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Performance of two cultivars of onion under different dates of transplanting as *kharif* production

Mata Prasad, Sutanu Maji, Maya Ram, Razauddin and Ramesh Chand Meena

Abstract
An experiment was conducted at Horticulture Research Farm in the Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhim Rao Ambedkar University, Lucknow, Uttar Pradesh, India to observe the effect of different date of transplanting on yield and quality of two cultivars for off-season (*kharif and* late *kharif onion*) production. There were eight date of transplanting (30th August, 10, 20, 30th September, 10, 20, 30th October and 10th November) and two cultivars (Agrifound Dark Red and L-883) which were laid out in factorial randomized block design (two factors) with three replications. Two year data showed a significant variation in bulb yield and quality of onion due to transplanting in different dates as well as varietal variation. Transplanting on 30th September showed maximum vegetative growth in terms of length of bulb, dry matter content, polar diameter, equatorial diameter, volume of bulb, specific gravity, number of scale/bulb. Among the two varieties, L-883 showed better performance in respect of growth, yield and bulb quality in off-season production as well as in terms of monetary returns. Therefore, it may be concluded that cultivation of L-883 variety may be transplanted on 30th September for profitable off season production at Lucknow region to address the seasonal gap between market demand and production, which also can be beneficial for the customers by minimizing price rise.

Keywords: Off season, kharif onion yield and quality

Introduction
Onion (*Allium cepa* L.) is one of the most important vegetable crops among the various bulb-producing vegetables. It is generally grown as a winter crop in India. Because of the scarcity of onions, the market price often skyrocketed from October onwards. *Kharif* onions played a crucial role in meeting this demand-supply gap and thereby reducing the price of onions. Growing onions during the *kharif* season is somewhat of a new strategy to be adopted in eastern India. Suitable agro-techniques are needed to get a remunerative return from large scale *kharif* season cultivation. In West Bengal, generally, onions are cultivated during *the Rabi* season and the bulbs are made available from April onwards. The state has to depend on the other states that produce *kharif* and late *kharif* onions for the supply of bulbs during the lean period (October to March).

Such dependencies sometimes result in abnormal increases in prices. The situation may be improved to some extent, if the possibilities and potentialities of *kharif* onion cultivation are exploited. The growth and yield of cultivated crop lands are mainly influenced by two factors *viz*., genetically and cultural or management. Genetic makeup and the environment are the factors which influence the performance of a cultivar by influencing all important traits (Brewster, 1). Planting time is one important factor that greatly influences the growth and yield of onions (Mondal and Brewster, 12). It is also known for its anti-bacterial, antiviral, anti-allergenic, and anti-inflammatory potential. India is the second largest producer of onions (14.34 mt, 26.74 t/ha) in the world after China, and Maharashtra is the leading onion-producing state in India with a 32% share (Anon., 2020) [1]. *The kharif* onion provides a high price as compared to the main (*rabi*) season onion. Although there are so many varieties of onions available in the local market, their performance has not been tested under Lucknow conditions as a *kharif crop*, and there is great confusion regarding the selection of the right variety of onion for the *kharif* season as well as the proper date of transplanting, since date of transplanting had a significant effect (Prasad *et al*., 2017).

