

Genetic variability studies in Byadagi chilli (*Capsicum annum* L.)

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(Received: October, 2023 ; Accepted: June, 2024)

DOI: 10.61475/JFS.2024.v37i2.01

Abstract: A study on genetic variability, correlation and path coefficient for different quantitative and quality traits in 58 Byadagi chilli accessions was carried out in the Botany Garden of University of Agricultural Sciences, Dharwad during-kharif 2021. High variability was observed in number of fruits per plant, fruit weight, fruit length, fruit width and dry fruit yield. High PCV, GCV, heritability and GAM estimates was observed for the number of fruits per plant. Dry fruit yield showed significant positive correlation with the traits viz., plant height, number of primary branches, number of secondary branches, number of fruits per plant, fruit weight, fruit length and fruit width. The traits such as number of primary branches, number of fruits per plant, fruit weight, fruit length, fruit width, days to first flowering and oleoresin content exhibited positive direct influence on dry fruit yield, hence direct selection through these traits is effective for improving the yield.

Key words: Byadagi hilli, Genetic advance, Genotypic coefficient of variation, Heritability, Phenotypic coefficient of variation

Introduction

Chilli (*Capsicum annum* L.), a spice and vegetable crop with $2n = 24$ chromosomes, is the third most important crop of Solanaceae family after potato and tomato (Naz *et al.*, 2006). The fruits come in a wide variety of sizes, shapes, colours, textures and pungency levels (Rego *et al.*, 2009). There are more than 400 different varieties of chilli worldwide. They are used in a variety of ways and harvested in green, red and fully dried states (Pujar *et al.*, 2017).

The crop is used as a spice seasoning, food supplement, medicine, vegetable and ornamental plant. It is a good source of vitamins A, B, C and E, oleoresin, sugars and minerals. The presence of calcium, phosphorus, iron, sodium and copper in trace amounts contributes to the taste of food. The Capsicum (C18H27NO3), a crystalline, acrid and volatile alkaloid found in the placenta of the fruit, is used in both allopathic and ayurvedic medicine for a variety of preventive and therapeutic purposes. In addition, chilli helps to fight gastric and colon cancer and is suitable for obese diets (Tayeb Rezvani *et al.*, 2013 and Dang *et al.*, 2014).

Among several chilli varieties grown by the farmers, the Byadagi variety is a famous variety grown mainly in north Karnataka is very popular. This variety is known for its deep red colour due to very high colour units of 1,50,000 - 2,50,000 CU. This variety is grown in Dharwad, Gadag and Haveri districts under rainfed conditions. The average yield ranges from 0.5 to 1.25 t/ha. Other districts such as Bellary, Raichur and Gulbarga, where the "Guntur" variety was popular earlier but recently to Byadagi variety due to its high oleoresin content and high yields (3.75 to 5.00 t/ha).

In the Byadagi variety two variants exists viz., Kaddi and Dabbi. The Kaddi type has a length of 12-15 cm and low pungency. It is a slender, straight, light green and turns deep

red when ripe and develops the characteristic wrinkles after ripening. This variety has the highest colour value. Its calyx covers the pod and it is reasonably resistant to pests and diseases. On the other hand, Dabbi are larger and more convex at the calyx. The fruit length is between 10 and 12 cm. The fruits have a light green colour that turns to an attractive, bright, deep red when ripe. When completely dry, this variety also develops a wrinkled surface on the fruit.

Due to high level of cross pollination, lack of proper maintenance breeding several variants have evolved over a period of time and fail to correspond to the quality of the original Byadagi type, the consumer at large area were under confusion and traders sell several variants in the name of Byadagi, though these do not meet the real Byadagi traits. Considering these points, the present investigation was planned with the objective assess the genetic variability in Byadagi dabbi and Byadagi kaddi chilli variants collection from north Karnataka.

Material and methods

The collected 57 variants of Byadagi kaddi and dabbi were evaluated at Botany Garden, Department of Genetics and Plant Breeding, University of Agricultural Sciences, Dharwad, during kharif season of 2021-22 (Table 1). A total of fifty-seven Byadagi chilli accessions were collected from different locations of north Karnataka and 1 check variety Rudra was used in the investigation during the year 2021.

