International Journal of Minor Fruits, Medicinal and Aromatic Plants. Vol. 9 (2) : 109-115, December 2023

Effect of dates of transplanting on bulb yield and quality of *kharif* onion cultivars

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Received : 27.03.2023 ; Revised : 03.07.2023 ; Accepted : 18.07.2023

DOI : 10.53552/ijmfmap.9.2.2023. 109-115

ABSTRACT

An experiment was performed at Horticulture Research Farm of Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, to study the influence of different dates of transplanting on bulb quality of two cultivars for off-season kharif onion, in the year 2018-19 and 2019-20. Two Kharif onion cultivars viz., Agrifound Dark Red and L-883 were selected and laid out in factorial randomized block design (two factors) with eight different dates of transplanting and each treatment combination replicated thrice. It was found that onion bulb quality was significantly affected by transplanting on different dates for both cultivars. Among them, transplanting on 20th September produced bulb with maximum total soluble solids, total sugars and ascorbic acid. Among the two varieties, L-883 had maximum titratable acidity. However, maximum bulb yield was obtained when it was transplanted on 30th September resulting the highest yield. The results of the above study indicate that L-883 bulbs can be transplanted on 30th September for profitable off season (kharif) production, and on 20th September for better quality bulbs at Lucknow region.

***Keywords*:** onion, kharif onion, yield, quality

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important and commercial vegetable bulb crop cultivated extensively in India. It belongs to family Alliaceae, having chromosome number 16 (2n = 2 x = 16). This bulb vegetable is grown mainly during the *rabi* season and included in the daily diet of people around the globe. Allyl propyl disulphide is a volatile compound present in onion, responsible for pungency. This plant has various therapeutic effects (Ouzid *et al*., 2021) and is used for treating loss of appetite, prevention of atherosclerosis, age related changes in blood vessels as well as reduces the risk of gastric cancer. In terms of area and production of onions, India ranks second to China. In India, major onion growing states are Maharashtra, Karnataka, Madhya Pradesh, Bihar, Rajasthan, Gujarat, Andhra Pradesh, Haryana, Uttar Pradesh and West Bengal. In India, onion is cultivated in an area of about 1320130 hectares with a production of 20931250 MT and productivity of 15.86 tonnes per hectare. In Uttar Pradesh state of India, it is grown in about 30.00 ha area with a production of 508.90 MT and productivity of 16.94 tonnes/ha. (NHB Data based 2021-22) The production of *kharif* onion has numerous advantages over the *rabi* (winter) onion *i.e.* increases total production to fulfill the demand for fresh onion in the market. *Kharif* onion also provides a higher price as than *rabi* season onion crop. There are very few *kharif* season varieties known to farmers (Dewangan *et al*., 2012). However, there are many onion varieties available in the local market, but their performances have not yet been evaluated under Lucknow conditions, and is unclear which onion variety is to be chosen for *kharif* season. Due to lack of technical knowledge on this aspect, the onion growers of these regions are suffering up to a great extent, not only due to low bulb production but also problems in keeping quality of bulb in *kharif* season cultivation. The *rabi* season onion is harvested in April-May is stored all over the country and slowly available for domestic supply and export until September-October. There is a critical gap in onions supply from October to March and, as a result, prices shoot up in the country. In this period of dearth, a successful harvest in the *kharif* season can fill the shortage between demand and supply of onions. Keeping this view, the present experiment

was conducted to assess the influence of various dates of transplanting on *kharif* onion production with two onion varieties.

