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Seedling Emergence and Seedling Growth Parameters of Late *kharif* Onion (*Allium cepa* L.) in Response to Sowing Dates and varieties in North-East India

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ABSTRACT: Growing late *kharif* onion varieties on a specific time has been a major concern for onion growers for continues supply of onion in market especially during November to February and to get high market price. In recent years so many varieties had been developed for late *kharif* season but their performance in a particular region at a specific time need to evaluate specially in North-East India due to erratic monsoon, cloudy weather, continuous drizzling. This perspective paper presents the response of various onion varieties at different sowing dates in Assam. Research experiment was carried out during the year 2020-21 and 2021-22 at Horticulture Experimental Farm, Department of Horticulture, College of Agriculture, Assam Agricultural University, Jorhat, Assam. The experiment was laid out in factorial Randomized Block Design with five red onion varieties viz., Arka Kalyan, Bhima Dark Red, Agrifound Dark Red, Bhima Super and Bhima Red and three dates of sowing viz., 25th August, 5th September and 15th September which were replicated three times. Results obtained showed that onion varieties, sowing dates and their interactions were significantly different when it comes to the seedling height 25, 30, 35 and 40 DAS, and seedling growth index 25, 30, 35 and 40 days after sowing. The variety Bhima Super sowing at 25th August showed highest plant height (19.25 cm) and maximum seedling growth index (2150.43) after 40 days sowing on pooled analysis, which helps to determine the level of activity and performance of the seed. Vigorous and healthy seeds also perform better in field and can be used as green onions for curries and salad. Days to 50% emergence of onion seedling was not affected by varieties, sowing dates and their interactions.

KEYWORDS: Onion, Bhima Super, Varieties, August, Seedling, Late *kharif*.

INTRODUCTION

Onion is a biennial or a perennial plant, but is usually treated as an annual and harvested in its first growing season. It is one of the most important vegetable crop grown throughout the world and is said to be native of Central Asia and Mediterranean region (McCollum, 1976). The plant has shallow adventitious fibrous roots (Ranjitkar, 2003), bulb, and tubular leaves. The bulb of onion consists of swollen bases of green foliage and fleshy scales. The inforescence is umbel and develops from a ring-like apical meristem. It is composed of white or greenish-white small fowers, which grow at the tip of the stem in the second year of the plant (Pareek *et al.*, 2018). Onion is an indispensable item in every kitchen as condiment and vegetable (Behera *et al.,* 2017). Onion is very common in human diet that a meal without a vegetable is supposed to be incomplete in any part of the world. Onion is highly nutritional and its dietary use improves digestion and mental health and lower down toxigenicity of oils. Onion has potential in treating cardiovascular disease, hyperglycemia, and stomach cancer (Upadhyay, 2016). Onion is an important commercial vegetable crop. It is grown predominantly in Rabi season but in some parts of India it is grown in *kharif* and late *kharif* season also (Singh, 2000). Onion is not cultivated commercially in north-eastern region due to unfavourable climatic conditions. Hence, entire requirement of this region is being met by procurement from outside the region. Preliminary trials envisaged the scope of growing off season onion through bulblets during *khaif* under foothills of Nagaland (Jamir *et a1*., 2013). For healthy and vigorous onion seedling production in late *kharif* season cloudy

atmosphere, rains and incidence of various pests and diseases are the most important limiting factors. Therefore, at present Kharif onion cultivation is restricted to certain area with low yield potential and poor keeping quality (More *et al.,* 2019). Importance of *Kharif* cultivation of onion to stabilize the prices is well accepted (Directorate of Onion and Garlic Research, 2013). The time of sowing and transplanting exerts a distinct effect on growth of onion (Nayee *et al.,* 2009 and Kandil *et al.,* 2013). Successful onion production depends on the selection of right varieties that are adapted to different conditions imposed by specific environment. Therefore, identification of specific cultivars suitable for specific season is an indispensible step towards increase in production and productivity of onion (Hirave *et al.,* 2015). *Kharif* onion is an off-season cultivation of the crop for which standardization of varieties and sowing dates is of immense utility. Considering all these factors present research work was undertaken to investigate the effect of varieties and sowing dates on the growth of onion seedling.

