DOI : 10.5958/0974-0112.2018.00030.0

Indian J. Hort. 75(1), March 2018: 161-164

Short communication

Evaluation and variability study in garlic

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ABSTRACT

Thirty diverse genotypes of garlic (*Allium sativum* L.) were evaluated for important quantitative and qualitative traits. The genotype JAS 28 showed highest value for quantitative traits such as, leaf length (36.33 cm), leaf width (1.74 cm), pseudostem diameter (0.84 cm), equatorial diameter of bulb (4.16 cm), average weight of bulb (27.0 g), marketable yield (117.0 q/ha) and total yield (118.0 t/ha). Further, maximum plant height (62.20 cm), number of cloves/ bulb (23.66) and average weight of bulb(27.0 g) were observed in the genotype JAS 16. The genotype JAS 5 had maximum polar diameter of bulb (3.82 cm) and matured in minimum days (137.33 days), which could be easy selection for earliness along with high yield. Looking to the diversity among the genotypes, the traits evaluated for variability analysis showed high PCV and GCV for number of cloves/ bulb, pseudostem diameter and width. The heritability coupled with genetic advance as per cent of mean among the genotypes was, however, high in case of marketable yield, total yield, average weight of bulb, leaf length, average weight of 10 cloves and pseudostem length. Thus, the present investigation showed maximum diversity among the genotypes and the genotypes JAS 28 and JAS 16 were found to be good parental material to be used in breeding programme.

Key words: *Allium sativum*, coefficient of variation, heritability, variability.

Garlic (*Allium sativum* L.) is one of the most important remunerative bulbous spice and medicinal crop. It is second most widely used spice after onion belonging to Alliaceae family. Garlic is rich in protein, phosphorus, potassium, calcium, magnesium and carbohydrates. The fresh peeled garlic cloves contain 62.8% moisture, 29% carbohydrate, 6.3% protein, 1% mineral matter, 0.8% fiber, 0.1% fat, 1% total ash, 0.03% calcium, 0.31% phosphorus, 0.0001% iron, 0.4 mg/100 g nicotinic acid and 13 mg/100 g vitamin 'C'. The uninjured bulb contains a colourless, odourless water soluble amino acid 'allin'. On crushing the garlic bulb the enzyme allinase breaks down allin to produce allicin of which the principle ingredient is the odouriferous diallyldisulphide. Garlic contains about 0.1% volatile oil. The exploration of genetic variability in the available germplasm is a prerequisite in a breeding programme for effective selection of superior genotype. The partitioning of total variability into heritable and non-heritable components by using suitable design will enable the breeder to know whether the superiority of selection is inherited by the progenies.

An experiment was conducted at the Vegetable Research Farm, Horticulture Complex, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur during *Rabi* 2013-14 to evaluate thirty garlic genotypes. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and each replication consisted of thirty plants. These genotypes of garlic were collected from Mandsaur, Ratlam, Chhindwara, Betul, Neemach and Seoni districts of Madhya Pradesh for investigation. Randomly marked ten plants from each plot were taken for observation on fourteen characters *viz.,* plant height (cm), No. of leaves/ plant, leaf length (cm), leaf width (cm), pseudostem length (cm), pseudostem diameter (cm), polar diameter of bulb (cm), equatorial diameter of bulb (cm), No. of cloves/ bulb, average bulb weight (g), average weight of 10 cloves (g),marketable yield (q/ha), total yield (q/ha) and days to maturity. The variance components and coefficient of variation were determined according to Burton (2). The heritability in broad sense (h^2bs) was calculated using formula proposed by Hanson *et al.* (3) and expected genetic advance was worked out as suggested by Johnson *et al.*(5).

Mean performance of thirty genotypes on fourteen characters of garlic is presented in Table 1. The analysis of variance showed that the genotypes under study differed significantly among themselves for all the characters studied. Wide range of variation was recorded in leaf length (26.73-36.33 cm), days to maturity (137.33-147.33), average weight of bulb (10.67-15.50 g), No. of cloves/ bulb (23.66-21.25), plant height (40.73-62.20 cm), total bulb yield (79.20-118.80 q/ha) and marketable bulb yield (70.87-117 q/ha). These observations also corroborated with those of Jabeen *et al.* (4), Tsega *et al.* (12) and Mishra *et al.* (9).

