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Growth and Yield Increments of Onion (*Allium cepa* L.) with Transplanting Dates, Cultivars and Zinc in Semi-Arid Conditions of Rajasthan

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ABSTRACT: Due to early and late transplanting of onion seedling, use of local seed and inefficient cultivars as well as inadequate nutrients are contributing factors to reduce marketable yield of onion. For optimal marketable bulb yield, ideal planting time is critical for better and efficient exploitation of plant resources. It is also a well-known premise that selection of cultivar seed is one of the most important variables in getting in higher growth and yield attributes. The experiment was conducted at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during 2020-21 and 2021-22 in *Rabi* season. The treatment combinations, was laid out in split-plot design with two transplanting dates (10th December and 01st January) and three cultivars (RO-01, RO-59 and Bhima Shakti) were kept in main plots. Four zinc (control, Soil application of zinc sulphate @ 25 kg/ha, dipping of seedling in zinc solubilizer before transplanting, foliar spray of zinc sulphate @ 0.5% at 30 & 45 DAT) were applied in sub plots. As per results transplanting on 01st January and Bhima Shakti cultivar with foliar spray of zinc sulphate @ 0.5% at 30 & 45 DAT siginificantly increased the growth, yield attributes and yield of onion *i.e.* plant height and number of leaves at 45 DAT, bolting percent, average bulb weight and marketable bulb yield in both years as well as in pooled analysis. Thus, findings were in conclusion that 01st January transplanting and Bhima Shakti cultivar with foliar spray of zinc sulphate @ 0.5% at 30 & 45 DAT have the potential effect to improve growth parameters as well as average bulb weight and marketable bulb yield of onion.

Keywords: Cultivar, growth, onion, yield and zinc.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial crop not only in India but also in the world. It can be transported to a long distance without much transit injury losses. India ranks second in onion production contributing 13.31 percent of total vegetable production of the India. Production of onion in India is 26.64 million tonnes in area of 1.62 million ha (Anonymous, 2020-21). Onion is rich in protein, calcium, phosphorus and carbohydrates Bhattacharjee *et al.* (2013). The pungency in onion is due to a volatile oil known as allylpropyl disulphide. The outer skin colour is due to the presence of quercetin. Now a day, commercially prepared onion products include dehydrated flakes and powders usually made from white cultivars with high dry-matter content and onion oil is produced by distillation Currah and Proctor (1990). Dehydration of onion is required to provide a way for utilization during off-season and pretreatments are used to improve the quality attributes of onion slices. Onion is very sensitive to temperature and photoperiod. Therefore, the transplanting date play a vital role in determining the bulb yield. In North Indian conditions, sowing time of nursery is October to the middle of November and transplanting time of seedlings is from middle of December to January. Bolting and seed germination are dependent on temperature Corgan *et al*. (2000). Onion varieties differ in size, colour of skin, pungency and maturation of bulbs etc. Large sized bulbs are mild in pungency with sweet in taste as compared to small sized onions. Red coloured cultivars are more pungent than silver skinned varieties and keep better in storage. Various cultivars of the same species grown even in the same environment give different yields as the performance of a cultivar mainly depends on the interaction of genetic makeup and environment.

Therefore, cultivators are not able to get desired growth and yield of onion only by management practices. Hence, application of zinc through zinc solubilizer, soil application and foliar application stimulate plant growth that enhances the biological efficiency of crops. The present investigation was conducted to know the effect of transplanting dates, cultivars and zinc on growth and Yield of Onion.

MATERIALS AND METHODS

The experiment was conducted during 2020-21 and 2021-22 in *rabi* season at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Jaipur) by laying out in split block design (SPD) with three replications

consisting of twenty four treatment combinations. The treatment combinations, was laid out in split-plot design with two transplanting dates (10th December and 01st January) and three cultivars (RO-01, RO-59 and Bhima Shakti) were kept in main plots. Four zinc methods (control, Soil application of zinc sulphate @ 25 kg/ha, dipping of seedling in zinc solubilizer before transplanting, foliar spray of zinc sulphate @ 0.5% at 30 & 45 DAT) were applied in sub plots. The raised beds were prepared of size 3 × 1 m. The seed sowing was performed on 15th October and 03rd November of 2020 and 2021, respectively followed by light irrigations with the help of watering can. Nutrients like nitrogen, phosphorus and potassium were applied through urea, single super phosphate and muriate of potash, respectively. Healthy, uniform size and inoculated/no-inoculated seedlings different cultivars of onion of about 10 cm height were transplanted in the main field on 10th December of 2020 & 2021 and 01st January of 2021 and 2022. The plant spacing was kept 20 × 10 cm.

