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Manish Kumar Singh
M. Sc. Research Scholar, Dept. of Horticulture, Faculty of Agriculture, Udai Pratap Autonomous College, Bhojubir, Varanasi (U.P) India

Nishant Srivastava
M. Sc. Research Scholar, Dept. of Agronomy, Naini Agricultural Institute, Faculty of Agriculture, SHUATS, (U.P) India

Rohit Kumar Singh
M. Sc. Research Scholar, Dept. of Horticulture, Udai Pratap Autonomous College, (U.P) India

Correspondence
Manish Kumar Singh
M. Sc. Research Scholar, Dept. of Horticulture, Faculty of Agriculture, Udai Pratap Autonomous College, Bhojubir, Varanasi, (U.P) India

Integrated effect of biofertilizers and inorganic fertilizers on growth, yield and quality of onion (*Allium cepa* L.)

Manish Kumar Singh, Nishant Srivastava and Rohit Kumar Singh

Abstract

A field experiment was conducted during *Rabi* season of 2015 at Vegetable Research Farm, Department of Horticulture, Udai Pratap College, Varanasi. The experiment consisted 16 treatment combinations *viz*. T_1 - N+P+K (100% Recommended Full Does), T_2 -75% N+P+K+25% Azotobacter, T_3 -50% N+P+K+50% Azotobacter, T_4 -25% N+P+K+75% Azotobacter, T_5 - N+75%P+K+25% PSB, T_6 - N+50%P+K+50% PSB, T_7 - N+25%P+K+75% PSB, T_8 -75%N+75%P+K+25%, T_9 - 50%N+50%P+K+50% Azotobacter+50%PSB, T_{10} -25%N+25%P+K+75% Azotobacter+75%PSB, T_{11} - 75%N+50%P+K+25% Azotobacter+50%PSB, T_{12} -50%N+75%P+K+50% Azotobacter+25%PSB, T_{13} - 25%N+50%P+K+75% Azotobacter+50%PSB, T_{14} -25%N+P+K+75% Azotobacter+25%PSB, T_{15} - 75%N+25%P+K+25% Azotobacter+75%PSB and T_{16} -50%N+25%P+K+50% Azotobacter+25%PSB Azotobacter+25% PSB, which was laid out in randomized block design (RBD) with three replications. The result revealed that the application of 50:45:100 kg NPK/ha and inoculation of field with 1.25 ± 0.62 kg/ha Azotobacter and PSB significantly recorded the higher bulb yield of 303 q/ha.

Keywords: Biofertilizers, Inorganic, Azotobacter, PSB, Onion.

Introduction

Vegetables form the most important component of a balanced diet and act as a protective food. India occupies a prime position in the world in vegetable production and is 2 nd largest producer of vegetable next to china. India produces about (168.30) million tones of vegetables from an area of (9.541) miliion hectares,and productivity (17.64q/h) which is far below to the desired requirement (300g/capita/day) to fulfill the need of the growing population. Onion is one of the most important vegetable cum condiment crop grown throughout the world including India. Onion *(Allium cepa* L.) is a cultivated annual herb of Alliaceae family, grown for its underground bulbous stem which can also help the plant for perennial succession. India occupies an area of 1.203 mha with productionof 19.401 MT of onion (2015). In India, the major onion producing states are Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Bihar, Orissa, Tamil Nadu, Uttar Pradesh, Madhya Pradesh and Rajasthan. These states together accounts for 96 percent of total area and 85 percent production of onion in the country. Maharashtra is the leading producer of onion Share 30% of the total production.

