Evaluation of white onion (*Allium cepa* L.) genotypes for growth, yield, quality, pest and disease parameters

Abstract

Onion (*Allium cepa* L.), belonging to the family Alliaceae with a chromosome number 2n=16, is a crucial culinary vegetable grown extensively for local consumption and export. This study aimed to evaluate aimed to evaluate white onion genotypes for growth, yield, quality, pest and disease resistance. Conducted at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during late *kharif* 2023-24, the experiment used a randomized complete block design with twenty-six genotypes. Data on various growth and yield parameters were recorded and analyzed. Significant disparities were observed among genotypes for growth parameters such as plant height, leaf length and neck diameter. Safed Ghavriyu exhibited the highest plant height and number of leaves per plant, while Bhima Shubra and Milky White showed superior leaf length and neck diameter, respectively. Yield traits also varied, with Bhima Shweta having the highest dry matter content and Safed Ghavriyu the highest fresh and dry weight per plant, single bulb weight, and total yield per hectare. Genotypes showed significant differences in resistance to thrips and purple blotch disease, with Safed Ghavriyu demonstrating the lowest disease incidence. The highest total soluble solids (TSS) content was found in PWO-2, while W-210 had the highest total sugar content. Milky White registered the highest pyruvic acid content, contributing to its pungency. The results highlight the importance of genetic variability and environmental factors in the growth and yield of white onion, providing insights for developing high-yielding, disease-resistant varieties suitable for different agro-climatic conditions in India.

Keywords: White onion, evaluation, genotypes, growth, yield characters

Introduction

Onion (*Allium cepa* L.) is one of the important culinary vegetable belongs to family *Alliaceae*, having chromosome number 2n=16. It is a native of South West-Asia, from where it spread all over the world. The crop is mainly grown for local consumption and for export purposes. It is known by several vernacular names *viz.*, Pyaz in Hindi, Eerulli / Ullagaddi in Kannada, Venkayam in Tamil and Kanda in Marathi. It is indispensable item in every kitchen and used as vegetable,

spice cum condiment due to its flavor, aroma, smell, taste and medicinal properties. It is being used to prepare salads, pickles, chutneys, curries, soups, sauces and for seasoning of various foods. Hence, it is popularly known as ‘‘**Queen of Kitchen’’**. Among the cultivated *Alliums* in India onion is a prominent export-oriented vegetable and forms the world's second largest producer after China. In India, it is being cultivated in an area of 1.43 million hectares, producing 26.09 million tonnes with a productivity of 18.23 t/ha (Anon., 2021).

Onion is an herb, scapigerous, bulbous, shallow rooted, foetid and highly cross-pollinated crop. It is being grown as an annual crop for bulb production and as a biennial crop for seed production Among the different types of onion, white onion is grown for variety of purposes from kitchen to factory made processed products/food such as rings, flakes, granules, powder, canned onion. The dried processed onion can be reconstituted by cooking in water during preparation of food. These dehydrated onions processed food are considered as a potential product in global trade and they are greater demand in European countries (Murthy and Subrahmanyam, 1999). The processing industries are preferable demands for white onion which are having globose or round shaped bulb with high total soluble solid (TSS) (>18%) content. By comparing the major white onion producing countries, existing Indian white onion varieties are low productivity and low TSS (11-13 %) (Mahajan and Pathak, 2014). The existing white onion genotypes shown wide variations in yielding ability when they are grown under varied agro-climatic conditions. In this regard, many SAU’s, NHRDF and ICAR institutes have developed and released high yielding varieties for commercial cultivation based on the suitability of agro-climatic conditions. As India being a vast country with diversified agro climatic regions, single variety/genotype may not suitable for all the agro-climatic conditions. The production and productivity of any crop not only depends on cultural practices but also depends on genetic variability.

Material and Methods

The present investigation on Evaluation of white onion (*Allium cepa* L.) genotypes for growth, yield, quality, pest and disease parameters was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during late *kharif* 2023-24. Twenty-six genotypes were collected from different institutions and geographical diverse locations and evaluated using randomized complete block design (RCBD) consisting three replications. Five plants were selected randomly from each replication and data were recorded for the characters *viz.*, plant height at harvest (cm), number of leaves per plant at harvest, leaf length at harvest (cm),

Bolting (%), neck diameter of bulb (cm), days to maturity, fresh weight of plant (g), dry weight of plant (g), dry matter content of plant (%), equatorial diameter (cm), polar diameter (cm), bulb index, doubles (%), ten bulb weight (g), average weight of bulb (g), total yield (kg/plot), total yield (t/ha), marketable yield (t/ha), harvest index (%), purple blotch incidence(%), thrips incidence, TSS (°Brix), reducing sugar (%), non-reducing sugar (%), total sugar(%) and pyruvic acid (µ moles/ g). The data were analyzed to find out the superior genotypes for development of good quality onion varieties suitable for northern transitional zone of Karanataka.