Zinc was applied by three methods *viz.* soil application of zinc sulphate, treating of onion seedling with zinc solubilizer and foliar spray of zinc sulphate. As per treatment combination, 25 kg zinc sulphate per ha was mixed in soil just before transplanting. Two foliar spray of zinc sulphate @ 0.5 percent after 30 and 45 days of transplanting. Suspension of 5 ml zinc solubilizer in 1 litre of water was prepared for treatment of seedlings and then dipped the roots of onion seedling in the solution for 10 minutes before transplanting. Five plants were tagged in each plot to record observations. Observations were recorded manually plant height, number of leaves, bolting percent, average weight of bulb and marketable bulb yield. The bolting percent and marketable bulb yield were calculated by using formula as given below:

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

$$\text{Marketable bulb yield (q/ha)} = \frac{\text{Marketable bulb yield(kg/plot)} \times 10,000}{\text{Netareaofplot (m}^2) \times 100}$$

RESULT AND DISCUSSION

The effect of two transplanting dates (10th December and 01st January) and three cultivars (RO-01, RO-59 and Bhima Shakti) combined with application methods of zinc (control, soil application of zinc sulphate at 25 kg/ha, dipping of seedling in zinc solubilizer before transplanting and foliar spray of zinc sulphate @ 0.5%) was studied to understand the growth and yield attributes of onion. The results obtained are presented in Table 1 & 2.

Effect of transplanting dates on growth and yield parameters of onion. The result of present study (Table 1 and 2) clearly indicated that plant height (34.17 cm), number of leaves (5.20), minimum bolting percent (0.155), average bulb weight (81.10 g) and marketable bulb yield (360.00 q/ha) of onion in both the years as well as in pooled mean analysis increased significantly with delay transplanting, cultivars and zinc. This might be because of low average temperature in late transplanting during the growth period resulted in good foliage growth and formation of ample canopy able to enhance photosynthesis, hence increasing average bulb weight as well as bulbs yield per fad. Temperature and photoperiod are the major ecological factors influencing the growth and development of onion plant in all phases Coolong and Randle (2003). Prolong low temperature increases bolting and also the speed of the phenomenon Tarpaga *et al*. (2011). From early planting, bulb formation might have occurred earlier and thus may receive more induction, which resulted into higher number of bolter Nandpuri (1990). Increasing trend in yield attributes as noted with delayed transplanting might be due to more congenial climate and low temperature prevailing for long period provide favourable climatic condition for bulb development and genetic makeup.

Similar findings have been reported by Nayee *et al.* (2009); Jilani *et al.* (2010); Mohanta and Mandal (2014); Ali *et al.* (2016 b) in onion.

Effect of cultivars on growth and yield parameters of onion. The results (Table 1 and 2) showed that significantly increased the plant height at 45 DAT (33.52 cm), number of leaves at 45 DAT (5.14), bolting percentage (0.182), average bulb weight (79.37 g) and marketable bulb yield (361.10 q/ha)of onion in cultivar Bhimashakti as compared to RO-01 cultivar. However, it is found statistically at par to RO-59 cultivar in case of all above growth and yield parameters in pooled mean analysis. This might be due to primitive effects of varietal genetic makeup affects to vegetative growth which ultimately lead to more photosynthetic activities and enhancing the rate of cell division and cell enlargement of plants Dwivedi *et al*. (2012). Each cultivar has its own specific characteristics and accordingly variation in these parameters may be attributed to genetic difference of cultivars. Onion cultivars may have different morphological and biochemical characteristics that affect the biomass accumulation among different storage and vegetative parts and the average bulb weight within cultivars was due to their genetic variability, reported by Jilani and Ghaffoor (2003).

Similar results were also reported by Devi *et al*. (2014); Tarai *et al.* (2015); Utangi *et al*. (2015); Gosai *et al.* (2018); Ganiger *et al*. (2018)in onion and Thakur *et al.* (2022) in coriander.

Effect of zinc on growth and yield parameters of onion. The maximum and significantly better values of growth attributes of onion like plant height at 45 DAT (34.77), number of leaves per plant at 45 DAT (5.26), bolting percentage (0.145), average bulb weight (79.68 g) and marketable bulb yield (357.58 q/ha) were recorded under foliar application of zinc sulphate @ 0.5% over rest of the treatments except soil application of zinc sulphate at 25 kg per ha which was found statistically at par in pooled analysis. This might be due to the stimulating effect of zinc sulphate in cell division and cell elongation. It is effective for the synthesis of plant hormones like auxin and carbohydrate formation Pankaj *et al*. (2018). The potent reasons responsible for superior performance of growth, yield and yield attributes might be due to supply of nutrients in

available form. The increased growth parameters provided greater sites for photosynthesis and diversion of photosynthates towards sink. Foliar application of zinc also helpful for matching to the need of plants Abedin *et al*. (2012).

These results are in conformity with the findings of Tohamy *et al*. (2009); Samad *et al*. (2011); Bhat *et al.* (2018) in onion.