Among the availability of macro nutrients it is evident that nitrogen is the most deficient element in the soil. Availability of nitrogen is of prime importance for growing plants as it is a major and indispensable constituent of protein and nucleic acid molecules. It is an integral part of chlorophyll molecules which are responsible for photosynthesis. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs which finally leads to higher productivity. Bio-fertilizers are the inoculation of micro-organisms, which are capable of mobilizing nutritive elements from non-usable form to usable form through biological process. They are cost effective and inexpensive source of plant nutrients. Also they do not require nonrenewable source of energy during their production and improve crop growth arid quality of the product by producing plant hormones which helps in sustainable crop production through maintenance of soil productivity. *Azotobacte,* a non-symbiotic, free-living, aerobic nitrogen fixing bacteria, can substitute part of inorganic fertilizers. Azotobacter inoculation saves nitrogenous fertilizers by 10-20 per cent (Mohandas, 1999) [5]. It fixes about 25 to 30 kg/ha atmospheric nitrogen in the root region of many vegetables, spices and condiments Ramanathan (1990) [6] and Shende *et al*., (1977) [7] observed enhanced seed germination by *Azotobacter* inoculation. This is partly due to ability of Azotobacter to produce growth promoting and antifungal antibiotic substances (Mushustin and Shelniknova, 1972).

Phosphorus is the second most important nutrient after nitrogen for the growth and development of plants and microorganisms. Out of the total amount of added phosphorus fertilizer, only 10 -20 % is available to the plants, the rest remain in the Soil as insoluble phosphorus in the rock phosphate and tricalcium phosphate. PSB significantly helps in the release of insoluble inorganic phosphate and make it available to the plants. Some bacteria such as *Bacillus* and *Pseudomana* possess the ability to solubilize the inorganic phosphate and make them available to the plants by production of organic acid. These microorganism are known to produce the amino acid, vitamins and growth promoting substances like IAA, GA etc. which results in better growth and development of plants. Addition of this microorganism saves fertilizers. It also optimizes the intake of phosphorus by the plants (Chokar and Subba Rao, 1967) [2].

Therefore, keeping in view the importance of onion and it's optimal nutrient requirement to maintain sustainable production, so that the growers can get a reasonable profit and at the same time the consumer can buy it at a reasonable price, the present investigation was undertaken.

Materials and Methods

The investigation was carried out during Rabi season at Vegetable Research Farm, Department of Horticulture, Udai Pratap College is about, Varanasi 5 km away from Varanasi railway station in the North Eastern part of the Varanasi city at 25°18' North latitude, 83°03' East Longitude and about 75.7m above MSL.

The soil was sandy loam with pH 6.7, organic carbon 0.49%, available nitrogen 192 kg/ha, phosphorus 26 kg/ha and potassium 130 kg/ha. The treatment combinations *viz*. T_1 - N+P+K (100% Recommended Full Does), T_2 -75% N+P+K+25% Azotobacter, T_3 -50% N+P+K+50% Azotobacter, T_4 -25% N+P+K+75% Azotobacter, T_5 - N+75%P+K+25% PSB, T_6 - N+50%P+K+50% PSB, T_7 - N+25%P+K+75% PSB, T_8 -75%N+75%P+K+25%, T_9 - 50%N+50%P+K+50% Azotobacter+50%PSB, T_{10} - 25%N+25%P+K+75% Azotobacter+75%PSB, T_{11} - 75%N+50%P+K+25% Azotobacter+50%PSB, T_{12} - 50%N+75%P+K+50% Azotobacter+25%PSB, T_{13} - 25%N+50%P+K+75% Azotobacter+50%PSB, T_{14} - 25%N+P+K+75% Azotobacter+25%PSB, T_{15} - 75%N+25%P+K+25% Azotobacter+75%PSB and T_{16} - 50%N+25%P+K+50% Azotobacter +25%PSB Azotobacter +25% PSB which was laid out in Randomised Block Design (RBD) consisting of 16 treatment combinations with three replications; plot size was 3 x 2.6 m. Onion was sown on 30th Nov. 2015 with variety Agrifound Light Red of onion and the recommended dose was 100 kg N + 60 kg P_2O_5 + 100 kg K_2-O/ha. Nitrogen was applied as per treatment through urea, half as basal dose and remaining half at 40 days after transplanting. Phosphorus and potassium was applied through single super phosphate and murate of potash respectively just before transplanting. About seven weeks old seedlings having of 10 to 15 cm height were transplanted at 20 x 10 cm spacing. The transplanting was done on 24.01.2016. The other usual common packages of practices were followed time to time and periodical growth observations were recorded. Harvesting was done manually by hand digger at neck fail stage. The harvested bulbs along with tops were weighed and subjected to other observations.

