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Studies on Genetic Variability and Correlation Coefficient of Garlic (*Allium Sativum* L.) Genotypes Under Chhattisgarh Plain Condition

Samaptika Kar*, Praveen Sharma*, D. A. Sarnaik and Damini Thawait*****

ABSTRACT: *The study on genetic variability and correlation coefficient of different garlic genotypes was conducted at Department of Horticulture, IGKV, Raipur during the Rabi 2012-13. The total 22 genotypes including one check were evaluated under RBD with 3 replications. The study revealed that the phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for all the traits. Genotypic co-efficient of variation was higher for marketable yield per hectare, total yield per hectare, weight of 10 outer cloves, plant emergence, average bulb weight and number of cloves per bulb. The correlation analysis study among different characters revealed that selection for bulb yield should be based on marketable yield, plant emergence, number of leaves per plant, plant height, equitorial diameter and average bulb weight.*

Key words: *Genetic Variability, Correlation Coefficient, garlic*

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the important spice crops highly placed for its flavour enhancing capacity and high medicinal properties like antimicrobial, antidiebetic and anticarcinogenic action. The total area under garlic cultivation in the world is 12.25 lakh hectares with 156.85 lakh tonnes production, where as India is the second largest garlic producing country with the production of 8.34 lakh metric tonnes from 1.65 lakh hectare area and having average of productivity 5.06 tonnes per hectare (Anon, 2011a). Garlic has higher nutritional values than other bulbous crops. In Chhattisgarh garlic occupies 4215 hectare area with the production *of 22358.22 metric tonnes per hectare.* (Anon, 2011b). Although the climatic condition is favourable for garlic cultivation Chhattisgarh farmers are showing less interest for garlic cultivation due to the unavailability of region specific varieties or genotypes. Therefore the productivity in the state is very low as compared to national average. The development and recommendation of high yielding varieties for this region is very essential to enhance the production productivity and farmers preference for garlic cultivation. Due to asexual propagation, clonal selection is an important breeding method and little work has been done on the association between different traits which are prerequisites for executive a selection programme (Singh *et al.* 2012). The degree of variability is a base for a successful breeding programme. Keeping view of these facts the experiment was conducted to determine the variability of agronomic traits with the aim to identify suitable genotypes of garlic for cultivation.

MATERIALS AND METHODS

The experiment was carried out under All India Network Research Project on onion and garlic at the Horticulture Farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during Rabi season of 2012-2013. The experiment was laid out on 10th day of October, 2012 with twenty two genotypes of garlic, replicated thrice in randomized block design. Each clone was planted by dibbling in a plot size of 2 x 2.25 meter with a spacing of 15 x 10 cm. Recommended cultural and plant protection practices were followed equally in all the plots as and when

* Department of Horticulture, College of Agriculture, IGKV, Raipur, (C. G.) India
** Directorate of Research Services, IGKV, Raipur, (C. G.) India
*** Department of Agronomy, College of Agriculture, IGKV, Raipur (C. G.), India
(corresponding author E-mail: to.samptikakar@gmail.com

required. Observations were recorded on ten randomly selected plants in each replication for all the characters. Yield was recorded after curing the bulbs in shade for a week in order to obviate the moisture variation. The data were analysed statistically according to the method outlined by Panse and Sukhatme (1967). The variability was analysed for different character like plant emergence percentage, plant height (cm), collar height (cm), collar thickness (cm), number of leaves per plant, fourth leaf length (cm), fourth leaf width (cm), polar diameter (cm), equitorial diameter (cm), neck thickness (cm), average bulb weight (g), number of cloves per bulb, weight of 10 outer cloves (g), marketable yield (t/ha.), TSS, total yield (t/ha.). Correlation coefficients were calculated at genotypic levels, estimated as given by Searle (1961). The significance of correlation coefficient (r) was tested by comparing 't' value at (n-2) degree of freedom.

