IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
Volume **8** | Issue 1 | January, 2013 | 179-182

RESEARCH ARTICLE

Genetic variability, heritability and genetic advance in cauliflower (*Brassica oleracea* var. *botrytis* L.)

■ **PRATIMA SINGH, SANJAY KUMAR, SUTANU MAJI AND ABHISHEK SINGH**

SUMMARY

Sixteen genotypes of cauliflower were evaluated to study the magnitude of genetic variability and character association for growth, yield and quality traits. The genotypes were evaluated for fourteen quantitative characters *viz.*, plant height, stem diameter, number of leaves, leaf length, leaf width, fresh weight of leaf, total weight of the plant, days taken to curd initiation, days taken to curd maturity, diameter of the curd, average weight of curd with guard leaves, curd weight without guard leaves, vitamin C and yield of curd with guard leaves. The Present study showed that both phenotypic co-efficient of variation (PVC) and genotypic co-efficient of variation (GCV) were higher for most of the traits and indicates that characters were much influenced by environmental factors. The estimate of high heritability in broad sense was observed for two traits *viz.*, curd weight without guard leaves and vitamin C, while the moderate heritability was observed for stem diameter. The high genetic advance in per cent of mean showed by curd weight with guard leaves while the lowest genetic advance in per cent of mean showed by leaves plant^{-1}. High heritability coupled with high genetic advance was observed for curd weight with guard leaves which are governed by additive gene and could be effectively improved through selection. The genotypes Pusa Snowball K-1 showed high genotypic co-efficient of variability for vitamin C followed by Pusa Sharad and Pusa Hybrid-2, while the genotype K-1 showed low genotypic and phenotypic co-efficient of variability for number of leaves plant^{-1}.

Key Words : Genetic variability, Heritability, Genetic advance, Cauliflower

How to cite this article : Singh, Pratima, Kumar, Sanjay, Maji, Sutanu and Singh, Abhishek (2013). Genetic variability, heritability and genetic advance in cauliflower (*Brassica oleracea* var. *botrytis* L.). *Internat. J. Plant Sci.*, **8** (1) : 179-182.

Article chronicle : Received : 19.07.2012; **Revised :** 25.11.2012; **Accepted :** 10.12.2012

The cauliflower (*Brassica oleracea* var. *botrytis* L.) is an important vegetable not only among the cole crops but also among other groups of vegetables grown in india. It is thought to have been domesticated in Mediterranean region since the greatest range of variability in the world types of *Brassica oleracea* is found there. It is herbaceous annual vegetable grown for its tender 'curd' and biennial for seed production. It has small, thick stem, bearing whorl of leaves and branched tap root system. The main growing point develops into shortened shoot system whose apices make up the convex surface of curd and the curd is a prefloral fleshy apical meristem. The edible part *i.e.* curd is generally white in colour and may be enclosed by inner leaves before the exposure. The nature and amount of genetic variability in the germplasm indicate the scope of improvement in the character through selection. However, the efficiency of selection in approving the character by exploiting the genetic variability character in question the genotype and phenotypic co-efficient of variation and helpful in expressing the nature where as the estimate of the heritability provides index of transmissibility of character, respectively with these views, the present investigation has been conducted to assess the GCV and PCV of selected 16 genotypes of cauliflower under Lucknow condition.

MEMBERS OF THE RESEARCH FORUM

SANJAY KUMAR, Department of Applied Plant Science (Horticulture) Babasahab Bhimrao Ambedkar University, LUCKNOW (U.P.) INDIA
Email: sanjay123bhu@gmail.com

Address of the Co-authors:
PRATIMA SINGH, SUTANU MAJI AND ABHISHEK SINGH, Department of Applied Plant Science (Horticulture) Babasahab Bhimrao Ambedkar University, LUCKNOW (U.P.) INDIA

MATERIALS AND METHODS

The experimental material for the present study

consisted of sixteen genotypes of cauliflower obtained from Indian Agricultural Research Institute Regional Station, Katrain (Kullu Valley), H.P. and Indian Institute of Agricultural Research, Pusa, New Delhi. The experiment was conducted using Randomized Block Design (RBD) with three replications at Horticulture Research Farm of Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University, Vidya-Vihar, Rae Bareli Road, Lucknow (U.P.) during *Rabi* season of 2011. Observations were recorded from five randomly selected plants of each genotypes of each replication for fourteen characters *viz.*, plant height, stem diameter, number of leaves, leaf length, leaf width, fresh weight of leaf, total weight of the plant, days taken to curd initiation, days taken to curd maturity, diameter of the curd, average weight of curd with guard leaves, curd weight without guard leaves, vitamin C and yield of curd with guard leaves. The data generated were subjected to analysis the variability through genotypic co-efficient of variation (GCV) phenotypic co-efficient of variation (PCV) and genetic advance as suggested by Burton and De vane (1953) and Johnson *et al*. (1955).