Results and Discussion

Growth Parameter

The data on plant height as presented in table 1 revealed that the onion plants attained significantly maximum height 46.28 cm after 105 DAT, respective in the treatment T_{12} which received 50:45:100 kg NPK/ha and application of 1.25 kg/ha Azotobacter and 0.62 kg PSB/ha followed by T_3 which received 50:60:100 kg NPK/ha with application of 1.25 Kg/ha *Azotobacter*/ha and height was recorded 45.28 cm at 105 DAT.

The data regarding leaf length are presented in Table 1. The leaf length of onion plant was found significantly higher 46.28 cm in the treatment combination of T_{12} i.e., 50:45:100 Kg NPK/ha +1.25 kg *Azotobacter* + 0.62 kg PSB/ha as compared to other treatments. The second best treatment was T_3 which received 50:60:100 kg NPK/ha + 1.25 kg/ha *Azotobactor* which recorded 45.28 cm leaf length at 105 DAT.

The significant increase in plant height and leaf length at harvesting stage were observed due to inoculation of *Azotohacter* and PSB (Table 1), which improved nitrogen status of the soil as it is a free nitrogen fixer and PSB increases the availability of phosphorus in the soil resulting in higher uptake of phosphorus due to increase in the solubility and mobilization of insoluble soil phosphorus. Thus, efficient and healthy strain of Azotobacter and PSB in Rhizosphere have resulted in greater fixation of atmospheric nitrogen, increased the availability of phosphorus for use by the plant, resulting in vigorous growth of plant. Similar results have been reported by Dibut *et at*., (1993) [3] and Martinez *et al.*, (1994) [4].

Yield and Yield attributes

As revealed by data all the treatments were found significant over the control except T_6, T_7 and T_{11}. The equatorial diameter of bulb increased significantly in the treatment T_{12} (50:45:l00 Kg NPK/ha + 1.25 kg Azotobacter + 0.62 kg PSB/ha) over all other treatments and it was recorded 5.45 cm but it was statistically at par with treatment T_{13} (25:30:100 kg NPK/ha+ 1.87 kg *Azotobacter* + 1.25 kg PSB/ha) and T_4(25:60:100 kg NPK/ha and *Azotobacter* @ 1.87 kg/ha) and recorded 5.36 and 5.33 cm equatorial diameter of bulb, respectively.

The data regarding number of scales per bulb are presented in Table 1 showed that the maximum number of scales per bulb was found 8.62 attained in T_{12} which received 50:45:100 kg NPK/ha with 1.25 and 0.62 Kg/ha Azotobacter and PSB respectively. But statistically at par with treatment T_9 with number of scale 8.28which receive 50:30:100 kg NPK/ha + 1.25 Kg/ha Azotobacter and PSB both.

A perusal of data revealed that volume of bulb was significantly affected by application of different levels of nitrogen, phosphorus and bio fertilizers (Table 1).The result showed that the maximum bulb volume was 62.28 cc in T_{12} which received 50:45:100 Kg NPK/ha with 1.25 and 0.62 kg/ha *Azotobacter* and PSB respectively but statistically at par with T_8 in which the inorganic fertilizers were used @ 75: 45:100 Kg NPK/ha and 0.62 Kg/ha *Azotobacter* and PSB both.

