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Effect of planting density and inorganic fertilizers on growth and yield of onion

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A B S T R A C T

Haphazard and inappropriate plant spacing and poor soil fertility management practices are among the major factors constraining onion production. Therefore, a field experiment was conducted in Lovely Professional University from November 2017 to April 2018 to assess the influence of spacing (15×10cnm, 15×10cm and 10×10cm) and different nitrogenous fertilizers (Urea, Calcium nitrate and N:P:K mixture) on growth, yield, and quality of onion. The experiment was laid out in a randomized complete block design (RCBD) of with three replications. Significant difference was observed among all the treatments. The tallest plants (63.67cm) were obtained from the treatment with N: P: K applications well as those spaced at 10 cm intra and inter row spacing. Nitrogen fertilizers and spacing interacted significantly to influence all parameters. Thus, nitrogen fertilizer across the increasing spacing significantly increased number of leaves (30 DAT) fresh bulb weight and bulb diameter. The highest value of plant height (30, 60, and 90 DAT) and number of leaves (60, 90 and 120 DAT) were observed from the application of calcium nitrate and plant spacing of 15×10 cm. whereas total bulb yield was highest in T1S2 (18.53T ha^{-1}). It can be concluded that the highest benefit with low cost of production was obtained in response to the application of nitrogen fertilizers (urea & calcium nitrate) and spacing (15x10cm & 10x10cm) was optimum for producing the crop in the limited area.

Introduction

Onion (*Allium cepa* L., 2n= 16) is a very important winter season crop belongs to Alliaceae family (Sultana *et al.*, 2007). It requires proper vernalization temperature for early flowering and higher yield of bulb (Kabir *et al.*, 2008). For flower induction it requires low temperature (Khokhar *et al.*, 2007). Onion induce flowering in temperature ranging from 5°C - 13°C, inflorescences growth temperature between 20°C - 25°C (Serkara *et al.*, 2017). Onion has an anti-viral, anti-bacterial, anti-allergenic, anti-inflammatory property and due to the presence of flavonoids it reduces the chances of cancer, heart disease and diabetes (Belay *et al.*, 2015). Due to its several advantages it is very important to adopt best agronomic practices for the improvement of yield and quality of bulb in onion. Nutrients have an important role in improvement of productivity and quality of vegetable crops. Onion is heavy nutrient feeder crop due to its shallow and unbranched root system; hence it require high amount of fertilizers for obtaining good yield

(Brewster, 1994; Rizk *et al.,* 2012). Plant spacing is also an important factor determining onion yield and quality. In crop production, canopy development is very important to optimize light interception, photosynthesis and dry matter accumulation to harvestable parts. So crop canopy can be managed by alternating row spacing and plant population; as the plant density increases, yield per unit area also increases (Silvertooth, 2001). Therefore the current research was executed to determine the effect of planting density and inorganic fertilizers on growth and yield parameters of onion.

Materials and Methods

The field experiment was laid out at Main Agricultural Research Farm of Lovely Professional University, Phagwara during *rabi* season during 2017in Randomized Block Design (RBD) with three replications using single Onion var. cv. "Red Nasik N-53". It consisted 10 treatments with 3 nitrogenous fertilizers and spacing's in combinations *viz;* T1S1 (Urea + 15 x 15 cm), T1S2 (Urea + 15 x 10 cm), T1S3 (Urea + 10 x 10 cm), T2S1 (CaNO3 + 15 x 15 cm), T2S2 (CaNo3 + 15 x 10 cm), T2S3 (CaNO3 + 10 x 10 cm), T3S1 (N:P:K + 15 x 15 cm), T3S2 (N:P:K + 15 x 10 cm), T3S3 (N:P:K + 10 x 10 cm), T0S0 (Control). The seedlings were raised by preparing the raised beds at dimension of 3.0 x 1.2 x 0.15 m and by applying 40 kg of well rotten farmyard manure and 0.5 kg di-ammonium phosphate per bed. The beds were perfectly levelled and then onion seeds were sown in line sowing. Forty five days old, uniform and healthy seedlings were used for transplanting. The transplanting was done at the different spacing as mentioned in the treatments. At the time of transplanting, upper one third portions of leaves were removed to decrease the rate of transpiration. Nitrogenous fertilizers viz. Urea, CaNO3 and 19:19:19 (N: P: K) were applied at three split doses as mentioned in the treatments. Half dose of nitrogen was applied as basal dose and remaining half dose in split doses were given after 30 and 60 days of transplanting respectively. First light irrigation was given just after planting. The subsequent irrigation was given according to climatic requirement. To keep the plots free from weeds and to thrash the soil, first weeding was done after one month in all treatments. Four weeding's were done in each plot at different intervals.

