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EVALUATION OF GARLIC (*ALLIUM SATIVUM* L.) BULB GENOTYPES FOR YIELD AND QUALITY CHARACTERISTICS

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ABSTRACT

Garlic (*Allium sativum* L.) has been recognised for all over the world as a valuable spice. In order to identify good quality garlic genotypes were tested at Horticulture Research and Extension Centre Arsikere, University of Horticultural Sciences, Bagalkot, Karnataka. The observation was recorded for agronomic traits and six quality parameters. Significant difference was recorded in the performance of the garlic genotypes in rabi and kharif seasons. The total yield per hectare recorded highest values in genotype GS-38, GS-36, GS-50 (Yamuna safed), GS-35 and GS-49 (Bhima purple). The lowest yield was recorded in GS-34. The higher bulb yield may be attributed to cumulative effects of number of leaves per plant, polar and equatorial diameter of bulb, number of cloves per bulb and average weight of cloves. The quality parameters like TSS, pungency, allicin, sulpur and chlorophyll content were recorded highest values in rabi season than kharif season. The quality parameters like neck thickness were reported to be highest in genotypes GS-35 during rabi season, kharif and pooled analysis (1.80 cm 1.62 and 1.71 cm respectively). The GS-38 recorded the highest TSS during rabi season (41.20 %) and kharif season (37.56%).The oty-1 recorded significantly highest pungency (44.99 µmole of PA/ g of FW),while, GS-36 recorded significantly highest protein (17.67%) in pooled data. The results of this study could be useful for improving garlic production under central dry zone of Karnataka. The genotype 36 and GS-38 have high bulb weight, yield with allicin, sulphur content. It can be released as variety after multiplication testing.

Keywords **:** Garlic, genotypes, khariff, rabi, protein, pungency.

Introduction

Garlic (*Allium sativum* L.) is the second most widely cultivated spice crop after onion, under the genus *Allium* and it belongs to the family Alliaceae. It is an important bulbous vegetable, spice or condiment with medicinal value used throughout the world. It is multiple or compound bulb consisting of 10-20 bulblets or segments called clove covered by parchment membrane. The genus *Allium* is one of the largest genera of the Alliaceae family comprising of 450 species and most of them are biannual plants bearing underground storage bulb and bulbils (Lanzotti, 2006), which are of high economic significance (Kamenetsky and Rabinowitch, 2006).

Garlic is used as vegetable in combination with onion, tomato and ginger in preparation of curries, curry powder, pickling, dehydrated products, garlic paste, garlic oils and garlic powder. Garlic powder and oil is used in pharmaceutical preparations. Besides bulbs, leaves and rarely bearing flowers and top set bulbils on the scape which are also edible. Many investigators studied quality variation among the garlic genotypes. Because garlic does not produce seed, breeder cannot develop cultivar specific to growing regions. So garlic can be improved by selection and

planted genotypes most productive, qualitative under central dry zone of Karnataka. The objectives of this study was to evaluate the performance of fifty-two garlic genotypes for yield and quality characteristics.

Materials and Methods

Fifty-two diverse garlic genotypes/varieties were collected from different parts of the country. The different genotypes along with released verities were planted in RBD with 3 replications at HREC Arsikere. Planting of individual cloves was done at a spacing of 15X10cm.The recommended agronomic practices were followed to ensure a healthy crop growth and development. The soil of the experimental block was black with medium organic matter. The area is located in 800 mt MSL, mean minimum temperature 13.84^0 C, the mean maximum temperature 34.62^0 C with average rainfall 694 mm peak in May-June and September-October. Observations were recorded for yield and qualities characteristics on randomly selected 5 plants in each replication for the all the characters viz. number of clove, bulb weight (gram), bulb yield per hectare (kg), neck thickness, TSS, Pugency, protein, chlorophyll, sulphur, and allicin by using the standard methods. The data of different genotypes and varieties characters statistically analyzed as stated by Panse and Sukhatme (1967).

Table 1: Source of collection of genotypes/varieties under study.

S. No.	Garlic Genotype	Source of collection
01	GS-1,GS-2,GS-3,GS-4,GS-5,GS-6	Mandya Pradesh
02	GS-7,GS-8,GS-9,GS-10,GS-11	Uttar Pradesh
03	GS-12,GS-13	Jammu
04	GS-14,GS-15	Tamil Nadu
05	GS-16,GS-17,GS-18,GS-19,GS-20,GS-21,GS-22,GS-23	DOGR, Pune, Maharastra Maharashtra
06	GS-24,GS-25,GS-26,GS-27,GS-28	Karnataka
07	GS-29,GS-30,GS-31,GS-32,GS-33,GS-34	Gujarat
08	GS-35,GS-36,GS-37,GS-38,GS-39,GS-40	Haryana
09	GS-41,GS-42,GS-43	Rajasthan
10	GS-44,GS-45	New Delhi
11	GS -46 (DWG-1)	UAS, Darwad
12	GS -47(DWG-2)	UAS, Darwad
13	GS -48 (Swetha)	MPKV, Rahuri
14	GS -49 (Bhima purple)	DOGR,Pune, Maharastra
15	GS -50 (Yamanasafed)	NHRDF, Nasik
16	GS -51 (Oty -1)	TNAU, Coimbatore
17	GS -52 (AAS-2)	UHS, Bagalkot

Result and Discussion

Number of cloves per bulb

The number of cloves per bulb for the rabi season was found to be varied from 7.47 to 22.57 across the genotypes. The results indicated the mean highest number of cloves per bulb was noticed in GS-38 (22.57) followed by GS-35 (22.23),GS-50 (21.57) and GS-36 (21.47) as compared to check variety GS-52 (20.22).The lowest number of cloves per bulb was significantly recorded in GS-20 (8.60) during rabi season.