RESULTS AND DISCUSSION

The analysis of variance revealed the significant differences among the genotypes used in the present investigation for all the characters studied *viz.*, plant height, stem diameter, number of leaves, leaf length, leaf width, fresh weight of leaf, total weight of the plant, days taken to curd initiation, days taken to curd maturity, diameter of the curd, average weight of curd with guard leaves, curd weight without guard leaves, vitamin C and yield of curd with guard leaves (Table 1). A wide range of variation was recorded for all the characters suggesting presence of high genetic variability. The extent of variability present in the cauliflower genotypes was measured for various traits in term of mean, range, phenotypic variation, genotypic variation, phenotypic co-efficient of variation (PVC) and genotypic co-efficient of variation (GCV), heritability (broad sense), genetic advance and genetic advance as per cent of mean are given in Table 2. The phenotypic and genotypic co-efficient at variation help to measure the range of variability in the characters to provide a tool to compare the variability present among various quantitative characters. Table 2 showed that there was wide

Table 1: Analysis of variance for 16 genotypes of cauliflower

Sr. No.	Source of Variation	D.F	Characters													
			Stem diameter (cm)	Plant weight (kg)	Leaf Width (cm)	Leaf length (cm)	Leaf fresh weight (g)	Leaves/ plant	Plant height (cm)	Curd Initiation days	Curd maturity days	Curd diameter (cm)	Curd weight with guard leaves (g)	Curd weight without guard leaves	Vitamin C (mg/ 100g)	Total yield (q/h)
1.	Replications	2	0.13	0.006	0.75	1.09	17.12	0.04	0.11	6.42	0.87	0.30	56.07	129.91	0.14	8.93
2.	Treatments	15	0.59	0.267	14.43	37.74	3209.89	4.01	37.35	1263.83	1090.14	21.27	96514.64	25076.61	1686.62	13232.92
3.	Error	30	0.06	0.012	0.16	1.10	7.75	0.17	0.12	6.62	3.18	0.13	31.88	3.97	0.26	4.04

Table 2: Estimates of range, mean, heritability, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), genetic advance as percentage for different characters in cauliflower

Sr. No.	Characters	Range		Mean	PCV	GCV	Heritability	Genetic advance	Genetic advance % of mean
		Mini.	Max.						
1.	Stem diameter(cm)	2.43	3.90	3.06	15.98	13.81	74.7	0.96	31.53
2.	Plant weight(cm)	1.46	2.85	2.21	14.05	13.15	87.6	0.72	32.51
3.	Leaf width(cm)	17.13	23.88	19.53	11.35	11.16	96.7	5.66	28.97
4.	Leaf length(cm)	32.80	46.06	39.36	9.27	8.88	91.7	8.83	22.45
5.	Leaf fresh weight(g)	307.14	398.67	363.86	9.01	8.97	99.3	85.93	23.61
6.	Leaves/plant	15.60	19.33	17.74	6.79	6.37	88.1	2.80	15.78
7.	Plant height(cm)	32.90	44.13	38.24	9.25	9.21	99.0	9.25	24.19
8.	Curd initiation days	64.00	123.79	104.04	19.83	19.67	98.4	53.62	51.53
9.	Curd maturity days	77.96	135.08	114.38	16.71	16.64	99.1	50.03	43.74
10.	Curd diameter(cm)	10.83	18.83	13.87	19.31	19.31	98.1	6.94	50.04
11.	Curd weight with guard leaves	425.88	1004.22	761.19	23.57	23.56	99.1	473.20	62.16
12.	Curd weight without guard leaves	626.41	889.14	739.96	12.35	12.35	100	241.29	32.60
13.	Vitamin C (mg/100g)	27.83	102.76	64.26	36.90	36.89	100	62.57	97.38
14.	Total yield(q/h)	157.64	372.60	281.93	23.56	23.55	99.9	175.22	62.15

