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RESEARCH ARTICLE

Evaluation of onion (*Allium cepa* L.) genotypes for growth and yield traits

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Abstract

Onion is an economically important vegetable crop, widely cultivated for its culinary, nutritional and processing value. India ranks second globally in onion production; however productivity remains lower compared to several other countries, highlighting the need for genotype evaluation and improvement. The present investigation was carried out during the 2022–23 *rabi* season at the Department of Horticulture, University of Agricultural Science (UAS), Gandhi Krishi Vigyana Kendra (GKVK), Bengaluru, to assess 18 onion genotypes collected from different districts of Karnataka, along with a check variety, *Bhima Super*. The experiment was laid out in a randomized complete block design (RCBD) with three replications under red sandy loam soil conditions. Data were recorded on 23 growth, yield and quality parameters. Significant variability was observed among genotypes for most of the traits studied. Seed germination ranged from 35.31 % (*Nagpur Local*) to 98.08 % (*Bidar Local-2*). At 90 Days after transplanting (DAT), plant height varied between 54.39 cm (*Nagpur Local*) to 66.54 cm (*Bidar Local-1*). Yield attributes revealed that *Bidar Local-2* exhibited the highest bulb weight (107.30 g), ten-bulb weight (1270 g) and yield per ha (46.23 t/ha), exceeding the check variety (42.19 t/ha). Quality parameters also showed distinct differences, with *Bidar Local-4* recording the highest total soluble solids (TSS) content (16.40 °Brix) and *Gadag Local-4* showing the minimum neck thickness (0.57 cm), a desirable trait for improved storability. Based on overall growth, yield and quality performance, *Bidar Local-2*, *Bidar Local-1*, *Chitradurga Local-1* and *Bellary Local* were identified as promising genotypes. These superior genotypes may serve both for direct cultivation and as valuable genetic resources in onion crop improvement programmes.

Keywords: crop improvement; growth; local genotypes; onion; quality; yield

Introduction

Onion (*Allium cepa* L.) belongs to the family Alliaceae and has a chromosome number of 2n=16. It is one of the most widely grown and popular vegetable crops in India. Globally, onion ranks as the second most crucial vegetable crop, surpassed only by tomato. It plays an indispensable role in kitchens, serving both as a vegetable and a condiment that enhances the flavor of a wide range of dishes. Due to its versatile nature, it is often affectionately referred as the 'Queen of the kitchen'. Moreover, onions find usage in salads and pickles. Notably, the processing industry has increasingly utilizing onions for producing dehydrated products such as onion powder and flakes (1). Thus, onions have an extensive culinary, dietary, therapeutic, trading, income and employment generation value.

The onion plant is a biennial or perennial herb characterized by shallow fibrous roots, a bulb and hollow tubular leaves. When crushed, the plant parts release a pungent odour due to the presence of allyl-propyl disulphide ($C_6H_{12}S_2$). The inflorescence is an umbel composed of small white to whitish-blue, cross-pollinated flowers. The fruits are capsules containing black seeds. Bulbs exhibit variations in shape and colour red, white or yellow. Quercetin, a flavonoid, determines bulb skin colour and imparts antioxidant, anti-inflammatory and health-promoting properties.

The bulb is composed of fleshy and enlarged leaf bases. The outer leaf bases of the bulb lose moisture and become scaly by the time of harvesting and the inner leaves thicken as the bulb develops. In the plains of North India, most onion cultivars are short-day varieties. Long-day varieties do not form bulbs under short-day conditions and vice versa, short-day cultivars fail to produce bulbs when planted under long-day conditions (2).

Onion is a crop of global importance, with India ranking as the second-largest producer after China. The major onion-producing states in India are Maharashtra, Karnataka, Madhya Pradesh, Gujarat and Rajasthan. It is cultivated over an area of 1941.12 thousand ha , producing approximately 31687.19 million t annually. In Karnataka, onion occupies 231.84 thousand ha, yielding about 2779.50

thousand t (3). India also ranks third in onion export, following the Netherlands and Spain.

Despite its vast cultivation area and high production volume, Indias' onion productivity remains lower than the global average, reflecting a distinct yield gap. This variation can be attributed to differences in soil type, climate, management practices and varietal adaptability. Therefore, regional genotype assessment is essential for identifying onion varieties suited to specific agro-climatic zones to ensure higher yield, better bulb quality, stress tolerance and enhanced export competitiveness.

The productivity of onion cultivation in India continues to lag behind that of more advanced countries. To enhance productivity, several measures can be adopted, including the selection of region-specific varieties, adoption of appropriate agronomic practices such as balanced nutrition and optimal water management and the use of need-based plant protection measures. Additionally, efficient harvesting and post-harvest handling are crucial. Onion cultivars exhibit significant variation in yield potential when grown under different agro- climatic conditions. The yield and quality of onions are influenced by factors such as soil type, climatic conditions and the specific variety or hybrid used. Each cultivar has distinct soil and climate requirements for optimal performance. Given India's diverse agro-climatic regions, it is essential to utilise different varieties or hybrids suited to specific environment. A single variety or hybrid may not be universally suitable for all the regions. Therefore, there is a need to introduce or develop new varieties or hybrids specifically tailored to different agro-climatic conditions in different regions of the country (4).

The effectiveness of any crop improvement program in a region depends on the existing genetic variability and a clear understanding of its diverse components. For onion, developing varieties adapted to specific agro-climatic zones requires systematic collection and evaluation of diverse genotypes. Assessing these genotypes for growth and yield traits helps identify superior lines with better adaptability, productivity and quality, thereby bridging the regional productivity gap and contributing to sustainable crop improvement and farmer welfare (5).

The quality of onion bulbs is also of great importance for local consumption and processing markets. To breed for higher yield and superior quality, it is essential to maintain an extensive and diverse genotype collection. In this context, the present study was conducted to evaluate onion genotypes for their growth and yield parameters.