MATERIALS AND METHODS

The field experiments were conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat, Assam, India during late *kharif* season of 2020-2021 and again repeated in 2021-22. The experimental field AAU, Jorhat is situated at 26°47' North latitude and 94°12' East longitude and 87 m above the mean sea level. Certified onion seeds were collected from Indian Institute of Horticultural Research, Bangalore, Directorate of Onion and Garlic Research, Rajgurunagar, Pune and National Horticultural Research and Development Foundation, New Delhi. The treatment combinations consisted of five different varieties *viz*., Arka Kalyan, Bhima Dark Red, Agrifound Dark Red, Bhima Super and Bhima Red and three dates of sowing *viz*., 25th August, 5th September and 15th September. Design used was Factorial Randomized Block Design (FRBD) with three replications. Days to 50 per cent seedling emergence counted from date of nursery sowing to 50 per cent germination of seedlings. Seedling height was recorded from 10 randomly selected plants 25, 30, 35 and 40 days after sowing. Seedling height was recorded from 10 randomly selected plants and measured with the help of a meter scale from the base of the neck of the plant up to the tip of the longest leaf at 25, 30, 35 & 40 days after sowing. The mean plant height was calculated and expressed in centimeter. The experimental data recorded were subjected to statistical analysis using analysis of variance technique suggested by Panse and Sukhatme (1978). SGI computed from the germination and total seedling length. *i.e.*, root length + shoot length at 25, 30, 35 & 40 days after sowing as suggested by Abdul Baki and Anderson (1973) and expressed as whole number,

SGI = (Germination per cent) × (Shoot length + Root length)

RESULTS AND DISCUSSION

Effects of different sowing dates, varieties and their interaction on days to 50% seedling emergence. The results showed that days to 50 per cent seedling emergence of onion is not affected by sowing dates, varieties and their interaction only and there may be other factors such as growing media, temperature, nutrients, status of the field *etc.*, which could modify the seedling emergence of onion. The results are confirmatory with findings of Zaghloul *et al.* (2013); Kumar *et al.* (2021) at nursery stage in onion.

Effects of different sowing dates, varieties and their interaction on seedling height 25, 30, 35 and 40 DAS. Significant effect of sowing dates, varieties and their interaction were observed on plant height 25, 30, 35 and 40 days after sowing (Table 1-3 and Fig. 1). Highest (8.90 cm) plant height 25 DAS was found in D_1 (25th Aug) and lowest (8.06 cm) observed in D_3 (15th Sep). Variety Bhima Super showed maximum (9.49 cm) plant height and minimum (6.95 cm) in V_1 (Arka Kalyan). Significant interaction effect of sowing dates and varieties was found on seedling height at 25 DAS. Maximum (10.48 cm) plant height was observed in D_1V_4 while shortest (6.21 cm) plants were observed in D_3V_1. Highest plant height 30 DAS was recorded for 25th August sowing date (12.04 cm) and variety Bhima Super (12.99 cm). Interaction effect of sowing dates and varieties showed significant difference among the treatments. Maximum (13.93 cm) seedling height was found in D_1V_4 (Bhima Super sowing at 25th August) which was at par with D_3V_5 (Bhima Red sowing at 15th September). Minimum (9.27 cm) plant height was observed in D_3V_1 (Arka Kalyan sowing at 15th September). Similarly, significant interaction effect of sowing dates and varieties was found on seedling height at 35 days after sowing and maximum (16.79 cm) seedling height was observed in D_1V_4 (Bhima Super sowing at 25th August) which was at with D_1V_5 (Bhima Red sowing at 15th September) and D_3V_4 (Bhima Super sowing at 15th September). Shortest (12.89 cm) plants were observed in D_3V_1 (Arka Kalyan sowing at 15th September). Significant variation was observed among the varieties, sowing dates and their interactions in respect of seedling height 40 days after sowing. The seedling height was the highest (17.22 cm) in D_1 (25th Aug) while minimum (16.61 cm) in D_3 (15th Sep) and maximum (18.34 cm) seedling height was recorded in V_4 (Bhima Super) followed by V_5 (Bhima Red) and V_2 (Bhima Dark Red) and minimum (15.68 cm) height was recorded in V_1 (Arka Kalyan).

