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Hasan Raja
Department of Vegetable Science, N.D.U.A. & T. Kumarganj Faizabad, Uttar Pradesh, India

CN Ram
Department of Vegetable Science, N.D.U.A. & T. Kumarganj Faizabad, Uttar Pradesh, India

Sriom
Department of Vegetable Science, N.D.U.A. & T. Kumarganj Faizabad, Uttar Pradesh, India

KK Bhargav
Department of Vegetable Science, N.D.U.A. & T. Kumarganj Faizabad, Uttar Pradesh, India

Maneesh Pandey
Department of Vegetable Science, N.D.U.A. & T. Kumarganj Faizabad, Uttar Pradesh, India

Akshay Jain
Department of Vegetable Science, N.D.U.A. & T. Kumarganj Faizabad, Uttar Pradesh, India

Correspondence
Hasan Raja
Department of Vegetable Science, N.D.U.A. & T. Kumarganj Faizabad, Uttar Pradesh, India

Genetic Variability Assessment in garlic (*Allium sativum* L.) Genotypes

Hasan Raja, CN Ram, Sriom, KK Bhargav, Maneesh Pandey and Akshay Jain

Abstract
The present investigation was carried out to estimate genetic variability among eighty genotypes/hybrid of Garlic for twelve characters comprised of bulb yield and its contributing characters. These genotypes were planted in augmented block design during Rabi-2015-16 at Main Experimental Station of Department of Vegetable Science, Narendra Deva University of Agriculture, Kumarganj, Faizabad (U.P.). On the basis of mean performance, the genotype NDG-33 was the highest yielder followed by NDG-32 and minimum was found in NDG-54. Based on mean performance NDG- 33, NDG-32. NDG-26, NDG-9 and NDG- 34 were identified as high yielder for bulb yield per plant. These genotypes may further be utilized in breeding programme aimed at improving bulb yield in garlic. Analysis of variance indicated presence of considerable variability for all the twelve characters. The estimates of phenotypic co-efficient of variation (PCV) were higher than the genotypic co-efficient of variation (GCV) for all the characters. High GCV and PCV were observed for Number of cloves per bulb, diameter of clove, weight of clove, neck thickness of bulb, width of leaf and length of clove.

Keywords: Garlic, Variability, Yield, GCV and PCV

Introduction
Garlic (*Allium sativum* L.), a member of the Alliaceae family, is one of the most aromatic herbaceous annual spices (Kurian, 1995) [7]. It is the second most widely spice crop of the cultivated Allium crops, next to onion in the world (Purseglove, 1975) [11] with a characteristic pungent smell. The cloves of garlic bulb are used in flavouring of various vegetarian and non-vegetarian dishes. The significance of this spice is increasing owing to its wide range of medicinal properties (Chanchan *et al.*, 2014) [1]. Garlic shows wide morphological and agronomic variations in colour, size of bulb, plant height, flowering, number and size of the cloves, days to harvesting, resistance to storage capacity, dormancy and adaptation to agro-climatic situations (Mario *et al.*, 2008) [8]. Despite the importance of crop, so far very limited breeding work has been done. As a first step of systemic breeding programme, collection and evaluation of germplasm is required. The adequacy of germplasm collection is determined by the amount of genetic variability present in the germplasm. However, yield is a complex character and its direct improvement is difficult. A crop breeding programme aimed at increasing the plant productivity requires consideration not only on yield but also its components that have direct or indirect influences on yield. Knowledge in respect of nature and magnitude of association with different component characters is a prerequisite to bring the improvement in desired direction.

Garlic is one of the important major vegetable crops in India. Plant breeders are primarily concerned with the improvement of quantitative and qualitative characters of any crop. This can be achieved by quantifying the genetic variation available for various characters of economic importance and inter-relationship among them. To improve the yield through selection of better varieties, knowledge on the nature of association of bulb yield with yield contributing characters is very essential. Hence, the present research was conducted to evaluate performance of eighty genotypes of garlic varieties with the objective of identifying the varieties with highest growth, yield, and quality to replace or be used with the low yielding local variety.

