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Genetic Variability, Heritability and Genetic Advance in Garlic (*Allium sativum* L.)

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ABSTRACT

Genetic variability, heritability and genetic advance in twenty five genotypically diverse indigenous genotypes of garlic (Allium sativum L.) was collected deferent part of Uttar Pradesh and trail was conducted at Main Experimental Station of Vegetable Science, Narendra Dev University of Agriculture & Technology, Kumaganj Faizabad (U.P.) during rabi 2007-08 with the objective to study the genetic variability for different characters in available genotype and to work out heritability and genetic advance in per cent of mean. The experiment was conducted in Randomized Block Design with three replications. The single plot sized 2.00 x 0.30m^2 with the distance of 15 cm row to row and 10 cm plant to plant. Observations were recorded on plant height(cm), number of leaves per plant, length of leaves (cm), width of leaves (cm), fresh yield per plant (g), length of each bulb (cm), diameter of each bulb (cm), number of cloves per bulb, length of each clove(cm), diameter of each clove (cm), days to harvest, total soluble solids (T.S.S%), dry matter (%), acidity(%).The maximum phenotypic and genotypic coefficient of variation was observed in fresh yield per plant (g), number of cloves per bulb among vegetative characters and acidity content in quality characters. All the characters showed very high heritability except total soluble solids (T.S.S.) which showed very low heritability width of leaves followed by acidity showed high heritability in broad sense as well as genetic advance in per cent of mean.

Key words: *Garlic, genetic variability, heritability, genetic advance and yield.*

INTRODUCTION

Garlic (*Allium Sativum* L.) is the second most widely cultivated bulb crop after onion and belongs to the family Amaryllidaceae (alliaceae). It has long been recoginsed as a valuable spice and condiment throughout India. It is a frost hardy bulbous, erect annual herb of 30-100 cm in height narrow flat leaves and bears small white flowers and bulbils. The seed stalk bears a terminal inflorescence, which in term bear bulbis instead of flowers. The shoot of garlic become flat and finally aborts after the development of bulbils in the inflorescence[3].

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A compound bulb consists of 6-35 smaller bulbils or segments called "cloves'' which are formed from axilary bulbs of the young foliage leaves and is surrounded by a thin white or pinkish papery sheath.

Garlic has high nutritive value. It has been considered as a rich source of carbohydrates, proteins and phosphorus. Ascorbic acid content was reported to be very high in green garlic. The uninjured bulb contains a colourless, odorless and water soluble amino acid called "alliin" and converted in to "allicin" after crushing the bulb of which the principle ingredient is the odoriferous diallyl disulphide. Garlic contains moisture 62.8%, protein 6.3%, fat 0.1%, Fiber 0.80%, mineral matter per 1.00%, carbohydrate 29%, Phosphorus 0.31%, Calcium 0.03%, Iron 0.001%, per 100g. Fresh peeled garlic clove and dehydrated garlic powder, respectively. It also contains vitamin. A 175 i.U., vitamin B 0.68% and vitamin B2 0.08% in dehydrated garlic powder. Pruthi[5].

MATERIALS AND METHODS

The present research was carried out at Main Experiment Station Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Faizabad (U.P.), India during *rabi* 2007-08. Geographically Narendra Nagar (Kumarganj) falls under humid sub-tropical climate and is located in between 26.47^0 N latitude and 82.12^0 E longitude at an altitude of 113.1 meters above the mean sea level. The experimental field had sandy loam, slightly alkaline (pH 8.0) soil, low in organic carbon and nitrogen, medium in phosphorus and potassium. The mechanical composition of soil constituted 64.4 per cent sand, 27.8 per cent silt and 11.3 percent clay.

