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Studies on genetic variability characteristics in Byadgi Dabbi derivatives of Chilli (*Capsicum annuum* L.) under Northern dry zone of Karnataka

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Abstract
Genetic variability, heritability and genetic advance as percent of mean for 20 characters were assessed by field evaluation observed for all the characters considered for the study. The analysis of variance indicated presence of significant variability among the genotypes for all the characters. Higher GCV and PCV values indicated presence of substantial genetic variability and less environmental influence for number of primary branches at 120 DAT, number of fruits per plant, fruit yield per plant, length of dry pod and oleoresin content. High heritability coupled with high genetic advance as percent mean were noticed for plant height at 60 and 120 DAT, number of primary branches at 120 DAT, number of secondary branches at 120 DAT, number of fruits per plant, fruit yield per plant, dry fruit yield per plant, fruit length, fruit diameter, length of dry pod, oleoresin, color, moisture and ascorbic acid suggesting presence of additive gene action for inheritance of these yield attributes. Hence, simple selection would be effective for improvement of these traits.

Keywords: chilli, variability, heritability, byadgi dabbi, genetic advance

1. Introduction
Chilli (*Capsicum annuum* L.) with chromosome number 2n=2X=24 is a new world crop from the Solanaceae family originated and domesticated in the American tropics. It is one of the cash crops grown for its fruits and the spice of commerce. In Asian diet chilli has a unique role as a spice as well as vegetable. It is also high valued crop grown commercially in almost all parts of the world. Chilli stands as the second largest spice commodity only after black pepper (*Piper nigrum* L.) in the international trade from India. Hence it is also referred as universal spice or wonder spice. India being the world's largest producer, consumer and exporter of chilli and has the largest area of 7.33 lakh ha (18.11 lakh acres) accounting for 42.81% of world area. India leads the world in chilli production with 17.64 lakh tonnes followed by China (3.21 lakh tonnes), Ethiopia (2.94 lakh tonnes), Thailand (2.47 lakh tonnes) and Pakistan (1.48 lakh tonnes). (Chilli Outlook 2021) [4].
Byadgi cultivar is known for high color with negligible amount of pungency and are the most preferred varieties by chilli producers and oleoresin industries. Inspite of the potential economic and industrial importance of the crop, due attention was not given towards a need-based crop improvement programme. For most of the improved cultivars, varietal uniformity is one of the main requirements. On the other hand, variability is a desirable goal in germplasm collection, since the material conserved in such collection represents the new material for the breeding program. The variability among different genotypes arises either due to geographical separation or due to genetic barriers to crossability. The existing elite germplasm collected from the different regions of Haveri district shows considerable diversity which needs to be statistically estimated to get the complete genetical information and superior genotypes should be identified for the breeding programme to obtain the desired results. Keeping in view the present investigation is planned to evaluate the genetic variability for different characters to estimate the scope of advance for selection and diversity of genotypes for identification of suitable parents for hybridization to improve yield attributing traits.

2. Material and Method
The research was conducted at vegetable block, college of horticulture Bagalkot (university of horticultural science, Bagalkot), which comes under northern dry zone of Karnataka (zone-3)

and this location is situated at 16.10' north latitude and 17° 42' east longitude and elevation of 542 m above mean sea level. The annual average rainfall of South-West monsoon and North-East monsoon is 57.89 mm during the year 2020. During the experimental period, the meteorological data were recorded at the recorded at the meteorological observatory of MHREC, UHS, Bagalkot.

The material for the present study comprised of 64 Byadgi Dabbi chilli genotypes in which 14 lines are derived from "Tirlapur selection", 25 lines are derived from "75 Byadgi Dabbi selection" and 25 lines are derived from "70 Byadgi Dabbi selection". The details of genotypes are given below. The experiment was laid out in completely randomized block design (RCBD) with two replications. Fourty five days old seedlings were transplanted to the experimental plot the experimental plot was ploughed and brought to fine tilth and were applied farm yard manures (FYM) and recommended dose of fertilizers (NPK). Seedlings were transplanted at spacing of 60 cm × 60 cm in two replications. Observations were recorded from five randomly selected plants in each experimental plot for growth, yield and quality parameters. The estimates of genotypic and phenotypic coefficient of variation were calculated according to Burton and Devane (1953) [3], heritability in broad sense (Falconer, 1981) [5] and expected genetic advance as per the procedure of Johnson *et al*. (1955) [7].

