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

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ABSTRACT

Eleven genotypes of garlic (Allium sativum L.) were assessed for yield and other yield related attributes. Analysis of variance showed significant difference among all the genotypes for all the characters under study. Little differences were found between magnitude of phenotypic coefficient of variation (PCV) and genetic coefficient of variation for all the traits under study indicated that the trait were least affected by environment and are genetically controlled. High heritability coupled .with high genetic advance as per cent of mean was recorded for total bulb yield (97.66), TSS (96.13), average weight of ten cloves (96.06), average weight of ten bulbs (93.73), no. of cloves (92.14) and marketable yield (89.54) indicating that additive genetic variance was predominant. Among the evaluated germplasm lines, SKAU-G-05 performed better in respect of total bulb yield (308.73 q/ha), marketable yield (290.21 q/ha), average weight of ten bulb (57.93 g), number of cloves (61.33) and no. of pseudo stem length (3.36 cm). Therefore, the results of the present study revealed that good scope for garlic improvement is possible through selection. Furthermore, among the genotypes, SKAU-G-05 being superior for yield and other yield traits might be used by the breeders for further clonal selection.

Key words: *Garlic, Heritability, Genetic advance.*

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the important medicinal and vegetable crops next to onion in India for local and export market.[4] At the national level, it is the second most important cultivated bulb crop after onion in area and production[12]. It has been widely used throughout history as a food additive for both its flavor and medicinal effects. The available literature indicated that fresh and processed garlic may have some health benefits on human beings such as anti-carcinogenic, anti-fungal and anti- bacterial properties. It is currently used for its unique flavor as a food ingredient as well as a dietary supplement. Furthermore, a liquid garlic spray is used as an insect repellent for other crops.

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Clonal selection is a major breeding method for garlic improvement since plant sterility usually precludes crop improvement through cross-hybridization. It was found that garlic shows wide morphological and agronomic variations in colour and size of bulb, plant height, flowering, number and size of the cloves, days to harvesting, resistance to storage capacity, dormancy and adaptation to agroclimatic situations[6] but the performance of different garlic germplasm is variable in different growing regions. The studies about genetic variability in available germplasm are useful to devise an efficient selection programme for breeders[3]. Keeping these facts in view, the present investigation was undertaken to estimate variability, heritability and genetic advance as per cent of mean for yield and yield related traits in garlic germplasm.

MATERIAL AND METHODS

An experiment was conducted at Horticulture Farm, Department of Horticulture, Faculty of Agriculture Wadura-SKUAST-K, India to asses variability, heritability and genetic advance as per cent of mean during rabi season 2011-2012 and 2012-2013.The material comprised of 11 genotypes of garlic including a local check (Table-1) grown in randomized block design with 3 replications. The crop was planted in the last week of October in plots of size 3.00x 2.00 m and spacing of 15 (row to row) × 10 cm (plant to plant). 100:60:60 kg NPK/ha in form of urea, diammonium phosphate and muriate of potash, respectively was applied along with FYM. The All observations were recorded for different traits as per standard procedure from ten randomly selected plants of each genotype in all the three replications. Observations were recorded for plant height (cm), no. of leaves per plant, leaf length at 4th leaf (cm), pseudo stem length (cm), Polar diameter (cm), equatorial diameter (cm), no. of cloves, average weight of ten bulbs (gm), TSS (^{0}B), average weight of ten cloves (gm), total bulb yield (q/ha) and marketable yield (q/ha). The recorded data were analyzed statistically by comparing means using one way ANOVA and the significance was determined by Duncan's Multiple Range Test using SPSS for windows (v. 15. SPSS Inc USA). The genotypic and phenotypic coefficient of variations was calculated according to formulae[2]. Heritability in broad sense and expected genetic advance as percent of mean was worked out as per[9].

