IMPACTS OF SEEDLINGS TRANSPLANTING DATES OF 'RED CREOLE' ONION ON BULB YIELD

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ABSTRACT

An experiment was carried out in Randomized Complete Block Design (RCBD) replicated four times in the field of Agriculture Research Station (ARS), Dailekh during the consecutive years 2010/11 and 2011/12 to study the impacts of seedlings transplanting dates of 'Red Creole' onion on bulb yield and yield contributing characters. Two years' pooled results showed that seedlings transplanted on December 15 (Mangsir 30) recorded the highest pooled marketable bulb yield (29.99 mt/ha), plant density (4,20,000), number of leaves (10.10/plant) and bulb diameter (5.68 cm). Seedlings transplanted on November 30 (Mansir 15) had the highest number of marketable bulbs (3, 77,500 /ha) and TSS (19.67%). Seedlings transplanted on December 15 showed to be the most appropriate dates for maximum bulb yield and its contributing characters under the mid-hill environments of Dailekh.

Key Words: Experiment, pooled, plant density, leaves, diameter

INTRODUCTION

Onion (*Allium cepa* L.) belongs to family Amaryllidaceae (Amaryllis) or Liliaceae and is one of the most important monocotyledonous, cross-pollinated cool season vegetable crops. The bulb of onion consists of swollen bases of green foliage leaves and scales. It is widely cultivated in many areas of the world including the tropics and the temperate regions. The most important onion producing countries are USA, Romania, India, Italy and Turkey. The probable origin of onion is Afghanistan while Tajikistan, Uzbekistan, Western Tien Shan, India, Western Asia and the areas around the Mediterranean Sea are the secondary centers of its origin (Jilani, 2004).

The onion is one of the most important commercial vegetable crops grown in Nepal. It can be grown successfully throughout the most of the warm temperate hill areas of Nepal and also in the Terai because of congenial biophysical conditions. Bulbs produced in the hills have a very high potential for supply in the domestic markets of the Terai as well as for export to South East Asian countries. Additionally, It is used both in raw and matured bulb stages as vegetable and spices. The pungency in onion is due to a volatile oil known as allyl-propyl-disulphide. It has become the integral components of culinary preparations. Besides being used as condiments, the medicinal properties of the commodity add value to its importance.

The per capita consumption of fresh onion in Nepal is 7.7 kg which is quite lower than recommendation of 18 kg per annum. The varieties of onion cultivated in the country have potential yields ranging from only 12 to 21 t/h (CADP, 2008). The in-country production of onion accounts for less than 50% of the total supplies in the major market centers of Nepal even during the harvesting season from April to June (Koirala *et al.*, 1995 and Gautam *et al.*, 2006). Among vegetables, the highest quantity of onion (61, 68,318 mt) with economic value (NRs 661,186,159) was imported from India (MoAC, 2010). On account of the pressing needs, onion should be cultivated in Nepal with the necessary support to reduce the huge amount of import from India.

The study was conducted to find out the appropriate seed sowing and seedling transplanting dates for dry onion bulb production in normal season in the field of ARS, Dailekh since the precise results of research on different dates of seed sowing and seedling transplanting for normal season dry bulb production is not yet documented in the context of mid-hills of Midwestern Region, Nepal.

MATERIALS AND METHODS

Seven weeks old seedlings were transplanted on six different dates in well-prepared experimental plots with four replications in RCBD. As per schedule, seeds were sown in nursery beds about seven weeks before seedlings were transplanted in the main plots. A total of six different transplanting dates were:

1. October 31 (Kartik 15)
2. November 15 (Kartik 30)
3. November 30 (Mansir 15) as control
4. December 15 (Mansir 30)
5. December 30 (Paush 15)
6. January 13 (Paush 29)

