Plant Archives Vol. 19 No. 1, 2019 pp. 772-776 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

IMPACT OF BIO-FERTILIZER ON GROWTH, YIELD AND QUALITY OF ONION (*ALLIUM CEPA* L.) CV. PUSA RED

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Abstract

The experiment consisted of twelve treatments *viz.* control, FYM (100%), V.C. (100%), FYM (50%) + Neemcake (50%), Rhizobium (50%) + V.C (50%), *Azotobactor* (50%) + Neemcake (50%), PSB(50%) + *Trichodarma* + *Azotobactor* (25%), *Trichodarma* (100%), PSB (25%) + Rhizobium (25%) + *Trichodarma* (50%), V.C (25%)+ Neemcake (50%) + *Trichodarma* (25%), FYM (25%) + V C(25%) + *Trichodarma* (50%),V.C (50%) + Neemcake (25%) + *Trichodarma* (25%). The results revealed that combined application of PSB (25%) + Rhizobium (25%) + *Trichodarma* (50%) increase the maximum height of plant, number of leaves per plant, bulb diameters, neck thickness of bulb, length of bulb, number of scales, fresh weight of bulb, total soluble solid (T.S.S.) except weight of bulb and yield in treatments *Trichodarma* (100%) under Lucknow conditions.

Key words : *Allium cepa* L., cultural practices, climatic factors, crop yield

Introduction

Onion (*Allium cepa* L.) is one of the most important commercial crops among vegetable, spice and condiments in India. It is an important bulb crop cultivated all over the world on commercial scale both for local consumption and export. It was cultivated in more than 175 countries, on nearly 3 million ha, producing more than 50 million tonnes. India is the second largest producer after China in India producing 20333 MT, an area 1178 million ha and productivity 16.3 MT/ha (NHB Database, 2014-15). Gujarat, Madhya Pradesh, Orissa, Rajasthan Tamilnadu Bihar and Maharashtra, it is state cover of maximum area and production of onion in India. Maharashtra is largest producer of onion in the country with is about 30 lakh MT production from 1.03million ha which is about 25 per cent to the production and 20 per cent to the total area the onion production depend mainly on area cultural practices like nutrition irrigation plant protection measure beside the congenial climatic factors.

It is especially rich in protein, carbohydrate and ascorbic acid. About 38 kcal. Calories of energy is obtained from 100g onion .Nutritive value of onion (nutritive value per100 g onion scales) water (89 g) lipids (0.16 g) carbohydrate (8.6 g) fibre (1.8 g) potassium (157 mg) sulphur (70 mg)phosphorus (33gm) calcium (20gm) vitamin C (6.4 gm.) vitamin E (0.26 gm.) vitamin B6 (0.116gm.) folic acid (19mcg.) glutamic acid (0.118g) argentine (0.156g) lysine (0.055g) leucine (0.041g). Bio-fertilizer have recently gained with momentum for effecting the sustainable increase the crop yield under various agro climate condition role of bio-fertilizer on the crop growth. It is using bio-fertilizer with adding mineral and organic matter led to improve of vegetative growth yield and quality of plant. Mixture of FYM and Neem cake increase the yield of onion and enriched nutrient content of bulb of onion. Thus there is ample scope for increasing production through fertilizer especially, that organic manure and bio-fertilizer in light texture soil. The microorganism involved in P solubilising can enhance plant growth by increasing the efficiency of biological nitrogen fixation, enhancing the availability of other trace element and by production of plant growth promoting substances. Bio–NP fertilizer gave significant increment in yield component of sesame plant Bio-NP ensure better nitrogen consumption. Which is essential to plant growth the *Azospirillum* bacteria and "tikbaw" convert the air born nitrogen into ammonia. Ammonia penetrates to the root zone and makes the necessary 50 per cent available needs