Seedling height is affected not only by genotypes but also with weather conditions like temperature, photoperiod and external inputs such as water and nutrients. Variety Bhima Super sown on 25th August registered highest plant height than other treatments. The variation in genetic constitution may be attributed to varied growth parameters which in turn resulted in different synthesis and utilization efficiency of photosynthetic product in the plants which ultimately affect the plant height.

The findings were in conformity with the results of Cramer (2003); Zaghloul *et al.* (2013). Bosekeng and Coetzer (2015) also found significantly higher plant growth with early sowing dates.

Table 1: Effect of sowing dates on days to 50% seedling emergence, seedling height 25, 30, 35 and 40 DAS (Pooled mean of two years 2020-21 and 2021-22).

Sowing date/ Treatment	Days to 50% Emergence	Seedling height 25 DAS	Seedling height 30 DAS	Seedling height 35 DAS	Seedling height 40 DAS
D_1 (25th Aug)	6.97	8.90	12.04	15.09	17.22
D_2 (5th Sep)	7.06	8.36	11.66	14.73	17.04
D_3 (15th Sep)	7.20	8.06	11.28	14.48	16.61
S.Ed (+)	0.17	0.19	0.22	0.24	0.24
CD (0.05)	NS	0.38	0.44	0.49	0.48

Table 2: Effect of varieties on days to 50% seedling emergence, seedling height 25, 30, 35 and 40 DAS (Pooled mean of two years 2020-21 and 2021-22).

Variety/ Treatment	Days to 50% Emergence	Seedling height 25 DAS	Seedling height 30 DAS	Seedling height 35 DAS	Seedling height 40 DAS
V_1 (Arka Kalyan)	7.16	6.95	10.05	13.29	15.68
V_2 (Bhima Dark Red)	7.00	8.90	11.94	15.10	17.03
V_3 (AFDR)	7.27	7.82	10.78	13.98	16.18
V_4 (Bhima Super)	7.16	9.49	12.99	16.07	18.34
V_5 (Bhima Red)	6.78	9.00	12.54	15.40	17.55
SEd (+)	0.22	0.24	0.29	0.31	0.31
CD (0.05)	NS	0.49	0.58	0.63	0.62

Table 3: Interaction effect of sowing dates and varieties on days to 50% seedling emergence, seedling height 25, 30, 35 and 40 DAS (Pooled mean of two years 2020-21 and 2021-22).

Treatment combination	Days to 50% Emergence	Seedling height 25 DAS	Seedling height 30 DAS	Seedling height 35 DAS	Seedling height 40 DAS
D_1V_1	7.00	7.56	10.72	13.73	16.02
D_1V_2	7.00	9.21	12.08	15.22	16.75
D_1V_3	7.33	7.85	10.79	14.01	16.35
D_1V_4	7.00	10.48	13.93	16.79	19.25
D_1V_5	6.50	9.34	12.67	15.71	17.73
D_2V_1	7.33	7.08	10.16	13.24	15.48
D_2V_2	6.83	8.50	11.63	14.93	16.94
D_2V_3	7.17	7.43	10.34	13.57	15.52
D_2V_4	7.00	8.72	12.35	15.58	17.85
D_2V_5	7.00	8.55	11.93	15.08	17.25
D_3V_1	7.17	6.21	9.27	12.89	15.55
D_3V_2	7.17	9.01	12.11	15.15	17.40
D_3V_3	7.33	8.17	11.20	14.36	16.66
D_3V_4	7.50	9.26	12.69	15.84	17.91
D_3V_5	6.83	9.12	13.02	15.41	17.67
SEd (+)	0.38	0.43	0.50	0.55	0.54
CD (0.05)	NS	0.86	1.00	1.10	1.08