Materials and Methods

A field experiment was conducted during the rabi season of 2022-23 at the Department of Horticulture, (UAS), GKVK, Bengaluru, to evaluate 18 onion genotypes along with the check variety '*Bhima Super*' for growth, yield and quality traits (Table 1). The experimental site had red sandy loam soil with a pH of 6.40, electrical conductivity (EC) of 0.67 dS/m and available nitrogen (N), phosphorus (P) and potassium (K) of 302.05, 80.00 and 280.30 kg/ha respectively. The trial was laid out in a RCBD with three replications. Each plot measured 1 × 1 m and seedlings raised in portrays were transplanted at a spacing of 15 × 10 cm after 6-8 weeks.

The recommended fertilizer dose of 125:75:125 NPK kg/ha was applied using urea, DAP and MOP as nutrient source. Half of the nitrogen and the full dose of P and K were applied as a basal dose, while the remaining N was top-dressed 45 days after transplanting. Bulbs were harvested at full maturity.

Table 1. List of onion genotypes used for the study.

Treatments	Sources of collection
T_1	Bellary Local (Pattanaseragu)
T_2	Nagpur Local (Maharashtra)
T_3	Chitradurga Local-1 (Chitradurga)
T_4	Chikkamagaluru Local-1 (Kaduru Giriyapura)
T_5	Chikkamagaluru Local-2 (Kaduru Sahaja seeds)
T_6	Gadag Local-1 (Doni)
T_7	Gadag Local-2 (Kalsapur)
T_8	Gadag Local-3 (Gavarawad)
T_9	Gadag Local-4 (Bodhihal)
T_{10}	Vijayapura Local (Telgi)
T_{11}	Bengaluru Local (Nelemangala)
T_{12}	Bidar Local-1 (Bavagi)
T_{13}	Bidar Local-2 (Halahalli)
T_{14}	Bidar Local-3 (Hallikhed B)
T_{15}	Bidar Local-4 (Siddeswar)
T_{16}	Bidar Local-5 (Khanapur)
T_{17}	Bidar Local-6 (Tugaon)
T_{18}	Chitradurga Local-2 (Challakere)
T_{19} (Check)	Bhima Super

Observations were recorded on five randomly selected plants per genotype for twenty-three characters *viz.,* seed germination (%), plant height(cm), number of leaves/plant, leaf length (cm), leaf width (cm), leaf chlorophyll, collar girth (cm), number of days to harvest, number of scale leaves/bulb, neck thickness (cm), bulb length (cm), bulb weight (g), bulb equatorial diameter (cm), ten bulb weight (g), yield per plant (kg), yield per plot (kg), yield per hectare (t), bulb dry weight (g), plant dry weight (g), bulb color, total soluble solids (^{0}brix), number of split bulbs (%) and bolting (%).

Statistical analysis were carried out using Microsoft Excel and OPSTAT software.

Results and Discussion

Germination of seeds ranged from 35.31 % (*Nagpur Local*) to 98.08 % (*Bidar Local-2*) with an average mean of 68.22 b% (Table 2). The check variety *Bhima Super* recorded a germination rate of 73.14 %. The percentage of seed germination determines the final crop stand and a lower germination rate can adversely affect yield while increasing input cost (6).

The data of average plant height at 30 DAT was recorded with an average mean of 43.78 cm. The data showed that the highest plant height was reported in *Bidar Local-6* (48.68 cm) followed by *Gadag Local-4* (48.02 cm) and lowest was reported in *Chitradurga Local-1* (37.40 cm). The check variety *Bhima Super* recorded 44.28 cm. At 60 DAT, the maximum plant height was observed in *Bidar Local-1* (58.80 cm), followed by *Gadag Local-2* (58.27 cm), while the minimum was recorded in *Nagpur Local* (49.93 cm). The check variety *Bhima Super* had a height of 55.40 cm, with a mean value of 53.15 cm. At 90 DAT, the maximum plant height recorded was 66.54 cm in *Bidar Local-1* followed by *Gadag Local-2* (63.35 cm) and minimum of 54.39 cm was recorded in *Nagpur Local*. The check variety Bhima Super recorded 60.85 cm, with an overall mean of 59.70 cm for this trait (Table 2 & Fig.1). Similar variations in plant height among onion genotypes have been reported in previous studies (7, 8).

At 30 DAT, the maximum number of leaves per plant was recorded in *Bidar Local-6* (5.80), while *Chitradurga Local-2* produced