RESULTS AND DISCUSSION

Significant differences were found among garlic genotypes for all the traits under study (Table 1), indicating that there was sufficient diversity among the germplasm lines. The genotype SKAU-G 01 showed maximum mean values for plant height, number of leaves and leaf length (76.40 cm, 20.60 and 44.73 cm) respectively. SKAU-G 05 recorded the maximum values for pseudo stem length (3.36 cm), number of cloves (61.33 cm), average weight of ten bulbs (57.93 gm), total bulb yield (308.73 q/ha) and marketable yield (290.21 q/ha). SKAU-G 04 showed maximum mean value for polar diameter (4.45 cm) whereas SKAU-G 03 showed maximum mean for average weight of ten cloves (96.70 gm). These high ranges of variation among different lines could be utilized by breeders for the improvement through selection of desired traits[5]. The range of mean values based on phenotype expression could represent only an approximate estimate of the variation or magnitude of divergence present among different genotypes. In the present investigation, the magnitude of phenotypic coefficient of variation (PCV) was observed to be more than the corresponding genetic coefficient of variation for all the traits studied (Table 2). High estimates of PCV were observed for equatorial diameter (32.71%), leaf length at 4th leaf stage (26.26%), TSS (22.97) and polar diameter (22.29). The traits exhibiting high phenotypic and genotypic coefficient of variations are of economic importance and there is scope for improvement of these traits through selection. However, differences were modest indicating that characters are least affected by environment and are genetically controlled and hence,

selection could be made effective on the basis of phenotypic performance[14]. The selection of the characters having high PCV and GCV in any crop improvement programme[7]. Heritability in broad sense ranged from (54.47 to 97.66%). High value of heritability was recorded for total bulb yield (97.66%) followed by TSS (96.13%), average weight of ten cloves (96.06%), average weight of ten bulbs (93.73%) and no. of cloves (92.14%) respectively (Table 2). High heritability for above characters clarified that, they were least effected by environmental modifications and selection based on phenotypic performance would be reliable. The findings are in consonance with observation[8,13]. The heritability estimates along with genetic advance are more useful than the heritability values alone for selecting the best individual. From the present investigation, the genetic advance as percent of mean ranged from 5.68 to 73.82%. High estimates of genetic advance was recorded by Leaf length at 4th leaf (73.82%) followed by average weight of ten bulbs (70.65%), no of cloves (66.83%) and TSS (66.51%). High values of heritability, GCV and genetic advance as percent of mean were observed for TSS, average weight of ten Cloves, leaf length at 4th leaf, average weight of ten bulbs and no. of cloves suggesting that these traits are genetically controlled by additive gene action and can be improved through selection [11]. High heritability coupled with low genetic advance as percent of mean with low GCV were observed for no. of leaves, pseudo stem length, polar diameter, equatorial diameter suggesting that these traits were governed by non additive gene action and selection would not be effective[10,1,5]. The present investigation indicated that good scope for garlic improvement is possible through selection on suitable traits in desirable genotypes. Furthermore, SKAU-G 05 being superior among the evaluated germplasm lines could be used by breeders for further improvement through clonal selection

