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Screening of Onion (*Allium cepa* L.) Genotypes for High Yield Potential in Mid Hills Region of Himachal Pradesh

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Authors' contributions

This work was carried out in collaboration between both authors. Author Yogita conceptualized the research, conducted experiments, analyzed data and wrote the main manuscript text and Author Srishti helped in data curation and reviewing the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Onion (*Allium cepa* L.) is one of the most important bulbous vegetable crops, belongs to the family *Amaryllidaceae*. Thirty genotypes were taken under study. Sufficient significant variation was observed among all the genotypes for all the characters under study. The maximum plant height was seen in the genotype UHF-ONI-13 (69.08 cm) while, minimum in the genotype UHF-ONI-7 (34.15 cm). Highest polar diameter and equatorial were represented by the genotype UHF-ONI-13 (5.59 cm) and Bhima Kiran (5.99 cm), respectively. There were nine genotypes which exhibited globular shape, three showed torpedo shape and eighteen showed flat shape. The majority, comprising 18 genotypes, exhibited a dark red color for their bulb skinThe genotype recorded to have earliest 50 per cent neck fall was UHF-ONI-4 (129.67 days). Maximum bulb weight was

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recorded by the genotype UHF-ONI-13 (82.95 g). Bulb yield per plot and per hectare was observed maximum in UHF-ONI-13 (8.19 kg and 436.86 q). UHF-ONI-13, UHF-ONI-15 and UHF-ONI-16 performed better than other genotypes for yield and other imperative horticultural characters. Thus, these genotypes can be used for further breeding improvement programmes of onion for different traits.

Keywords: Onion; mean value; polar and equatorial diameter; quantitative traits.

1. INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important bulbous vegetable crop, belongs to the family Amaryllidaceae and having diploid chromosome number 2n=2x=16. According to Vavilov [1], Central Asia is the primary centre of origin. The Near East and Mediterranean region are considered to be its secondary centre of origin. It is a cool season crop. It can be cultivated in a vast range of climatic conditions. It is a cross pollinated crop, mainly pollinated by honey bees and blowflies [2]. The crop is annual for bulb production and biennial for seed production. It can withstand freezing temperature as it is a hardy crop. In every nation of the world, onions are eaten, either as an essential part of the diet or as a condiment. It is the indispensable item in every kitchen as vegetable, spice and condiment; so popularly quoted as “Queen of Kitchen”. The whole plant is edible and available in many forms like frozen, powered, fresh, canned, pickled, caramelized, dehydrated and chopped forms. Sulphur containing volatile oil compound (allyl propyl disulphide) is the main reason behind the pungency of onion [3].

In order to develop new cultivars with desired yield and quality traits in the present situation, a breeder must have a thorough understanding of the variability found in the existing germplasm. The more variation there is in the available germplasm, the higher the probability of identifying superior genotypes. The nature of crop yield is complex and relies on its contributing characters and their interactions. Knowledge of the interrelation of these traits with yield will be more helpful to plan the selection strategies for improving the yield. High variation in genetic components can be seen due to cross pollinated nature of the onion crop. This genetic variability can be exploited in the development of varieties or lines for different breeding objectives.

For bringing about the improvement, it is required to analyse the diverse germplasm of onion for selecting high yielding genotype with other desirable characters, which can be adopted as such for commercial production or can be incorporated in the future breeding programmes for the improvement of yield and quality traits. The extent of genetic variability present in a crop is of great importance for its improvement as the efficiency of selection mainly depends on it [4].

2. MATERIALS AND METHODS

The present investigation was carried out on 30 diverse genotypes of onion including Nasik Red as check at the experimental farm of the Department of Vegetable Sciences, College of Horticulture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during the Rabi season of 2019-20 and 2020-21 respectively. The experimental farm is situated at 30˚5″N latitude and 77˚9″E longitude at an elevation of 1,270 meters above mean sea level at Nauni, about 14 km away from the South-East of Solan (HP). The location is characterized as sub-humid, sub-temperate with mild summers and cool winters. The soil structure of the experimental farm was characterized as sandy loam to clay loam. The pH of the soil ranges from 6.85-7.04. Graphical representation of data pertaining to the temperature, relative humidity during the growing seasons is presented in Fig. 1 and Fig. 2. The experimental material was laid out in Randomized Complete Block Design (RCBD) with three replications. Seedlings were transplanted in the last week of December during 2019-20 and 2020-21 respectively at a spacing of 15×10cm in a plot size of 1.5×1m^2 which accommodated 100 plants per plot.