In kharif season among genotypes evaluated, GS-38 found recorded highest number of cloves per bulb (21.98) followed by GS-35 (21.47) and GS-34 (20.47), while minimum number of cloves per bulb was observed in GS-33(6.03). The genotypes studied resulted in significant differences for number of cloves per bulb from mean pooled data analysis. The genotype GS-35 found significantly more number of cloves per bulb (21.85) followed by GS-38 (21.78), GS-36 (20.72) and GS-50 (20.12), while lowest number of cloves per bulb was recorded in GS-33(7.37). All the genotypes recorded highest number of cloves per bulb during rabi season than kharif season. However, the mean data of the number of cloves per bulb was recorded highest in rabi season (15.22) than kharif season (13.04).

The combined impacts of plant height, cloves per bulb, and average clove weight may result in higher bulb yield. The number of cloves attributed to the yield potential of the genotype and variation among the genotype might be due to genetic makeup of that genotype.

Bulb weight

During rabi season mean data of bulb weight varied significantly among the genotypes ranged from 7.60 to 20.57 g. The mean highest bulb weight was documented in genotypes GS-38 (20.57 g) followed by

GS-50 (20.17 g), GS-36 (19.80 g), GS-49 (19.43 g) and GS-35 (19.0 g). However, the mean lowest bulb weight was recorded in GS-48(8.03 g).

Bulb weight from kharif season mean analysis was found to be significantly varied from 6.57 gram to 17.70 gram. The mean highest bulb weight was recorded in GS-38 (17.61 g) followed by GS-50 (16.60 g) and GS-35 (17.70 g) compared to minimum recorded in GS-48(6.98 g).

In pooled analysis the range of significant variation was observed among the germplasm for bulb weight varied from 7.09 to 19.14 g. The highest bulb weight was significantly highest recorded in GS-38 (19.09 g) followed by GS-50 (18.39 g) GS-36 (18.40 g) and GS-35 (18.75 g).Among different genotypes studied, the lowest bulb weight was noticed in GS-48 (7.51g). All the genotypes recorded highest bulb weight during rabi season than kharif seasons. However the mean data of the bulb weight was recorded highest in rabi season (14.13 g) than kharif season (12.78 g).

Bulb yield per hectare

During rabi season data, total yield per hectare ranged from 4.11 to 10.53tonnes per ha with a mean of 6.60tonnes per ha. The results revealed that the genotype GS-38(10.53 t/ha) recorded the highest yield and it was on par with GS-36 (10.13 t/ha), GS-50 (9.90 t/ha), GS-35 (9.58 t/ha). However, the lowest yield was documented in GS-44 (4.11 t/ha) among different genotypes.

During kharif season data, among 52 garlic genotypes evaluated, results revealed that the genotype GS-35recorded the highest yield (8.71t/ha) followed by GS-38 (8.51 t/ha), GS-50(8.43 t/ha) and GS-16 (7.90 t/ha) among different genotypes.

The yield of mean data varied from 3.88tonne to 9.62tonnes. Among the garlic genotypes observed under study, the genotype GS-38 recorded significantly highest bulb yield per hectare (9.52 tonne) followed by GS-36 (9.11 tonn), GS-50 (9.21 tonne),GS-35 (9.15 tonne), GS-27 (8.54tonne). However lowest bulb yield per hectare was found in GS-34 (4.15tonne) compared to all other genotypes. Further the mean data of the yield per hectare was recorded highest in rabi season (6.60tonne/ha) than kharif season (5.96 tonn/ha).

The genotype GS-38 recorded significantly highest bulb per hectare during rabi season and mean analysis (10.53 tonnes and 8.51tonnes per hectare respectively) and followed by GS-36 recorded bulb per hectare during rabi season, kharif season and mean analysis (10.13 tonnes, 8.08 and 9.11 tonnes per hectare respectively) and genotype GS-50 recorded bulb per hectare during rabi season, kharif and mean data (9.99 tonnes, 8.43 tonnes and 9.21tonnes respectively).

The total yield per hectare recorded highest values in genotype GS-38, GS-50 (Yamuna safed), GS-36, GS-35 and GS-49 (Bhima purple). The lowest yield was recorded in GS-34. The higher bulb yield may be attributed to cumulative effects of number of leaves per plant, polar and equatorial diameter of bulb, number of cloves per bulb and average weight of cloves. The variation in yield amongst the cultivars was also reported by Partha and Ranjit (2009); Lawande *et al.* (2009); Panse *et al.* (2013); Mishra *et al.* (2013); Umamaheshwarappa *et al.* (2014); and Tarique (2015).

Neck thickness of the bulb

The observation recorded for this trait during rabi season showed 52 garlic genotypes of present study, the mean highest neck thickness was recorded in GS-15(1.80 cm) followed by GS-36(1.71 cm), GS-1(1.61 cm) and GS-42 (1.61cm). Whereas lowest neck thickness was recorded in GS-32(0.49 cm) compared to all other genotypes.

