The Pharma Innovation Journal 2021; 10(6): 1165-1173

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(6): 1165-1172
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www.thepharmajournal.com
Received: 14-04-2021
Accepted: 29-05-2021

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Effect of some quality traits of onion (*Allium cepa* L.), variety and planting date on seed yield in late kharif planting under Odisha condition

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Abstract
Quality seed is the basic and critical input of onion production. However, the seed supply is inadequate, which leads to increase in price every year. The quality is also not up to mark. The seed production in onion is very difficult phenomena. Apart from the suitable varieties, appropriate time of planting is also one of the important factors, which influences the growth, yield and quality of crop and ultimately the seed yield and quality. Odisha owing to its agro-climatic diversity has much potential in producing onion that it can meet whole of its demand and export to the other states, which need to be explored. This present study was carried out to identify a suitable variety and time of planting for quality onion seed production under Odisha condition. Healthy and disease free bold seedlings of five different varieties of onions raised by adopting standard nursery techniques were transplanted at five different dates of planting. It was observed that both the date of planting and varieties significantly influenced the plant height at three different days after planting (DAP) *viz*. 75, 90 and 105. Similar effect was also observed on the number of leaves per plant. The influence on the survival (%) from seedling to bulbing and from bulbing to seed setting was also studied. According to the pooled data of both years, the highest seed yield per hectare was recorded in Arka Niketan (701.49 kg), irrespective of the effect of planting date. Similarly, irrespective of variety, the highest seed yield per hectare was recorded in the in D_2 planting i.e., 25th September (809.51 kg) which was statistically significant from others.

Keywords: Onion, seed yield, planting date, survival percent, seed production

Introduction
Onion (*Allium cepa* L.) is one of the most important and oldest vegetable crops known to mankind and an integral component of culinary preparations being consumed worldwide. With the production of 21564 thousand MT of onion from an area of 1270 thousand hectares, India ranks second both in area and production after China (2016-17). But the per cent share to world production is only 19%. Apart from this, productivity of onion in India stands at only 16.11 t/ha, which is lower than world average of 18.67 t/ha. Though onion is grown in different times of a year, the main crop is in rabi accounting to 50-60% of total onion production and 20-25% each in kharif and late kharif in the country. Among the various onion producing states in India, Maharashtra is leading in area and production while Gujarat in productivity. During last 35 years it is observed that in Odisha the area under production has increased three fold but the productivity has only reached to 12.0 tonnes/ha (2012-13) which is below the national and world average. The position of Odisha in the country is 12th with production of 379.34 thousand tonnes, which shares only 1.63% to the nation (Anonymous, 2018) [3]. Out of thirty, the major onion producing districts of Odisha are Kalahandi, Bolangir, Bargarh, Nuapada, Sambalpur, Ganjam, Angul, Deogarh and Boudh (Sahoo *et al.* 2016) [10]. As per reports of state Agriculture and Farmers' Empower Department, the people of the state consume four lakhs metric tonnes of onion a year, whereas the net production in the state is nearly 2.7 lakh metric tonnes. So the rest quantity is imported from Maharashtra, Tamil Nadu and Andhra Pradesh every year. But the fact that will put everyone wondering is Odisha has so much potential in producing onion that it can meet whole of its demand and export to the other states. The agro-climatic diversity in the state with its high rainfall distribution over a four-month monsoon and reasonably moderate winter, allow growing of onion in the state. The low temperature in hilly area at higher altitude offer ideal conditions for growing off-season onion preferably during both *kharif* and late *kharif* season (Tripathy *et. al.* 2013) [11].

But this is a dream yet to be fulfilled. Quality seed is the basic and critical input for achieving the desired vegetable production. Onion is usually propagated by true botanical seed except multiplier onion where crop is produced through vegetative means by bulb lets. The demand for quality onion seed is increasing (Amsalu *et al*., 2014) [1]. However, seed supply is inadequate, its price is increasing every year and onion seed available in the market are poor in quality. Most of the demand for onion seed is either meets by private sectors or unorganized sectors and rest is met by farmers own seed, often produced without following isolation requirement. Only 9.6 per cent of the demand is met by public sectors. The seed production in onion is very difficult phenomena. Besides selection of suitable varieties, appropriate time of planting is also one of the important factors, which influences the growth, yield and quality of crop as a climatic factor. Atmospheric temperature, humidity and day length affect the crop as well as seed yield. So, planting at different times is considered to test the suitable dates for quality seed production. In practice, two methods are followed for onion seed production *i.e.* seed to seed method and bulb to seed method. As seed to seed method is easy and cost effective, the farmers of Odisha should be encouraged for producing seed to meet the seed demand of the state with technical advice from government level. Thus, the present investigation was carried out to identify a suitable variety and time of planting for quality onion seed production in Odisha.

Material and Methods

Site description

This field experiment was conducted in the newly developed experimental plot of AINRP on Onion and Garlic, College of Horticulture, Odisha University of Agriculture and Technology, Chiplima, Sambalpur, Odisha, India, during the late *kharif* season of 2014-15 and 2015-16. The storage experiment was conducted in the Post-Harvest Management Laboratory of College of Horticulture, Odisha University of Agriculture and Technology, Chiplima, Sambalpur, Odisha during summer 2015 and 2016. Geographically Sambalpur is situated at 20^0 21' North latitude and 80^0 55' East longitude and 178.8 m above MSL and comes under West Central Table land agro-climatic zone of the state.

Soil type of the experimental site

The soil of experimental field was sandy loam texture with high organic carbon (0.23 mgg^{-1}), pH (5.8), available nitrogen, phosphorous, potassium and sulphur were 230.5 kg ha^{-1}, 21.03 kg ha^{-1}, 114.23 kg ha^{-1} and 9.89 ppm, respectively. The bulk density, particle density and porosity were 1.620 gcc^{-1}, 2.056 gcc^{-1} and 21.3% respectively.

Experimental details and treatments

The present experiment was laid out in Split-plot design (Dates of planting in main plots and varieties in sub-plots). Healthy and disease free bold seedlings of five different varieties of onions raised by adopting standard nursery techniques were transplanted at five different dates of sowing (Table 1) during the late *kharif* season of 2014-15 and 2015-16. Size of the sub-plots was 1.5 m x 2.0 m and the spacing was maintained at 15 cm x 10 cm. All the standard inter-cultural operations were performed at specified stage of plant growth. The field experiment was carried out with three replications.