Results and Discussion

Genotypes showed significant disparity for growth parameters. Among the genotypes at harvest, maximum plant height (64.44 cm) and number of leaves per plant (11.82.) were documented in Safed Ghavriyu. Higher leaf length (60.45 cm) and neck diameter of bulb (1.39 cm) was recorded in Bhima Shubra and Milky White genotype, respectively.

Among the genotypes assessed, nine genotypes did not show any bolting [White Deshi, Indus WG-4, Indus WG-6, W-125, W-498, PWO-2, Budhel Expert, Bailhongal Local and Agrifound White] and which are *on par* with Indus WG-2, Indus WG-5, W-210, W-398 (0.5 % each). Among the genotypes evaluated for days to maturity of onion W-364, Milky White, Gadag Local genotypes took minimum days to maturity (95 days each) followed by W-125 (96 days) and Bhima Shubhra (98 days).

The variation growth parameter is due to growth is an irreversible increase in size and shape of a plant and is influenced by the complex interaction between environmental factors, physiological processes and genetic constitution of the genotypes. Among the various factors affecting the plant growth, environment factors play a vital role in the growth and development. Similar variations in growth parameter *w.r.t* white onion genotypes was noticed by Umamaheswarappa *et al.* (2018), Amarananjundeswara *et al.* (2020), and Singh *et al.* (2020).

The yield traits like dry matter, polar and equatorial diameter were significantly differed with genotypes. The results revealed that, Bhima Shweta genotype accumulated maximum dry matter (15.26 %) content, followed by W-125 (15.02 %), Indus WG-2 (14.97 %), PWO-2 (14.61 %), Indus WG-4 (14.56 %) and Bailhongal Local (14.55 %). Such increased dry matter content of plant is mainly due to genotypic nature of plant. Polar diameter of bulb (5.58 cm) in Indus WG-1 and equatorial diameter of bulb (7.04 cm) in Safed Ghavriyu. The observed variations in

enlargement of bulb diameter (equatorial and polar) might be due to varietal character, photosynthetic activity and translocation of photosynthates to bulb. Among genotypes evaluated, ten genotypes did not show any double bulb formation. However, maximum double bulb formation was observed in Milky White (1.70 %). Such formation of double bulb mainly depends on the genotype, weather conditions and agronomic practices followed. The outcome of these results is in consistence with the works of Priyadarshani (2018), Yadav *et al.* (2010) and Devi *et al*. (2014).

The yield parameters such as fresh weight, dry weight, single bulb weight, ten bulb weight, bulb yield per plot, total bulb yields per hectare, marketable bulb yield per hectare and harvest index (%) were found significantly higher in genotypes Safed Ghavriyu (120.63 g/plant, 17.00 g/plant, 99.28 g, 990.90 g, 8.96 kg/plot 29.87 t/ha, 27.05 t/ha and 82.30 %) followed by Bhima Safed (117.68 g/plant, 16.60 g/plant, 95.08 g, 948.70 g, 8.69 Kg/plot, 28.97 t/ha, 26.85 t/ha and 80.80 %). Such variations due to genotypic characteristics, environmental factors, based on cultural practices adopted and nutrient availability to the plant might have directly influenced on bulb weight. These results are in corroborated with the findings of Mahantesh *et al.* (2009), Yasmin (2009), Lakshmipathi (2016), Suhas (2016), Sahu *et al*. (2017) and Hulagannavar *et al*. (2023).