Table 2: Mean performance of onion genotypes for growth parameters

Sl. No.	Treatments	Seed Germination (%)	Plant height (cm)			Leaves per plant			Leaf length (cm)			Leaf width (cm)		
			30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
1.	T_1	42.00	39.15	53.60	57.11	5.10	9.24	11.42	39.64	46.19	51.57	0.71	1.14	1.17
2.	T_2	35.31	38.72	49.93	54.39	4.73	7.63	9.19	36.52	43.09	46.17	0.67	1.08	1.11
3.	T_3	41.85	37.40	51.80	55.65	4.73	8.66	9.79	35.52	43.26	47.32	0.66	0.99	1.02
4.	T_4	66.00	45.03	50.20	53.55	5.80	7.93	8.76	40.36	44.84	49.67	0.78	1.23	1.27
5.	T_5	80.80	45.07	55.05	62.35	5.33	7.32	9.58	44.70	51.66	57.73	0.78	1.18	1.20
6.	T_6	90.05	44.31	52.47	55.71	5.40	8.40	9.34	45.77	46.82	48.48	0.78	1.16	1.18
7.	T_7	71.49	45.42	58.27	63.35	5.40	8.40	9.37	41.64	52.18	55.95	0.76	1.01	1.03
8.	T_8	92.84	39.74	50.27	57.45	5.13	8.06	9.15	40.76	46.85	49.71	0.75	1.15	1.18
9.	T_9	88.46	48.02	55.33	59.61	5.60	8.26	9.37	43.75	48.32	50.66	0.74	1.05	1.07
10.	T_{10}	73.43	44.88	51.93	59.17	5.40	7.66	9.79	40.23	47.31	53.24	0.79	1.21	1.24
11.	T_{11}	72.48	46.19	52.20	57.55	5.26	8.00	9.24	45.21	47.75	49.95	0.80	1.34	1.36
12.	T_{12}	37.69	46.36	58.80	66.54	5.33	8.53	10.43	45.95	54.81	59.57	0.77	1.18	1.21
13.	T_{13}	98.08	44.45	56.73	63.76	5.40	8.24	10.79	45.16	53.69	57.92	0.77	1.24	1.26
14.	T_{14}	87.08	43.52	53.67	59.55	5.66	7.46	8.80	40.88	50.96	53.67	0.78	1.03	1.08
15.	T_{15}	38.24	43.23	53.80	62.33	5.00	7.53	9.23	41.73	50.73	54.58	0.70	0.98	1.01
16.	T_{16}	82.00	44.34	54.67	63.46	5.60	8.58	9.32	39.08	50.49	53.82	0.80	1.11	1.13
17.	T_{17}	61.62	48.68	56.60	63.33	5.80	7.71	9.60	43.29	50.43	53.68	0.78	1.02	1.05
18.	T_{18}	63.65	43.18	50.53	58.54	4.53	7.65	9.79	39.31	49.86	51.43	0.73	1.10	1.13
19.	T_{19} (Check)	73.14	44.28	55.40	60.85	5.37	8.00	9.82	44.80	52.25	57.30	0.75	1.32	1.37
	Mean	68.22	43.78	53.15	59.70	5.28	8.05	9.62	41.80	49.03	52.76	0.76	1.14	1.16
	CV	1.21	4.79	5.16	1.32	6.83	7.18	14.41	3.02	2.70	2.74	1.43	1.15	0.55
	F-test (0.05)	*	*	*	*	*	*	NS	*	*	*	*	*	*
	S.Em±	0.47	1.21	1.60	0.45	0.20	0.33	0.80	0.73	0.76	0.83	0.006	0.008	0.009
	CD (0.05)	1.37	3.47	4.60	1.31	0.59	0.95	2.29	2.09	2.19	2.49	0.018	0.022	0.027

CV: Coefficient of variation; S.Em: Standard Error of mean; DAT: Days after transplanting; NS: Non-significant; *: Significant at p≤0.05

the minimum (4.53). The check variety *Bhima Super* had 5.37 leaves, with a mean of 5.28. At 60 DAT, *Bellary Local* exhibited the highest number of leaves (9.24) and *Bidar Local-3* had the lowest (7.46); *Bhima Super* recorded 8.00 leaves with a mean of 8.05. At 90 DAT, *Bellary Local* again recorded the maximum (11.42), while *Chikkamagaluru Local-1* produced the minimum (8.76). The check variety *Bhima Super* had 9.82 leaves per plant, with a mean of 9.62.

Physiologically, a higher number of leaves enhances the total photosynthetic surface area, enabling greater light interception, CO_2 assimilation and biomass accumulation. This directly contributes to higher carbohydrate reserves, which support bulb growth and yield potential. Genotypes with consistently higher leaf counts, such as *Bellary Local*, may therefore exhibit superior performance under favorable conditions. These results align with previous findings (9, 10), which also linked increased leaf number with improved productivity.

The average leaf length at 30 DAT range from 35.52 cm to 45.95 cm, with the mean value of 41.80 cm. During this period, the maximum leaf length was recorded in *Bidar Local-1* (45.95 cm), while the minimum was observed in *Chitradurga Local-1* (35.52 cm). The check variety *Bhima Super* recorded a leaf length of 44.80 cm. Likewise, the average value of leaf length recorded at 60 DAT was 49.03 cm and it ranged from 43.09 cm to 54.81 cm. The genotype having highest leaf length was *Bidar Local-1* (54.81 cm) and it was lowest in *Nagpur Local* (43.09 cm). The check variety *Bhima Super* recorded 52.25 cm of length. At 90 DAT, the average leaf length ranged between 46.17 cm to 59.57 cm, with a mean of 52.76 cm. The longest leaves were observed in *Bidar Local-1* (59.57 cm) and the shortest in *Nagpur Local* (46.17 cm). The check variety *Bhima Super* recorded a leaf length of 57.30 cm .

Regarding leaf width, at 30 DAT the maximum value was observed in *Bidar Local-5* (0.80 cm) and the minimum in *Bidar Local-4* (0.70 cm), while *Bhima Super* recorded 0.75 cm. At 60 DAT, *Bengaluru Local* exhibited the maximum leaf width (1.34 cm) and *Bidar Local-4* the minimum (0.98 cm), whereas *Bhima Super* recorded 1.32 cm. At 90 DAT, *Bhima Super* had the maximum leaf width (1.37 cm) and *Bidar Local-4* the minimum (1.01 cm). The observed differences in leaf diameter among cultivars may be attributed to variations in their genetic architecture (11). Comparable findings have been reported in previous studies (4, 11) (Table 2).

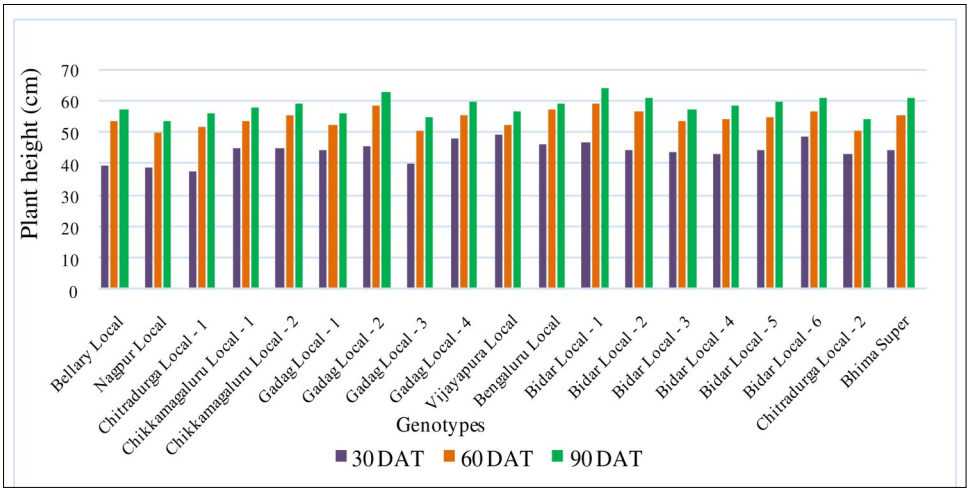

Fig. 1. Plant height of onion genotypes at different growth stages.