Effects of different sowing dates, varieties and their interaction on seedling growth index 25, 30, 35 and 40 DAS. The data pertaining to the effect of sowing dates, varieties and their interaction on seedling growth index have been presented in Table 4-6. The highest SGI (1090.08) was recorded in D_1 (25th August) which was statistically different from other treatments whereas, D_3 (15th Sep) recorded the lowest (999.06) SGI 25 days after sowing. Significant effect of varieties was observed (Fig. 2) and maximum (1164.21) SGI recorded in V_4 (Bhima Super) and minimum (930.99) SGI recorded in V_1 (Arka Kalyan). The interaction effect was significant on SGI at 25 DAS. Maximum (1271.95) SGI was recorded in D_1V_4 (Bhima Super sown on 25th August) and Minimum (846.69) SGI 25 DAS was found in D_3V_1 (Arka Kalyan sown on 15th September). Maximum SGI (1399.17) 30 DAS found in D_1 (25th Aug) and variety Bhima Super (1512.43) followed by V_5 (Bhima Red) and V_2 (Bhima Dark Red) and minimum SGI (1312.21) 30 DAS was found in D_3 (15th Sep) and in variety (1234.74) Agrifound Dark Red (V_3). Significant interaction effect between sowing dates and the varieties for SGI 30 DAS was recorded maximum (1619.35) by D_1V_4 (Bhima Super sown on 25th August) and minimum (1155.03) by D_3V_1(Arka Kalyan sown on 15th September). Maximum SGI (1683.03 and 1904.97) found in D_1 (25th Aug) and minimum (1608.29 and 1827.72) in D_3 (15th Sep) 35 and 40 days after sowing. Variety Bhima Super (V_4) recorded maximum (1804) SGI 35 DAS followed by V_5 and V_2 and minimum (1525.40) for variety Agrifound Dark Red (V_3). Maximum (2042.42) SGI 40 days after sowing was recorded in variety Bhima Super (V_4) followed by V_5 and V_1 and minimum (1745.53) with variety Agrifound Dark Red (V_3). Treatment combination D_1V_4 recorded maximum (1892.22) SGI at 35 DAS and minimum (1487.40) was recorded in recorded in D_2V_3 (AFDR sown on 5th Sep). Similarly, Interaction effect of sowing dates and varieties on SGI 40 DAS was found highest (2150.43) for D_1V_4 (Bhima Super sowing at 25th Aug) and minimum (1686.14) in D_2V_3 (AFDR sown on 5th Sep).

Table 4: Effect of sowing dates on seedling growth index 25, 30, 35 and 40 days after sowing (Pooled mean of two years 2020-21 and 2021-22).

Sowing date/Treatment	SGI 25 DAS	SGI 30 DAS	SGI 35 DAS	SGI 40 DAS
D_1 (25^{th} Aug)	1090.08	1399.17	1683.03	1904.97
D_2 (5^{th} Sep)	1013.99	1331.23	1612.18	1846.79
D_3 (15^{th} Sep)	999.06	1312.27	1608.29	1827.72
SEd (+)	**20.02**	**23.22**	**25.92**	**28.71**
CD (0.05)	**39.98**	**46.37**	**51.75**	**57.33**

Table 5: Effect of varieties on seedling growth index 25, 30, 35 and 40 days after sowing (Pooled mean of two years 2020-21 and 2021-22).

Variety/Treatment	SGI 25 DAS	SGI 30 DAS	SGI 35 DAS	SGI 40 DAS
V_1 (Arka Kalyan)	930.99	1245.91	1558.98	1814.99
V_2 (Bhima Dark Red)	1031.47	1313.30	1590.30	1782.01
V_3 (AFDR)	954.42	1234.74	1525.40	1745.53
V_4 (Bhima Super)	1164.21	1512.43	1804.00	2042.42
V_5 (Bhima Red)	1090.80	1431.39	1693.82	1914.19
SEd (+)	**25.85**	**29.97**	**33.45**	**37.06**
CD (0.05)	**51.62**	**59.86**	**66.81**	**74.02**

Table 6: Interaction effect of sowing dates and varieties on seedling growth index 25, 30, 35 and 40 DAS (Pooled mean of two years 2020-21 and 2021-22).

