Journal Crop and Weed, 11(1):128-131(2015)

Evaluation of garlic (*Allium sativum* L.) genotypes for plant architecture and yield

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Received: 29-09-2014, Revised:17-05-2015, Accepted:20-05-2015

ABSTRACT

The present investigation was carried out to screen the 21 genotypes of garlic for plant growth, yield and yield contributing parameter under field condition for two consecutive years. Attempt has been made to assess the genetic variation for plant architecture and yield traits of garlic genotypes. Among genotypes, RAUG-4 observed as the tallest plant having maximum number of leaves, however, RAUG-5 had the ability to complete their life cycle at a shortest period and potent to produce larger size of bulb along with maximum marketable as well as total yield. The plants with medium height bearing sizeable number of leaves with a rapid growth, quickly to harvest photo radiation and accumulated photosynthates into the economic partat a better way. Besides the superior genotypes are RAUG-5 and RAUG-16, RAUG-12, RAUG-7, RAUG-15 and RAUG-4 were moderate yielder. However, the genotype RAUG-1, RAUG-2, RAUG-3, RAUG-6 RAUG-10, RAUG-14, RAUG-17 exhibited somewhat lower performance (45- 70 q ha^{-1}) while accession RAUG-8, RAUG-9, RAUG-11, RAUG-18 RAUG-19 and RAUG-20 depicted as poor yielder.

Keywords: Garlic, germplasm, plant architecture, yield

Garlic (*Allium sativum* L.) is an important bulb crop next to onion. The cloves of garlic bulb are used in flavoring of various vegetarian and non-vegetarian dishes. The significance of this spice is increasing owing to its wide range of medicinal properties (Chanchan *et al.,* 2014). Garlic is considered as one of the most important species in the family Alliaceae and as an important bulb crop next to onion. It is a diploid species (2n=2=16) cultivated since 3000 years B.C. (McCollum,1987). It is generally not fertile and thus propagated by cloves. A wide range of adaptability to soil types, temperatures and day length, makes its farming possible from tropics to temperate region.The flavor in garlic is easily diagnosed and has anti-infective properties such as power suppliers, insecticidal, anti-bacterial, antifungal, anti-cancer, lowering of blood sugar, blood lipids, and reduction of blood platelet aggregation (Agusti, 1990). It is a winter perennial crop having more nutrient and water exhaustive in nature.

Clones of garlic are variable for morphophysiologic traits (Avato *et. al*.,1998), and commercial cultivars can be selected and identified on the basis of canopy structure and yield related traits (Zepeda, 1997).Genotypes may also differ in pungency, length of storage, colour, size, number of cloves per bulb, hardiness, and suitability for cooking. Some even store longer, some are more gourmets in flavor and some mature earlier and others later (Immelman, 2006).Genetic variation among populations of cultivated garlic is precious for an economic use of genes and genomes. The collection of cultivated garlic germplasms and its genetic evaluation will identify accessions that could be useful to obtain cultivars using clonal selectionto be used in breeding programmes. The objectives of this research work have to assess genetic variation for plant architecture and yield traits of garlic germplasms.

MATERIALS AND METHODS

Field evaluation of 21 genotypes obtained from different parts of Bihar and Jharkhand was carried out at the xperimental arm of Tirhut College of Agriculture, Rajendra Agricultural University, Dholi, Muzaffarpur, Bihar, India during the *rabi* season of 2010-11 and 2011-12. The 21 genotypes *viz.,* RAUG-1 to RAUG-20 along with one prominent check variety (G-323) were grown in randomized block design with 3 replications in two successive years (2009-10 and 2010-11). The crop was planted in the second week of October at a spacing of 15 × 10 cm. Fertilizer 120:80:80 kg NPK ha^{-1} in the form of urea, diammonium phosphate and muriate of potash, respectively was applied. Total phosphorus and potassium and half of the nitrogen was applied before planting and rest amount of nitrogen was top dressed in two equal splits 30 and 45 days after planting during weeding (Chanchan, *et al*., 2014). All other agricultural practices, were performed as recommended. A random sample of ten plants of each genotypes was collected from each plot to estimate the plant height (cm) and number of leaves per plant at 75 days after planting. However, polarand equatorial diameter, number of cloves per bulb, bulb weight, weight of 10 cloves,

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marketable and total yield were recorded from randomly selected of 10 plant at the time of harvesting and statistically analyzed as per the standard procedure (Sukhatme and Amble, 1995).

