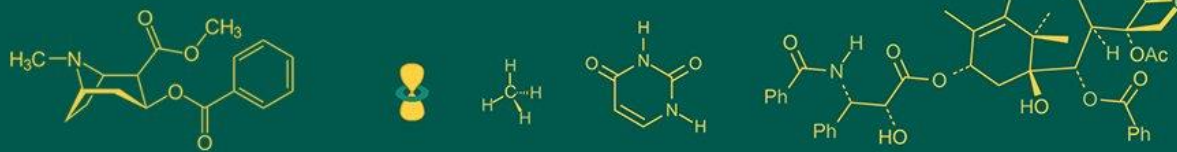


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Performance evaluation of *Kharif* onion (*Allium cepa* L.) genotypes for morphological and yield traits

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Abstract

Kharif onion production is frequently constrained by erratic rainfall, prolonged cloudy weather and high disease incidence, resulting in reduced bulb yield and productivity. Identification of superior genotypes adapted to these conditions is essential for the development of high yielding cultivars. Therefore, the present investigation was conducted during the *kharif* season of 2023 at the ICAR-Directorate of Onion and Garlic Research, Rajgurunagar, Pune, Maharashtra, India to evaluate 31 onion genotypes for morphological and yield related traits under field conditions. The experiment was laid out in a Randomized Block Design with three replications. Significant differences were observed among the evaluated genotypes for all the traits studied, indicating the presence of substantial variability. Genotype DOGR-2118 exhibited superior performance for average bulb weight, pseudo stem width, yield per plot and bulb yield per hectare, whereas RHRO-2022-10 recorded superior vegetative growth with maximum plant height and number of leaves per plant. DOGR-2108, RHRO-2022-5 and DOGR-2101 were identified as promising genotypes for pseudo stem length, equatorial diameter and polar diameter, respectively, while DOGR-2111 exhibited the minimum neck thickness. The observed variability among the evaluated genotypes provides valuable opportunities for selecting superior lines for rainy season cultivation. The identified genotypes may be utilized in varietal improvement programmes and as potential parental material for developing high yielding onion cultivars adapted to *kharif* conditions.

Keywords: *Allium cepa* L., bulb yield, genotype evaluation, *kharif* season, morphological traits

Introduction

Onion (*Allium cepa* L.) is one of the most widely cultivated vegetable crops worldwide owing to its culinary versatility, nutritional value and economic importance. A member of the family Amaryllidaceae, onion possesses a diploid chromosome number of $2n = 2x = 16$. In India, it constitutes an important vegetable crop, serving both as a staple dietary ingredient and a major export commodity. Besides being a rich source of carbohydrates, proteins, dietary fibre, vitamins and essential minerals, onion contains bioactive phytochemicals, particularly quercetin and sulphur-containing lachrymatory compounds, which exhibit antioxidant, anti-inflammatory, hypocholesterolemic and anticancer properties ^[1].

Onion production in India is highly seasonal, leading to pronounced fluctuations in market supply and prices. Onion prices generally remain high during September-November and decline from January to March-April. Since onion storage largely dependent on *rabi* bulbs, which are generally exhausted by August - September, storage losses often exceed 30%, leading to reduced market availability ^[2] and ^[3]. Consequently, *kharif* and late *kharif* onion cultivation plays a crucial role in maintaining onion availability during this period while providing farmers with better market prices than the *rabi* crop ^[3].

Despite its economic importance, *kharif* onion cultivation remains challenging because the crop is exposed to erratic monsoon rainfall, prolonged cloudy weather and continuous drizzling during crop growth. These conditions favour the development of foliar and soil borne diseases, increase weed infestation and adversely affect bulb yield and keeping quality. Consequently, *kharif* onion cultivation is confined to limited areas with relatively low productivity ^[4]. These production constraints highlight the need for the development of genotypes better adapted to

kharif growing conditions. Therefore, the development of improved cultivars adapted to monsoon conditions is essential for sustaining kharif onion production.