Treatment combination	SGI 25 DAS	SGI 30 DAS	SGI 35 DAS	SGI 40 DAS
D_1V_1	1003.09	1329.10	1621.99	1870.48
D_1V_2	1074.07	1344.82	1620.97	1778.31
D_1V_3	965.23	1244.84	1539.51	1774.55
D_1V_4	1271.95	1619.35	1892.22	2150.43
D_1V_5	1136.08	1457.73	1740.47	1951.08
D_2V_1	943.19	1253.60	1551.10	1788.22
D_2V_2	994.97	1286.49	1578.53	1777.00
D_2V_3	917.77	1193.98	1487.40	1686.14
D_2V_4	1089.14	1450.05	1756.85	1996.22
D_2V_5	1050.27	1377.23	1667.58	1891.03
D_3V_1	846.69	1155.03	1503.84	1786.27
D_3V_2	1025.39	1308.58	1571.39	1790.71
D_3V_3	980.26	1265.41	1549.31	1775.92
D_3V_4	1131.55	1467.90	1762.93	1980.59
D_3V_5	1086.06	1459.21	1673.41	1900.45
SEd (+)	**44.77**	**51.92**	**57.95**	**64.20**
CD (0.05)	**89.40**	**103.69**	**115.72**	**128.21**

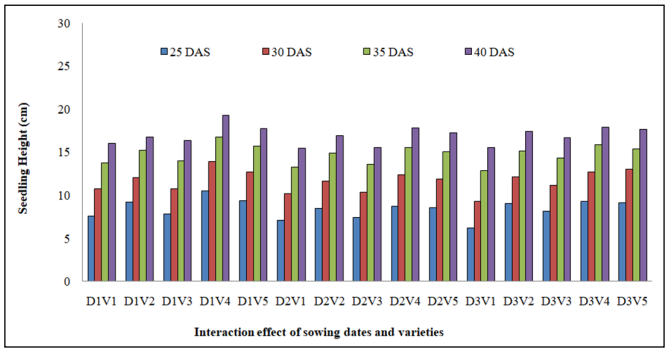

Fig. 1. Graphical representation of seedling height (cm) at 25, 30, 35 and 40 DAS on pooled analysis.

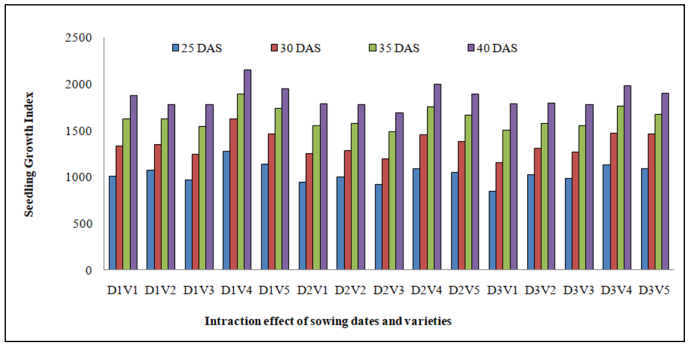

Fig. 2. Graphical representation of Seedling Growth Index at 25, 30, 35 and 40 DAS on pooled analysis.

Higher seedling growth index found in D_1V_4 (Bhima Super Sowing at 25th August) than the other treatments, this variation might be due to high germination (%) and seedling height which have contributed to greater seedling growth index. The results of this study are in close agreement with the findings of Zaghloul *et al.* (2013); Gebeyehu (2016); Kumar *et al.* (2021) under different climatic conditions with different varieties.

CONCLUSIONS

From the present study, it was found that the sowing dates, varieties and their interaction showed significant effect on most of the growth parameters of onion plant except days to 50 % seedling emergence. Early sowing D_1 (25th August) performed better than other sowing dates. Out of five varieties, Bhima Super (V_4) and Bhima Red (V_5) exhibited better growth. Among the treatment combinations, D_1V_4 (Bhima Super on 25th August sowing) was the best in seedling height (19.25 cm) and seedling growth index (2150.43) at 40 days after sowing. These treatment combination offers great potential for healthy and vigorous seedlings production in onion which finally shows better performance in the main field in terms of yield and yield attributing characters. Nutrient and chlorophyll content of the leaves were not investigated in the study. Such study may be conducted in future.

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Conflict of Interest. None.

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