White onion genotypes shown significant differences with respect to thrips and purple blotch disease incidence. Among the genotypes assessed, none of the genotypes showed immune to thrips and purple blotch incidence. While, Indus WG-5, Milky White and Safed Ghavriyu genotypes showed resistance to thrips incidence with a scale of one. For purple blotch disease incidence minimum purple blotch incidence in Safed Ghavriyu (11.16 %) followed by Milky White (13.55 %), Bhima Safed (13.97 %), Gadag Local (14.23 %) and Indus WG-5 (14.54 %) genotypes were performed better compared to rest of the genotypes. These variation in pest and disease incidence might be due to environmental factors such as temperature, wind velocity and sunshine hours. Similar findings were also reported by, Suhas *et al*. (2016), Tripathy *et al.* (2016), Solanki *et al*. (2019) and Singh *et al.* (2020) in onion.

Maximum TSS (17.25 ° Brix) content was reported in PWO-2 followed by Indus WG-1 (16.25 ° Brix) and Indus WG-3 (15.76 ° Brix) genotypes. The observed disparity of TSS content in genotypes may be due to varietal character, physiological activity of plant and availability of nutrients. Whereas, W-210 genotype registered maximum reducing sugar (3.79 %) and total sugar (7.62 %) content. While, Indus WG-3 genotype documented maximum non-reducing sugar (3.78

%) content. The observed variations for reducing, non-reducing and total sugar content in genotype may be due to genetic constitution of genotypes. These outcomes of results are also in consistent with the works of Umamaheswarappa *et al.* (2015), Sachin *et al*. (2015), Lakshmipathi *et al*. (2017), Singh *et al.* (2020) and Solanki *et al*. (2020).

Among the genotypes studied, the Milky White genotype had registered maximum pyruvic acid (5.02 µ moles/g) content followed by Telagi Local (4.98 µ moles/g), Budhel Expert, Gadag Local (4.90 µ moles/g each), W-125 (4.86 µ moles/g) and Bailhongal Local (4.60 µ moles/g). While, White Deshi genotype exhibited minimum pyruvic acid (2.39 µ moles/g) content. The content of pyruvic acid influences the pungency as well as storage period of bulb. This may be due to high temperature during growth and sulphur fertilizer can lead to increased synthesis of volatile sulphur compounds, resulting in more pungency in onions. These results are in line with the reports of Gallina *et al.* (2012), Abedi *et al.* (2013), Dhumal *et al*. (2007) and Solanki *et al*. (2020).

Conclusion

The study revealed significant disparities among white onion genotypes in growth parameters, yield traits, pest and disease resistance, and quality traits, primarily attributed to genetic differences, environmental factors, and agronomic practices. Notably, Safed Ghavriyu excelled in plant height, yield parameters, and resistance to purple blotch, while Bhima Shubra and Milky White showed superior leaf length and neck diameter, respectively. Genotypes like Bhima Shweta and PWO-2 stood out in dry matter and TSS content, respectively. These findings underscore the evaluation of white onion genotypes for growth, yield, quality and pest and disease parameters provides valuable insights for developing improved onion varieties tailored to specific agricultural conditions. By leveraging genetic variability and environmental factors, breeders and farmers can work towards cultivating onions with enhanced traits that meet consumer demands and ensure sustainable production practices.

Table 1. Mean performance of white onion genotype for growth, yield, quality, pest and disease parameters

