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Effect of integrated nutrient management on growth and yield of onion (*Allium cepa* L.) cv. Pusa Madhvi

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ABSTRACT

A field experiment was carried out to assess the effect of integrated nutrient management on growth and yield of onion cv. Pusa Madhvi at Horticultural Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow, U.P. India during the year 2013-14. 10 treatments [RDF as control, FYM, Vermicompost, PSB, Azotobacter, Azosprillium, and combination with nitrogen, phosphorus and potash] were applied with three replications and laid out under Randomized Block Design. The results showed that the maximum plant height (74.32 cm), bulb diameter (4.60 cm), neck thickness (1.06 cm), bulb length (4.39 cm) and number of leaves (9.88) per plant were recorded under treatment T_{10} - RDF (50%) + Vermicompost (50%) at 90 (DAT). Whereas, the maximum leaf length (62.23 cm) was observed in the treatment T_5 (Azotobacter @ 100%). Although, the treatment T_5 showed the maximum bulb weight (175.67 g) but the maximum yield (283 q ha^{-1}) and TSS (12.30 ^{0}B) were recorded in T_{10}. Thus, it can be concluded that treatment T_{10} i.e. application of RDF (50%) + Vermicompost (50%) was suitable for better growth and higher production of onion cv. Pusa Madhvi under Lucknow condition having high soil pH of 8.2.

Keywords : Biofertilizers, growth, onion, organic manures, quality and yield

Onion (*Allium cepa* L.) belongs to family Alliaceae, is one of the most important commercial vegetable crops cultivated extensively in India and world. It is an indispensable item in every kitchen as spice, vegetable as well as salad, therefore, commands extensively in internal market. Onion is preferred for its flavour and pungency which is due to the presence of a volatile sulphur compound allyl propyl disulphide. Onion bulb is a rich source of minerals like phosphorus, calcium and carbohydrates, protein and vitamin C etc. It is being used in several ways as a fresh, frozen, dehydrated bulbs and green bunching types. It contains several anti-cancer agents which have shown to prevent cancer in animals. The beneficial compound called 'quercetin' present in onion has shown to be powerful antioxidant. India is the second largest producer of onion in the world, next to China, accounting for 11.40 per cent of the area and 10.40 per cent of the world production and 16 per cent of productivity. In the world, onion occupies an area of 3.64 m ha, with production of 68.45 mt and the average productivity being 18.82 t ha^{-1}. China, India, U.S.A, Pakistan, Turkey and Russian Federation, Iran, Brazil, Mexico and Spain are the major onion producing countries in the world (Anon., 2013). Maharashtra is the leading onion growing state of India while, other important states are Gujarat, Karnataka, Bihar, Madhya Pradesh, Andhra Pradesh, Rajasthan, Haryana, Uttar Pradesh and Tamil Nadu. Nutrient management practices play an important role for good crop of onion like other crops. Recently organic nutrient management has got rapid momentum due to consciousness of health hazard and environmental safety (Maji, 2013). Among the organics vermicompost is a rich source of macro and micro nutrients, vitamins, growth hormones etc. (Kale *et al*., 1992; Maji and Das, 2008). Integrated nutrient management (INM) provides excellent opportunities to overcome all the imbalances besides sustaining soil health and enhancing crop production. It optimizes the benefits from all possible sources of plant nutrients in an integrated manner (Greenland, 1975). Hence, this investigation was planned to identify the ideal integrated nutrient management package for onion at Lucknow condition.

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MATERIALS AND METHODS

The experiment was laid out during *rabi* season at Horticulture Research Farm, Babasaheb BAU, Lucknow, U.P, India. The experimental area was under subtropical climatic condition having hot summer with maximum temperature 45^{0}C, minimum temperature ranging from 3.5^{0}C to15^{0}C in winter and relative humidity ranging from 60-80 per cent in different seasons of the year. The soil of experimental field had high pH of 8.2. Seeds of onion cv. Pusa Madhvi were sown on nursery beds prepared earlier. The soil of seed bed was prepared with compost and mulching was done with news paper to protect the young seedlings from adverse climatic condition. Covering materials were removed from the bed after seed germination (5-6 days after sowing) for optimum growth of seedlings. 60 DAS

