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Studies on Performance of White Onion Advance Lines for Growth and Yield for Selection of Quality Variety

R. K. Singh[1*], S. K. Singh[2] and A. K. Tailor[3]

[1]Department of Vegetable Science, Banda University of Agriculture and Technology, Banda UP, India
[2]NHRDF, New Delhi, India
[3]National Horticultural Research and Development Foundation, Nashik, Maharashtra, India

**Corresponding author*

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A B S T R A C T

India is second largest producer of onion in the world after China. Onion (*Allium cepa* L.) is commercially cultivated and widely consumed as vegetable and as spices in India. About 73.23 million tons of onions are produced in the world from 3.65 million ha area. India, being major onion-producing country, produces 20.13 million tons from 1.19 million ha, with a very low productivity of 16.24 t/ha in comparison to Republic of Korea (64.58 t/ha), USA (54.47 t/ha), Spain (53.69 t/ha), Netherland (45.80 t/ha), Japan (42.46 t/ha), Germany (41.86 t/ha) and United Kingdom (41.15 t/ha). Lack of recommended or released variety of high yielding as well as good keeping quality in the country, it creates price fluctuation during off season arrival period. To meet out the domestic requirement and also to fulfill the export demand, selection of high yielding genotype under different agro-climatic conditions is necessary. The experiment was conducted at Nashik and Karnal during *Rabi* 2017-18. The trial conducted at Nashik, revealed that the highest gross yield (382.13 q/ha) and marketable yield (250.47 q/ha) were recorded in advance line-874 which was at par with line-827 in respect of marketable yield. Highest TSS (13.05%) and dry matter content (14.44%) were noted in line-830 and found at par with lines-562, 799, 823, 832, 865, 886 and Agrifound White, however at Karnal, the highest gross yield (290.28 q/ha) and marketable yield (258.82 q/ha) were recorded in lines-810 and 562, respectively, which were par with advance line-562 in respect of gross yield. The highest total soluble solids (14.40 %) were recorded in advance line-810. It is concluded that the above genotypes can be utilized for white onion breeding programme for develop a good quality variety for different agroclimatic condition.

Introduction

Onion is one of the most important underground bulbous vegetable crops grown in India, having both the food and medicinal values. It is widely cultivated for internal consumption as well as for the export. India is the second largest producer of onion in the world after China. About 73.23 million tons of onions are produced in the world from 3.65 million ha area. India, being major onion-producing country, produces 20.13 million tons from 1.19 million ha, with a very low productivity of 16.24 t/ha in comparison to Republic of Korea (64.58 t/ha), USA (54.47 t/ha), Spain (53.69 t/ha), Netherland (45.80 t/ha), Japan (42.46 t/ha), Germany (41.86 t/ha) and United Kingdom (41.15 t/ha). The white onion with high total soluble solids highly utilized for dehydration purpose such

as flakes powder, paste, crush and pickle, etc. (Singh *et al.*, 2004).Processed onion, highly competitive commodity in the international market should possess certain desirable traits such as high yield retentive attractive colour, high pungency and good drying ratio (Kurade and Mathias, 1972).The main white onion growing states in India are Maharashtra, Gujarat, Karnataka and Madhya Pradesh. and has many medicinal properties. The production of white onion is now becoming popular among farmers, producers and exporter. The exporters export the white onion from Maharashtra and Gujarat and they are demanding a good white onion variety which has greater potential for dehydration.

About 55-60% of onion comes from *Rabi* season and 40-45% from *Kharif* and late *Kharif* season. Because of its high export potential, it comes under cash crop apart from vegetable (Pandey, 1989). It is predominantly a *Rabi* season crop and most onion cultivars are sensitive to photo period and thus their range of adoption is limited (Gupta and Singh, 2010). Lack of recommended or released variety of high yielding as well as good keeping quality in the country, it creates price fluctuation during off season arrival period.