Table 1: Details of treatments used in the study

Main plot (Dates of planting)	Sub-plot (Varieties)
D1 = 10th September	V1 = Agrifound Dark Red (ADR)
D2 = 25th September	V2 = Agrifound Light Red (ALR)
D3 = 10th October	V3 = Bhima Shakti
D4 = 25th October	V4 = Bhima Super
D5 = 10th November	V5 = Arka Niketan

Observations recorded

The following observations with respect to growth yield and yield attributing characters were recorded during different growth period of the crop.

1. Plant height (cm)

At 75, 90 and 105 days after transplanting, the plant height of ten randomly selected plants was measured with the help of meter scale from ground level to tip of the longest leaf, held vertically and expressed in centimetre.

2. Number of leaves per plant

At 75, 90 and 105 days after transplanting number of unfolded, green and photosynthetically active leaves per plant of 10 randomly selected plants were counted. The average values were subjected to statistical analysis.

3. Collar thickness (cm) at 75, 90 and 105 DAP

Girth of the plant at the base of 10 randomly selected plants was measured by digital calliper and average values were used for statistical analysis.

4. Survival percentage from seedling to Bulbing

Observations were recorded on daily basis for any mortality of plants from the date of planting till bulbing i.e. before appearance of seed stalk. The figure was expressed on percent basis out of 200 seedlings planted.

5. Survival percentage from Bulbing to seed setting

Mortality count continued from the date of bulbing till seed setting considering the survival of plants at bulbing as 100%. Accordingly the final plant stand was calculated and expressed in percent basis.

6. Average seed yield per plant and seed yield per hectare

Total of umbels of 10 randomly selected plants were collected, threshed and winnowed. The weight of pure seeds was taken in a precision balance. The average seed yield per plant was calculated and expressed in g. Seed yield per hectare (kg) was calculated from by multiplying the total plant population with the average seed yield per plant.

Statistical analysis

The data collected for all the characters involved under study were subjected to the statistical analysis for proper interpretation and drawing conclusion. The standard method of Analysis of Variance technique appropriate to the Split-Plot Design was adapted. The observed data was transformed to both angular and square root transformation wherever necessary. By taking the two years data a pool analysis was worked out. The treatment differences were tested by employing 'F' test at five per cent level of significance on the basis of null hypothesis. The appropriate standard errors (S.Em.±) were calculated in each case and the Critical Difference (C.D.) at five per cent level of probability was

worked out to compare the two treatment means, where the treatment effects were found significant under 'F' test. The percentage co-efficient of variation (C.V.%) was also worked out for all the cases. Correlation analysis was calculated as per Pearson's simple correlation method using the pooled mean of different days of planting using the OPSTAT statistical software, (http://14.139.232.166/opstat/default.asp).

Results and Discussion

1. Average plant height at 75 DAP

Average plant height at 75 days after planting was highly influenced by variety & dates of planting recording a positive & significant effect during both the years of study (Table 2). In the first year highest plant height was recorded in V_3 (68.77 cm) which was highly significant follow by V_1 (66.81 cm), V_5 (66.41 cm), V_2 (65.93 cm) & V_4 (65.03 cm) where V_1, V_5 & V_2 and V_2 & V_4 are at par. Similarly in the second year of trial (2015-16) V_3 (68,58 cm) recorded the height plant height followed by V_5 (66.75 cm) which are at par. Though, V_1 resulted second position in first year, it recorded the lowest height of 63.97 cm in the second year. Finally, V_3 maintained the highest plant height of 68.68 cm, followed by V_5 (66.58 cm) which are at par and V_4 recorded the shortest (65.18 cm).

Further, with respect to the dates of planting is concerned, D_1 recorded the maximum plant height of 70.61 cm which in absolutely significant over all the dates of planting followed by D_3 (69.27 cm), D_2 (68.53 cm), D_4 (63.03 cm) & D_5 (61.50 cm); the shortest height which was 5.09 cm shorter than the average height as recorded in the first year of experiment. However, D_3 & D_2 are at par to each other. In the second year of experiment (2015-16) dates of planting followed the same sequence as it was in the year (2014-15). Finally, the means of the two years results followed the same path depicting D_1; the highest (70.06 cm) & D_5 the lowest plant height (61.38 cm) at 75 DAP. There is an increase of 8.68 cm in plant height between D_1 and D_5. The average plant height owing to dates of planting arrived at 66.39 cm.

Further interaction effect of V x D during 2014-15 also expressed significant results recording D_1V_2 (75.17 cm); the best combination, followed by D_1V_3 (71.03 cm), D_1V_5 (70.57 cm), D_1V_4 (68.77 cm) and D_1V_1 (67.13 cm) in which D_1V_3, D_1V_5 & D_1V_4 and D_1V_5, D_1V_4 & D_1V_1 are found at par. In the second year of experiment D_1V_2 (74.77 cm) recorded the highest plant height and D_1V_1 (64.53 cm); the shortest. Islam and Mondal, (2005) [7] also reported that planting dates significantly influenced the growth and seed yield of onion. Anisuzzaman *et al.* (2009) [2] while studied the effects of planting time on bulb growth and seed production of onion cv. Taherpuri, observed that onion planted on 21st November had highest plant height (47.74 cm) at 75 days after planting.

2. Average plant height at 90 DAP

On perusal of the data presented in Table 3, it is the evident from 2014-15 that V_5 recorded the highest plant height of 72.49 cm followed by statistically similar V_3 (72.48 cm), while V_4 recorded the shortest (68.44 cm) plant height. Except the statistically at par V_5 and V_3, all other varieties were significantly different from each other. But in the second year, V_3 surpassed V_5 recording highest plant height (71.65 cm). On analyzing 2 years of results it is clear that finally V_3 maintained the highest plant height (72.06 cm) follow by V_5 (71.66 cm) and both were at par.

Similarly, the plant height at 90 DAP was significantly influenced by the dates of planting and D_1 recorded the highest average plant height of 74.89 cm & 73.27 cm in 2014-15 & 2015-16 years respectively & D5 the lowest. However, when the mean of the two years was considered D_1 recorded the highest plant height of 74.08 cm followed by V_3 (72.23 cm) which were at par to each other.

