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RESEARCH ARTICLE

Study about genetic variability, heritability and genetic advance in garlic (*Allium sativum*)

■ **Chandan Tiwari, A. Pandey and S. K. Singh**

SUMMARY

The study genetic variability, heritability, genetic advance analysis in garlic (*Allium sativum* L.) sixteen genotypes experimental trial was conducted at RRS NHRDF, Salaru, Karnal during 2016-17 and 2017-18. The experiment was conducted in Randomize Block Design with three replications. Observations were recorded for sixteen characteristics. The higher magnitude of genetic variability, heritability, genetic advance observed for plant establishment, plant stand at maturity, % marketable bulb (on wt. basis), gross yield (kg/plot), marketable yield (kg/plot), marketable yield (qt/ha), average weight of bulb (g), weight of 20 bulbs, bulb polar diameter (cm), bulb equatorial diameter (cm), T.S.S (%), average no of cloves per bulb at genotypic levels. High heritability coupled with high genetic advance in percent of mean was recorded for average no of cloves per bulb, marketable yield (kg/plot), marketable yield (qt/ha), gross yield (kg/plot), gross yield (qt/ha), that selection for these traits would be effective for the improvement of bulb yield per plant. The level of variation found in the collection showed the great potentiality of improving agronomic characters in garlic.

Key Words : Genetic variability, Heritability, Genetic advance

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Garlic (*Allium sativum*), a member of Liliaceae family is an important spice consumed globally and is bestowed with immense medicinal benefits.

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garlic are rich in trace elements (zinc, magnesium, copper, selenium and iodine), protein content, dietary fibre, tocopherols, ascorbic acid, polyphenols. It helps in digestion of food, reduces cholesterol level in human blood and lowers blood sugar. The significance of this spice is increasing owing to its wide range of medicinal properties (Chanchan *et al.*, 2014). These major digestive cancers cause nearly one-fourth (27%) of all the cancer related deaths. Some of the advanced stages as in the liver cancer have no effective systemic chemotherapy options (Ng *et al*., 2012). Garlic is mostly strong flavoured due to presence of sulphur containing compounds that impart their distinctive small and pungency. Garlic grown is

mainly in Gujarat, Madhya Pradesh, Orissa, Maharashtra, Uttar Pradesh and Rajasthan. Since, production and productivity does not depend only on area and cultural practices but also on the genotypes of the crop and environmental conditions (Lawande *et al.,* 2009). The present study was conducted to investigate genetic variability, heritability and genetic advance of 16 diverse genotypes collected from different sources.

The germplasm serves as most valuable natural reservoir and main source of genes pool having resistance to several biotic and abiotic resistance. Therefore, collection, conservation and evaluation of germplasm is indispensable for present as well as future crop improvement.

MATERIAL AND METHODS

The experiment was conducted at experimental farm, RRS NHRDF Karnal, Salaru. During two connective year 2016-17 and 2017-18. sixteen genotypes were grown in a Randomized Block Design with three replications. The raised beds were prepared with drip irrigation system for the planting of garlic germplasm. The drip irrigation was made between all plots. Each genotype was planted in a plot of 2.25×1.2 m size by keeping 15×10 cm distance between two rows and two plants, respectively. Recommended cultural practices were followed for raising the crop. Observations were recorded on plant stand at maturity (PSM), % plant establishment (PPE), maximum height of plant (cm) (PH), no. of leaves (NOL), neck thickness (cm) (N), bulb equatorial diameter (cm) (E), bulb polar diameter (cm) (P), weight of 20 bulbs (kg) (WOB), average weight of bulb (g) (ABW), average number of cloves per bulb (NOC), marketable yield (kg/plot) (MY), marketable yield (qt/ha) (MY), % marketable bulb (On Wt. basis) (MBW), total soluble solids (%) (TSS), gross yield (kg/plot) (GY), gross yield (qt/ha) (GY). In addition to this, it is requisite to know the types and nature of yield components and their inter relationship. The genetic variability analysis gives information of the relative importance of various contributing characters.

RESULTS AND DISCUSSION

The analysis of variance for different characters is presented in Table 1. The mean sum of square due to genotype were significant for the characters like plant stand at maturity, % plant establishment, maximum height of plant (cm), no. of leaves, neck thickness (cm), bulb equatorial diameter (cm), bulb polar diameter (cm), weight of 20 bulbs (kg), average weight of bulb (g), average number of cloves per bulb, gross yield (kg/plot), marketable yield (kg/plot), marketable yield (qt/ha), % marketable bulb (On Wt. basis), T.S.S (%), gross yield (qt/ha).

The mean performance value with respected to the characters revealed that, the germplasm G-417 followed by G-404 and G-6.