The work conducted on selection of suitable white onion is very scanty (Saimbhi *et al.*, 1971 and Sethi *et al.*, 1993). To meet out the domestic requirement and also to fulfill the export demand, selection of high yielding genotype under different agro- climatic conditions is necessary. In onion, local genotypes play important role in development of new cultivars. The main onion growing states in India are Maharashtra, Gujarat, Karnataka, Tamil Nadu, Odisha, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Bihar and Punjab. It is used as a salad or cooked in various ways in all curies, fried or baked and also used in processed form e.g. flakes powder, paste, crush and pickle, etc. National Horticultural Research and Development Foundation, Nashik, collected good number of germplasm and evaluated their performance regarding different attributes. Hence under present study a total of 17 germplasm along with one check Agrifound White at Nashik while at Karnal also 14 genotypes along with one check Agrifound White were evaluated to assess their performance for selection of high yielding varieties for *Rabi* season.

Materials and Methods

The present investigation was carried out at National Horticultural Research and Development Foundation at Nashik, Maharashtra and Karnal, Haryana during *Rabi* 2017-18. The experiment was laid out in randomized block design with three replications. The Nashik (20^0 N latitude and 73^0 E longitudes) is located at altitude of 492 meter above mean sea levels. The minimum and maximum temperature and humidity is ranging between 10 ^{0}C to 40 ^{0} C and 48 % to 80 %, respectively, with an annual rain fall around 881 mm.

The soil of the trial was clay loam, medium in organic carbon (0.58%), available nitrogen (385.2 kg/ha), phosphorus (45.13kg/ha) and high in available potash (291.2kg/ha). The study comprises under present study a total of 17 germplasm along with one check Agrifound White at Nashik, while at Karnal also 14 genotypes along with one check Agrifound White selected among more than 200 genotypes evaluated at this centre. The seeds were sown on 4/11/2017 and seedlings were transplanted on 09/01/2018 at Nashik, while at Karnal, the seeds were sown on 13/11/2017 and seedlings were transplanted on 28/01/2018, however, harvesting was done as per maturity of bulbs at Nashik from 24/04/2018 to 28/04/2018 and at Karnal on

04/05/2018-14/05/2018. 50 to 55 days old seedlings of each onion genotypes were transplanted in flat beds in the spacing of 15 cm x 10 cm in a plot of 3.6 m x 1.8 m size. The recommended package of practices was uniformly followed during whole experiment period to raise a successful crop. Randomly selected ten plants from each plot were taken to record the observations on plant establishment (%), plant height (cm), leaves per plant, neck thickness (cm), equatorial bulb diameter (cm), polar bulb diameter, P: E ratio, weight of 20 bulbs (kg), days for harvesting, doubles (%), bolters (%), rotten %, total soluble solid (%), dry matter content(%), gross yield (q/ha), marketable yield (q/ha), skin intactness at harvest, compactness of bulbs, colour of bulbs, shape of bulbs, thrips incidence and intensity, stemphylium blight intensity. The data were analyzed to find out the superior genotypes for development of good quality onion varieties suitable for different agro climatic conditions.

Results and Discussion

At Nashik, the data presented in Table-1 observed that traits such as number of leaves per plant, neck thickness, equatorial bulb diameter, polar bulb diameter and P: E ratio, exhibited non-significant differences. Highest % of plant establishment (96.97) and plant height (69.53 cm) were noted in line-832 and check variety Agrifound White, respectively, and were at par with lines-784, 823 and 885 in respect of % of plant establishment and lines-799, 869 and 857 regarding plant height.

Highest 20 bulbs weight (1.16 kg) was recorded in line-830. The significant and highest bulb diameter and bulb weight was recorded in white onion variety Agrifound White and others advance lines (Singh *et al.*, 2010; Singh, 1991; Mohanty, 2001; Patel *et al.*, 1985; Sidhu *et al.*, 1986; Singh *et al.*, 2010; Singh *et al.*, 2010; Singh *et al.*, 2011 and Singh *et al.*, 2011) reported that bulb diameter; size index and weight of bulb had correlated positively and increases the total yield. Lowest doubles on number basis (0.29 %) were recorded in advance line-886 and it was at par with advance lines-562, 799, 810, 823, 827, 869, 885 and 857.

