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Effect of Bio-fertilizers on Growth, Yield and Quality Traits of Onion *(Allium cepa* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was conducted in the sandy loam soils during *Rabi* season in 2015-16 at Horticulture Research Farm-II of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University Lucknow (UP), India to study the Effect of Bio-fertilizers on Growth, Yield and Quality Traits of Onion *(Allium Cepa* L.). The experiment was laid in Randomized block design with three replications. The treatments consists of T_1 (control), T_2 (Azotobacter 50% + Azospirillum 50%), T_3 (Azotobacter 50% + PSB 50%), T_4 (Azospirillum 50% + PSB 50%), T_5 (Azospirillum 50% + VAM 50%), T_6 (NPK 100%, T_7 (NPK 50%), T_8 (Azotobacter 50% + NPK 50%), T_9 (VAM 50% + PSB 50%), T_{10} (VAM 50% + NPK 50%), T_{11} (*Azotobacter* 50% + VAM 50%) and T_{12} (Azospirillum 100%). The execution of treatment T_6 recorded significantly highest plant height, the number of leaves per plant, quality parameters and bulb yield (401.97 q/ha) and yield attributes over the rest of the treatment.

Keywords: Bio-fertilizer; fertilizer; growth; variety; yield.

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1. INTRODUCTION

The onion (*Allium cepa* L.) is an important bulbous comes under the vegetable and spices crop. According to Hasegawa et al. [1] centre of origin is central Asia, however, its cultivation is widespread in many countries around the world. India is the second-largest producer of onion next to China in the world. India shares 22.18 % of the area and 18.78 % of the production. In India, it is being grown in an area of 0.83 mha with 13.57 million tone production and average productivity is 16.30 t/ha. Maharashtra is the leading state in onion production in India and other important states are Karnataka, Gujarat, Bihar, Madhya Pradesh, Andhra Pradesh, Rajasthan, Haryana, Uttar Pradesh and Tamil Nadu [2]. In terms of income, onion is the second most important vegetable crop after tomato in the world [3]. Onion because of its common use in kitchen regarded as "Queen of Kitchen" (Selviraj, 1976). Onion is characterized by the presence of S- containing alkaloid (Allyl Propyle disulphide) (Nguven and Nhu, 1989) which imparts it a distinctive smell and pungency and have antibacterial and antiseptic properties (Duke and Ayensu, 1985). The demand for onion continuously increasing in domestic as well as in international market required intensive cultivation practices with high yielding varieties. The indiscriminate use of synthetic fertilizers resulted in soil degradation, deterioration of soil health; decline in the quality of the product which may lead human health hazards and unstable production. For sustainable production and productivity as well as quality, use of organic manure and bio-fertilizers may be the alternative means [4]. Therefore, the integrated use of different nutrients management options has become necessary for increasing productivity of onion by sustaining the soil productivity. Biofertilizers are biologically active products or microbial inoculants of bacteria, algae and fungi which may help in biologically fixed atmospheric N_2 and help in mobilization of other nutrients. It includes a range of nitrogen fixers, *viz*., *Rhizobium*, *Azotobacter*, *Azospirillium*, blue-green algae and *Azolla*, Phosphate solubilizing bacteria (PSB), phosphate solubilizing fungi and Vesicular Arbuscular Mycorrhizae (VAM). Out of these the importance of *Azotobacter* and *Azospirillium* has been well recognized for vegetable crops. Besides, there are other biofertilizers, Besides increasing phosphate levels, To find out the effect of biofertilizers on vegetative growth parameters of onion cv. Nasik Red. With this background of investigations, an attempt has been made to investigate the effect of bio-fertilizer with chemical fertilizer on plant growth, yield and quality of Rabi season onion. cv. Nasik Red.