3. Results and Discussion

The analysis of variance (Table 1) revealed highly significant variations among the genotypes for all the characters at P=0.01. The result indicates that much variability exists in the genotypes for all the character studied in the experiment and there is scope to select the better parental genotypes to develop hybrid for breeding program. However, the analysis of variation itself is not enough and a conclusive result to explain all the inherent genotypic variation in the genotypes, here the simple statistical approach plays important role in examining the range of variations. Range of variation exhibited by all the traits in the present experiment (Table 2 and 3) indicates the presence of sufficient variation among the genotypes for all the characters examined under the study.

3.1 Growth Parameters

In present experiment plant height (cm) 120 DAT showed maximum range of variability from 59.09 to 94.13 with a mean of 72.53 followed by Days to first harvest from 57.82 to 66.28 with a grand mean of 61.74, plant height (cm) 90 DAT from 52.53 to 72.51 along with a grand mean of 58.98, plant height (cm) 60 DAT from 31.26 to 52.84 along with a grand mean of 40.69, days to first flowering from 30.65 to 35.91 along with a grand mean of 33.28, number of secondary branches at 120 DAT from 7.63 to 16.84 along with a grand mean of 9.56, number of secondary branches at 60 DAT from 6.98 to 11.14 along with a grand mean of 8.54, number of primary branches at 120 DAT from 2.51 to 9.17 along with a grand mean of 4.18 and number of primary branches at 60 DAT from 2.01 to 4.70 along with a grand mean of 3.15 (Table 2). The magnitude of phenotypic coefficient of variability was higher than that of genotypic coefficient of variability for all the characters indicating that effect of environment on their genetic expression.

High to moderate genotypic co-efficient of variation and phenotypic co-efficient of variation (>10%) were recorded for plant height at an interval of 60 and 120 DAT, number of primary branches at the interval of 60 and 120 DAT and number of secondary branches at 120 DAT (Table 2), which indicates the wide variability among the genotypes and the result obtained by present study were similar with the result obtained by Ajjappalvara and Channagoudra (2009) [1]. It shows the presence of high variability in the genotypes for selection and the difference between PCV and GCV were minimum for the morphological traits studied in this experiment, indicating that trait under the study were less influenced by the environment. Heritability (>60%) and genetic advance over mean (>20) were high for morphological characters. Similar results were reported by Kadwey *et al.* (2016) [8] for number of primary branches and Megharaj *et al.* (2017) [12], Pujar *et al.* (2017) [13], Yogeshkumar *et al.* (2018) [17], Kumar *et al.* (2020) [9] and Tirupathamma *et al*. (2021) [16] for all the morphological characters studied in this experiment. The additive variation is major contributor for the expression of these morphological traits. Thus, there is an ample scope for improving these characters by direct selection, crop improvement can be done through selecting the superior genotype among the sixty-four genotypes studied in the experiment.

Low genotypic coefficient of variation and phenotypic coefficient of variation was observed for plant height at 90 DAT, number of secondary branches at 60 DAT, days to first flowering and days to first harvest. 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 Manju and Sreelathakumary (2002) [10], Bijalwan (2015) [2], Kadwey *et al.* (2016) [8] and Meena *et al.* (2016) [11]. Low GCV and PCV was observed for days to first flowering and days to first harvest reported by Manju and Sreelathakumary (2002) [10], Bijalwan (2015), Sran and Jindal (2019) [15] and Farwah *et al.* (2020) [6].