Materials and Methods

The experiment was conducted at Horticulture Research Farm in the Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhim Rao Ambedkar University, Lucknow, Uttar Pradesh, India (26^0 50´N, 80^0 52´E, 123m MSL). During 2018-19 and 2019-20 The experiment was consisted of eight different transplanting dates (D_1 30th August, D_2 10th September, D_3 20th September, D_4 30th September, D_5 10th October, D_6 20th October, D_7 30th October and D_8 10th November) and two cultivars *viz.*, Agrifound Dark Red (V_1) and L-883 (V_2). Transplanting was done in 1.95 m x 2 m plots at 15 cm x 10 cm spacing on respective data. Seeds of the selected onion cultivars were collected from National Horticultural Research and Development Foundation, Deoria Centre, Uttar Pradesh, India. Seeds were sown in the nursery on 5th June for transplanting on 30th August and on subsequent dates as to the date of transplanting in the experimental design. The entire recommended package of practices was adapted to all the cultivars and treatments uniformly to raise a good crop. Plots were irrigated at intervals of 7-10 days until maturity depending on weather condition. During maturity, when 2/3rd of the leaves became yellow in colour with neck fall, the bulbs were harvested and cured for short period for 5 days (EIAR, 2007). Onion seeds were sown on permanent nursery beds to raise seedlings for transplanting in the main field. Fine and fully decomposed farmyard manures @ 3-4 kg/m^2 were mixed with soil 10 days before sowing of seed. Before sowing, the seeds were treated with Thiram @ 2g/kg of seeds to avoid damping off. Seeds were sown in lines spaced at 5 cm distance and were covered with finely sieved compost followed by light watering by rose can. The seed beds were covered with straw till seed germination and water was sprinkled regularly.

At the time of field preparation, FYM (20 t/ha) was incorporated into the field. A recommended dose of NPK (120:60:80) was given to each treatment in the form of urea, single super phosphate and muriate of potash. One third dose of nitrogen, full dose of phosphorus and potash were applied as basal dose at the time of final field preparation, while two thirds of nitrogen was applied in two-split doses at one month interval.

Result and Discussion

3.1: Effect of different date of transplanting on length of the bulb and dry matter contain attributing traits in onion cultivars

On the basis of pooled values of two years of data (2018-19 and 2019-20), the maximum bulb length (63.91 mm) was found when it was done on September 30th (D_4) followed by 20th October transplanting (D_6). Among the two cultivars, L-883 (V_2) showed the bulb length (59.81 mm & 58.50 mm, in 2018-19 and 2019-20, respectively) compared to the variety Agrifound Dark Red (V_1) (58.09 mm & 57.76 mm in two years, respectively). The interaction effect of both the date of transplanting and cultivars was noted as having a statistically significant effect on the bulb length. The maximum bulb length (66.53 mm and 65.53 mm in 1st and 2nd year trials, respectively) was observed with D_4 xV_2 (30th September transplanting x L-883 variety), followed by D_6xV_1 (10th October x Agrifound Dark Red), and the minimum bulb length (48.46 mm and 47.79 mm in two years, respectively) was observed with D_1V_1 (30th August x Agrifound Dark Red).

Moderate transplanted plants also had higher average dry matter content percentage as compared to early and late transplanted plants. However, the dry matter content (15.22%) was observed in D_4 (30th September) followed by D_6 (20th October). Cultivar L-883 produced the maximum dry matter (13.10% and 12.79% in 2018-19 and 2019-20, respectively), followed by the variety Agrifound Dark Red (12.60% and 11.99%in two years, respectively). The interaction effect of both the date of transplanting and cultivars were noted as having a statistically significant effect on dry matter content. However, the maximum dry matter content (17.45% &16.45%) was observed within the D_4 xV_2 (30th September x L-883) followed by D_6xV_1 (10th October x Agrifound Dark Red) and the minimum dry matter content (9.96% and 9.80% in two years respectively) was observed in D_1V_1 (30th August x Agrifound Dsark Red).

3.2. Effect of different date of transplanting on polar diameter and equatorial diameter

The various planting dates and cultivars also had a significant effect on the Polar diameter. The moderate transplanted plants were stronger than the early and late transplanted plants. The maximum polar diameter (53.98 mm) was observed in D_4 (30th September) followed by D_6 (20th October). Cultivar L-883 produced the maximum polar diameter V_2 (48.43 mm and 47.37 mm in 2018-19 and 2019-20, respectively), followed by the variety Agrifound Dark Red V_1 (46.84 mm and 45.94 mm in two years, respectively). The interaction effect of both the date of transplanting and cultivars were noted as having a statistically significant effect on the polar diameter. However, the maximum polar diameter (58.68 mm and 55.47 mm in two years, respectively) was observed within treatment combinations D_4 x V_2 (30th September transplanting x L-883 variety) followed by D_6 x V_1 (10th October x Agrifound Dark Red). Whereas the minimum polar diameter (41.33 mm and 40.49 mm in two years' time respectively) was observed in D_1V_1 (30th August x Agrifound Dark Red).

