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ORIGINAL RESEARCH ARTICLE



Effects of transplanting time on the yield and quality of onion (*Allium cepa* L.)

M.A. Khan¹, M.M. Rahman^{1*} , R. Sarker¹, M.I. Haque² and S.N. Mazumdar³

¹Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Faridpur - 7800, BANGLADESH

²Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Gazipur - 1701, BANGLADESH

³Spices Research Centre, Bangladesh Agricultural Research Institute, Bogura - 5810, BANGLADESH

*Corresponding author's E-mail: musfiqur.bari@gmail.com

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ABSTRACT

A field experiment was conducted at Spices Research Sub-Centre (SRSC), Bangladesh Agricultural Research Institute (BARI), Faridpur, Bangladesh during the winter season of 2018-2019 to investigate the influences of transplanting times of seedlings and the varieties on the yield and quality of onion bulbs. There were six levels of transplanting time such as T₁: November 15, T₂: November 30, T₃: December 15, T₄: December 30, T₅: January 14 and T₆: January 29 under the trial. The varieties used in the study were: BARI Onion-1 and BARI Onion-4. The experiment was laid out in a randomized complete block design (RCBD) of factorial concept with three replications. The results revealed that dates of transplanting, varieties and their combined effects had significant effect on the parameters studied with minor exception. The plant height, number of leaves/plant and incidence of bolting were decreased with the passage of transplanting time. The maximum values (54.51 cm, 8.53 and 71.28%) of the aforementioned traits were recorded at early transplanting on November 15, respectively. The reduced percent of bolting (2.22%) was observed at December 30. While no incidence of bolting was found under transplanting on 14-29 January. Bulb diameter, individual bulb weight, yield, total soluble solid content and dry matter content of bulb were increased up to transplanting on December 15. Afterwards the values of aforesaid parameters were gradually decreased. The highest yield (17.65 t/ha), total soluble solid content (17.02 °brix) and dry matter content of bulb (15.95%) were obtained from December 15 insignificantly followed by December 30 (16.30 t/ha). The delayed transplanting on 29 January markedly reduced the yield (6.72 t/ha), total soluble solid content (12.58 °brix) and dry matter content of bulb (11.61%) as well. The variety BARI Onion-4 performed better in respect of yield and yield attributes but it showed inferior quality. The combined effect of December 15 x BARI Onion-4 gave the highest yield attributes and yield of onion followed by the combination of November 30 x BARI Onion-4 and December 30 x BARI Onion-4 while the values among the three treatments were statistically similar.

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INTRODUCTION

In Bangladesh, the total annual production of onion bulbs is 17.38 lakh metric tonnes and its bulb yield is very low, being 9.71 t/ha (BBS, 2020) as compared to Indian onion yield, being 16.10 t/ha (Ratan *et al.*, 2017). The productivity and quality of

onion depend on many factors. Among them, date of seedling transplanting and variety are important factors. Several workers in the world found significant variation on the yield and quality of onion due to the date of seedling transplanting and varieties. Different transplanting times fall in different environment. Temperature and photoperiod are the major

ecological factors influencing onion growth and development (Rabinowitch, 1985) as those control the onion plant in all phases (Coolong and Randle, 2003). Bulb yields at harvest maturity declined with progressively warmer temperatures (Daymond et al., 1997). Transplanting date significantly affected on plant height, number of leaves per plant, percent bolting and bulb yield of onion (Ojha et al., 2019). Vegetative growth, bulb development, maturity and quality of onion also vary from variety to variety (Simon et al., 2014). Number of leaves per plant, diameter of bulb, individual bulb weight, bulb yield in onion was influenced by the varieties, as described by (Demisie and Tolessa, 2017). In Bangladesh, onion is traditionally transplanted on different dates of December-January. But onion plants, with some of the dates, show many flower stalks and split bulbs. While onions, with some of the dates, are harvested in early shower. Both of the aforesaid situations limit yield and quality of onion bulbs. Determining an appropriate seedling transplanting time is one of the most important requirements for getting maximum quantity of quality onion. The situation deserves increasingly important to adjust transplanting time of onion seedlings for getting targeted achievements as per variety. Therefore, the present work was undertaken to find out the seedlings transplanting times on the yield and quality of onion with varieties: BARI Onion-1 and BARI Onion-4.