3.2 Yield and Quality Characters

The experiment majorly depends mainly on two characters and yield parameters are one among them. Color (ASTA value) showed maximum range of variability from 97.75 to 171.14 with a mean of 133.99 followed by ascorbic acid (mg/100g) from 90.11 to 145.35 along with a grand mean of 116.85, number of fruits per plant from 48.01 to 166.94 along with a grand mean of 92.16, fruit yield per plant (g) from 204.6 to 1221.14 along with a grand mean of 53.04, dry fruit yield per plant (g) from 20.47 to 122.11 along with a grand mean of 53.02, moisture (%) from 10.10 to 17.96 along with a grand mean of 13.70, oleoresin (%) from 6.06 to 15.92 along with a grand mean of 9.49, fruit length (cm) from 3.97 to 11.79 along with a grand mean of 7.72, length of dry pod (cm) from 3.77 to 10.90 along with a grand mean of 7.10, average fruit weight (g) from 4.27 to 7.31 along with a grand mean of 5.73 and fruit diameter (mm) from 2.36 to 5.13 along with a grand mean of 3.74.

The characters like number of fruits per plant, fruit yield per plant, fruit diameters along with quality characters like moisture, color, oleoresin and ascorbic acid are very important yield attributing characters of chilli, the genotypic co-efficient of variation and phenotypic co-efficient of variations were high to moderate (>10%) for the character which indicates the wide variability among the genotypes (Table 3). Selection of better performing genotype for further

crop improvement is much needed as the difference between genotypic and phenotypic variation is lesser which implies the environmental influence for the character is negligible and the result exhibited by the experiment found to be parallel with the experiment of Sarkar *et al.* (2009) and moving in the same direction. Heritability (>60%) and genetic advance over the mean (>20%) for the yield parameters were high, this result indicates that additive gene action plays important role in expression of the yield characters and the selection among the genotypes used in the experiment better method to improve the yield parameters, the experiments conducted by the Sarkar *et al.* (2009) [14] Sran and Jindal (2019) [15], Kumar *et al.* (2020) [9], Farwah *et al.* (2020) [6] and Thirupathamma *et al.* (2021) [16] were found to be similar with the result exhibited by present experiment.

Low GCV and PCV for average fruit weight and fruit length was observed. Yogeshkumar *et al.* (2018) [17] observed similar results of moderate estimates of GCV and PCV for average fruit weight.

4. Conclusion

On basis of results obtained from the present experiment, it can be concluded that the Byadgi Dabbi derivatives of chilli genotypes used has vast genetic variability with narrow differences between genotypic coefficients of variation and phenotypic coefficients of variation, high to moderate heritability and genetic advance over mean for most of the characters, so the selection would be more feasible for these traits.

Table 1: ANOVA for growth, yield and quality parameters for Byadgi Dabbi derivatives of chilli

Sl. No.	Source of variations	Replication	Genotypes	Error	C. D @ 5%
Degrees of Freedom		**1**	**63**	**63**	
1	Plant height at 60 DAT (cm)	2.59	52.26**	2.84	3.37
2	Plant height at 90 DAT (cm)	8.97	42.37**	4.71	4.34
3	Plant height at 120 DAT (cm)	20.26	166.02**	8.39	5.79
4	No. of primary branches at 60 DAT	0.22	1.62**	0.93	0.78
5	No. of primary branches at 120 DAT	0.18	5.52**	2.13	0.73
6	No. of secondary branches at 60 DAT	0.36	1.12**	0.42	1.30
7	No. of secondary branches at 120 DAT	0.13	6.48**	0.55	1.48
8	Days to first flowering	0.14	4.14**	0.59	1.53
9	Days to first harvest	0.07	8.31**	1.25	2.23
10	Number of fruits per plant	37.17	1107**	47.63	13.79
11	Average fruit weight (g)	0.50	0.56**	0.16	0.79
12	Fruit yield per plant (g)	146.89	663.04**	360.27	55.08
13	Dry fruit yield per plant (g)	154.86	706.83**	23.60	9.71
14	Fruit length (cm)	0.45	7.72**	0.30	1.09
15	Fruit diameter (mm)	0.66	2.76**	1.14	0.74
16	Length of dry pod (cm)	0.12	7.02**	0.15	0.76
17	Oleoresin (%)	0.76	10.75**	0.28	1.06
18	Color (ASTA value)	11.25	872.53**	14.53	7.62
19	Moisture (%)	1.80	9.86**	0.38	1.24
20	Ascorbic acid (mg/100g)	41.12	385.25**	15.87	7.96

