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INTERACTION EFFECT OF CHEMICAL AND BIO-FERTILIZERS ON GROWTH AND YIELD OF ONION (*Allium cepa* L.)

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ABSTRACT : The present investigation comprising the supplementation of chemical and biofertilizers for onion crop was carried out under field conditions at Horticultural Research Farm of Babasaheb Bhimrao Ambedkar University, Lucknow during *rabi* season of 2010-2011. The experiment comprised of four levels of chemical fertilizers and six levels of biofertilizers. The maximum plant heights, number of leaves, neck thickness, bulb diameter, bulb weight, number of scales and yield were found with the application of T_{12} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM) that was closely followed by T_{11} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 2 kg/ha Phosphobacteria), T_{18} (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM) and T_{17} (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha Azotobacter + 2 kg/ha Phosphobacteria) respectively. Minimum number of days required for bulb formation and number of days taken to maturity were also obtained with the application of T_{12} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM). Results obtained by the application of inorganic fertilizers with biofertilizers exhibited significant effect on various parameters studied under the investigation.

Keywords : *Chemical fertilizer, biofertilizer, Azotobacter, VAM, onion, growth, yield.*

Onion (*Allium cepa* L.), is bulbous biennial herb of family Alliaceae is one of the most important vegetable cum condiment crops demanded worldwide. Moreover, onion is the only vegetable in which India figures prominently in the world for production and export (Singh and Joshi, 12). Onion is an immense potential crop being part of medicinal values and hence, useful in fever, dropsy, catarrh and chronic bronchitis. Raw onion has an antiseptic value through the alimentary canal. It promotes bile production and reduces blood sugar. It is rich in minerals like phosphorus and calcium, vitamin C, protein and carbohydrates. In order to meet the increasing demand of the consumers and fill the gap in off-season, onion is now gaining popularity as *kharif* season crop too. Crop production of onion is affected by several factors. Usually little or no chemical fertilizer is added to this crop and hence characterized by low yield. Therefore, there is a need to study the possible ways of improving the yields of this crop. Biofertilizer have recently gained with momentum for affecting the sustainable increase in crop yield under various agro climatic conditions. Biofertilizers are live carrier based microbial preparations used in agriculture as low input resources to enhance the availability of plant nutrients or promote the growth by way of synthesizing growth factors. Role of biofertilizer on the crop growth and yield was documented by Vijayakumar *et al.* (13) and Ramakrishnan and Thamizhiniyan (8). *Azotobacter* fixes atmospheric nitrogen independently near the root zone thus, enhancing the available nitrogen to the soil whereas phosphobacteria solublize the soil phosphorus and makes them easily available for the plants. Vesicular-Arbuscular Mycorrhizae (VAM) play a vital role in development of stronger root system, improved growth (Zandavalli *et al.,* 14), nutrient uptake, increase tolerance of host roots to soil borne pathogens (Nelson and Achar, 6).

Uses of biofertilizers in onion production, to at least partially supplement its nutrient demand and to improve soil fertility by way of the integration of different sources of plant nutrients in desired. Onion has a good response for biofertilizer inoculation due to real nature of their root

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morphology. Literature indicates the very little information, therefore, keeping in view the above facts, present research work was undertaken on growth, yield and yield attributing characters of onion applying various biofertilizers and graded level of chemical fertilizers.

MATERIALS AND METHODS

The present investigation was carried out at the Horticultural Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow during the rabi season of 2010-2011. The experiment comprised of four levels of inorganic fertilizers- 1. $N_0P_0K_0$ (Without inorganic fertilizers) C_0, 2. $N_1P_1K_1$ (100 kg N + 50 kg P + 70 kg K/ha) C_1, 3. $N_2P_2K_2$ (75 kg N +37.5 kg P + 52.5 kg K/ha) C_2, 4. $N_3P_3K_3$ (50 kg + 25 kg P + 35 kg K/ha) C_3; and six levels of biofertilizers-1. Uninoculated (Without biofertilizers) B_0, 2. *Azotobacter* (2 kg /ha) B_1, 3. Phosphobacteria (PSB) (2 kg/ha) B_2, 4. Vesicular-Arbuscular Mycorrhizae (VAM) (1900 kg/ha) B_3, 5. *Azotobacter* (2 kg/ha) + Phosphobacteria (2 kg/ha) B_4, and 6. *Azotobacter* (2 kg/ha) + VAM (1900 kg/ha) B_5.