MATERIALS AND METHODS

Experimental design and lay out

A field trial was carried out at Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Faridpur, Bangladesh in the winter season of 2018-2019 to explore the effects of varieties and date of seedling transplanting on yield and quality of onion. Six dates of onion seedling transplanting were considered under the study such as T₁: November 15, T₂: November 30, T₃: December 15, T₄: December 30, T₅: January 14 and T₆: January 29. While two varieties were tested in this trial as V₁: BARI Onion-1 and V₂: BARI Onion-4. The experiment was laid out in a randomized complete block design (RCBD) of factorial arrangement with three replications.

Edaphic and climatic factors

The experimental site is belonging to Agro Ecological Zone (AEZ) no. 11 (High Ganges River Floodplain). The geographic coordinates of the trial site are 23°11' N and 89° 09' E. While its elevation is about 12 meters above sea level. Among the crops grown in the area, onion is predominantly cultivated as irrigated crop. Soil samples were randomly collected at 0-30 cm soil depth for physical and chemical analysis before the commencement of the experiment. The physico-chemical properties of the field experimental plot are summarized in the Table 1. While fortnightly average air temperature, average relative humidity (RH) and total rainfall for the trial location during 2018-2019 are illustrated in the Figure 1. The weather data were collected from the Weather Observatory Station, Spices Research Sub-Centre, BARI, Faridpur, Bangladesh. The

findings of the soil sample analysis showed that the trial field was texturally clay loam with the values of pH and organic matter, being 7.85 and 1.91%, respectively. The contents of B, S, K, P and total N were: 0.26 mg/g soil, 10.75 mg/g soil, 0.42 meq/100 g, 14.27 mg/g soil and 0.12%, respectively. The weather data depicted that fortnightly air temperature, rainfall and relative humidity were varied with the dates of transplanting.

Cultivation practices

The 1st seed sowing of BARI Onion-1 and BARI Onion-4 was done in the seed beds on 02 October, 2018 and then the seed sowing was continued at 15-day interval up to six sowings. The main experimental field was fertilized with 5 tonnes well-decomposed cowdung, 120 kg N, 50 kg P, 85 kg K and 40 kg S per hectare. Nitrogen, phosphate, potash and sulphur were supplied in the form of Urea, TSP, MP and Gypsum, respectively. The entire quantity of cowdung, P, K, S and one third of N were applied as basal dose during land preparation. The remaining N was used as top dress in two equal splits at 20 and 30 days after seedlings transplanting. However, the seedlings transplanting was started on November 15, 2018 and continued up to on January 29, 2019 with 15-day interval in flat bed having spacing of 15 cm x 10 cm. The 40-day old uniform and healthy seedlings were transplanted. Before transplanting, roots of the seedlings were soaked in Rovral (Iprodione) solution for 5 minutes and about 5 cm of seedling tops were trimmed out. The unit plot size was 3.00 m x 1.50 m. The fungicide mancozeb/iprodione @ 3 g/1 litre of water was sprayed at fortnightly interval commencing from one month after transplanting of seedlings. All other management practices like weeding, irrigation were followed similarly for each treatment.

Harvest and post-harvest managements

Bulbs were harvested at maturity when the pseudo stem becomes flaccid and unable to support the leaf blades (Brewster, 1990a). Onions were harvested on several days as per maturity symptoms with dates of transplanting. Growing periods of onion were November 15-March 4, November 30-March 10, December 15-March 19, December 30-March 25, January 15-April 3 and January 30-April 10 under six treatments of transplanting, respectively. The leaves of harvested onion were removed at seven days after curing by cutting 8-10 cm above the bulb (Brewster, 1990b). After curing, the total bulb fresh weight was measured for each plot.

