International Journal of Agriculture, Environment and Biotechnology
Citation: *IJAEB*: **17**(02): 67-72, June 2024
DOI: 10.30954/0974-1712.02.2024.1

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

RESEARCH PAPER

Onion Growth, Yield and Quality as Influenced by Planting Time and Seedling Age

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Paper No. 1112 **Received:** 21-02-2023 **Revised:** 22-04-2024 **Accepted:** 25-05-2024

ABSTRACT

The production of quality onion bulb is very important for producing the quality seed in the next season. Consequently, the experiment was conducted on sandy loam soil at CCS Haryana Agricultural University, Hisar during winter season of 2014-15 and 2015-16 with nine treatments combinations viz. three transplanting dates and three age of seedlings planted in a Factorial Randomized Block Design with tree replications. Maximum plant height (68.4 cm), number of leaves per plant (8.2) and bulb yield (310.8 q/ha) was recorded in 30th December transplanted crop as compared to other transplanting dates. However, bulb quality parameters like neck thickness (9.64 mm), bolting (1.20%) and split bulb (5.2%) were noticed significantly minimum with delayed transplanting on 15th January as compared to earlier date. There was no significant differences were recorded between 50 and 60 days old seedlings for plant height, number of leaves and bulb yield, however, these parameters were maximum as compared to 70 days old seedlings, while, neck thickness of bulb, bolting and split bulb percentage were recorded minimum. So it is concluded that in semi-arid, sub tropical region of north western India particularly in Haryana state, 50 to 60 days old seedlings planted on 30th of December produced higher yield and quality bulb of onion.

HIGHLIGHTS

- Onion is one of the most important commercial vegetables cultivated worldwide. Production of quality bulb is very important for producing the quality seed in the next season.
- The optimum age of seedlings and transplanting time play an important role in quality bulb production, therefore, the present study was conducting to know the best time to transplant seedlings and when to transfer these for getting higher yield and quality of onion bulb.

Keywords: Onion, Planting time, Seedling age, Bolting, Split bulb, Bulb yield

Onion (*Allium cepa* L.) belongs to the family Alliaceae. Onion is one of the most important commercial vegetables cultivated worldwide. It is a high value and high income generating vegetable crop for most farmers or producers. All over the world, it is an essential part of the human diet and it is a rich source of several minerals and vitamins (Raemaekers 2001). Onion can be eaten raw, boiled, baked, fried, dried or roasted and commonly used in salads, soups, curries and other dishes. It has been reported that onion extract can be a strong cardiovascular and anticancer agent with hypocholestrolemic thrombolytic and antioxidant effect (Block 1985). Several antioxidant compounds, mainly polyphenols and sulphur containing compounds have been found in onion (Nuutila *et al*. 2003).

Modern agriculture requires seeds of the highest

How to cite this article: Panghal, V.P.S., Duhan, D.S., Lal, M. and Kumar, A. (2024). Onion Growth, Yield and Quality as Influenced by Planting Time and Seedling Age. *Int. J. Ag. Env. Biotech.*, **17**(02): 67-72.

Source of Support: None; **Conflict of Interest:** None

quality that are needed in order to be perform precision sowing. Furthermore, planting of high quality seedlings is necessary to get rapid and uniform growth, which has a major impact on the final vegetable yield and its quality. Unfortunately, onion seeds usually have a low quality, resulting in slow and asynchronous germination as well as seeds producing a high number of abnormal seedlings, especially during field stress conditions after planting in the early spring (Borowski and Michałek 2006). Thus, there is a need of producing quality bulb for production of quality seed of onion.

Onion requires long-day length for production and maturation of bulb (Amin and Rahim 1995), but in India short-day length prevails in the growing season of onion. So, to minimize the cultivation and production problems as well as production of superior quality bulb for further using in seed production programme, emphasis must be given to improve cultivation methods of onion, such as proper planting time, planting geometry, age of seedling and accurate fertilization and other cultural practices viz., weeding and mulching. Planting time is one of the most important factors that greatly influence the growth and yield as well as superior bulb of onion. Adjusting planting time is very important for quality bulb production. The optimum time of transplanting of seedling is generally governed by climate of the region particularly temperature and photoperiods (Chandravanshi 2013).

Age of seedlings has also play an important role in quality bulb production, which was further used for seed production in the next season. Although some research work has been done in India and abroad on the above aspect, yet the studies in relation to this has not been conducted so far under existing agro-climatic conditions of Northern Plains of India particularly in Haryana. Therefore, keeping this in view, the present investigation entitled "Onion Growth, Yield and Quality as Influenced by Planting Time and Seedling Age" was undertaken with the objective to study the impact of planting time and seedling age on growth, yield and quality of onion bulb production.