All of the aforementioned six treatments were evaluated in the field of ARS, Dailekh during winter-early summer season of the consecutive years in 2010/11 and 2011/12. Seeds and seedlings of normal season onion 'Red Crole' was used for all the treatments. The recommended manuring and fertilization were applied @ 20 tons FYM plus 100 kg N: 50 kg P_2O: 50 kg K_2O/ha respectively. Recommended FYM was incorporated into soil during the first land preparation time. Half dose of nitrogen, full dose of P_2O and K_2O were applied to the soil just prior to transplanting the seedlings. The experimental area was $4m^2$ (2mx2m). Fifty Seedlings /m^2 were transplanted in the crop geometry of 20 cm between the rows and 10 cm within the rows. The remaining half dose of Nitrogen was side-dressed into two split doses: 21 days and 45-50 days after transplanting. The rest of the intercultural operation and plant protection measures were adopted as per recommended for standard bulb production technology of onion crop. Transplanted seedlings were lightly irrigated with water-cane till the complete establishment of seedlings in the experimental field. Then, crops were lightly irrigated at an interval of 10-12 days till the late winter as per needed. From the spring to early summer season, the frequency of irrigation was increased gradually. Nevertheless, irrigation was ceased just about 15 days prior to the day of harvesting. Data were recorded on plant density, number of marketable and unmarketable bulb per ha, marketable and unmarketable bulb yield, bolting %, number of leaves per plant, polar length of bulb (cm), diameter of bulb (cm), number of rings per bulb, number of centers per bulb and TSS %.

RESULTS

Of twelve characters, two years' pooled results of five characters viz., plant density/ha, number of marketable bulbs/ha, marketable bulb yield/ha, unmarketable bulb yield/ha, bolting %, and diameter of bulb (cm) were highly significant, and the pooled results of only two characters viz., number of leaves per plant as well as number of centers per bulb were significant at 0.05 levels but two years' pooled results of four characters viz., number of unmarketable bulbs per ha, polar length of bulb (cm), number of rings per bulb and TSS % were found to be non-significant at 0.05 levels.

Table 1. Plant density, number of marketable and unmarketable bulbs as influenced by different dates of seedlings transplanting of 'Red Creole' onion during 2010/11 and 2011/12 at ARS, Dailekh.

Dates of seedlings transplanted	Plant density/ha			Number of marketable bulbs/ha			Number of unmarketable bulbs/ha		
	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled
Oct 31	287500^{c}	431250^{a}	359400^{d}	233750^{c}	320000	276900^{d}	53750	112750	82500
Nov 15	346250^{b}	400000^{ab}	373150^{cd}	291250^{b}	312500	302500^{cd}	55000	86250	70650
Nov 30	415000^{a}	417500^{a}	416250^{ab}	388750^{a}	36625	377500^{a}	26250	51250	38750
Dec 15	415000^{a}	425000^{a}	420000^{a}	327500^{b}	376000	345000^{ab}	87500	62500	75000
Dec 30	396250^{a}	410000^{a}	404400^{ab}	331250^{b}	335000	333150^{bc}	67500	75000	71250
Jan 13	410000^{a}	368750^{b}	389400^{bc}	318750^{b}	300000	309400^{bcd}	91250	68750	80000
Mean	378333	408750	393767	315205	334958	324075	63538	62750	69692
F- test	**	*	**	**	NS	**	NS	NS	NS
CV (%)	6.24	6.35	4.58	10.74	11.49	7.04	53.53	41.72	28.73
CD (P≤0.05)	35595	31750	22900	51000	57650	34385	51250	47685	30175
SEm±	11810	12970	9020	16920	19125	11405	17005	15820	10010

- The figures with the same small letters in a column are not significantly different by DMRT at 0.05 levels.
- NS, * and ** indicates non-significant, significant and highly significant differences at 0.05 levels.

The result of plant density in the year 2010/11 was highly significant; however, it was found to be only significant in the year 2011/12. The pooled result of two years showed highly significant with mean value of 393776/ha. Seedlings transplanted on December 15 recorded the highest pooled plant density (4,20,000/ha) which was statistically inconsequential with the pooled plant density of seedlings transplanted on November 30 (4, 16,250/ha) and December 30 (4, 04400/ha). To the contrary, the lowest pooled plant density (3, 59,400/ha) resulted in the seedlings transplanted on October 31; nevertheless, the pooled plant density of the treatment did not differ statistically from those of the seedlings transplanted on November 15 (3, 73,150/ha) in Table 1.

The pooled number of marketable bulbs/ha was variable between 2, 76,900 and 3, 77,500 showing the mean value of 3, 24,075/ha. Seedlings transplanted on November 30 recorded remarkably the highest number of marketable bulbs (3, 77,500/ha) significantly followed by seedlings transplanted on December 15 with 3, 45,000/ha and December 30 with 3, 33,150/ha. Contrastingly, the lowest pooled number of marketable bulbs resulted in the seedlings transplanted on October 31 with 2, 76,900/ha (Table 1). On the other hand, the pooled number of unmarketable bulbs /ha ranged between 38,750 (seedlings transplanted on November 30) and 82,500 (seedlings transplanted on October 31) having the mean value of 69,692/ha (Table 1).