Sl. No.	Genotype	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
1	Akola Safed	60.03	10.66	51.12	2.50	1.27	100.00	90.25	12.40	13.74	5.66	4.69	0.83	1.56
2	Bhima Shwetha	62.41	10.93	51.86	5.00	1.18	109.00	102.24	15.60	15.26	5.92	4.45	0.75	0.92
3	White Deshi	57.89	10.17	50.21	0.00	0.92	116.00	73.22	9.60	13.11	5.43	4.96	0.91	0.63
4	Telagi Local	61.37	10.68	58.46	10.50	1.21	104.00	80.32	10.20	12.70	5.96	5.00	0.84	1.08
5	Indus WG-Dhawal	62.43	11.23	55.38	1.50	1.21	122.00	93.47	11.10	12.58	5.94	5.03	0.85	0.76
6	Indus WG-1	61.12	11.04	55.13	4.50	1.14	115.00	101.32	13.90	13.72	6.53	5.58	0.85	0.51
7	Indus WG-2	62.13	11.18	53.64	0.50	1.09	119.00	81.52	12.20	14.97	6.09	5.01	0.82	0.00
8	Indus WG-3	57.35	10.54	53.81	3.50	1.28	107.00	104.98	13.50	12.86	6.75	5.56	0.82	0.00
9	Indus WG-4	51.64	9.47	45.35	0.00	0.97	122.00	79.66	11.60	14.56	6.19	5.10	0.82	0.67
10	Indus WG-5	61.23	10.26	54.59	0.50	1.17	112.00	105.32	14.10	13.39	6.89	5.49	0.80	0.00
11	Indus WG-6	60.98	10.84	53.83	0.00	0.89	119.00	68.28	9.20	13.47	5.16	4.23	0.82	0.00
12	W-125	60.70	10.89	54.96	0.00	1.09	96.00	80.54	12.10	15.02	6.15	4.60	0.75	0.58
13	W-210	58.71	10.90	52.91	0.50	1.18	105.00	77.92	10.00	12.83	5.92	5.07	0.86	0.00
14	W-398	60.15	10.57	53.08	0.50	1.15	100.00	69.32	9.40	13.56	4.67	4.29	0.92	1.18
15	W-364	58.68	10.22	51.62	1.00	1.26	95.00	71.60	9.20	12.85	4.29	3.56	0.83	0.00
16	W-498	58.27	10.28	51.14	0.00	1.10	110.00	50.12	7.10	14.16	4.13	3.38	0.82	0.28
17	Milky White	59.55	10.92	55.89	13.00	1.39	95.00	104.61	13.20	12.62	6.60	5.03	0.76	1.70
18	Alibaug Local	60.23	10.83	52.06	8.00	1.27	106.00	75.09	10.10	13.45	5.78	4.87	0.84	0.96
19	Bhima Shubhra	62.15	11.27	60.45	6.00	1.26	98.00	105.49	13.20	12.51	5.91	4.45	0.75	0.48
20	PWO-2	46.27	8.75	41.43	0.00	0.91	126.00	49.98	7.30	14.61	3.28	2.31	0.70	0.00
21	Budhel Expert	63.26	11.22	56.27	0.00	1.01	109.00	79.76	9.70	12.16	5.40	4.59	0.85	0.00
22	Gadag Local	62.06	11.15	57.45	16.00	1.31	95.00	107.69	14.40	13.37	6.14	5.53	0.90	1.22
23	Bailhongal Local	51.94	8.51	45.88	0.00	0.93	109.00	54.30	7.90	14.55	3.61	2.57	0.71	0.00
24	Safed Ghavriyu	64.44	11.82	57.42	9.50	1.26	115.00	120.63	17.00	14.09	7.04	5.23	0.74	1.26
25	Bhima Safed	57.13	10.86	56.27	5.50	1.23	109.00	117.68	16.60	14.11	6.88	5.52	0.80	0.33
26	Agrifound White (C)	57.48	10.88	51.13	0.00	1.13	113.00	85.72	11.50	13.42	5.31	4.19	0.79	0.00
Mean		59.22	10.62	53.13	3.40	1.15	-	85.81	11.62	13.60	5.68	4.63	0.81	0.54
S.Em. ±		1.93	0.29	1.80	0.21	0.03	-	3.79	0.53	0.31	0.21	0.10	0.02	0.03
C.D @ 5%		5.50	0.85	5.13	0.61	0.10	-	10.78	1.52	0.88	0.62	0.28	0.06	0.10

C- Check

Note: X_1-Plant height at harvest (cm), X_2- No. of leaves per plant at harvest, X_3-Leaf length at harvest (cm), X_4-Bolting (%),X_5-Neck diameter of bulb (cm), X_6- Days to maturity, X_7-Fresh weight of plant (g), X_8-Dry weight of plant (g), X_9- Dry matter content of plant (%), X_{10}-Equatorial diameter (cm), X_{11}-Polar diameter (cm), X_{12}-Bulb index and X_{13}- Doubles (%).

Table 1. Contd……...