At 30, 60 and 90 DAT, the check variety *Bhima Super* consistently recorded the highest leaf chlorophyll content (55.84, 59.22 and 55.76 respectively) and the minimum leaf chlorophyll was recorded in *Gadag Local - 4* (46.73, 50.63 and 47.08 respectively. Similar results reported significantly higher chlorophyll content (61.48) in fresh leaves of the Baswant-780 genotype (12).

At 30 DAT, the maximum collar girth was noted in *Bidar Local -1* (1.12 cm) and the minimum in *Chitradurga Local-2* (0.91 cm), with an average of 1.07 cm. The check variety *Bhima Super* recorded 1.03 cm. At 60 DAT, the maximum collar girth was again noted in *Bidar Local-1* (1.70 cm), while the minimum was observed in *Bidar Local-4* (1.12 cm), with an average of 1.42 cm. *Bhima Super* also recorded 1.42 cm. At 90 DAT, *Bidar Local-1* had the maximum collar girth (1.76 cm) and *Bidar Local-4* recorded the minimum (1.15 cm)). The average collar girth for this stage was 1.46 cm, while *Bhima Super* measured 1.45 cm.

At 30 DAT, the collar girth was non-significant because development of bulb had not yet started; bulb initiation occurred during this period and variation among genotypes became evident by 90 DAT. Collar girth is an important trait, as reduced collar and neck thickness contribute to better bulb storability (4). Significant variation in collar girth was observed among the genotypes, with *Bidar Local-5*, *Chikkamagaluru Local-1*, *Bidar Local-4*, *Gadag Local-3* and *Gadag Local-4* exhibiting the lower values. Similar findings have been reported by previous studies (10, 13).

Increased plant height, leaf length, leaf width and number of leaves likely enhanced carbohydrate synthesis and utilization for cell development. I Improved nutrient absorption further boosts higher dry matter production. This synergy between growth attributes and nutrient uptake promotes carbohydrate synthesis, cell build-up and overall biomass enhancement (4) (Table 3).

The number of days to harvest was counted from the date of transplanting to the date of harvesting. Genotypes exhibiting both high yield and earliness are considered more desirable, as these are important objectives in crop improvement programs. The average number of days taken for harvest among all the genotypes was 103.16 days. The maximum duration from transplanting to harvest was observed in *Nagpur Local* (115 days), while the minimum was recorded in *Bengaluru Local* (87 days). The check variety *Bhima Super* took 98 days from transplanting to harvest. The variation in total crop duration was likely due to the inherent genetic makeup of the varieties. These findings are in agreement with the findings of many previous studies (5, 11,14).

The number of scale leaves per bulbs varied from 7.50 to 11.25. The highest number of scale leaves per bulb was recorded in *Gadag Local-3* (11.25), while the lowest was observed in *Chikkamagaluru Local-1* (7.50). The check variety *Bhima Super* produced 9.25 scale leaves per bulb, with an overall average of 9.53 scale leaves per bulb. The number of scale leaves per bulb has a direct influence on yield. Genotypes such as *Gadag Local-3*, *Bidar Local-2*, *Bidar Local-3* and *Bidar Local-6* exhibited significantly higher numbers of scale leaves, indicating their superiority with respect to the yield potential. This is the most desirable trait in breeding/ selection for higher bulb yield of the genotypes. Comparative findings have been reported in earlier studies (13, 15).

The weight of the bulb of different onion genotypes ranged from 72.85 g to 107.30 g. While the overall average was recorded 95.24 g. The maximum bulb weight was noted in *Bidar Local-2* (107.30 g) and minimum was noted in *Gadag Local-4* (72.85 g). The check variety *Bhima Super* reported 98 g of bulb weight. The higher single bulb weight may be due to genotypic character, photosynthetic activity and nutrient availability, which directly influence bulb yield. Such variations in onion genotypes were also reported in previous studies (4, 6, 16-18).

The weight of ten bulbs was found to be highest in *Bidar Local-2* (1270 g) and lowest in *Gadag Local-4* (832.50 g). While the weight of ten bulb in the check variety *Bhima Super* was 1092.50 g, with an overall mean of 1066.21 g. Since *Bidar Local-2* recorded the highest individual bulb weight, it also exhibited the maximum ten-bulb weight, indicating consistency in performance. Similar observations have been reported in previous studies (15).

Yield is a complex trait influenced by various factors, including growth, photosynthetic rate, assimilation and conversion of photosynthates, angle of the leaf, no. of leaf, vigour of the plant

Table 3. Mean performance of onion genotypes for growth parameters.