No bolters on number basis was recorded in advance line-830, however, no rotten bulbs were recorded in any line except line-562, 784 and 830. The advance lines which showed minimum bolters and doubles can be utilized for good quality onion bulb variety. (Bhonde *et al.*, 1991) also recorded similar range of bolting in their study of different varieties.

The highest TSS (13.05 %) and dry matter (14.44 %) were recorded in advance line-830 and was at par with advance lines-562, 799, 823, 832, 865, 886 and Agrifound White. Highest gross yield (382.13 q/ha) and marketable yield (250.47 q/ha) were recorded in line-874 and was at par with line-827 in respect of marketable yield. Minimum duration (105 days) for maturity was taken by lines-793, 799 and 886. The duration for maturity ranged from 105 to 109 days.

The data of Karnal presented in Table-2 revealed that the trait P:E ratio exhibited non-significant differences. The highest % of plant establishment (98.61) was recorded in advance line-810 and it was at par with all the advance lines except 784, 823, 827 and 874. Maximum plant height (69.07cm) and no of leaves per plant (7.13) were recorded in advance line-793 and 830, respectively and was at par with lines-562, 810, 827, 830, 836 and 869 in respect of plant height, while lines-562, 784, 793,823 and 869 regarding number of leaves per plant. Thinnest neck (1.53 cm) was recorded in lines-832, 874, 885 and Agrifound White which was at par with lines-784, 827, 830, and 857.

Table.1 Performance of white onion advance line at Nashik during *Rabi*, 2017-18

Advance lines	Plant Establish-ment (%)	Plant height (cm)	No. of leaves/ plant	Neck thickness (cm)	Equatorial bulb diameter (cm)	Polar bulb diameter (cm)	P:E Ratio	Weight of 20 bulbs (kg)
L-562	82.41	64.40	8.80	1.43	5.43	3.61	1.51	1.09
L-784	85.12	65.80	8.33	1.41	5.08	3.70	1.37	1.04
L-793	72.22	66.60	8.33	1.41	5.30	3.61	1.47	1.04
L-799	73.61	66.93	8.67	1.39	5.23	3.68	1.42	0.95
L-810	62.73	65.67	8.40	1.37	5.29	3.51	1.51	0.92
L-823	87.33	66.20	8.53	1.38	5.35	3.52	1.52	1.03
L-827	79.17	61.67	8.53	1.40	5.45	3.57	1.53	1.01
L-830	84.38	65.80	8.60	1.40	4.30	3.46	1.24	1.16
L-832	96.97	64.47	8.47	1.39	5.31	3.38	1.57	0.98
L-836	78.70	64.23	8.80	1.40	5.19	3.41	1.52	0.92
L-842	71.15	65.73	8.53	1.36	5.23	3.47	1.51	0.94
L-865	77.31	64.87	8.40	1.43	5.36	3.54	1.52	0.93
L-869	75.40	67.87	8.20	1.42	5.39	3.43	1.57	0.96
L-874	82.29	65.00	8.53	1.37	5.29	3.63	1.46	0.99
L-885	85.37	65.73	8.40	1.42	5.33	3.63	1.47	0.98
L-886	78.47	65.27	9.00	1.37	5.40	3.53	1.53	0.99
L-857	76.92	69.20	8.67	1.42	5.29	3.51	1.51	0.94
Agrifound white (C)	78.65	69.53	8.93	1.41	5.31	3.53	1.50	0.99
S Em±	**6.10**	**1.37**	**0.31**	**0.05**	**0.35**	**0.11**	**0.10**	**0.04**
CD at 5%	**12.40**	**2.78**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.08**
CV %	**9.41**	**2.55**	**4.37**	**3.99**	**8.11**	**3.82**	**8.52**	**5.40**