Observation and collection of data

The data recorded were: plant height (cm), number of leaves per plant (no.), percent bolting (%), diameter of bulb (cm), individual bulb weight (g), percent multiplier (split) bulbs (%), total soluble solid content (°brix), dry matter content of bulb (%), bulbs weight per plot (kg/ha) then calculated as yield per hectare (t). Ten plants were randomly selected from each plot for data recording and averaging it. Simple randomization of each plot was done to select ten plants and plant parameters cited above were recorded. Plant height and number of leaves were

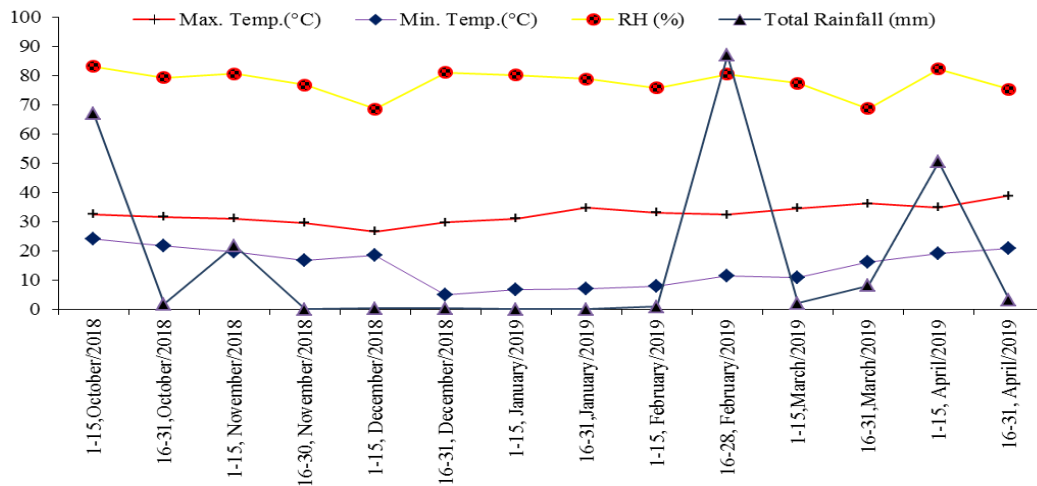


Figure 1. Fortnightly average air temperature, average relative humidity and total rainfall at SRSC, BARI, Faridpur during 2018-2019.

recorded at 30 and 60 days after seedling transplanting. But average plant height and number of leaves were presented in the paper. The number of bolting plants was visually counted in each plot, recorded and expressed in percent in relation to the total number of plants. The number of multiplier bulbs was visually counted in each plot, recorded and expressed in percent in relation to the total number of bulbs per plot. The total soluble solids (TSS) content of bulbs were recorded by hand refractometer (ATAGO, Master-53M, Japan) with a range of 0-53 °brix. The percent dry matter content of bulbs was calculated by dry weight basis as per procedure of Walle *et al.* (2018).

Statistical analysis of the data

The recorded data were analyzed statistically as suggested by Gomez and Gomez (1984) and the means were compared by least significant difference (LSD) method.

RESULTS AND DISCUSSION

Effects of seedlings transplanting times

The result of the data depicted that dates of seedlings transplanting had significant effect on the characters under the study (Table 2). The highest plant height (54.51 cm), number of leaves/plant (8.53) and incidence of bolting (71.28%) were obtained from early transplanting (T_1) of seedlings on 15 November followed by T_2 (November 30). Onion plants grown from transplanting seedlings on 15-30 November receives colder weather condition than those of later transplanting ones (Figure 1). The Figure 1 further illustrated that maximum temperature started rising after 15 December and continued up to the end of crop season. The maximum values for plant height, number of leaves/plant and percent bolting from earlier transplanting might be due to longer cold period prevailing. The present results concur with those of Ojha *et al.* (2019). They also found maximum plant height, number of leaves/plant and percent bolting from earlier transplanting of seedlings. Incidences of bolting occurred at four consecutive transplanting dates from T_1 - T_4 were 71.28, 50.00, 26.00 and 2.22%, respectively. This phenomenon happened due to low temperature but comparatively longer low temperature was prevailing at earlier transplanting than later one. The