During kharif season the neck thickness significantly recorded highest in genotype GS-15(1.62cm) followed by GS-36(1.54cm), GS-14(1.46 cm), and GS-15(1.62 cm). Whereas lowest neck thickness was significantly recorded in GS-32(0.44 cm) compared to all other genotypes.

In pooled analysis of both seasons, neck thickness significantly varied from0.47 cm to 1.71 cm with total mean of 1.20 cm. Among the 52 genotypes GS-35 recorded significantly higher neck thickness (1.71cm) followed by GS-36(1.62 cm).GS-14(1.54 cm), GS-1(1.53 cm). The genotype GS-32 noted lowest neck thickness content than other genotypes.

Lowest neck thickness increases the storage life of the cultivars by reducing the neck rot which might be due to improper curing. The genotype GS-32 recorded the minimum neck thickness. However, maximum neck thickness after curing was noticed in GS-35, GS-36, GS-14, GS-01 and GS-50 (Yamuna safed). The variation present among the genotypes might be due to varietal character. Similar findings were reported by Mohanty and Prusti (2002); Moustafa *et al.* (2009); Kamala *et al.* (2011); and Sharma *et al.* (2015).

Total soluble solids (%)

The per cent TSS content of the different garlic genotypes is presented in Table 3.TSS content was ranged between 23.60 to 41.20 per cent. The genotype GS-38 recorded highest TSS (41.20 %) which was on

par with GS-36 (39.60 %) and followed byGS-26 (39.60%), GS-25 (36.52%), GS-17 (29.70 %), GS-48 (38.46%) While, lowest TSS was noticed in GS-6 (23.60 %) during rabi season.

The observation recorded for TSS of kharif season studied in 52 garlic genotypes showed significant difference among genotypes. The highest value was observed in GS-38 (37.56%) and followed by GS-36(36.54%), GS-29 (35.96%), GS-27(34.96%) and GS-28 (34.56%), while lowest value was noted in GS-6(18.95%) compared to other genotypes. The genotype GS-38 recorded higher values for TSS followed by GS-36, GS-17, GS-25 and Yamuna safed. While, lower TSS was recorded in GS-6. The variation might be due to genetic characteristic of the genotypes. These variations are similar to the findings of Seifel *et al.* (2011); Dubey and Singh (2012); Singh *et al.* (2012).

Pungency (µmole of pyruvic acid/ g of FW)

Pungency in different cultivars varied from 20.65 to 44.99 µmole of PA/ g of FW with a mean of 31.35 µmole of PA/ g of FW. The mean highest pungency was noticed in Oty-1 (44.99 µmole of PA/ g of FW) followed by Bhima purple (42.16 µmole of PA/ g of FW), GS-36 (41.04 µmole of PA/ g of FW) and GS-27 (40.86 µmole of PA/ g of FW) in pooled data analysis. However, the lowest pungency was recorded in GS-12 (20.65 µmole of PA/ g of FW). The same trend was noticed in kharif and rabi season also.

A significant difference was recorded for the pungency content in different garlic genotypes. Highest pungency was recorded in Oty-1, Bhimapurple, GS-36, GS-27 and GS-26. However, the lowest pungency was recorded in GS-12. The variation in pungency level might be due to genetic makeup of the varieties. Similar reports are made by Adela *et al.* (2013).

Crude protein (%)

The per cent crude protein content is illustrated in table 4. The crude protein content ranged from 9.92 to 17.67 per cent. The result revealed that genotype GS-27 (17.67 %) recorded pooled mean higher crude protein which was on par with GS-36 (17.03 %) and GS-11 (16.98 %), while, pooled mean lowest crude protein was recorded in GS-4 (10.37 %) However, six genotypes found to be above mean of 14.45 per cent in two years pooled analysis.

The result revealed that genotypes GS-27, GS-36, Yamuna safed, GS-11 and GS-38 recorded highest crude protein content. The variation in protein content might be due to the varietal character and similar variations for crude protein content was recorded by Moustafa *et al.* (2009).

Chlorophyll content (SPAD value)

The chlorophyll content ranged from 39.21 to 81.59 per cent. The result revealed that Swetha variety (81.59 %) has recorded highest chlorophyll content which was on par with Bhima purple (78.91 %), GS-20 (73.05 %), and GS-4 (72.16 %) While, lowest chlorophyll content was recorded in GS-35 (40.87 %) in pooled mean analysis. The same trend was noticed in kharif and rabi season also.

A significant difference was recorded for the chlorophyll content in different garlic genotypes. Highest chlorophyll was recorded in GS-38, Swetha, Bhīma purple, GS-20 and GS-4. However, the lowest chlorophyll was recorded in GS-35. The variation in chlorophyll level might be due to genetic makeup of the varieties.

Sulpur (%)

The result revealed that genotype GS-4 has recorded highest sulpur content (0.05 %) which was on par with GS-38 (0.04 %), GS-36 (0.03 %) and Yamuna safed (0.03 %) while, lowest sulphur was recorded in GS-20 (0.01 %) in 2 years pooled mean analysis. The same trend was noticed in kharif and rabi season also. The result revealed that genotype GS-4, GS-38, GS-36, Yamuna safed and GS-35 recorded highest sulphur content. While, lowest sulphur was recorded in GS-20. The variation in sulphur content is might be due to the varietal character.