Materials and Methods
Geographically the experimental site (Kumarganj, Faizabad) falls under humid sub-tropical climate and is located at 26.47° N latitude and 82.12° E longitude at an altitude of 113 meter above the mean sea level. Geographically, it falls in the north east gangetic alluvial plains of eastern U.P. region.

The Experimental field had sandy loam soil, low in organic carbon,nitrogen, medium in phosphorous, potash and slightly alkaline (pH-8.0) in nature. The mechanical mixture of soil was 64.4 % sand, 27.8 % silt and 11.3 % clay.

The experimental material of garlic used in the present study were, the collections from different places of Uttar Pradesh. Eighty genotypes have been used in the present study. The experiment was laid out in augmented block design. These 80 genotypes were evaluated and studied for their growth, yield and quality performance based on morphological and agronomical measurements.

The following observations were recorded during the course of experimentation on following characters- Plant height (cm), Number of leaves per plant, Length of leaf (cm), Width of leaf (cm),Neck thickness of bulb (cm), Diameter of bulb (cm),Length of bulb (cm), Bulb yield per plant (g), Number of cloves per bulb, Weight of clove (g), Length of clove (cm), Diameter of clove (cm), Total soluble solids (%).The observations were recorded on five randomly selected plants of each row. Average of data from the sampled plant of each treatment was used for statistical analyses in order to draw valid conclusions. The statistical parameters like mean, range were calculated as per the standard methods of analysis (Panse and Sukhatme, 1967) [10].

Results and Discussion

Plant breeding programme of any crop aims at improving the existing types or evolving a new type which is superior to existing ones. Collection of genotypes from different geographical origin and evaluation for assessing the extent of variability are the first step in any crop improvement programme, as this offers a new broad genetic base population to make further selections (Robinson, 1965) [12]. To initiate selection and to facilitate varietal improvement, a study of yield related characteristics is a must. This will highlight the potentialities of wider varietal range either for direct introduction or to utilize these types as parents in future breeding programme.

The analysis of variance for the design of experiment indicated that the mean squares due to genotypes were highly significant for most of the characters indicating a wide genetic variability among the genotypes Table 1. The variation due to checks were also highly significant for are the characters like plant height (42.93 cm), number of leaves per plant (1.03), length of leaf (20.62 cm), width of leaf (0.18 cm), neck thickness of bulb (0.15 cm), diameter of bulb (0.27 cm), bulb yield per plant (19.33 g), number of cloves per bulb (80.59), weight of clove (0.13 g), length of clove (0.41cm), diameter of clove (0.27) and total soluble solids (11.47%).

Mean performance serves as an important criterion in eliminating the undesirable types in a selection programme. The result of the present investigation revealed that there exists significant variations were observed for different characters. The mean performance and range of the 80 genotypes for all the twelve characters are presented in the Table 2.

Table 1: Analysis of variance (Augmented design) for twelve characters in garlic germplasm.

S. No.	Characters	Source of variation		
		Blocks	Checks	Error
		d.f. (6)	d.f. (2)	d.f. (12)
1	Plant height (cm)	3.26	42.93**	6.30
2	Number of leaves per plant	0.48	1.03*	0.23
3	Length of leaf (cm)	1.08	20.62**	1.88
4	Width of leaf (cm)	0.06	0.18*	0.03
5	Neck thickness of bulb (cm)	0.05	0.15**	0.02
6	Diameter of bulb (cm)	0.08	0.27*	0.06
7	Bulb yield per plant (g)	1.45	19.33**	1.30
8	Number of cloves per bulb	2.85	80.59**	1.06
9	Weight of clove (g)	0.05	0.13**	0.01
10	Length of clove (cm)	0.13	0.41**	0.06
11	Diameter of clove (cm)	0.02	0.27**	0.03
12	Total soluble solids (%)	1.41	11.47**	1.69