Thus, having a total of 24 (4x6) treatment combinations, *i.e.* T_1 (C_0B_0), T_2 (C_0B_1), T_3 (C_0B_2), T_4 (C_0B_3), T_5 (C_0B_4), T_6 (C_0B_5), T_7 (C_1B_0), T_8 (C_1B_1), T_9 (C_1B_2), T_{10} (C_1B_3), T_{11} (C_1B_4), T_{12} (C_1B_5), T_{13} (C_2B_0), T_{14} (C_2B_1), T_{15} (C_2B_2), T_{16} (C2B3), T_{17} (C_2B_4), T_{18} (C_2B_5), T_{19} (C_3B_0), T_{20} (C_3B_1), T_{21} (C_3B_2), T_{22} (C_3B_3), T_{23} (C_3B_4) and T_{24} (C_3B_5). The quantity of fertilizers was given as per treatment. The entire amount of phosphorus and potassium along with half dose of nitrogen were applied as basal dose during the field preparation and rest amount of nitrogen was applied as top dressing in two- equal split doses at 30 and 60 days after transplanting. *Azotobacter,* Phosphobacteria and Vesicular-Arbuscular Mycorrhizae were applied at the time of transplanting *i.e. Azotobacter* and PSB as seedling root treatment and VAM as soil application. The transplanting was done in the last week of December 2010 and the seedlings were transplanted in the evening at 10 x 15 cm spacing. The experiment was laid out in R.B.D with twenty four treatments and replicated thrice. All the standard package of practices and plant protection measures were timely adopted to raise the crop successfully. Five randomly selected plants from each replication were utilized for recording observations on plant height (cm), number of leaves/ plant, number of days required for bulb formation, number of days taken to bulb maturity, neck thickness, bulb diameter, bulb weight, number of scales per bulb and yield (q/ha). Statistical analysis of the data was done as per standard method.

RESULTS AND DISCUSSION

Growth parameters

The observations recorded on plant height, number of leaves per plant, number of days required for bulb formation and number of days taken to maturity was significantly influenced by the interaction of inorganic fertilizers and biofertilizers. Perusal of Table 1 clearly indicates that the maximum plant heights and number of leaves (30.60 cm, 41.13 cm and 58.06 cm and 4.00, 5.86 and 8.00, respectively) were recorded at 30, 60 and 90 days after transplanting with the application of T_{12} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM) which remained at par with treatment T_{11} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 2 kg/ha Phosphobacteria) and T_{18} (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM).Whereas, the minimum plant heights and number of leaves were recorded 20.20 cm, 28.60 cm and 40.53 cm and 2.33, 4.00 and 5.26, respectively at 30, 60 and 90 days after transplanting under control. These results are in confirmation with the findings of Jayathilake *et al*. (3) and Plenchette *et al.* (7). Singh *et al.* (11) also reported increased plant height and leaf number of onion with the use of VAM. Minimum number of days required for bulb formation (67.06) and number of days taken to maturity (129.86) were obtained with the application of T_{12} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 1.9

Table 1: Interaction effect of chemical and bio-fertilizers on growth and yield of onion (*Allium cepa* L.) under Lucknow conditions.

