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Performance of garlic (*Allium sativum* L.) genotypes for yield and quality attributes under central dry zone of Karnataka

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Abstract
Garlic (*Allium sativum* L.)is an important ingredient in daily Indian diet and various researches have proved that garlic is good for health and is beneficial in curing various health problems. It has been shown to display anti-bacterial, anti-fungal, anti-atherosclerotic and anti-carcinogenic effects. Nine different garlic genotypes were evaluated at Zonal Agricultural and Horticultural Research Station, Babbur Farm, Hiriyur, during the year of 2016-17 with the main objective to select the promising genotypes for yield and qualitative traits. Among nine genotypes, maximum total soluble solids was recorded in the genotype Agrifound White (40.38 %), whereas the least was recorded in Bhima Purple (32.81 %). Maximum pyruvic acid content was recorded in Yamuna Safed (27.19 µ moles per g fresh weight), while the minimum pyruvic acid content was recorded in Agrifound Parvati (21.15 µ moles per g fresh weight). The highest polar diameter (4.42 cm), equatorial diameter (3.96 cm) and average bulb weight (19.01 g) was noticed in the genotype Bhima Purple. The highest yield was recorded in the genotype Bhima Purple (8.65 t/ha) which was on par with Yamuna Safed-3 (8.59 t/ha), while the minimum yield was observed in the genotype Bhima Omkar (5.20 t/ha).

Keywords: *Allium sativum* L., medicinal value, yield and quality parameter

Introduction
Garlic (*Allium sativum* L.) is the second most widely cultivated vegetable crop after onion, under the genus *Allium* and belongs to the family Alliaceae having chromosome number 2n (2X) = 16. India is the second largest garlic producing country with production of 12.52 lakh tonnes from 2.31 lakh hectare area and having an average productivity of 5.44 tonnes per hectare. In India major garlic producing states are Madhya Pradesh, Gujarat, Uttar Pradesh, Rajasthan, Assam, Punjab, Maharashtra, West Bengal and Haryana. In Karnataka, garlic is grown during *Rabi* season in an area of 5.19 thousand hectares with production of 5.47 thousand ton and a productivity of 1.05 tons per hectare (Anon, 2015) [4].

Garlic has been used since ancient times for both culinary and medicinal purposes (Butt *et al*., 2009) [6]. It is an important ingredient in daily Indian diet. Various researches have proved that garlic is good for health and is beneficial in curing various health problems. It has been shown to display anti-bacterial, anti-fungal, anti-atherosclerotic, hypoglycemia, detoxification and anti-carcinogenic effects (Pal *et al*., 2006 and Shinkawa *et al*., 2009) [12, 18]. Some authors also reported that garlic is effective in regulating plasma lipid levels (Shinkawa *et al*., 2009) [18] and increases plasma anti-coagulant activity (Ackermann *et al*., 2001) [2]. Several studies have demonstrated garlic and its organo-sulfur compounds to be potent antioxidants by displaying radical-scavenging activity and modulating cellular antioxidant enzyme activity. The unique flavor and health-promoting functions of garlic are generally attributed to its rich content of sulfur-containing compounds such as alliin, g-glutamylcysteine and their derivatives (Tsai *et al*., 2012) [21]. Presence of these sulphur compounds in garlic is the cause of its pungent smell. Garlic acts as an antiseptic and helps in curing the wounds very quickly. By adding a freshly cut raw clove to food three times a day helps in fighting against various infection and acts against inflammation, including colds and coughs. Studies in China have shown that garlic contains chemicals that prevent cancer.

However, in spite of all advantages and health benefits farmers are less interested for garlic cultivation due to non-availability of specific varieties or genotypes for suitable regions as the performance of genotypes varies with region, season and other growing conditions. Hence, there is a prime need to evaluate some of the available genotypes to find out their suitability, this intern could have a great potential for the commercial production of garlic. Thus numerous varieties are developed in garlic but very little information regarding their performance in central dry zone of Karnataka. Therefore, identification of high yielding genotypes is a continuous process for recommending for cultivation in a specific region, however which can be furthermore used in varietal improvement. Hence, evaluation of garlic genotypes is very essential to see the performance of genotypes for their adoptability and agronomic performance like yield and quality traits to identify the potential genotype.