*, ** Significant at 5% and 1% probability level, respectively

Table 2: Mean performance of eighty genotypes for twelve characters in garlic

Characters / No. of genotypes	Plant height (cm)	Number 0f leaves per plant	Length of leaf (cm)	Width of leaf (cm)	Neck thickness of bulb (cm)	Diameter of bulb (cm)	Bulb yield per plant (g)	Number of cloves per bulb	Weight of clove (g)	Length of clove (cm)	Diameter of clove (cm)	T.S.S (%)
NDG-1	69.01	9.12	33.23	1.18	1.21	4.20	24.12	19.34	2.24	1.11	1.23	37.11
NDG-2	69.40	9.32	41.20	1.20	1.32	4.28	25.16	25.11	2.46	1.21	1.70	37.32
NDG-3	69.60	6.80	38.21	1.02	2.10	4.26	22.12	19.44	2.44	1.02	1.11	36.20
NDG-4	66.20	8.24	35.60	1.42	1.56	3.40	21.10	18.23	2.42	1.03	1.29	34.95
NDG-5	45.36	8.40	27.80	1.04	1.21	4.16	25.12	23.51	2.46	1.90	1.64	34.20
NDG-6	45.60	6.80	32.20	1.22	1.31	4.16	23.91	22.33	2.38	1.70	1.35	30.23
NDG-7	64.80	8.32	39.40	2.16	1.65	3.90	22.22	18.55	1.90	1.50	1.44	32.20
NDG-8	60.20	8.60	33.20	1.34	1.34	3.82	24.13	23.46	2.30	1.04	1.34	31.23
NDG-9	49.60	7.20	30.20	1.10	1.52	3.70	28.11	25.94	1.70	1.10	1.66	29.32
NDG-10	66.32	8.20	40.20	1.96	1.43	4.20	20.91	23.23	2.46	1.23	1.45	35.40
NDG-11	55.12	8.40	33.21	1.68	1.25	4.08	18.10	13.33	2.40	1.44	1.34	33.60
NDG-12	62.12	7.80	38.20	1.92	1.67	3.46	21.12	15.44	2.40	1.12	1.78	37.40
NDG-13	64.80	7.40	40.60	2.46	1.71	4.18	18.02	18.70	2.46	1.90	1.41	34.00
NDG-14	59.40	8.12	35.12	2.18	1.45	4.24	24.94	23.44	2.12	1.14	1.61	32.40
NDG-15	59.60	8.20	37.60	1.56	1.21	3.62	20.67	15.33	2.20	1.34	1.78	40.80
NDG-16	61.80	8.89	35.20	2.28	1.41	3.98	21.23	14.52	1.96	1.07	1.34	28.42
NDG-17	62.40	8.01	31.60	2.38	1.59	4.06	19.12	18.77	2.12	1.04	1.02	32.80
NDG-18	66.20	8.32	33.40	2.86	1.75	4.20	26.66	19.46	2.26	1.06	1.76	32.00