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of the plant available for root consumption. Also, bio NP changes unavailable P to available from in the soil through the activity microorganism Ahmed *et al*., (2015). Bio-fertilizer *i.e.* nitrobeine has greater amount of bacteria which responsible for fixation of nitrogen by atmosphere. Application of nitrobeine achieved the following merits ,decreasing the amount of mineral-N by 25 per cent and increasing the availability of various nutrient by plant moreover, the inoculation of legume seed crop with associated N-fixing with adding minerals or organic fertilizer led to improve the vegetative growth yield and quality of onion. Organic material such as farm yard manure, neem cake and bio fertilizer improve soil chemical, physical and biological that are important for plant growth. Organic farming provides several benefits to the growers. It reduces production cost and it is an environmentally friendly method of cultivation. Addition of organic fertilizer improve soil structure and enhances activates of useful soil organisms. Agricultural commodities result from organic cultivation is good for human health. Farmers are currently changing from conventional to organic farming systems which used no synthetic fertilizer and pesticide Colla *et al.,* (2002). Trichoderma is a genus belongs to the filamentous class deuteromycetes. The members are generally found in all soil. The fungus is valuable source for the commercial production of enzyme and helpful in recycling cellulosic waste material while producing useful by product Samuels, (1996). *Trichoderma* can function at the same time both as microbial antagonistic and plant symbionts for these reasons, close to 20 fungal bio control preparation abroad are based on *Trichoderma*. *Trichoderma harzianum* is a saprophytic fungus which is generally used as a bio control agent against a wide range of economically important aerial and soil plant pathogen and has been extensively studies as potential bio control agents. However, some studies have also shown that it can stimulate the growth of a number of vegetable and bedding plant crops. Various species of *Trichoderma* were also effective in the promotion of growth and yield of various crops Bal and Altintas, (2006). *Trichoderma harzanum* and *Trichoderma virens* promoted growth of cucumber, muskmelon and cotton seedling Kaveh *et al*., (2011). Application of *Trichoderma* spp. was not conducive to increase yield on tomato culture for yield and quality characteristic were not enhanced by the application of *Trichoderma* spp. *Trichoderma* species can improve plant growth and development De souza *et al*., (2008). Growth stimulation is evidenced by increase in biomass productivity, stress resistance and increase nutrient absorption. *Trichoderma* spp. Can also produce metabolites with activates analogous to plant hormones.

Materials and Methods

The present investigation "Impact of bio-fertilizer on growth, yield and quality of onion (*Allium cepa* L.) cv. Pusa Red " as conduct at the Horticultural research farm of Department of Applied Plant Science (Horticulture) Babasaheb Bhimrao Ambedkar University (A Central University) Vidya Vihar, Rae Bareli Road, Lucknow Utter Pradesh during *Rabi* season (2015-16). Onion seed Pusa Red were sown on nursery beds of Horticulture Research farm, BBAU, Lucknow, Oct 2015 broadcasting methods on raised bed about 5-6 meter long, one meter width and 10 cm above ground level, was prepared. The seed beds were cover with compost. Mulches and that attached with polythene paper above the bed to protect the young seedling from adverse climate condition 45 days after sowing, bulb lets were ready for transplanting. This healthy bulb let uniform shapes and size was selected and transplanting is prepared. . The observations on height of plant (cm), number of leaves per plants, length of leaves, neck thickness, diameter of bulb (cm), length of bulb (cm), number of scales, average weight of bulb, yield (t/ha) and T.S.S. On set of the Rabi season these healthy bulb uniform shape and size were selected and transplanted well prepared field Statistical analysis of the data obtained in different set of experiments was calculated following the standard procedure as stated by Panse and Sukhatme (1989).

Results and discussion

Growth characters

Plant height (cm)

The maximum plant height (65.51 cm) was shown constantly by the treatment T_8 by application of P.S.B (25%) + Rhizobium (25%) +*Trichoderma* (50%) at 90 DAT (table 1). Followed by T_7 *Trichoderma* (100%) showed maximum plant height (63.83 cm.). Reddy and Reddy (2005) studied the effects of different levels of vermicompost (0, 10, 20 and 30 t ha^{-1}) on growth of onion (cv. N-53). The plant height, number of leaves per plant and leaf area increased significantly with increasing levels of vermicompost from 10 to 30 t/ha. Significantly higher plant height, number of seed stalks per plant in onion was recorded with the application of FYM @ 10, 15 and 20 t/ha than 5 t/ha Patil *et al*., (2007).

Number of leaves per plant

Number of leaves per plant was observed maximum (7.20) under the treatment T_8 P.S.B (25%)+ + Rhizobium (25%) + *Trichoderma* (50%) at 90 DAT (table 1). followed by recorded in (7.13) T_{10} F.Y.M (25%) + V.C

Table-1: Effect of biofertilizer on vegetative growth parameters.