Sl. No.	Treatments	Leaf chlorophyll			Collar girth (cm)		
		30DAT	60DAT	90DAT	30DAT	60DAT	90DAT
1.	T_1	49.30	53.27	51.73	0.73	1.51	1.54
2.	T_2	50.86	52.72	49.72	1.05	1.69	1.72
3.	T_3	50.45	54.33	52.46	0.99	1.50	1.56
4.	T_4	49.79	51.52	48.44	1.06	1.25	1.27
5.	T_5	51.52	53.70	51.13	1.11	1.45	1.49
6.	T_6	52.10	54.85	52.30	1.06	1.49	1.52
7.	T_7	53.72	55.06	52.73	1.15	1.52	1.66
8.	T_8	52.90	56.18	53.27	1.12	1.27	1.31
9.	T_9	46.73	50.63	47.08	1.09	1.30	1.34
10.	T_{10}	50.86	53.87	51.44	1.17	1.38	1.41
11.	T_{11}	54.10	56.80	53.76	1.14	1.42	1.45
12.	T_{12}	46.90	55.88	54.55	1.12	1.70	1.76
13.	T_{13}	53.42	52.29	51.89	1.20	1.47	1.51
14.	T_{14}	53.75	55.65	54.76	1.06	1.25	1.28
15.	T_{15}	49.96	52.57	50.69	1.13	1.12	1.15
16.	T_{16}	50.24	53.69	50.43	1.17	1.23	1.26
17.	T_{17}	50.82	53.68	50.89	1.01	1.50	1.54
18.	T_{18}	47.77	54.94	52.28	0.91	1.53	1.57
19.	T_{19} (Check)	55.84	59.22	55.76	1.03	1.42	1.45
Mean		51.11	54.25	51.86	1.07	1.42	1.46
CV		2.69	6.75	1.76	13.10	4.96	4.35
F-test (0.05)		*	NS	*	NS	*	*
S.Em±		0.79	2.11	0.52	0.08	0.04	0.03
CD (0.05)		2.28	6.06	1.51	0.23	0.11	0.10

and the adaptability of genotypes to local conditions. In the present study, the genotype *Bidar Local-2* recorded the highest bulb yield per plant (0.11 kg), followed by genotype *Bidar Local-1*, *Chitradurga Local-1* and *Bellary Local*. This clearly shows that these genotypes are well adoptable to the local condition/suitable to cultivating in the present environment and the lowest bulb yield per plant was recorded in *Gadag Local-4* (0.07 kg), whereas 0.10 kg of yield per plant was obtained in *Bhima Super*. While the overall average yield per plant was 0.09 kg. Similar findings have been reported in previous studies (8, 16-18).

A considerable variation was found with respect to the yield per plot parameter. Significant difference was observed for total bulb yield per plot among the onion genotypes evaluated. The variation in yield per plot could be attributed to differences in weight and size of the bulb. The highest yield per plot was observed in *Bidar Local-2* (5.77 kg) and lowest was observed in *Gadag Local-4* (3.90 kg), whereas the check variety *Bhima Super* produced a yield of 5.27 kg yield per plot. The overall average was noted 5.12 kg yield per plot. Similar findings were obtained by previous studies (8, 13, 19, 20).

Yield is an important parameter that depends not only on the length, width and size of the bulb but also on crop health, nutrient uptake from the soil and prevailing environmental conditions. Variations in crop yield per ha were observed among the different genotypes of onion as shown in Table 4 & Fig. 2. The maximum yield per ha of onion was obtained in *Bidar Local-2* (46.23 t), which surpassed the check variety *Bhima Super* (42.19 t), while the yield per ha was obtained in *Gadag Local-4* (31.2 t). The average yield per ha was noted 51.17 t. By analyzing the Table 4, based on the performance of the different onion genotypes, *Bidar Local-2* (46.23 t), *Bidar Local-1* (45.33 t), *Chitradurga Local-1* (45.33 t) and *Bellary Local* (44.75 t) exhibited high yield potential. Similar variations among onion genotypes have been reported by previous researchers (2, 5, 12, 14, 21, 22).

The length of the bulb was measured and it was ranged between 4.10 cm (Gadag Local-3) to 5.35 cm (Vijayapura Local) with a mean value 4.72 cm, whereas bulb length in check Bhima Super was 4.73 cm. Many other researchers found similar results in onion genotypes (4, 6). The yield of the onion crop is directly affected by both polar and equatorial diameter of the bulb. This influence is attributed to the accumulation of photosynthates in the bulb. The equatorial diameter of the bulb was found to be maximum in Bellary Local (6.69 cm) which is on par with the check Bhima Super (6.06 cm) and it was found minimum in Gadag Local-4 (5.75 cm). The overall mean value was 6.29 cm but statistically no significant difference was observed from Table 4. The market value of the bulb is influenced by the shape and size, which in turn, are determined by the equatorial diameter and polar diameter of the bulb. Such findings were also found by previous studies (5, 18, 21). In onions, a significant trait for selection of genotypes with better keeping quality is a bulb that has a minimum neck thickness.

A smaller neck thickness reduces the likelihood of microbial accumulation and infection during storage, making it a crucial criterion for assessing bulb quality. On the other hand, a larger neck thickness can facilitate microbial growth, leading to potential storage issues (4). The more neck thickness of onion was recorded in Bidar Local-6 (1.42 cm) and lesser neck thick was recorded in Gadag Local-4 (0.57 cm). Neck thickness in check Bhima Super was also found lesser (0.67 cm). The average mean value for neck thickness of the bulb was 0.98 cm. In onion for better keeping quality, the cultivar should have minimum neck thickness, a desirable parameter as explained by previous researcher (23). Similar results were also recorded by many previous studies (9, 11, 17). The bulb dry weight was ranged from 13.29 g (Gadag Local-4) to 34.67 g (Bidar Local-2) with an average value 23.78 g, whereas check Bhima Super recorded 28.64 g of bulb dry weight. The percentage of dry weight in the bulb can be increased due to either bulb desiccation or solids accumulation. Conversely, it can be decreased as a result of respiration or higher bulb hydration. These factors directly impact the overall dry weight of the bulb (20). The plant dry weight of different onion genotypes was ranged from 15.97 g (Gadag Local-4) to 36.83 g (Bidar Local-2) with an average value of 26.56 g. While

Table 4. Mean performance of onion genotypes for yield parameters.