Table 1: Mean performance of different advance line for different traits

Genotypes	Plant height (cm)	No. of leaves	Leaf length 4th leaf (cm)	Pseudo stem length (cm)	Polar Diameter (cm)	Equatorial Diameter (cm)	No. of cloves	Average weight of ten bulbs (gm)	TSS	Average weight ten of cloves (gm)	Total bulb yield (q/ha)	Marketable Yield (q/ha)
SKAU-G 01	76.40^{a}	20.60^{a}	44.73^{a}	2.26^{ed}	3.92^{abc}	5.20^{a}	48.00^{cd}	28.50^{c}	38.36^{a}	37.73^{gf}	171.00^{cd}	153.90^{de}
SKAU-G 02	42.73^{e}	7.33^{de}	21.53^{g}	2.66^{bc}	2.53^{c}	3.78^{c}	36.66^{f}	21.16^{d}	28.70^{ef}	19.33^{i}	130.33^{e}	119.91^{e}
SKAU-G 03	71.73^{ab}	6.33 ^{de}	27.00^{f}	1.32^{h}	3.79 ^{abc}	4.76 ^{ab}	20.33^{g}	52.73^{a}	28.10^{f}	96.70^{a}	290.93^{a}	276.39^{a}
SKAU-G 04	74.66 ^{a}	10.46^{c}	18.53^{g}	1.58^{gh}	4.24^{ab}	5.31^{a}	42.00^{def}	55.00^{a}	32.03^{cde}	77.33^{c}	293.60^{a}	275.98^{a}
SKAU-G 05	41.26^{e}	5.66^{e}	17.00^{g}	3.36^{a}	3.33 ^{abc}	5.39^{a}	61.33^{a}	57.93^{a}	32.00^{cde}	85.10^{b}	308.73^{a}	290.21^{a}
SKAU-G 06	70.43^{abc}	6.20 ^{de}	32.53^{ed}	2.43^{bcd}	4.45^{a}	4.89 ^{ab}	55.33 ^{ab}	41.90^{b}	35.01^{abc}	47.00^{e}	223.33^{b}	207.70^{b}
SKAU-G 07	67.13^{bcd}	9.20^{cd}	33.93^{cde}	2.73^{b}	3.05 ^{abc}	4.58 ^{abc}	53.00^{bc}	41.66^{b}	29.68^{def}	29.60^{h}	222.67^{b}	209.12^{b}
SKAU-G 08	64.83^{cd}	11.66^{c}	38.63^{cb}	1.83^{gf}	3.01 ^{abc}	4.45 ^{abc}	42.33 ^{def}	35.40^{b}	33.04^{bcd}	57.33^{d}	212.80^{b}	202.16^{bc}
SKAU-G 09	61.33^{d}	5.67^{e}	28.53^{ef}	2.38^{cd}	2.55^{c}	3.98^{bc}	39.66^{ef}	26.00^{cd}	24.36^{g}	39.73^{f}	159.67^{de}	153.28^{de}
SKAU-G 10	73.13^{ab}	17.60^{b}	40.66^{ab}	1.96^{ef}	2.86^{bc}	4.73 ^{ab}	46.33^{cde}	39.16^{b}	36.36^{ab}	46.70^{e}	235.00^{b}	223.25^{b}
Local check	70.89^{abc}	16.14^{b}	40.68 ^{ab}	3.53^{a}	3.63 ^{abc}	5.12 ^{a}	20.36^{g}	36.66^{b}	33.85^{cb}	31.66^{gh}	198.67^{cb}	173.02^{cd}

Figures given in parenthesis are angular transformed values. Means followed by the same letter within the columns are not significantly different (P= 0.05) using Duncan's multiple range test.

Table 2: Range, mean, coefficient of variation, heritability and genetic advance for different traits in garlic

Characters	Range	Grand mean	Varaince		Coefficients of variation		Heritability (%)	Genetic Advance	GA as percent mean
			OG	OP	PCV(%)	GCV(%)			
Plant Height	41.26-76.40	64.57	31.89	37.78	9.51	8.74	84.40	18.45	28.57
No of leaves	5.66-20.60	10.37	0.34	0.39	6.02	5.62	87.17	0.59	5.68
Leaf length 4th leaf	17.00-44.73	30.41	54.74	63.78	26.26	24.32	85.82	22.45	73.82
Psendostem length	1.32-3.53	2.36	0.14	0.18	17.97	15.85	77.77	0.21	8.89
Polar diameter	2.53-4.45	3.36	0.45	0.57	22.29	19.96	78.94	0.71	21.13
Equitorial diameter	3.78-5.39	3.39	0.67	1.23	32.71	24.12	54.47	0.73	21.15
Number of cloves	20.33-61.33	41.70	52.89	57.45	18.17	17.44	92.14	27.87	66.83
Average weight of ten bulbs	21.16-57.93	40.76	59.89	63.89	19.61	18.98	93.73	28.80	70.65
TSS	24.36-38.36	31.92	51.78	53.76	22.97	22.54	96.13	21.23	66.51
Average weight of ten Cloves	19.33-96.70	51.66	97.78	101.78	19.52	19.14	96.06	18.19	35.21
Total Bulb Yield (q/ha)	159.67-308.73	222.43	389.48	398.78	8.90	8.87	97.66	26.44	11.88
Marketable Yield (q/ha)	119.91-290.21	200.10	478.89	534.78	11.55	10.93	89.54	41.23	20.60

P CV: Phenotypic coefficient of variation, GCV: Genotypic coefficient of variation, ÓG: Genotypic variance, ÓP: Phenotypic varianc

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