present outcome is in accordance with the finding of Ojha *et al.* (2019). Ojha *et al.* (2019) stated that earlier bulb formation might have occurred from earlier transplanting and thus might be received more induction, which resulted into higher number of bolter (Ojha *et al.*, 2019). Brewster (1994) also noted that at low temperature plants catch sufficient leaves resulting in the sexual phase. Prolong low temperature increases bolting and also the speed of the phenomenon (Tarpaga *et al.*, 2011). The earlier transplanting dates resulted in higher incidence of bolting and severely reduced marketable yield (Hutton and Wilson, 1986) as bolter bulb bears hard center (bottom part of a flower stalk in the centre of a bulb) which deteriorates the quality of bulbs. The delay transplanting (T_5 and T_6) produced the minimum values for plant height, number of leaves/plant and percent bolting. However, the lowest values of plant height (33.56 cm), number of leaves per plant (4.58), incidence of bolting (0%) were noted by T_6 (January 29). And these lowest values were followed by T_5 (January 14). The shortest plant, the lowest number of leaves per plant and no incidence of flowering stalks obtained from January 14-29 transplanting might be due to higher temperature prevailing (Figure 1) that reduced growth of onion plant. Wright and Sobeih (1986) stated that higher temperature decreases leaf number and longer the day, sooner the plant growth ceases. Singh and Korla (1991) transplanted onion seedlings at fortnightly intervals starting from November 16 to December 31 and concluded that delay in transplanting caused decreased in number of leaves. Temperature and photoperiod are the major ecological factors influencing onion growth and development (Rabinowitch, 1985) as those control the onion plant in all phases (Coolong and Randle, 2003). The delay in sowing adversely influences the growth and development of plants due to shortened growth period with high temperature (Mohamedali and Nourai, 1988). While Khan and Shanmugasundaram (2013) stated that at the same planting time, bolting markedly reduced number of leaves. No flowering stalks at fifth and sixth stages of transplanting were observed due to higher temperature prevailing during growing period. High temperature is unfavourable for flowering in onion, as reported by Nikus and Mulugeta (2010).

Table 1. Physico-chemical properties of initial soil at the experimental plot of SRSC, BARI, Faridpur in 2018-2019.

Soil texture	Soil pH	OM (%)	K	Ca	Mg	Total N (%)	P	S	B	Zn	Fe	Cu	Mn
			meq/100 g				mg/g soil						
Clay loam	7.85	1.91	0.42	11.90	3.63	0.12	14.27	10.75	0.26	1.27	29.90	3.02	14.83
Critical level			0.12	2.0	0.5	0.12	7.0	10.0	0.2	0.6	4.0	0.2	1.0

Table 2. Effects of seedlings transplanting times on development, yield and quality of onion at SRSC, BARI, Faridpur during 2018-2019.

Transplanting time	Plant height (cm)	No. of leaves/plant	Bolting (%)	Split bulb (%)	TSS (^o brix)	Bulb dry matter (%)	Bulb diameter (cm)	Bulb weight (g)	Yield (t/ha)
T ₁	54.51	8.53	71.28	15.69	16.09	15.57	3.59	23.10	16.25
T ₂	54.50	8.45	50.00	16.20	16.33	15.77	3.82	24.73	16.59
T ₃	52.15	7.72	26.00	14.13	17.02	15.95	4.08	26.26	17.65
T ₄	51.90	7.20	2.22	12.29	16.66	15.09	3.72	24.35	16.32
T ₅	37.15	5.40	0.00	9.06	15.16	13.05	2.61	12.57	8.11
T ₆	33.56	4.58	0.00	7.01	12.58	11.61	2.30	10.53	6.72
LSD (0.05)	2.493	1.118	3.599	2.623	1.288	1.659	0.268	2.718	2.398
CV%	5.06	7.79	3.91	6.39	8.34	10.05	7.27	5.56	6.56
Level of sig.	**	**	**	**	**	**	**	**	**

Footnote-** Significant at 1% level of significance, T₁: November 15, T₂: November 30, T₃: December 15, T₄: December 30, T₅: January 14 and T₆: January 29, Trans.-Transplanting, TSS-Total soluble solid content.