The pooled marketable bulb yield varied from 16.09 to 29.99 mt/ha with the mean value of 22.31 mt/ha. The seedlings transplanted on December 15 recorded considerably the highest pooled marketable bulb yield (29.99 mt/ha) which differed significantly from those of the rest of the five treatments. To the contrary, the seedlings transplanted on January 13 and October 31 resulted significantly the lower pooled marketable bulb yields (16.09 mt/ha and 16.76 mt/ha respectively) as comparing against those of the pooled marketable bulb yields noted in the remaining four treatments (Table 2). The pooled unmarketable bulb yield was variable between 0.8725 and 1.505 mt/ha with the mean value of 1.424 mt/ha. The seedlings transplanted on October 31 had the higher pooled unmarketable bulb yield (2.505 tm/ha) as comparing to those of the rest of the five treatments. The lowest pooled unmarketable bulb yield was noted in the seedlings transplanted on November 30 with 0.8725 mt/ha (Table 2).

Table 2. Marketable bulb yield, unmarketable bulb yield and bolting % as influenced by different dates of seedlings transplanting of 'Red Creole' onion during 2010/11 and 2011/12 at ARS, Dailekh.

Dates of seedlings transplanted	Marketable bulb yield (mt/ha)			Unmarketable bulb yield(mt/ha)			Bolting %		
	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled
1. Oct 31/KT 15	17.15^{d}	16.38^{c}	16.76^{d}	1.525^{a}	3.475^{a}	2.505^{a}	32.80^{ab}	34.90^{a}	33.84^{a}
2.Nov.15/ KT.30	21.42^{c}	21.50^{b}	21.47^{c}	0.8750^{ab}	2.075^{b}	1.470^{b}	24.98^{b}	26.17^{b}	25.56^{a}
3.Nov.30/MS.15	27.10^{b}	24.05^{b}	25.58^{b}	0.4000^{b}	1.350^{c}	0.8725^{c}	18.78^{b}	20.15^{b}	22.53^{a}
4.Dec.15/MS.30	31.73^{a}	28.25^{a}	29.99^{a}	1.050^{ab}	1.150^{c}	1.097^{bc}	0.010^{c}	0.7750^{c}	0.392^{b}
5.Dec.30/PS.15	25.45^{b}	22.45^{b}	23.95^{b}	1.125^{a}	1.200^{c}	1.150^{bc}	0.2750^{c}	0.0200^{c}	0.135^{b}
6.Jan.13/PS.29	19.30^{cd}	12.88^{c}	16.09^{d}	1.450^{a}	1.475^{c}	1.450^{b}	0.2750^{c}	0.010^{c}	0.132^{b}
Mean	23.69	20.92	22.31	1.07	1.788	1.424	12.850	13.671	13.76
F –test	**	**	**	*	**	**	**	**	**
CV (%)	9.37	12.86	6.32	39.41	17.40	18.19	49.54	40.04	43.02
CD (P≤0.05)	3.347	4.055	2.126	0.6359	0.4694	0.3901	12.08	8.247	9.671
SEm±	1.110	1.345	0.7052	0.2110	0.1557	0.1294	4.008	2.736	3.208

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The pooled bolting per cent was highly significant, having variation between 0.132 and 33.84% with the mean value of 13.76 per cent. The pooled bolting per cent was noted minimally in the seedlings transplanted on January 13, December 30 and December 15 with 0.132, 0.135 and 0.392% respectively. On the other hand, the pooled bolting per cent was noted maximally in the seedlings transplanted on October 13, November 15 and November 30 with 33.84, 25.56 and 22.53 % respectively (Table 2).

The pooled number of leaves per plant was noted to be significantly variable between 8.8 and 10.10 with the mean value of 9.71 per plant. Although the seedlings transplanted on December 15 recorded the higher pooled number of leaves per plant than the remaining five treatments it is at par with the seedlings transplanted on four other dates: December 30 (9.82),January 13 (9.82) , November 30 (9.80) and November 15 (9.88) respectively (Table 3).

Table 3. Number of leaves per plant, polar length of the bulb and diameter of the bulb as influenced by different dates of seedlings transplanting of 'Red Creole' onion during 2010/11 and 2011/12 at ARS, Dailekh.

