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RESEARCH PAPER

Effect of organic manures, biofertilizers and micronutrients on growth, yield and quality of onion (*Allium cepa* L.)

ANIL KUMAR, R. B. RAM, SUTANU MAJI*, SACHIN KISHOR, RAHUL YADAV, GOVIND AND KAMAL RAM MEENA
Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, LUCKNOW (U.P.) INDIA
Email: majisutanu@gmail.com; anilkumar38060@gmail.com

Abstract : A field experiment was conducted during the *Rabi* season to find out the effect of organic manures, biofertilizers and micronutrients on growth, yield and quality of onion cv. NHRDF Red - 2. There were 13 treatments *viz.*, T_0 (Recommended dose of fertilizers), T_1 Poultry manure, T_2 vermicompost, T_3 *Azotobacter*, T_4 VAM, T_5 *Azotobacter* + RDF (50%) + zinc, T_6 *Azotobacter* + RDF(75%) + zinc, T_7 VAM + RDF(50%) + boron, T_8 VAM + RDF (75%) + boron, T_9 RDF (25%) + VAM + poultry manure (50%) +*Azotobacter* +boron, T_{10} (RDF (25%) + VAM + vermicompost (50%) + *Azotobacter* +boron, T_{11} RDF (25%) + VAM + poultry manure (50%) *Azotobacter* + zinc, T_{12} RDF (25%) + VAM + vermicompost 50% *Azotobacter* + zinc and the experiment was laid out under RBD with three replications. The study clearly revealed that there were significant effects of various treatments on the growth, yield and quality attributes of onion. The number of leaves per plant (12.15), plant height (73.02cm), neck thickness (22.00mm), bulb length (6.46 cm), bulb diameter (7.20cm), yield (398.36 kg/ha^{-1}) were recorded maximum in treatment T_{12} whereas T.S.S (14 ºB), vitamin C (12.11mg/100g), total sugars (10.52%), reducing sugar (6.23%) and non-reducing sugar (4.28%) were found maximum in T_{10} treatment as compared to other treatment. However, T_{12} was good for higher yield improvement and T_{10} was the best for quality improvement among the all treatments under study, the application of T_{12} (RDF (25%) + VAM + Vermicompost 50% *Azotobacter* +Zinc) may be suggested for successful cultivation of onion in Lucknow.

Key Words : Organics, Biofertilizers, Micronutrients, Onion, Yield, Quality

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INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial bulbous vegetables. It is grown in western, northern as well as in southern India. Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Bihar, Rajasthan, Tamil Nadu, Odisha, Gujarat, Haryana, Uttar Pradesh and West Bengal are major onion growing states

*** Author for correspondence:**

in India. India produces onion about 162897 million tonnes from 9396 mha area (Anonymous, 2014). India ranks second in the world sharing 12.3 per cent of after China. Onion is an integral and essential part of kitchen for taking as fresh as salad or for cooking. It has bisexual flower and is highly cross pollinated crop. The edible portion is a modified stem, botanically known as "tunicated bulb" which develops underground.

A pound of onion contain protein 6 g, fat 0.9 g, carbohydrates 44 g, calcium 137 mg, phosphorus 188 mg, iron 2.1 mg, thiamine 0.15 mg, riboflavin 0.1 mg, niacin 0.6 mg and ascorbic acid 38 mg (Thomson and Kelly, 1998). Its pungency is due to the presence of a volatile oil allyal propyl disulphide (Malik, 1994).