MATERIALS AND METHODS

Description of the study area

The field experiment was conducted during winter season of 2014-15 and 2015-16 at research farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, situated in the semi-arid sub tropical region of north western India in Haryana state. The elevation of this Site is 215.2 meters above sea level and lies at 29°10′ N latitude and longitude 75°46′ E. The soil of experimental field was sandy loam in texture, low in organic carbon, medium in available N and P with slightly alkaline reaction.

Description of climatic conditions

The climatic tract of this region is hot and dry winds during summer and dry severe cold in winter. The total rainfall (approx. 400 mm) and its distribution in this region are subjected to large variation. About 80 to 90 percent of the total rainfall is received through southwest monsoon during July to September with few showers during winter and spring seasons. The maximum and minimum temperature show wide degree of fluctuations during summer and winter months. The meteorological data on various parameters as observed during the period of experimentation are presented in Table 1.

Treatments and experimental design

There were nine treatment combinations *viz.*, three planting dates (15th December, 30th December and 15th January) and three age of seedlings (50, 60 and 70 days) planted in a Factorial Randomized Block Design with tree replications. The pooled data presented in the Table 2 are the mean values of different parameters. The statistical method described by Panse and Sukhatme (1967) was followed for the analysis of variance and interpretation of experimental results. For this OPSTAT a statistical software was used (http://14.139.232.166/opstat/index.asp), developed by Chaudhry Charan Singh Haryana Agricultural University, Hisar, Haryana, India. All the tests of significance were made at 5% level of the significance. Critical difference was computed to test the significance of difference between means of two treatments.

Crop raising and data recording

The experimental field was prepared by three harrowing each followed by planking to prepare a suitable planting bed. The seeds of onion variety Hisar -2 was sown in the nursery at 50, 60 and 70

Table 1: Agro-meteorological data during the period of experimentation

Month	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
2014-2015					
December, 2014	19.5	6.00	96.0	61.0	0.3
January, 2015	17.3	5.10	97.1	68.9	0.1
February, 2015	20.5	7.50	94.8	65.8	0.3
March, 2015	25.7	11.5	91.5	56.8	1.6
April, 2015	33.0	16.7	76.3	38.3	0.7
May, 2015	37.6	21.8	68.0	32.0	0.0
2015-2016					
December, 2015	22.4	6.0	96	46	0.0
January, 2016	19.6	7.1	95	65	0.0
February, 2016	23.8	7.2	92	49	5.3
March, 2016	29.7	13.6	89	47	25.2
April, 2016	37.8	18.4	62	26	0.0
May, 2016	41.4	24.6	62	34	44.3

Source: *Department of Agricultural Meteorology, Chaudhary Charan Singh, Haryana Agricultural University, Hisar.*

days before the date of planting and transplanted accordingly in the net plot of 3.0 m × 3.0 m with plant spacing of 15 cm × 10 cm. The recommended package of practices was followed for raising the crop successfully. The crop was harvested in 135 days after planting and observations were recorded on various growth, yield and bulb quality parameters. Ten plants were selected at random from each plot and plant height, number of leaves per plant and neck thickness were measured for these selected plants, and then, the average of the selected plants was worked out for each plot, respectively. Harvesting of each plot was done separately, and then, the total bulb yield obtained from each net plot was converted into quintal per hectare. For bolting percent parameter, the plants which bear bolt per plot before harvest of the crop were counted and converted in to percentage by following formula—

$$\text{Bolting (\%)} = \frac{\text{Number of bolt plant per plot}}{\text{Total number of plants per plot}} \times 100$$

For calculation of split bulb percent, the number of split bulb per plot was counted after harvest of the bulb and converted into percentage by following formula—

$$\text{Split bulb (\%)} = \frac{\text{Number of split bulb per plot}}{\text{Total number of bulb per plot}} \times 100$$

RESULTS AND DISCUSSION

Since there was no significant difference between the results of the year 2014-15 and 2015–16 in respect of different parameters, pooled analyses were done and discussed.

Effect of planting time

Transplanting dates caused significant effect ($p < 0.05$) on plant height and the number of leaves per plant (Table 2). Maximum plant height (68.4 cm) and number of leaves per plant (8.2) was recorded in 30th December transplanted crop as compared to other planting dates (Table 2). Onion crop showed vigorous vegetative growth when transplanted on 30th December could mainly be due to favourable weather conditions which stimulates cytokine and gibberellins' accumulation, modifying the hormonal balance and leading the plant to increase the plant development and responsible for more height and leaves (Tesfaye *et al*. 2018). The taller plant height provides more photosynthetic capacity to the plant than shorter height with more number of leaves. This might be attributed to the increase in the vegetative growth of the onion plant through the effect of planting time. Likewise, the significant effect of planting dates on plant height and number of leaves per plant was also reported by Mehri *et al*. (2015).