The observations were recorded for different characters *viz.*, plant height (cm), number of leaves per plant, leaf length (cm), neck thickness (cm), polar diameter (cm), equatorial diameter (cm), bulb shape index, bulb skin colour, days to 50 per cent neck fall, days to harvest, dry matter (%), TSS (˚B), doubles/deformed bulb (%), average bulb weight (g), bulb yield per plot (kg) and per hectare (q)**.** The data recorded was analyzed by using MS- Excel and OPSTAT. Analysis of variance was carried out as per the procedure given by Gomez and Gomez [5]. The

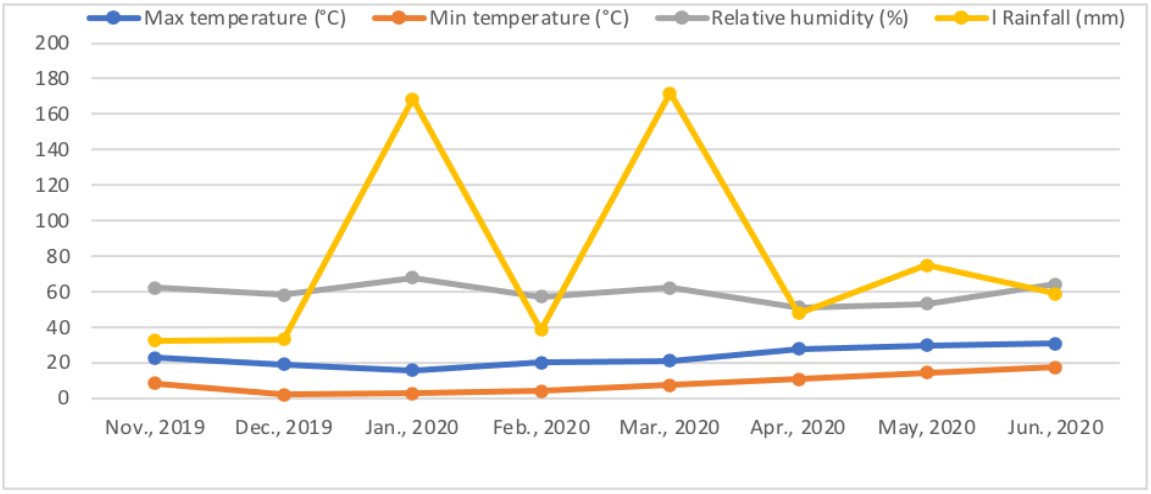

Fig. 1. Graphical representation of data pertaining to temperature, relative humidity and rainfall during the growing season (November 2019 to June 2020)

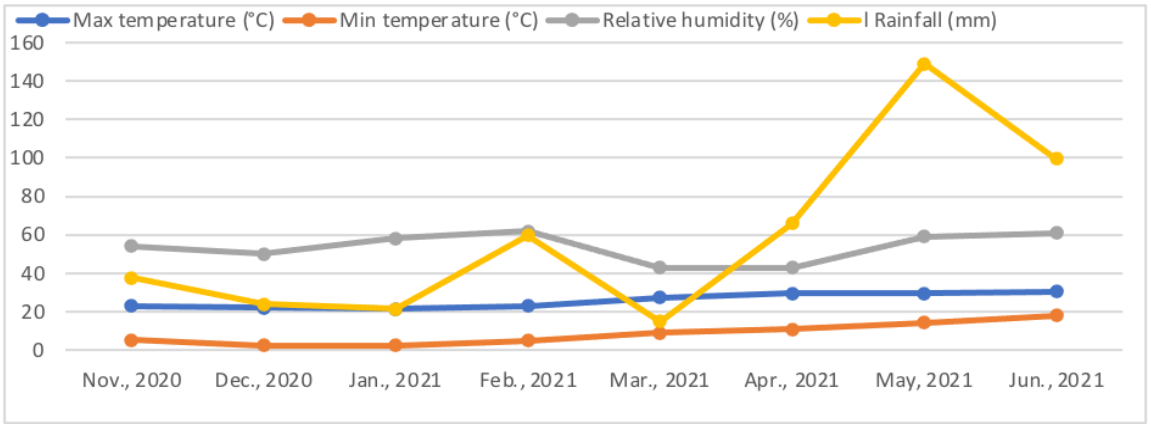

Fig. 2. Graphical representation of data pertaining to temperature, relative humidity and rainfall during the growing season (November 2020 to June 2021)

Source: Meterological Observatory, Department of Environmental Sciences, UHF, Nauni, Solan, (HP) 173 230

mean values of each genotype of each replication for all the traits under study were subjected to statistical analysis as per Randomized Complete Block Design.