RESULT AND DISCUSSION

The pooled data of two consecutive years 2009-10 and 2010-11 presented in table 1 indicated significant variations among the with respect to vegetative growth and yield parameters .The results depicted a handsome amount of deviation with respect to plant height 42.47 to 75.62 cm with a mean value of 55.31 cm. The germplasm, RAUG-4 had produced significantly highest plant height of 75.62 cm over the tested germplasm. However the significantly lowest plant height (42.47 cm) was observed for RAUG-14 followed by RAUG-19 (43.22 cm). The number of leaves per plant varies significantly and value ranged from 5.06 to 7.87 with general mean of 6.33. The maximum number of leaves per plant (7.87) was also found for the genotypes RAUG-4 and leaves number did not statistically variate with genotype RAUG-1, RAUG-2, RAUG-18, while significantly least number of leaves per plant was noted for the germplasm RAUG-19 (5.06) and result have not been differed with the genotype RAUG-20, RAUG-13, RAUG -7. Days to harvesting is an important parameter that decides the crop length and fitted well in a particular cropping sequence at a particular location. The earliness or late in maturity traits are utilized in the breeding programme for crop improvement. The data presented in table-1 depicted significant variation for days to harvesting among the accessions that differ from 139 .67 days (RAUG-5 and G-323) to 148.00 days (RAUG-13) and grand mean was 145.01 days. Result also exhibited that there was no one accessions have been found earlier to harvest over the control cultivar (G-323) but similar result with RAUG-5 and *at par* with RAUG-12. Variation in these plant growth parameters have already been attributed by Hariom and Srivastava (1976), Ahmed and Hoque (1986) and Islam *et al.* (2004).

Significant deviations were noticed among the lines pertaining to the polar and equatorial diameter of the individual bulbs (Table 2) which varied from 4.02 - 4.64 and 4.19 - 4.89 cm respectively. In both the cases the accession RAUG-5 performed better as compared to other lines and results at par with the control cultivar G-323.The bulb diameter with respect to polar side was lowest (4.02 cm) in case of RAUG-15 and in case of equatorial was for RAUG-1 (4.19 cm). The length and width of the garlic bulb as precisionally indicated as polar and equatorial diameter of the bulb decides the economic size and an important parameter to study for various genotypes in garlic pertaining to crop improvement. Variation in bulb size have also been confirmation with the studied of Korla and Rastogy (1979), Ahmed and Hoque (1686) and Islam *et al.* (2004) in garlic. genotypes of evaluated garlic lines under investigation produced bulbs in which the number of cloves per bulb and 10 cloves weight were observed to vary in a great extent from 7.00-26.80 and 3.55-7.80 g respectively. The greatest number of cloves per bulb (26.80) was counted for RAUG-18 and results parity with RAUG-5 (25.60) followed by RAUG-10 (23.00), however, lowest value was recorded for RAUG-8 with grand mean of 16.93 (Fig 1). While significantly maximum weight with respect to average 10 cloves (7.80 g) was found also for RAUG-5 overall other germplasm investigated along with established variety G-323 (7.14 g). The least weight of 10 cloves (3.55 g) was weighed in case of RAUG-11. The number of cloves per bulb and average 10 cloves weight attributed to the yield potential of the accessions and varied from each other might be due to their differences in genetic configuration which was supported by Hariom and Srivastava (1976), Korla and Rastogy (1979), Moeir (1979) and Andrad *et al*. (1982) during comparing some selected variety genotype of garlic.

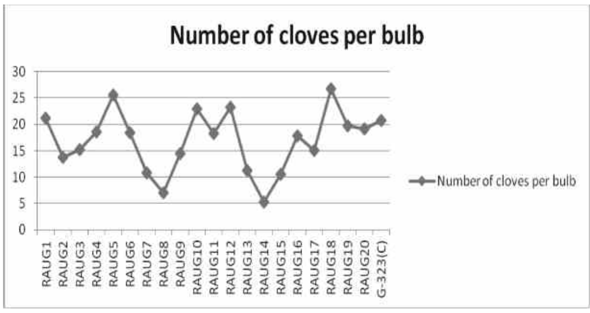

Fig 1: Performance of different germplasm for number of cloves per bulb

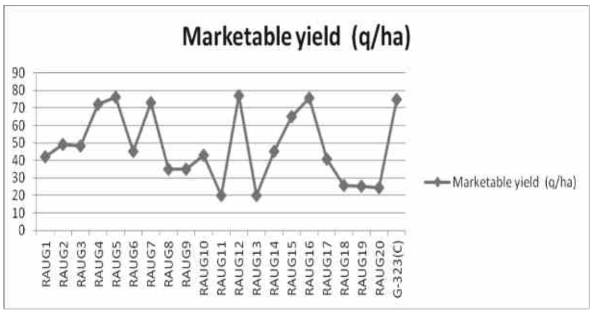

Fig 2: Performance of different germplasm for marketable yield (q ha^{-1})

Table 1: Performance of garlic genotypes for growth, yield and yield contributing characters (Pooled of 2 years)