$$t = \sqrt{r(n-2/1-r^2)}$$

RESULTS AND DISCUSSION

Data presented in Table1 indicated highest range of variation (22.86-95.98) for plant emergence followed by number of cloves (0.00-29.43 g). For fourth leaf width the range of variation was very narrow (0.71-1.24 cm). The genetic coefficient of variation (GCV) and Phenotypic coefficient of variation (PCV) of the garlic genotypes has been depicted in Figure nos.4.1 and 4.2. High magnitude of genotypic as well as phenotypic coefficient of variations were recorded for traits *viz*., marketable yield per hectare (65.14 and 66.47), total yield per hectare (56.72 and 58.11), weight of 10 outer cloves (41.09 and 42.10), plant emergence (40.12 and 43.71), average bulb weight (35.81 and 38.79) and number of cloves per bulb(28.75 and 31.03), neck thickness(29.47 and 32.64) and collar thickness (19.23 and 22.42) suggests the substantial improvement can be achieved in garlic through selection for these traits. Moderate PCV and GCV were recorded for equatorial diameter (19.33 and 18.41), collar thickness (22.42 and 19.23), polar diameter (17.90 and 17.35) and fourth leaf length (17.94 and 15.37) respectively suggest existence of considerable variability in the population. Selection based on these traits may also be given the improvement in genotypes. Remaining characters had low genotypic and phenotypic coefficient of variation. Highest PCV and GCV were exhibited by marketable yield (66.47 and 65.14) whereas lowest PCV and GCV were recorded for TSS (6.61 and 5.32). The results of the present study are close agreement with the findings of Islam *et al.* (2004), Zahedi *et al.* (2007), Tsega *et al.* (2010), Singh *et al.* (2012), Yadav *et al.* (2012). They recorded high phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for average weight of cloves, plant height, bulb weight, number of cloves per bulb. Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits indicating that environmental factor influences their expression. Wide difference between phenotypic and genotypic coefficient of variations indicated their

Table 1
Genetic Parameter of Variation for Bulb Yield and its Components in Garlic

S.No.	*Parameters*	*Range*	*Mean*		*Coefficient of Variation (%)*		*h2 (b) (%)*	*Genetic-advance*	*G.A. as % of mean*
	Characters	*Minimum*	*Maximum*		*Genotypic*	*Phenotypic*			
1	Plant emergence	22.86	95.98	55.70	40.12	43.71	84.2	42.25	75.85
2	Plant height (cm)	42.11	66.58	58.44	11.11	14.13	61.8	10.51	17.98
3	Collar height(cm)	13.11	29.61	20.13	21.98	24.69	79.2	8.11	40.28
4	Collar thickness(cm)	2.14	4.95	3.81	19.23	22.42	73.6	1.29	33.85
5	No. of leaves/plant	7.07	9.73	8.72	6.46	11.87	29.70	0.63	7.225
6	Fourth leaf length(cm)	20.15	36.50	29.65	15.37	17.94	73.4	8.05	27.15
7	Fourth leaf width(cm)	0.71	1.24	0.98	9.44	17.78	28.2	0.10	10.20
8	Polar diameter(cm)	1.49	4.27	2.96	17.35	17.90	93.9	1.02	34.45
9	Equitorial diameter(cm)	1.52	3.85	3.46	18.41	19.33	90.7	1.25	36.12
10	Neck thickness(cm)	0.05	0.62	0.42	29.47	32.64	81.5	0.23	54.76
11	Average bulb weight(g)	3.93	19.77	11.94	35.81	38.79	85.2	8.13	68.09
12	No. of cloves/bulb	0.000	29.43	18.99	28.75	31.03	85.9	10.42	54.87
13	Weight of 10 outer cloves(g)	0.000	14.11	7.96	41.09	42.10	95.3	6.58	82.66
14	Marketable yield(t/ha)	0.36	6.88	2.83	65.14	66.47	96.0	2.80	98.94
15	TSS	32.33	40.30	36.24	5.32	6.61	64.9	3.20	8.83
16	Total yield (t/ha)	0.61	6.88	3.03	56.72	58.11	95.3	2.90	95.71

sensitiveness to environmental fluctuations whereas narrow difference showed less environmental interference on the expression of these traits. The traits which showed high phenotypic and genotypic coefficient of variations are of economic importance and there is scope for improvement of these traits through selection.

Correlation refers to degree and direction of association between two or more than two variables. It measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for genetic improvement of dependent characters. The correlation is presented in table 2.