NDG-19	67.40	7.80	34.20	3.01	1.45	3.70	25.33	20.55	2.62	1.01	1.04	36.01
NDG-20	69.20	9.40	34.40	2.40	1.61	3.74	22.33	20.46	2.32	1.13	1.11	33.20
NDG-21	62.80	7.20	36.60	1.66	1.32	4.16	21.91	20.23	2.38	1.12	1.23	31.20
NDG-22	70.60	8.20	35.80	1.24	1.22	4.34	26.56	26.22	2.54	1.10	0.99	34.60
NDG-23	69.00	9.00	36.60	1.64	1.43	3.78	17.56	25.23	3.20	1.03	1.71	34.80
NDG-24	59.60	8.40	30.00	1.94	1.75	4.10	25.99	18.56	2.40	1.23	1.34	35.23
NDG-25	69.60	6.80	37.20	2.08	1.81	3.96	19.94	23.23	2.30	1.40	1.04	37.90
NDG-26	54.40	8.00	27.60	2.26	1.25	3.38	28.15	13.14	2.36	1.01	1.31	33.23
NDG-27	56.40	6.80	30.60	1.80	1.96	3.76	16.94	15.23	2.32	2.03	2.01	36.00
NDG-28	43.80	6.20	24.80	2.16	1.71	3.80	20.30	16.76	1.62	1.04	1.21	35.60
NDG-29	39.20	4.60	26.20	2.12	1.45	4.12	18.40	14.97	2.44	1.06	1.77	31.80
NDG-30	43.00	6.40	27.00	2.82	1.23	2.74	19.67	17.23	2.32	1.17	1.45	32.80
NDG-31	39.20	7.00	28.20	1.26	1.21	3.32	15.66	14.11	1.68	1.10	1.63	34.60
NDG-32	47.00	7.60	28.80	1.32	1.10	3.46	28.44	23.44	2.82	1.03	1.41	34.40
NDG-33	53.20	6.40	33.40	1.20	1.32	2.48	29.12	24.10	1.82	1.44	1.29	35.40
NDG-34	51.20	5.80	32.60	1.26	1.45	2.68	27.01	16.36	1.74	1.07	1.75	33.20
NDG-35	50.80	5.60	34.20	1.34	1.41	3.56	25.01	14.94	1.42	1.32	1.34	31.80
NDG-36	45.40	6.80	28.00	1.24	1.85	2.54	20.44	19.36	1.70	1.02	1.15	35.80
NDG-37	35.00	4.80	26.10	0.88	1.10	2.68	17.11	13.46	1.62	1.34	1.71	34.20
NDG-38	54.60	6.20	37.20	1.30	1.67	2.46	25.23	23.31	2.48	1.07	1.3	31.80
NDG-39	43.60	6.40	29.20	1.28	1.70	2.24	22.11	11.10	2.44	2.04	1.45	34.00
NDG-40	54.20	8.60	30.40	1.68	1.63	4.08	20.46	20.60	1.26	1.10	1.65	39.40
NDG-41	61.60	8.80	26.60	1.68	1.54	3.94	28.11	25.91	2.42	1.70	1.49	34.60
NDG-42	51.40	8.80	27.60	1.80	1.42	3.7	23.44	26.60	2.34	1.10	1.35	35.20

