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Assessment of genetic variability, heritability and genetic advance for growth, yield and quality traits of Byadgi Dabbi genotypes of chilli (*Capsicum annuum* L.)

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Abstract
The present investigation was carried out during *kharif* 2018-19 at Horticulture Research and Extension Centre, Haveri (Devihosur) with 29 genotypes of chilli in a randomized complete block design with two replications to estimate the genetic variability, heritability and genetic advance for 16 selected parameters. Analysis of variance revealed significant differences among the genotypes for all the traits studied indicating the presence of sufficient variability in the studied material. Higher PCV is observed over GCV for all the traits studied, indicating the predominance of environment over the genetic parameters. High magnitude of PCV and GCV were observed for number of fruits per plant, dry fruit yield per plant, dry fruit yield per hectare and capsaicin content suggesting the existence of wide range of genetic variability in the germplasm for these traits and thus the scope for improvement of these characters through simple selection would be better. High heritability coupled with high GAM was observed for number of fruits per plant, dry fruit yield per plant, dry fruit yield per hectare, weight of 100 dry fruits, number of seeds per fruit and capsaicin content indicating the predominance of additive gene action making the simple selection more effective.

Keywords: Byadgi Dabbi, variability, heritability, genetic advance over mean

Introduction
Chilli (*Capsicum annuum* L.) a member of the Solanaceae family, originated from South and Central America. It is one of the commercial vegetable cum spice crop at the global level. It deserves its place in vegetable, spice and as well as condiments. It is an important constituent of many foods as it is adding flavour, colour, pungency, vitamin A and C. Simultaneously, it is also used medically for the treatment of fever, cold, indigestion, constipation and as pain killer (Dagnoko *et al*., 2013) [2]. The alkaloid capsaicin present in placenta of the chilli fruit responsible for its pungency has diverse prophylactic and therapeutic uses in Allopathic and Ayurvedic medicine (Sumathy and Mathew, 1984) [20]. The Byadgi Dabbi cultivar is good source of oleoresin due to its thin and wrinkled skin, high colour count, low pungency and characteristic aroma. This has varied uses in processed food beverage industries and got high export potential. In India, there is no home which does not consume chilli. In Karnataka, Byadgi Dabbi and Byadgi Kaddi cultivars are grown in the specific districts such as Dharwad, Gadag and Haveri since centuries and are grown in rain fed condition with an optimal yield of 6-8 quintals per hectare.

The genus *Capsicum* includes 30 species in which five are under cultivation namely, *Capsicum annuum*, *C. frutescens*, *C. chinense*, *C. pubescens* and *C. baccatum* (Bosland and Votava, 2000). Among the five cultivated species, chilli (*Capsicum annuum* L.) is the most important commercial crop in India. The genus *Capsicum* is an often cross pollinated crop and natural cross pollination may go up to 62 per cent depending upon the extent of style exertion, time of dehiscence of anthers, wind direction, temperature fluctuation and insect population (Murthy and Murthy, 1962 and Hosmani, 1993) [18, 6], which accounts for considerable variation in fruit quality and yield parameters.

The critical assessment of nature and magnitude of variability in the germplasm stock is one of the important pre-requisites for formulating effective breeding methods (Krishna *et al*. 2007) [11]. Improvement in any crop is proportional to the magnitude of its genetic variability present in germplasm. Greater the variability in a population, there are the greater chance for effective selection for desirable types (Vavilov, 1951) [21]. Heritability is the portion of phenotypic variation which is transmitted from parent to progeny. Higher the heritable variation, greater

will be the possibility of fixing the characters by selection. Hence, heritability studies are of foremost importance to judge whether the observed variation for a particular character is due to genotype or due to environment. Heritability estimates may not provide clear predictability of the breeding value. Thus, estimation of heritability accompanied with genetic advance is generally more useful than heritability alone in prediction of the resultant effect for selecting the best individuals (Johnson *et al*. 1955) [9]. Therefore, the present investigation was carried out with a view to study the genetic variability, heritability and genetic advance for 16 selected parameters of Byadgi Dabbi genotypes.

