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Studies on assessment of growth, yield and quality of white onion (*Allium cepa* L)

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Abstract
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. 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 trial was conducted at Nashik and Karnal during *Rabi* 2016-17, revealed that at Nashik significantly highest gross yield (337.22 q/ha) and marketable yield (312.78 q/ha) were recorded in advance line-857 and were at par with check variety Agrifound white. The total soluble solid and dry matter content exhibited non-significant differences. At Karnal highest gross yield (394.93 q/ha) and marketable yield (322.07 q/ha) were recorded in advance line-798 and line-629, respectively, and were at par with advance lines-629, 810, 878 and 886 in respect of gross yield, however, advance lines 810, 885, 886 and check variety Agrifound White regarding marketable yield. The highest total soluble solid (15.27%) was recorded in advance line-629 and was at par with advance lines-791, 798 and 837. 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.

Keywords: White onion, *Allium cepa*, genotypes, evaluation, utilization of onion

Introduction
Vegetables occupy an important place in diversification of agriculture, playing a pivotal role in food and nutritional security of the growing population in our country. Onion is widely cultivated for internal consumption as well as for the export. India, being major onion-producing country, produces 20.13 million tons from 1.19 million ha, with a very low productivity of 16.24 tonnes/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). Per capita annual availability of onion in the world is the highest in Sudan with 91.80 kg, followed by the Netherlands (78.17 kg), Tajikistan (50.35 kg), Uzbekistan (36.93 kg), Kazakhstan (34.89 kg) and India consumed only (15.41 kg). In India, Maharashtra is leading state in area (38.88%) and in production (30.22%) with a productivity of 12.53 tonnes/ha, followed by Madhya Pradesh, Karnataka, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana, Tamil Nadu, Odisha, Telangana. 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) [9]. 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) [3]. 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.

Because of its high export potential, it comes under cash crop apart from vegetable (Pandey, 1989) [5]. 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) [2]. Lack of recommended or released variety of high yielding as well as good keeping quality in thecountry, 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) [7, 8]. 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.

Materials and Methods

The present investigation was carried out at National Horticultural Research and Development Foundation at Nashik, Maharashtra and Karnal, Haryana during *Rabi* 2016-17. 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 15 genotypes along with one check Agrifound White at Nashik, while at Karnal also 10 genotypes along with one check Agrifound White. The seeds were sown on 28/10/2016 and seedlings were transplanted on 04/01/2017 at Nashik, while at Karnal, the seeds were sown on 04/11/2016 and seedlings were transplanted on 04/01/2017, however, harvesting was done as per maturity of bulbs at Nashik from 28/03/2017 to 10/04/2017 and at Karnal on 18/04/2017. Eight to nine-week-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 (%), total soluble solid (%), dry matter content (%), gross yield (q/ha), marketable yield (q/ha), thrips/plant and 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

The data presented in table-1 (Nashik), revealed that the highest plant establishment (92.19%) and plant height (59.73 cm) were recorded in advance line-885 and 857, respectively, and were at par with advance lines-501, 629 and 857 in respect of plant establishment, however, advance lines-798 and 886 regarding plant height. Number of leaves/plant and neck thickness exhibited non-significant differences. Maximum equatorial bulb diameter (5.95 cm), polar bulb diameter (4.68 cm) and 20 bulbs weight (1.41 kg) were recorded in advance line-857 and were at par with check variety Agrifound White in respect of equatorial bulb diameter, however, advance lines-784 and check variety Agrifound White regarding polar bulb diameter. The highest P: E ratio (0.85) was recorded in advance line-886. 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, Sidhu *et. al*., 1986, Singh *et. al.* 2010 Singh *et. al.*, 2011 and Singh *et. al.*, 2011) [12, 10, 4, 11, 14, 13, 15]. reported that bulb diameter; size index and weight of bulb had correlated positively and increases the total yield.

Lowest bolters (2.05%) and doubles (4.90%) on number basis were recorded in advance line-629 and 837, respectively, and were at par with advance lines-784, 791, 837, 857, and 877 in respect of bolters, however, advance lines-629 and 857 regarding doubles. (Bhonde *et. al.,* 1991) [1] also recorded similar range of bolting in their study of different varieties. The total soluble solid and dry matter content exhibited non-significant differences.

Significantly highest gross yield (337.22 q/ha) and marketable yield (312.78 q/ha) were recorded in advance line-857 and were found at par with check variety Agrifound White. The lowest intensity of stemphylium blight (9.10%) and number of nymphs/plant (28.73) were recorded in check variety Agrifound White and were at par with advance lines-629, 784, 791, 798, 810, 837, 857, 876 and 886 regarding intensity, while, advance lines-562, 784, 798 and 810 in respect of thrips per plant. The minimum duration for bulb maturity, (93 days) were taken by advance line-784 and were at par with advance lines-501 and 629.