The development of improved cultivars adapted to kharif conditions depends largely on the availability and effective utilization of genetic variability. Knowledge of genetic variability and the association among economically important traits forms the basis of any crop improvement programme and facilitates the selection of superior genotypes. Therefore, characterization of available germplasm for qualitative and quantitative traits, together with the assessment of relationships among important traits is essential for the effective utilization of existing variability in onion breeding [5].

Most studies on onion diversity in India have primarily focused on a limited number of commercial varieties or local germplasm, resulting in inadequate exploration of the broader genetic diversity available within the crop. Comprehensive characterization of genetically diverse onion germplasm is essential for identifying promising parental lines for hybridization and future breeding programmes [6]. Consequently, the available genetic diversity remains underutilized, limiting the identification of diverse and promising parental lines. Morphological characterization serves as the first step in the description and classification of plant genetic resources and provides a reliable basis for assessing phenotypic diversity and identifying superior genotypes for crop improvement [7].

Therefore, the present study was undertaken to characterize 29 onion genotypes along with two commercially cultivated kharif onion varieties based on morphological and yield related traits under kharif conditions to identify superior genotypes for future onion breeding programmes.

Materials and Methods

A field experiment was conducted during the kharif season of 2023 at the ICAR-Directorate of Onion and Garlic Research (ICAR-DOGR), Rajgurunagar, Pune, Maharashtra, India (18.84° N, 73.88° E), situated in a subtropical dry humid agro-climatic region. The experiment was established in a Randomized Block Design (RBD) with three replications and comprised 29 onion genotypes along with two commercially cultivated kharif onion varieties. Fungicide-treated seeds were sown in the nursery during the second week of June 2023, and the crop was managed according to the recommended production practices of ICAR-DOGR for kharif onion. Data were recorded on key morphological and yield attributes, including plant height (cm), number of leaves per plant, pseudostem length (cm), pseudostem width (mm), equatorial diameter (cm), polar diameter (cm), neck thickness (mm), average bulb weight (g), yield per plot (kg plot⁻¹) and yield per hectare (t ha⁻¹).

Growth parameters

Plant height (cm)

Plant height was measured at harvest by recording the distance from the soil surface to the apex of five randomly selected plants from each plot using a steel scale. The mean plant height was calculated and expressed in centimetres (cm).

Number of leaves per plant

Five plants were randomly selected from each plot at harvest and the number of green, fully expanded functional leaves per

plant was recorded. The mean number of leaves per plant was calculated for analysis.

Pseudo stem length (cm): Pseudo stem length was measured at harvest as the distance from the bulb top to the point of leaf base attachment using a steel scale. Measurements were recorded from five randomly selected plants in each plot and the mean pseudo stem length was expressed in centimetres (cm).

Pseudo stem width (mm): Pseudo stem width was determined at harvest using a vernier caliper by measuring the maximum diameter at the midpoint of the pseudo stem. Measurements were taken from five randomly selected plants in each plot and the mean value was expressed in millimetres (mm).

Yield parameters

Equatorial diameter (cm)

The equatorial diameter of the bulb was measured at its widest point (mid-length) using digital vernier calipers in millimeters (mm). These values were subsequently converted to centimeters (cm) to calculate the mean for each treatment.

Polar diameter (cm): Polar diameter (cm) was measured at harvest using a digital vernier caliper between the polar ends of five randomly selected bulbs from each plot. Measurements recorded in millimetres (mm) were converted to centimetres (cm) and the mean polar diameter was calculated.

Neck thickness (mm): Neck thickness was measured at the narrowest point of the neck above the bulb using a digital vernier caliper. Measurements were recorded from five randomly selected bulbs in each plot and the mean neck thickness was calculated.