The experiment was laid out in randomized complete block design with all the recommended cultivation practices. The spacing of 60 x 15 cm was followed. The plant height (cm), Number of primary branches, Number of secondary branches, Number of fruits per plant, Fruit weight (g), Fruit length (cm), Fruit width (cm), Days to First Flowering, Days to 50% Flowering,

Days to final harvest, Fruit wrinkles, Leaf curl index, Ascorbic acid content (g/100 g), Capsaicin content (SHU), Oleoresin content (%), Dry fruit yield (g) These data was recorded on each of five random plants for different quantitative traits was averaged and subjected to analysis using R software version. The variability parameters were worked out.

The phenotypic correlation co-efficient and path coefficient analysis (Dewey and Lu,1959) was worked out.

Results and discussion

Analysis of variance revealed highly significant differences for all the studied traits. Evaluated characters were exhibited different levels of variability, heritability and genetic advance among the studied genotypes (Table 2). Low to high phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were recorded. The highest GCV and PCV values were found particularly for number of fruits per plant (40.28% and 41.54%), dry fruit yield (35.08% and 39.39 %) and fruit wrinkles (29.72% and 34.88%). The highest broad sense heritability value manifested for number of fruits per plant (94.02%) followed by fruit length (95.45%), while the lowest heritability was revealed by days to final harvest (45.52%). Further the traits number of fruits per plant, fruit length, fruit width showed high heritability coupled with high genetic advance (>50%) indicating these traits are under the control of additive gene action.

When considered mean, range, PCV and GCV, lot of variability was seen for number of fruits per plant, fruit length, fruit width, fruit wrinkles and dry fruit yield. The selection among these genotypes with standard traits of original Byadagi kaddi and dabbi is required. However, narrow differences were observed for ascorbic acid, capsaicin content and oleoresin content.

The trait plant height exhibited moderate PCV and GCV along with high heritability and genetic advance over the mean indicating moderate variation for this trait. Plant height exhibited significant and positive correlation with dry fruit yield (0.28), number of primary branches (0.77), number of secondary branches (0.79), number of fruits per plant (0.22), fruit length (0.46), fruit width (0.39) and ascorbic acid content (0.26) (Table 3). Plant height reported indirect positive effect on yield through number of fruits plant^pper plant (0.2406) followed by fruit weight (0.0557), fruit length (0.0668) and days to fifty percent flowering (0.0485) indicating that selection of this trait in future breeding program will be effective (Table 4). Earlier Janaki *et al.* (2015), Udachappa *et al.* (2017), Nahak *et al.* (2018), Nehru *et al.* (2012) and Ibrahim *et al.* (2001) reported the similar trend for this trait.

The trait number of fruits per plant reported high PCV and GCV along with high heritability and high GAM in 58 landraces indicating this trait is under the control of additive gene action and improvement for this trait through selection would be effective. The trait showed significant and positive correlation with dry fruit yield (0.66) and fruit length (0.85). The indirect effect of number of fruits per plant has influenced dry fruit