3. RESULTS AND DISCUSSION

Significant variations in the genotypes for each trait under investigation were found using the experimental design's analysis of variance (Table 1), indicating that the germplasm had sufficient genetic variability. Hussen and Albaiaty [6], Deepanshu and Singh [4] and Khan et al. [7] also recorded adequate variability in their genetic materials in their studies.

Significant variations were observed among the genotypes for plant height, which ranged from 34.15-69.09 cm with population mean for the trait was 47.64 cm (Table 2). Maximum plant height was observed in genotype UHF-ONI-13 (69.09 cm) while, minimum recorded in UHF-ONI-7 (34.15 cm). There were 15 genotypes which had more value for plant height over the check variety, Nasik Red (46.05cm). Number of leaves per plant varied from 5.50-8.30, with population mean of 6.95. Maximum number of leaves were observed in genotype UHF-ONI-13 (8.30) which was statistically at par with UHF-ONI-16 (8.07), whereas minimum was recorded in genotype UHF-ONI-1 (5.50) which was statistically at par with UHF-ONI-11 (5.54). There were seven genotypes which recorded to had more value for number of leaves per plant over check variety (7.44). The mean and range values for leaf length were observed as 38.18 cm and 27.57-

55.00 cm (Table 2), respectively. According to the comparison, among the mean values for different onion genotypes maximum leaf length was observed in genotype UHF-ONI-13 (55.00 cm) which was statistically at par with UHF-ONI-18 (53.57 cm). Minimum plant height was observed in UHF-ONI-7 (27.57 cm). There were 22 genotypes which had more value for leaf length over the check variety (33.90cm). Mean values for neck thickness ranged from 0.95-1.73 cm. The mean of the population is 1.31 cm. Maximum neck thickness was recorded in genotype UHF-ONI-12 (1.73 cm), while minimum in genotype UHF-ONI-11 (0.95 cm).

Bulb diameters (polar and equatorial) are directly related to the yield. All the genotypes showed significant variations for both polar and equatorial diameter in onion. Mean values for this trait are presented in the Table 2 for different genotypes. The range of polar diameter values varied from 3.59-5.83 cm, with population mean of 4.57 cm. The highest polar diameter among all genotypes was represented by genotype UHF-ONI-13 (5.83 cm), which was statistically at par with genotype UHF-ONI-4 (5.77 cm). The lowest polar diameter was observed in genotype UHF-ONI-3 (3.59 cm). The check variety has polar diameter of 4.28 cm. Mean performance of the genotypes for the equatorial diameter of the bulb showed that the range varied from 4.07-5.99 cm, with the population mean of 4.98 cm (Table 2). The highest equatorial diameter was recorded in genotype Bhima Kiran (5.99 cm), which was statistically at par with Bhima Red (5.89 cm). There were 11 genotypes which had more value for equatorial diameter than check variety (5.10cm). The shape of the bulb is an important feature for market acceptability.

It is an important feature to know the earliness in the genotype. The mean performance of different genotypes for days to 50 per cent neck fall is presented in Table 3, which ranged from 129.67-161.83 days. The overall mean population was recorded to be 144.30 days. Genotype observed to have earliest 50 per cent neck fall was UHF-ONI-4 (129.67 days) which was statistically at with genotype UHF-ONI-6 (133.50 days). While, maximum number of days were taken by genotype UHF-ONI-18 (161.83 days) and found statistically at par with UHF-ONI-12 (160.33 days), as presented in Table 3. There were 14 genotypes which had more value for average bulb weight than the check variety (64.32g).