seedlings were ready for transplanting. The healthy seedlings having uniform growth were selected and transplanted on well prepared field at afternoon. The field was prepared by ploughing with disc plough and subsequent ploughing was done with cultivator followed by levelling. The required area was then marked and plots were prepared according to the layout plan. The soil of the experimental site was irrigated before transplanting for optimum moisture. Seedling were treated with *Azotobacter* (100%) @ 1 Kg ha^{-1} and PSB (100%) @ 2 kg ha^{-1} and according to the other treatments. After proper treatment the selected seedlings were transplanted in field at a spacing of 10 x 15 cm. From every plot 5 plants were taken randomly for recording of observations. The observations were recorded for plant height, leaf length, number of leaves, neck thickness, diameter of bulb, bulb length, yield, number of scales, total soluble solids, and bulb weight. The bulb yield per hectare was calculated based on plot yield. Vegetative observations were recorded at 30, 60 and 90 DAT. The quality parameters were studied in the laboratory of Department of Applied Plant Science (Horticulture), following standard method as suggested by AOAC (2000). The experiment was laid out in Randomized Block Design with ten treatments with three replications. The treatments were T_1 - (100% RDF as control), T_2 - FYM (100%), T_3 – Vermicompost (100%), T_4 – PSB (100%), T_5 – *Azotobacter* (100%), T_6 – *Azosprillium* (100%), T_7 - Nitrogen (50%) + FYM (50%), T_8 - Phosphorus (50%) + FYM (50%), T_9 - Potash (50%) + FYM (50%) and T_{10} - RDF (50%) + Vermicompost (50%). The recorded data were statistically analyzed using analysis of variance as formulated at 5% level of significance (Panse and Sukhatme, 1985).

Table 1: Effect of integrated nutrient management on growth, yield, quality of onion cv. Pusa Madhvi

Treatments	Plant height (cm)	No. of leaves $plant^{-1}$	Length of leaves (cm)	Neck thickness (cm)	Bulb diameter (cm)	Bulb length (cm)	No. of scales $bulb^{-1}$	Yield (q ha^{-1})	TSS (^{0}Brix)
T_1- Control	52.33	5.30	42.33	1.06	3.91	3.52	4.20	166.05	10.10
T_2- FYM (100%)	55.36	6.50	51.67	1.20	4.31	3.87	6.00	170.37	10.90
T_3- Vermicompost (100%)	61.35	7.66	55.57	1.16	4.41	4.20	5.56	173.45	11.40
T_4- PSB (100%)	62.25	5.80	48.67	1.14	4.22	3.66	6.20	185.18	11.60
T_5- *Azotobacter* (100%)	65.35	6.60	62.23	1.11	4.10	3.78	7.56	230.24	12.30
T_6- *Azosprillium* (100%)	66.4	6.20	46.00	1.16	4.43	4.27	5.50	219.13	12.10
T_7-N (50%) + FYM (50%)	68.05	7.80	51.60	1.13	4.25	3.67	6.30	198.76	11.30
T_8- P (50%) + FYM (50%)	70	8.80	58.60	1.22	4.28	4.01	5.80	203.70	11.50
T_9- K (50%) + FYM (50%)	63.26	7.25	44.31	1.12	4.26	4.36	5.20	235.18	11.10
T_{10}- RDF (50%) + VM (50%)	74.32	9.88	54.35	1.25	4.60	4.39	7.20	283.33	12.20
SEm (±)	**1.65**	**0.16**	**1.28**	**0.04**	**0.045**	**0.05**	**0.26**	**14.11**	**0.21**
LSD (0.05%)	**4.91**	**0.47**	**3.82**	**0.10**	**0.13**	**0.16**	**0.79**	**41.94**	**0.64**

Note : *RDF -Recommended Dose of Fertilizer, FYM -Farm Yard Manure, VM-Vermicompost PSB- Phosphate Solubilizing Bacteria, N- Nitrogen, P- Phosphorus, K- Potash*