Table 1. List of chilli genotypes used in the study

Accession no	Farmer/trader name/village/Taluka/District
AK-1	Gurappa imbavali, Koliwad, Hubli, Dharwad.
AK-2	Vijappakurubar, Koliwad, Hubli, Dharwad.
AK-3	Nagappa Pujari, Koliwad, Hubli, Dharwad.
AK-4	Somashekkartimmapur, Koliwad, Hubli, Dharwad.
AK-5	Basavrajulagaddi, Koliwad, Hubli, Dharwad.
AK-6	Eshwar maligwad, Koliwad, Hubli, Dharwad.
AK-7	Veeranna banavi, Koliwad, Hubli, Dharwad.
AK-8	Ningappa patil, Bandiwada, Hubli, Dharwad.
AK-9	Yamanappa bisnur, Bandiwada, Hubli, Dharwad.
AK-10	Pakappa angadi, Bandiwada, Hubli, Dharwad.
AK-11	Yelappahalakeri, Bandiwada, Hubli, Dharwad.
AK-12	S.g.patil, Bandiwada, Hubli, Dharwad.
AK-13	Chand shab, Bandiwada, Hubli, Dharwad.
AK-14	Manju kar, Bandiwada, Hubli, Dharwad.
AK-15	Shashidar madpati, Bandiwada, Hubli, Dharwad.
AK-16	Shabash soodi, Bandiwada, Hubli, Dharwad.
AK-17	Jagadish mulgund, Bhadrapura, Navalgund, Dharwad.
AK-18	Ramappa, Bhadrapura, Navalgund, Dharwad.
AK-19	Gangadhar meti, Bhadrapura, Navalgund, Dharwad.
AK-20	Srikant arikeri, Bhadrapura, Navalgund, Dharwad.
AK-21	Ravi bhadrapur, Bhadrapura, Navalgund, Dharwad.
AK-22	Shekappa gondi, Nalvadi, Navalgund, Dharwad.
AK-23	Mahanteshpoori, Nalvadi, Navalgund, Dharwad.
AK-24	Kalappa mulgund, Nalvadi, Navalgund, Dharwad.
BK-25	Basappa kaginele, Byadagi, Byadagi, Haveri.
BK-26	Devappa meti, Byadagi, Byadagi, Haveri.
BK-27	Sharanukuri, Byadagi, Byadagi, Haveri.
BK-28	Manju lagalore, Byadagi, Byadagi, Haveri.
BK-29	Jagadish nandihal, Hulakoppa, Kalghatgi, Dharwad.
BK-30	Kallappakallur, Hulakoppa, Kalghatgi, Dharwad.
BK-31	Devappa gaddi, Sirbyadagi, Byadagi, Haveri.
AD-32	Sheikaiyya, Annigeri, Annigeri, Dharwad.
AD-33	Mahesh dippi, Annigeri, Annigeri, Dharwad.
AD-34	Devappa, Annigeri, Annigeri, Dharwad.
AD-35	Manjappa, Annigeri, Annigeri, Dharwad.
AD-36	Manjunath hosatti, Annigeri, Annigeri, Dharwad.
AD-37	Irappa kuri, Annigeri, Annigeri, Dharwad.
AD-38	Shekappa chavan, Annigeri, Annigeri, Dharwad.
AD-39	Basavraj arkanig, Annigeri, Annigeri, Dharwad.
BD-40	Shekrayyahiremath, Jalabra, Byadagi, Haveri.
BD-41	Hanchalappa meti, Jalabra, Byadagi, Haveri.
BD-42	Deepak hudda, Jalabra, Byadagi, Haveri.
BD-43	Kashayyakalmath, Jalabra, Byadagi, Haveri.
BD-44	Rudraiyya poojar, Jalabra, Byadagi, Haveri.
BD-45	Mudukappa barker, Shiggaon, Shiggaon, Haveri.
BD-46	Ravigoudagoudar, Shiggaon, Shiggaon, Haveri.
BD-47	Hanumappahosamani, Shiggaon, Shiggaon, Haveri.
BD-48	Mallu gadaginagar, Shiggaon, Shiggaon, Haveri.
BD-49	Mahesh dippi, Shiggaon, Shiggaon, Haveri.
BD-50	Rudraiyyagoudar, Shiggaon, Shiggaon, Haveri.
BD-51	Veeresh, shiggaon, Shiggaon, Haveri.
BD-52	Mallangouda b, Shiggaon, Shiggaon, Haveri.
BD-53	Veeraiyya d, Savanur, Savanur, Haveri.
BD-54	Basavaiyya h, Savanur, Savanur, Haveri.
BD-55	Ashok, Savanur, Savanur, Haveri.
BD-56	Basappa a, Savanur, Savanur, Haveri.
BD-57	Kantappa, Savanur, Savanur, Haveri.
Rudra	CHECK variety

Table 2. Estimates of genetic variability parameters for quantitative and quality traits in Byadagi chilli accessions of north Karnataka

Character	Mean	Range	PCV (%)		GCV (%)	h ² (%)	GAM at 5%
			Min.	Max.			
Plant height (cm)	75.22	51.25	101.30	16.18	15.07	86.84	28.94
Number of primary branches	6.82	5.00	9.50	18.10	13.29	53.90	20.10
Number of secondary branches	8.58	6.00	12.00	18.33	13.01	50.35	19.01
Number of fruits per plant	21.54	8.00	42.50	41.54	40.28	94.01	80.46
Fruit weight (g)	1.50	0.41	2.25	30.64	25.98	71.88	45.37
Fruit length (cm)	10.12	5.60	15.00	23.96	23.41	95.45	47.11
Fruit width (cm)	1.38	0.90	2.25	24.23	21.71	80.29	40.07
Days to first flowering	35.09	28.50	44.50	11.20	9.92	78.43	18.10
Days to 50% flowering	65.10	58.00	75.00	6.27	5.39	73.88	9.55
Days to final harvest	142.09	139.50	145.50	1.41	0.95	45.52	1.32
Fruit wrinkles	3.28	1.00	4.50	34.88	29.72	72.61	32.17
Leaf curl index	2.54	2.00	3.00	19.76	15.53	61.83	25.16
Ascorbic acid content (g/100g)	77.01	73.60	80.60	2.87	2.24	61.11	3.61
Capsaicin content (SHU)	3081.90	2465	3655	10.75	8.49	62.34	13.81
Oleoresin content (%)	13.16	10.15	15.58	12.16	9.61	62.45	15.64
Dry fruit yield (g)	30.02	12.60	72.78	39.39	35.08	79.31	64.35
PCV- Phenotypic coefficient of variation	h ² – Broad sense heritability		GCV- Genotypic coefficient of variation				
GAM-Genetic advance over mean	SHU- Scoville heat unit						