NDG-43	41.60	8.80	22.80	1.54	1.11	3.42	25.22	24.31	2.42	1.01	1.90	32.60
NDG-44	54.80	7.60	25.40	1.62	1.34	3.18	18.15	16.32	2.30	1.03	0.92	37.80
NDG-45	58.40	7.80	29.40	1.76	1.61	3.78	26.44	20.22	2.26	1.13	1.02	37.00
NDG-46	65.00	7.40	32.40	1.90	1.25	3.96	24.11	23.40	2.46	1.41	1.78	35.60
NDG--47	62.80	9.40	35.80	2.40	2.02	4.3	23.10	21.11	2.28	1.03	1.34	40.32
NDG-48	66.60	7.00	39.40	1.78	1.65	4.22	22.11	23.34	1.72	1.15	0.88	38.00
NDG-49	66.80	8.80	32.50	2.16	1.91	4.24	24.47	22.91	2.40	1.10	1.45	41.01
NDG-50	55.80	8.40	24.80	1.64	1.45	3.82	21.11	23.92	2.66	1.02	1.31	38.20
NDG-51	51.40	7.00	25.00	1.38	1.19	4.04	25.56	25.60	2.26	1.07	1.11	35.00
NDG-52	57.00	8.80	24.20	1.54	1.38	3.66	26.11	20.91	2.08	1.23	1.19	32.00
NDG-53	46.40	8.40	25.00	1.82	1.21	3.42	24.93	21.60	1.82	1.21	0.90	36.60
NDG-54	59.20	9.20	33.20	1.76	1.01	4.20	15.16	11.10	2.26	1.34	1.45	34.00
NDG-55	62.20	9.20	37.40	2.22	1.31	3.66	24.11	22.91	3.48	1.06	1.11	38.20
NDG56	66.80	7.00	38.60	1.78	1.45	3.53	22.30	26.10	2.52	1.03	1.51	36.00
NDG-57	62.40	9.00	31.80	1.76	1.67	4.02	23.51	22.11	2.22	1.05	1.62	32.20
NDG-58	66.60	9.60	33.00	2.00	1.29	4.26	23.23	23.30	2.60	1.11	1.81	36.80
NDG-59	50.80	8.20	26.80	1.76	1.37	3.82	20.76	22.54	2.18	1.34	1.34	30.20
NDG-60	55.40	8.20	29.00	2.06	1.45	3.12	19.30	22.20	2.20	1.23	1.22	33.80
NDG-61	67.20	9.60	33.60	1.80	1.53	4.12	23.51	21.22	2.22	1.65	1.51	33.40
NDG-62	53.20	8.40	23.80	1.66	1.19	4.06	24.30	25.71	2.32	1.71	1.14	36.80
NDG-63	56.60	8.60	35.80	1.72	1.67	3.88	25.11	23.60	2.36	1.61	1.30	39.80
NDG-64	67.80	6.40	33.80	1.70	1.54	3.92	18.51	20.55	2.24	1.23	1.30	35.00
NDG-65	66.40	8.20	31.20	1.88	1.73	4.28	17.34	24.01	2.38	1.03	1.42	38.60
NDG-66	50.00	8.00	25.40	1.54	1.69	3.12	22.74	19.21	1.88	1.06	1.31	38.80
NDG-67	62.40	9.00	35.40	1.74	1.78	3.94	20.15	18.10	2.30	1.11	1.10	37.60
NDG-68	57.20	8.40	33.40	1.68	1.65	2.84	23.43	22.60	2.38	2.01	1.45	32.00
NDG-69	58.20	7.40	33.80	1.70	1.41	3.4	25.71	23.66	2.32	2.30	1.09	34.20
NDG-70	59.80	6.60	33.20	1.54	1.37	3.32	21.23	21.11	2.40	1.40	1.25	38.20
NDG-71	61.60	7.80	34.00	1.86	1.35	3.62	23.55	22.60	2.36	1.01	1.33	35.20
NDG-72	57.20	6.60	31.00	1.52	1.21	4.00	17.43	20.22	2.32	1.51	1.73	29.80
NDG-73	52.00	7.60	30.00	1.50	1.67	2.24	21.77	21.06	1.84	1.32	1.51	36.80
NDG-74	49.80	7.80	27.40	1.42	1.54	2.84	24.33	24.65	1.72	1.12	1.13	36.80
NDG-75	54.80	7.40	30.00	1.42	1.75	3.92	23.44	23.91	2.24	1.06	1.33	33.60
NDG-76	58.40	6.80	37.40	1.48	1.81	4.06	21.12	22.50	2.62	1.01	1.47	33.80
NDG-77	45.40	7.60	30.20	1.30	1.67	3.78	22.77	22.22	2.08	1.23	1.34	30.20
G-41	56.60	7.47	30.42	1.42	1.33	3.41	24.20	21.95	2.79	1.19	1.32	35.61
G-50	60.20	7.65	37.77	1.34	1.32	3.33	23.52	20.52	2.53	1.14	4.41	36.58
G-282	57.53	7.42	57.53	1.33	1.44	3.43	21.04	15.49	2.70	1.13	1.38	35.16
Mean	57.57	7.72	33.07	1.46	1.46	3.63	22.64	20.40	2.34	1.23	1.38	35.03
Std error	1.343	0.25	0.73	0.10	0.08	0.13	0.61	0.55	0.13	0.06	0.14	0.69
C. V. %	4.294	6.42	3.71	13.64	12.23	7.29	4.98	5.34	9.22	9.36	13.58	3.60
Lowest	35.000	4.600	22.80	0.88	1.01	2.24	15.16	11.10	1.26	1.01	0.88	28.42
Highest	70.600	9.600	41.20	3.01	2.10	4.34	29.12	26.60	3.48	2.30	2.01	41.01