Regarding the treatment combinations of V x D; it was observed during 2014-15 that D_1V_2 recorded the maximum plant height (79.70 cm) followed by D_1V_3 (76.10 cm), D_1V_5 (74.43 cm), D_1V_1 (72.47 cm) and D_1V_4 (71.77 cm), where D_1V_2 & D_1V_3 and D_1V_3, D_1V_5, D_1V_1 & D_1V_4 were found at par. Similarly, during 2015-16 the same trend was also noticed. Finally, the mean data of both the years revealed that D_1V_2 significantly recorded the maximum plant height (79.90 cm) followed by D_1V_3 (75.18 cm), D_1V_5 (72.77 cm), D_1V_4 (71.43 cm) and D_1V_1 (71.13 cm) where D_1V_3 & D_1V_5 and D_1V_5, D_1V_4 & D_1V_1 were statistically at par. Finally, it was observed from treatment combinations of dates of planting and varieties that D_1V_2 significantly recorded the highest plant height (79.90 cm) while the shortest was recorded in D_5V_3 (62.68 cm). The result of this study was also supported by Ud-deen (2008) [12] and Islam and Mondal, (2005) [7], who also observed significant influence of planting dates on growth of onion.

3. Average plant height at 105 DAP

It is evident from Table 4 that plant height at 105 DAP of onion was significantly affected by both the varieties & date of planting. During the year 2014-15, V_5 (Arka Niketan) recorded the highest plant height (75.35 cm) followed by V_3 (Bhima Sakti) (74.17 cm) which were statistically at par. V_2 (ALR) recorded the lowest plant height of 64.35 cm which was at par with V_4 & V_1. But during 2015-16, V_3 surpassed V_5 though both were at par. When the mean data was taken into consideration V_5 proved to be the promising one recording a maximum and highest plant height of 74.23 cm leaving behind V_3 (74.10 cm) although both were statistically at par.

Regarding the dates of planting a significant effect was noticed in both the years of study. D_1 recorded the highest average plant height of 74.82 cm, 73.27 cm and 74.04 cm in the year 2014-15, 2015-16 and average of both the years respectively. It was clearly evident that D_1 proved to be the best date of planting in terms of average plant height was concerned and D_5 the least in both the years of study.

When the interaction effect of variety and dates of planting was studied it was clear that D_1V_3 recorded the maximum plant height (79.23 cm) during 2014-15. Similarly, during 2015-16 D_1V_2 (78.20 cm) recorded maximum plant height followed by D_1V_3 (77.43 cm), D_1V_5 (74.87 cm), D_1V_4 (68.50 cm) and D_1V_1 (67.33 cm). It is evident from the mean of both the years that D_1V_3 (78.33 cm) recorded highest plant height followed by D_1V_2 (77.35 cm), D_1V_5 (76.07 cm), D_1V_4 (70.40 cm) and D_1V_1 (68.07 cm) where, D_1V_3, D_1V_2 & D_1V_5 and D_1V_4 & D_1V_1 were found at par.

The treatment combination between dates of planting and varieties also have pronounced effect on plant height at 105 DAP and revealed that D_1V_3 (79.23 cm) recorded maximum plant height. Similarly during 2015-16 D_1V_2 (78.20 cm) recorded maximum plant height followed by D_3V_3 (78.10 cm). The mean of both the years also found significant recording highest plant height in treatment combination D_3V_3 (78.65 cm) while D_5V_2 scored the shortest plant height of 59.00 cm. The results was supported by Mollah *et al.* (2015) [9] and Islam and Mondal, (2005) [7].

Table 2: Average plant height of onion at 75 DAP

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	67.13	75.57	71.03	68.77	70.57	70.61	64.53	74.77	69.77	70.07	68.43	69.51	65.83	75.17	70.40	69.42	69.50	70.06
D2	71.43	70.13	72.90	64.47	63.73	68.53	68.77	69.70	71.77	63.53	64.17	67.59	70.10	69.92	72.33	64.00	63.95	68.06
D3	67.23	67.93	73.23	69.20	68.73	69.27	65.90	67.40	73.93	68.07	69.00	68.86	66.57	67.67	73.58	68.63	68.87	69.06
D4	63.03	60.30	67.83	61.33	62.67	63.03	64.40	61.37	67.10	62.23	63.70	63.76	63.72	60.83	67.47	61.78	63.18	63.40
D5	65.20	55.70	58.87	61.37	66.37	61.50	56.27	58.47	60.33	62.77	68.47	61.26	60.73	57.08	59.60	62.07	67.42	61.38
Mean	66.81	65.93	68.77	65.03	66.41	66.59	63.97	66.34	68.58	65.33	66.75	66.20	65.39	66.13	68.68	65.18	66.58	66.39
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.381	1.089	2.194	2.217			0.800	2.287	3.719	4.681			0.178	0.501	5.318	1.470		
D	0.377	1.230					0.636	2.073					0.645	1.933				
V within D	1.317	3.868					2.641	7.693					1.238	3.658				
D within V	0.852	2.436					1.789	5.114					1.647	4.634				

Table 3: Average plant height of onion at 90 DAP

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	72.47	79.70	76.10	71.77	74.43	74.89	69.80	80.10	74.27	71.10	71.10	73.27	71.13	79.90	75.18	71.43	72.77	74.08
D2	75.00	73.10	75.00	66.67	72.20	72.39	72.13	72.37	74.40	66.63	69.97	71.10	73.57	72.73	74.70	66.65	71.08	71.75
D3	70.20	69.73	77.77	71.63	73.87	72.64	67.73	70.87	76.17	70.47	73.83	71.81	68.97	70.30	76.97	71.05	73.85	72.23
D4	68.50	66.40	71.17	66.90	71.43	68.88	66.27	64.83	70.40	67.57	68.57	67.53	67.38	65.62	70.78	67.23	70.00	68.20
D5	69.67	61.60	62.37	65.23	70.53	65.88	68.57	63.93	63.00	65.87	70.63	66.40	69.12	62.77	62.68	65.55	70.58	66.14
Mean	71.17	70.11	72.48	68.44	72.49	70.94	68.90	70.42	71.65	68.33	70.82	70.02	70.03	70.26	72.06	68.38	71.66	70.48
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.359	1.027	3.087	1.962			0.622	1.778	2.758	3.440			0.178	0.502	5.063	1.386		
D	0.565	1.844					0.499	1.626					0.651	1.953				
V within D	1.457	4.387					2.056	5.992					1.249	3.691				
D within V	0.804	2.297					1.391	3.975					1.661	4.672				