MATERIALS AND METHODS

The experiment was conducted during the year 2018-19 and 2019-20 at the Horticulture Research Farm of the Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh (26°552 North latitude and 80°592 East longitude, 123 m from MSL). The climate is subtropical with a dry, hot summer (maximum 45° C) and cool winter (3° C), and the soil is somewhat alkaline. The meteorological observation collected from Indian Institute of Sugarcane Research (ICAR-IISR) Lucknow near to experimental area, during the experimental period showed that it received maximum rainfall during August-September period of both the years and some erratic rainfall during winter months of January (Table 2). The present experiment consisted of eight different transplanting dates and two cultivars of *kharif* onion were used namely, Agrifound Dark Red (V_1) and L-883 (V_2). The transplanting of onion seedlings was done on 1.95 m x 2 m plots at 15 cm x 10 cm spacing on respective dates. Seeds of selected onion cultivars were collected from the National Horticultural Research and Development Foundation, Deoria Centre, Uttar Pradesh, India. Seeds were sown in the nursery on 5th June for transplantation on 30th August and on subsequent dates of transplanting, as per the experimental design. The soil was mixed with finely crumbled and fully decomposed farmyard manures (FYM) at 3-4 kg/m^2 ten days before seeds were sown. To prevent damping off, the seeds were treated with thiram at a rate of 2g per kg of seeds before sowing. Seeds were sown in lines spacing at 5 cm distance and covered with finely sieved compost. There were eight dates of transplanting (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, D_8-10th November) for both selected onion cultivars, laid out in factorial randomized block design. To raise a healthy crop, all recommended practices were uniformly adapted to all cultivars and treatments. Plots were irrigated frequently at 7-10 days intervals until maturity, depending on weather conditions. At maturity, when two thirds of the leaves turned yellow with neck fall, the onion bulbs were harvested and cured for a short period of five days. The observations were taken following standard procedure (Ranganna, 1991) on bulb yield and quality parameters. Treatment specific input and output costs were computed using on farm market price and other economic indicators such as net return and benefit : cost ratio. The cost of cultivation (Rs. per ha) was computed using the local market price of various inputs used in production. Using the on farm market price, the monetary return of onion bulb yield was calculated in rupees. The gross income (Rs. per ha) was calculated by adding the monetary value of the onion bulb by multiplying bulb yield (q per ha) with price (Rs per quintal). Net return (Rs. per ha) of each treatment was computed by subtracting the cost of cultivation from the specific treatment's gross income. Subsequently, benefit: cost ratio (B: C) was worked out by dividing the net return of a treatment by the expenditure incurred. The observed data were analyzed statistically and treatment mean was compared at 5% level of significance.

RESULTS AND DISCUSSION

Effect of different dates of transplanting on bulb yield (kg per plot and q/ha) on onion cultivars (*kharif*)

Recorded observations were analysed and presented in Table 1. The bulb yield (kg/plot) of variety V_2(L-883) was found as the highest (10.32 kg/plot) when transplanted in D_4 - 30thSeptember transplanting as compared to variety V_1(Agrifound Dark Red) at D_6 transplanting date i.e. 20$_{th}$ October transplanting (9.97 kg/plot), while, the minimum yield was reported at D_1, 30th August transplanting (7.81 kg/plot) in variety V_1. Similar result was found in the case of yield per ha (q/ha). The maximum yield/ha was observed on D_4 *i.e.*30thSeptember transplanting (393 q/ha) in variety V_2, while the minimum was reported on D_1 i.e.30th August transplanting (7.81 kg/plot) in variety V_1. The similar findings were also noted by Sharma *et al*. (2003), Mahanthesh (2009) and Prasad *et al*. (2017) in onion.

Table 1: Effect of date of transplanting on *kharif* onion production.

D-Date of transplanting; V- Variety; * SEm and CD values are based on mean of V_1 and V_2