Table 3. Effects of varieties on development, yield and quality of onion at SRSC, BARI, Faridpur during 2018-2019.

Variety	Plant height (cm)	No. of leaves/plant	Bolting (%)	Split bulb (%)	TSS (^o brix)	Bulb dry matter (%)	Bulb diameter (cm)	Bulb weight (g)	Yield (t/ha)
BARI Onion-1	45.75	6.48	24.51	12.51	17.16	14.94	3.11	18.77	12.53
BARI Onion-4	48.84	7.50	25.31	12.28	14.78	14.07	3.60	22.09	14.67
LSD (0.05)	2.096	1.003	-	-	1.743	-	0.086	2.798	1.986
CV%	5.06	7.79	3.91	6.39	8.34	7.96	7.27	5.56	6.56
Level of sig.	*	*	NS	NS	*	NS	*	*	*

Footnote-** Significant at 1% level of significance, * Significant at 5% level of significance, NS: Not significant and TSS-Total soluble solid content.

While the diameter of bulb, individual bulb weight and yield were increased up to third stage of transplanting time ranged from 3.59-4.08 cm, 23.10-26.26 g and 16.25-17.65 t/ha, respectively. The present result is not consistent with the finding of Hamasaki *et al.* (1999). They reported that the more leaves present, the larger bulb was obtained from the onion plant. But in the current experiment, the bulb weight and bulb size might be reduced due to production of flowering stalk. Once onions bolt, their bulbs stop growing. Khan and Shanmugasundaram (2013) stated that at same planting time, bolting markedly reduced bulb weight. The storage of photosynthate in onion bulb was hampered and was in turn utilized for flowering stalks ignition, which might be the reasons for smaller bulb size (Arvin and Banakar, 2002). Then the values of these traits were declined up to last stage of transplanting ranged from 3.72-2.30 cm, 24.35-10.53 g and 16.32-6.72 t/ha, respectively. Minimum bulb size and individual bulb weight from late transplanting seedlings were probably due to growing of late transplanted crops at higher temperature (Figure 1). The findings are in line

with the findings of Khan and Shanmugasundaram (2003). Bulb size and bulb weight were reduced markedly at long day length with high temperature, as described by Khan and Shanmugasundaram (2003). Bulb weight was affected by planting time (Hutton and Wilson, 1986). Delay in transplanting reduced bulb weight (Singh and Korla, 1991).

The yield was increased up to the third transplanting from 16.25 to 17.65 t/ha. After that it was decreased. The yield obtained (16.32 t/ha) at 4th transplanting was at par with the values of T₁, T₂ and T₃. The maximum yields obtained from the first to third transplanting might be because of low temperature prevailing for long period (Figure 1) as low temperature is favorable for bigger bulb development. Generally, in spite of greater yield obtained from first three transplanting dates, the yield was increased steadily from first transplanting to third one. The percent bolting of T₁, T₂, T₃ and T₄ were 71.28, 50.00, 26 and 2.2%, respectively. Decreasing trend in yield from third to first stage of transplanting might be due to higher incidence of bolting. The yields were markedly reduced by delaying

transplanting at T₅ and T₆ (8.11 and 6.72 t/ha), respectively. The reduced yields from late transplanting of seedlings might happen due to producing smaller bulbs by seedlings of late transplanting and due to higher temperature prevailing during growing period at late transplanting. The similar claims were also made by Alamin *et al.* (2017). They noted that the late sowing date exposed the crop to early high temperature which adversely affected vegetative growth which resulted in minimum bulb diameter and yield as well. Bulb yields at harvest maturity declined with progressively warmer temperatures (Daymond *et al.*, 1997). Reduction in total yield was recorded at later sowing dates was caused by a reduction in average bulb size (Hutton and Wilson, 1986). Singh and Korla (1991) transplanted onion seedlings at fortnightly intervals starting from November 16 to December 31 and concluded that delay in transplanting caused decreased in yield.