Allicin (%)

The per cent Allicin were analyzed in different garlic genotypes and presented in Table 4. Allicin content was found to be highestGS-31(0.85 %) which was at par with GS-38 (0.75 %), GS-34 (0.71 %),GS-12(0.71%)and GS-5(0.71),while, the lowest was found in GS-42(0.41 %) during rabi season mean data.

During kharif season the highest content of allicin was noticed in genotype GS-31 (0.75 %), it was on par with GS-12 (0.71%), followed by GS-38(0.70 %) and GS-27 (0.69 %), However, the mean lowest was found in GS-42 (0.41%).At pooled analysis, Allicin content was found to be highest GS-31(0.80 %) which was at par with GS-38(0.73%) and followed by GS-36(0.71%), GS-12(0.71%) and GS-1(0.68%), while, the lowest was found in GS-22(0.37 %).

The result revealed that genotype GS-31,GS-38,GS-36 and GS-12 recorded highest allicin content and lowest was recorded in GS-22. The variation in allicin content is might be due to the varietal character and similar variations for allicin content was recorded by Moustafa *et al.* (2009).

Conclusion

GS-36, GS-38 and GS-50 (Yamuna safed) may directly be adopted in the production in central dry zone of Karnataka and theses are nominated genotypes for breeding programme to improve productivity and quality of the studied garlic genotypes.

Table 2: Mean performance of yield parameters of different garlic genotypes

Genotypes	Number of cloves per bulb			Bulb Weight (gram)			Yield per hectare (tons)		
	Rabi	Kharif	Mean	Rabi	Kharif	Mean	Rabi	Kharif	Mean
GS -1	15.32	12.67	14.00	10.48	9.04	9.76	5.65	5.26	5.46
GS-2	15.38	11.93	13.66	12.42	11.54	11.98	5.68	5.57	5.63
GS-3	16.17	13.00	14.59	15.67	13.57	14.62	4.88	5.11	5.00
GS-4	20.38	20.42	20.40	16.40	14.50	15.45	6.07	6.11	6.09
GS-5	15.37	13.93	14.65	10.83	13.17	12.00	5.79	5.73	5.76
GS-6	20.02	18.21	19.12	17.10	13.63	15.37	6.45	5.95	6.20
GS-7	19.20	19.14	19.17	10.17	12.60	11.39	5.02	3.99	4.51
GS-8	13.53	10.27	11.90	12.57	9.17	10.87	6.20	6.25	6.23
GS-9	13.33	11.31	12.32	9.63	8.60	9.12	5.99	5.03	5.51
GS-10	21.08	16.63	18.86	8.92	8.07	8.50	6.11	6.02	6.07
GS-11	18.20	18.15	18.18	7.60	7.43	7.52	5.26	5.05	5.16
GS-12	15.57	13.85	14.71	9.06	9.60	9.33	5.57	5.23	5.40
GS-13	14.87	10.68	12.78	8.03	7.13	7.58	6.91	6.10	6.51
GS-14	13.13	11.53	12.33	17.63	13.50	15.57	7.39	6.83	7.11
GS-15	19.48	16.53	18.01	16.43	16.43	16.43	8.45	8.24	8.35
GS-16	16.53	13.30	14.92	15.20	13.97	14.59	8.12	7.90	8.01
GS-17	10.44	8.25	9.35	18.08	15.20	16.64	8.32	7.82	8.07
GS-18	13.57	10.58	12.08	15.83	13.73	14.78	8.19	7.00	7.60
GS-19	10.57	8.16	9.37	16.77	14.43	15.60	7.55	7.06	7.31
GS-20	8.60	6.57	7.59	16.57	13.55	15.06	5.90	5.34	5.62
GS-21	12.00	6.93	9.47	13.47	11.63	12.55	6.84	6.12	6.48
GS-22	11.23	8.44	9.84	13.47	13.57	13.52	5.94	4.97	5.46
GS-23	8.55	8.30	8.43	10.45	9.90	10.18	5.11	5.10	5.11
GS-24	9.48	9.51	9.50	14.60	13.50	14.05	5.82	5.74	5.78
GS-25	17.93	16.53	17.23	9.41	10.69	10.05	6.19	6.17	6.18
GS-26	17.60	15.57	16.59	11.17	11.80	11.49	6.12	6.07	6.10
GS -27	19.65	17.07	18.36	15.83	14.83	15.33	9.08	8.00	8.54
GS-28	14.63	11.45	13.04	15.77	14.27	15.02	5.36	4.93	5.15
GS-29	15.60	11.60	13.60	13.60	14.65	14.13	8.25	7.45	7.85
GS-30	9.53	7.52	8.53	12.57	12.48	12.53	7.37	5.97	6.67
GS-31	14.47	11.87	13.17	12.60	11.30	11.95	6.40	5.34	5.87
GS-32	8.70	8.63	8.67	10.53	11.00	10.77	6.41	4.03	5.22
GS-33	8.71	6.03	7.37	10.43	9.90	10.17	5.33	3.97	4.65
GS-34	7.47	7.47	7.47	9.53	8.32	8.93	4.28	4.02	4.15
GS-35	22.23	21.47	21.85	19.00	17.70	18.35	9.58	8.71	9.15
GS-36	21.47	19.97	20.72	19.80	17.00	18.40	10.13	8.08	9.11
GS-37	11.57	9.63	10.60	11.57	11.37	11.47	9.07	8.11	8.59
GS-38	22.57	20.98	21.78	20.57	17.61	19.09	10.53	8.51	9.52
GS-39	10.53	9.40	9.97	14.67	13.54	14.11	6.41	5.19	5.80
GS-40	10.60	8.83	9.72	10.53	11.02	10.78	6.10	5.12	5.61
GS-41	16.43	13.37	14.90	15.27	11.49	13.38	6.28	6.38	6.33
GS-42	12.90	11.17	12.04	12.52	10.94	11.73	5.34	5.36	5.35
GS-43	10.57	10.07	10.32	12.93	10.42	11.68	6.12	5.09	5.61
GS-44	19.97	17.53	18.75	9.63	6.57	8.10	4.11	4.17	4.14
GS-45	16.43	13.57	15.00	17.80	14.31	16.06	4.70	3.64	4.17
GS -46 (DWG-1)	17.43	15.60	16.52	10.14	8.25	9.20	4.25	3.98	4.12
GS -47(DWG-2)	19.47	16.13	17.80	9.73	9.43	9.58	6.35	5.30	5.83
GS -48 (Swetha)	15.57	11.57	13.57	8.03	6.98	7.51	4.98	5.24	5.11
GS -49 (Bhima purple)	15.57	13.60	14.59	19.43	16.59	18.01	5.82	6.07	5.95