Material and methods:

Field experiment was conducted with 29 Byadgi Dabbi genotypes during *kharif* 2018-19 at HREC, Devihosur, Haveri of University of Horticultural Sciences, Bagalkot. The experiment was laid out in randomized complete block design (RCBD) with two replications with spacing of 60x60 cm row to row and plant to plant. All the recommended package of practices and plant protection measures were followed to raise the crop healthy. Five plants were randomly selected from each genotypes and replication and observations were recorded on different growth, yield and quality parameters. Analysis of variance in respect of various characters was studied and the genetic variability for the different characters was estimated. Heritability (broad sense) and genetic advance as percentage of mean were calculated as per Hanson *et al*. (1956) [5] and Johnson *et al*. (1955) [9].

Result and discussion:

Analysis of variance was worked out for growth, earliness, yield and quality related traits. Analysis of variance revealed (Table 1) significant differences among genotypes for all growth, earliness, yield and quality parameters indicating presence of significant variability in the genotypes which can be exploited through selection. These findings are in line with earlier reports of Singh and Singh (2011), Krishnamurthy *et al*. (2013) and Janaki *et al*. (2015) [19, 12, 7].

Table 1: Analysis of variance (mean sum of squares) for growth, earliness, yield and quality parameters in chilli (*cv*. Byadgi Dabbi)

Sl. No.	Source of variation/Characters	Replications	Treatments (Genotypes)	Error	S. Em±	CD (5%)	CD (1%)
	Degrees of freedom	1	28	28			
	I. Growth parameters						
1.	Plant height (cm)	19.164	68.914**	22.259	3.33	9.66	13.03
2.	Plant spread from E-W (cm)	10.433	35.230*	17.479	2.95	8.56	11.55
3.	Plant spread from N-S (cm)	6.529	18.041*	37.823	4.34	12.59	16.99
4.	Primary branches	15.724	0.722*	0.381	0.43	1.26	1.70
5.	Secondary branches	2.201	1.688**	0.604	0.54	1.59	2.14
	II. Earliness parameters						
6.	Days to first flowering	4.413	4.892*	2.592	1.13	3.29	4.44
7.	Days to 50% flowering	0.107	8.996*	4.482	1.49	4.33	5.85
	III. Yield parameters						
8.	Number of fruits per plant	0.142	16.104**	4.125	1.43	4.16	5.61
9.	Average dry fruit weight (g)	0.108	0.140**	0.038	0.13	0.40	0.54
10.	Fruit length (cm)	1.150	1.410**	0.493	0.49	1.43	1.94
11.	Fruit diameter (mm)	5.773	4.051*	1.833	0.95	2.77	3.74
12.	Dry fruit yield per plant (g)	20.640	140.943**	5.40	1.64	4.76	6.42
13.	Dry fruit yield per hac (q/ha)	0.044	13.492**	1.102	0.74	2.15	2.90
14.	Weight of 100 dry fruits (g)	37.103	472.093**	41.869	4.57	13.25	17.88
15.	Number of seeds per fruit	0.14	716.726**	28.625	3.78	10.95	14.78
	IV. Fruit quality parameters						
16.	Capsaicin (SHU)	9564012.00	171057667.08**	252759.12	355.49	1029.84	1389.24

The extent of variability with respect to 16 characters in different genotypes measured in terms of mean, range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) along with the amount of heritability (h^2), expected genetic advance and genetic advance as per cent of mean (GAM) are presented in Table 2.

In the present investigation PCV (Table 2) was higher than GCV for all the traits studied, it indicates that genetic factors were predominantly responsible for expression of characters and selection could be made effectively on the basis of phenotypic performance. These results are in conformity with Mishra *et al*. (2001) and Bendale *et al.* (2006) [17, 1]. High estimates of GCV and PCV were observed for number of fruits per plant (21.46 and 27.89), dry fruit yield per plant (29.41 and 30.56), dry fruit yield per hectare (28.92 and 31.39) and capsaicin content (91.18 and 91.32). These characters having higher range of variation in the germplasm and have better scope of improvement through selection. These results are in confirmation with Janaki *et al.* (2015), Maurya *et al.* (2015), Meena *et al.* (2016) and Yogeshkumar *et al.* (2018) [7, 15, 16, 22]. Low GCV and PCV was observed for plant height, plant spread from east to west, plant spread from north to south, days to first flowering and days to 50 per cent flowering. This suggests the need for generation of variability either by introduction, exploration or by hybridization to get substantial gain in their improvement. Similar results were also reported by Meena *et al.* (2016) [16] for plant height. Jogi *et al.* (2017) [8] for plant spread. Yogeshkumar *et al.* (2018) [22] for days to first flowering and days to 50 per cent flowering. Moderate GCV and PCV were observed for average dry fruit weight, weight of 100 dry fruits and number of seeds per fruit. Similar results were reported by Kadwey *et al.* (2016) [10] and Yogeshkumar *et al.* (2018) [22].