Table 1: Effect of transplanting dates, cultivars and zinc on plant height and number of leaves of onion.

Treatments	Plant height (cm)			Number of leaves per plant			Bolting percent		
	At 45 DAT			At 45 DAT					
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Transplanting dates									
T_1- 10th December	31.08	27.96	29.52	4.69	4.04	4.37	0.256	0.184	0.220
T_2- 01st January	36.15	32.18	34.17	5.51	4.89	5.20	0.184	0.126	0.155
SEm±	**0.47**	**0.49**	**0.34**	**0.08**	**0.07**	**0.05**	**0.004**	**0.003**	**0.002**
CD (P=0.05)	**1.48**	**1.56**	**1.01**	**0.25**	**0.21**	**0.15**	**0.012**	**0.009**	**0.007**
Cultivars									
C_1- RO-1	30.52	27.22	28.87	4.35	3.96	4.15	0.225	0.159	0.192
C_2- RO-59	34.96	31.34	33.21	5.39	4.70	5.05	0.221	0.156	0.189
C_3-Bhima Shakti	35.38	31.65	33.52	5.55	4.74	5.14	0.214	0.150	0.182
SEm±	**0.58**	**0.61**	**0.42**	**0.10**	**0.08**	**0.06**	**0.005**	**0.003**	**0.003**
CD (P=0.05)	**1.82**	**1.91**	**1.23**	**0.31**	**0.26**	**0.19**	**NS**	**NS**	**NS**
Zinc application									
Z_0 – Control	29.13	25.93	27.24	4.01	3.85	3.93	0.280	0.230	0.255
Z_1 – Soil application of zinc sulphate (25 kg/ha)	36.17	32.29	34.23	5.61	4.82	5.22	0.190	0.120	0.155
Z_2 – Dipping of seedling in zinc solublizer before transplanting	32.60	29.10	30.85	5.11	4.33	4.72	0.230	0.160	0.195
Z_3 – Foliar spray of zinc sulphate @ 0.5% at 30 & 45 DAT	36.57	32.96	34.77	5.66	4.86	5.26	0.180	0.110	0.145
SEm±	**0.48**	**0.52**	**0.35**	4.69	4.04	4.37	**0.004**	**0.004**	**0.003**
CD (P=0.05)	**1.38**	**1.48**	**1.00**	5.51	4.89	5.20	**0.010**	**0.011**	**0.007**

Table 2: Effect of transplanting dates, cultivars and zinc on average bulb weight and marketable bulb yield of onion.

Treatments	Average bulb weight (g)			Marketable bulb yield (q/ha)		
	2020-21	2020-21	2020-21	2020-21	2021-22	Pooled
Transplanting dates						
T_1- 10th December	69.72	64.64	67.18	338.28	287.71	312.99
T_2- 01st January	84.05	78.14	81.10	390.98	329.02	360.00
SEm±	**1.12**	**1.09**	**0.78**	**4.70**	**4.20**	**3.15**
CD (P=0.05)	**3.52**	**3.44**	**2.30**	**14.82**	**13.23**	**9.30**
Cultivars						
C_1- RO-1	67.57	62.28	64.93	322.98	266.41	294.70
C_2- RO-59	80.85	75.39	78.12	381.65	325.71	353.68
C_3-Bhima Shakti	82.24	76.50	79.37	389.24	332.96	361.10
SEm±	**1.37**	**1.34**	**0.96**	**5.76**	**5.14**	**3.86**
CD (P=0.05)	**4.31**	**4.21**	**2.82**	**18.15**	**16.21**	**11.39**
Zinc application						
Z_0 – Control	69.95	64.65	67.30	329.14	273.30	301.22
Z_1 – Soil application of zinc sulphate (25 kg/ha)	81.13	75.56	78.34	382.86	326.51	354.68
Z_2 – Dipping of seedling in zinc solublizer before transplanting	74.00	68.49	71.24	360.62	304.36	332.49
Z_3 – Foliar spray of zinc sulphate @ 0.5% at 30 & 45 DAT	82.48	76.88	79.68	385.88	329.28	357.58
SEm±	**1.30**	**1.33**	**0.93**	**4.96**	**4.87**	**3.48**
CD (P=0.05)	**3.72**	**3.81**	**2.62**	**14.23**	**13.96**	**9.82**

CONCLUSION

The results of two years of experimentation and pooled analysis relieved that transplanting date 10th December and Bhima Shakti significantly increased plant height, number of leaves per plant, bolting per cent, average bulb weight and marketable bulb yield. Similarly, foliar application of zinc sulphate (0.5 %) recorded maximum plant height, number of leaves per plant, bolting per cent, average bulb weight and marketable bulb yield harvest.

FUTURE SCOPE

The findings established will help the farmers to obtain good plant growth and bulb yield by following proper transplanting date, cultivar selection and micronutrients.

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Conflict of Interest. None.

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