Table 4: Average plant height of onion at 105 DAP

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	68.80	76.50	79.23	72.30	77.27	74.82	67.33	78.20	77.43	68.50	74.87	73.27	68.07	77.35	78.33	70.40	76.07	74.04
D2	69.00	64.27	75.83	63.17	76.27	69.71	70.30	74.40	76.73	63.60	72.47	71.50	69.65	69.33	76.28	63.38	74.37	70.60
D3	64.00	61.13	79.20	62.73	75.00	68.41	65.40	68.40	78.10	68.83	76.03	71.35	64.70	64.77	78.65	65.78	75.52	69.88
D4	61.33	62.90	73.63	63.80	74.83	67.30	64.73	63.97	72.23	65.70	70.00	67.33	63.03	63.43	72.93	64.75	72.42	67.31
D5	66.83	56.93	62.97	62.20	73.37	64.46	66.87	61.07	65.60	63.57	72.20	65.86	66.85	59.00	64.28	62.88	72.78	65.16
Mean	65.99	64.35	74.17	64.84	75.35	68.94	66.93	69.21	74.02	66.04	73.11	69.86	66.46	66.78	74.10	65.44	74.23	69.40
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.628	1.794	3.795	3.527			0.765	2.185	4.613	4.238			0.179	0.502	5.093	1.410		
D	0.675	2.203					0.832	2.713					0.645	1.935				
V within D	2.217	6.538					2.709	7.991					1.240	3.662				
D within V	1.404	4.012					1.710	4.886					1.649	4.640				

Table 5: No. of Leaves per plant at 75 DAP

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	10.30	10.83	12.40	10.97	11.10	11.12	10.33	10.83	10.33	11.23	11.33	10.81	10.32	10.83	11.37	11.10	11.22	10.97
D2	12.67	11.60	10.47	12.97	13.93	12.33	12.10	11.67	12.40	12.60	13.77	12.51	12.38	11.63	11.43	12.78	13.85	12.42
D3	13.00	12.60	11.60	12.67	11.60	12.29	12.40	11.93	12.43	12.50	12.67	12.39	12.70	12.27	12.02	12.58	12.13	12.34
D4	12.03	11.07	11.57	12.00	11.60	11.65	12.07	11.30	11.53	12.27	12.07	11.85	12.05	11.18	11.55	12.13	11.83	11.75
D5	11.87	10.80	9.70	11.47	11.33	11.03	11.87	10.87	11.63	11.73	11.97	11.61	11.87	10.83	10.67	11.60	11.65	11.32
Mean	11.97	11.38	11.15	12.01	11.91	11.69	11.75	11.32	11.67	12.07	12.36	11.83	11.86	11.35	11.41	12.04	12.14	11.76
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.079	0.225	5.989	2.605			0.113	0.323	5.589	3.700			0.071	0.201	13.334	3.323		
D	0.181	0.589					0.171	0.557					0.286	0.858				
V within D	0.392	1.210					0.450	1.352					0.540	1.599				
D within V	0.176	0.502					0.253	0.723					0.715	2.012				

4. No. of leaves per plant at 75 DAP

Varieties and date of planting expressed significant effect on production of leaves at 75 DAP (Table 5). During first year of study V_4 recorded maximum number of leaves per plant

(12.01) at 75 DAP followed by V_1 (11.97) and V_5 (11.91) and all were statistically at par. But V_2 recorded significantly less number of leaves followed by V_3; the lowest (11.15). As evident from Table 4, it was seen that during 2015-16 late *kharif* season V_5 recorded maximum number of leaves of 12.36. The mean of both the years result revealed that V_5 produced maximum number of leaves (12.14) followed by 12.04 in V_4 and both were statistically at par with each other and V_2 recorded the lowest (11.35). When the dates of planting were considered, it was seen that D_2 recorded maximum number of leaves (12.33) followed by D_3 and both are at par in the year 2014-15. Similar trend was observed in 2015-16 and also when the mean of both years was taken into consideration and D_5 recorded the lowest number of leaves in both the years.

As regards to the effect of varieties within the date, it was seen that D_2V_5 recorded the best treatment combination in production of maximum no. of leaves per plant recording 13.93, 13.77 and 13.85 in 2014-15, 2015-16 and pool analysis data respectively. During 2014-15, maximum number of leaves per plant was recorded in D_2V_5. However the pool data revealed that maximum production of leaves per plant at 75 DAP was in D_2V_5 (13.85). Similarly, the interaction effect of dates of planting and varieties have seen significant effect on production of leaves at 75 DAP. During 2014-15 late *kharif* planting maximum leaf production was recorded in treatment combination D_2V_5 (13.93). During 2015-16 also D_2V_5 (13.77) significantly produced maximum number of leaves. The average of both the years result indicated that treatment combination D_2V_5 (13.85) recorded highest number of leaves. Here all the above treatment combinations are found statistically at par except D_1V_1. Anisuzzaman *et al.* (2009) [2] studied the effects of planting time on seed production of onion and observed that onion cv. Taherpuri planted on 21st November had highest leaves plant^{-1} (25.73) at 75 days after planting.

5. No. of leaves per plant at 90 DAP

On perusal of data presented in Table 6, expressed that both variety and date of planting have significant effect on production of leaf numbers during late *kharif* planting recorded at 90 DAP. In the first year of study, V_3 recorded maximum number of leaves (12.66) followed by V_2 (12.51), though both are equal on statistical point of view. Same trend was also observed in second year. When mean data was calculated, V_3 significantly recorded maximum number of leaves per plant (12.78) followed by 12.56 in V_2.

The effect of dates of planting on leaf number, expressed that D_2 recorded significantly maximum leaf numbers (13.01) in the year 2014-15. However, during second year of experiment D_3 (13.10) also significantly recorded maximum number of leaves per plant followed by D_2 (12.75). On analysis of both year results it is revealed that D_3, D_2 and D_4 at statistical at par although D_3 recorded maximum number of leaves and D_1 (11.55); the least.

Treatment combinations of V x D expressed that D_2V_5 significantly produced maximum number of leaves of 14.00. In the second year also maximum production of leaves per plant was noticed in D_2V_5 (13.77). However, the pool data revealed that maximum production of leaves per plant at 90 DAP was recorded in D_2V_5 (13.88). Further the interaction effect of dates of planting with varieties revealed during 2014-15 planting D_2V_5 significantly recorded maximum number of leaves of 14.00. In the second year experiment D_3V_2 (13.87) recorded maximum number of leaves per plant. Similarly, the mean data for both the years of study depicted that D_2V_5 (13.88) recorded maximum number of leaves while D_1V_1 (10.33) the shortest. There was a difference of 3.55 number of leaves per plant between the treatment no. D_2V_5 and D_1V_1. The results of the study are supported by Manna *et al.* (2016) [8].