Variety/Date of transplanting		Yield (kg/plot)		Yield (q/ha)		Reducing sugar (%)		Non Reducing sugar (%)		Total sugar (%)		TSS (%)		Ascorbic acid (mg/100g)		Acidity (%)	
		V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
D_1-30th August		7.81	8.19	300.22	314.75	4.42	5.19	3.57	4.43	7.99	9.62	8.81	9.68	8.23	8.43	0.54	0.50
D_2-10th September		8.48	8.67	325.9	331.75	4.78	5.27	4.19	4.22	8.97	9.45	10.22	10.52	8.64	9.34	0.51	0.47
D_3-20th September		9.08	9.54	349.09	362.52	4.97	6.35	4.29	4.89	9.26	11.07	12.14	12.07	9.92	10.39	0.45	0.26
D_4-30th September		9.72	10.32	371.46	393.91	5.34	5.41	3.53	4.33	8.87	9.75	11.87	11.52	9.08	9.33	0.35	0.42
D_5-10th October		9.25	9.47	363.19	361.49	4.90	5.65	4.07	4.14	8.97	9.75	12.49	11.09	9.68	9.09	0.34	0.42
D_6-20th October		9.97	8.95	378.43	353.37	5.66	5.39	4.21	3.92	9.87	9.31	12.21	11.24	9.24	8.80	0.39	0.36
D_7-30th October		9.38	8.83	359.51	342.03	5.73	5.44	4.49	4.33	10.23	9.77	12.82	11.31	10.24	9.38	0.32	0.45
D_8-10th November		8.66	9.87	332.91	379.47	4.88	5.15	3.96	3.80	8.84	8.93	10.73	10.93	8.69	9.45	0.48	0.42
SEm (±)	D	0.024		5.42		0.12		0.14		0.18		0.61		0.025		0.005	
	V	0.012		2.71		0.06		0.07		0.09		0.08		0.012		0.002	
	D×V	0.033		7.66		0.18		0.2		0.26		0.23		0.035		0.007	
CD(P=0.05)	D	0.068		15.73		0.37		0.42		0.52		0.47		0.072		0.014	
	V	NS		NS		0.18		0.21		0.26		0.23		0.036		0.007	
	D×V	0.097		22.24		0.52		0.59		0.74		0.66		0.102		0.020	

Table 2: Weekly meteorological observation during the experimental period.

Period		Mean temperature (^{o}C)		Relative humidity (%)		Wind velocity (km/hr)	Rainfall (mm)/ annum
Weekly data	Date	Max.	Min.	Max.	Min.		
1	27/08/18 to 02/09/18	33.1	25.3	95	78	1.6	22.45
2	03/09/18 to 09/09/18	30.8	24.2	96	85	2.1	20.91
3	10/09/18 to 16/09/18	33.3	24.6	86	61	5.9	0
4	17/09/18 to 23/09/18	33.9	23.4	89	58	3.2	0.65
5	24/09/18 to 30/09/18	34.2	23.1	87	50	3.1	0.28
6	01/10/18 to 07/10/18	33.3	24.6	86	61	5.9	0
7	08/10/18 to 14/10/18	33.9	23.4	89	58	3.2	0
8	15/10/18 to 21/10/18	34.2	23.1	87	50	3.1	0
9	22/10/18 to 28/10/18	33.1	21.1	85	54	2.8	0
10	29/11/18 to 04/11/18	32.2	20.2	86	52	2.5	0
11	05/11/18 to 11/11/18	34.3	22.7	85	53	3.1	0
12	12/11/18 to 18/11/18	29.5	12.7	97	43	2.8	0
13	19/11/18 to 25/11/18	26.5	9.6	83	35	2.5	0
14	26/11/18 to 02/12/18	26.3	7.0	96	34	1.3	0
15	03/12/18 to 09/12/18	27.2	6.5	89	32	1.1	0
16	10/12/18 to 16/12/18	25.1	5.7	85	33	2.2	0
17	17/12/18 to23/12/18	24.2	5.4	78	32	1.2	0
18	24/12/18 to 30/12/18	23.8	4.6	75	31	1.1	0
19	31/12/18 to 07/01/19	22.7	4.9	97	45	1.5	0
20	08/01/19to 14/01/19	22.6	5.8	93	37	1.8	0
21	15/01/19to 21/01/19	22.9	4.5	96	40	2.3	0
22	22/01/19 to 28/01/19	21.8	10.3	90	65	2.0	0.78
23	29/01/19 to 04/02/19	22.3	7.0	94	45	2.7	0
24	05/02/19 to 11/02/19	22.5	9.5	97	58	2.5	2.65
25	12/02/19 to 18/02/19	23.6	10.4	94	53	2.3	0.2
26	19/02/19 to 25/02/19	26.4	11.3	93	42	3.6	0
27	26/02/19 to 04/03/19	23.6	9.5	91	51	2.9	0.82
28	05/03/19 to 11/03/19	27.5	10.9	88	38	4.4	0
29	12/03/10 to 18/03/19	30.5	13.1	78	30	4.1	0
30	19/03/19 to 25/03/19	32.1	15	71	27	5.5	0
31	27/08/19 to 02/09/19	34.7	24.8	92	65	1.4	0.77
32	03/09/19 to 09/09/19	35.1	24.9	90	67	1.5	0.8
33	10/09/19 to 16/09/19	33.8	23.6	94	77	1.7	6.6
34	17/09/19 to 23/09/19	30.2	22.2	96	90	1.3	15.06
35	24/09/19 to 30/09/19	27.8	19.6	97	89	2.0	26.97
36	01/10/19 to 07/10/19	31.0	19.2	95	63	1.3	0.71
37	08/10/19 to 14/10/19	33.1	17.1	95	55	1.3	0
38	15/10/19 to 21/10/19	32.0	16.8	95	58	0.6	0
39	22/10/19 to 28/10/19	30.0	11.6	94	53	1.3	0
40	29/10/19 to 04/11/19	30.0	15.2	94	55	1.2	0
41	05/11/19 to 11/11/19	29.5	14.9	92	53	1.8	0
42	12/11/19 to 18/11/19	29.4	13.0	90	38	1.9	0
43	19/11/19 to 25/11/19	27.7	11.9	94	44	2.1	0