It is apparent from table 1 that treatments T_2, T_8, T_{11} and T_{12} showed significant difference for the dry weight of bulb over the control. The maximum dry weight was recorded 16.69 g in the treatment combination of T_{12} which were receiving 50:45:100 kg NPK/ha and inoculated with 1.25 and 0.62 kg/ha *Azotobcter* and PSB respectively but it was statistically at par with treatment T_8 which received 75:45:100 kg NPK/ha' and 0.62 kg/ha *Azotobacter* and PSB each and recorded 15.89 g dry weight of bulb.

The result showed that the treatment T_{12} produced highest fresh weight bulb (60.46 g) over the other treatments which were supplied with 50:45:100 kg NPK/ha with 1.25 kg/ha *Azotobacter* and 13.62 kg PSB/ha. But it was statistically at par with T_4 (25:60:100 kg NPK/ha + 1.87 kg/ha *Azotobacter*) and T_8 (75:45:100 kg NPK/ha + 0.62 kg/ha *Azotobacier* and PSB both) with 54.52 and 54.21 g fresh weight of bulb, respectively.

Data pertaining to yield of bulb (q/ha) are presented in Table 1. The result showed that the maximum yield 303.92 q/ha attained in T_{12} which received 50:45:100 kg NPK/ha with 1.25 and 0.62 kg/ha Azotobacter and PSB respectively, followed by T_4which received 25:60:100 kg NPK/ha + 1.87 kg/ha *Azotobacter* and recorded 272.82 q/ha average bulb yield.

Results of the present investigation revealed that the application of *bio-fertilizers* with *Azotobacter* significantly increased bulb diameter, number scale per bulb, fresh weight of bulb, volume of bulb and bulb yield (Table 1).

The fact that *Azotobacter* is known to produce antifungal, antibiotic substances that inhibit the activities of various type of soil fungi It can also synthesize and secrete thiamin, riboflavin, pyridoxin, cyanocobalamine, nicotinic acid, pentathenic acid, indole acetic acid and gibberellins or gibberellin like substances resulting in vigorous plant growth and dry matter production which in turn resulted in better fertilization, bulb development and ultimately the higher yield. Similar results have also been reported by Dibut (1993) [3] and Bhonde *et al*. (1997) [1].

Azotobacter inoculation helped in increasing nitrogen availability, because it is a micro *aerophillic* nitrogen fixer. It colonizes the root mass, fixes nitrogen in loose association with plants and these bacteria induce the plant root to secrete a mucilage which create low oxygen involvement and helps to fix atmospheric nitrogen which refracted in the better yield attributes and PSB increases the availability of phosphorus for growth and development of plant and phosphorus enhances the plant resistance.

Soil application method of bio-fertilizer proved most efficient inoculants to increase yield attributes and yield. These results are in close conformity with the findings of Joi and Shende (1977) [7] and Bhonde *et al*. (1997) [1].

The highest TSS 12.28 % was recorded in treatment T_{12} which were treated with 50:45:100 kg NPK/ha, 1.25 kg/ha Azotobacter and 0.62 kg/ha PSB, Followed by treatment combination (T_{13}) which received 25:3 0: 100 kg NPK/ha + 1.87 kg Azotobacter /ha + 1.25 kg PSB/ha? The lowest TSS 10.62 % was noted in controlled condition (T_1) where no biofertilizer were used.

Bio-fertilizer application had non-significant effect in influencing sulphur content and pungency. This might be due to the fact that there was a poor establishment of source to sink mechanism with plant system.

On the basis of one year experiment it can be concluded that the application of 50:45:100 kg NPK/ha and inoculation of field with 1.25 ± 0.62 kg/ha Azotobacter and PSB significantly recorded the higher bulb yield of 303 q/ha.

Table 1: Integrated effect of bio-fertilizers and inorganic fertilizers on growth, yield and quality of onion.