6. No. of leaves per plant at 105 DAP

With reference to the data presented in Table 7, it was revealed that leaves number per plant at 105 DAP was highly influenced by variety & dates of planting in both the years of study. It was evident that V_3 recorded maximum no. of leaves per plant (12.73) followed by V_2 (12.51), V_4 (11.86), V_5 (11.81) & V_1 (11.49) in the year 2014-15 where, all the varieties tested were statistically at par with each other. The trend in the second year of study expressed that V_3 also counted more no. of leaves per plant (12.99) followed by V_2 (12.70), V_5 (12.11), V_4 (11.93) & V_1 (11.44) although both V_3 & V_2 are statistically at par. Finally the mean data also revealed that V_3 borne maximum & absolutely significant number of leaves (12.86) followed by V_2 (12.61), V_4 (11.90), V_1 (11.46), and V_5 (11.21) in which all the varieties were distinctly different from each other in terms of number of leaves per plant.

Regarding the date of planting, though D_2 recorded maximum number of leaves per plant (12.90), there exists no significant difference among different dates during the first year of experiment. However during second year of study, D_3 recorded maximum no. of leaves (13.02). The pooled data also revealed that D_3 recorded maximum number of leaves (12.88).

There exists a positive and significant difference in treatment combinations of variety with dates of planting. In the year 2014-15 (13.87), and 2015-16 (13.37) D_2V_5 recorded the maximum number of leaves per plant. However, the mean data of both the years result revealed that D_3V_2 (13.85) recorded maximum number of leaves.

Regarding the treatment combination of dates of planting with varieties it was revealed that during first year, though D_2V_5 recorded the maximum number of leaves per plant (13.87). However, during second year and mean of both the years there was found positive and significant difference between the treatment combinations in production of number of leaves per plant. Treatments like D_2V_5, D_2V_3, D_1V_3, D_2V_2 & D_4V_3 and D_2V_3, D_1V_3, D_2V_2, D_4V_3, D_4V_2 & D_2V_4 are found at par. Similarly the mean data reflects a significant result recording maximum number of leaves in treatment combinations D_3V_2 (13.85). There exists a difference of 4.72 numbers of leaves between the maximum and minimum leaf producing treatments. The results was supported by Manna *et al.* (2016) [8] who observed significant effect of date of planting on No. of leaves per plant.

7. Survival percent from seedling to bulbing

On perusal of the data presented in the Table 8 it was observed that survival percent of plants from seedling to bulbing was influenced by variety and dates of planting sowing a positive & significant result. During 2014-15 although V_4 recorded maximum survival percent (98.93%) followed by V_2 (98.80%) and V_3 (98.67%) they were at par. V_1 recorded the lowest survival of 97.40% and it is statistically at par with V_5 (98.00%). But during the year 2015-16, V_3 recorded significantly higher survival percent

(96.80%). However when the average of both the years data was analysed, it was seen that there exists no significant difference among varieties, although V_3 recorded maximum survival % of (97.73%) & V_1; the minimum (96.40%).
The effect of dates of planting on survival % revealed a significant result. In the 1st year D_3 recorded the highest survival percent of 98.93%. However, all three treatments were statistically at par along with D_2 with D_4. Further, in the 2nd year of study, D_5 significantly recorded a survival of 97.73%. But the pool data analysis expressed a non-significant result although D_5 scored 98.17%, which was the highest survival percent.
The interaction effect of variety & dates expressed a non-significant result during 2014-15, though D_3V_4 recorded highest survival percent. However, in the next year D_5V_3 (99.17%) recorded highest percent of survival. However the mean of both the years recorded a non-significant effect although varieties in D_2 planting performed better over others.
During 2014-15 the interaction effect of dates & variety expressed a non-significant result even maximum percent of survival was recorded in D_2V_4 & D_3V_4 (99.50%) and minimum in D_1V_1 (95.67%). However during 2015-16, there exists significant difference among the treatment combinations recording highest percent of survival in D_5V_3 (99.17%). Moreover, the mean of both the years record a non-significant effect although maximum survival and minimum survival were recorded in D_5V_3 (99.17%) and D_1V_1 (94.75%) respectively.

8. Survival % from bulbing to seed setting

The effect of variety on survival percent from bulbing to seed setting indicated a significant result during both the years of study (Table 9). During 1st year V_4 scored 99.23% survival followed by V_5 (98.74%) & both are statistically at par and V_2 recorded the lowest (97.15%). Again V_3 (98.05%) with V_1 (97.55%) and V_1 (97.55%) with V_2 (97.15%) were also found statistically at par. In the 2nd year same tread was not observed and V_2 recorded the highest survival percent (98.72%). However, the mean data of both the years recorded a non-significant effect although maximum survival percent was recorded in V_4 (98.67%).
Regarding the effect of dates of planting on survival percent of plants it was observed that in the first year D_1 (99.48%) stood first followed by D_4 (99.18%). Though there exists a significant difference among the treatments, D_4, D_3 &D_2 are at par with D_1. In the year 2015-16 although D_4 scored the maximum (98.62%). The mean data of both the years revealed that although D_4 (98.90%) scored the maximum and D_5 (96.31%); the minimum.
Although the interaction effects of variety and dates of planting revealed a significant difference during both the years of study, the mean of both the years expressed a non-significant effect. During 2014-15, during first date of planting D_1V_4 (99.83%) recorded highest survival, however, in the next year in 4th date of planting, D_4V_2 (98.97%) recorded highest survival. However, the mean of both the years found non-significant though the varieties under planting in 4th date recorded highest percent of survival.
Further, the interaction effect of dates of planting and variety revealed a significant difference during both the years of study. In the first year D_1V_4 (99.83%) proved to be the best treatment combination. During 2015-16 maximum survival percent was recorded in treatment combination D_2V_3 (99.13%). Here also same trend was observed as in 2014-15 recording an at par result among all the above except the lowest one. The mean data though revealed a non-significant effect D_4V_3 (99.31%) recorded the highest survival and D_5V_2 (94.16%); the lowest.