Average bulb weight (g): Average bulb weight was determined at harvest by weighing five randomly selected bulbs from each plot using a digital weighing balance. The mean bulb weight was calculated and expressed in grams (g).

Yield per plot (kg plot⁻¹): Yield per plot (kg) was recorded after field curing by weighing the total bulb yield harvested from each plot. Total yield comprised marketable bulbs as well as unmarketable bulbs, including split, doubled, rotted, and prematurely bolted bulbs, and was expressed as kilograms per plot (kg plot⁻¹).

Yield per hectare (t ha⁻¹)

Marketable bulb yield was estimated from the marketable bulbs harvested from each plot after field curing by excluding split, doubled, rotted, unmarketable, and prematurely bolted bulbs. The plot yield was converted to tonnes per hectare (t ha⁻¹).

Statistical analysis

The experimental data were subjected to analysis of variance (ANOVA) using a Randomized Block Design (RBD). Statistical analyses were performed using the R-based web application GRAPES version 1.1.0 [8]. Genotype means were separated using Tukey's Honest Significant Difference (HSD) test at the 5% probability level ($P \leq 0.05$).

Table 1: List of genotypes used in the study

Sr. No.	Name of genotype	Bulb colour	Source
1	DOGR-2101	Red	ICAR-DOGR, Rajgurunagar, Pune
2	DOGR-2102	Red	ICAR-DOGR, Rajgurunagar, Pune
3	DOGR-2103	Red	ICAR-DOGR, Rajgurunagar, Pune
4	DOGR-2104	Red	ICAR-DOGR, Rajgurunagar, Pune
5	DOGR-2105	Red	ICAR-DOGR, Rajgurunagar, Pune
6	DOGR-2106	Red	ICAR-DOGR, Rajgurunagar, Pune
7	DOGR-2107	Red	ICAR-DOGR, Rajgurunagar, Pune
8	DOGR-2108	Red	ICAR-DOGR, Rajgurunagar, Pune
9	DOGR-2109	Red	ICAR-DOGR, Rajgurunagar, Pune
10	DOGR-2110	Red	ICAR-DOGR, Rajgurunagar, Pune
11	DOGR-2111	Red	ICAR-DOGR, Rajgurunagar, Pune
12	DOGR-2112	Red	ICAR-DOGR, Rajgurunagar, Pune
13	DOGR-2113	Red	ICAR-DOGR, Rajgurunagar, Pune
14	DOGR-2114	Red	ICAR-DOGR, Rajgurunagar, Pune
15	DOGR-2115	Red	ICAR-DOGR, Rajgurunagar, Pune
16	DOGR-2116	Red	ICAR-DOGR, Rajgurunagar, Pune
17	DOGR-2117	Red	ICAR-DOGR, Rajgurunagar, Pune
18	DOGR-2118	Red	ICAR-DOGR, Rajgurunagar, Pune
19	DOGR-2119	Red	ICAR-DOGR, Rajgurunagar, Pune
20	RHRO-2022-1	Red	MPKV, Rahuri
21	RHRO-2022-2	Red	MPKV, Rahuri
22	RHRO-2022-3	Red	MPKV, Rahuri
23	RHRO-2022-4	Red	MPKV, Rahuri
24	RHRO-2022-5	Red	MPKV, Rahuri
25	RHRO-2022-6	Red	MPKV, Rahuri
26	RHRO-2022-7	Red	MPKV, Rahuri
27	RHRO-2022-8	Red	MPKV, Rahuri
28	RHRO-2022-9	Red	MPKV, Rahuri
29	RHRO-2022-10	Red	MPKV, Rahuri
30	Bhima Super	Red	ICAR-DOGR, Rajgurunagar, Pune
31	Bhima Dark Red	Dark Red	ICAR-DOGR, Rajgurunagar, Pune

Table 2: Mean performance of onion genotypes for morphological and yield-related traits under kharif conditions