GS -50 (Yamanasafed)	21.57	18.67	20.12	20.17	16.60	18.39	9.99	8.43	9.21
GS -51 (Oty -1)	19.80	16.32	18.06	16.83	14.63	15.73	9.38	7.67	8.53
GS -52 (AAS-2)	20.22	18.33	19.28	10.70	9.55	10.13	6.05	5.22	5.64
Mean	**15.22**	**13.04**	14.13	**13.43**	**12.13**	12.78	**6.60**	**5.96**	6.28
Maximum	**22.57**	**21.47**	22.02	**20.57**	**17.70**	19.14	**10.53**	**8.71**	9.62
Minimum	**7.47**	**6.03**	6.75	**7.60**	**6.57**	7.09	**4.11**	**3.64**	3.88
SE d	**1.19**	**0.89**	1.04	**1.15**	**1.01**	1.08	**0.28**	**0.30**	0.29
CD @ 0.05%	**2.37**	**1.47**	1.92	**2.29**	**2.00**	2.15	**0.56**	**0.59**	0.58
CV (%)	**9.60**	**8.39**	9.00	**10.53**	**10.19**	10.36	**5.22**	**6.14**	5.68

Table 3: Mean performance of quality parameters of different garlic genotypes

Genotypes	**Neck thickness (cm)**			**TSS (%)**			**Pungency (Pyruvic Acid (µmol/g)**		
	Rabi	**Kharif**	**Mean**	**Rabi**	**Kharif**	**Mean**	**Rabi**	**Kharif**	**Mean**
GS -1	1.61	1.45	1.53	29.20	25.69	27.45	22.45	20.52	21.49
GS-2	1.54	1.39	1.46	28.66	25.23	26.95	25.05	23.01	24.03
GS-3	1.42	1.28	1.35	31.20	26.54	28.87	26.32	23.45	24.88
GS-4	1.29	1.16	1.23	28.12	24.56	26.34	29.85	27.09	28.47
GS-5	1.02	0.92	0.97	24.58	21.76	23.17	28.65	25.98	27.32
GS-6	1.01	0.91	0.96	23.60	18.95	21.27	31.56	29.74	30.65
GS-7	1.51	1.36	1.43	30.10	24.69	27.40	31.10	27.65	29.38
GS-8	1.10	0.99	1.05	35.32	29.75	32.54	35.10	32.80	33.95
GS-9	1.27	1.14	1.21	33.96	28.36	31.16	32.27	31.16	31.71
GS-10	1.02	0.92	0.97	34.50	29.56	32.03	29.85	28.96	29.41
GS-11	1.42	1.28	1.35	33.20	29.14	31.17	28.69	26.36	27.53
GS-12	1.52	1.37	1.44	24.50	19.65	22.08	21.85	19.45	20.65
GS-13	1.40	1.26	1.33	28.12	23.29	25.71	28.47	28.17	28.32
GS-14	1.62	1.46	1.54	32.60	28.96	30.78	24.56	23.69	24.12
GS-15	1.80	1.62	1.71	34.80	29.65	32.22	31.56	31.56	31.56
GS-16	1.50	1.35	1.43	28.60	24.89	26.75	32.69	32.96	32.83
GS-17	1.48	1.33	1.41	39.20	30.25	34.73	38.78	37.96	38.37
GS-18	1.45	1.31	1.38	38.52	33.96	36.24	31.54	30.47	31.01
GS-19	1.51	1.36	1.43	37.50	31.56	34.53	34.56	32.69	33.62
GS-20	1.42	1.28	1.35	36.50	31.85	34.18	28.56	26.95	27.76
GS-21	1.38	1.24	1.31	36.10	32.69	34.40	26.52	24.96	25.74
GS-22	1.35	1.22	1.28	36.40	31.96	34.18	22.56	21.69	22.12
GS-23	1.38	1.24	1.31	35.40	30.56	32.98	30.52	29.45	29.99
GS-24	1.41	1.27	1.34	37.80	32.96	35.38	38.56	37.45	38.01
GS-25	1.52	1.37	1.44	39.52	33.96	36.74	31.74	30.69	31.22
GS-26	1.31	1.18	1.24	39.60	33.85	36.72	40.69	38.96	39.83
GS -27	1.10	0.99	1.05	38.10	34.96	36.53	41.85	39.87	40.86
GS-28	1.20	1.08	1.14	37.40	34.56	35.98	38.96	36.74	37.85
GS-29	0.68	0.61	0.65	37.60	35.96	36.78	36.17	34.39	35.28
GS-30	0.60	0.54	0.57	31.20	30.85	31.03	31.45	29.87	30.66
GS-31	0.50	0.45	0.48	30.20	25.96	28.08	29.63	27.45	28.54
GS-32	0.49	0.44	0.47	31.20	26.96	29.08	30.45	28.96	29.71
GS-33	0.55	0.50	0.52	29.50	24.56	27.03	31.45	30.56	31.01
GS-34	0.56	0.50	0.53	29.30	24.85	27.08	28.96	26.78	27.87
GS-35	1.80	1.62	1.71	34.50	32.54	33.52	31.14	30.14	30.64
GS-36	1.71	1.54	1.62	39.60	36.54	38.07	41.52	40.56	41.04
GS-37	1.51	1.36	1.43	28.60	26.35	27.48	31.45	30.69	31.07
GS-38	1.41	1.27	1.34	41.20	37.56	39.38	39.56	38.69	39.13
GS-39	1.01	0.91	0.96	32.60	30.65	31.62	28.56	26.98	27.77
GS-40	1.42	1.28	1.35	36.70	33.47	35.09	31.56	28.69	30.12
GS-41	1.52	1.37	1.44	37.20	33.69	35.45	34.56	32.47	33.52
GS-42	1.61	1.45	1.53	37.40	32.69	35.05	32.56	24.58	28.57
GS-43	1.21	1.09	1.15	32.10	29.54	30.82	36.78	28.47	32.63