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Table 1. Mean performance of thirty genotypes on different characters of garlic

Genotypes	Plant height (cm)	No. of leaves/ plant	Leaf length (cm)	Leaf width (cm)	Pseudo stem length (cm)	Psedostem diameter (cm)	Polar diameter of bulb (cm)	Equatorial diameter of bulb (cm)	No. of cloves/ bulb	Average weight of 10 cloves (g)	Days to maturity	Average weight of bulb (g)	Marketable yield (q/ha)	Total yield (q/ha)
JAS 1	46.60	6.93	28.13	0.95	7.87	0.42	2.18	3.07	18.67	10.67	140.00	19.33	79.00	83.60
JAS 2	52.23	7.40	30.53	0.97	6.80	0.48	2.18	3.15	11.00	14.16	138.66	15.67	90.79	96.80
JAS 3	46.53	6.40	29.60	0.84	7.66	0.42	2.02	3.02	12.66	14.33	139.00	18.00	73.24	83.53
JAS 4	54.93	7.53	29.66	1.03	7.86	0.49	2.42	3.40	15.33	13.66	138.66	20.33	85.21	90.20
JAS 5	47.86	6.86	31.93	1.12	6.80	0.74	3.82	3.58	21.00	11.36	137.33	23.00	72.62	103.40
JAS 6	43.40	6.73	28.46	1.00	7.00	0.65	2.37	3.59	17.66	13.33	139.33	23.33	80.23	83.53
JAS 7	48.93	6.86	30.66	1.14	6.60	0.75	2.36	3.58	14.66	14.16	139.66	20.67	88.97	103.27
JAS 8	47.93	7.06	29.53	1.18	6.93	0.74	2.45	3.39	14.33	15.50	144.66	22.00	92.29	96.80
JAS 9	50.26	7.26	29.93	1.08	7.86	0.62	2.46	3.40	15.33	12.30	140.66	20.67	90.61	101.20
JAS 10	53.20	7.40	30.40	1.02	8.93	0.68	2.48	3.70	20.00	12.33	140.33	23.67	73.26	81.40
JAS 11	52.33	7.60	29.33	1.02	7.86	0.70	2.37	3.32	17.33	14.00	144.33	24.33	74.78	100.13
JAS 12	49.60	7.46	30.06	1.12	7.73	0.64	2.33	3.42	16.00	12.33	140.00	19.00	78.48	99.00
JAS 13	51.80	7.66	30.40	1.06	6.20	0.73	2.46	3.59	17.00	13.83	140.00	22.67	99.73	116.60
JAS 14	48.20	7.00	31.86	1.22	7.66	0.79	2.47	3.81	15.33	12.66	141.00	20.67	93.58	103.33
JAS 15	49.73	6.66	32.20	1.10	8.26	0.73	2.35	3.56	23.66	10.76	141.00	25.00	91.41	96.73
JAS 16	62.20	7.20	32.33	1.18	7.53	0.83	2.49	3.86	23.00	14.30	147.33	27.00	115.00	116.60
JAS 17	58.53	7.40	35.60	1.21	7.53	0.79	2.55	4.01	19.66	11.83	141.33	24.00	100.12	103.40
JAS 18	56.33	7.60	31.93	1.15	8.26	0.79	2.50	3.68	19.33	13.16	144.00	26.00	103.43	107.80
JAS 19	55.86	8.06	33.66	1.12	8.60	0.71	2.49	3.65	19.66	11.33	140.66	23.00	89.31	103.40
JAS 20	54.00	7.60	31.73	1.27	6.73	0.82	2.48	3.80	17.66	13.50	146.00	21.67	98.81	112.20
JAS 21	41.00	6.93	26.73	1.08	6.46	0.53	2.27	3.33	16.33	12.33	141.00	19.00	80.30	85.80
JAS 22	40.73	6.73	27.00	0.88	7.80	0.62	2.24	3.09	16.00	13.00	140.00	21.00	80.86	94.47
JAS 23	50.40	7.40	29.40	1.00	7.00	0.64	2.33	3.33	20.66	12.50	140.00	24.67	88.99	96.73
JAS 24	42.80	6.80	27.53	0.93	7.06	0.59	2.16	3.09	20.33	11.33	145.00	22.67	70.87	79.20
JAS 25	44.66	6.80	29.40	0.94	6.86	0.63	2.17	3.21	22.00	11.83	140.66	23.67	81.55	96.73
JAS 26	46.20	6.53	31.66	1.07	7.00	0.70	2.36	3.68	19.33	12.50	141.66	23.67	108.09	116.60
JAS 27	47.06	7.33	31.33	1.36	6.20	0.78	2.50	3.65	18.33	12.46	140.00	23.00	88.96	96.73
JAS 28	61.73	6.53	36.33	1.74	6.26	0.84	2.77	4.16	22.33	14.90	146.66	27.00	117.00	118.80
JAS 29	52.20	7.20	30.33	1.04	7.53	0.64	2.43	3.64	21.66	11.33	140.66	24.00	83.65	90.07
JAS 30	51.53	7.60	31.06	0.94	7.80	0.62	2.40	3.46	23.00	11.66	145.33	24.00	92.63	99.00
SEm±	3.11	0.16	0.24	0.07	0.19	0.04	0.07	0.13	1.55	0.26	1.34	0.24	0.52	0.49
C.D. 5% level	8.89	0.47	0.70	0.20	0.55	0.12	0.20	0.39	4.45	0.76	3.84	0.69	1.49	1.42