Sr. No.	Name of genotype	Plant height (cm)	Number of leaves plant ⁻¹	Pseudo stem length (cm)	Pseudo stem width (mm)	Equatorial diameter (cm)	Polar diameter (cm)	Neck thickness (mm)	Average bulb weight (g)	Yield per plot (kg)	Yield per hectare (t ha ⁻¹)
1	DOGR-2101	63.67 ^{abcd}	9.20 ^{bcdef}	5.30 ^{abcdef}	13.22 ^{abcd}	5.47 ^{abcd}	5.77 ^a	12.05 ^{ab}	83.21 ^{abcde}	25.52 ^{bcde}	35.86 ^{abcd}
2	DOGR-2102	64.35 ^{ab}	8.13 ^{bcdefg}	6.17 ^{abc}	14.93 ^{ab}	5.66 ^{abcd}	5.72 ^a	12.31 ^{ab}	82.42 ^{abcde}	20.72 ^{cdefg}	34.53 ^{abcdef}
3	DOGR-2103	61.97 ^{abcde}	8.67 ^{bcdef}	5.63 ^{abcde}	13.31 ^{abc}	5.58 ^{abcd}	5.37 ^{ab}	11.39 ^{ab}	90.61 ^{abc}	23.09 ^{bcdefg}	37.37 ^{ab}
4	DOGR-2104	61.23 ^{abcde}	9.00 ^{bcdef}	5.57 ^{abcde}	12.86 ^{abcd}	5.18 ^{abcd}	5.03 ^{abcd}	9.22 ^{bcd}	90.17 ^{abc}	24.91 ^{bcdef}	34.85 ^{abcdef}
5	DOGR-2105	55.91 ^{efgh}	6.13 ^{fg}	6.13 ^{abc}	10.63 ^{cde}	2.37 ^{hi}	4.34 ^{def}	13.84 ^a	63.75 ^{fgh}	2.57 ^h	5.46 ⁱ
6	DOGR-2106	61.54 ^{abcde}	8.80 ^{bcdef}	5.83 ^{abcd}	13.55 ^{ab}	2.06 ⁱ	4.81 ^{bcd}	11.73 ^{ab}	65.05 ^{fg}	16.68 ^{fg}	27.79 ^{defg}
7	DOGR-2107	57.41 ^{defg}	8.47 ^{bcdef}	5.87 ^{abcd}	13.75 ^{ab}	5.10 ^{abcde}	4.69 ^{bcde}	11.19 ^{ab}	63.93 ^{fgh}	23.94 ^{bcdefg}	27.86 ^{cdefg}
8	DOGR-2108	60.96 ^{abcde}	9.00 ^{bcdef}	6.47 ^a	14.57 ^{ab}	5.49 ^{abcd}	4.64 ^{bcde}	11.14 ^{ab}	71.67 ^{def}	15.82 ^g	26.37 ^{fgh}
9	DOGR-2109	60.01 ^{abcdef}	8.07 ^{cdefg}	6.27 ^{ab}	13.09 ^{abcd}	4.82 ^{bcde}	4.71 ^{bcde}	10.78 ^{ab}	51.67 ^h	20.16 ^{defg}	33.60 ^{abcdefg}
10	DOGR-2110	60.77 ^{abcde}	8.53 ^{bcd}	6.13 ^{abc}	13.76 ^{ab}	5.62 ^{abcd}	5.06 ^{abcd}	12.50 ^{ab}	80.08 ^{bcde}	30.27 ^{ab}	35.44 ^{abcd}
11	DOGR-2111	53.94 ^{fgh}	6.13 ^{fg}	5.50 ^{abcde}	10.39 ^{de}	2.17 ⁱ	3.94 ^{efg}	5.66 ^d	33.97 ⁱ	22.69 ^{bcdefg}	25.59 ^{gh}
12	DOGR-2112	53.73 ^{fgh}	7.47 ^{defg}	5.80 ^{abcd}	12.38 ^{bcd}	4.77 ^{cde}	4.83 ^{bcd}	11.70 ^{ab}	63.55 ^{fgh}	23.93 ^{bcdefg}	26.56 ^{efgh}
13	DOGR-2113	36.33 ⁱ	5.13 ^g	4.20 ^{fg}	8.86 ^e	3.57 ^{fg}	3.80 ^{fg}	9.36 ^{bc}	58.12 ^{gh}	7.41 ^h	19.11 ^h