GS-44	0.92	0.83	0.87	28.60	24.69	26.65	28.95	24.78	26.87
GS-45	0.93	0.84	0.88	34.50	29.47	31.99	29.56	28.69	29.12
GS -46 (DWG-1)	1.10	0.99	1.05	34.52	29.65	32.09	32.74	31.47	32.11
GS -47(DWG-2)	1.20	1.08	1.14	33.65	31.74	32.69	32.10	30.96	31.53
GS -48 (Swetha)	0.81	0.73	0.77	38.56	33.96	36.26	29.56	29.56	29.56
GS -49 (Bhima purple)	1.61	1.45	1.53	34.65	30.47	32.56	42.62	41.69	42.16
GS -50 (Yamanasafed)	1.50	1.35	1.43	33.51	31.54	32.53	36.02	30.96	33.49
GS -51 (Oty -1)	1.61	1.45	1.53	35.60	31.84	33.72	48.20	41.78	44.99
GS -52 (AAS-2)	1.10	0.99	1.05	34.52	32.87	33.69	41.20	38.78	39.99
Mean	**1.27**	**1.14**	**1.20**	**33.66**	**29.66**	**31.66**	**32.34**	**30.35**	**31.35**
Maximum	**1.80**	**1.62**	**1.71**	**41.20**	**37.56**	**39.38**	**48.20**	**41.78**	**44.99**
Minimum	**0.49**	**0.44**	**0.47**	**23.60**	**18.95**	**21.27**	**21.85**	**19.45**	**20.65**
SE d	**0.037**	**0.033**	**0.020**	**0.949**	**0.842**	**0.518**	**0.925**	**0.866**	**0.517**
CD @ 0.05%	**0.073**	**0.065**	**0.048**	**1.882**	**1.669**	**1.768**	**1.835**	**1.718**	**1.767**
CV (%)	**3.530**	**3.500**	**3.520**	**3.450**	**3.480**	**3.470**	**3.500**	**3.500**	**3.500**