In the present content of rapid civilization, global warming, climate change, indiscriminate use of synthetic fertilizers and pesticides, sustainable production of agricultural crops is the prime objectives of agricultural researchers and policy makers. Organic production and integrated use of benefits are the key issues of today crop production. As onion is used as fresh or as cooking the production of onion with judicial application of chemical fertilizers along with bio fertilizers, organic manures, compost and micro nutrients in an integrated way is useful to reduce health hazards as well as to protect environment. Organic farming provides several benefits to the growers. It reduces production cost and it is an environmentally friendly method of cultivation. Addition of organic manures, bio fertilizers and micro nutrients improved soil structure and enhances activities of use full soil organism, to maintain flora and fauna. Impact of vermicompost and composted farmyard manure on growth and yield of onion and garlic were studied by (Rao *et al*., 2010 and Suthar, 2009). The process of conversion of organic waste into bio fertilizer with the help of traditional composting which can be used to minimize the environmental pollution and is a good alternative to restrict the use of chemical fertilizers for sustainable agriculture (Kitturmath *et al.*, 2007). Giraddi *et al*. (2008) studied the nutrient changes during earthworm *Eudrilus eugeneiae* (Kinberg) mediated vermicomposting of the agro industrial wastes such as press mud, bagasse, coir waste, rice husk and groundnut shells and also studied the vermitechnology for successful management of municipal waste. Onion responds well to azotobacterization and yield increase upto 20 per cent (Meshram and Shende, 1990). However, there exists wide variation in nitrogen fixing capacity of various strains of *Azotobacter* (Vinay, 1998) and strain specificity to crop plants has also been reported by Rajakumar and Lakshman (1990). It was also seen that micronutrients play an important role for production of onion. Application of boron can increase bulb size, number of clove/bulb and yield of onion (Smriti *et al*., 2002). Response of zinc application has also been reported by Lal and Maurya (1981). Boron and zinc are the most important micro nutrient and are essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth (Brady, 1990 and Manna, 2013). Effect of micro nutrients on growth and yield of onion under calcareous soil environment (Alam *et al*., 2010). Vermicompost has been reported to contain several plant growth promoters, enzymes, beneficial bacteria and mycorrhizae (Gupta, 2007). Response of onion to combined application of biological and chemical nitrogen fertilizers on growth and yield of onion was reported by Bagali *et al*. (2012) and Balemi *et al*. (2007). Effect of bio fertilizers on growth, yield and nutrient uptake of onion was studied by Mengistc and Singh (1999). Yadav *et al.* (2005) studied the effect of different bio fertilizers in association with phosphorus on growth and yield to onion. Therefore, present investigation was designed to produce onion crop with minimum synthetic input to reduce health hazards as it is consumed directly and for sustainable development of agriculture.

MATERIAL AND METHODS

The experiment was conducted using onion cultivar NHRDF Red -2 during the *Rabi* season of 2013-2014 at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow (Utter Pradesh) India to find out the influence of different sources of nutrients both synthetic and organics on growth, yield and quality of onion. A total of 13 treatments *i.e.* T_0 (Recommended dose of fertilizers), T_1 (Poultry manure), T_2 (Vermicompost), T_3 (*Azotobacter*), T_4 (VAM), T_5 (*Azotobacter* + RDF 50% + zinc), T_6 (*Azotobacter* + RDF 75% + zinc), T_7 (VAM + RDF 50% + boron), T_8 (VAM + RDF 75% + boron), T_9 (RDF 25% + VAM + Poultry manure 50% + *Azotobacter* + boron), T_{10} (RDF 25% + VAM + Vermicompost 50% + *Azotobacter* + Boron), T_{11} (RDF 25% + VAM + poultry manure 50% + *Azotobacter* + zinc), T_{12} (RDF 25% + VAM + vermicompost 50% + *Azotobacter* + zinc) including control were laid out in Randomized Block Design (RBD)

with three replications. Organic manures *viz.,* poultry manure and vermicompost were applied on equivalent weight of recommended dose of NPK fertilizers (100:50:70kg NPK/ha) according to the treatments along with biofertilizers (*Azotobacter* @ 2 kg/ha and VAM @ 20 g/m^2) and micronutrients (Zinc and Boron @ 0.5%). The data were recorded for its growth vegetative yield and quality attributes control such as plant height, number of leaves per plant, neck thickness, bulb length, bulb diameter, yield, T.S.S, vitamin C, total sugars, reducing sugar and non-reducing sugar. The laboratory analysis was done according to the standard procedure as mentioned by A.O.A.C. (2000). The recorded data were statistically analyzed and treatment effects were compared at 5 per cent level of significance (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

There were significant differences in plants height at 30, 60, and 90 days after transplanting due to application of organic manures, biofertilzers and micro nutrients and their treatments combination (Table 1). The maximum plant height (73.02 cm) was recorded under T_{12} with RDF 25% + VAM + vermicompost 50% + *Azotobacter* + zinc 0.5% at 90 DAT, where as the minimum plant height (68.46 cm) was recorded in T_0 (control). Similar result was also reported by Mishra *et al.* (1990) who showed that foliar application of $ZnSO_4$ (0.5%) and $FeSO_4$ (1.0%) recorded significantly higher plant height and other growth parameters as compared to other treatments in onion.