The range value for days to harvest character varied from 135.84-169.50 days. The mean value of this character is 152.52 days. Genotype earliest to harvest was UHF-ONI-4 (135.84 days) which was statistically at par with genotype UHF-ONI-6 (140.00 days). Maximum number of days to harvest was taken by the genotype UHF-ONI-18 (169.50 days) and found statistically at par with UHF-ONI-12 (168.50 days). The check variety has taken 149.33 days to harvest. The maximum amount of dry matter was observed in genotype UHF-ONI-21 (17.51%), which was statistically at par with UHF-ONI-2 (17.13%). The analysis of data indicated that the mean TSS of the population is 15.23^{o}B, maximum amount of TSS was recorded in genotype UHF-ONI-7 (20.56^{o}B) and minimum in UHF-ONI-12 (11.32^{o}B). TSS in check variety was recorded to be 15.53^{o}B (Table 3). Maximum doubles/deformed bulbs were recorded in genotype UHF-ONI-19 (9.83%) while, minimum in genotype UHF-ONI-4 (2.34%) (Table 3). The data analysis revealed that mean per cent of doubles/deformed bulbs was 5.12 per cent, as shown in Table 3.

The Average bulb weight exhibited significant variation among the onion genotypes. The mean values of bulb weight varied from 41.49 to 81.45 g (Table 2). Maximum bulb weight was recorded by the genotype UHF-ONI-13 (81.45 g) and found at par with UHF-ONI-15 (80.90 g). Whereas, minimum bulb weight was observed in UHF-ONI-7 (41.49 g) and found statistically at par with UHF-ONI-3 (42.10 g) and UHF-ONI-5 (43.72 g), as represented in Table 3. There were 14 genotypes which had more value for average bulb weight than the check variety (64.32g).

All crop enhancement programmes have the primary goal of increasing yield. The differences in the mean values for bulb yield per plot and per hectare varied between 3.76-8.70 kg per plot and 200.52-463.97 q per hectare (Table 3). Maximum bulb yield per plot and per hectare was observed in UHF-ONI-13 (8.70 kg and 463.97 q). Minimum yield was observed in UHF-ONI-3 (3.76 kg and 200.52 q). The overall mean value for bulb yield was found to be 6.12 kg per plot and 326.38q per hectare. There were 13 genotypes which had more value for bulb yield than the check variety (6.22 kg and 331.71 q). Similar trends for significant variation in the bulb yield per plot and per hectare has been reported by Sharma et al. [8], Singh et al. [9], Chatto et al. [10], Parmar et al. [11], Sahu et al. [12], Hussen and Albaiaty [13], Pujar et al. [14], Esho et al. [13] and Deepanshu and Singh [4] in onion.

Table 1. Analysis of variance for different horticultural traits in onion during 2019-20 and 2020-21 (Pooled)

Characters Source	Mean Sum of Squares			
	Replications	Genotypes	Error	Total
df	2	29	58	89
Plant height (cm)	1.47	197.56*	3.00	202.03
Number of leaves per plant	0.11	1.12*	0.03	1.25
Leaf length (cm)	0.20	123.48*	2.06	125.74
Neck thickness (cm)	0.27	93.06*	1.00	94.32
Polar diameter (cm)	0.01	0.60*	0.01	0.62
Equatorial diameter (cm)	0.03	0.62*	0.01	0.66
Bulb shape index	0.01	0.03*	0.01	0.05
Days to 50% neck fall	0.60	184.48*	3.32	188.40
Days to harvest	0.27	181.65*	2.78	184.69
Dry matter (%)	0.33	6.94*	0.10	7.36
Total soluble solids (^{o}B)	0.73	11.04*	0.32	12.09
Doubles/Deformed bulbs (%)	0.34	9.13*	0.60	10.07
Average bulb weight (g)	1.12	445.38*	1.79	448.30
Bulb yield per plot (kg)	0.01	4.74*	0.01	4.75
Bulb yield per hectare (q)	13.91	13466.84*	17.29	13498.04

**Significant at 5% level of significance*

Table 2. Yield and yield attributes showing attributes showing pooled mean performance of thirty genotypes of onion (Pooled)

Sr. No.	Genotypes	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Neck thickness (cm)	Polar diameter (cm)	Equatorial diameter (cm)	Bulb Shape Index (BSI)
1.	UHF-ONI-1	44.68	6.50	36.87	1.16	4.29	4.42	0.96
2.	UHF-ONI-2	39.95	7.60	32.80	1.32	4.36	4.48	0.97
3.	UHF-ONI-3	40.90	7.17	34.63	1.17	3.91	4.04	0.96
4.	UHF-ONI-4	41.80	7.40	34.58	1.26	5.64	4.62	1.19
5.	UHF-ONI-5	37.47	7.37	30.55	1.11	4.48	4.54	1.00
6.	UHF-ONI-6	44.82	6.50	36.30	1.18	4.29	4.77	0.89
7.	UHF-ONI-7	34.15	7.67	27.57	1.26	4.19	4.20	0.99
8.	UHF-ONI-8	48.42	7.23	37.62	1.18	4.27	5.09	0.85
9.	UHF-ONI-9	48.73	7.00	38.87	1.38	4.85	4.80	1.02