The data of Karnal presented in Table-2, revealed that the traits plant height, number of leaves per plant, equatorial bulb diameter, polar bulb diameter, P: E ratio, weight of 20 bulbs, and thrips per plant exhibited non-significant differences. The highest plant establishment (98.61%) were recorded in two advance lines-886 & L-629 and were found at par with advance lines-784, 791, 798, 810, 878, 885 and check Agrifound White. The thinnest color (1.30 cm) was recorded in advance line 885. The minimum bolters on number basis (2.29%) was recorded in advance line-798 and was found at par with check variety Agrifound White, however, lowest doubles (1.68%) was noted in advance line-886 and was found at par with advance line-784 and check variety Agrifound White. The highest total soluble solid (15.27%) was recorded in advance line-629 and was at par with advance lines-791, 798 and 837.

Highest gross yield (394.93 q/ha) and marketable yield (322.07 q/ha) were recorded in advance line-798 and advance line-629, respectively, and were at par with advance lines-629, 810, 878 and 886 in respect of gross yield, however, advance lines 810, 885, 886 and check variety Agrifound White regarding marketable yield. The lowest intensity of stemphylium blight (6.10%) was recorded in advance line-885 and was found at par with advance lines-784, 837, 878 and Agrifound White. All advance lines took 104 days for maturity.

Table 1: Performance of white onion advance genotypes at Nashik during *Rabi* 2016-17

Advance lines	% Plant establish-ment	Plant height (cm)	No. of leaves/ plant	Neck thick-ness (cm)	Equatorial bulb diameter (cm)	Polar bulb diameter (cm)	P: E Ratio	Weight of 20 bulbs (kg)	Bolters% on number basis		Doubles% on number basis	
L-501	90.28	50.47	7.73	1.30	5.56	4.01	0.73	1.13	3.16	(10.18)	8.96	(17.40)
L-562	87.67	49.33	7.07	1.33	5.51	4.07	0.75	1.10	6.99	(15.31)	15.13	(22.86)
L-629	89.74	50.27	6.67	1.31	5.64	4.11	0.80	1.18	2.05	(8.10)	5.36	(13.38)
L-784	81.25	50.07	6.80	1.29	5.84	4.53	0.70	1.28	2.87	(9.73)	7.28	(15.64)
L-791	83.85	51.27	7.47	1.28	5.69	4.06	0.67	1.20	2.37	(8.85)	7.89	(16.30)
L-798	75.35	57.40	8.07	1.35	5.49	3.80	0.71	1.03	4.00	(11.53)	11.78	(20.05)
L-799	85.26	50.80	7.07	1.29	5.50	3.88	0.75	1.05	5.69	(13.78)	12.19	(20.43)
L-810	81.20	50.40	7.80	1.32	5.40	4.13	0.75	1.13	4.50	(12.24)	12.88	(21.01)
L-836	66.84	52.40	7.33	1.25	5.49	4.06	0.78	1.02	5.38	(13.24)	10.54	(18.93)
L-837	72.57	54.93	7.27	1.32	5.75	4.30	0.81	1.20	2.35	(8.78)	4.90	(12.72)
L-857	89.06	59.73	8.20	1.39	5.95	4.68	0.68	1.41	2.94	(9.86)	5.61	(13.68)
L-876	72.92	50.00	7.27	1.31	5.56	4.06	0.72	1.08	6.87	(15.17)	14.03	(21.98)
L-877	75.17	50.27	7.80	1.31	5.57	4.02	0.69	1.10	2.74	(9.51)	9.59	(18.03)
L-885	92.19	51.33	7.33	1.33	5.51	3.82	0.73	1.08	4.49	(12.17)	9.14	(17.58)
L-886	72.92	57.00	8.33	1.36	5.51	4.04	0.85	1.07	5.33	(13.34)	10.09	(18.49)
A White (C)	73.44	49.93	8.40	1.34	5.88	4.67	0.00	1.32	3.86	(11.32)	7.48	(15.84)
S Em±	2.58	2.02	0.54	0.03	0.04	0.11	0.02	0.04	-	0.95	-	0.9
CD at 5%	5.27	4.13	NS	NS	0.08	0.22	0.04	0.08	-	1.94	-	1.84
CV%	3.92	4.74	8.77	3.19	0.95	3.33	3.65	4.26	-	10.12	-	6.17