Genotypic and phenotypic co-efficients of variation presented in Table 2. High magnitude of genotypic and phenotypic co-efficient of variations were recorded for traits *viz.*, average no of cloves per bulb 22.385 to 23.087 suggested the substantial improvement on garlic through selection for these traits. Moderate GCV and PCV were recorded for average weight of bulb (g) 11.061 to 12.225, gross yield (kg/plot) 13.367 to 14.648, marketable yield (kg/plot) 13.474 to 14.694, marketable yield (qt/ha) 13.474 to 14.694 gross yield (qt/ha) 13.368 to 14.648 suggested existence of considerable variability in the population. Selection for these traits may also be given the importance for improvement programme. Characters Plant stand at maturity 0.455 to 3.780, % plant establishment 0.446 to 3.78, maximum height of plant (cm) 3.65 to 4.76, no. of leaves 5.550 to 6.760, neck thickness (cm) 4.280 to 5.725, bulb equatorial diameter (cm) 2.740 to 3.814, bulb polar diameter (cm) 5.009 to 6.491, weight of 20 bulbs (kg) 5.620 to 6.971, % marketable bulb (On Wt. basis) 0.084 to 0.475, T.S.S (%) 2.880 to 5.762, had low genotypic and phenotypic

Table 1 : Analysis of variance for 20 quantitative characters in garlic

Source of variation	Degree of freedom	Mean squares															
		PSM	PPE	PH	NOL	N	E	P	WOB	ABW	NOC	GY (plot/kg)	MY (plot/kg)	MY (q/ha)	MBW	T.S.S. (%)	GY (q/ha)
Replication	1	76.045	23.461	63.281	2.258	0.005	0.195	0.279	0.03	36.615	2.526	0.139	0.127	174.284	0.096	65.094	190.028
Variation	15	43.148	13.31	28.44	0.457	0.013	0.039	0.054	0.003	15.664	75.119	0.625	0.627	860.658	0.231	5.253	857.349
Error	15	41.913	12.945	7.418	0.088	0.004	0.012	0.014	0.001	1.562	2.318	0.057	0.054	74.422	0.217	3.143	78.158

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : Mean, range, genotypic and phenotypic co-efficient of variation, heritability (%) in genetic advance and genetic advance in (%) for 16 quantitative characters in garlic

Sr. No.	Characters	Grand mean	Range		GCV	PCV	Heritability (%)	Genetic advance	Genetic advance in per cent of mean
			Min.	Max.					
1.	PSM	172.542	159	178.67	0.455	3.78	1.451	0.195	0.113
2.	PPE	95.857	88.34	99.26	0.446	3.78	1.39	0.104	0.108
3.	PH	88.814	83.80	94.07	3.65	4.768	58.626	5.114	5.758
4.	NOL	7.728	6.75	8.50	5.557	6.76	67.578	0.727	9.41
5.	N	1.578	1.44	1.72	4.283	5.725	55.965	0.104	6.6
6.	E	4.215	3.93	4.44	2.749	3.814	51.944	0.172	4.081
7.	P	2.847	2.70	3.19	5.009	6.491	59.562	0.227	7.964
8.	WOB	0.572	0.51	0.64	5.62	6.971	65.009	0.053	9.335
9.	ABW	24.006	19.01	28.83	11.061	12.225	81.866	4.949	20.617
10.	NOC	26.952	15.54	37.20	22.385	23.087	94.013	12.051	44.712
11.	GY (plot/kg)	3.986	3.02	4.94	13.367	14.648	83.28	1.002	25.13
12.	MY (plot/kg)	3.973	3.011	4.94	13.474	14.694	84.085	1.011	25.452
13.	MY (q/ha)	147.153	111.52	182.75	13.474	14.694	84.082	37.452	25.451
14.	MBW	99.663	98.78	99.98	0.084	0.475	3.149	0.031	0.031
15.	T.S.S (%)	35.556	31.69	38.49	2.888	5.762	25.127	1.061	2.983
16.	GY (q/ha)	147.649	111.83	182.79	13.368	14.648	83.291	37.108	25.133

co-efficient of variation. The PCV and GCV for all the yield attributing traits and yield were medium, while these parameters were low for growth and quality traits studied. Similar results for some important traits are reported by Dhar (2002).

Co-efficients 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), (Mehta and Patel, 1985) and (Khar *et al*., 2005).

An attempt has been made in the present investigation to estimate heritability in broad sense and categorized as low (<50%), moderate (50%-70%) and high (>70%) as suggested by Robinson (1966).

The high heritability was observed for some characters Average no of cloves per bulb 94.010, marketable yield (kg/plot) 84.090, marketable yield (qt/ha) 84.080, gross yield (kg/plot) 83.280, gross yield (qt/ha) 83.290. High heritability for above traits clarified that, they were least effected by environmental modifications and selection based on phenotypic performance would be reliable. The findings are in consonance with observations of Tsega *et al.* (2010).

The expected to high estimate genetic advance were found for marketable yield (qt/ha) and gross yield (qt/ha). However, plant height, leaves/plant and maturity duration showed low heritability and low genetic advance, as also reported by Agarwal and Tiwari (2004).

Conclusion:

Considering the overall result, it is apparent that certain information obtained here will help in future for improving existing garlic genotypes.

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