The Experimental material of garlic used in the present study were the collections from different places of U.P. Twenty five genotypes namely NG-1, NG-2, G-50, NG-3, NG-4, NG-5, NG-6, NG-7, NG-8, NG-9, NG-10, NG-11, NG-12 ,NG-13, NG-14 ,NG-15 ,NG-16 ,NG-17, NG-18, NG-19 ,NG-20, NG-21, NG-22, NG-23 and NG-24 have been used for studies . The experiment was conducted in Randomized Block Design with three replications. In single plot sized 2.00 x $0.30m^2$ with the distance of 15 cm row to row and 10 cm plant to plant. Recommended cultural and plant protection measures were followed to raise a healthy crop and good expression of the characters. Observations were recorded on randomly selected plants from each plot for nine characters namely on plant height(cm), number of leaves per plant, length of leaves (cm), width of leaves (cm), fresh yield per plant (g), length of each bulb (cm), diameter of each bulb (cm), number of cloves per bulb, length of each clove(cm), diameter of each clove (cm), days to harvest, total soluble solids (T.S.S%), dry matter (%), acidity (%).

RESULTS AND DISCUSSION

Based on result of mean performance of garlic germplasm lines including for 14 characters in the experiment has been described below: A perusal of Table 1.2. We absorbed The maximum plant height was observed in NG-1 followed by NG18.In addition The maximum number of leaves was recorded in NG-1 followed by NG-4

The maximum length of leaves was recorded in NG-4. The maximum width of leaves was recorded in NG-4 followed by NG-6.while on the basis of days from sowing to harvest the genotype NG1considered late variety while the genotype G50 is considered as early maturing variety similarly. The maximum number of cloves per bulb was recorded NG-5 followed by NG-11, G-50, NG-18.Moreover The maximum length of each clove was recorded in NG-1 followed by NG-9. The maximum diameter of each bulb was recorded in NG-1 followed by NG-7. Furthermore The maximum number of diameter of each clove was recorded in NG-1 followed by NG-6.The maximum TSS was recorded in NG-10 followed by NG-14 and NG-23.The maximum acidity was recorded in NG-13. The maximum dry matter per cent was observed in NG-15 followed by NG-18, NG-20 and NG-16.Moreover the maximum fresh yield per plant was recorded in NG-1 followed by NG-6, NG-16, G-50 and NG-8.

Based on mean performance, different genotype showed wide variation for yield attributing character making them plant breeder for improvement of desired traits.

The phenotypic and genotypic coefficients of variation were computed to assess the nature and magnitude of existing variability in the germplasm. The high magnitude of genotypic coefficient of variation (GCV) along with phenotypic coefficient of variation (PCV) was recorded for fresh yield per plant, width of leaves (cm), number of clove per bulb and diameter of each clove (Table 1.3). This indicated greater scope for optaining high selection response in the germplasm in which the traits mentioned above showed high CCV and PCV values. The existence of high variability in these characters in garlic has also been reported by Barman *et al*[1]., Thakur *et al*[8]., shinde *et al*[6]. The characters exhibiting high PCV and GCV values, as mentioned clove, are likely to allow reasonable scope of improvement through selection in respective environment owing to moderate genetic variability available in the germplasm collections evaluated. The important direct selection parameters, heritability in broad sense (h^2) and genetic advance in per cent of mean (Ga), provide index of transmissibility of traits and gives indication about the effectiveness of selection in improving the characters. Genetic advance in per cent mean was observed for plant height, length to leaves, width of leaves, yield per plant (g) fresh, length of each bulb, number of cloves per bulb.

The characters like acidity, width of leaves, diameter of each clove, length of each clove, length of each bulb exhited very high genetic advance and genetic advance in per cent of mean which indicated that these would be ideal traits for improvement through selection owing to their high transmissibility and variability. Thus, the germplasm lines evaluated very high response to selection for the characters exhibiting high heritability along with very high genetic advance in to field in question. The high estimates of heritability and genetic advance observed in present study are in agreement with. Mohanty[4], Singh *et al*[7]., Futane *et al*[2]. This suggesting that all these traits are genetically controlled by additive gene action and they can be further improved through mass selection.