Table 3. Phenotypic correlation coefficients among quantitative and quality traits in Byadagi chilli accessions of north Karnataka

TRAITS	PH	NPB	NSB	NFPP	FWT	FL	FWD	D1F	DFH	DFH	FWR	LCI	ASC	CAPS	OLE	DFY
PH	1.00															
NPB	0.77**	1.00														
NSB	0.79**	0.79**	1.00													
NFPP	0.22*	0.14	0.08	1.00												
FWT	0.07	0.18	0.17	-0.55**	1.00											
FL	0.46**	0.34**	0.29**	0.85**	-0.51**	1.00										
FWD	0.39**	0.41**	0.46**	-0.56**	0.53**	-0.35**	1.00									
D1F	-0.34**	-0.27**	-0.27**	0.05	0.11	-0.11	-0.22*	1.00								
DFH	-0.33**	-0.26**	-0.26**	0.05	0.11	-0.095	-0.22*	0.98**	1.00							
DFH	-0.06	-0.03	-0.09	-0.04	0.01	-0.06	0.015	0.14	0.14	1.00						
FWR	-0.17	-0.19*	-0.19*	0.12	-0.16	0.09	-0.05	0.24**	0.22*	-0.067	1.00					
LCI	-0.15	-0.11	-0.16	0.10	-0.17	0.01	-0.05	-0.03	-0.02	0.08	0.26**	1.00				
ASC	0.26**	0.22*	0.16	0.14	0.03	0.30**	0.01	-0.17	-0.18	-0.17	0.04	-0.05	1.00			
CAPS	0.02	0.09	0.07	0.16	-0.01	0.16	-0.003	-0.08	-0.09	-0.02	-0.06	-0.06	0.03	1.00		
OLE	0.04	0.12	0.21*	-0.45**	0.39**	-0.38**	0.43**	-0.17	-0.18	-0.01	-0.18	-0.06	-0.06	0.17	1.00	
DFY	0.28**	0.28**	0.22*	0.66**	0.22*	0.53**	0.20*	-0.12	-0.11	0.10	0.03	-0.10	0.15	0.18	-0.15	1.00

*significant at 1% **significant at 5%

PH-Plant height (cm)	FWT-Fruit weight (g)	DFH-Days to 50% flowering
ASC-Ascorbic acid content (g/100g)	NPB-Number of primary branches	FL-Fruit length (cm)
DFH-Days to final harvest	CAPS- Capsaicin content (SHU)	NSB-Number of secondary branches
FWD-Fruit width (cm)	FWR-Fruit wrinkle	D1F- Days to first flowering
OLE- Oleoresin content (%)	NFPP-Number of fruits per plant	LCI -Leaf curl index
DFY-Dry fruit yield (g)		

yield through indirect positive effect on yield through fruit length (0.1225) followed by days to first flowering (0.0047) and days to final harvest (0.0022). Sujatha *et al.* (2017), Deepo *et al.* (2020), Manoj *et al.* (2018), Shweta *et al.* (2018) and Vidya *et al.* (2018) reported similar trend for this trait. The above parameters showed selection for these traits would be effective in increasing the dry fruit yield.

The trait fruit weight exhibited high PCV and GCV along with high heritability and high GAM indicating that this trait is under the control of additive gene action and selection of this trait would be effective. Fruit weight exhibited significant and positive correlation with dry fruit yield (0.22), fruit width (0.53) and oleoresin content (0.39). Fruit weight found to have indirect

positive effect on yield through oleoresin content (0.0143) followed by days to first flowering (0.0107), fruit width (0.117) and leaf curl index (0.0114) similar trend for the traits were also reported by Sujatha *et al.* (2017) and Deepo *et al.* (2020). The residual effect observed suggests that the traits chosen for the path coefficient analysis were important characters affecting the yield and that no major yield components were left un studied during this investigation.