Sl. No.	Treatments	Days from transplanting to harvest	No. of scale leaves per bulb	Bulb weight (g)	Ten bulb weight (g)	Yield per plant (kg)	Yield per plot (kg)	Yield per ha (t)	Bulb length (cm)	Bulb equatorial diameter (cm)	Neck thickness (cm)	Bulb dry weight (g)	Plant dry weight (g)
1.	T_1	110	9.80	104.16	1250.00	0.10	5.59	44.75	5.06	6.69	1.12	28.05	30.25
2.	T_2	115	9.00	97.23	1070.00	0.10	5.23	41.87	4.37	6.14	1.14	20.57	22.67
3.	T_3	103	9.50	105.25	1175.00	0.11	5.67	45.33	4.44	6.39	0.92	32.83	35.87
4.	T_4	92	7.50	101.05	1090.00	0.10	5.43	43.47	4.47	6.47	0.79	25.06	27.12
5.	T_5	107	9.77	89.70	1087.50	0.09	4.80	38.43	4.94	6.44	0.97	17.25	19.22
6.	T_6	97	9.50	102.35	1105.00	0.10	5.50	44.03	4.66	6.05	0.87	26.95	28.85
7.	T_7	104	9.50	101.80	1050.00	0.10	5.47	43.73	4.83	6.26	0.94	20.45	22.31
8.	T_8	101	11.25	80.50	847.00	0.08	4.32	34.53	4.10	5.84	0.82	15.34	17.88
9.	T_9	98	9.50	72.85	832.50	0.07	3.90	31.20	4.24	5.75	0.57	13.29	15.97
10.	T_{10}	102	9.25	102.27	1205.00	0.10	5.50	44.03	5.35	6.4	1.30	16.68	18.84
11.	T_{11}	87	8.50	88.45	1000.00	0.09	4.75	37.97	4.91	6.42	1.24	19.96	21.86
12.	T_{12}	107	9.50	105.20	1250.00	0.11	5.67	45.33	4.85	6.38	1.26	30.38	33.55
13.	T_{13}	102	11.00	107.30	1270.00	0.11	5.77	46.23	4.95	6.45	0.92	34.67	36.83
14.	T_{14}	111	10.00	83.50	919.33	0.08	4.48	35.28	4.84	6.47	0.77	20.17	22.17
15.	T_{15}	105	7.77	90.90	1100.00	0.09	4.88	39.01	4.94	6.45	0.89	22.24	24.78
16.	T_{16}	103	9.50	90.45	1025.00	0.09	4.86	38.88	4.67	6.37	1.11	27.67	29.61
17.	T_{17}	106	10.50	97.70	944.50	0.10	5.25	42.00	5.12	6.54	1.42	26.08	28.08
18.	T_{18}	112	10.50	90.95	1022.33	0.09	4.88	39.01	4.18	5.99	0.84	25.51	37.55
19.	T_{19} (Check)	98	9.25	98.00	1092.50	0.10	5.27	42.19	4.73	6.06	0.67	28.64	31.24
Mean		103.16	9.53	95.24	1066.21	0.09	5.12	40.91	4.72	6.29	0.98	23.78	26.56
CV		1.30	4.57	2.33	6.95	2.37	7.11	5.02	4.32	5.03	9.54	3.72	3.71
F-test (0.05)		*	*	*	*	*	*	*	*	NS	*	*	*
S.Em±		0.77	0.25	1.28	31.66	0.001	0.21	1.08	0.11	0.18	0.05	0.51	0.56
CD (0.05)		2.23	0.72	3.68	90.81	0.004	0.60	3.40	0.33	0.52	0.15	1.46	1.63

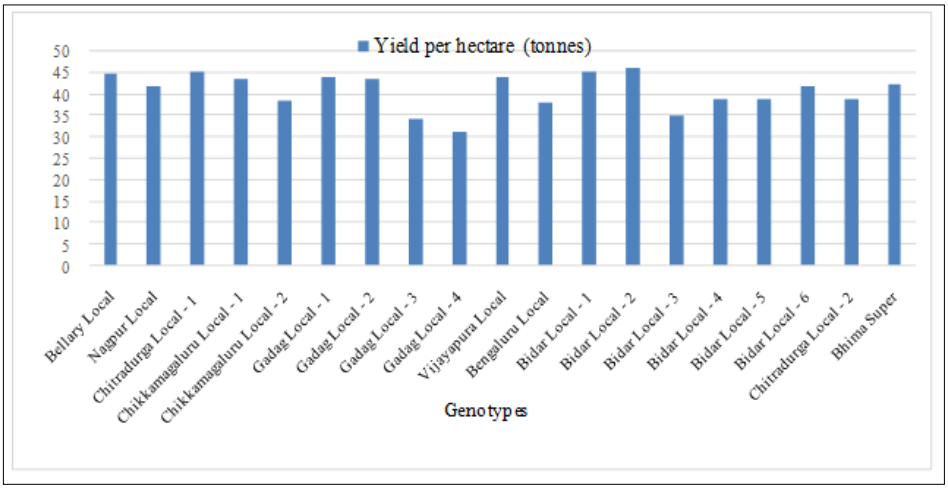

Fig. 2. Yield per hectare of onion genotypes.

check Bhima Super recorded 31.24 g of plant dry weight. As variation in accumulation of photosynthates results variation in the dry matter of the plant which was evident in all the vegetative growth observations. Similar findings were also obtained by previous studies (6, 16, 18) (Table 4).

Bulb length, bulb equatorial diameter, neck thickness and dry weight are the parameters, having influence on storability and keeping quality of the bulb. These traits are highly influenced by genetic makeup of the individual genotypes and were no influence of environment. Hence the superior genotype can be assessed by these traits.

As in the environment, as genotypes are collected from across the state and huge variation was there with respect to the environmental conditions. This is the evident in the study as Gadag Local-3 has shown highest bolting percentage and least was seen in Bidar Local-4. Hence the season and environmental condition plays major role here. The variation in bolting percentage observed among different onion varieties can be attributed to both the genetic composition of the plants and the prevailing weather conditions during the crop transplantation period as reported by previous researcher (24, 25). These findings are in accordance with many previous studies (4, 23). Split bulb percentage of onion was calculated and the average value was noted 3.75 %. The highest Split bulb percentage was observed in Gadag Local-1 (10.18 %) and no split bulb percentage was observed in Bengaluru Local, Bidar Local-6 and check Bhima Super. These results are in conformity with the findings of many previous studies (9, 10, 26).