Table 1 showed the effect of different treatments on the number of leaves of onion and it was found significant at 30, 60 and 90 days after transplanting. The maximum number of leaves per plant (12.15) with RDF (25%) + VAM + vermicompost (50%) + *Azotobacter* + zinc was recorded under T_{12} at 90 DAT, Whereas, the minimum number of leaves (10.09) was recorded in T_8. The increased number of leaves might be due to the presence of vital macro and micronutrient availability with vermicompost (Giraddi, 1993 and Tanunathan *et al.*,1997 and Shobha and Pappiah, 2000) reported that application of vermicompost appears to be very effective amendment in onion.

It was seen that the maximum neck thickness of (22.00 mm) was measured with RDF (25%) + VAM + vermicompost (50%) + *Azotobacter* + zinc T_{12} at 90 DAT, whereas the minimum neck thickness (17.41mm) was measured in T_4. These results corroborate the

Table 1: Growth parameters of onion as influenced by various source of nutrients

Treatments	Plants height (cm)			Number of leaves/plant			Neck thickness (mm)			Bulb length (cm)	Bulb diameter (cm)	Bulb yield (kg/ plot)	Bulb yield (t/ha)
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT				
T_0	28.06	58.88	68.46	5.16	7.60	11.19	6.41	14.09	20.07	5.87	5.86	5.04	33.64
T_1	29.01	59.24	68.62	5.28	7.90	10.41	6.62	13.67	19.13	5.37	6.20	5.66	37.78
T_2	29.21	61.22	71.11	5.21	8.00	10.45	6.82	14.17	18.93	5.06	6.16	5.41	36.11
T_3	25.73	62.25	68.42	4.64	7.72	10.64	6.96	10.98	18.70	4.87	5.95	5.48	36.56
T_4	24.39	58.22	71.51	4.98	7.41	10.86	6.59	13.30	17.41	5.38	6.33	4.88	32.56
T_5	26.64	61.16	70.81	5.38	7.82	11.39	6.61	12.27	18.65	5.83	5.88	5.50	36.71
T_6	29.42	63.28	71.32	5.65	8.31	11.49	7.07	15.12	20.49	5.95	6.38	5.78	38.58
T_7	29.04	61.94	70.49	5.17	7.13	10.13	6.17	13.22	18.78	4.92	6.05	4.95	33.00
T_8	24.58	63.21	70.62	4.88	8.14	10.09	6.74	13.94	19.17	5.73	5.64	5.18	34.56
T_9	26.00	61.96	70.95	5.24	7.55	11.07	6.65	13.39	18.41	5.72	6.27	5.75	38.11
T_{10}	28.95	62.88	70.42	5.59	7.60	10.67	6.29	13.44	19.40	5.88	6.32	5.20	34.69
T_{11}	29.93	63.46	71.42	5.69	8.53	11.81	7.70	15.29	20.57	6.02	6.45	6.17	41.16
T_{12}	31.96	65.14	73.02	6.16	9.22	12.15	8.08	17.20	22.00	6.46	7.20	6.29	41.98
S.E.±	0.727	01.236	00.821	0.238	0.340	0.390	0.269	123.72	177.35	0.311	0.204	0.267	0.514
C.D. (P=0.05)	2.1300	3.63	2.41	0.69	0.99	1.45	0.79	NS	NS	0.912	0.598	0.78	1.48

T_0 - (Recommended dose of fertilizers), T_1 -Poultry manure, T_2 -Vermicompost, T_3 -*Azotobacter*, T_4 -VAM, T_5 -*Azotobacter* + RDF (50%) + zinc, T_6 -*Azotobacter* + RDF (75%) + zinc, T_7 -VAM + RDF (50%) + boron, T_8 -VAM + RDF (75%) + boron, T_9 -RDF (25%) + VAM + poultry manure (50%) +*Azotobacter* + boron, T_{10} -(RDF (25%) + VAM + vermicompost (50%) + *Azotobacter* + boron, T_{11} -RDF (25%) + VAM + poultry manure (50%) *Azotobacter* + zinc, T_{12} -RDF (25%) + VAM + vermicompost 50%+ *Azotobacter* +zinc NS= Non- significant

findings of Mishra *et al*. (1990) who mentioned that foliar application of $ZnSO_4$ (0.5) and $FeSO_4$ (1.0%) recorded significantly higher plant height and other growth parameters as compared to other treatments in onion.