Treatments	Plant height (cm)			No. of leaves (cm)			Length of leaves (cm)			Neck thickness of bulb (cm)
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	
Control	29.40	35.28	51.74	3.20	4.73	6.40	29.26	34.13	46.22	1.25
F.Y.M (100%)	32.20	40.83	56.83	4.00	5.00	6.67	30.17	39.19	49.28	1.38
V.C (100%)	34.49	42.10	59.86	4.00	5.27	6.93	30.79	39.44	51.17	1.27
F.Y.M (50%) + Neemcake(50%)	35.26	43.29	60.80	3.60	5.80	6.87	31.36	39.58	51.97	1.56
Rhizobium (50%) + V.C (50%)	34.85	42.69	61.60	4.00	5.33	6.87	31.51	41.76	51.75	1.46
Azotobacter (50%) + Neemcake (50%)	36.73	42.73	62.30	3.60	4.87	6.47	33.14	40.29	52.36	1.43
P.S.B (50%)+*Trichoderma* +*Azotobacter* (25%)	37.86	43.79	62.59	4.40	5.33	7.00	33.73	41.79	53.30	1.51
Trichoderma (100%)	40.13	44.56	63.83	4.20	5.53	6.93	35.13	41.11	51.70	1.71
P.S.B(25%)+Rhizobium(25%) +*Trichoderma*(50%)	40.74	46.15	65.51	5.00	5.93	7.20	35.18	43.39	54.56	1.72
V.C(25%)+NeemCake(50%) +*Trichoderma*(25%)	40.55	44.86	63.59	4.40	5.60	6.93	33.89	42.72	54.25	1.48
F.Y.M(25%)+V.C (25%) +*Trichoderma* (50%)	39.88	45.70	63.70	4.60	5.73	7.13	34.83	42.80	53.63	1.53
V.C(50%)+NeemCake(25%) +*Trichoderma* (25%)	40.08	45.16	63.82	4.60	5.53	7.07	34.79	42.16	53.73	1.51
S.E.(m)±	0.60	0.76	0.58	0.17	0.23	0.16	0.42	0.87	1.19	0.02
C.D. at 5% (P=0.05)	1.78	2.23	1.70	0.49	0.69	0.46	1.23	2.57	3.52	0.06

(25%) + Trichoderma (50%) and minimum number of leaves (6.40) was recorded in T_5 *Azotobacter* (50%) + Neemcake (50%) recorded significantly higher number of leaves per plant (9.20) and plant height (60.7 cm) with application of 100% NPK + FYM @ 20 t/ha + PSB + *Trichodarma* (T_6). The total dry matter also showed significant difference among treatment with maximum no of leaves and plant height on garlic.

Length of leaf (cm)

When leaf growth was studied, T_8 P.S.B (25%) + + Rhizobium (25%) +*Trichoderma* (50%) showed the maximum leaf length (54.56 cm). The treatment T_0 (control) showed the minimum leaf length (46.22cm) (table 1). Although, *Azotobacter* showed a better performance but was not comparable with *Azospirillum* in aspect of growth attributes. Majhabi *et al*., (2011).

Neck thickness (cm)

The observations recorded in case of neck thickness of bulb among various treatments were found significant at all growth stage. At 90 DAT treatment T_8 P.S.B (25%) + Rhizobium (25%) + *Trichoderma* (50%) showed the maximum neck thickness (1.72 cm), where as minimum neck thickness (1.06 cm) was recorded in T_0 (Table 1). Banjre *et al.,* (2015) recorded significantly higher neck thickness of plant (1.17) with application of 75% RDF+ *Azotobacter*.

Bulb diameter (cm)

However, the treatments indicated that treatment T_8 P.S.B. (25%) +Rhizobium (25%) + Trichoderma (50%) showed highest value (6.80 cm) as compared to all the other treatment in respect of Bulb diameter. Minimum bulb diameter was recorded (3.79 cm) in T_0. (table 2). Significantly higher bulb weight and polar diameter was recorded with the combined application of organic manure (FYM at 10 t ha^{-1}) and inorganic fertilizers (NPK at 120:75:60 kg ha^{-1}) compared to other treatments Chadha *et al*., (2006).

Bulb length (cm):

The effect of various biofertilizer treatments in respect of bulb length of plant was found to be significant. However, the maximum bulb length (6.63 cm) was observed under treatment T_8 (P.S.B (25%) + Rhizobium (25%) + *Trichoderma* (50%) (Table 2). Minimum bulb length (4.27 cm) was observed under the treatment T_0 by Reddy and Reddy (2005) in Andhra Pradesh (India) recorded significantly higher bulb length, diameter and weight of onion with higher levels of vermicompost (from 10 to 30 t ha^{-1}) and nitrogen fertilizer (from 50 to 200 kg

Table 2: Effect of biofertilizer on yield, yield attributing traits and quality of onion..