Table 4: Mean performance of quality parameters of different garlic genotypes

Genotypes	Crude Protein (%)			Chlorophyll (SPAD value)			Sulphur (%)			Allicin (%)		
	Rabi	Kharif	Mean	Rabi	Kharif	Mean	Rabi	Kharif	Mean	Rabi	Kharif	Mean
GS -1	14.27	13.47	13.87	64.52	61.45	62.99	0.02	0.02	0.02	0.70	0.65	0.68
GS-2	12.77	12.03	12.40	63.56	60.87	62.22	0.01	0.08	0.05	0.66	0.66	0.66
GS-3	16.53	15.47	16.00	58.56	53.96	56.26	0.01	0.01	0.01	0.61	0.50	0.56
GS-4	10.17	10.57	10.37	74.61	69.71	72.16	0.07	0.02	0.05	0.58	0.51	0.55
GS-5	11.30	10.50	10.90	71.49	69.19	70.34	0.02	0.02	0.02	0.68	0.61	0.65
GS-6	16.53	15.67	16.10	70.25	67.45	68.85	0.02	0.02	0.02	0.60	0.55	0.57
GS-7	17.47	15.87	16.67	50.23	46.95	48.59	0.01	0.01	0.01	0.51	0.42	0.47
GS-8	11.50	9.57	10.53	58.43	54.14	56.28	0.01	0.01	0.01	0.31	0.25	0.28
GS-9	13.77	12.17	12.97	45.30	42.34	43.82	0.02	0.01	0.02	0.62	0.56	0.59
GS-10	14.77	10.87	12.82	66.45	61.56	64.01	0.02	0.02	0.02	0.66	0.52	0.59
GS-11	17.50	16.47	16.98	70.23	65.96	68.10	0.03	0.02	0.03	0.69	0.61	0.65
GS-12	10.20	9.63	9.92	52.47	48.96	50.72	0.02	0.02	0.02	0.71	0.71	0.71
GS-13	14.10	14.50	14.30	53.74	50.62	52.18	0.02	0.02	0.02	0.64	0.59	0.61
GS-14	12.63	12.70	12.67	62.30	59.65	60.98	0.02	0.02	0.02	0.61	0.59	0.60
GS-15	13.07	13.70	13.38	64.20	61.47	62.84	0.03	0.03	0.03	0.68	0.60	0.64
GS-16	11.07	11.77	11.42	70.20	66.95	68.58	0.02	0.02	0.02	0.59	0.48	0.54
GS-17	12.57	10.67	11.62	66.25	63.85	65.05	0.02	0.02	0.02	0.61	0.52	0.57
GS-18	14.20	13.47	13.83	68.89	64.78	66.84	0.03	0.02	0.02	0.65	0.61	0.63
GS-19	15.07	14.67	14.87	71.25	68.56	69.90	0.03	0.02	0.03	0.71	0.60	0.65
GS-20	16.23	15.63	15.93	74.56	71.54	73.05	0.01	0.01	0.01	0.49	0.35	0.42
GS-21	11.40	12.73	12.07	64.58	60.58	62.58	0.02	0.01	0.01	0.42	0.40	0.41
GS-22	13.23	12.73	12.98	65.95	62.96	64.46	0.01	0.01	0.01	0.38	0.35	0.37
GS-23	12.47	11.70	12.08	55.45	59.65	57.55	0.02	0.02	0.02	0.60	0.51	0.56
GS-24	14.87	14.53	14.70	69.56	66.58	68.07	0.02	0.02	0.02	0.50	0.42	0.46
GS-25	12.67	12.07	12.37	71.45	67.89	69.67	0.02	0.02	0.02	0.48	0.42	0.45
GS-26	14.97	14.23	14.60	69.58	66.89	68.23	0.02	0.02	0.02	0.71	0.42	0.70
GS -27	17.73	17.60	17.67	68.14	64.78	66.46	0.02	0.02	0.02	0.49	0.69	0.46
GS-28	13.27	13.20	13.23	64.25	62.36	63.31	0.02	0.02	0.02	0.61	0.54	0.58
GS-29	15.27	14.20	14.73	62.52	60.45	61.49	0.02	0.02	0.02	0.63	0.61	0.62
GS-30	14.70	13.27	13.98	64.47	61.78	63.13	0.02	0.02	0.02	0.70	0.60	0.65
GS-31	13.67	13.17	13.42	66.45	25.96	46.21	0.03	0.03	0.03	0.85	0.75	0.80
GS-32	12.80	11.80	12.30	51.45	26.96	39.21	0.01	0.01	0.01	0.51	0.41	0.46
GS-33	11.93	10.23	11.08	54.78	24.52	39.65	0.02	0.01	0.02	0.62	0.60	0.61
GS-34	14.23	10.50	12.37	58.95	24.85	41.90	0.02	0.02	0.02	0.71	0.61	0.66
GS-35	13.43	12.07	12.75	48.78	32.96	40.87	0.02	0.02	0.02	0.61	0.51	0.56
GS-36	17.87	16.20	17.03	70.89	36.85	53.87	0.03	0.03	0.03	0.71	0.62	0.71
GS-37	15.43	14.27	14.85	62.85	26.45	44.65	0.03	0.03	0.03	0.60	0.51	0.56

GS-38	18.13	15.50	16.82	82.56	37.58	60.07	0.04	0.04	0.04	0.75	0.70	0.73
GS-39	14.13	13.10	13.62	56.98	30.96	43.97	0.03	0.03	0.03	0.51	0.61	0.56
GS-40	11.20	10.20	10.70	58.95	33.87	46.41	0.02	0.02	0.02	0.58	0.55	0.56
GS-41	15.43	14.20	14.82	62.85	33.45	48.15	0.02	0.02	0.02	0.61	0.61	0.61
GS-42	14.53	12.53	13.53	64.85	32.78	48.82	0.01	0.01	0.01	0.41	0.41	0.41
GS-43	15.67	12.17	13.92	68.58	29.63	49.11	0.01	0.01	0.01	0.42	0.42	0.42
GS-44	16.10	15.10	15.60	70.56	24.69	47.63	0.03	0.02	0.03	0.31	0.30	0.30
GS-45	13.10	12.10	12.60	72.56	29.54	51.05	0.01	0.01	0.01	0.51	0.41	0.46
GS -46 (DWG-1)	17.47	15.43	16.45	68.85	66.45	67.65	0.01	0.01	0.01	0.49	0.44	0.47
GS -47(DWG-2)	17.67	16.20	16.93	66.12	63.45	64.78	0.02	0.01	0.02	0.51	0.50	0.51
GS -48 (Swetha)	14.10	12.07	13.08	82.65	80.54	81.59	0.03	0.03	0.03	0.52	0.52	0.52
GS -49 (Bhima purple)	14.63	12.40	13.52	81.26	76.56	78.91	0.03	0.02	0.03	0.61	0.60	0.61
GS -50 (Yamanasafed)	18.07	15.13	16.60	70.65	65.95	68.30	0.03	0.03	0.03	0.71	0.62	0.67
GS -51 (Oty -1)	13.07	12.07	12.57	72.32	66.74	69.53	0.02	0.02	0.02	0.69	0.63	0.66
GS -52 (AAS-2)	16.07	15.07	15.57	66.12	60.12	63.12	0.03	0.03	0.03	0.54	0.51	0.52
Mean	**14.33**	**13.21**	**13.77**	**65.26**	**53.36**	**59.31**	**0.02**	**0.02**	**0.02**	**0.59**	**0.53**	**0.56**
Maximum	**18.13**	**17.60**	**17.67**	**82.65**	**80.54**	**81.59**	**0.07**	**0.08**	**0.05**	**0.85**	**0.75**	**0.80**
Minimum	**10.17**	**9.57**	**9.92**	**45.30**	**24.52**	**39.21**	**0.01**	**0.01**	**0.01**	**0.31**	**0.25**	**0.28**
SE d	**0.404**	**0.373**	**0.224**	**1.860**	**1.580**	**0.995**	**0.002**	**0.002**	**0.000**	**0.017**	**0.015**	**0.009**
CD @ 0.05%	**0.801**	**0.739**	**0.766**	**3.685**	**3.128**	**3.397**	**0.004**	**0.004**	**0.004**	**0.033**	**0.030**	**0.032**
CV (%)	**3.450**	**3.450**	**3.460**	**3.490**	**3.620**	**3.560**	**10.31**	**11.33**	**10.79**	**3.500**	**3.480**	**3.490**