A perusal of table 2 revealed that a large amount of variability was present in plant height. The maximum plant height was observed in NDG-22 (70.6 cm). The shortest plant height was observed in NDG- 37 (35 cm) against the population mean of (57.57 cm). thirty genotypes namely NDG-1, NDG-2, NDG-3, NDG-4, NDG-7, NDG-8, NDG-10, NDG-12, NDG13, NDG-14, NDG-15, NDG-16, NDG-17, NDG-18 NDG-19, NDG-20, NDG-21, NDG-22, NDG-23, NDG-24, NDG-25, NDG-41, NDG-45, NDG-46, NDG-47, NDG-48, NDG-49, NDG-54, NDG-55 and NDG-56 exhibited higher mean values as compared to general mean (57.57), while, NDG-5, NDG-6, NDG-9, NDG-11, NDG-26, NDG-28, NDG-29, NDG-30, NDG-31, NDG-32, NDG-33, NDG-34, NDG-35, NDG-36, NDG-37, NDG-38, NDG-39, NDG-40, NDG-42, NDG-43, NDG-44, NDG-50, NDG-51, NDG-52, NDG-53, NDG-59, NDG-60, NDG-62, NDG-63 and NDG-66 showed lower mean values.

The genotypes exhibited considerable variation for the leaves per plant. It ranged between (4.60) to (9.60). The maximum leaves per plant was recorded in NDG-58 (9.60) followed by NDG-20 (9.40) and NDG-2 (9.32), while the minimum value in NDG-29 (4.60) against the population mean of (7.72). The length of leaf exhibited sufficient variability ranged from 22.80 cm to 41.20 cm. The maximum length of leaf was recorded in NDG-2 (41.20 cm) followed by NDG-13 (40.60 cm) and NDG-10 (40.20 cm) while the minimum in NDG-43 (22.80 cm) against the population mean of 33.07 cm. The maximum width of leaf was recorded in NDG-19 (3.01 cm) followed by NDG-18 (2.86 cm) while, minimum in NDG-37 (0.88cm) against the population mean of (1.46 cm). The maximum neck thickness of bulb was recorded in NDG-3 (2.10 cm). The mean value of neck thickness of bulb ranged the from 1.01 cm to 2.10 cm against the population mean 1.46 cm, while the minimum neck thickness of bulb was recorded in NDG-54 (1.01 cm). The diameter of bulb ranged from 2.24 cm to 4.34 cm against the population mean of 3.63 cm. The maximum diameter of bulb was recorded in NDG-22 (4.34 cm) followed by NDG-47 (4.30), NDG-2 (4.28 cm) and NDG-3 (4.26 cm). The minimum diameter of bulb was observed in NDG-39 (2.24 cm). The maximum bulb yield per plant was recorded in NDG-33 (29.12 g) followed by NDG-32 (28.44 g) against the population mean (22.64 g) while, the minimum bulb yield /plant was recorded in NDG-54 (15.16 g). The mean value of cloves per bulb ranged from (11.10) to (26.60) against the population mean of (20.40). The maximum clove per bulb was recorded in NDG-42 (26.60) followed by NDG-22 (26.22), NDG-56 (26.10) and NDG-9 (25.94). While, minimum clove per bulb was recorded in NDG-39 (11.10). The maximum weight of clove was recorded in NDG-55 (3.48 g) followed by NDG-23 (3.20 g), NDG-32 (2.82 g), G-41 (2.79 g), G-282 (2.70g) against the population mean (2.34g). While, minimum weight of clove was recorded in NDG-40 (1.26 g). The mean value of length of clove ranged from (1.01) to (2.30) cm against the general mean of (1.23 cm). The highest length of clove was recorded in NDG-69 (2.30 cm) followed by NDG-39 (2.04 cm), NDG-27 (2.03 cm), while lowest length of clove per bulb was recorded in NDG-19 (1.01 cm). The mean value of diameter of clove ranged from (0.88 cm) to (2.01 cm) against the population mean (1.38 cm). The maximum diameter of clove was recorded in NDG-27 (2.01 cm) followed by NDG-43 (1.90 cm), NDG-58 (1.81 cm), NDG-46 (1.78 cm) and NDG-29 (1.77 cm) while, minimum diameter of clove was observed in NDG-48 (0.88 cm). Large amount of variability was found for total soluble solids (%). The mean value of total soluble solids ranged from (28.42) to (41.01) per cent. The maximum total soluble solids was recorded in NDG-49 (41.01%) followed by NDG-15 (40.80%), NDG-47 (40.32%), NDG-63(39.80) and NDG-40 (39.40%), while NDG-16 (28.42%) had the lowest value for this character. The higher TSS value in these genotypes may be due to its inherent characteristics. Similar results were observed by Singh and Chand (2004) [13]. Present findings are in accordance with reports of Kohali and Prabal (2000) [6] and Jogdande *et al.* (2004) [2]. These results are also accordance with the findings of Futane *et al.* (2006) [3] and Singh and Chand (2004) [13] who reported significant differences for bulb yield in different garlic varieties.