The genotypic and phenotypic coefficients of variations are of greater use in determining the extent of variability present within the material. The genetic parameters for some characters of garlic are presented in Table 2. The phenotypic coefficient of variation (PCV) varied from 2.29% for days to maturity to 21.25% for No. of cloves/ bulb. PCV expressed in terms of percentage was comparatively high for No. of cloves/ bulb (21.25%), pseudostem diameter (18.45%) and leaf width (17.90%). The results were in agreement with the findings of Khar *et al.* (7) and Panse *et al.* (10). However, moderate PCV was

Table 2. Genetic parameters for fourteen characters of Garlic

Characters	Grand Mean	Range		Coefficient of variations		Heritability % (bs)	Genetic Advance	GA as % of mean
		Min.	Max.	PCV	GCV			
Plant height (cm)	50.29	40.73	62.20	13.89	8.84	40.48	5.83	11.58
No. of Leaves/ plant	7.15	6.40	8.06	6.61	5.27	63.51	0.62	8.65
Leaf length (cm)	30.62	26.73	36.33	9.71	6.57	95.72	4.04	13.21
Leaf width (cm)	1.09	0.84	1.74	17.90	13.85	59.86	0.24	22.16
Pseudostem length (cm)	7.35	6.20	8.93	10.35	9.29	80.67	1.26	17.21
Pseudostem diameter (cm)	0.67	0.42	0.84	18.45	14.66	63.17	0.16	23.48
Polar diameter of bulb (cm)	2.43	2.02	3.82	7.16	4.99	48.54	0.17	7.02
Equatorial diameter of bulb (cm)	3.51	3.02	4.16	9.79	6.99	50.99	0.36	10.28
No. of cloves/ bulb	18.31	11.00	23.66	21.25	15.32	51.95	4.16	22.74
Average weight of 10 cloves (g)	12.78	10.67	15.50	9.88	9.20	86.69	2.27	17.79
Days to maturity	141.5	137.33	147.33	2.29	1.59	48.12	3.21	2.27
Average weight of bulb (g)	22.42	15.67	27.00	11.81	11.66	97.49	5.31	23.68
Marketable yield (q/ha)	88.84	70.87	117.00	13.78	13.75	99.45	25.09	28.24
Total yield (q/ha)	98.56	79.20	118.80	11.12	11.08	99.38	22.43	22.76

recorded for plant height (13.89%), marketable yield (13.78%), average weight of bulb (11.81 %), total yield (11.12%) and pseudostem length (10.35%), whereas low PCV for average weight of 10 cloves (9.88 %), equatorial diameter of bulb (9.79 %), leaf length (9.71%), polar diameter of bulb (7.16%), No. of leaves/ plant (6.61%) and days to maturity (2.29%) was recorded which indicated that there is limited scope for improvement (Table 2). Agarwal and Tiwari (1) reported lowest values for number of leaves per plant. As estimated phenotypic variation can not differentiate between the effects of genetic and environmental effects was carried out to partition the real genetic differences.

The genotypic coefficient of variations (GCV) were comparatively high for No. of cloves/ bulb (15.32%) and moderate for plant height (13.89%), pseudostem diameter (14.66%), leaf width (13.85), marketable yield (13.75%), average weight of bulb (11.66%) and total yield (11.08%). Similar results were also reported by Singh and Chand (11) and Mishra *et al.* (9). Low GCV was recorded for pseudostem length (9.29%), average weight of 10 cloves (9.20%), plant height (8.84%), equatorial diameter of bulb (6.99%), leaf length (6.57%), No. of leaves/ plant (5.27%), polar diameter of bulb (4.9%) and days to maturity (1.59%).

The relative amount of heritable portion of total variation was found out with the help of heritability estimates and genetic advance. In the present study, high heritability estimates were obtained for most of the traits *viz.,* marketable yield, total yield, average weight of bulb, leaf length, average weight of 10 cloves and pseudostem length. These results were in close proximity to those of Singh and Chand (11) and Khar *et al.* (7). High heritability coupled with genetic advance as per cent of mean was observed for marketable yield, total yield, average weight of bulb, pseudostem diameter, number of cloves per bulb and leaf width suggesting preponderance of additive genes. It also indicated high response for selection of high yielding genotypes as these traits are governed by additive gene actions. High values of heritability supplemented with moderate genetic advance as per cent of mean were manifested by pseudostem length and average weight of 10 cloves which might be attributed to additive gene action conditioning their expression and phenotypic selection for their amenability can be brought out. These findings are in agreement to those of Singh and Chand (11), Kumar *et al.* (8), Kalra *et al.* (6) and Mishra *et al.* (9).

It can, therefore, be concluded that there was good range of variability among the genotypes studied and the genotypes JAS 28 and JAS 16 could be included as parental material in improvement programme.

ACKNOWLEDGEMENT

Authors are highly grateful to Director Research Services, JNKVV Jabalpur for providing necessary facilities and assistance for conducting the present experiment.

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Received : March, 2016; Revised : October, 2017;
Accepted : Janaury, 2018