Table 1.1: Analysis of variance for 14 characters in garlic

Sl. No.	Characters	MSS		
		Replication (2)	**Treatments (24)**	**Error (48)**
1.	Plant height (cm.)	0.003	54.694**	1.070
2.	Number of Leave per plant	0.040	0.908**	0.155
3.	Length of Leaves (cm)	2.310	95.558**	1.947
4.	Width of Leaves (cm)	0.010	0.284**	0.018
5.	Length of each bulb (cm)	0.149	0.710**	0.047
6.	Diameter of each bulb (cm)	0.002	0.092**	0.008
7.	Number of cloves per bulb	0.410	64.512**	3.852
8.	Length of each clove (cm)	0.001	0.554**	0.098
9.	Diameter of each clove (cm)	0.053	0.316**	0.042
10.	Days to harvest	13.24	97.547**	12.476
11.	Yield per plant fresh	4.126	51.71**	2.30
12.	Dry matter (%)	3.996	9.598**	1.096
13.	T.S.S. (%)	32.435	12.608**	6.707
14.	Acidity (%)	0.000	0.001**	0.000

**Significant at 1% level

Table 1.2: Mean performance of 25 genotypes for 14 characters of garlic

Sl. No.	Genotypes	Plant height (cm)	Number of Leaves per plant	Length of Leaves (cm)	Width of Leaves (cm)	Yield per plant (g) fresh	Length of each bulb (cm)	Diameter of each bulb (cm)	Number of cloves per bulb	Length of each clove (cm)	Diameter of each clove (cm)	Days to harvest	Total soluble solid (T.S.S. %)	Dry matter (%)	Acidity (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	NG-1	57.52	11.73	38.20	1.49	31.13	4.34	5.07	19.95	3.60	2.56	163.00	37.07	20.40	0.21
2	NG-2	51.40	10.53	40.07	1.29	14.37	3.28	4.46	22.93	2.25	1.62	139.00	40.00	19.33	0.24
3	G-50	51.30	10.73	39.07	1.33	16.41	3.09	4.67	25.87	2.13	1.31	136.33	40.23	17.50	0.26
4	NG-3	47.80	10.27	33.67	1.31	15.76	3.13	4.60	21.33	2.76	1.58	149.33	38.70	21.80	0.25
5	NG-4	48.60	11.47	45.07	2.47	16.10	2.76	4.43	15.13	2.54	1.75	142.00	37.00	19.10	0.24
6	NG-5	46.10	10.53	36.07	1.31	12.46	3.31	4.64	28.33	2.33	1.39	152.67	40.73	20.47	0.28
7	NG-6	49.20	10.80	37.60	1.55	16.80	3.41	4.24	19.87	2.84	2.15	142.67	38.20	18.83	0.23
8	NG-7	48.50	10.20	33.53	1.23	16.10	3.06	4.68	15.33	2.62	1.76	140.33	38.30	21.43	0.25
9	NG-8	51.62	10.53	33.67	1.59	16.17	3.17	4.52	14.14	2.43	1.68	142.00	37.27	23.43	0.27
10	NG-9	51.46	10.40	36.87	1.37	13.21	3.79	4.60	22.73	2.79	1.52	141.00	40.07	23.07	0.26
11	NG-10	50.60	10.27	33.53	1.22	14.98	3.55	4.55	18.60	2.76	1.92	148.00	42.43	22.83	0.28
12	NG-11	45.73	9.87	36.47	1.11	13.37	2.95	4.46	27.87	2.00	1.49	139.33	40.70	19.70	0.25
13	NG-12	44.90	10.33	32.53	1.06	12.04	2.33	4.48	25.27	1.73	1.18	143.33	37.30	20.33	0.24
14	NG-13	41.20	9.67	28.60	0.92	15.55	3.05	4.37	21.53	2.35	1.57	138.33	42.17	21.70	0.30
15	NG-14	48.10	9.73	29.33	1.01	12.84	2.94	4.44	17.60	2.07	1.99	142.33	38.20	22.53	0.21
16	NG15	54.03	9.80	27.47	0.97	10.07	2.75	4.08	13.27	1.82	1.87	146.33	34.30	23.77	0.26
17	NG-16	52.20	9.73	36.13	1.11	16.69	3.27	4.60	19.33	2.12	1.33	141.00	37.50	20.70	0.24
18	NG-17	55.20	10.00	32.87	1.08	11.48	3.47	4.68	24.27	2.10	1.46	141.33	39.40	23.53	0.28
19	NG-18	56.50	10.53	36.40	1.27	12.74	3.27	4.48	25.72	2.43	1.35	139.33	37.67	23.70	0.25
20	NG-19	51.37	10.13	35.73	0.99	11.06	2.53	4.53	17.93	2.00	1.49	148.67	37.13	21.00	0.26
21	NG-20	46.10	10.20	31.00	1.13	11.61	2.40	4.48	13.40	1.47	1.27	137.33	35.50	23.60	0.22
22	NG-21	45.90	10.47	20.73	1.04	10.88	2.07	4.54	18.37	2.18	1.99	145.33	36.43	20.47	0.29
23	NG-22	43.73	9.60	25.67	1.13	11.73	3.53	4.60	12.60	2.26	1.84	140.00	39.10	19.40	0.26
24	NG-23	40.90	9.33	23.13	1.23	10.47	2.76	4.61	21.93	2.63	2.00	145.33	41.23	19.27	0.25
25	NG-24	47.20	9.93	26.00	1.22	10.42	2.89	4.51	23.32	1.82	1.37	141.67	36.57	21.00	0.24
	Grande mean	48.73	10.27	33.18	1.26	14.22	3.08	4.53	20.27	2.36	1.66	143.44	38.53	21.16	0.25