Treatments	Plant height (cm)			Number of leaves/ plant			Number of days required for bulb formation	Number of days taken to bulb maturity	Neck thickness (cm)	Bulb diameter (cm)	Bulb weight (g)	Number of scales per bulb	Yield (q/ha)
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT							
T_1	20.20	28.60	40.53	2.33	4.00	5.27	79.20	140.00	0.81	4.13	78.20	5.80	169.78
T_2	21.13	30.13	43.07	2.53	4.20	5.47	77.60	138.07	0.86	4.50	91.33	6.33	174.44
T_3	19.87	29.53	42.20	2.63	4.20	5.47	78.07	138.07	0.85	4.27	87.60	6.27	172.11
T_4	20.93	30.57	44.20	2.60	4.27	5.87	77.80	138.20	0.90	4.77	96.87	6.60	204.44
T_5	21.67	31.07	44.47	2.63	4.47	6.00	76.80	137.47	0.95	4.80	101.00	6.87	223.55
T_6	22.20	31.47	45.77	3.00	4.53	6.07	72.00	136.40	0.96	5.00	107.07	7.00	253.89
T_7	24.60	36.20	54.60	3.20	4.47	6.33	71.07	134.07	1.27	5.93	135.33	7.20	322.22
T_8	26.67	35.60	55.33	3.20	4.80	6.40	71.87	132.00	1.35	6.20	141.33	8.27	342.22
T_9	27.07	37.33	54.07	3.47	5.00	7.00	71.93	133.67	1.42	7.00	147.33	9.00	365.44
T_{10}	27.20	37.00	54.07	3.40	5.13	7.20	71.00	132.00	1.45	7.20	150.27	9.00	368.88
T_{11}	29.07	39.13	57.67	3.53	5.50	7.73	69.07	130.00	1.48	7.53	174.80	9.87	397.78
T_{12}	30.60	41.13	58.07	4.00	5.87	8.00	67.07	129.87	1.51	8.07	180.27	10.33	417.77
T_{13}	27.07	37.87	50.67	3.00	4.67	6.20	72.93	134.20	1.30	6.13	131.33	8.20	308.88
T_{14}	25.80	36.07	52.27	3.07	4.67	6.53	72.67	134.00	1.30	6.20	138.67	8.27	333.33
T_{15}	25.67	35.67	49.07	3.13	4.73	6.80	72.73	134.07	1.32	6.33	138.67	8.33	340.00
T_{16}	26.03	36.07	51.20	3.47	4.80	7.27	72.67	134.67	1.32	6.27	140.80	8.20	338.33
T_{17}	27.73	38.27	55.40	3.60	5.00	7.47	70.67	131.60	1.48	7.00	150.67	9.00	368.22
T_{18}	27.93	39.47	56.13	3.67	5.33	6.27	70.53	130.40	1.50	7.33	159.33	9.73	380.22
T_{19}	26.00	32.07	46.07	2.73	4.93	6.27	76.40	135.53	1.17	5.33	132.00	7.27	244.66
T_{20}	25.30	35.27	51.20	2.77	4.60	6.20	75.60	134.60	1.17	5.80	130.67	7.47	270.00
T_{21}	25.13	36.13	50.67	2.87	4.47	6.27	75.47	134.80	1.19	5.93	132.00	7.27	286.66
T_{22}	25.67	34.00	48.47	2.87	4.53	6.47	74.33	135.00	1.23	6.00	132.67	7.67	288.11
T_{23}	25.27	35.00	48.27	2.93	4.73	6.53	74.00	133.60	1.30	6.40	138.00	8.07	316.66
T_{24}	25.93	35.13	51.00	3.07	4.87	6.60	73.00	133.80	1.39	6.67	140.67	8.53	326.66
C.D. (P=0.05)	1.69	0.57	0.40	0.18	0.23	0.22	0.57	23.39	0.04	0.22	2.98	0.32	16.29

kg/ha VAM) that was closely followed by T_{11} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 2 kg/ha Phosphobacteria) and T18 (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM), respectively. Whereas, maximum number of days required for bulb formation (79.20) and number of days taken to maturity (140.00) were obtained under control. The observation is in the agreement with report of Ranjan *et al.* (9).

Yield and yield attributing characters

The results indicated that the yield and yield attributing characters viz., neck thickness, bulb diameter, bulb weight and number of scales were significantly increased by inorganic and biofertilizers. It was also further observed (Table 1) that the maximum neck thickness (1.51 cm), bulb diameter (8.06 cm), bulb weight (180.26 g) and number of scales (10.33) were found with the application of T_{12} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM) that was closely followed by T11 (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 2 kg/ha Phosphobacteria), T18 (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM) and T_{17} (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha *Azotobacter* + 2 kg/ha Phosphobacteria), respectively. Whereas, the minimum neck thickness (0.80 cm), bulb diameter (4.13 cm), bulb weight (78.20 g) and number of scales (5.8) were obtained under control. The hyphae of mycorrhizal fungi often penetrate 7 cm or more beyond the root into the rhizosphere and may be absorbing water and nutrients from soil solution of different osmotic potential than the root surface Rodes and Gerdemann (10). The improved water relations of mycorrhizal plants, although attributed to 'P' nutrition, could further benefit the water balance of plants. Biofertilizers along with chemical fertilizers resulted in substantial increase in bulb yield. Maximum yield (417.77 q/ha) was seen under T_{12} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM) that was closely followed by T_{11} (100 kg N + 50 kg P + 70 kg K/ha + 2 kg/ha *Azotobacter* + 2 kg/ha Phosphobacteria), T_{18} (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha *Azotobacter* + 1.9 kg/ha VAM) and T_{17} (75 kg N +37.5 kg P + 52.5 kg K/ha + 2 kg/ha *Azotobacter* + 2 kg/ha Phosphobacteria), respectively. Thus, the yield maximization through VAM inoculation (Andrea *et al.,* 1) could be achieved at VAM + ½ P + K against sole full dose of NPK. Similar results were also corroborates by Gurubatham *et al.* (2), Jayathilake *et al.* (4) and Mosse (5).

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