2. MATERIALS AND METHODS

The experiment was conducted at Horticulture Research Farm - II of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University situated at Vidya Vihar, Raebareli Road, Lucknow- 226 025, UP, India. Geographically university is situated at an elevation of 111 meters above Mean Sea Level (MSL) in the subtropical climate of central Uttar Pradesh at 26.56° North latitude and 80.52° East longitudes. The climate of the region is subtropical with maximum temperature ranging from 22°C to 45°C in summer, minimum temperature ranging from 3.5°C to 15°C in winter and relative humidity ranging from 60-80% in different seasons of the year. The soil was sandy loam well-levelled field having proper drainage and slightly alkaline in reaction pH ranging from 7.5 to 8.5. The experiment was laid out in a randomized block design (RBD) having three replication. The treatments consists of T_1 (control), T_2 (*Azotobacter* 50% + *Azospirillum* 50%), T_3 (*Azotobacter* 50% + PSB 50%), T_4 (*Azospirillum* 50% + PSB 50%), T_5 (*Azospirillum* 50% + VAM 50%), T_6 (NPK 100%), T_7 (NPK 50%), T_8 (*Azotobacte*r 50% + NPK 50%), T_9 (VAM 50% + PSB 50%), T_{10} (VAM 50% + NPK 50%), T_{11} (*Azotobacter* 50% + VAM 50%) and T_{12} (*Azospirillum* 100%). The onion variety used in the experiment was "Nasik Red". The Seedlings were raised in the nursery. The nursery was raised in the uniform seedbed of 1.0 m width and convenient length prepared by mixing fully decomposed FYM (3-4 kg m^2). The 45 days old seedlings of uniform growth were transplanted in evening hour at a spacing of 15x10 cm in flatbeds. The gross plot size was 0.90 m x 0.80 m. The recommended plant protection measures were taken as and when required. The recommended dose of phosphorus and potash were applied at the time of transplanting. Half of the nitrogen was applied as the basal and remaining half of N was applied 45 days after planting. Bio-fertilizer was applied, next days after transplanting per treatment as required in each plot. The growth parameters viz., the height of the plant and the number of leaves were recorded at 30, 60 and 90 days after transplanting. after maturity, onion bulb dug out and recorded the neck thickness (cm), the

diameter of the bulb (cm), number of scales per bulb, the yield of the fresh bulb (kg/plot), the yield of the fresh bulb (q/ha), Total Soluble Solids (°B), Ascorbic acid (%), and all sugars (%) was recorded. Data regarding the height of five tagged plants was measured with the help of meter-scale at 30, 60, 90 days after transplanting and the mean value of plant height has been presented.

3. RESULTS AND DISCUSSION

3.1 Growth Parameter

The maximum plant height at 30 DAT (Table 1) was recorded by the application of treatment T_6 (NPK 100%) followed by T_{11} (*Azotobactor* 50% + VAM 50%) however, at 60 and 90 DAT, T_{11} (*Azotobactor* 50% + VAM 50%) recorded maximum plant height T_6 (NPK 100%) and minimum in the T_1 (control). Ghanti and Sharangi [5] also found that the height of the plant was maximum (43.46 cm) with the application of *Azotobacter*+VAM on onion cv. Sukhsagar. These findings are in agreement with Mandhare et al*.* [6] and Schmitz et al. [7]. The maximum number of leaves per plant at 30 DAT (Table 1) was maximum in treatment T_6 (NPK 100%) followed by T_{11} (*Azotobactor* 50% + VAM 50%) however, at 60 and 90 DAT T_{11} (*Azotobactor* 50% + VAM 50%) recorded the maximum number of leaves per plant followed by T_6 (NPK 100%). The minimum number of leaves per plant was found where no treatment was applied in T_1 (control). Martinez et al. [8] reported that application of *Azotobactor* treatment increased 22.24% leaf number. The significant increase in plant height, length of leaves might be due to mineral form of nitrogen application in soil increased the potential of soils and consequently affects plant production. The Azospyrillum and VAM seed treatment help in better root proliferation which in turn helps phosphate availability in soils and uptake of other nutrients to the greater extent. So cell division and cell enlargement which increase cell size might have helped in plant height and number of branches. The neck thickness of bulb among various treatments was found significant at all growth stage over control (Table 2). The neck thickness of the bulb was recorded at 90 DAT revealed treatment T_6 (NPK 100%), showed the maximum neck thickness (1.80 cm) which is Followed by T_8 (*Azotobacter* 50% + NPK 50%) and minimum neck thickness was observed in T_4 (*Azospirillum* 50% + PSB 50%). The report of Yogita and Ram [9] also have a similar conclusion with the application of NPK 100%. The diameter of bulb and number of scales is maximum in T_7 (NPK 100%), T_8 (*Azotobactor* 50% + NPK 50%). Sharma et al*.* [10] experimented and have found a similar conclusion. The result may be due to the role of mineral fertilizers on the promotion of onion plant growth and the role of biofertilizers on increasing the availability of nitrogen and phosphorus to onion plant for observation with 100% of NPK fertilizers. A similar result of the superiority of chemical fertilizers (100% NPK) was obtained by Desuki et al*.* [11].

3.2 Yield Attributes

The data in respect to yield attributes *viz.* fresh bulb weight, fresh bulb yield presented in Table 2, showed that all the treatment have a significant effect over the control. Among the treatment, T_6 (NPK 100%) gave the maximum fresh bulb weight (150.05 g) and bulb yield (401.97 q/ha) Followed by the treatment T_8 (Azotobactor 50% + NPK 50%) with fresh bulb weight (120.28 g) and fresh bulb yield (333.16 q/ha). The increased yield might be due to increased growth attributes and better accumulation of photosynthetic. According to Lal, et al*.* [12] also reported an increase in yield attributes due to the combination of fertilizers and biofertilizers.