RESULTS AND DISCUSSION

Table 1, clearly indicated that the maximum plant height (74.32 cm) was recorded under treatment T_{10} *i.e.* application of RDF (50%) + vermicompost (50%) at 90 DAT. Figure 1 showed the pattern of increase in plant height which was varied at 30, 60 and 90 DAT. The figure showed that maximum plant height (41.50 cm) at 30 DAT was recorded under application of vermicompost @ 100% (T_3) followed by T_6 (40.71 cm). Among all the treatments at 60 DAT, it was noted that plant under treatment T_{10} had the maximum height of 64.35 cm followed by T_6. Similarly, number of leaves per plant was also recorded at 30, 60 and 90 DAT (Fig. 2) and maximum number of leaves was counted under application of vermicompost @ 100% (T_3) at 30 DAT. The number of leaves per plant according to various treatments has been presented in table 1 and variation at different days interval had been depicted in Fig. 2. Table 1 showed that the treatment T_{10} produced the maximum number of leaves per plant at later stage of growth followed by T_8 (Phosphorus @ 50% + FYM @ 50%) and minimum was recorded under control. The number of leaves was counted maximum under the treatment T_3 and lowest under control at 30 DAT. At 60 DAT, treatment T_{10} and T_6 were statistically very close to each other and they recorded maximum number of leaves of onion. It was clearly seen that application of *Azotobacter* @ 100% (T_5) increased the length of leaves at maximum

rate (62.20 cm) among the treatments and poor result was observed under T_9 (Phosphorus @ 50% + FYM @ 50%) which was much closed to the control. The control plant showed minimum length of leaves (42.33 cm). It was revealed from the data presented in table 1 that the neck thickness was increased by all the treatments as compared to control and the maximum neck thickness (1.25 cm) was measured under T_{10} and minimum under control (1.06 cm). Similarly, the bulb diameter also increased by all treatments over the control. Significantly superior bulbs were obtained under the treatment T_{10} having maximum diameter of 4.60 cm followed by T_6 (4.43 cm). A significant but close improvement was recorded in case of length of bulb. However, the maximum bulb length (4.39 cm) was recorded under T_{10} followed by T_9 and minimum length of bulb (3.90 cm) was measured under control plant. A wide variation was found in number of scale per bulb due to various treatments. The application of *Azotobacter* @ 100 % (T_5) resulted maximum number of scale per bulb (7.56 bulb^{-1}) followed by T_{10} (RDF @ 50% + vermicompost @ 50 %) whereas, bulb under control showed minimum number of scales (4.20). Although, the cultivar Pusa Madhvi generally yields about 300 q ha^{-1} but in our experiment yield was very poor and the minimum yield of 166.05 q ha^{-1} was recorded under control condition and all the treatments were found superior producing more yield as compared to control. Among the treatment application of RDF @ 50% + vermicompost @ 50 % recorded maximum yield (283q ha^{-1}) followed by T_9. The quality parameter *i.e.* total soluble solid (TSS) was calculated. It was found that onion bulb under control showed the minimum TSS (10.10 ^{0}Brix) while, maximum TSS (12.20 ^{0}Brix) was recorded under T_{10} (RDF @ 50 % + vermicompost @ 50%).It was evident from table 1 that plant height was increased by the application of all the treatments as compared to control. Among them, T_{10} (RDF @ 50% + vermicompost @ 50%) increased plant height at maximum level. Similarly, Reddy and Reddy (2005) showed that application of vermicompost 10 to 30 t ha^{-1} significantly increased plant height. Increment of plant height of onion with application FYM was also reported by Patel *et al*. (2007), Ethel *et al*. (2009) and Sharma *et al*. (2008) in scented rice. Similar to the plant height, number of leaves was also recorded higher under treatment T_{10}.

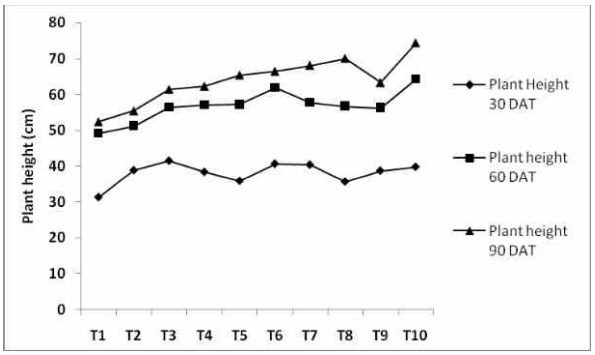

Fig. 1: Effect of integrated nutrient management on increase in plant height of onion at various dates.