Table 1.3: Range, mean, coefficient of variation, heritability and genetic advance for different characters in garlic

Sl. No.	Characters	Range	Grand mean± SE	Coefficient of variation		Heritability in broad sense (%)	Genetic Advance	Genetic advance in (%) of mean
				Genotypic (%)	Phenotypic (%)			
1.	Plant height (cm.)	40.90-57.52	48.73±0.59	8.67	8.93	97.13	2.00	4.10
2.	Number of Leaves per plant	9.33-11.73	10.27±0.22	4.87	6.20	78.64	1.62	15.77
3.	Length of Leaves (cm)	20.73-45.07	33.18 ±0.80	16.84	17.35	97.01	1.99	6.02
4.	Width of Leaves (cm)	0.92-1.49	1.26±0.07	23.72	26.01	91.19	1.87	149.39
5.	Yield per plant (g) fresh	10.07-31.13	14.22±0.87	28.54	30.47	93.65	1.92	13.57
6.	Length of each bulb (cm)	2.07-4.34	3.08±0.12	15.24	16.81	90.67	1.86	60.56
7.	Diameter of each bulb (cm)	4.08-5.07	4.53±0.05	3.683	4.22	87.24	1.79	39.65
8.	Number of cloves per bulb	12.60-28.33	20.27±1.13	22.18	24.21	91.64	1.88	9.31
9.	Length of each clove (cm)	1.73-3.60	2.76±0.18	16.54	21.25	77.84	1.60	68.05
10.	Diameter of each clove (cm)	1.88-2.56	1.66±0.11	18.22	22.08	82.48	1.69	102.53
11.	Days to harvest	136.33-163.00	143.44±2.03	3.71	4.45	83.33	1.71	1.19
12.	Total soluble solids (T.S.S. %)	34.30-42.43	38.53±1.49	3.64	7.64	47.62	0.98	2.24
13.	Dry matter (%)	17.50-23.77	21.16±0.60	7.95	9.37	84.92	1.74	8.26
14.	Acidity (%)	0.21-0.30	0.25±0.00	8.36	10.17	82.50	1.69	672.31

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