The TSS of the bulbs was ranged from 11.60 ^{0}Brix to 16.40 ^{0}Brix and the overall average of TSS was 14.41 ^{0}Brix. The maximum TSS was reported in Bidar Local-4 (16.40 ^{0}Brix) and minimum TSS was noted in Bengaluru Local (11.60 ^{0}Brix). Whereas, check Bhima Super reported 14.05 ^{0}Brix. Among the genotypes tested, namely PBR-14-50, PBR-14-59, PBR-14-60 and PBR-14-63, have shown significantly higher TSS compared to the control. The elevated TSS and increased dry weight in these genotypes are particularly suitable for processing purpose. Similar observations were obtained by previous studies (18, 20, 27).

All the genotypes were evaluated for bulb colour based on visual observations. Among the genotypes, one genotype *i.e.* Nagpur Local was found to be White colour. Two genotypes, *i.e.* Chitradurga Local-1 & 2 were found to be Dark red in colour. Chikkamagaluru Local-1 & 2, Gadag Local-2 & 3, Vijayapura Local, Bidar Local-3 and check Bhima super Genotypes were found to be light red in colour and rest of genotypes *i.e.* Bellary Local, Gadag Local-1 & 4, Bengaluru Local and Bidar Local-1, 2, 4, 5 & 6 were found to be red in color (Table 5). The color of the bulb is a crucial factor not only for the Local market but also for export purposes. Likewise, findings were also reported by various previous studies (5, 16, 17, 28).

Table 5. Mean performance of onion genotypes for quality parameters

Sl. No.	Treatments	Bolting (%)	Split bulb (%)	TSS (^{0}Brix)	Bulb color
1.	T_1	9.25	2.76	15.35	Red
2.	T_2	7.85	1.85	12.15	White
3.	T_3	3.70	4.62	14.84	Dark Red
4.	T_4	2.77	6.48	13.80	Light Red
5.	T_5	12.03	1.85	14.22	Light Red
6.	T_6	10.25	10.18	14.20	Red
7.	T_7	26.88	7.40	15.30	Light Red
8.	T_8	27.54	3.70	12.90	Light Red
9.	T_9	8.32	8.32	12.10	Red
10.	T_{10}	17.70	2.77	15.20	Light Red
11.	T_{11}	16.66	0.00	11.60	Red
12.	T_{12}	18.33	2.77	16.10	Red
13.	T_{13}	16.96	2.77	15.20	Red
14.	T_{14}	13.62	1.85	14.50	Light Red
15.	T_{15}	0.00	1.85	16.40	Red
16.	T_{16}	6.44	7.40	15.30	Red
17.	T_{17}	11.70	0.00	14.30	Red
18.	T_{18}	26.19	4.62	16.30	Dark Red
19.	T_{19} (Check)	4.62	0.00	14.05	Light Red
Mean		12.67	3.75	14.41	-
CV		69.07	16.27	5.37	-
F-test (0.05)		*	*	*	-
S.Em±		5.05	0.68	0.44	-
CD (0.05)		14.49	1.95	1.28	-

Conclusion

The study revealed significant variability among onion genotypes for growth, yield and quality traits, with Bidar Local-2, Bidar Local-1, Chitradurga Local-1 and Bellary Local performing superior to the check variety. For farmers, these genotypes can be directly adopted for cultivation to achieve higher yield, better bulb quality and improved storability, thereby enhancing profitability. For breeders, these identified genotypes serve as valuable genetic resources for crop improvement, particularly in developing high-yielding, stress-tolerant and quality-enhanced onion varieties suited to diverse agro-climatic conditions. This dual utility underscores the importance of regional genotype evaluation in bridging the productivity gap and strengthening onion production in India.

Authors' contributions

BH carried out field and laboratory experiments and drafted the manuscript. CS contributed in conceptualization and provided the supervision. PKR conceived the experimental layout and carried out the statistical design. STR participated in plant protection throughout the experiment. ABMK participated in collection and provided seed varieties utilised in the study.KPN conceived the post-harvest study. SHL and YS participated in writing and editing of the manuscript. PVM provided the resources needed for the study. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: The Authors declare no conflict of interest.