Sl. No.	Genotype	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}
1	Akola Safed	629.90	63.78	5.29	17.63	13.10	70.67	3.0	28.49	14.85	2.42	2.48	5.12	3.54
2	Bhima Shwetha	789.20	79.23	7.65	25.50	23.46	77.49	3.0	18.54	12.98	2.74	2.61	5.58	4.08
3	White Deshi	501.00	50.50	3.96	13.20	10.68	68.97	3.0	38.17	13.25	2.83	2.15	5.17	2.39
4	Telagi Local	639.10	64.50	5.60	18.67	16.87	80.30	3.0	19.67	13.75	2.29	2.62	5.14	4.98
5	Indus WG-Dhawal	705.50	70.96	6.52	21.73	20.65	75.92	3.0	19.79	13.28	2.68	2.71	5.63	3.76
6	Indus WG-1	766.00	77.01	7.14	23.80	22.84	76.01	2.0	17.69	16.25	3.00	3.01	6.27	2.40
7	Indus WG-2	595.40	59.83	4.90	16.33	15.31	73.39	4.0	25.49	15.23	3.23	3.62	7.16	4.23
8	Indus WG-3	817.50	82.14	7.67	25.57	23.19	78.24	3.0	16.54	15.76	3.17	3.78	7.28	3.26
9	Indus WG-4	583.40	58.63	5.09	16.97	14.81	73.60	3.0	29.50	12.30	3.29	2.61	6.13	3.50
10	Indus WG-5	838.70	84.18	7.88	26.27	23.69	79.93	1.0	14.54	14.95	3.09	3.10	6.45	3.78
11	Indus WG-6	490.50	49.36	4.17	13.90	12.54	72.29	3.0	30.96	14.25	3.18	2.95	6.39	2.98
12	W-125	606.80	60.89	5.62	18.73	17.25	75.60	3.0	21.49	10.88	2.44	2.82	5.51	4.86
13	W-210	551.40	55.55	5.13	17.10	15.72	71.29	3.0	23.34	13.20	3.79	3.52	7.62	2.78
14	W-398	532.70	53.56	4.90	16.33	14.59	77.26	2.0	25.69	14.13	2.88	2.43	5.52	4.06
15	W-364	546.60	55.05	4.74	15.80	13.68	76.89	3.0	28.01	12.30	2.24	3.02	5.52	4.50
16	W-498	343.60	34.77	3.10	10.33	5.45	69.37	4.0	39.18	10.34	2.47	2.43	5.11	3.88
17	Milky White	835.20	83.83	7.63	25.43	23.50	80.14	1.0	13.55	12.10	2.35	3.07	5.69	5.02
18	Alibaug Local	532.00	53.59	4.85	16.17	15.43	71.37	3.0	22.49	12.12	2.78	3.28	6.34	4.18
19	Bhima Shubhra	858.30	86.14	7.60	25.33	23.03	81.66	2.0	16.83	12.78	2.52	2.82	5.58	4.08
20	PWO-2	312.00	31.69	2.24	7.47	4.18	63.41	2.0	23.75	17.25	2.33	3.39	6.02	3.09
21	Budhel Expert	570.90	57.47	4.63	15.43	13.30	72.05	3.0	29.86	14.26	2.51	2.52	5.25	4.90
22	Gadag Local	866.80	86.69	7.76	25.87	22.92	80.50	2.0	14.23	12.23	2.95	3.20	6.43	4.90
23	Bailhongal Local	386.30	39.03	3.08	10.27	9.35	71.88	4.0	38.57	12.34	2.65	2.37	5.23	4.60
24	Safed Ghavriyu	990.90	99.28	8.96	29.87	27.05	82.30	1.0	11.16	12.80	3.68	2.72	6.64	4.35
25	Bhima Safed	948.70	95.08	8.69	28.97	26.85	80.80	2.0	13.97	13.80	2.65	2.96	5.87	3.56
26	Agrifound White (C)	637.00	63.83	4.97	16.57	14.05	74.46	3.0	22.69	13.38	3.10	3.05	6.41	3.67
Mean		649.05	65.25	5.76	19.20	17.06	75.22	2.65	23.24	13.49	2.82	2.89	5.96	3.90
S.Em. ±		30.37	3.01	0.27	0.90	0.78	1.87	-	1.13	0.62	0.13	0.13	0.27	0.17
C.D @ 5%		86.27	8.55	0.77	2.56	2.24	5.32	-	3.22	1.78	0.38	0.38	0.77	0.50

C- Check

Note: X_{14}- Ten bulb weight (g), X_{15}-Average bulb weight, X_{16}-Total yield (kg/plot), X_{17}-Total yield (t/ha), X_{18}-Marketable yield (t/ha), X_{19}-Harvest index (%), X_{20}-Thrips incidence, X_{21}-Purple blotch severity (%), X_{22}- TSS (°Brix), X_{23}-Reducing sugar (%), X_{24}-Non-reducing sugar (%), X_{25}-Total sugar (%) and X_{26}-Pyruvic acid (µ moles/g).

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