14	DOGR-2114	57.59 ^{cdefg}	7.17 ^{defg}	5.35 ^{abcdef}	14.40 ^{ab}	5.02 ^{abcde}	4.52 ^{cdef}	11.81 ^{ab}	70.85 ^{ef}	21.46 ^{cdefg}	35.76 ^{abcd}
15	DOGR-2115	58.00 ^{bcdefg}	7.93 ^{cdefg}	5.33 ^{abcdef}	12.92 ^{abcd}	3.42 ^{gh}	3.21 ^g	6.10 ^{cd}	60.86 ^{fgh}	23.54 ^{bcdefg}	33.23 ^{abcdefg}
16	DOGR-2116	59.39 ^{abcdef}	8.33 ^{bcdefg}	4.47 ^{efg}	12.48 ^{bcd}	5.35 ^{abcd}	4.39 ^{def}	11.32 ^{ab}	67.27 ^{fg}	19.69 ^{efg}	32.81 ^{abcdefg}
17	DOGR-2117	62.36 ^{abcde}	8.53 ^{bcdef}	5.33 ^{abcdef}	13.64 ^{ab}	5.67 ^{abcd}	5.14 ^{abcd}	12.46 ^{ab}	92.33 ^{ab}	28.24 ^{abcd}	28.62 ^{cdefg}
18	DOGR-2118	61.65 ^{abcde}	8.93 ^{bcdef}	5.47 ^{abcde}	15.75 ^a	5.72 ^{abc}	5.26 ^{abc}	13.03 ^a	93.67 ^a	36.00 ^a	39.99 ^a
19	DOGR-2119	52.47 ^{gh}	6.00 ^{fg}	4.10 ^g	13.95 ^{ab}	4.08 ^{efg}	4.47 ^{cdef}	13.07 ^a	62.33 ^{fgh}	5.67 ^h	10.42 ⁱ
20	RHRO-2022-1	62.80 ^{abcd}	10.14 ^{abcd}	4.77 ^{defg}	13.84 ^{ab}	5.88 ^{ab}	4.49 ^{cdef}	10.48 ^{ab}	83.87 ^{abcd}	23.52 ^{bcdefg}	35.87 ^{abcd}
21	RHRO-2022-2	61.93 ^{abcde}	11.33 ^{ab}	4.50 ^{efg}	12.63 ^{bcd}	5.74 ^{abc}	5.15 ^{abcd}	11.64 ^{ab}	89.60 ^{abc}	25.57 ^{bcde}	29.62 ^{bcdefg}
22	RHRO-2022-3	63.60 ^{abcd}	10.20 ^{abcd}	5.00 ^{cdefg}	14.06 ^{ab}	5.24 ^{abcd}	4.38 ^{def}	11.30 ^{ab}	79.85 ^{cde}	24.77 ^{bcdef}	31.75 ^{abcdefg}
23	RHRO-2022-4	65.40 ^a	10.33 ^{abcd}	5.00 ^{cdefg}	13.28 ^{abcd}	5.71 ^{abc}	4.42 ^{def}	9.19 ^{bcd}	79.79 ^{cde}	20.68 ^{cdefg}	33.36 ^{abcdefg}
24	RHRO-2022-5	63.18 ^{abcd}	9.10 ^{bcdef}	5.13 ^{bcdefg}	14.34 ^{ab}	6.05 ^a	4.43 ^{def}	10.45 ^{ab}	82.53 ^{abcde}	25.56 ^{bcde}	34.27 ^{abcdef}
25	RHRO-2022-6	64.11 ^{abc}	9.53 ^{abcde}	4.93 ^{defg}	13.96 ^{ab}	5.70 ^{abcd}	4.80 ^{bcd}	11.71 ^{ab}	82.63 ^{abcde}	28.66 ^{abc}	33.80 ^{abcdefg}
26	RHRO-2022-7	62.13 ^{abcde}	9.87 ^{abcde}	5.37 ^{abcdef}	14.33 ^{ab}	5.78 ^{abc}	4.80 ^{bcd}	13.45 ^a	82.86 ^{abcde}	25.01 ^{bcde}	35.02 ^{abcde}
27	RHRO-2022-8	62.87 ^{abcd}	10.73 ^{abc}	4.80 ^{defg}	12.19 ^{bcd}	5.73 ^{abc}	4.57 ^{bcdef}	9.11 ^{bcd}	83.23 ^{abcde}	25.77 ^{bcde}	32.27 ^{abcdefg}
28	RHRO-2022-9	62.63 ^{abcd}	10.27 ^{abcd}	5.20 ^{bcdefg}	12.27 ^{bcd}	5.59 ^{abcd}	4.71 ^{bcde}	11.87 ^{ab}	88.85 ^{abc}	25.69 ^{bcde}	37.48 ^{ab}