The various planting dates and cultivars also had a significant effect on the Equatorial diameter. The moderate transplanted plants were than the early and late transplanted plants. The maximum equatorial diameter (69.06mm) was observed in D_4 (30th September) followed by D_6 (20th October). Cultivar L-883 produced the maximum equatorial diameter V_2 (64.17 mm and 63.73mm in 2018-19 and 2019-20, respectively), followed by the variety Agrifound Dark Red V_1 (63.22 mm and 62.51 mm in two years, respectively). The interaction effect of both the date of transplanting and cultivars were noted as having a statistically significant effect on the equatorial diameter. However, the maximum equatorial diameter (74.50mm and 73.43mm in two years, respectively) was observed within treatment combinations D_4 x V_2 (30th September transplanting x L-883 variety) followed by D_6 x V_1 (10th October x Agrifound Dark Red). Whereas the minimum equatorial diameter (51.31 mm and 50.71 mm in two years' time respectively) was observed in D_1V_1 (30th August x Agrifound Dark Red).

3.3. Effect of different date of transplanting on volume of bulb and specific gravity

The various planting dates and cultivars had a significant effect on volume of bulb. The moderate transplanted plants were than the early and late transplanted plants. However, the maximum volume of bulb (75.82ml) was observed in D_4 (30th September) followed by D_6 (20th October). While, onion cultivars significantly influenced the volume of onion bulb The cultivar L-883 produced the volume of bulbV_2 (72.08 ml and 68.88 ml in 2018-19 and 2019-20, respectively), followed by the variety Agrifound Dark Red.V_1 (70.29ml and 65.88ml in two years respectively) The interaction effect of both the date of transplanting and cultivars were noted as having a statistically significant effect on volume of onion bulb. However, the maximum volume of bulb (85.00ml & 80.31ml) was observed within the D_4 xV_2 (30^{th} September x L-883) followed by D_6xV_1 (10^{th} October x Agrifound Dark Red).Whereas, the minimum volume of bulb (61.33ml and 57.17ml in two years respectively) was observed in D_1V_1 (30^{th} August x Agrifound Dark Red).

The various planting dates and cultivars had a significant effect on specific gravity. Maximum specific gravity (1.17g/cc) was observed in D_4 (30^{th} September) followed by D_6 (20^{th} October) at .While, onion cultivar L-883 showed the maximum specific gravityV2 (1.13g/cc and 1.11g/cc in 2018-19 and 2019-20, respectively), followed by the variety Agrifound Dark Red V_1 (1.11g/cc and 1.10g/cc in two years respectively).The interaction effect of both date of transplanting and cultivars was noted as a statistically significant effect on specific gravity. Maximum specific gravity (1.23g/cc &1.20g/cc) was observed with D_4 xV_2 (30^{th} September x L-883) followed by the D_6xV_1 (10^{th} October x Agrifound Dark Red). Whereas, the minimum specific gravity (1.04g/cc and 1.01g/cc in two years respectively) was observed in D_1V_1 (30^{th} August x Agrifound Dark Red).

3.4. Effect of different date of transplanting on number of scale per onion bulb.

The various planting dates and cultivars had a significant effect on number of scale also. Maximum number of scale (11.75) was observed in D_4 (30^{th} September) followed by D_6 (20^{th} October) at .While, onion cultivar L-883 showed the maximum number of scale (10.00 and 9.12 in 2018-19 and 2019-20, respectively), followed by the variety Agrifound Dark Red V_1 (9.46 and 8.54 in two years respectively).The interaction effect of both date of transplanting and cultivars was noted as a statistically significant effect on number of scale. Maximum number of scale (13.00& 12.33) was observed with D_4 xV_2 (30^{th} September x L-883) followed by the D_6xV_1 (10^{th} October x Agrifound Dark Red). Whereas, the minimum number of scale per onion bulb (6.33 and 5.33 in two years respectively) was observed in D_1V_1 (30^{th} August x Agrifound Dark Red).