The estimate of phenotypic and genotypic coefficients of variability gives a clear picture of amount of variations present in the available germplasm. For all the traits studied, we recorded a higher PCV over the GCV indicting towards the major role of environment the expression of traits. The estimates of phenotypic coefficient of variation (PCV) were higher than the genotypic coefficient of variation (GCV) for all the characters. Coefficients of variability varied in magnitude from trait to trait, either low or moderate or high. Therefore, it indicated the presence of high diversity Among all the characters high GCV and PCV were high for width of leaf, length of clove, diameter of clove, weight of clove, number of cloves per bulb, neck thickness of bulb and bulb yield per plant in the genotypes. Similar results were reported by (Korla *et al.* 1981) [5], (Mehta and Patel, 1985) [9] and (Khar *et al.* 2005) [4].

Table 3: Estimates of range, general mean, genotypic and phenotypic coefficient of variation in percent of mean for twelve characters in garlic.

Parameters / Characters	Range		General mean	Genotypic coefficients of variation (%)	Phenotypic coefficients of variation (%)
	Min.	Max.			
	1	2	3	4	5
Plant height (cm)	70.60	35.00	57.57	7.35	5.97
Number of leaves per plant	9.60	4.60	7.72	9.39	6.85
Length of leaf (cm)	41.20	22.80	33.07	7.71	6.76
Width of leaf (cm)	3.01	0.88	1.64	20.71	15.58
Neck thickness of bulb (cm)	2.10	1.01	1.46	19.85	15.64
Diameter of bulb (cm)	4.34	2.24	3.63	10.49	7.54
Bulb Yield per plant (g)	29.12	15.16	22.64	11.79	10.69
Number of clove per bulb	26.60	11.10	20.40	27.16	26.63
Weight of clove (g)	2.30	1.01	1.23	18.96	16.49
Length of clove (cm)	3.48	1.26	2.34	15.47	12.42
Diameter of clove (cm)	2.01	0.88	1.38	23.85	19.61
Total soluble solids %	41.01	28.42	35.03	6.16	4.99

Based on the present results, it can be concluded that Analysis of variance revealed highly significant differences among the genotypes for all the characters showing thereby considerable amount of genetic variability for all the characters and were amenable to improvement. The estimates of phenotypic co-efficient of variation (PCV) were higher than the genotypic co-efficient of variation (GCV) for all the characters. Both PCV and GCV were high for number of clove per, diameter of clove, weight of clove, neck thickness of bulb, width of leaf and length of clove in the genotypes. The number of cloves had positive and desirable association with bulb yield and selection of these traits would be effective for yield improvement in garlic. It was observed that genotypes NDG-33, NDG-32, NDG-26, NDG-9 and NDG- 34 produced highest bulb yield per plant which indicated that these genotypes may be considered in breeding programme and recommended as a potential replacement to the low yielding variety under field conditions.

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