29	RHRO-2022-10	65.63 ^a	12.60 ^a	5.05 ^{cdefg}	14.87 ^{ab}	5.96 ^a	4.49 ^{cdef}	10.50 ^{ab}	92.12 ^{abc}	25.86 ^{bcde}	36.43 ^{abc}
30	Bhima Super	50.56 ^h	7.13 ^{defg}	4.73 ^{defg}	13.44 ^{abc}	4.63 ^{def}	4.42 ^{def}	10.23 ^{ab}	64.13 ^{fgh}	19.16 ^{efg}	30.82 ^{bcdefg}
31	Bhima Dark Red	52.01 ^{gh}	6.80 ^{efg}	4.90 ^{defg}	14.65 ^{ab}	4.79 ^{cde}	4.58 ^{bcdef}	11.44 ^{ab}	66.40 ^{fg}	18.19 ^{efg}	30.32 ^{bcdefg}
	Mean	59.36	8.64	5.30	13.30	4.97	4.68	11.03	74.88	21.96	30.72
	Range	36.33 - 65.63	5.13 - 12.60	4.10 - 6.47	8.86 - 15.75	2.06 - 6.05	3.21 - 5.77	5.66 - 13.84	33.97 - 93.67	2.57 - 36.00	5.46 - 39.99
	SE(m)	1.20	0.57	0.20	0.52	0.19	0.15	0.65	2.23	1.47	1.54
	MSD	6.70	3.21	1.18	2.92	1.07	0.81	3.62	12.47	8.23	8.59
	CV (%)	3.49	11.50	6.91	6.80	6.68	5.36	10.16	5.16	11.62	8.66