4. Discussions

Results showed that maximum bulb length (65.17 mm) under the treatment T_7 (1st December transplanting and wheat straw mulching) and the minimum (49.57 mm) was recorded under T_{12} (without any type of mulching). Mulching at the date of transplanting, which was late? Likewise, the bulb length was also found to be supported by this result. The work of Singh (2005).

Among the parents, the average bulb dry matter content varied in the range from 9.45% (Makoibronzi) to 15.69% (Bunkinobeo). For F_1 generation, the lowest average content of dry matter has been determined in hybrid combination Makoibronzi x Piroška (10.19%), whereas the highest dry matter content had hybrid Piroška x Bunkinobeo (15.05%). The content of dry matter in F_2 generation varied from 10.53% (Makoibronzi x Piroška) to 14.85% (Jaseničkicrveni x Bunkinobeo), Wal and Corgan (1999) [8] pointed out higher dry matter content in bulbs of white onions, which has been confirmed in our research.

Polar diameter and equatorial diameter of bulb is an important character which determines the shape and size of bulb. Polar and equatorial diameters of bulb were significantly influenced by planting dates and cultivars. The maximum polar and equatorial diameter was observed in 30th September planting, followed by planting on 15th September. Increased trend of bulb diameters were noted as planting delayed from August to September. Sharma *et al*. [14] also reported on maximum bulb polar and equatorial diameters were measured in Indam Marshal, closely followed by Agrifound Dark Red. Haldar *et al*. [4] also reported similar trends. Interaction effect of planting date and variety on equatorial diameter was noted statistically significant. Agrifound Dark Red and Indam marshal, when planted on 30th September noted highest value of equatorial diameter.

In general, the significant improvement in yield attributes of onions with farm yard manure could be ascribed to an overall improvement in vigor and crop growth, as already explained in the preceding paragraphs. Because an adequate and small amount of major nutrients supplied through FYM during a plant's life is thought to be important in promoting the rapid volume of bulb, these parameters were recorded significantly higher with the application of 40 tones' of FYM per hectare. FYM, coupled with increased net photosynthesis, and helping in the translocation of photosynthesis in the storage organ of the bulb, resulted in increased diameter and weight of bulbs (Singh *et al*., 1995) [5].

The data pertaining to specific gravity in onion are presented in Table 15 and Fig. 16. Significant differences were recorded among the different treatments with respect to specific gravity. The maximum specific gravity (1.40) was found in T_{12} i.e. Boron 0.2 % + zinc 0.5 % and it was on par (1.35) withT19 i.e. Boron 0.2 % + copper 0.2 % + zinc 0.3 %, T20 I.E.S. Boron 0.3 % + copper 0.4 % + zinc 0.5 % (1.34) and T6 i.e. Zinc 0.5 % (1.33), while the minimum specific gravity (0.95) was found in T21 (control). Similar results were also reported by Ballabh *et al*. (2013) [2] specific gravity (1.3) was found in Zn @ 4 mg/l with an increase of 23 % over control.

The mulching with wheat straw and first date of transplanting (T_7) also increased the number of scales per bulb which was maximum (9.27 mm) among all the treatments. Hygrotech (2010) [4] also noted similar trend in production guidelines of onion.

Table 1: Effect of dates of transplanting length of bulb and dry matter contain.