Ethical issues: None

References

1. Bal S, Maity T, Maji A. Evaluation of onion genotypes for growth, yield and quality traits under gangetic-alluvial plains of west bengal. Int J Chem Stud. 2020;8:2157-62. https://doi.org/10.36948/ijfmr.2023.v05i05.7415
2. Upadhyay A, Dubey AK, Pandey P, Singh V, Dixit S. Evaluation of onion (*Allium cepa* L.) accessions for yield attributes and yield for central Uttar Pradesh. J Pharmacogn Phytochem. 2020;9(3):1457-9. https://doi.org/10.22271/phyto.2020.v9.i3x.11516
3. Anonymous. Annual report of area and production of horticulture crops. Indiastat agri.; 2022
4. Amarananjundeswara H, Suhas YH, Aravinda Kumar JS, Gowda VR, Reddy MTB. Evaluation of onion (*Allium cepa* L.) genotypes for growth and yield parameters under eastern dry zone of Karnataka. Int. J Che. Stud. 2020;8(6):2790-9. https://doi.org/10.22271/chemi.2020.v8.i6an.11203
5. Singh PR, Mahajan V, Verma A, Lalramhlimi B, Khade YP, Gedam P, Shukla N, Sogam O, Singh M. Genetic variability, character association and path analysis for different traits in white onion genotypes under short day condition. J Environ Biol. 2021;4(3): 401-11. https://doi.org/10.22438/jeb/43/3/MRN-1990
6. Ajayi AT, Adekola MO, Taiwo BH, Azuh VO. Character expression and differences in yield potential of ten genotypes of cowpea (*Vigna unguiculata* L. Walp). Int J Plant Res. 2014;4(3):63-71. https://doi.org/10.5923/j.plant.20140403.01
7. Patel DM, Varma LR, Kumari S. Varietal evaluation of vegetable cowpea (*Vigna unguiculata* (L.) Walp) with respect to plant growth, flowering and fruiting behavior under north Gujarat condition. Int J Curr Microbiol Appl Sci. 2018;7(7):3913-20. https://doi.org/10.20546/ijcmas.2018.707.455
8. Umamaheswarappa P, Naik AH. Evaluation of onion (*Allium cepa* L.) genotypes for growth, yield and quality parameters under central dry zone of Karnataka. Int J Environ Sci. 2015; 33(2A): 992-5.
9. Hirave PS, Wagh AP, Alekar AN, Kharde RP. Performance of red onion varieties in kharif season under Akola conditions. J Hortic. 2015;2(2);1-3. https://doi.org/10.4172/2376-0354.1000132
10. Tripathy P, Sahoo BB, Dash DK. Evaluation of rabi onion (*Allium cepa* L.) genotypes under western table land of odisha. Int J Farm Sci. 2016;6(3):216-22. https://doi.org/10.13140/RG.2.2.20354.09922
11. Dubey S, Verma S, Chandrakar K, Keshari R. Suitability of kharif onion varieties in Mahasamund district of Chhattisgarh. J Krishi Vigyan. 2019;7(2):243-7. https://doi.org/10.5958/2349-4433.2019.00040.0
12. Prithiani S, Dighe SS, Jakhar R, Pushpa K, Gautam D. Evaluation of different varieties on growth characteristics of onion (*Allium cepa* L.). J Pharm Innov. 2022;11(3):386-8.
13. Meghana N, Prakash K, Srinivasa V, Kantharaj Y, Shashikala SK. Assessment of onion (*Allium cepa* L.) varieties for growth and yield attributes under central dry zone of Karnataka. J. Pharm. Innov. 2021;10(12):1712-15.
14. Roy A, Islam AFMS, Tabassum R. Morphological features and yield evaluation of onion (*Allium cepa* L.) genotypes in acid soil. Int J Plant Breed. 2016;10(3):116-24. https://doi.org/10.3923/ijpbg.2016.116.124
15. Behera TK, Mandal J, Mohanta S, Padhiary AK, Behera S, Behera D, Rout RK. Assessment of growth, yield and quality of onion genotypes under red and laterite zone of West Bengal. J. Pharmacogn. Phytochem. 2017: 6(6):493-7.
16. Fathima AF, Paramaguru P, Lakshmanan V, Venkatesan K. (2019). Evaluation of aggregatum onion (*Allium cepa* L. var. *aggregatum* Don.) genotypes for yield and quality traits. J Agric Eco. 2019;8:75-83. http://doi.org/10.53911/JAE
17. Gautam IP, Pradhan NG, Luitel BP, Subedi S. Evaluation of Onion Genotypes for Growth and Bulb Yield in Mid Hill of Nepal J Nep Agric Res. 2019;5:53-61. https://doi.org/10.3126/jnarc.v5i1.23805
18. Naresh B, Thapa U, Choudhuri P, Thakur P, Majumder A. Performance of Different Onion (*Allium cepa* L.) Genotypes in Rabi Season under Short Day Conditions of West Bengal. Biol Forum. 2021;13(4):242-7.
19. Peerzade DA, Harish, BN. Evaluation of onion genotypes for different economic traits in central dry zone of Karnataka. Glob J Res Anal. 2017;8(4):502-3.
20. Mane NV, Kale VS, Karande PJ, Nagre PK, Sonkamble AM, Kayande NV. Evaluation of different onion varieties and genotypes. J Pharmacogn Phytochem. 2020;9(6):1108-10.
21. Thingalmaniyan KS, Rohini N, Arumugam T. Performance evaluation of aggregatum onion genotypes (*Allium cepa* var. *aggregatum*) for yield, quality and resistance characters. Int J Curr Microbiol Appl Sci. 2017;6(9):634-42. https://doi.org/10.20546/ijcmas. 2017.606.075
22. Dhar M, Mandal J, Maity TK, Mohanta S. Evaluation of kharif onion (*Allium cepa* L.) varieties under different planting dates. J Pharmacogn Phytochem. 2019;8(2):1317-21.
23. Gupta N, Bhargav KS, Dixit AK. Evaluation of Kharif Onion (*Allium cepa* L.) Varieties in Malwa Agro Climatic Zone of Madhya Pradesh. Int J Curr Microbiol Appl Sci. 2020;9(12):2722-2727. https://doi.org/10.20546/ijcmas.2020.912.323
24. Gosai JA, Rathawa SA, Dhakad R, Jatav A, Verma LR. Evaluation of Different Varieties of Onion (*Allium cepa* L.) under North Gujarat Condition. Int J Curr Microbiol Appl Sci. 2018;7(5):3775-80. https://doi.org/10.20546/ijcmas.2018.705.438
25. Tripathy P, Sahoo BB, Priyadarshini A, Das SK, Dash DK.

Standardization of kharif onion cultivars. Int J *Bio-res Stress Manag*; 2014;5(2):269-74. https://doi.org/10.5958/0976-4038.2014.00566.1

26. Agnivesh Yadav, RK Singh, Suraj Luthra, Rakesh Kumar, Chandroday Prakash Tiwari, Virendra Kumar, Ramesh Rajbhar, Lalu Prasad. Evaluation of Onion (*Allium Cepa* L.) Genotypes for Yield and Its Attributes Traits under Bundelkhand Region of Uttar Pradesh, India. Journal of Advances in Biology & Biotechnology; 2024;27 (5):32–40. https://doi.org/10.9734/jabb/2024/v27i5759
27. Imran M, Kang H, Kim EH, Lee SG, Park HM, Choi H. Environmental and genetic effects on phytochemical and nutritional composition of onion (*Allium cepa* L.) varieties in South Korea. Frontiers in Plant Science; 2025;16:1649912. https://doi.org/10.3389/fpls.2025.1649912
28. Kim SH, Iwar, Han J, Choi I, Lee J, Ochar K. Variability of bulb morpho-geometrical properties in onion (*Allium cepa* L.) germplasm collections, using digital imaging tools. Frontiers in Plant Science; 2025;16:12338057.

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