Application of nutrients *i.e.* T_{12} RDF (25%) + VAM + vermicompost (50%) + *Azotobacter* + zinc (T_{12}) recorded the maximum bulb length (6.46 cm) after harvesting. The minimum bulb length (5.06 cm) was recorded in T_2 (Vermicompost 100%). Similar results was also obtained by Reddy and Reddy (2005) when studied on the effect of different levels of vermicompost (0, 10, 20 and 30 t/ha) and nitrogen fertilizer (0, 50, 100, 150 and 200 kg/ha) on the growth and yield of onion cv. N-53. Bulb diameters also followed the similar pattern and found maximum under T_{12} while minimum bulb diameter (5.64 cm) was recorded in T_8 (VAM + RDF-75% + Boron). It was also found that the maximum yield of 6.29 kg/plot and 41.98 t/ha was observed under treatment T_{12} *i.e.* RDF (25%) + VAM + vermicompost (50%) + *Azotobacter* + zinc and minimum yield of (4.88 kg/plot, 32.56 t/ha) was recorded in T_4. Similar results were also obtained by Patil *et al*. (2012).

Table 2 showed the influence of organic manures, biofertilizers and micro nutrients on quality parameters of onion. The total soluble solids was recorded to be the highest (14.00 °B) under treatment T_{10} with RDF (25%) + VAM + vermicompost (50%) + *Azotobacter* + boron and the minimum (11.21°B) TSS in T_0 with RDF (100%). Similar findings were also obtained by Manna (2013) who reported that application of 0.5 per cent boron as foliar spray recorded significantly higher TSS and other quality parameters as compared to other treatments in onion.

Similarly, the ascorbic acid was recorded to be highest under the treatment T_{10} (12.11mg/100g) and minimum under T_2 (10.19mg/100g). The analogous results were also obtained by Gupta (2007) who mentioned quality of onion and its' keeping quality were improved by the application of vemicompost.

Interestingly, similar pattern of influence *i.e.* maximum total sugars (10.52%), reducing sugar (6.23%) and non-reducing sugar (4.28%) were noted under treatment T_{10} followed by RDF(25%) + VAM + vermicompost (50%)+ *Azotobacter* + boron but in general all the treatments improved the quality parameters in respect of TSS, total sugar, reducing sugar and non-reducing sugar content. The improvement of yield and quality of broccoli, radish, onion were also noted by Singh *et al*. (2014); Kumar *et al*. (2014); Meena *et al*. (2014); Sahu *et al*. (2014) and Maji *et al*. (2015).

Conclusion :

The experiment demonstrated the effects of different treatment combination of organic manures, biofertilizers and micronutrients on the growth yield and quality attributing parameter of onion. Among the treatments T_{12} (RDF 25% + VAM + vermicompost 50%+ *Azotobacter* +zinc) significantly improved growth

Table 2 : Yield and quality improvement of onion as influenced by various sources of nutrients

Treatments	T.S.S (ºB)	Vitamin C (mg/100g)	Total sugars (%)	Reducing sugar (%)	Non-reducing sugar (%)
T_0	11.21	10.42	8.35	5.10	3.24
T_1	11.45	10.35	8.05	4.43	3.77
T_2	11.24	10.19	8.42	5.11	3.01
T_3	12.01	10.55	8.47	4.71	3.76
T_4	11.42	10.89	8.53	4.78	3.75
T_5	11.60	11.08	8.96	5.33	3.63
T_6	11.41	11.28	8.63	5.26	3.36
T_7	11.36	11.19	8.11	5.27	3.08
T_8	12.31	11.74	9.89	5.95	3.94
T_9	13.09	12.00	10.21	6.09	4.15
T_{10}	14.00	12.11	10.52	6.23	4.28
T_{11}	11.65	10.57	8.37	5.95	2.78
T_{12}	11.68	11.10	8.16	4.81	3.35
S.E.±	0.23	0.26	0.10	0.195	0.23
C.D. (P=0.05)	0.67	0.67	0.77	0.19	0.23

and yield of onion and treatment T_{10} (RDF 25% + VAM + vermicompost 50% + *Azotobacter* + boron) positively influenced the quality of onion in terms of T.S.S, vitamin C, reducing sugar, total sugars, and non-reducing sugar value.

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