To harvest the crop irrigation was stopped before two weeks of harvest. Bulbs are harvested when 50% top leaves collapsed.Observations were recorded on growth and yield parameters.The data on quantity observations recorded were subjected to statistical analysis by using OPSTAT data analysis online software(Sheoran *et al.,* 1998).

Results and Discussion

Effect of fertilizers and spacing on growth parameters

Plant height

Data presented in table 1 that wider spacing and nitrogenous fertilizers had significant effect on plant height. In the present investigation, maximum plant height at 30, 60, 90 and 120 days after transplanting was recorded in T2S3 and minimum in T3S1, T1S1. Results showed that plant height was highest in T2S3 ($CaNO_3$ with 15 x 10cm spacing). It is might be due to the effect of wider spacing in which plant can grow freely with proper utilization of nutrients and water from the soil as well as with nitrogenous fertilizer responsible for vegetative growth of the crop. Results were in conformity with Ahmed *et al.,* (2017), Gebretsadik and Dechassa (2016), Abuga (2014), Ghoname *et al.,* (2007) reported maximum plant height in wider row spacing with nitrogenous fertilizers.

Number of leaves

In the present experiment mean value of number of leaves after 30 days of planting was ranged from 2.7 to 3.34 (table 1). Result revealed that T3S3, T2S3, T1S3, T3S2, T1S2 and T2S1 were significantly superior to control. Number of leaves after 60 days of planting was ranged from 3.93 to 4.80. T1S3 shows maximum number of leaves (4.80) and minimum TISI (3.94). Results revealed that T1S3was significantly superior in comparison to control while T2S3 were statistically similar. Number of leaves after 90 days of transplanting was ranged from 5.00 to 5.64. T2S3 shows maximum number of leaves (5.64) and minimum in T2S1 (5.00). Results showed that T2S3 (5.64) was statistically similar with control. Number of leaves after 120 days of transplanting was ranged from 6.87 to 8.00. T2S3 shows maximum number of leaves (8.00) and minimum (6.87) in T2S1. Results observed that T2S3was significantly superior in comparison to control. Number of leaves was highest in T1S3, T2S3 and T3S3 might be due to the effect of wider spacing in which plant can grow freely with proper utilization of nutrients and water from the soil and with nitrogenous fertilizer responsible for vegetative growth of the crop. Additionally, plants also used maximum sunlight efficiently to put up better growth than those having closer spacing. Results were in conformity with Abuga (2014), Ghoname *et al.*, (2007), Naik and Hosamani (2004).

Effect of fertilizers and spacing on yield parameters

Fresh bulb weight (kg)

It is an important yield parameter of onion, in current study fresh bulb weight was ranged from 95.89kg to 135.49kg. T3S3 shows maximum weight of fresh bulb (135.49) and minimum (95.89) in T2S3. Results revealed that all the treatments, 'T3S3, T1S3, T3S1, T2S1, T1S1, T3S2, T1S2, T2S2 and T2S3 were statistically superior to control. Fresh bulb weight was maximum in T3S3 (15×10) might be due to the less plant population per unit area. Results was conformity with Gupta (1991) reported high fresh bulb weight at 15×10 spacing.