Treatments	Plant height (cm)	Leaf length (cm)	Equatorial Diameter (cm)	Number of scales/ bulb	Volume of bulb (cc)	Dry weight (g/100g)	Fresh weight of bulb (g)	bulb yield (q/ha)	TSS ^{0} Brix
1. N+P+K (100% Recommended Full Does)	37.62	37.62	4.31	5.62	43.28	13.38	42.58	204.28	10.62
2.75% N+P+K+25% Azotobacter	41.95	41.95	5.08	8.28	50.78	15.74	45.98	230.12	11.62
3. 50% N+P+K+50% Azotobacter)	45.28	45.28	5.13	6.95	53.53	14.31	49.63	248.38	11.62
4. 25% N+P+K+75% Azotobacter	41.95	45.28	5.33	7.28	55.56	14.77	54.52	272.82	11.12
5. N+75%P+K+25% PSB	39.62	37.62	4.96	7.95	51.83	13.53	47.19	236.15	11.45
6. N+50%P+K+50% PSB	43.28	43.28	4.92	6.28	53.31	13.88	48.77	243.18	11.78
7. N+25%P+K+75% PSB	38.56	38.62	4.35	6.62	43.59	13.59	41.62	222.83	10.78
8. 75%N+75%P+K+25% Azotobacter+25%PSB	42.28	42.28	5.34	6.95	57.26	15.89	54.21	271.28	11.82
9. 50%N+50%P+K+50% Azotobacter+50%PSB	42.95	42.95	5.08	8.28	50.48	14.70	45.58	228.12	11.45
10.25%N+25%P+K+75% Azotobacter+75%PSB	42.28	38.62	4.98	6.28	54.40	13.75	49.38	247.12	11.28
11.75%N+50%P+K+25% Azotobacter+50%PSB	42.62	42.62	4.39	8.28	45.77	15.55	44.52	220.78	11.95
12.50%N+75%P+K+50% Azotobacter+25%PSB	46.28	46.28	5.45	8.62	62.28	16.69	60.46	303.92	12.28
13.25%N+50%P+K+75% Azotobacter+50%PSB	45.28	45.28	5.36	8.28	55.82	14.72	51.18	256.12	11.95
14. 25%N+P+K+75% Azotobacter+25%PSB	42.28	42.28	5.09	8.28	54.32	14.85	49.94	250.65	10.95
15.75%N+25%P+K+25% Azotobacter+75%PSB	40.28	40.28	4.99	6.62	53.87	14.34	49.56	248.02	11.78
16.50%N+25%P+K+50% Azotobacter+25%PSB	44.28	44.28	5.21	7.62	55.52	14.80	51.03	255.38	11.28
CD (P = 0.05)	0.03	0.02	0.12	0.02	0.02	0.03	0.02	0.05	0.02

References

1. Bhonde SR, Sharma SB, Chougule AB. Effect of bio-fertilizer in combination with nitrogen through organic and inorganic source on yield and quality of onion. News Letters, Na. Hort. Res. Deb. Found. 1997; 17:1-3.
2. Chokar PK, Subba Rao NS. Phosphorus solublization by fungi associated with legume rootnodule. Canadian J. Microbbio. 1967; 13:749-753.
3. Dibut B, Martinez R, Gonzalez R. Stimulation of growth and yield of onions by bacterization in red ferralliticsolils. La Habana, Cuba, Instituto Nacional de Investigacioners de la Cana de Azucar (INICA), 1993, 223-225.
4. Martinrz R, Dibut B, Gonzalez R, Acosta C. Effect of the application of biopreparations based on Azotobacterchroococcum on tomato and onion crops in red ferrallitic soils. 90- anos-de-la-Estacion-Experimental- Agro- nomica- de- Santiago –de- las-Vegas, 1994, 167-184.
5. Mohandas S. Bio-fertilizer of horticultural crops. Indian Hort. 1999; 43(4):32-37.
6. Ramanathan M. Bio-fertilizer boost species yield. Spice India. 1990; 2(6):2-3.
7. Shende ST, Apte RG, Singh T. Influence of Azotobactore on germination of rice and cotton seed. Current Science. 1977; 46:15-18.