Variety Date of trans-planting	Length of bulb (mm)							Dry matter contain (%)						
	2018-19			2019-20				2018-19			2019-20			
	V1	V2	Mean	V1	V2	Mean	Pooled	V1	V2	Mean	V1	V2	Mean	Pooled
$D_1$30th August	48.46	51.22	49.84	47.79	50.98	49.39	49.61	9.96	10.46	10.21	9.80	10.10	9.95	10.08
$D_2$10th September	52.20	52.80	52.50	51.86	52.14	52.00	52.25	10.78	11.20	10.99	10.40	10.86	10.63	10.81
D_3 20th September	53.43	61.22	57.33	52.77	57.22	54.99	56.16	11.32	13.60	12.46	11.12	13.46	12.29	12.38
$D_4$30th September	62.79	66.53	64.66	60.79	65.53	63.16	63.91	14.04	17.45	15.74	12.96	16.45	14.71	15.22
D_5 10th October	62.07	60.31	61.19	61.73	60.64	61.19	61.19	13.86	13.78	13.82	12.88	13.71	13.29	13.56
$D_6$10th October	64.66	62.94	63.80	63.99	58.99	61.49	62.65	16.27	12.80	14.53	15.43	12.66	14.05	14.29
$D_7$10th October	59.66	63.74	61.70	61.48	62.41	61.95	61.82	12.94	12.14	12.54	11.84	12.07	11.96	12.25
$D_8$10th November	61.46	59.74	60.60	61.67	60.07	61.10	60.77	11.62	13.34	12.48	11.49	13.01	12.25	12.37
Mean	58.09	59.81		57.76	58.50			12.60	13.10		11.99	12.79		
SE(m) ±	D	0.40			0.45				0.29			0.24		
	V	0.10			0.22				0.15			0.12		
	DxV	0.56			0.63				0.41			0.34		
CD 5%	D	1.16			1.20				0.85			0.69		
	V	0.58			0.65				0.42			0.34		
	DxV	1.64			1.84				1.20			0.97		

Table 2: Effect of dates of transplanting polar diameter and equatorial diameter.

Variety Date of trans-planting	Polar diameter							Equatorial diameter						
	2018-19			2019-20				2018-19			2019-20			
	V1	V2	Mean	V1	V2	Mean	Pooled	V1	V2	Mean	V1	V2	Mean	Pooled
$D_1$30th August	41.33	42.73	42.03	40.70	41.49	41.10	41.57	51.31	56.73	54.02	50.71	56.03	53.37	53.70
$D_2$10th September	44.66	48.61	46.63	42.77	43.51	43.14	44.89	57.83	59.23	58.53	57.37	58.90	58.13	58.33
D_3 20th September	45.00	47.16	46.08	45.40	51.50	48.45	47.26	61.10	65.20	63.15	60.80	64.47	62.63	62.89
$D_4$30th September	52.68	58.68	55.68	49.12	55.47	52.29	53.98	64.65	74.50	69.58	63.67	73.43	68.55	69.06
D_5 10thOctober	47.81	44.31	46.06	46.50	47.47	46.99	46.52	69.21	66.67	67.94	67.63	66.07	66.85	67.39
$D_6$10thOctober	53.14	51.40	52.27	53.44	48.43	50.94	51.60	70.81	67.07	68.94	69.91	66.73	68.32	68.63
$D_7$10thOctober	46.67	48.17	47.42	44.63	43.75	44.19	45.80	68.40	60.39	64.40	66.87	60.39	63.63	64.01
$D_8$10th November	43.43	46.41	44.92	44.95	47.33	46.14	45.53	62.41	63.60	63.01	63.11	64.00	63.56	63.28
Mean	46.84	48.43		45.94	47.37			63.22	64.17		62.51	63.75		
SE(m) ±	D	0.74			0.57				0.71			0.61		
	V	0.37			0.28				0.35			0.30		
	DxV	1.05			0.8				1.01			0.87		
CD 5%	D	2.15			1.65				2.07			1.78		
	V	1.08			0.82				NS			0.89		
	DxV	3.05			2.33				2.93			2.52		

Table 3: Effect of date of transplanting volume of bulb and specific gravity.