Genotypes	Plant height (cm)	No. of leaves plant^{-1}	Days to harvest	Polar diameter (cm)	Equatorial diameter (cm)	No. of cloves bulb^{-1}	Average bulb weight (g)	Average weight of 10 cloves (g)	Marketable yield (q ha^{-1})	Total yield (q ha^{-1})
RAUG1	58.67	7.04	144.33	4.11	4.19	21.2	14.12	4.49	42.10	45.20
RAUG2	57.24	7.05	147.67	4.25	4.42	13.8	16.45	6.72	49.19	50.80
RAUG3	52.21	6.86	144.67	4.14	4.27	15.2	10.55	3.97	48.40	52.85
RAUG4	75.62	7.87	143.67	4.18	4.45	18.6	20.78	6.99	72.15	75.00
RAUG5	68.45	6.88	139.67	4.64	4.89	25.6	20.41	7.80	76.05	82.30
RAUG6	64.68	6.67	146.67	4.40	4.49	18.4	18.65	6.33	45.15	52.20
RAUG7	49.09	5.82	145.00	4.77	4.94	10.8	16.75	7.69	72.90	75.90
RAUG8	48.66	7.21	145.33	4.20	4.31	7.0	16.54	6.27	35.05	39.60
RAUG9	55.66	6.25	145.00	4.44	4.58	14.4	14.12	5.73	35.10	39.35
RAUG10	51.63	6.02	146.00	4.50	4.64	23.0	18.70	5.45	42.95	45.15
RAUG11	63.02	6.25	147.00	4.50	4.63	18.2	10.56	3.55	20.10	25.10
RAUG12	68.21	6.88	141.00	4.50	4.60	23.2	18.74	5.42	77.10	82.15
RAUG13	47.24	5.89	148.00	4.31	4.43	11.2	16.35	5.12	20.10	24.60
RAUG14	42.47	5.83	147.00	4.29	4.42	5.2	10.65	6.57	45.16	52.50
RAUG15	54.28	6.87	147.00	4.02	4.20	10.6	12.75	5.82	65.10	70.16
RAUG16	52.09	5.65	143.67	4.15	4.26	17.8	20.54	7.19	75.90	80.21
RAUG17	44.06	5.21	143.00	4.26	4.35	15.0	14.41	5.60	40.65	45.50
RAUG18	64.46	7.05	146.67	4.42	4.56	26.8	14.21	3.80	25.50	30.15
RAUG19	43.22	5.06	147.33	4.39	4.54	19.8	14.54	4.70	25.10	30.90
RAUG20	44.05	5.25	147.00	4.29	4.43	19.2	20.52	6.85	24.40	30.60
G-323(C)	57.78	6.47	139.67	4.62	4.80	20.71	19.64	7.14	74.90	80.87
Grand Mean	**55.37**	**6.38**	**145.01**	**4.35**	**4.49**	**16.93**	**16.18**	**5.86**	**48.24**	**52.90**
Sem (±)	**1.77**	**0.89**	**2.38**	**0.10**	**0.09**	**0.43**	**0.33**	**0.08**	**5.58**	**7.55**
LSD (0.05)	**4.01**	**1.96**	**5.14**	**0.30**	**0.26**	**1.20**	**0.92**	**0.23**	**11.61**	**15.53**

Regarding the average weight of bulb (Table 2) for different genotypes showed different from as low as 10.55 g (RAUG-3) results *at par* with RAUG-11 (10.56 g) and RAUG-14 (10.65 g) to as high as 20.78 g for RAUG-4 genotype while performance did not differed significantly with RAUG-5 (20.45 g), RAUG-16 (20.54 g) and RAUG-20 (20.52 g) followed by the control variety G-323 (19.64 g) used for standard check. Variations in bulb weight of garlic for different lines are in accordance with the finding of Agarwal and Tiwari (2013). It is also worthwhile to mention the report of Thompson and Kelly (1976).

The different genotypes of garlic under studied had different yield potential pertaining to marketing yield as well as total yield (q ha^{-1}) and were observed to vary from 20.10-76.05 and 24.60- 82.80 q ha^{-1}respectively, while the general mean was 48.24 and 52.90 q ha^{-1} for marketable and total yield. In both the parameters *i.e.*, marketable yield and total yield the genotype RAUG-5 performed better 76.05 and 82.80 q ha^{-1}respectively over other accessions and results were *at par* with RAUG-16 (75.90 qha^{-1}) and G-323 (74.90qha^{-1}) for marketable yield (Table 2 and Fig 2). However, the significantly lowest value for both the traits 20.10 and 24.60 q ha^{-1}respectively was observed for genotype RAUG-13 and similar digits had reflected for genotypes RAUG-11 for marketable yield. Variation in bulb yield among different genotypes might be attributed to their genetic makeup and ability for different in net assimilation rate resulting into production of photosynthates. The variations in the bulb yield of different genotypes of garlic have also been reported (Bisht and Agarwal, 1996; Kaur *et al*., 1994; Agarwal and Tiwari, 2005; 2013). Superiority of RAUG-5 garlic genotype has also been reported by Agarwal and Tiwari (2013).

Considering yield potential and other desirable traits the superior genotypes are RAUG-5RAUG-16, RAUG-12, RAUG-7 and RAUG-4 that can be selected preliminarily and might be used for further breeding trial for further crop improvement with a view to develop new varieties.

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