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References

Adela, G., Helena, C., Ivana, B., Ales, R., & Michal, V. (2013). Characteristics of garlic of Czech origin. *Czech Journal of Food Sciences*, **31**(6), 581–588.

Anthon, G. E., & Barrett, D. M. (2003). Modified method for the determination of pyruvic acid with dinitrophenylhydrazine in the assessment of onion pungency. *Journal of the Science of Food and Agriculture*, **83**(12), 1210–1213.

Dubey, B. K., & Singh, R. K. (2012). Selection of garlic genotypes for yield, quality, and better storage. *Indian Journal of Horticulture*, **69**(1), 125–128.

Kamala, V., Gupta, A. J., Rajput, A. S., & Sivaraj, N. (2011). Diversity of bulb traits in onion germplasm collected from Chhattisgarh and Maharashtra. *Indian Journal of Horticulture*, **71**, 499–504.

Kamenetsky, R., & Rabinowitch, H. D. (2006). The genus *Allium*: A developmental and horticultural analysis. *Horticultural Reviews*, **32**, 329–368.

Mishra, R. K., Prasad, K., Pandey, S., & Gupta, R. P. (2013). Evaluation of garlic accessions for growth, yield, quality, and resistance to stemphylium blight disease in Northern India. *Indian Journal of Horticulture*, **26**(2), 291–296.

Mohanty, B. K., & Prusti, A. M. (2002). Mahalanobis's generalized distance analysis in onion. *Research on Crops*, **3**, 142–144.

Moustafa, Y. M. M., Latif, S. S., Abdel-Naem, G. F., Fouly, H. M. H., & Ahmed, S. I. (2009). Performance of new imported foreign garlic genotypes grown under Egyptian conditions. *Egyptian Journal of Agricultural Research*, **87**(1), 219–240.

Nieuwhof, M., Debruyn, J. W., & Carresten, F. (1973). Methods to determine solidity and dry matter content of onions (*Allium cepa* L.). *Euphytica*, **22**, 39–47.

Panse, R., Jain, P. K., Avneesh, G., & Singh, D. S. (2013). Morphological variability and character association in diverse collection of garlic germplasm. *African Journal of Agricultural Research*, **8**(23), 2861–2869.

Partha, C., & Ranjit, C. (2009). Evaluation of some garlic (*Allium sativum* L.) germplasm for their suitability under Terai zone of West Bengal. *International Journal of Agriculture, Environment and Biotechnology*, **2**(3), 271–273.

Piper, C. S. (1966). *Soil and plant analysis* (pp. 1–368). Hans Publishers, Bombay.

Ranganna, S. (1986). *Manual of analysis of fruit and vegetable products* (pp. 1–30). Tata McGraw Hill Publishing Company Ltd., New Delhi.

Seifel, N. H., Yasser, M. M., Moustafa, G. F., Abdel-Naem, G. F., & Ismail, A. A. W. (2011). Studying different quantitative and qualitative traits of some white and colored bulb garlic genotypes grown under a drip irrigation system. *Australian Journal of Basic and Applied Sciences*, **6**(1), 98–106.

Sharma, D., Banayal, S. K., & Jarial, K. (2015). Studies on the performance of garlic genotypes (*Allium sativum* L.) under sub-tropical condition of Himachal Pradesh. *Journal of Spices and Aromatic Crops*, **24**(2), 106–111.

Singh, R. K., Dubey, B. K., & Bhonde, S. R. (2012a). Studies on some garlic genotypes for yield, quality, and storage. *SAARC Journal of Agriculture*, **10**(2), 165–170.

Tarique, A. (2015). *Characterization and genetic variability study in garlic (Allium sativum L.)* (M.Sc. thesis). Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India.

Umamaheshwarappa, H., Chandrappa, H., & Rajendra, P. K. T. (2014). Evaluation of garlic (*Allium sativum* L.) genotypes for growth and yield traits under Central Dry Zone of Karnataka. *Environment and Ecology*, **32**(2A), 638–641.