Meterial and Methods

The present investigation was carried out at Zonal Agricultural and Horticultural Research Station, Babbur farm, Hiriyur, Karnataka. Nine genotypes such as Yamuna Safed-3, Agrifound Parvati, Yamuna Safed, Yamuna Safed-2, Yamuna Safed-8, Agrifound White, Bhima Purple, Bhima White and Rajalli Gadde were tested in randomized block design with three replications during the *rabi* season of 2016-17. The cloves of garlic varieties were dibbled in flat beds at a spacing of 15 cm X 10 cm in a plot size of 2 m X 2 m. The recommended cultural practices were followed for raising good crop. Five plants from each plot were selected randomly to record the observations on polar diameter (cm), equatorial diameter (cm), average bulb weight (g), total bulb yield per hectare (t), total soluble solids (%), pyruvic acid (µ moles per gram fresh weight), shape of mature bulbs, bulb skin colour and clove skin colour. The cloves of ten randomly selected garlic bulbs were crushed and the paste was used to find the total soluble solids in samples (Nieuwhof *et al.*, 1973) [11] and the total soluble solids values were recorded with the help of digital refractometer and expressed in per cent. Pungency was estimated according to method described by Anthon and Barrett (2003) [5].

Result and Discusion

The results obtained in the present investigation of evaluation of garlic (*Allium sativum* L.) genotypes for their yield and quality parameters under central dry zone of Karnataka during *rabi* of 2016-17 are discussed and presented in Table 1 and 2.

Yield parameters

The data pertaining to polar diameter (cm), equatorial diameter (cm), average bulb weight (g), average number of cloves per bulb, average weight of ten cloves, per cent marketable yield, total bulb yield per hectare (t), total soluble solids and pyruvic acid differed significantly during *rabi* of 2016-17 under central dry zone of Karnataka (Table 1).

Table 1: Mean performance of garlic genotypes for yield and quality parameters

Sl. No.	Genotypes	PD (cm)	ED (cm)	ABW (g)	ANCB	AWTC	PMY	TY (t/ha)	TSS (%)	PA(µ moles)
1	Yamuna Safed-3	3.87	3.30	15.06	12.67	14.27	84.42	8.59	38.29	24.36
2	Agrifound Parvati	4.26	3.68	14.44	11.00	12.97	82.60	8.03	36.61	21.15
3	Yamuna Safed	3.81	3.06	12.61	9.67	9.27	74.67	7.51	37.63	27.19
4	Yamuna Safed-2	3.24	3.02	12.88	10.67	10.20	78.61	6.97	38.75	25.18
5	Yamuna Safed-8	3.35	2.98	11.55	8.33	7.73	68.87	6.17	35.58	23.09
6	Agrifound White	3.51	3.28	11.97	10.00	9.36	81.24	5.62	40.38	26.82
7	Bhima Purple	4.42	3.96	16.43	6.67	16.10	83.56	8.65	32.81	21.73
8	Bhima Omkar	3.30	3.00	10.57	6.00	7.11	71.11	5.20	36.51	24.10
9	Rajalli Gadde	3.75	3.39	12.22	11.67	10.45	79.26	7.12	35.54	23.26
	Mean	3.72	3.30	13.08	9.63	10.83	78.26	7.10	36.90	24.10
	S. Em ±	0.03	0.04	0.37	0.39	0.22	2.23	0.23	0.45	0.60
	CD at 5%	0.10	0.13	1.10	1.17	0.67	6.69	0.69	1.34	1.80

Whereas, PD- Polar diameter, ED- Equatorial diameter, ABW- Average bulb weight, ANCB- Average number of cloves per bulb, AWTC- Average weight of ten cloves, TY- Total yield, PMY- Per cent marketable yield, TSS- Total soluble solids and PA- Pyruvic acid.