Sr. No.	Genotypes	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Neck thickness (cm)	Polar diameter (cm)	Equatorial diameter (cm)	Bulb Shape Index (BSI)
10.	UHF-ONI-10	45.00	7.45	36.75	1.16	4.22	4.70	0.90
11.	UHF-ONI-11	42.85	6.50	34.43	0.98	4.90	5.04	0.97
12.	UHF-ONI-12	51.63	8.27	44.57	1.75	4.84	5.28	0.93
13.	UHF-ONI-13	69.08	8.80	56.00	1.59	5.69	5.19	1.11
14.	UHF-ONI-14	50.58	7.70	40.02	1.33	5.25	5.05	1.04
15.	UHF-ONI-15	52.00	8.23	42.23	1.47	5.08	5.73	0.86
16.	UHF-ONI-16	60.90	8.57	47.28	1.54	5.15	5.10	1.03
17.	UHF-ONI-17	57.35	8.17	44.67	1.45	4.86	4.43	1.10
18.	UHF-ONI-18	67.85	8.37	54.07	1.34	4.81	5.11	0.92
19.	UHF-ONI-19	53.73	7.93	43.10	1.37	4.30	4.96	0.86
20.	UHF-ONI-20	39.68	6.93	34.22	1.14	4.42	4.86	0.89
21.	UHF-ONI-21	52.72	7.53	42.48	1.42	3.97	5.40	0.72
22.	Bhima Shubra	50.22	7.43	38.17	1.49	4.54	5.19	0.88
23.	Bhima Raj	40.13	7.13	32.92	1.26	4.24	5.12	0.81
24.	Bhima Red	50.28	7.27	39.42	1.29	4.61	5.88	0.79
25.	Bhima Shakti	49.82	7.80	40.07	1.49	4.50	5.56	0.82
26.	Bhima Shweta	42.33	7.83	35.90	1.40	4.38	5.06	0.87
27.	Bhima Kiran	46.85	7.27	34.05	1.38	4.68	5.99	0.75
28.	Bhima Dark Red	44.22	6.53	34.50	1.33	4.08	4.94	0.84
29.	Palam Lohit	43.92	7.83	35.28	1.44	4.30	5.01	0.86
30.	Nasik Red (Check)	46.05	7.83	34.90	1.52	4.43	5.10	0.85
Mean		47.94	7.53	38.49	1.34	4.58	4.99	0.92
Range		34.15-69.06	6.50-8.80	27.57-56.00	0.98-1.75	3.91-5.69	4.04-5.99	0.72-1.19
$C.D_{0.05}$		2.84	0.28	2.35	0.05	0.08	0.10	0.03
Genotype		1.72	0.42	2.82	0.05	0.08	0.13	0.03
Years		NS	NS	NS	NS	NS	NS	NS
Genotype x Years		NS	NS	NS	NS	NS	NS	NS

Table 3. Yield and yield attributes showing attributes showing pooled mean performance of thirty genotypes of onion (pooled)