Table 3: Mean performance of 16 genotypes of cauliflower for 14 characters

Sr. No.	Genotypes	Characters													
		Stem diameter (cm)	Plant weight (kg)	Leaf width (cm)	Leaf length (cm)	Leaf fresh weight (g)	Leaves/ plant	Plant height (cm)	Curd initiation days	Curd maturity days	Curd diameter (cm)	Curd weight with guard leaves (g)	Curd weight without guard leaves	Vitamin C (mg/ 100g)	Total yield (q/h)
1.	Pusa Himjyoti	2.70	2.18	17.83	36.33	331.59	17.10	36.03	64.00	78.63	11.40	656.66	654.15	46.83	243.20
2.	Pusa Snowball k-1	3.90	2.85	23.88	46.06	398.67	19.33	44.13	123.79	135.08	18.83	1004.22	889.12	102.76	372.60
3.	Pusa Snowball k-25	2.63	2.10	17.47	36.16	324.55	16.43	34.63	122.33	132.23	11.03	514.22	638.20	38.06	190.86
4.	Pusa Snowball-1	2.80	2.19	18.37	38.53	364.23	18.06	36.83	122.66	130.13	12.86	787.44	689.67	51.23	291.48
5.	Pusa Hybrid-2	3.40	2.48	22.60	42.86	394.68	18.93	42.80	84.33	96.33	17.00	989.55	872.06	91.90	366.29
6.	Pusa Shukti	3.00	2.18	18.60	38.60	374.04	17.96	37.13	93.33	107.80	13.33	845.66	744.24	66.73	313.08
7.	Pusa Sharad	3.66	2.55	23.32	43.90	396.97	19.00	43.90	73.00	85.93	18.10	998.66	885.89	99.20	369.74
8.	Pusa Paushya	3.43	2.25	20.01	41.90	390.94	18.33	40.76	67.66	77.96	15.13	740.88	785.94	80.93	274.19
9.	Jonavan	3.16	2.21	19.22	40.30	385.34	18.26	38.26	112.33	121.23	14.46	716.77	775.40	71.33	265.42
10.	Helna	2.66	2.14	17.83	36.33	324.69	16.93	35.33	112.00	121.90	11.06	661.77	644.82	42.10	245.02
11.	Doc Elgon	3.33	2.21	19.78	41.36	388.20	18.30	39.10	116.66	119.00	14.66	777.99	778.60	75.83	287.89
12.	NCFH	3.53	2.39	21.77	42.83	394.30	18.76	41.80	114.00	123.86	16.50	988.33	792.31	83.80	365.90
13.	Hermia	2.46	1.85	17.46	35.03	317.79	15.60	34.06	114.30	124.06	10.93	530.22	636.79	34.86	196.29
14.	EC-162587 (old)	2.80	2.18	18.36	36.53	348.32	17.20	36.26	113.00	124.20	12.03	719.77	677.80	47.90	267.41
15.	Kt-8	3.06	2.20	18.92	39.20	380.39	18.10	37.96	113.66	124.76	13.76	821.10	747.97	66.83	303.94
16	Kn-81	2.43	1.46	17.13	33.80	307.14	15.60	32.90	117.66	127.03	10.83	425.88	626.41	27.83	157.64
G.M.(X)		3.06	2.21	19.53	39.30	363.86	17.74	38.24	104.04	114.38	13.87	761.19	739.96	64.26	281.93
S.E.±		0.14	0.06	0.23	0.60	1.60	0.24	0.20	1.48	1.03	0.21	3.26	1.15	0.29	1.16
C.D. at 5%		0.41	0.18	0.67	1.74	4.64	0.69	0.59	4.29	2.97	0.60	9.41	3.32	0.86	3.35