Conclusion

The present study concludes that, the yield attributing traits such as plant height, number of fruits per plant and fruit weight which showed a high positive direct effect, as well as positive correlation with the dry fruit yield if considered in selection

Table 4. Phenotypic path coefficients among quantitative and quality traits in Byadagi chilli accessions of north Karnataka

TRAITS	PH	NPB	NSB	NFPP	FWT	FL	FWD	DIF	DFE	DFH	FWR	LCI	ASC	CAPS	OLE	DFY
PH	-0.1157	0.0064	-0.0057	0.2406	0.0557	0.0668	0.0086	-0.0347	0.0485	0.0033	0.0049	0.0099	-0.0128	-0.0003	0.0014	0.2769
NPB	-0.0893	0.0083	-0.0058	0.1452	0.1500	0.0486	0.0090	-0.0274	0.0379	0.0015	0.0054	0.0071	-0.0108	-0.0016	0.0045	0.2826
NSB	-0.0908	0.0065	-0.0073	0.0804	0.1447	0.0421	0.0103	-0.0275	0.0376	0.0049	0.0056	0.0106	-0.0075	-0.0013	0.0076	0.2157
NFPP	-0.0258	0.0011	-0.0005	1.0787	-0.4687	0.1225	-0.0124	0.0047	-0.0068	0.0022	-0.0035	-0.0066	-0.0066	-0.0029	-0.0165	0.6589
FWT	-0.0075	0.0014	-0.0012	-0.5918	0.8544	-0.0739	0.0117	0.0107	-0.0160	-0.0006	0.0046	0.0114	-0.0014	0.0002	0.0143	0.2163
FL	-0.0533	0.0028	-0.0021	0.9115	-0.4356	0.1450	-0.0078	-0.0110	0.0139	0.0030	-0.0026	-0.0006	-0.0142	-0.0029	-0.0142	0.5317
FWD	-0.0449	0.0034	-0.0034	-0.2086	0.4524	-0.0513	0.0221	-0.0223	0.0316	-0.0008	0.0013	0.0031	-0.0003	0.0001	0.0161	0.1985
DIF	0.0394	-0.0022	0.0020	0.0491	-0.1259	-0.0156	-0.0048	0.1021	-0.1429	-0.0073	-0.0070	0.0021	0.0083	0.0014	-0.0063	0.1076
DFE	0.0384	-0.0021	0.0019	0.0503	0.0935	-0.0138	-0.0048	-0.1182	-0.1459	-0.0074	-0.0062	0.0016	0.0088	0.0016	-0.0067	0.1090
DFH	0.0073	-0.0002	0.0007	0.1345	0.0095	-0.0082	0.0003	0.0141	-0.0205	-0.0530	0.0020	-0.0053	0.0084	0.0003	-0.0005	0.0894
FWR	0.0197	-0.0015	0.0014	0.1291	-0.1360	0.0767	-0.0010	0.0248	-0.0313	0.0037	-0.0290	-0.0173	-0.0020	0.0010	-0.0065	0.0318
LCI	0.0172	-0.0009	0.0012	0.1067	-0.1456	0.0013	-0.0010	-0.0032	0.0034	-0.0042	-0.0075	-0.0667	0.0022	0.0012	-0.0021	-0.0978
ASC	-0.0306	0.0018	-0.0011	0.1465	0.0246	0.0427	0.0001	-0.0176	0.0266	0.0092	-0.0012	0.0031	-0.0483	-0.0005	-0.0023	0.1530
CAPS	-0.0018	0.0007	-0.0005	0.1713	-0.0109	0.0227	-0.0001	-0.0077	0.0126	0.0009	0.0016	0.0043	-0.0014	-0.0183	0.0062	0.1797
OLE	-0.0045	0.0010	-0.0015	-0.4797	0.3295	-0.0555	0.0096	-0.0175	0.0266	0.0008	0.0051	0.0037	0.0030	-0.0031	0.0371	0.1455

-residual effect -0.2680 PH-Plant height (cm) FWT-Fruit weight (g) DFE-Days to 50% flowering ASC-Ascorbic acid content (g/100g) NPB-Number of primary branches FL-Fruit length (cm) DFH-Days to final harvest CAPS-Capsaicin content (SHU) NSB-Number of secondary branches FWD-Fruit width (cm) FWR-Fruit wrinkle OLE-Oleoresin content (%) NFPP-Number of fruits per plant DIF-Days to first flowering LCI-Leaf curl index DFY-Dry fruit yield (g)

process will steadily support and increase the dry fruit yield in chilli. Hence the above-mentioned characters should be given

top most priority while formulating a selection strategy for improvement of yield in chilli.

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