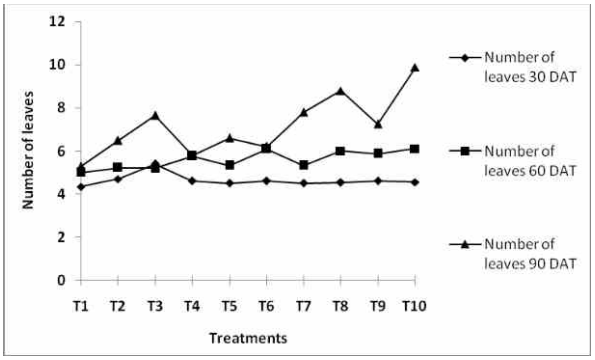

Fig. 2: Effect of integrated nutrient management on number of leaves of onion.

Varu *et al*. (1997) recorded higher number of leaves per plant with the application of *Azotobactor*, PSB. The better effect due to application of organic and biofertilizer on vegetative growth was also recorded by several workers *i.e.* Sahu *et al*. (2014) in okra, Singh *et al*. (2014) in broccoli, Dushyant *et al*. (2014) in stevia, Kumar *et al*. (2014) in radish, Meena *et al*. (2014) in tomato, Kashyap *et al*. (2014) in brinjal, Maji and Das (2008) in guava. Similar observation was recorded in case of length of leaves which showed that application of *Azotobactor* @ 100% recorded maximum length of leaves which was corroborated with the finding of Chatto *et al*. (1997) in knolkhol. Table 1 revealed that at the time of harvesting the neck thickness, bulb length were maximum when the plants were treated with RDF (50%) + vermicompost (50%) (T_{10}) as compared to other treatments as well as untreated control. Chadha *et al*. (2006) stated that the bulb length, bulb diameter, weight of onion increased significantly with combine application of vermicompost and nitrogen fertilizer. Similar results were also found in the work of Reddy and Reddy (2005) and Ethel *et al*. (2009). However, the literature regarding effect of organic manure on number of scales was not available but, in the present study it was observed that application of *Azotobactor* (100%) produced maximum number of scales per bulb. The

maximum yield was recorded under T_{10} (RDF + vermicompost @ 50% each) which caused 70.63% more yield than untreated control. This trend was also observed in case of TSS. The present result was also supported by several workers (Singh and Singh, 1995; Mallangouda and Subedi, 1996; Bhattarai and Subedi, 1995; Singh *et al*., 1967; Gupta *et al*., 1989; Yadav and Yadav, 2001). Singh and Pandey (2006) also stated that organic manure (FYM and vermicompost *etc*) along with lower percentage inorganic fertilizer improved the onion yield as part of INM. Similarly, the combined application of inorganic manure and organic fertilizer improved the quality of onion bulb as reported by Ethel and Mondal (2005), Hari *et al*. (2009). However, Siabhi and Randhawa (1983), Shukla and Prabhakar (1989), Maier *et al*. (1990) and Vachani and Patel (1993) reported that there was no significant effect of inorganic fertilizer specially N and P on TSS. Singh and Dhankar (1989) noticed consistent decrease in TSS content of the onion bulb with application of N and increased with K application upto 100 kg K_2O ha^{-1}.

The superior yield and quality of onion was under application of T_{10} (RDF + vermicompost @ 50 % each) might be due to better vegetative growth of treated plants which produced more photosynthates and metabolites resulting higher yield and quality (Maji and Das, 2008). The superior quality of onion under vermicompost treatments might be due to beneficial effect of organism which are brought about mucon deposited epidermal cell and coelomic cell of earthworm containing plant growth factor and B group vitamin (Bano *et al*., 1987).

On the basis of above result, it can be concluded that the application of RDF (50 %) + vermicompost (50 %) (T_{10}) may be suggested for better growth, yield and quality of onion cv. Pusa Madhvi in Lucknow subtropical condition.

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