Total soluble solid content was increased insignificantly from first transplanting to third one which ranged from 16.09-17.02 °brix, respectively. Then it was reduced significantly to 14.58 °brix at the last transplanting (January 29). The lower TSS content of bulbs from earlier transplanting might be due to bearing profuse hard centres. While, the reduced TSS content from late transplanting was due to occurring rainfall at the maturity stages of bulbs (Figure 1). The maximum dry matter content (15.95%) of bulb was recorded from transplanting seedlings on 15 December. Afterwards the dry matter content was decreased with the passage of transplanting time. However, the highest dry matter was insignificantly followed by the value of November 15 (15.57%), November 30 (15.77%) and December 30 (15.09%). Significantly the minimum dry matter was obtained from late transplanting of seedlings. The early shower was occurring at the late harvest under the treatments January 14 and January 29 (Figure 1). The Figure 1 exhibited that under these two treatments, temperature and relative humidity were also comparatively higher than those of earlier ones. So, the lowest dry matter obtained from the bulbs of late transplanting might be due to receiving much water and higher temperature by onion bulbs. The finding of the current study confirms the previous finding of Alaminet *et al.* (2017). They recorded maximum dry matter of bulb from early transplanting under low temperature and minimum from late transplanting under high temperature. Onion quality also was influenced by temperature and rainfall (Lee *et al.*, 2012).

Effects of varieties

The varieties varied widely on the characters studied except percent bolting, split bulb and dry matter content of bulb (Table 3). The higher values of plant height (48.84 cm) and number of leaves per plant (7.50) were obtained from the variety BARI Onion-4. The variation between two varieties on plant height and number of leaves per plant might happen due to varietal genetic causes. Simon *et al.* (2014) and Kandil *et al.* (2013) also found significant difference on the plant height. The result on leaf number is supported by Deshi *et al.* (2018) and Demisie and

Tolessa (2017) who opined that the varieties had profound influence on number of leaves/plant. According to Ojha *et al.* (2019), the varieties did not show significant variation on plant height. The variety BARI Onion-4 showed significantly higher bulb diameter (3.60 cm) and individual bulb weight (22.09 g) than those of BARI Onion-1 (3.11 cm and 18.77 g), respectively. The genetic makeup of the varieties might be the possible reasons for these variations. The results on bulb diameter and individual bulb weight corroborate the findings of Demisie and Tolessa (2017) and Simon *et al.* (2014). They stated that bulb development and individual bulb weight were differed significantly by the varieties. Genetic factors influence growth and bulb development, as noted by Khokhar (2017). Between the two varieties, BARI Onion-4 significantly performed better on yield (14.67 t/ha). The higher yield of BARI Onion-4 was resulted from its heavier bulb. Demisie and Tolessa (2017) and Simon *et al.* (2014) reported similar results as varieties differed significantly in bulb yield. Out of two varieties, BARI Onion-1 had higher total soluble solid content (TSS) of bulb (17.16 °brix). The result of the present trial on TSS content is at par with the finding of Kandilet *et al.* (2013). They found significant variation among the varieties on TSS content. The varieties showed insignificant variation on the incidence of bolting, the percent split bulb and dry matter content of bulb. Ojha *et al.* (2019) also found insignificant variation between the varieties on incidence of bolting. On the contrary, Deshi *et al.* (2018) and Simon *et al.* (2014) noted that the varieties showed significant variation on bulb dry matter content. The incidence of bolting and percent split bulb was considerably influenced by the varieties, as published by Boyhan *et al.* (2009).