Table 2: Effect of planting date and seedlings age on production of onion bulb (pooled data of two years)

Treatments	Plant height (cm)	No. of leaves/ plant	Neck thickness (mm)	Bolting (%)	Split bulb (%)	Bulb yield (q/ha)		
						2014-15	2015-16	Mean
Date of transplanting								
15th December	61.3	7.6	11.2	5.01	10.80	281.5	300.5	291.0
30th December	68.4	8.2	10.7	3.40	7.62	300.2	321.3	310.8
15th January	65.1	7.7	9.5	1.02	3.91	286.3	303.1	294.7
C.D. at 5%	1.23	0.3	0.4	0.61	1.20	8.7	6.8	7.91
Age of seedlings								
50 days	65.5	7.8	10.2	2.50	6.60	285.9	310.3	298.1
60 days	66.3	8.1	10.3	2.95	7.13	288.9	315.7	302.3
70 days	64.0	7.6	10.9	3.90	8.57	278.2	298.9	288.6
C.D. at 5%	1.23	0.3	0.4	0.61	1.20	8.7	6.8	7.91

Note: *Interaction effect of date of planting and age of seedling was non-significant.*

The transplanting of onion seedling delayed from 15th December to 15th January, the bulb quality parameters such as neck thickness, bolting and split bulb percent were reduced. The minimum values (9.5 mm, 1.02 and 3.91%) of the aforementioned traits were recorded at late transplanting on 15th January, respectively. The maximum values for neck thickness, percent bolting and splitting bulbs from earlier transplanting might be due to longer cold period prevailing. The present outcome is in accordance with the finding of Khan *et al*. (2020) and Ojha *et al*. (2019). They observed reduced incidence of bolting with delayed transplanting in onion. 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.

Bulb yield had significantly influenced by different planting dates and recorded highest (310.8 q/ha) in 30th December transplanted crop as compared to early and late seedling transplanting date. The stimulatory effect of seedling transplanting on 30th December may be attributed to the suitable weather condition during vegetative growth, which contributed to good foliage growth and formation ample canopy able to make best photosynthesis, hence increasing bulb weight as well as total bulbs yield. The reduced yields from late transplanting of seedlings might happen 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 yield as well. The present findings are in close conformity with the result of Kandil *et al.* (2013), Ansari (2007) and Patil *et al.* (2012).

Effect of age of seedlings

The plant height was significantly influenced due to the variation in age of seedling. The highest plant (66.3 cm) was obtained from 60 days old seedlings transplanted followed by the seedlings of 50 days old (65.5 cm) and the lowest (64.0 cm) was recorded when plants were grown with 70 days old seedlings (Table 2). The number of leaves per plant counted at maturity of plant was significantly influenced due to variation in age of seedling. The number of leaves per plant was the highest (8.1) when the plants were transplanted with 60 days old seedlings followed by 50 days old (7.8) seedlings and the lowest number of leaves per plant (7.6) when the plants were transplanted with 70 days old seedlings. An increased number of leaves indicates good growth and development of onion crop and is directly related to the bulb yield. The more number of leaves per plant resulted more photosynthetic area and thereby higher yield. Latif *et al.* (2010) also reported highest plant height and number of leaves per plant in onion when plants were grown with 50 days old seedlings.

Transplanting of different age of seedlings significantly influenced the bulb quality in respect to neck thickness, bolting and split bulb percent. As the age of seedlings increased from 50 to 60

days there was slightly increase in neck thickness, bolting and split bulb percent, while, these traits were increased significantly maximum when plant was grown with 70 days old seedlings. It is clear from the present study that bulb quality in respect of neck thickness, percent bolting and split bulb were reduced when crop grown from more than 60 days old seedlings. The present results were dissimilar with the finding of Anbes *et al*. (2018); they reported that seedling age from 6 to 8 weeks did not significantly affect the formation of neck thickness of onion. Brewester (1987) reported that neck-thickness is a physiological event that is influenced by seasons, sites and cultivars.

Variation in age of seedling significantly influenced the bulb yield (Table 2). The highest bulb yield (302.3 q/ha) was recorded when 60 days old seedlings were transplanted followed by 50 days old seedlings (298.1 q/ha) and the lowest bulb yield (288.6 q/ha) was recorded when plants were grown with 70 days old seedlings. This may be absorbed to the fact that 50 or 60 days old seedlings synthesized much more photosynthates which translocated towards the reproductive organs (bulbs). The present study is also confirming the result of Latif *et al*. (2010), they reported that the highest bulb yield was produced by 50 days old seedlings.

CONCLUSION

Under the present study the optimum date of seedlings transplanting was 30th December for getting maximum productivity and quality of onion bulbs. Early transplanting produced profuse bolter bulbs and split bulb, while, transplanting seedlings after 30th December reduced the percent bolting to a great extent due to prevailing higher temperature. Regarding optimum age of seedlings, 50 to 60 days old seedlings should be planted for better yield and quality of onion bulb under the semi-arid sub tropical region of north western India in Haryana state.

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