Date of seedlings transplanted	Leaf number per plant			Polar length of bulb (cm)			Diameter of bulb (cm)		
	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled
1. Oct 31/KT 15	8.55^{b}	9.050^{b}	8.80^{b}	3.55	3.34	3.45	4.57^{b}	5.01^{b}	4.79^{b}
2.Nov.15/KT.30	9.60^{a}	10.17^{a}	9.88^{a}	3.65	3.50	3.58	4.60^{b}	5.07^{ab}	4.84^{b}
3.Nov.30/MS.15	9.52^{a}	10.07^{a}	9.80^{a}	3.52	3.66	3.59	4.65^{b}	5.30^{ab}	4.98^{b}
4.Dec.15/MS.30	9.90^{a}	10.30^{a}	10.10^{a}	3.67	3.48	3.58	5.30^{a}	6.06^{a}	5.68^{a}
5.Dec.30/PS.15	9.57^{a}	10.07^{a}	9.82^{a}	3.75	3.63	3.69	4.50^{b}	5.16^{ab}	4.83^{b}
6.Jan.13/PS.29	9.57^{a}	10.08^{a}	9.82^{a}	3.77	2.62	3.20	4.30^{b}	4.05^{c}	4.18^{c}
Mean	9.45	9.94	9.71	3.65	3.38	3.52	4.65	5.11	4.84
F-test	*	*	*	NS	NS	NS	**	*	**
CV (%)	5.15	4.93	5.01	4.46	16.00	6.94	5.98	12.13	6.99
CD (P≤0.05)	0.7337	0.7399	0.7322	0.2477	0.8144	0.3692	0.4209	0.9340	0.5133
SEm±	0.2434	0.2455	0.2429	0.08216	0.2702	0.1225	0.1396	0.3098	0.1703

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The pooled polar length of bulb was found to be insignificantly different and varied from 3.20 cm to 3.69 cm with the mean value of 3.52 cm. The pooled diameter of the bulb was highly significant, having shown the variation between 4.18 cm and 5.68 cm with the mean value of 4.84 cm.
The pooled number of rings per bulb was noted to be insignificant which ranged from 5.62 to 6.87 with the mean value of 6.42 per bulb (Table 4). The pooled number of centers per bulb was noted to be significant which varied from 1.75 to 2.29 with the mean value of 1.91 per bulb.

Table 4. Number of rings and centers per bulb, and TSS per cent as influenced by different dates of seedlings transplanting of 'Red Creole' onion during 2010/11 and 2011/12 at ARS, Dailekh.

Dates of seedlings transplanted	Number of rings per bulb			Number of Centers per bulb			TSS per cent		
	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled	2010/11	2011/12	Pooled
1. Oct 31/KT 15	6.870	6.875	6.87	1.745^{b}	1.750	1.75b	16.25	20.17	18.21
2.Nov.15/ KT.30	5.625	5.625	5.62	1.727^{b}	1.700	1.72b	17.50	19.75	18.63
3.Nov.30/MS.15	6.120	6.125	6.12	1.950^{b}	1.928	1.94ab	19.63	19.71	19.67
4.Dec.15/MS.30	6.875	6.875	6.87	1.900^{b}	1.825	1.86b	15.13	19.83	17.48
5.Dec.30/PS.15	6.173	6.250	6.21	2.325^{a}	2.225	2.29a	16.50	20.42	18.46
6.Jan.13/PS.29	6.773	6.875	6.82	1.975^{b}	1.900	1.94ab	18.00	19.75	18.88
Mean	6.406	6.437	6.42	1.937	1.887	1.91	17.17	19.938	18.56
F -test	Ns	ns	Ns	*	ns	*	ns	ns	Ns
CV (%)	13.38	13.09	13.21	11.86	13.01	12.25	11.10	7.36	6.55
CD (P≤0.05)	1.292	1.270	1.279	0.3470	2.163	0.3535	2.872	2.212	1.833
SEm±	0.4287	0.4213	0.4243	0.1151	0.7176	0.1173	0.9528	0.7338	0.6081

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The seedlings transplanted on December 30 recorded the highest number of pooled rings per bulb (2.29 per bulb) but it was statistically inconsequential with those of the seedlings transplanted on November 30 (1.94 per bulb) and January 13 (1.94 per bulb). In contrast, the pooled number of rings per bulb was minimally low in the seedlings transplanted on November 15 (1.72 per bulb), October 31 (1.75 per bulb) and December 15 (1.86 per bulb) (Table 4). The pooled TSS (Total Soluble Solid) per cent was noted to be insignificant due to the effects of transplanting dates of seedlings. It ranged from 17.48 per cent to 19.67 per cent with the mean value of 18.56 per cent (Table 4).