Table.1 Mean value for growth parameters

Treatment	Plant height (cm)				Number of leaves per plant			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T0S0	19.72	30.65	44.35	59.23	3.14	4.40	5.54	7.60
T1S1	18.13	22.82	39.67	59.17	3.07	3.94	5.14	7.54
T1S2	18.22	26.95	41.64	59.01	3.20	4.27	5.14	7.34
T1S3	19.80	29.97	42.98	61.07	3.34	4.80	5.27	6.87
T2S1	17.23	25.69	44.67	62.83	3.00	4.14	5.00	7.47
T2S2	17.34	26.34	43.84	59.72	2.74	4.20	5.20	7.34
T2S3	20.35	31.85	46.74	63.02	3.34	4.74	5.64	8.00
T3S1	15.50	26.63	44.75	60.91	2.94	4.27	5.27	7.34
T3S2	19.87	29.27	45.80	63.66	3.20	4.27	5.34	7.34
T3S3	20.06	29.01	45.26	61.33	3.34	4.34	5.27	7.34
C.D	2.65	3.73	1.33	2.06	0.27	0.38	0.20	0.16
SE (m)	8.22	1.25	0.44	0.69	0.09	0.13	0.07	0.05
C.V	0.88	7.73	1.75	1.95	4.92	5.03	2.19	1.21

Table.2 Mean value for yield parameters

Treatment	Fresh bulb weight (kg)	Bulb diameter (cm)	Bulb yield (t ha^{-1})
T0S0	83.65	3.93	23.74
T1S1	111.49	4.68	18.22
T1S2	98.07	4.66	37.66
T1S3	124.68	5.13	32.53
T2S1	123.76	5.32	34.04
T2S2	95.93	4.84	31.89
T2S3	95.89	5.09	21.44
T3S1	124.38	5.12	28.39
T3S2	108.97	5.18	32.74
T3S3	135.49	5.46	31.89
C.D.	1.43	0.14	6.46
SE(m)	0.48	0.05	2.16
C.V.	0.75	1.69	12.78

Bulb diameter (cm)

In the present investigation mean value of bulb diameter was varied from 3.94 cm to 5.46 cm. T3S3 showed maximum bulb diameter (5.46) and minimum in T0S0 (3.94). It was noticed that T3S3, T2S1, T3S2, T1S3, T3S1, T2S3, T2S2, T1S1 and T1S2 were significantly superior values as compare to control. Results were in conformity with Islam *et al.*, (2015) indicated increased bulb diameter with wider spacing and minimum in closure spacing in combination with N: P: K fertilizer application. Bulb diameter was maximum in T3S3 (15×10) due to wider spacing plant produced large size bulbs.

Fresh bulb yield (t ha^{-1})

In the current study the total bulb yield differed significantly by different spacing. Fresh bulb yield was ranged from 18.22kg to 37.66kg. Results observed that T1S2, T2S1, T3S2, T1S3, T3S2 and T2S2 were significantly different in comparison to control while T3S1 was statistically similar. Fresh bulb yield was maximum in T1S2 (10×10) might be due to more number of bulb produced per unit area. Plants also have used maximum nutrients for production of more number of bulbs. Result was in conformity with Karsanbhai (2003) and Misra *et al.*, (2016) showed high yield at less spacing (10×10cm). Response to use of urea and calcium nitrate mixture as a source of nitrogenous fertilizers with decreasing spacing (15x10cm and 10x10cm) significantly increased the yield of the highest fresh bulb weight and bulb diameter and bulb yield as compare to wider spacing (15x15cm) and N:P:K fertilizer. The highest yields of these parameters were achieved in treatment combination of the narrowest intra-row spacing and urea as well as calcium nitrate asa source of nitrogen. Therefore, the most economically attractive combinations for small scale farmers with low cost of production and higher benefits were application of urea and calcium nitrate along with 10-15 cm inter-row spacing in the study area.

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