*and** are significant at 5% level of significance, DAT-Days after transplant and C.D.-Critical difference.

Table 2: Estimates of genetic parameters of Byadgi Dabbi derivatives of chilli for growth parameters

Sl. No.	Character	Range		Mean	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
		Min.	Max.						
1	Plant height 60 DAT (cm)	31.26	52.84	40.69	11.755	12.46	88.94	9.29	22.83
2	Plant height 90 DAT (cm)	52.53	72.31	58.98	6.81	7.74	77.41	7.28	12.34
3	Plant height 120 DAT (cm)	59.09	94.13	72.53	11.80	12.46	89.73	16.70	23.06
4	Number of primary branches 60 DAT	2.01	4.70	3.15	12.45	17.55	50.37	0.57	18.22
5	Number of primary branches 120 DAT	2.51	9.17	4.18	38.47	39.45	95.11	3.23	77.30
6	Number of secondary branches 60 DAT	6.98	11.14	8.54	4.12	8.67	22.66	0.34	4.04
7	Number of secondary branches 120 DAT	7.63	16.84	9.56	16.99	18.68	82.76	3.04	31.85
8	Days to first flowering	30.65	35.91	33.28	3.61	4.03	71.21	2.09	6.29
9	Days to first harvest	57.82	66.28	61.74	2.72	3.27	69.44	2.89	4.68

S. Em.-Standard error of mean, GV-Genotypic variance, PV-Phenotypic variance, GCV-Genotypic co-efficient of variation, PCV-Phenotypic co-efficient of variation, h^2- Heritability, GA-Genetic advance, GAM-Genetic advance over a mean and CV-Co-efficient of variation.

Table 3: Estimates of genetic parameters of Byadgi Dabbi derivatives of chilli for yield and quality parameters

Sl. No.	Character	Range		Mean	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
		Min.	Max.						
10	Number of fruits per plant	48.01	166.94	92.16	24.19	25.33	91.26	43.88	47.62
11	Average fruit weight (g)	4.27	7.31	5.73	6.06	9.31	42.34	0.45	8.12
12	Fruit yield per plant (g)	204.6	1221.14	53.04	33.29	35.17	93.21	35.16	67.55
13	Dry fruit yield per plant (g)	20.47	122.11	53.02	34.29	35.17	93.21	35.81	67.55
14	Fruit length (cm)	3.97	11.79	7.72	24.25	25.25	92.18	3.70	47.96
15	Fruit diameter (mm)	2.36	5.13	3.74	13.03	16.33	63.63	0.80	21.41
16	Length of dry pod (cm)	3.77	10.90	7.10	25.63	26.18	95.77	3.66	51.66
17	Oleoresin (%)	6.06	15.92	9.49	23.57	24.22	94.67	4.48	47.25
18	Color (ASTA value)	97.75	171.14	133.99	15.27	15.53	96.61	41.24	30.92
19	Moisture (%)	10.10	17.96	13.70	15.42	16.07	92.07	4.17	30.49
20	Ascorbic acid (mg/100g)	90.11	145.35	116.85	11.28	11.78	91.63	25.99	22.24

S. Em.-Standard error of mean, GV-Genotypic variance, PV-Phenotypic variance, GCV-Genotypic co-efficient of variation, PCV-Phenotypic co-efficient of variation, h^2-Heritability, GA-Genetic advance, GAM-Genetic advance over a mean and CV-Co-efficient of variation

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