9. Average seed yield per plant

It was evident from Table 10, that there exists a significant effect of variety and dates of planting on seed yield per plant. In both the years as well as the mean data revealed that all the varieties tested are significantly different from each other. During 2014-15 highest and significant seed yield recorded was 6.55g per plant in V_5 followed by V_4 (5.60g). Similar result was also obtained in the second year of study recording significantly highest yield of 6.10 g per plants in V_5. Finally the average seed yield per plant of both the years recorded significantly maximum in V_5 (6.32g). It implies that V_5 is the maximum and highest seed yielder and V_3 the lowest.
Further, the planting times also significantly influenced the seed yield per plant depicting maximum seed yield of 7.29g in D_2 in 2014-15. However, in the next year though there was slightly decline in seed yield in all the varieties tested as well on the planting dates it followed the same trend recording significantly highest yield of 6.74g in D_2. Same trend was observed in mean data analysis results recording significantly highest yield in D_2 (7.02g) and lowest in D_5 (0.72g) and D_1 & D_3 are found statistically at par.
The interaction effect of varieties and dates of planting depicted that varieties in D_2 yielded more seed per plant recording significantly highest yield of 11.50 g in D_2V_5. Similar trend was seen in 2015-16 as well as in pool data recording highest average seed yield per plant in D_2V_5 (11.17g). Further the interaction effect of dates of planting within varieties also affected the per plant seed yield recording significantly maximum yield in D_2V_5 (11.50g) during 2014-15. Similar trend was recorded in 2015-16 as well as in the pool data recording significantly maximum seed yield per plot in D_2V_5 (11.17g). However, El-Helaly and Karam (2012) [6] reported that November planting had higher seed yield than rest of the planting dates under Giza, Ethiopia conditions.

10. Seed yield per hectare

It is evident from Table 11, that variety, dates of planting and their interaction effects had significant role on seed yield per hectare of land. During 2014-15 significantly highest seed yield was recorded in V_5 (711.60kg) per hectare followed by V_4 (323.35 kg), V_1 (499.50 kg), V_2 (229.30 kg) and V_3 (110.16 kg) and all the treatments are significantly different. Similar trend was also obtained in the second year of study recording significantly highest yield of 691.39 kg per in V_5 and V_3 the lowest; yielding 101.01 kg. Finally the pooled data also followed the same trend recording significantly maximum in V_5 (701.49 kg). It implies that V_5 was the maximum and highest seed yielder and V_3 the lowest. In both the years as well as the mean data revealed that all the varieties tested were significantly different from each other.
Demisie and Tolessa (2018) [5] also reported that in onion seed production programme, variety had a significant effect on various parameters including leaves plant^{-1}, leaf length, plant height. This increase in leaf number plant^{-1}and average plant height can lead to increase in photosynthetic area which can ultimately result in the increase in seed yield.
Further, the planting times also significantly influenced the seed yield per hectare recording highest seed yield in D_2

(830.47 kg) in 2014-15. During the next year it followed the same trend though there was slightly decline in seed yield in all the planting dates. Finally, the pooled data also followed the same trend as observed in both the years recording significantly highest yield in D_2 (809.51 kg).

There exists significant difference in seed yield per hectare when interaction effect of varieties and dates of planting was considered. In the year 2014-15 maximum seed yield was obtained in treatment combination D_2V_5 (1251.31 kg) in the year 2014-15. Similar trend was observed in 2015-16. So far as the pool data was considered it also followed the trend recording highest average seed yield per hectare in D_2V_5 (1226.65 kg) and lowest in D_2V_3 (143.59 kg).

Further, the interaction effect of dates of planting within varieties also affected the seed yield per hectare. During 2014-15 significantly maximum yield was obtained in D_2V_5 (1251.31 kg) and the lowest in D_5V_3 (12.39 kg). Similar trend was recorded in 2015-16 with slight deviation. The pool data followed the trend as recorded in 2014-15 yielding significantly maximum seed yield per plot in D_2V_5 (1226.65 kg). Ud-deen (2008) [12] and Islam and Mondal, (2005) [7], who also observed significant influence of planting dates on seed yield of onion. Ashagrie *et al*. (2014) [4] also observed significant interaction between different planting time (25th October and 5th &15th November) on both seed yield plant^{-1}, seed yield ha^{-1}.

Correlation analysis

The correlation analysis (Table 12) indicated positive correlation between the total seed yield per ha (kg) with all the parameters except survival (%) from seedling to bulbing. However, the correlation of total seed yield per ha (kg) with all others was statistically non-significant to each other except the average seed yield per plant (g), which was observed to highly significant (0.984). Similarly, the plant height at 75 DAP was observed to have positive significant correlation with plant height at 90 DAP (0.993) and plant height at 105 DAP (0.935). No. of leaves per plant at 75 DAP was also observed to have statistically significant positive correlation with No. of leaves per plant at 90 DAP (0.996) and No. of leaves per plant at 105 DAP (0.977). The No. of leaves per plant at 90 DAP was also having significant positive correction (0.981) with the No. of leaves per plant at 105 DAP.

Table 6: No. of leaves per plant at 90 DAP

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	10.33	12.17	13.20	10.97	11.13	11.56	10.33	12.20	12.63	11.23	11.30	11.54	10.33	12.18	12.92	11.10	11.22	11.55
D2	12.70	12.30	13.00	13.03	14.00	13.01	12.07	12.10	13.13	12.70	13.77	12.75	12.38	12.20	13.07	12.87	13.88	12.88
D3	13.03	13.80	12.73	12.70	11.63	12.78	12.47	13.87	13.80	12.67	12.70	13.10	12.75	13.83	13.27	12.68	12.17	12.94
D4	12.17	12.57	12.53	12.00	11.63	12.18	12.13	12.67	12.67	12.27	12.10	12.37	12.15	12.62	12.60	12.13	11.87	12.27
D5	11.87	11.70	11.83	11.50	11.30	11.64	11.83	12.20	12.27	11.70	11.97	11.99	11.85	11.95	12.05	11.60	11.63	11.82
Mean	12.02	12.51	12.66	12.04	11.94	12.23	11.77	12.61	12.90	12.11	12.37	12.35	11.89	12.56	12.78	12.08	12.15	12.29
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.076	0.218	2.208	2.415			0.109	0.313	3.023	3.433			0.073	0.206	12.740	3.262		
D	0.070	0.227					0.096	0.314					0.286	0.857				
V within D	0.259	0.758					0.368	1.077					0.542	1.603				
D within V	0.171	0.488					0.245	0.700					0.718	2.021				