Advance lines	Bolters on number basis (%)		Doubles on number basis (%)		Rotten (%)		TSS (%)	Dry matter (%)	Gross yield (q/ha)
L-562	1.69	(1.29)	0.55	(1.10)	0.55	(0.97)	12.82	14.11	278.87
L-784	1.16	(1.12)	0.71	(1.25)	0.44	(0.71)	12.20	13.51	217.84
L-793	0.76	(1.68)	1.06	(1.37)	0.00	(0.71)	11.51	12.88	208.57
L-799	2.37	(1.51)	1.39	(1.10)	0.00	(0.71)	12.96	14.23	292.16
L-810	1.80	(1.28)	0.71	(1.05)	0.00	(0.71)	12.13	13.49	313.98
L-823	1.18	(1.28)	0.60	(1.05)	0.00	(0.71)	12.89	14.25	197.51
L-827	2.19	(1.63)	0.41	(0.95)	0.00	(0.71)	12.02	13.38	298.73
L-830	0.00	(0.71)	0.82	(1.14)	0.60	(1.05)	13.05	14.44	232.08
L-832	0.93	(1.20)	1.20	(1.30)	0.00	(0.71)	12.98	14.39	315.26
L-836	1.75	(1.50)	1.17	(1.28)	0.00	(0.71)	12.58	14.02	244.33
L-842	1.50	(1.41)	0.89	(1.18)	0.00	(0.71)	11.16	12.56	244.69
L-865	0.59	(1.04)	0.91	(1.19)	0.00	(0.71)	12.67	14.07	245.86
L-869	0.76	(1.12)	0.52	(1.01)	0.00	(0.71)	12.31	13.71	249.00
L-874	2.12	(1.61)	1.68	(1.46)	0.00	(0.71)	11.64	13.03	382.13
L-885	0.60	(1.05)	0.39	(0.93)	0.00	(0.71)	10.67	12.17	203.72
L-886	0.87	(1.13)	0.29	(0.86)	0.00	(0.71)	12.93	14.25	260.71
L-857	0.80	(1.10)	0.57	(1.01)	0.00	(0.71)	11.27	12.67	288.84
Agrifound white (C)	0.88	(1.17)	1.10	(1.26)	0.00	(0.71)	12.78	14.07	244.37
S Em±	**-**	**0.14**	**-**	**0.12**	**-**	**0.01**	**0.21**	**0.20**	**20.55**
CD at 5%	**-**	**0.28**	**-**	**0.24**	**-**	**0.02**	**0.43**	**0.41**	**41.76**
CV %	**-**	**13.35**	**-**	**12.85**	**-**	**1.42**	**2.10**	**1.78**	**9.60**

Note: Data shows in parenthesis Square root transformed value

Advance lines	Marketable yield (q/ha)	Days for maturity	Skin intactness	Compactness of bulb	Color of bulb	Shape of bulb
L-562	193.31	108	Tight	Compact	White	G Round
L-784	132.06	107	Tight	Compact	White	G Round
L-793	176.21	105	Tight	Compact	White	G Round
L-799	189.49	105	Tight	Compact	White	G Round
L-810	190.37	109	Tight	Compact	White	G Round
L-823	115.79	108	Tight	Compact	White	G Round
L-827	229.76	108	Tight	Compact	White	G Round
L-830	140.88	109	Tight	Compact	White	G Round
L-832	189.60	109	Tight	Compact	White	G Round
L-836	163.54	107	Tight	Compact	White	G Round
L-842	162.15	109	Tight	Compact	White	G Round
L-865	157.88	109	Tight	Compact	White	G Round
L-869	156.34	106	Tight	Compact	White	G Round
L-874	250.47	108	Tight	Compact	White	G Round
L-885	160.91	109	Tight	Compact	White	G Round
L-886	188.21	105	Tight	Compact	White	G Round
L-857	218.58	109	Tight	Compact	White	G Round
Agrifound white (C)	185.52	109	Tight	Compact	White	G Round
S Em±	**14.47**	-	-	-	-	-
CD at 5%	**29.41**	-	-	-	-	-
CV %	**9.97**	-	-	-	-	-