Sr. No.	Genotypes	Days to 50 per cent neck fall	Days to harvest	Dry matter (%)	TSS (ºB)	Doubles / Deformed bulbs (%)	Average bulb weight (g)	Bulb yield per plot (kg)	Bulb yield per hectare (q/ha)
1.	UHF-ONI-1	136.50	148.67	16.07	16.65	7.79	46.98	4.26	226.92
2.	UHF-ONI-2	141.83	149.00	17.13	16.39	7.09	45.60	4.24	225.94
3.	UHF-ONI-3	135.83	145.50	14.74	16.96	6.43	42.10	3.75	199.99
4.	UHF-ONI-4	129.67	137.33	14.56	17.10	2.49	65.72	5.86	312.69
5.	UHF-ONI-5	136.67	144.33	13.94	16.87	2.79	43.72	4.27	227.54
6.	UHF-ONI-6	133.50	141.00	15.37	15.68	3.73	56.60	5.55	295.80
7.	UHF-ONI-7	137.17	144.50	15.01	20.56	4.76	41.98	4.18	222.66
8.	UHF-ONI-8	149.67	157.33	15.26	15.75	4.27	58.65	5.65	301.22
9.	UHF-ONI-9	148.33	155.83	14.02	12.64	4.61	58.55	5.45	290.47
10.	UHF-ONI-10	143.50	153.17	13.12	13.67	5.05	52.32	4.77	254.38
11.	UHF-ONI-11	141.67	150.83	14.39	16.87	5.94	56.43	5.31	283.19
12.	UHF-ONI-12	160.33	168.50	12.50	11.47	4.22	76.50	7.45	397.04
13.	UHF-ONI-13	148.33	157.67	11.96	12.89	4.69	82.95	8.19	436.86
14.	UHF-ONI-14	156.33	164.50	11.12	13.41	4.56	78.37	7.60	405.13
15.	UHF-ONI-15	153.50	160.67	11.38	14.93	5.28	81.90	7.95	423.80
16.	UHF-ONI-16	153.50	161.67	11.62	12.78	4.71	78.93	7.73	412.06
17.	UHF-ONI-17	140.83	149.50	13.11	14.53	4.64	68.17	6.74	359.53
18.	UHF-ONI-18	161.83	169.50	13.48	13.13	5.61	70.85	6.61	352.24
19.	UHF-ONI-19	154.83	164.67	12.77	15.07	10.33	61.98	5.89	313.85
20.	UHF-ONI-20	142.67	151.50	13.99	15.90	7.49	56.23	5.04	268.52
21.	UHF-ONI-21	141.33	150.00	17.51	15.59	4.68	67.97	6.41	341.67
22.	Bhima Shubra	141.83	149.17	12.95	14.18	3.76	72.85	7.11	379.27
23.	Bhima Raj	142.83	146.83	12.80	13.99	7.52	52.40	5.09	271.54
24.	Bhima Red	144.17	150.00	13.48	17.74	4.00	76.68	7.44	396.69
25.	Bhima Shakti	143.67	151.50	14.87	17.11	4.79	67.07	6.46	344.60
26.	Bhima Shweta	144.67	151.83	14.41	15.03	3.94	64.93	6.27	334.38
27.	Bhima Kiran	136.17	153.33	13.92	14.50	3.21	76.28	7.49	399.18
28.	Bhima Dark	141.00	147.83	13.60	13.06	7.33	56.55	5.51	293.76

Sr. No.	Genotypes	Days to 50 per cent neck fall	Days to harvest	Dry matter (%)	TSS (°B)	Doubles / Deformed bulbs (%)	Average bulb weight (g)	Bulb yield per plot (kg)	Bulb yield per hectare (q/ha)
	Red								
29.	Palam Lohit	149.67	158.67	14.87	16.23	7.62	66.93	6.36	338.91
30.	Nasik Red (Check)	141.33	149.33	13.97	15.53	5.67	65.32	6.29	335.54
Mean		144.44	152.81	13.93	15.21	5.30	62.75	6.00	319.77
Range		129.67-161.83	137.33-169.50	11.12-17.51	11.47-20.56	2.49-10.33	41.98-82.95	3.75-8.19	199.99-436.86
$C.D_{0.05}$		2.99	2.73	0.51	0.93	1.27	2.19	0.13	6.81
Genotype		4.53	4.25	0.66	1.38	0.26	2.45	0.15	7.83
Years		NS	NS	NS	NS	NS	NS	NS	NS
Genotype x Years		NS	NS	NS	NS	NS	NS	NS	NS

Table 4. Thirty onion genotypes with different bulb shape and colours

Sr no.	Genotypes	Bulb Shape	Bulb Colour
1.	UHF-ONI-1	GLOBULAR	DARK RED
2.	UHF-ONI-2	GLOBULAR	DARK RED
3.	UHF-ONI-3	GLOBULAR	DARK RED
4.	UHF-ONI-4	TORPEDO	LIGHT RED
5.	UHF-ONI-5	GLOBULAR	DARK RED
6.	UHF-ONI-6	FLAT	LIGHT RED
7.	UHF-ONI-7	GLOBULAR	LIGHT RED
8.	UHF-ONI-8	FLAT	DARK RED
9.	UHF-ONI-9	GLOBULAR	LIGHT RED
10.	UHF-ONI-10	FLAT	DARK RED
11.	UHF-ONI-11	GLOBULAR	DARK RED
12.	UHF-ONI-12	FLAT	LIGHT RED
13.	UHF-ONI-13	TORPEDO	DARK RED
14.	UHF-ONI-14	GLOBULAR	DARK RED
15.	UHF-ONI-15	FLAT	DARK RED
16.	UHF-ONI-16	GLOBULAR	DARK RED
17.	UHF-ONI-17	TORPEDO	LIGHT RED
18.	UHF-ONI-18	FLAT	BROWN