Table 7: No. of leaves per plant at 105 DAP

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	10.27	12.17	13.37	10.80	11.10	11.54	10.10	12.20	12.97	10.97	10.87	11.42	10.18	12.18	13.17	10.88	9.13	11.11
D2	12.53	12.37	13.17	12.57	13.87	12.90	11.93	12.70	13.20	12.63	13.37	12.77	12.23	12.53	13.18	12.60	13.62	12.83
D3	12.97	13.80	12.77	12.63	11.50	12.73	12.37	13.90	13.90	12.40	12.53	13.02	12.67	13.85	13.33	12.52	12.02	12.88
D4	11.20	12.50	12.50	11.83	11.50	11.91	11.73	12.67	12.70	12.13	12.07	12.26	11.47	12.58	12.60	11.98	9.87	11.70
D5	10.47	11.73	11.83	11.47	11.10	11.32	11.07	12.03	12.20	11.53	11.70	11.71	10.77	11.88	12.02	11.50	11.40	11.51
Mean	11.49	12.51	12.73	11.86	11.81	12.08	11.44	12.70	12.99	11.93	12.11	12.23	11.46	12.61	12.86	11.90	11.21	12.01
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.487	1.392	17.465	16.008			0.109	0.310	2.526	3.436			0.073	0.205	12.801	3.326		
D	0.531	NS					0.080	0.260					0.281	0.841				
V within D	1.726	NS					0.354	1.028					0.533	1.577				
D within V	1.089	NS					0.243	0.694					0.707	1.989				

Table 8: Survival % from seedling to bulbing

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	95.67 (9.78)	98.33 (9.92)	98.33 (9.92)	97.83 (9.89)	97.00 (9.85)	97.43 (9.87)	93.83 (9.69)	95.17 (9.76)	95.50 (9.77)	95.00 (9.75)	95.67 (9.78)	95.03 (9.75)	94.75 (9.73)	96.75 (9.84)	96.92 (9.84)	96.42 (9.82)	96.33 (9.81)	96.23 (9.81)
D2	97.00 (9.85)	99.33 (9.97)	99.17 (9.96)	99.50 (9.97)	98.50 (9.92)	98.70 (9.93)	93.17 (9.65)	94.83 (9.74)	95.67 (9.78)	94.33 (9.71)	94.67 (9.73)	94.53 (9.72)	95.08 (9.75)	97.08 (9.85)	97.42 (9.87)	96.92 (9.84)	96.58 (9.83)	96.62 (9.83)
D3	98.33 (9.92)	99.17 (9.96)	99.33 (9.97)	99.50 (9.97)	98.33 (9.92)	98.93 (9.95)	95.50 (9.77)	97.33 (9.87)	98.33 (9.92)	95.33 (9.76)	97.00 (9.85)	96.70 (9.83)	96.92 (9.84)	98.25 (9.91)	98.83 (9.94)	97.42 (9.87)	97.67 (9.88)	97.82 (9.89)
D4	97.67	98.50	97.33	98.50	98.67	98.13	96.67	96.33	95.33	96.83	97.00	96.43	97.17	97.42	96.33	97.67	97.83	97.28

	(9.88)	(9.92)	(9.87)	(9.92)	(9.93)	(9.91)	(9.83)	(9.81)	(9.76)	(9.84)	(9.85)	(9.82)	(9.86)	(9.87)	(9.81)	(9.88)	(9.89)	(9.86)
D5	98.33 (9.92)	98.67 (9.93)	99.17 (9.96)	99.33 (9.97)	97.50 (9.87)	98.60 (9.93)	97.83 (9.89)	97.33 (9.87)	99.17 (9.96)	97.17 (9.86)	97.17 (9.86)	97.73 (9.89)	98.08 (9.90)	98.00 (9.90)	99.17 (9.96)	98.25 (9.91)	97.33 (9.87)	98.17 (9.91)
Mean	97.40 (9.87)	98.80 (9.94)	98.67 (9.93)	98.93 (9.95)	98.00 (9.90)	98.36 (9.92)	95.40 (9.77)	96.20 (9.81)	96.80 (9.84)	95.73 (9.78)	96.30 (9.81)	96.09 (9.80)	96.40 (9.82)	97.50 (9.87)	97.73 (9.89)	97.33 (9.87)	97.15 (9.86)	97.22 (9.86)
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.011	0.031	0.243	0.425			0.009	0.027	0.535	0.370			0.064	NS	13.871	3.530		
D	0.006	0.020					0.014	0.044					0.250	NS				
V within D	0.034	NS					0.037	0.110					0.473	NS				
D within V	0.024	NS					0.021	0.060					0.627	NS				

Table 9: Survival % from bulbing to seed setting

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	99.12 (9.96)	99.29 (9.96)	99.49 (9.97)	99.83 (9.99)	99.65 (9.98)	99.48 (9.97)	96.45 (9.82)	98.60 (9.93)	98.95 (9.95)	98.07 (9.90)	96.69 (9.83)	97.75 (9.89)	97.79 (9.89)	98.95 (9.95)	99.22 (9.96)	98.95 (9.95)	98.17 (9.91)	98.61 (9.93)
D2	99.14 (9.96)	98.82 (9.94)	98.99 (9.95)	99.16 (9.96)	98.14 (9.91)	98.85 (9.94)	98.57 (9.93)	98.95 (9.95)	99.13 (9.96)	97.53 (9.88)	97.37 (9.87)	98.31 (9.92)	98.85 (9.94)	98.88 (9.94)	99.06 (9.95)	98.34 (9.92)	97.75 (9.89)	98.58 (9.93)
D3	98.64 (9.93)	98.82 (9.94)	98.99 (9.95)	98.99 (9.95)	98.98 (9.95)	98.88 (9.94)	98.08 (9.90)	98.11 (9.91)	98.14 (9.91)	98.25 (9.91)	98.63 (9.93)	98.24 (9.91)	98.36 (9.92)	98.47 (9.92)	98.56 (9.93)	98.62 (9.93)	98.80 (9.94)	98.56 (9.93)
D4	98.29 (9.91)	99.48 (9.97)	99.66 (9.98)	99.49 (9.97)	98.99 (9.95)	99.18 (9.96)	98.45 (9.92)	98.97 (9.95)	98.95 (9.95)	98.79 (9.94)	97.94 (9.90)	98.62 (9.93)	98.37 (9.92)	99.23 (9.96)	99.31 (9.97)	99.14 (9.96)	98.46 (9.92)	98.90 (9.94)
D5	92.54 (9.62)	89.34 (9.45)	93.12 (9.65)	98.66 (9.93)	97.95 (9.90)	94.32 (9.71)	98.81 (9.94)	98.97 (9.95)	98.16 (9.91)	97.94 (9.90)	97.94 (9.90)	98.37 (9.92)	95.68 (9.78)	94.16 (9.70)	95.64 (9.78)	98.30 (9.91)	97.95 (9.90)	96.34 (9.81)
Mean	97.55 (9.88)	97.15 (9.85)	98.05 (9.90)	99.23 (9.96)	98.74 (9.94)	98.14 (9.91)	98.07 (9.90)	98.72 (9.94)	98.67 (9.93)	98.12 (9.91)	97.71 (9.88)	98.26 (9.91)	97.81 (9.89)	97.94 (9.90)	98.36 (9.92)	98.67 (9.93)	98.23 (9.91)	98.20 (9.91)
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.012	0.034	0.408	0.459			0.009	0.025	0.367	0.348			0.064	NS	13.790	3.514		
D	0.010	0.034					0.009	NS					0.249	NS				
V within D	0.040	0.116					0.031	0.092					0.472	NS				
D within V	0.026	0.075					0.020	0.057					0.626	NS				