Variety Date of trans-planting	Volume of bulb (ml)							Specific gravity (g/cc)						
	2018-19			2019-20				2018-19			2019-20			
	V1	V2	Mean	V1	V2	Mean	Pooled	V1	V2	Mean	V1	V2	Mean	Pooled
$D_1$30th August	61.33	62.67	62.00	57.17	61.84	59.50	60.75	1.04	1.06	1.06	1.01	1.03	1.02	1.04
$D_2$10th September	65.00	71.67	68.33	64.28	69.15	66.72	67.52	1.07	1.08	1.08	1.05	1.09	1.07	1.07
D_3 20th September	69.67	68.67	69.17	65.16	61.16	63.16	66.16	1.12	1.15	1.14	1.08	1.11	1.10	1.12
$D_4$30th September	71.33	85.00	78.17	66.65	80.31	73.48	75.82	1.11	1.23	1.17	1.15	1.20	1.18	1.17
D_5 10th October	73.33	77.67	75.50	65.63	73.66	69.65	72.57	1.16	1.13	1.15	1.14	1.13	1.14	1.14
$D_6$10th October	82.00	70.67	76.33	75.16	70.19	72.68	74.50	1.19	1.17	1.18	1.17	1.10	1.14	1.16
$D_7$10th October	66.67	72.33	69.50	62.17	56.66	59.41	64.46	1.09	1.14	1.12	1.07	1.10	1.09	1.10
$D_8$10th November	73.00	68.00	70.50	70.83	72.58	71.70	71.10	1.11	1.10	1.11	1.16	1.15	1.16	1.13
Mean	70.29	72.08		65.88	68.19			1.11	1.13		1.10	1.11		
SE(m) ±	D	0.77			0.46				0.06			0.05		
	V	0.38			0.23				0.03			0.02		
	DxV	1.09			0.65				0.08			0.07		
CD 5%	D	2.24			1.34				0.17			0.16		
	V	1.12			0.67				0.08			0.06		
	DxV	3.16			1.89				0.24			0.23		

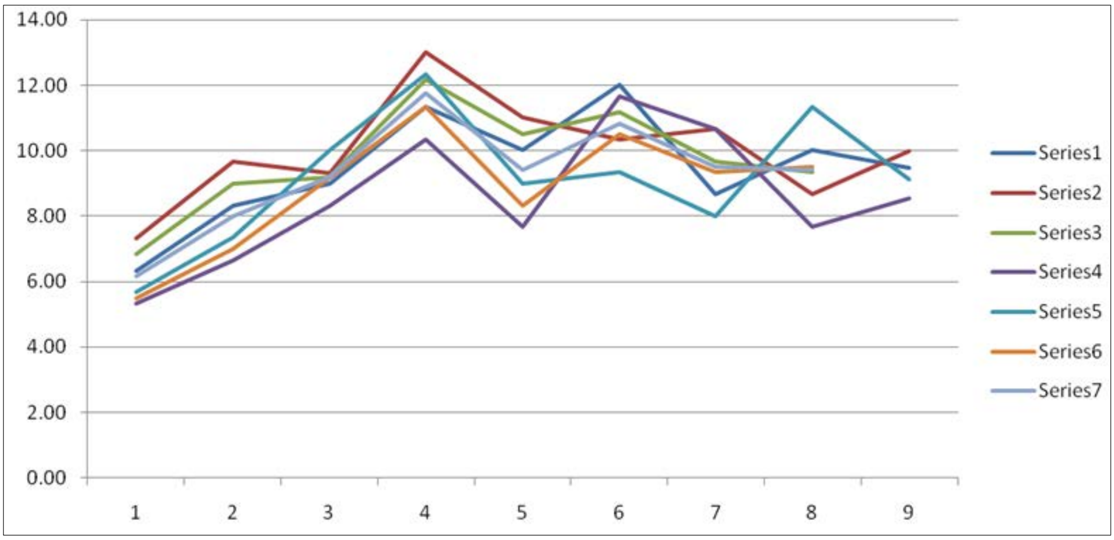

Fig 1: Effect of date of transplanting number of scale onion per bulb.

Conclusion

In the present investigations it was noticed that maximum values for growth and yield contributing traits like length of bulb, Dry weight of bulb, Polar diameter, Equatorial diameter, Volume of bulb, Dry matter content, Number of scale, were obtained in cultivar L-883. All the varieties produced maximum yield when transplanted on the 4th date of transplanting i.e. 30thSeptember. Therefore it can be summarized that cultivar L-883 transplanting on 30th September can be suggested for off season onion production in Lucknow condition.

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