range of variability present for the trait curd weight with guard leaves (761.19) followed by curd weight without guard leaves (739.96), fresh weight of leaves (363.86) and total yield (281.93) while the lowest variability was observed plant weight (2.21) followed by stem diameter (3.06). This study showed that the selected genotypes were not widely variable in respect of stem diameter and plant weight (among the fourteen character studied). The highest genotypic and phenotypic co-efficient of variability was observed for vitamin C while lowest phenotypic and genotypic co-efficient of variability was observed for leaves plant^{-1}. The phenotypic co-efficient of variability was observed highest for vitamin C followed by the yield attributes like curd weight with guard leaves, total yield, curd initiation days and curd diameter. Similar result was also reported by Mahesh *et al.* (2011). The performance study among the tested genotypes of cauliflower for the fourteen characters are illustrated in Table 3 which revealed that the genotypes Pusa Snowball Kt-1 showed high genotypic co-efficient of variability for vitamin C followed by Pusa Sharad and Pusa Hybrid-2 while the genotype Kn-81 showed the lowest genotypic and phenotypic co-efficient of variability for leaves plant^{-1}. Similar finding was also reported by Rehman and Ali (1989). Heritable variation can be found out with greater degree of accuracy when heritability is studied in conjunction with genetic advance. The value of heritability in broad sense for all the characters ranged from 74.7 (stem diameter) to 100 (curd weight without guard leaves). The high heritability was observed for two characters *viz.*, curd weight without guard leaves and vitamin C while the moderate heritability was observed for stem diameter. Heritability estimate is a informative parameter to the breeder for selecting the varieties for future use. Higher magnitude of heritability suggested major role of genotypic factor in the expression of characters. Thus, degree of success in selection depends upon the magnitude of heritability value. Furthermore, the progress in selection is also directly proportional to the amount of genetic advance. Therefore, the effect of selection is realized more quickly in those characters which have high heritability as well as genetic advance. The estimate of high heritability in broad sense was observed for two traits *viz.*, curd weight without guard leaves and vitamin C, followed by leaf fresh weight, curd maturity days, curd weight with guard leaves, plant height, curd initiation days and leaf width, Sharma *et al.* (2006) reported the similar findings. Genetic advance is still a more useful estimate because heritability value by itself does not have much significant as it fails to account for the magnitude of absolute variability. It is, therefore, necessary to utilize heritability in conjunction with selection differential which would then indicate the expected genetic gain resulting from selection. The expected response to selection is proportional to the narrow sense heritability. The genetic gain in the character is the product of the heritability and selection differential expressed in terms of phenotypic standard deviation of the character. The high genetic advance in per cent of mean was observed for vitamin C followed by curd weight with guard leaves, total yield, curd initiation days and curd diameter similar findings was reported by Singh *et al.* (2006). Whereas, the estimate of low genetic advance is observed for leaves plant^{-1}, followed by leaf length, leaf fresh weight, plant height, leaf width, stem diameter, plant weight, curd weight without guard leaves and curd maturity days.

In the present study, the highest estimate of heritability coupled with high genetic advance were obtained for all the characters curd weight without guard leaves and vitamin C, which showed that genotypic variance for those characters were probably due to high additive gene effect (Panse, 1957). Therefore, it can be concluded that genotypes having substantial diversity and variability for most of the characters are best suited for further crop improvement programme. Among all the selected genotypes Pusa Snowball Kt-1, Pusa Sharad, Pusa Hybrid-2, NCFH and Pusa Paushya were found to be the best performing with respect to yield and yield attributing characters.

REFERENCES

Burton, G.W. and Devane, E. H. (1953). Estimating heritability in tall feschue from replicated clonal material. *Agron. J.*, **45**: 48-481.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955). Estimate of genetic and environment variability in soyabean. *Agron. J.*, **47**: 314-318

Kumar, M., Sharma, S.P., Kalia, P. and Saha, P. (2010). Genetic variability and character association for yield and quality traits in early maturing Indian cauliflower. *Indian J. Hort.*, **67**:218-223.

Nieuwhof, M. (1963). Hybrid breeding in early spring cabbage. *Euphytica*, **12**(2): 189-197.

Panse, V.G. (1957). Genetics of quantitative characters in relation to plant breeding. *Indian J. Genet.&Pl. Breed.*,**47**:318-325.

Rehman, M.K. and Ali, M. (1989). Genetic variability and correlation studies in some cauliflower varieties. *Bangladesh Hort.*, **17**(1): 19-22.

Sharma, A., Sharma, S. and Prakash, C. (2006). Stability analysis for marketable head yield and its contributing horticultural traits in cabbage under high hills dry temperate conditions. *Veg. Sci.*, **32**(2): 133-137.

Singh, B., Pandey, A.K., Verma, A. and Rai, M. (2006). Genetic variability in aghani group of Indian cauliflower *(Brassica oleracea var. botrytis* L.). *Indian J. Plant Gen. Res.*, **19**(1): 113-117.

Singh, J., Singh, J. P. and Singh, R.D. (1995). Variability studies in tropical cauliflower. *Indian J. Hort.*, **52**(3): 218-221.

****
*****