Results

Significant variation was observed among the thirty one onion genotypes for all morphological and yield related traits evaluated (Table 2). Plant height varied significantly among the evaluated genotypes, ranged from 36.33 - 65.63 cm. The tallest plants were recorded in RHRO-2022-10, while DOGR-2113 produced the shortest plants. More than half of the evaluated genotypes exhibited plant heights above the overall mean of 59.36 cm, indicating considerable variability for vegetative growth among the onion genotypes under kharif conditions. Similarly, the number of leaves per plant varied from 5.13 to 12.60 with an overall mean of 8.64. The highest value recorded in RHRO-2022-10, which was statistically comparable with other superior genotypes, while the lowest value was observed in DOGR-2113. Pseudo stem length ranged from 4.10 to 6.47 cm with an overall mean of 5.30 cm, DOGR-2108 recording the maximum pseudo stem length, whereas DOGR-2119 recorded the minimum. Pseudo stem width varied between 8.86 - 15.75 mm with a mean value of 13.30 mm. The highest and lowest values recorded in DOGR-2118 and DOGR-2113 respectively.

Equatorial diameter ranged from 2.06 - 6.05 cm, averaging 4.97 cm across the evaluated genotypes. RHRO-2022-5 recorded the maximum equatorial diameter, while DOGR-2106 recorded the minimum. Polar diameter varied from 3.21 - 5.77 cm, with a mean of 4.68 cm. The highest polar diameter observed in DOGR-2101 and lowest in DOGR-2115. Neck thickness ranged from 5.66 - 13.84 mm, with a mean value of 11.03 mm, while DOGR-2111 and DOGR-2105 recording the minimum and maximum values, respectively. Average bulb weight ranged from 33.97 to 93.67 g, with a mean value of 74.88 g. The DOGR-2118 recorded the highest bulb weight, whereas DOGR-2111 recorded the lowest. Yield per plot varied from 2.57 to 36.00 kg with a mean value of 21.96 kg. The highest yield obtained in DOGR-2118 and lowest in DOGR-2105. Likewise, yield per hectare ranged from 5.46 to 39.99 t ha⁻¹, with a mean value of 30.72 t ha⁻¹. DOGR-2118 recording the highest yield and DOGR-2105 recorded the lowest.

Discussion

Plant height is primarily governed by the genetic constitution of the genotype, although its expression is also influenced by the prevailing kharif environmental conditions, including temperature, rainfall and soil fertility. Comparable observations have been reported by [9] and [3]. Leaf production depends on the vegetative growth potential of the genotype and its ability to initiate new leaves under prevailing environmental conditions. Under kharif conditions, factors such as frequent rainfall, high humidity, fluctuating temperatures and reduced sunshine may further influence leaf initiation and development. Similar observations were reported by [10] and [3]. Pseudostem length reflects the

vegetative vigour of onion genotypes and is largely governed by their genetic potential. Similar observations were reported by [9]. Pseudostem width is an important indicator of vegetative growth and differed among the evaluated genotypes owing to their genetic constitution. Comparable observations were also reported by [11].

Equatorial diameter is a key determinant of bulb size and is influenced by genetic factors regulating bulb development. Under kharif conditions, excessive rainfall and intermittent waterlogging may further restrict bulb enlargement by impairing root function and assimilate translocation [12]; [13] and [14]. Similar observations have been reported by [15] and [16]. Polar diameter represents bulb growth along the longitudinal axis and is primarily influenced by the genetic potential of the genotype. Comparable findings were reported by [15] and [16]. Neck thickness is influenced by the maturity behaviour and genetic constitution of onion genotypes, while excessive nitrogen fertilization may promote the development of thicker necks [17]. Similar observations were documented by [17] and [9]. Average bulb weight reflects the efficiency of bulb development and assimilate accumulation among the evaluated genotypes. Comparable observations have been reported by [18], [3] and [19]. Yield per plot reflected the productive potential of the evaluated genotypes under kharif conditions. Bulb yield per hectare represents the cumulative expression of yield contributing traits and the genetic potential of the evaluated genotypes. Similar findings were reported by [20], [19] and [16].

Conclusion

The present study demonstrated considerable variability among the evaluated onion genotypes for morphological and yield-related traits under kharif conditions, indicating substantial scope for selection of superior genotypes. Among the evaluated genotypes, DOGR-2118 emerged as the most promising owing to its superior bulb weight and yield performance, while RHRO-2022-10 exhibited excellent vegetative growth. The superior performance of these genotypes suggests their potential for cultivation under kharif conditions as well as their utilization in future onion breeding programmes. Overall, the findings provide valuable information for the selection of promising genotypes aimed at improving productivity and adaptation in rainy season onion.

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