Table.2 Performance of white onion advance lines at Karnal during *Rabi*, 2017-18

Advance lines	Plant Establish-ment (%)	Plant height (cm)	No. of leaves/ plant	Neck thickness (cm)	Equatorial bulb diameter (cm)	Polar bulb diameter (cm)	P:E Ratio	Weight of 20 Bulbs (kg)
L-562	97.92	68.27	6.93	1.64	5.01	3.77	1.33	1.16
L-784	94.44	66.00	6.93	1.58	5.15	3.54	1.46	1.15
L-793	95.00	69.07	6.93	1.62	4.94	3.51	1.41	1.17
L-810	98.61	68.93	7.07	1.73	5.00	3.73	1.34	1.21
L-823	93.33	67.60	6.93	1.61	5.04	3.59	1.40	1.07
L-827	94.72	68.93	6.60	1.59	4.89	3.59	1.37	1.16
L-830	96.39	68.67	7.13	1.58	4.84	3.46	1.40	1.09
L-832	97.50	60.07	6.13	1.53	4.79	3.63	1.32	1.02
L-836	97.78	68.40	6.67	1.58	4.88	3.61	1.35	1.04
L-865	97.78	66.67	6.33	1.60	4.83	3.53	1.37	1.13
L-869	96.39	68.27	7.00	1.60	4.78	3.43	1.40	1.18
L-874	93.89	66.27	6.67	1.53	4.97	3.45	1.44	1.09
L-885	97.22	63.60	6.13	1.53	4.61	3.25	1.42	1.01
L-857	97.22	63.27	6.07	1.57	4.88	3.53	1.38	1.04
Agrifound white (C)	95.83	67.53	6.33	1.53	4.55	3.42	1.33	0.81
S Em±	**1.30**	**0.68**	**0.11**	**0.03**	**0.14**	**0.12**	**0.06**	**0.05**
CD at 5%	**2.66**	**1.39**	**0.23**	**0.06**	**0.29**	**0.25**	**NS**	**0.10**
CV %	**1.66**	**1.25**	**2.08**	**2.14**	**3.42**	**4.30**	**5.19**	**6.05**

Advance lines	Bolters on number basis (%)		Doubles on number basis (%)		Rotten (%)		TSS (%)	Gross Yield (q/ha)	Market-able yield (q/ha)	Stemphylium blight Int. (%)		Thrips per plant
L-562	0.00	(0.71)	1.06	(1.25)	2.12	(1.62)	12.33	287.43	258.82	17.50	(4.24)	32.00
L-784	0.00	(0.71)	2.36	(1.68)	3.23	(1.93)	12.60	258.11	214.11	19.33	(4.45)	34.93
L-793	0.00	(0.71)	3.22	(1.92)	8.48	(3.00)	13.80	262.22	207.78	16.67	(4.13)	42.93
L-810	0.00	(0.71)	3.95	(2.09)	8.46	(2.99)	14.40	290.28	216.02	12.60	(3.62)	43.20
L-823	0.00	(0.71)	4.46	(2.23)	17.55	(4.24)	12.47	252.33	119.56	21.80	(4.72)	43.20
L-827	0.00	(0.71)	1.50	(1.41)	4.98	(2.34)	12.50	258.43	192.69	17.77	(4.27)	38.40
L-830	0.29	(0.86)	0.56	(1.03)	2.29	(1.66)	11.67	261.48	217.09	15.03	(3.94)	39.73
L-832	0.00	(0.71)	6.54	(2.65)	13.33	(3.71)	13.07	227.17	168.46	20.43	(4.57)	43.73
L-836	0.00	(0.71)	3.69	(2.04)	2.26	(1.55)	12.57	239.50	190.59	14.53	(3.87)	42.40
L-865	0.00	(0.71)	0.00	(0.71)	3.74	(2.05)	12.47	237.87	194.63	13.60	(3.75)	43.73
L-869	0.00	(0.71)	3.75	(2.06)	4.32	(2.19)	12.67	261.48	191.67	13.33	(3.72)	42.40
L-874	0.88	(1.17)	1.78	(1.51)	6.51	(2.65)	12.07	214.33	176.30	17.47	(4.23)	43.47
L-885	0.00	(0.71)	3.44	(1.98)	3.43	(1.98)	12.27	224.07	196.11	14.83	(3.90)	40.27
L-857	0.29	(0.86)	5.17	(2.38)	3.12	(1.90)	11.33	235.30	205.00	16.03	(4.06)	42.40
Agrifound white (C)	0.48	(0.98)	4.35	(2.19)	7.27	(2.78)	12.47	215.31	176.42	17.13	(4.20)	38.93
S Em±	**-**	**0.09**	**-**	**0.15**	**-**	**0.2**	**0.25**	**12.32**	**14.15**	**-**	**0.18**	**1.96**
CD at 5%	**-**	**0.18**	**-**	**0.31**	**-**	**0.41**	**0.51**	**25.24**	**28.98**	**-**	**0.37**	**4.01**
CV %	**-**	**14.96**	**-**	**9.9**	**-**	**9.94**	**2.40**	**6.08**	**8.88**	**-**	**5.46**	**5.89**