Total yield per hectare had recorded highly positive significant genotypic correlation with marketable yield (0.980), plant emergence (0.726), number of leaves per plant (0.587), plant height (0.489) and positive significant correlation was recorded with equitorial diameter (0.444), average bulb weight (0.433), fourth leaf length (0.406), TSS (0.393), collar height (0.338). These findings are in close confirmity with the reports of Rajlingam and Harapriya (2001), Singh and Chand (2003), Tsega *et al.* (2010), Singh *et al.* (2011) and Sonkiya *et al.* (2012). Plant emergence exhibited highly significant positive genotypic correlation with marketable yield per hectare (0.744), TSS (0.540), total yield per hectare (0.726), whereas positively significant with number of leaves per plant (0.385) and significantly negative corrrelation with collar thickness (-0.311). Plant height showed highly significant positive genotypic correlation with total yield (0.489), marketable yield (0.417), fourth leaf width (0.374) and polar diameter (0.351). The results of the present study are close agreement with the findings of Rajlingam and Harapriya (2001), Jaggi and Raina (2008), Tsega (2010) and Singh *et al.* (2011). At genotypic level collar height showed highly significant positive correlation with number of leaves per plant (0.719), fourth leaf width (0.487), whereas significant positive genotypic correlation had recorded with collar thickness (0.413), TSS (0.394), fourth leaf length(0.385), total yield (0.338), marketable yield (0.334), weight of 10 outer cloves(0.302), polar diameter(0.288). Collar thickness exhibited highly significant positive genotypic correlation with number of leaves per plant (0.774), fourth leaf width (0.581) and significant positive genotypic correlation with polar diameter (0.394), fourth leaf length (0.390). Number of leaves had recorded highly significant positive genotypic correlation with total yield (0.587), marketable yield (0.580), fourth leaf width(0.480) and significant positive genotypic correlation with polar diameter (0.442), equitorial diameter (0.422), average weight of bulbs (0.382). At genotypic level fourth leaf length exhibit highly significant positive correlation with average bulb weight (0.679), polar diameter (0.639) and equatorial diameter (0.587). It had recorded positive significant correlation with total yield (0.406), marketable yield (0.337), TSS (0.305), average weight of 10 outer cloves (0.286). Fourth leaf width showed negative significant correlation with TSS (0.337), number of cloves per bulb (0.330) and highly negative significant with neck thickness (-0.769). Polar diameter at genotypic level it showed highly significant positive correlation with equatorial diameter (0.805) and average bulb weight (0.700), weight of 10 outer cloves (0.534) whereas significant positive genotypic correlation had recorded with neck thickness (0.378). Equitorial diameter exhibited highly significant positive genotypic correlation with average bulb weight (0.833), TSS (0.536), weight of 10 outer cloves (0.471) and significant positive correlation with total yield per ha. (0.444), marketable yield (0.430), number of cloves per bulb (0.367). Average bulb weight showed significant positive genotypic correlation with total yield per hectare (0.433), marketable yield per hectare (0.406), number of cloves per bulb (0.394), weight of 10 outer cloves (0.394). Marketable yield at genotypic level showed highly significant positive correlation with total yield per hectare (0.980) and TSS (0.503). The findings are in accordance with the reports of Singh *et al.* (2011) and Sonkiya *et al.* (2012). In the present study, in most of the cases genotypic correlations were higher than the phenotypic correlation coefficients indicating the strong association between two characters genetically. Similar results in garlic also reported by Kalloo *et al.* (1982). The phenotypic correlation value is lessened by the significant interaction of environment. In some of the cases, the phenotypic correlation was slightly higher than the genotypic correlation indicating that the apparent association of two characters is not only due to the genes but also due to favourable influence of environment. In certain combinations, environmental correlation coefficient was significant but low magnitude in comparison to phenotypic and genotypic correlation coefficient. The direction of correlation coefficients at genotypic and phenotypic levels was same for most of the combination but, in general different for environmental correlations indicating independence of the environmentalfactor.