Table 10: Average seed yield per plant (g)

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	7.18	2.09	3.36	6.27	7.53	5.29	6.25	1.92	2.73	5.48	7.11	4.70	6.72	2.01	3.04	5.88	7.32	4.99
D2	7.89	4.53	3.14	9.41	11.50	7.29	7.26	4.17	2.45	8.96	10.85	6.74	7.57	4.35	2.80	9.19	11.17	7.02
D3	4.03	2.71	1.06	7.57	8.85	4.85	3.88	2.53	1.02	7.18	8.29	4.58	3.96	2.62	1.04	7.38	8.57	4.71
D4	1.88	1.40	0.59	3.75	3.24	2.17	1.67	1.19	0.48	3.52	2.81	1.94	1.78	1.30	0.54	3.64	3.02	2.05
D5	0.82	0.31	0.15	1.01	1.64	0.78	0.63	0.24	0.08	0.88	1.41	0.65	0.72	0.27	0.11	0.95	1.53	0.72
Mean	4.36	2.21	1.66	5.60	6.55	4.08	3.94	2.01	1.35	5.21	6.10	3.72	4.15	2.11	1.51	5.40	6.32	3.90
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	0.068	0.195	6.610	6.469			0.058	0.167	4.618	6.069			0.055	0.154	34.096	7.676		
D	0.070	0.227					0.044	0.145					0.243	0.728				
V within D	0.237	0.698					0.191	0.556					0.451	1.339				
D within V	0.152	0.435					0.130	0.373					0.595	1.674				

Table 11: Total seed yield per ha (kg)

	2014-2015						2015-2016						Pooled					
	V1	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**	**V1**	**V2**	**V3**	**V4**	**V5**	**Mean**
D1	641.84	247.23	316.82	549.88	622.45	475.64	628.51	238.26	266.42	522.05	605.16	452.08	635.17	242.74	291.62	535.97	613.80	463.86
D2	1099.65	517.16	153.09	1131.13	1251.31	830.47	1001.67	498.83	134.08	1106.14	1201.99	788.54	1050.66	507.99	143.59	1118.64	1226.65	809.51
D3	491.28	221.43	45.18	777.30	1031.79	513.39	456.75	218.14	58.92	720.63	1044.31	499.75	474.02	219.78	52.05	748.96	1038.05	506.57
D4	186.83	139.27	23.31	491.82	419.79	252.20	186.77	131.54	37.88	466.27	391.31	242.75	186.80	135.41	30.59	479.05	405.55	247.48
D5	77.87	21.40	12.39	166.61	232.64	102.18	71.27	22.34	7.76	165.11	214.19	96.13	74.57	21.87	10.07	165.86	223.41	99.16
Mean	499.50	229.30	110.16	623.35	711.60	434.78	468.99	221.82	101.01	596.04	691.39	415.85	484.24	225.56	105.58	609.69	701.49	425.32
	S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)			S.Em (±)	CD 0.05	CV(a) (%)	CV(b) (%)		
V	3.713	10.614	2.514	3.308			4.657	13.312	4.303	4.338			0.685	1.928	3.582	0.883		
D	2.822	9.204					4.620	15.067					2.781	8.339				
V within D	12.165	35.390					16.102	47.303					5.238	15.515				
D within V	8.303	23.733					10.414	29.767					6.934	19.508				

Table 12: Correlation coefficient matrix among the various parameters

	A	B	C	D	E	F	G	H	I	J
A	1.000									
B	0.993**	1.000								
C	0.935*	0.969**	1.000							
D	0.208NS	0.116NS	-0.083NS	1.000						
E	0.257NS	0.163NS	-0.045NS	0.996**	1.000					
F	0.314NS	0.212NS	-0.001NS	0.977**	0.981**	1.000				
G	-0.652NS	-0.723NS	-0.843NS	0.155NS	0.160NS	0.165NS	1.000			
H	0.650NS	0.670NS	0.633NS	0.358NS	0.390NS	0.288NS	-0.633NS	1.000		
I	0.865NS	0.845NS	0.785NS	0.488NS	0.497NS	0.552NS	-0.692NS	0.623NS	1.000	
J	0.771NS	0.740NS	0.665NS	0.608NS	0.606NS	0.653NS	-0.618NS	0.593NS	0.984**	1.000

A: Plant height at 75 DAP; B: Average plant height at 90 DAP; C: Average plant height at 105 DAP; D: No. of leaves per plant at 75 DAP; E: No. of leaves per plant at 90 DAP; F: No. of leaves per plant at 105 DAP; G: Survival (%) from seedling to bulbing; H: Survival (%) from bulbing to seed setting; I: Average seed yield per plant (g); J: Total seed yield per ha (kg).

** Significant at $P \leq .01\%$, * Significant at $P \leq .05\%$.

Acknowledgement

The authors thankfully acknowledge the AINRP on Onion & Garlic, College of Horticulture, OUAT, Chiplima, Sambalpur, Odisha, India, funded by DOGR, Rajgurunagar, Pune for providing inputs.

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