Note: Data shows in parenthesis Square root transformed value

Advance lines	Days for maturity	Thrips Inc. (%)	Skin intactness	Compactness of bulb	Color of bulb	Shape of bulb
L-562	107	100	Tight	Compact	White	Round
L-784	107	100	Tight	Compact	White	Round
L-793	104	100	Tight	Compact	White	Round
L-810	104	100	Tight	Compact	White	Round
L-823	107	100	Tight	Compact	White	Round
L-827	104	100	Tight	Compact	White	Round
L-830	107	100	Tight	Compact	White	Round
L-832	97	100	Tight	Compact	White	Round
L-836	104	100	Tight	Compact	White	Round
L-865	104	100	Tight	Compact	White	Round
L-869	107	100	Tight	Compact	White	Round
L-874	107	100	Tight	Compact	White	Round
L-885	107	100	Tight	Compact	White	Round
L-857	100	100	Tight	Compact	White	Round
Agrifound white (C)	104	100	Tight	Compact	White	Round
S Em±	-	-	-	-	-	-
CD at 5%	-	-	-	-	-	-
CV %	-	-	-	-	-	-

The highest equatorial bulb diameter (5.15 cm) and polar bulb diameter (3.77 cm) were recorded in advance lines-784 and 562, respectively and found at par with all the lines except, lines-830, 832, 865, 869, 885 and variety Agrifound White in respect equatorial bulb diameter, while lines-793, 830, 869, 874, 885 and Agrifound White regarding polar bulb diameter.

The highest weight of 20 bulbs (1.21 kg) was recorded in line-810 and it was at par with lines-562, 784, 793, 827, 865 and 869. Lowest rotten bulbs on number basis (2.26 %) were recorded in line-836 and it was at par with lines-562, 784, 830 and 857. No doubles were recorded in advance line-865. However, no bolters were recorded in any lines except advance lines-830, 857 and Agrifound White.

The highest total soluble solids (14.40 %) were recorded in advance line-810. Pungency is one of the important traits which considered as per the consumers preferences. It is suggested that the line which have high total soluble solid and dry matter content can be used for dehydration purpose. Similar findings were also reported by (Verma *et al.*, 1999).

Highest gross yield (290.28 q/ha) and marketable yield (258.82 q/ha) were recorded in advance lines-810 and 562, respectively and were found at par with line-562 in respect of gross yield. 100% stemphylium blight and thrips incidence were recorded in all the lines, however, the lowest intensity of stemphylium blight (12.60 %) and thrips population (32.00 nymphs/plant) were recorded in advance lines-810 and 562, respectively and was at par with lines-830, 836, 865, 869, and 885 in respect of stemphylium blight intensity and line-784 regarding thrips population. Minimum duration (97 days) for maturity was taken by advance line-832. The duration for maturity ranged from 97 to 107 days.

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