Table 2
Correlation Coefficient of Yield and its Components in Garlic

Characters		*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
1	**P**	0.207	0.221	-0.205	0.154	0.051	-0.062	-0.212	0.022	0.033	-0.166	-0.121	0.076	0.670**	0.417*	0.655**
	G	0.210	0.212	-0.311*	0.385*	0.057	-0.063	-0.268	0.022	0.031	-0.136	-0.102	0.088	0.744**	0.540**	0.726**
	E	0.224	0.262	0.195	-0.115	0.032	-0.092	0.276	0.018	0.040*	-0.332	-0.232	-0.041	0.014	0.072	0.057
2	**P**		0.534**	0.581**	0.634**	0.232	0.128	0.296*	0.132	0.023	0.128	-0.054	0.007	0.327*	-0.067	0.380*
	G		0.485**	0.587**	0.937**	0.250	0.374*	0.351*	0.208	0.075	0.197	0.050	0.025	0.417*	-0.156	0.489**
	E		0.691**	0.583**	0.284	0.198	-0.054	0.187	-0.125	-0.114	-0.064	-0.388*	-0.088	0.050	0.086	0.038
3	**P**			0.354*	0.446*	0.402*	0.255	0.272	0.208	0.082	0.191	0.033	0.276	0.300*	0.294	0.301*
	G			0.413*	0.719**	0.385*	0.487**	0.288*	0.244	0.049	0.246	0.078	0.302*	0.334*	0.394*	0.338*
	E			0.166	0.254	0.460**	0.064	0.211	0.009	0.216	-0.060	-0.182	0.142	0.095	0.042	0.071
4	**P**				0.487**	0.325*	0.251	0.311*	0.095	-0.058	0.153	-0.100	0.001	-0.142	-0.004	-0.128
	G				0.774**	0.390*	0.581**	0.394*	0.146	0.001	0.215	-0.029	0.013	-0.139	-0.019	-0.125
	E				0.290*	0.143	-0.032	-0.127	-0.153	-0.267	-0.087	-0.394*	-0.086	-0.243	0.030	-0.210
5	**P**					0.248	0.199	0.247	0.186	-0.068	0.238	0.044	0.062	0.290*	0.153	0.287*
	G					0.207	0.480**	0.442*	0.422*	-0.220	0.382*	0.243	0.095	0.580**	0.212	0.587**
	E					0.350*	0.084	0.63**	-0.129	0.111	0.141	-0.248	0.066	-0.117	0.121	-0.140
6	**P**						0.165	0.506**	0.489**	0.247	0.543**	0.019	0.257	0.296*	0.250	0.351*
	G						0.267	0.639**	0.587**	0.263	0.679**	0.043	0.286*	0.337*	0.305*	0.406*
	E						0.100	-0.194	0.063	0.195	0.033	-0.077	0.159	0.134	0.128	0.104
7	**P**							-0.027	-0.016	-0.348*	-0.015	0.154	-0.061	-0.021	0.240	-0.072
	G							-0.098	0.092	-0.769**	-0.154	0.330*	-0.175	-0.033	0.337*	-0.134
	E							0.111	-0.243	0.055	0.184	-0.025	0.158	-0.021	0.191	-0.015
8	**P**								0.747**	0.348*	0.633**	0.011	0.510**	0.033	0.099	0.129
	G								0.805**	0.378*	0.700**	0.019	0.534**	0.024	0.116	0.126
	E								0.060	0.163	0.076	-0.063	0.078	0.204	0.057	0.179
9	**P**									0.224	0.729**	0.296*	0.441*	0.405*	0.379*	0.411*
	G									0.226	0.833**	0.367*	0.471**	0.430*	0.536**	0.444*
	E									0.228	-0.032	-0.239	0.039	0.060	-0.180	-0.018
10	**P**										0.183	0.074	0.402*	0.044	-0.041	0.117
	G										0.223	0.085	0.456*	0.041	-0.099	0.133
	E										-0.019	0.015	0.001	0.084	0.123	0.001
11	**P**											0.372*	0.373*	0.393*	0.153	0.420*
	G											0.394*	0.394*	0.406*	0.239	0.433*
	E											0.242	0.218	0.332*	-0.109	0.354*
12	**P**												0.275	0.250	0.205	0.157
	G												0.277	0.268	0.232	0.161
	E												0.302*	0.085	0.141	0.136
13	**P**													0.111	0.328*	0.134
	G													0.117	0.399*	0.142
	E													-0.036	0.106	-0.033
14	**P**														0.407*	0.979**
	G														0.503**	0.980**
	E														0.082	0.981**
15	**P**															0.316*
	G															0.393*
	E															0.057

*** Significant at 5%, ** Significant at 1%** 1. Plant emergence 2. Plant height 3. Collar height 4. Collar thickness 5. No. of leaves/plant 6. Fourth leaf length 7. Fourth leaf width 8. Polar diameter 9. Equatorial diameter 10. Neck thickness 11. Average bulb weight 12. No. of cloves/bulb 13. Weight of 10 outer cloves 14. Marketable yield 15. TSS 16. Total yield

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