Table 2: Estimates of mean, range, components of variance, heritability, and genetic advance for growth, yield and quality parameters in chilli (*cv*. Byadgi Dabbi)

Sl. No.	Character	Mean±S.Em	Range		GV	PV	GCV (%)	PCV (%)	h2 (%) (BS)	GA	GAM (%)
			Min.	Max.							
1	Plant height (cm)	67.51±3.40	57.36	80.08	23.32	45.58	7.14	9.98	51.17	7.11	10.52
2	Plant spread E-W (cm)	42.88±2.96	36.17	50.20	8.87	26.35	6.94	11.97	33.68	3.56	8.30
3	Plant spread N-S (cm)	40.93±4.35	35.47	46.64	9.89	27.93	7.68	12.91	35.41	3.85	9.41
4	Primary branches	3.62±0.44	2.60	4.80	0.17	0.55	11.41	20.54	30.86	0.47	13.06
5	Secondary branches	8.09±0.55	6.50	10.00	0.54	1.14	9.09	13.23	47.28	1.04	12.88
6	Days to first flowering	32.00±1.14	29.50	34.50	1.15	3.74	3.35	6.04	30.73	1.22	3.82
7	Days to 50% flowering	41.89±1.50	35.50	44.00	2.25	6.74	3.58	6.19	33.49	1.79	4.27
8	Number of fruits per plant	11.40±1.44	6.10	17.80	5.98	10.11	21.46	27.89	59.22	3.88	34.02
9	Average dry fruit weight(g)	1.77±0.14	1.35	2.51	0.05	0.09	12.80	16.96	56.99	0.35	19.91
10	Fruit length(cm)	7.77±0.50	6.37	10.74	0.45	0.95	8.72	12.56	48.15	0.96	12.46
11	Fruit diameter(mm)	14.67±1.04	12.28	18.28	1.10	2.94	7.05	11.44	37.70	1.33	8.88
12	Dry fruit yield per plant(g)	27.99±1.64	13.32	44.10	67.76	73.17	29.41	30.56	92.61	16.31	58.30
13	Dry fruit yield per ha (q/ha)	8.61±0.74	4.32	13.05	6.19	7.29	28.92	31.39	84.90	4.72	54.89
14	Weight of 100 dry fruits (g)	127.49±4.58	105.49	171.96	215.11	256.98	11.50	12.57	83.71	27.64	21.68
15	Number of seeds per fruit	101.90±3.80	67.81	137.00	344.05	372.67	18.20	18.94	92.32	36.71	36.03
16	Capsaicin(SHU)	10134.59±355.49	3888.00	51253.00	85402460.00	85655220.00	91.18	91.32	99.70	19009.06	187.56

Very high heritability coupled with very high genetic advance as per cent over mean were recorded for number of fruits per plant, dry fruit yield per plant, dry fruit yield per hectare, weight of 100 dry fruits, number of seeds per fruit and capsaicin content indicating the predominance of additive gene action and hence direct phenotypic selection is useful with respect to these traits. These traits were less influenced by environmental factors. Similar findings were reported by Surya Kumari *et al.* (2010), Janaki *et al.* (2015) [14, 7] and Yogeshkumar *et al.* (2018) [22]. Moderate heritability coupled with moderate genetic advance as per cent over mean were recorded for plant height at 120 DAT, number of primary branches per plant, number of secondary branches per plant, average dry fruit weight and fruit length. These, results are in confirmation with Giritammannavar (1995), Gaddagimath (1985) and Kumar *et al.* (1993) [4, 3, 13]. Moderate heritability coupled with low GAM were recorded for plant height, plant spread from north to south, plant spread from east to west, days to first flowering, days to 50 per cent flowering and fruit diameter. These results are confirmed by Jogi *et al.* (2017) [8], Yogeshkumar *et al.* (2018) [22]. Moderate heritability coupled with low GAM indicates the these traits are governed by non-additive gene effects where little progress would be achieved by applying selection as the trait is highly influenced by environmental effects. The improvement in these traits would be more effective by selecting specific combinations followed by mating among lines. On the basis of information obtained from the present study, it indicates that there is an existence of greater amount of variability for all the characters in different genotypes, which can be efficiently utilized for further improvement of chilli genotypes by choosing effective breeding program based on genetic makeup of different traits.

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