Treatments	Bulb diameter (cm)	Bulb length (cm)	No. of scales/ Bulb	Yield			TSS (^{0}Brix)
				Average weight of bulb(g)	Bulb weight kg/plot	yield (t/ha)	
Control	4.70	4.27	7.00	35.94	2.01	23.96	10.63
F.Y.M (100%)	5.13	4.30	7.75	36.69	2.05	24.46	11.13
V.C (100%)	5.30	4.57	7.94	40.66	2.28	27.11	12.93
F.Y.M (50%) + Neemcake(50%)	5.67	5.37	8.23	42.00	2.35	28.00	11.87
Rhizobium (50%) + V.C(50%)	5.73	5.23	8.06	47.46	2.66	31.64	11.67
Acotobacter (50%) + Neemcake(50%)	5.83	5.83	8.51	51.97	2.91	34.65	13.20
P.S.B(50%)+Trichoderma+*Azotobacter* (25%)	6.47	6.20	8.13	56.64	3.17	37.76	12.97
Trichoderma (100%)	6.50	6.13	7.78	61.99	3.47	41.33	13.67
P.S.B(25%)+Rhizobium (25%)+Trichoderma(50%)	6.80	6.63	8.70	61.93	3.47	41.29	13.10
V.C(25%)+NeemCake (50%)+Trichoderma(25%)	6.20	6.17	8.17	68.50	3.84	45.67	11.97
F.Y.M(25%)+V.C (25%)+Trichoderma(50%)	6.07	6.03	7.79	61.75	3.46	41.16	12.60
V.C(50%)+NeemCake(25%)+Trichoderma (25%)	6.27	6.20	8.45	61.63	3.45	41.08	12.17
S.E.(m)±	0.23	0.19	0.64	1.92	0.10	1.28	0.51
C.D. at 5% (P=0.05)	0.67	0.56	NS	5.67	0.31	3.78	1.52

ha^{-1}) and similarly,

Number of scales:

The maximum number of scales was recorded in treatment T_8 (8.70) in application of P.S.B (25%) + Rhizobium (25%) + *Trichoderma* (50%), DAT followed by maximum number of scales was recorded in T_{11} (8.45) in application of VC (50%) + Neem Cake (25%) + *Trichoderma* (25%) where as minimum number of scales was recorded T_0 (7.00) in control plot. (Table 2).

Yield Characters

Bulb Weight (g)

The differences in respect of net Bulb weight among various treatments were found significant. The treatment T_9 VC (25%) + Neem Cake (50%) + *Trichoderma* (25%) gave the maximum bulb weight (68.50gm) (Table 2). The result was in contrast to the report given by Bahadur and Manohar (2001) who conduct an experiment to observe the response of okra to biofertilizers *viz. Azotobacter*, VAM and Phosphorus Solublizing Microorganism (PSM). They found that (*Azotobacter* +50% N and full dose of P and K) gave the highest average fruit weight including other yield attributes. However, the probable reason for the highest net curd weight due to PSB + 50% P and recommended dose of N & K through chemical fertilizers, might be due to phosphorus, being an essential plant nutrient for better plant growth. Moreover, production of antibiotic like compound, synthesis of growth promoting substances due to Phosphorus Solublizing Bacteria (PSB) helps in better plant growth. Minimum net weight of curd was (0.750 kg) observed under the control.

Bulb Yield (t/ha)

The maximum yield was recorded in T_9 (45.67 t/ha) by application of VC (25%)+ Neem Cake (50%) +Trichoderma (25%)@ 2 kg/ha and T_7 (41.33 t/ha) by application of *Trichoderma* (100%) also produced satisfactory yield next to superior treatment (table 2). The yield was significantly affected by the treatment per ha yield from the plot left untreated (control T_0). This result was supported by other reports Banjre *et al*., (2015) PSB@2 kg+ *Azotobacter* @ 2 kg are increased of bulb size and yield/ha with followed by RDF 75%+ *Azotobacter* and PSB are higher bulb yield compared to other treatment.

Quality Characters

T.S.S. (^{0}Brix):

The total soluble solids (^{O}Brix) are recorded to be highest (13.67) in T_7 by application of Trichoderma (100%) @ 2 kg/ha. Whereas minimum TSS was recorded (10.63) in T_0 (control) (table 2). Ethel *et al*., (2009) recorded 2.1 per cent higher TSS (14.31%) by Biofertilizer application *Azotobacter* @ 2 kg/ ha compared to control (12.2%).

Conclusion

On the basis of result presented it can be concluded that was P.S.B (25%) + Rhizobium (25%) + *Trichoderma* (50%) more effective in enhancing vegetative, morphological and qualitative parameters of onion. With regard to the assess the effect of biofertilizers on vegetative growth, yield and quality characters it was observed P.S.B (25%) +Rhizobium (25%) + *Trichoderma* (50%) was superior mostly all the treatments except

weight of bulb and yield . However, since this is based on experiment, further trials may be needed to substantiate the results in onion.

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