Contd.

Table 2 Contd.

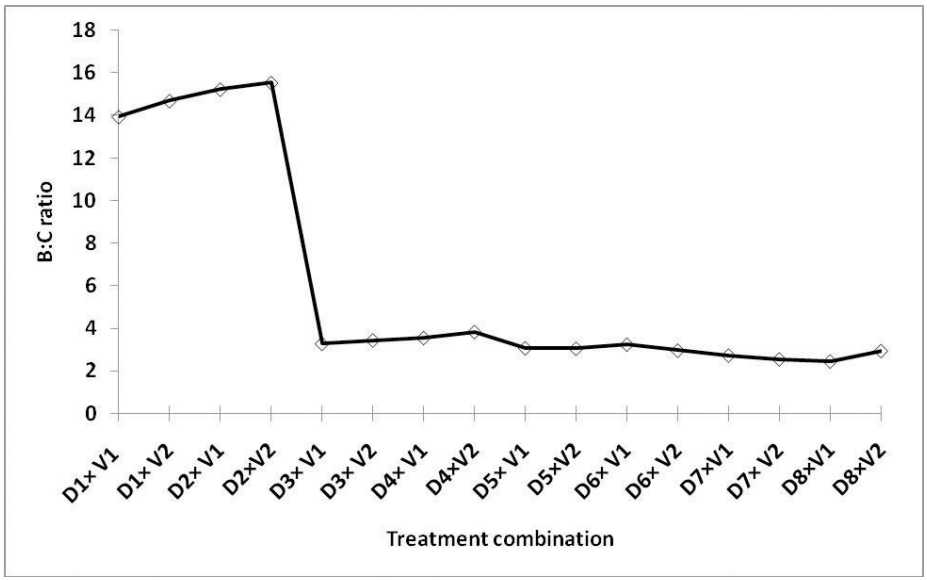
Period		Mean temperature (^{o}C)		Relative humidity (%)		Wind velocity (km/hr)	Rainfall (mm)/ annum
Weekly data	Date	Max.	Min.	Max.	Min.		
44	26/11/19 to 02/12/19	26.5	12.5	97	55	1.4	0
45	03/12 19 to 09/12/19	24.9	8.2	96	44	1.2	0
46	10/12/19 to 16/12/19	22.2	10.4	96	63	1.5	3.08
47	17/12/19 to 23/12/19	17.9	7.9	93	67	3.2	0
48	24/12/19 to 30/12/19	15.2	5.7	92	66	2.1	0
49	01/01/20 to 07/01/20	20.4	8.3	95.4	55.3	1.9	0.65
50	08/01/20 to 14/01/20	17.7	7.1	96.7	72.3	2.5	1.74
51	15/01/20 to 21/01/20	17.7	10.2	98.7	87.6	2.0	9.68
52	22/01/20 to 28/01/20	20.8	6.6	93	49.7	3.1	0
53	29/01/20 to 04/01/20	22.3	7.2	92.1	50.4	3.6	0
54	05/02/20 to 11/02/20	22.9	5.3	92.9	73.6	2.1	0
55	12/02/20 to 18/02/20	25.6	9.5	88.1	36.1	4.3	0
56	19/02/20 to 25/02/20	26.5	12.1	93.4	57.6	2.5	1.31
57	26.02/20 to 04/03/20	26.7	12.7	95.8	51.5	1.9	0.2
58	05/03/20 to 11/03/20	26.3	13.2	89	55.3	4.1	3.54
59	2/03/20 to 18/03/20	27.0	14.0	89.4	57.9	2.5	2.57
60	19/03/20 to 25/03/20	31.2	16.5	87.7	36.9	2.7	0
61	26/03/20 to 01/04/20	31.8	18.1	74.9	35.4	7.4	0.68