Advance lines	TSS (%)	Dry matter (%)	Gross yield (q/ha)	Marketable yield (q/ha)	Stemphylium blight Int. (%)		Thrips per plant	Days for maturity
L-501	12.80	14.23	220.56	203.33	11.93	(20.21)	39.00	94
L-562	12.40	13.76	210.56	195.56	11.60	(19.89)	32.57	96
L-629	12.73	14.22	264.00	244.00	9.75	(18.18)	34.83	95
L-784	12.93	14.31	311.67	292.78	10.17	(18.58)	32.40	93
L-791	13.53	14.95	274.56	257.22	10.20	(18.61)	33.50	108
L-798	12.93	14.30	222.78	206.11	10.17	(18.57)	32.77	107
L-799	13.13	14.58	196.00	182.13	11.67	(19.97)	33.10	109
L-810	13.13	14.57	182.67	168.00	9.90	(18.34)	32.87	108
L-836	14.07	15.36	202.78	181.11	12.33	(20.56)	35.17	107
L-837	12.73	14.12	282.22	274.56	10.67	(19.03)	37.13	109
L-857	13.13	14.55	337.22	312.78	9.43	(17.86)	29.07	105
L-876	12.60	13.61	187.22	172.89	10.20	(18.62)	35.67	108
L-877	13.53	15.00	206.67	191.67	11.87	(20.15)	35.67	109
L-885	13.00	14.31	208.33	191.11	12.30	(20.52)	35.27	107
L-886	14.00	15.36	209.44	195.00	10.87	(19.23)	36.73	107
A White (C)	13.20	14.53	327.22	311.11	9.10	(17.46)	28.73	109
S Em±	0.58	0.58	6.16	5.37	-	0.87	2.16	0.85
CD at 5%	NS	NS	12.58	10.97	-	1.78	4.41	1.74
CV%	5.42	4.88	3.14	2.94	-	5.56	7.76	1.00

Note: Data shows in parenthesis Arc sin transformed value

Table 2: Performance of white onion advance genotypes at Karnal during *Rabi* 2016-17

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)	TSS (%)	Bolters% on number basis	
L-629	98.61	62.07	6.87	1.62	5.39	3.76	0.70	1.60	15.27	4.24	(11.85)
L-784	98.33	61.60	7.00	1.49	5.38	3.71	0.69	1.59	14.27	9.88	(18.31)
L-791	95.00	63.67	6.47	1.56	5.47	3.80	0.69	1.63	15.00	4.57	(12.33)
L-798	96.94	63.47	6.87	1.67	5.41	3.77	0.70	1.69	14.80	2.29	(8.67)
L-810	96.67	63.07	6.47	1.61	5.43	3.88	0.71	1.64	14.40	4.59	(12.35)
L-837	71.30	63.20	6.87	1.69	5.77	3.76	0.65	1.66	14.80	6.42	(14.67)
L-857	96.94	64.20	6.33	1.55	5.53	3.82	0.69	1.59	14.47	9.98	(18.40)
L-878	98.33	62.47	6.80	1.47	5.50	3.87	0.70	1.63	14.20	3.67	(11.03)
L-885	97.50	61.20	6.60	1.30	5.51	3.76	0.68	1.59	13.87	11.12	(19.47)
L-886	98.61	61.33	7.07	1.54	5.52	3.90	0.71	1.61	14.60	10.13	(18.56)
Agri found White (C)	92.78	59.73	6.60	1.67	5.38	3.83	0.71	1.54	14.27	3.53	(10.31)
S Em±	2.84	1.66	0.27	0.07	0.12	0.10	0.01	0.04	0.25	-	0.96
CD at 5%	5.92	NS	NS	0.15	NS	NS	NS	NS	0.52	-	2.00
CV%	4.49	3.98	6.06	6.37	3.39	4.12	2.84	3.62	2.53	-	10.2

Advance lines	Doubles% on number basis		Gross yield (q/ha)	Marketable yield (q/ha)	Stemphylium blight Int. (%)		Thrips per plant	Days for maturity
L-629	4.78	(12.56)	367.04	322.07	7.23	(15.59)	27.67	104

L-784	2.26	(8.63)	334.19	279.85	6.47	(14.71)	26.73	104
L-791	11.37	(19.70)	356.89	270.04	8.33	(16.77)	27.40	104
L-798	22.35	(28.21)	394.93	268.30	7.47	(15.84)	27.60	104
L-810	10.35	(18.75)	386.54	313.67	7.67	(16.05)	29.53	104
L-837	4.06	(11.62)	314.07	256.11	6.23	(14.45)	27.33	104
L-857	4.01	(11.51)	327.69	270.07	7.57	(15.96)	27.60	104
L-878	18.33	(25.33)	390.00	276.41	6.90	(15.19)	27.73	104
L-885	2.85	(9.72)	353.26	294.00	6.10	(14.27)	27.67	104
L-886	1.68	(7.45)	355.44	300.22	8.47	(16.91)	27.53	104
Agrifound White (C)	2.40	(8.61)	344.74	308.26	6.73	(15.02)	27.27	104
S. Em.±	-	0.83	19.23	14.56	-	0.6	0.80	-
CD at 5%	-	1.73	40.11	30.37	-	1.25	NS	-
CV%	-	8.46	8.09	7.60	-	5.83	4.32	-

Note: Data shows in parenthesis Arc sin transformed value

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