DISCUSSION

The discussion has been made on the basis of two years' pooled results with those characters having F values highly significant viz. plant density, number of marketable bulb, marketable bulb yield, unmarketable bulb yield, bolting %, and diameter of bulb and those having F values only significant viz. number of leaves per plant and number of centers per bulb.

The earlier observational study on seedling transplanting dates had revealed that November second fortnight (Mangsir first fortnight) was observed and claimed as the best for high bulb yield under the mid-hill condition of Dailekh (observed from 1996 to 1998). Nevertheless, in the present study, the highest bulb yield (29.99 mt/ha) was recorded in the seedlings transplanted on December 15 than on Control/November 30 (25.58 mt/ha) and the other remaining transplanting dates, which was most presumably due to the contribution of the highest number of established plant density (420000/ha) coupled with appropriate transplanting dates of seedlings under favorable environment in course of climate change. Farooq *et al.* (1990) also recorded the highest bulb yield (35.6 mt/ha) on account of the highest number of established plant density (400000/ha) as compared to plant densities of 300000/ha (27.50 mt/ha) and 200000/ha (21.60 mt/ha). In addition, Dellacecca (2000) also recorded the highest bulb yield at the plant density of 80/ m^2. The pooled result of two years' bulb yield obtained in the present study is also in agreement with the findings of Boyhan et al.(2005) who recorded the highest bulb yield (16.028 mt/ha) from the seedlings transplanted on December 22; but Hirasy and Mehta (2005) recorded the highest bulb yield from the seedlings transplanted on November 15 (32.90 mt/ha) under Gujarat condition of India.

Bolting (premature development of seed stalks) is considered undesirable in warehouse onion crop as it shortens the shelf life and marketability of onion bulbs and even spoils the bulbs completely. Bolting also reduces the quality of bulb as it becomes fibrous and lightweight. The pooled bolting % was noted to be the lowest in the seedlings transplanted on January 13 (0.132%) but it was inconsequential with the pooled results of the seedlings transplanted on December 30 (0.136%) and December 15 (0.392%). The later the seedlings transplanted the lower was the bolting % recorded. In other words, the earlier the seedlings were transplanted the higher was the bolting % recorded. The result of the bolting % in the present study substantiates that increased number of bolting resulted in former seed sowing and transplanting dates while decreased number of bolting resulted in later seed sowing and transplanting dates (Mulkey and Talbot, !991). The pooled diameter of bulb was considerably greater in seedlings transplanted on December 15 (5.68 cm) than on control/November 30 (4.98 cm) and the rest of the different transplanting dates. The bulb diameter was noted to have increased gradually from seedling transplanted on October 31 (4.79 cm) through December 15 (5.68 cm), and then, it was observed to have subsequently decreased from the seedlings transplanted on December 30 (4.83 cm) and January 13 (4.18 cm).

There was significant effect of the dates of seedling transplanting on number of centers per bulb it being significantly maximum (2.29 per bulb) on Dec 30 transplanting. However, later seed sowing and seedling transplanting seems to have resulted into a slight increase in the number of centers per bulb which advocates the findings stated by Boyhan *et al,* (2005). It suggests that seed sowing and seedlings transplanting dates are important considerations in reducing the number of centers per bulb.

CONCLUSION AND RECOMMENDETION

Two years' pooled results showed that seedlings transplanted on December 15/Mangsir 30 contributed considerably to higher bulb yield (29.99 mt/ha), statistically the minimum bolting (0.392%), high number of leaves (10.10 per plant), wider diameter of bulb (5.68 cm) and minimum number of centres (1.86 per bulb). Even though seven weeks old seedlings transplanted on November 30 as control followed December 15 in respect of bulb yield the bulb quality was reduced due to significantly higher bolting (22.53 %) than on December 15 (0.135%). For higher yield and quality of bulb it is, therefore, technically necessary to suggest to 'Red Creole' onion growers that onion seed of 'Red Creole' has to be sown in the nursery bed during the last week of October/the second week of Kartik, and seedlings to be transplanted during the second week of December/ the last week of Mangsir under the mid-hill environment of Dailekh and similar areas of mid-western regions of Nepal. Furthermore, the present study not only hints the precision of onion seed sowing and seed transplanting dates but also gives clues for the possibility of seed sowing and seedlings transplanting dates for annual seed production on commercial scale.

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