The results revealed that, differences among the genotypes for yield parameters were found to be highly significant. Among the nine genotypes evaluated, Bhima Purple recorded highest polar diameter (4.42 cm) followed by Agrifound Parvati (4.26) as compared to rest of the genotypes. Whereas, significantly highest equatorial diameter (3.96 cm) was noticed in the genotype Bhima Purple. The significantly maximum average bulb weight was recorded in Bhima Purple (16.43 g) followed by Yamuna Safed-3 (15.06 g) as compared to rest of the genotypes. Yamuna Safed-3 produced highest number of cloves per bulb and maximum average weight of ten cloves was recorded in Bhima Purple (16.10). The highest yield was recorded in the genotype Bhima Purple (8.65 t/ha) which was on par with Yamuna Safed-3 (8.59 t/ha), while the minimum yield was observed in the genotype Bhima Omkar (5.20 t/ha). Maximum per cent marketable yield was recorded in Bhima Purple (84.42). The highest yield of bulbs from these genotypes can be attributed to maximum plant height, leaf number and leaf length as they have physiological capacity to mobilize and translocate photosynthates to organ of economic value which in turn might have increased the bulb yield. It may be related to highest polar diameter, equatorial diameter, average bulb weight and average weight of ten cloves which are major yielding contributing components and also these differences could be attributed to genetic architecture of the genotype. These results are in agreement with the findings of Shigwedha *et al*. (2009) [17], Umamaheswarappa *et al*. (2014) [22] and Fanaei *et al*. (2014) [7].

The results showed that significantly maximum TSS (40.38 %) was recorded in the genotype Agrifound White as compared to rest of the genotypes and lowest total soluble solids was noticed in the genotype Bhima Purple (32.81 %). Yamuna Safed recorded maximum pyruvic acid content (27.19 µmoles) which was on par with Agrifound White (26.82 µmoles) and it was lowest in the genotype Agrifound Parvati (21.15 µ moles) (Table 1). The variation might be due to genetic characteristic of the genotypes Sharma *et al*. (2015) [16] and Abedi *et al*. (2013) [1].

Quality parameters

The data pertaining to shape of mature bulbs, bulb skin colour and clove skin colour in different genotypes are presented in Table 2. Among nine genotypes Bhima Omkar showed flat shape bulbs and genotypes viz., Yamuna Safed-3, Yamuna Safed-2, Yamuna Safed, Yamuna Safed-8, Bhima Purple, Agrifound White, Agrifound Parvati and Rajalli Gadde showed round shape bulbs. Genotype Agrifound Parvati showed purplish white bulb colour and genotypes viz., Yamuna Safed-3, Yamuna Safed-2, Yamuna Safed, Yamuna Safed-8, Bhima Omkar, Rajalli Gadde and Agrifound White showed white bulb colour whereas, Bhima Purple showed light purple colour.

Table 2: Qualitative characters of different garlic genotypes

Sl. No.	Genotypes	Shape of mature bulb	Bulb skin colour	Clove skin colour
1	Yamuna Safed-3 (G-282)	Round	White	White
2	Agrifound Parvati (313)	Round	Pinkish White	Pinkish White
3	Yamuna Safed (G-1)	Round	White	White
4	Yamuna Safed-2 (G-50)	Round	White	Creamy White
5	Yamuna Safed-8 (G-384)	Round	White	White
6	Agrifound White (G-41)	Round	White	White
7	Bhima Purple	Round	Light Purple	Light Purple
8	Bhima Omkar	Flat	White	White
9	Rajalli Gadde	Round	White	White

Genotype Agrifound Parvati showed purplish white clove skin colour and genotypes viz., Yamuna Safed-3, Yamuna Safed, Yamuna Safed-8, Bhima Omkar, Rajalli Gadde and Agrifound White showed white clove skin colour, genotype Yamuna Safed-2 showed creamy white clove skin colour whereas, Bhima Purple showed light purple clove skin colour. The variation might be due to varietal character. These results are in agreement with the findings of Mishra *et al*. (2013) [10] and Prajapati (2015) [14].

Acknowledgment

It was evident from the study that, considerable degree of variability exists among the genotypes for yield and quality characters. Bhima Purple and Yamuna Safed-3 were found best performing genotypes for yield trait. The most promising genotypes for Pyruvic acid and total soluble solids contents were recorded in Yamuna Safed and Agrifound White respectively.

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