Combined effects of varieties and seedlings transplanting times

The combined effects of transplanting times and varieties had significant effect on the attributes studied (Table 4). Transplanting seedlings on November 30 with the variety BARI Onion-4 demonstrated the maximum plant height (56.10 cm) insignificantly followed by November 15 x BARI Onion-4 (56.09 cm). While the combined effect of November 15 x BARI Onion-4 showed higher number of leaves (8.48) and incidence of bolting (72.06%). The higher diameter of bulb (4.53cm), individual bulb weight (28.10 g) and bulb yield (18.88 t/ha) were noted from combined effects of December 15 x BARI Onion-4. The lower diameter of bulb (2.09 cm), individual bulb weight (8.40 g) and yield of bulb (5.62 t/ha) were recorded from the combined effects of January 29 x BARI Onion-1. Interaction of varieties and planting dates had significant on plant height, bulb diameter (Alaminet *et al.*, 2017). Kandil *et al.* (2013) and Boyhanet *et al.* (2009) observed significant variation among the combination of varieties and date of transplanting on incidence of bolting, percent split bulb, bulb weight and yield of onion. Interaction of varieties and dates of transplanting did not show significant difference on the values of growth and yield attributing characters (Ojha *et al.* 2019).

Table 4. Combined effects of varieties and seedlings transplanting times on development, yield and quality of onion at SRSC, BARI, Faridpur during 2018-2019.

Variety X Transplanting time	Plant height (cm)	No. of leaves/plant	Bolting (%)	Split bulb (%)	TSS (^o brix)	Bulb dry matter (%)	Bulb diameter (cm)	Bulb weight (g)	Yield (t/ha)	
V ₁	T ₁	52.93	8.58	70.50	15.49	17.89	16.01	3.43	23.01	15.44
	T ₂	52.90	8.51	46.89	16.40	17.87	16.20	3.63	23.19	15.52
	T ₃	50.19	7.33	27.35	14.52	18.03	16.42	3.63	24.43	16.42
	T ₄	51.29	6.28	2.35	12.52	17.13	15.69	3.55	22.61	15.29
	T ₅	35.29	4.13	0.00	9.24	16.02	13.57	2.35	11.03	6.92
	T ₆	31.92	4.10	0.00	6.91	16.04	11.79	2.09	8.40	5.62
V ₂	T ₁	56.09	8.48	72.06	15.89	14.29	15.13	3.75	25.30	17.06
	T ₂	56.10	8.39	53.11	16.00	14.79	15.35	4.01	26.28	17.66
	T ₃	54.11	8.29	24.65	13.74	16.01	15.51	4.53	28.10	18.88
	T ₄	52.51	8.12	2.09	12.06	16.19	14.49	3.89	26.09	17.35
	T ₅	39.01	6.67	0.00	8.88	14.30	12.53	2.88	14.11	9.30
	T ₆	35.20	5.06	0.00	7.11	13.12	11.44	2.51	12.66	7.82
LSD (0.05)	5.589	2.109	8.899	4.325	2.432	3.698	1.143	5.032	4.409	
CV%	5.06	7.79	3.91	6.39	8.34	9.58	7.27	5.56	6.56	
Level of sig.	*	*	**	*	*	**	*	*	*	

Footnote- **Significant at 1% level of significance, * Significant at 5% level of significance, T₁: November 15, T₂: November 30, T₃: December 15, T₄: December 30, T₅: January 14 and T₆: January 29, V₁: BARI Onion-1 and V₂: BARI Onion-4, Trans.-Transplanting, TSS-Total soluble solid content

Conclusion

Based on the outcomes of the present trial it could be concluded as follows: Under the present study the optimum date of onion seedlings transplanting was from 15-30 December for getting maximum productivity and quality of onion bulbs. Early transplanting produced profuse bolter bulbs. The bolter bulb bears hard center which reduces the quality and the market value of that bulb as well. Delayed transplanting of seedling markedly reduced the yield due to prevailing higher temperature and quality also like total soluble solid content and dry matter content of bulb due to occurring early rainfall at harvesting stage. Transplanting seedlings after 30 December reduced the percent bolting to a great extent while no bolting was occurred transplanting seedlings on 14-29 January due to prevailing higher temperature. In respect of yield, the variety BARI Onion-4 significantly performed better than that of the variety BARI Onion-1.

Conflicts of interest

The authors have no conflict of interest to declare.

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