3.3 Quality Characters

All the treatment recorded significantly high brix per cent than control (Table 2). Among the treatment total soluble solids (°B) is recorded highest (14.33 °B) in T_6 (NPK 100%) Followed by T_{12} (*Azosprillium* 100%) 14.24°B. Manna et al*.* [13] studied that the interaction effect of chemical and bio-fertilizers on growth, yield and quality of onion observed that total soluble solids (13.83°B) and Pyruvic acid (4.16 µ mol/g) was recorded in treatment with 75% RDF+PSB+*Azospirillum*. Ascorbic acid was found maximum (10.53%) in treatment T_{12} (*Azospirillum*) Followed by treatments T_6 (NPK) 10.42% whereas minimum ascorbic acid (7.65%) is found in treatment T_{10} (VAM 50% + NPK 50%). In respect to total sugars data revealed that the maximum sugar in treatment T_{10} (VAM 50% + NPK 50%) Followed by treatments T_8 (Azotobactor 50% + NPK 50%) whereas minimum sugar is found in treatment T_7 (NPK 50%). Yogita and Ram [9] have been observed maximum ascorbic acid, reducing sugar and total sugars were found with the application of T_{11} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha Azotobacter + 2kg/ha Phosphobacteria) [14].

Table 1. Effect of bio-fertilizers on growth parameters on onion

Treatments	Plant height (cm)			Number of leaves			Neck thickness of Bulb (cm)
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	
T_1	23.43	37.29	48.87	4.40	3.87	7.07	1.17
T_2	25.55	41.33	53.36	5.07	4.60	7.53	1.65
T_3	23.80	41.76	55.21	4.67	4.40	7.47	1.40
T_4	24.13	41.98	55.11	4.93	4.33	7.67	1.36
T_5	25.38	44.61	59.92	4.87	4.53	7.47	1.59
T_6	28.33	45.82	61.70	5.40	4.73	7.80	1.80
T_7	26.11	42.16	55.85	4.87	4.53	7.53	1.60
T_8	26.29	43.63	58.18	5.07	4.40	7.47	1.67
T_9	23.82	42.39	54.77	4.80	4.47	7.53	1.42
T_{10}	25.95	43.31	56.64	4.87	4.47	7.73	1.59
T_{11}	26.30	47.51	65.38	5.27	5.07	8.07	1.54
T_{12}	24.66	43.86	54.99	4.87	4.67	7.47	1.58
S.E.M.	0.53	1.21	1.27	0.08	0.12	0.13	0.10
C.D. 5%	1.56	3.57	3.72	0.24	0.36	0.39	0.29

Table 2. Effect of bio-fertilizers on yield and quality parameters on onion

Treatments	Bulb weight (g)	Number of scales/bulbs	Bulb yield q/ha	Bulb diameters (cm)	T.S.S (^{0}Brix)	Ascorbic acid (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total Sugars (%)
T_1	92.57	7.44	227.87	6.06	11.16	7.71	6.22	10.05	16.28
T_2	117.50	8.15	330.99	6.69	13.55	9.85	5.83	9.77	15.60
T_3	109.40	8.18	312.50	6.72	12.68	9.47	7.18	11.44	18.62
T_4	99.35	8.47	290.75	6.31	14.22	10.40	5.79	9.72	15.51
T_5	112.32	7.85	321.51	6.56	13.29	9.39	6.40	10.35	16.75
T_6	150.05	8.48	401.97	7.19	14.33	10.42	6.95	10.67	17.62
T_7	114.21	9.50	324.26	6.65	12.45	8.71	5.59	9.66	15.25
T_8	120.28	8.57	333.16	6.75	11.62	8.38	7.50	11.46	18.97
T_9	111.87	7.81	319.45	6.47	13.42	10.34	6.57	10.61	17.18
T_{10}	111.65	8.37	325.38	6.70	10.23	7.65	8.55	12.70	21.58
T_{11}	76.34	7.81	315.40	6.44	12.29	8.69	6.49	10.58	17.07
T_{12}	107.33	8.29	322.03	6.44	14.24	10.53	6.46	10.58	17.04
S.E.M.	9.48	0.103	12.21	0.05	0.19	0.14	0.17	0.21	0.36
C.D. 5%	27.82	0.30	35.82	0.16	0.57	0.43	0.50	0.64	1.05

4. CONCLUSION

It is, therefore, concluded that the application of biofertilizers (*Azospirillum* and PSB mixture) along with 100% recommended dose of fertilizers were recommended to obtain the highest yield with a better quality of onion bulbs.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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