Sr no.	Genotypes	Bulb Shape	Bulb Colour
19.	UHF-ONI-19	FLAT	DARK RED
20.	UHF-ONI-20	FLAT	DARK RED
21.	UHF-ONI-21	FLAT	LIGHT RED
22.	Bhima Shubra	FLAT	WHITE
23.	Bhima Raj	FLAT	DARK RED
24.	Bhima Red	FLAT	DARK RED
25.	Bhima Shakti	FLAT	LIGHT RED
26.	Bhima Shweta	FLAT	WHITE
27.	Bhima Kiran	FLAT	LIGHT RED
28.	Bhima Dark Red	FLAT	DARK RED
29.	Palam Lohit	FLAT	DARK RED
30.	Nasik Red (Check)	FLAT	DARK RED

Table 5. Best three genotypes with respect to different horticultural traits in onion

Characters	Genotypes with Mean Values
Plant height (cm)	UHF-ONI-13 (69.08), UHF-ONI-18 (67.85) and UHF-ONI-16 (60.90)
Number of leaves per plant	UHF-ONI-13 (8.80), UHF-ONI-16 (8.57) and UHF-ONI-18 (8.37)
Leaf length (cm)	UHF-ONI-13 (56.00), UHF-ONI-18 (54.07) and UHF-ONI-16 (47.28)
Neck thickness (cm)	UHF-ONI-12 (1.75), UHF-ONI-13 (1.59) and UHF-ONI-16 (1.54)
Polar diameter (cm)	UHF-ONI-13 (5.69), UHF-ONI-4 (5.64) and UHF-ONI-14 (5.25)
Equatorial diameter (cm)	Bhima Kiran (5.99), Bhima Red (5.88) and UHF-ONI-15 (5.73)
Bulb shape index	UHF-ONI-5 (1.19), UHF-ONI-13 (1.10) and UHF-ONI-17 (1.10)
Days to 50 per cent neck fall	UHF-ONI-4 (129.67), UHF-ONI-6 (133.50) and UHF-ONI-3 (135.83)
Days to harvest	UHF-ONI-4 (137.33), UHF-ONI-6 (141.00) and UHF-ONI-5 (144.33)
Dry matter (%)	UHF-ONI-21 (17.51), UHF-ONI-2 (17.13) and UHF-ONI-1 (16.07)
Total soluble solids (^{o}B)	UHF-ONI-7 (20.56), Bhima Red (17.74) and Bhima Shakti (17.11)
Doubles/Deformed bulbs (%)	UHF-ONI-19 (10.33), UHF-ONI-1 (7.79) and Palam Lohit (7.62)
Average Bulb weight (g)	UHF-ONI-13 (8.80), UHF-ONI-16 (8.57) and UHF-ONI-18 (8.37)
Bulb yield per plot (kg/plot)	UHF-ONI-13 (8.19), UHF-ONI-15 (7.95) and UHF-ONI-16 (7.73)
Bulb yield per hectare (q/ha)	UHF-ONI-13 (436.86), UHF-ONI-15 (423.80) and UHF-ONI-16 (412.06)

All 30 genotypes under study were grouped into 3 categories namely, torpedo (>1 BSI), globular (~ 1 BSI) and flat (<1 BSI). Flat shape was exhibited by 18 genotypes. Nine genotypes exhibited globular shape, while three genotypes showed torpedo shape. Majority of genotypes (18) under study had dark red colour of bulb skin, followed by nine genotypes of light red, two genotypes with white and one had brown skin colour (Table 4).

4. CONCLUSION

In present study, on the basis of overall performance genotypes, UHF-ONI-13, UHF-ONI-15 and UHF-ONI-16 performed better than other genotypes for yield and other imperative horticultural characters. Thus, these genotypes after proper testing can be released as a substitute to the existing one and can also be used for further breeding improvement programmes of onion.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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