Effect of different dates of transplanting on total soluble solids in bulb of onion cultivars

The perusal of data of the study significantly revealed that transplanting on 20th September (D_3) had highest TSS content in onion bulb followed by 30th October transplanting (D_7). Among the two cultivars, TSS was higher in L-883 (V_2) compared to the variety Agrifound Dark Red (V_1). The laboratory analysis recorded that maximum TSS was found with D_3xV_2(6.35^{0}Brix 20th September transplanting x L-883 variety), followed by D_7 x V_1(5.73 ^{0}Brix 30th October x Agrifound Dark Red), and the minimum TSS (4.42^{0}Brix) was observed in the bulb with D_1 x V_1(30th August x Agrifound Dark Red). Total sugars was also obtained highest in V_2 when transplanted on 20thSeptember where as V_1 showed the highest total sugars when transplanted on 30 October. Similar trend was also observed in case of reducing and non-reducing sugars. Ascorbic acid content was estimated and seen that it was very close among the two varieties, however, maximum ascorbic acid was found in variety L883 and transplanting date was 20th September. Whereas, variety V_1 (Agrifound Dark Red) showed maximum ascorbic acid when transplanted on 30 October. Likewise, very close difference was observed in acid content. These results are in close conformity with the findings of (Singh *et al*., 2000, Crowther *et al*., 2002) Mahanthesh *et al.* (2009), Patil *et al.* (2012) and Tripathy *et al.* (2014).

Economic analysis

The economic study (Fig. 1) revealed that different dates of transplanting had significant effect on gross return and net return for *kharif* onion production. It was also varied with varieties. Maximum gross and net return was obtained from variety V_2 (L- 883) when transplanted on 10 th September (D_2) followed by V_1 (Agrifound Dark Red) transplanted on same day (D_2). The higher net return caused are marketable increase in Benefit: cost ratio of (18.58) and (12.47) followed by (18.11) and (12.32) as compared to late transplanting. The highest B:C ratio obtained in early transplanting also boosted up early harvesting when there was very high price for onion due to unavailability on onion in market. The high demand caused high return as well as high B:C ratio. However, at later



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, D_8 -10th November; V_1 - Agrifound Dark Red and V_2 - L-883

Fig. 1: Benefit : cost ratio of onion production

stage of harvesting the market price was lower than early harvesting time and resulted less return and lower B: C ratio as compared to other treatments. It was also observed that in the second year of trial the market price was not so high all over the country and therefore, the net return and B: C ratio was comparatively lower than first year trial. Overall performance of *kharif* onion suggested that more return might be granted for *off season* production as was also stated by several scientist similar results like Nandal and Singh (2002), Kalhapure and Shete (2013) and Patel *et al.* (2011).

CONCLUSION

In the present investigation, it was noticed that maximum values for yield and bulb quality characters were observed in Variety L 883 when it was transplanted on 20th September (D_3 x V_2). However, it was also clear that all the varieties (V_1, V_2) produced higher yield when transplanted on 30th September (D_4) which exhibited maximum income and high B: C ratio (Fig.1). Although, there was sudden rise of price during August and mid September transplanting, but they had low yield than D_4. Therefore, it can be concluded that cultivar L-883 transplanting on 30th September can be suggested for off-season onion production in the subtropical agro-climatic region of Central Uttar Pradesh for good yield and quality but 10th September transplanting for more profit during this period of study

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