumar, A. 2009. Genetic variability, genetic advance and correlation studies in chilli (*Capsicum annuum*). *Indian J. Agri. Sci.,* **79**: 221–223.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Estimates of genetic and environmental variability in soyabean. *Agron. J.,* **47**: 314–318. [Cross Ref]

Moscone, E. A., Scaldaferro, M. A., Grabiele, M., Cecchini, N. M., Sanchez García, Y., Jarret, R. and Ehrendorfer, F. 2006. The evolution of chili peppers (*Capsicum*-Solanaceae): A cytogenetic perspective. In *VI International Solanaceae Conference: Genomics Meets Biodiversity,* **745** (pp.137-170). [Cross Ref]

Samadia D. K. 2007. Genetic variability studies in chilli germplasm under hot arid ecosystem. *Indian J. Hort.,* **64**: 477–479.

Singh, D. K. and Singh, A. 2011. Assessment of variability parameters and character association for quantitative traits in chilli (*Capsicum annuum* L.). *Prog. Agri.,* **11**: 113116.

Singh, M. D., Laisharam, J. M. and Bhagirath, T. 2005. Genetic variability in local chillies (*Capsicum annuum* L.) of Manipur. *Indian J. Hort.,* **62**: 203–205.

Verma, S. K., Singh, R. K. and Anja, R. R. 2004. Genetic variability and correlation studies in chilli. Prog. *Hort.,* **36**: 113–117.

Warshamana, I. K., Vikram, A. and Kohli, U. K. 2008. Genetic evaluation for physicochemical and yield traits in chilli (*Capsicum annuum* L.) under hilly conditions of Himachal Pradesh. *The Hort.J.,* **21**: 62–66.