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Effect of Various Organic Manures with Biofertilizers on Growth, Yield and Economics of Onion (*Allium cepa* L.)

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A B S T R A C T

An experiment was conducted at the Organic Production Block, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Uttarakhand during the year 2016. The experiment was laid out in randomized block design with three replicated and 9 treatments viz., T_1 Control, T_2 Vermicompost, T_3 FYM, T_4 Goat manure, T_5 Neem cake, T_6 Vermicompost + FYM + Goat manure, T_7 Vermicompost + FYM + Neem cake, T_8 Vermicompost + Goat manure + Neem cake, T9 FYM + Goat manure + Neem cake. The observations were recorded on different growth and yield attributes. Further, economics of different treatments was also worked out. The analysis of variance revealed significant differences among the treatments for all the characters under study. The treatment T3 FYM due to its persistent performance for yield (324.46 q/ha), gross income (Rs. 324460.00 q/ha), net returns (Rs. 251680.04 q/ha) and higher benefit: cost ratio (1:3.45). Thus, it can be concluded from the findings that application of FYM (2.8kg/1.2m^2) can be recommended for commercial cultivation of onion.

Introduction

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops cultivated extensively in India and belongs to the family Alliaceae and originated from the central Asia (Thamburaj and Singh, 2001). It is an indispensable item in every kitchen as vegetable and condiment. It is one of the few versatile vegetable crops that can be kept for a fairly long period and can safely with stand the hazards of rough handling long distance transport. Organic manures are considered helpful in improving the physical and nutritional status of the soil and also enhance the activity of soil microflora. They also add considerable amount of major nutrients in the soil besides, improving the soil properties. Further, decomposition of organics in the soil leads to different types of biological reactions which are helpful in preventing various diseases causing pathogens (Ramesh *et al.*, 2010). Biofertilizers offer an economically attractive and ecologically sound means of reducing external inputs and improving quality and quantity of vegetable produce. They contain microorganisms which are capable of mobilizing nutrient elements from

unavailable form to available form through different biological processes.

Materials and Methods

The present investigation was carried out at the Organic Production Block, college of Horticulture and Forestry, Bharsar, Uttarakhand during the Year 2016 "Agrifound Light Red" cultivar of onion. The experiment was laid out in a randomized complete block design (RCBD) at spacing 15cm × 10cm and plot size 1.20×1.0 m^2 with 3 replications and 10 treatments, which consisted of sole application of organic sources (Vermicompost, FYM, Goat manure, Neem cake)and their combinations (Table 1). In all treatments planting material were dipped in mixed culture of biofertilizers (*Azotobacter* + PSB). The data were recorded on growth and yield parameters like plant height (cm), number of leaves per plant, leaf length (cm), leaf diameter (cm), root length (cm), number of roots per plant, bulb length (cm), polar diameter (cm), equatorial diameter (cm), neck length (cm), neck thickness (cm), number of scales per bulb, bulb weight (g) yield per hectare (q/ha). Total soluble solid (^{0}B) and cost: benefit ratio and mean data were subjected to statistically analysis as per Gomez and Gomez (1984). Further; economics analysis of different treatments was tested depending upon the locally existing fixed and variable costs of different inputs.

Results and Discussion

Growth characters

The data pertaining to different growth characters at different stages revealed significant variations among the different treatments under study (Table 2 and 3). Maximum plant height (25.30cm, 46.46cm, and 56.93cm), number of leaves per plant (5.45, 7.46 and 9.16), root length (7.50 cm, 8.18 cm and 10.50 cm), and number of roots per plant (28.02, 70.78 and 107.89) was recorded at different stages 50,100 and 150 days after transplanting by the application of Vermicompost (T_2).This might due to application of vermicompost may be due to its rich content of macro and micro nutrients, vitamins, growth hormones and micro flora Bhavalkar (1991).

Table.1 Detail of treatments used in the present study

Treatment Code	Treatment Detail
T_1	Control
T_2	Vermicompost @0.6kg/plot
T_3	FYM @ 2.8kg / plot
T_4	Goat manure @ 0.5 kg / plot
T_5	Neem cake @ 0.3 kg / plot
T_6	Vermicompost + FYM + Goat manure complex (1/3rd amount of each i.e. @ 0.2; 0.93 and 0.16 kg/plot
T_7	Vermicompost + FYM + Neem cake complex (1/3rd amount of each i.e. @ 0.2; 0.93 and 0.1 kg/plot)
T_8	Vermicompost + Goat manure + Neem cake complex (1/3rd amount of each i.e. @ 0.2; 0.16 and 0.1 kg/plot)
T_9	FYM + Goat manure + Neem cake complex (1/3rd amount of each i.e. @ 0.93; 0.16 and 0.1 kg/plot)

Table.2 Effect of various organic manures with biofertilizers and their combinations on plant height, numbers of leaves per plant and Leaf length at different stages

Treatment code	Plant height(cm) ± SE(m)			Number of leaves per plant(cm) ± SE(m)			Leaf length(cm) ± SE(m)		
	50 DAT	100 DAT	150 DAT	50 DAT	100 DAT	150 DAT	50 DAT	100 DAT	150 DAT
T_1	15.57 ± 0.48	30.10 ± 0.43	`39.97 ± 0.44	3.10 ± 0.23	5.16 ± 0.40	7.21 ± 0.06	12.24 ± 0.15	26.66 ± 0.16	36.31 ± 0.16
T_2	25.30*± 0.33	46.46*± 0.74	56.93*± 3.32	5.45*± 0.03	7.46* ± 0.06	9.16 *± 0.03	20.64* ± 0.28	40.46 *± 0.17	51.27 *± 0.02
T_3	20.94*± 0.31	41.30* ± 0.67	51.66 *± 0.63	5.34 *± 0.36	7.22 *± 0.01	8.39 *± 0.02	17.61*± 0.01	38.63* ± 0.12	49.66 *± 0.08
T_4	20.68*± 0.74	34.78 *± 1.75	50.48*± 0.61	4.47 *± 0.10	7.23* ± 0.03	8.23 *± 0.03	16.34 *± 0.19	32.44 *± 0.10	47.48 *± 0.10
T_5	20.23*± 0.03	39.62 *± 0.14	48.09*± 0.13	3.93 ± 0.66	7.21* ± 0.00	7.46 *± 0.03	18.23* ±0.03	35.62 *± 0.14	39.42* ± 0.24
T_6	21.83*± 0.11	37.02*± 0.30	48.68 *± 0.59	3.55 ± 0.17	6.46* ± 0.46	7.23 ± 0.04	19.50 *±0.25	34.36 *± 0.06	43.68* ± 0.03
T_7	23.16*± 0.54	45.81*± 0.48	50.30 *± 0.56	5.26* ± 0.04	7.26* ± 0.03	9.07 *± 0.06	22.49* ± 0.24	42.48* ± 0.16	49.30* ± 0.12
T_8	20.97*± 0.07	43.65*± 0.21	49.41*± 0.27	4.99* ± 0.39	6.72* ± 0.03	8.02 *± 0.03	18.64* ± 0.26	39.65* ± 0.21	45.74 *± 0.11
T_9	22.81*± 0.50	41.67*± 0.33	50.23 *± 0.03	5.43 *± 0.09	7.27*± 0.39	9.05* ± 0.01	16.81* ± 0.09	39.34 *± 0.02	47.23 *± 0.03
± SE (d)	0.51	1.03	1.68	0.42	0.35	0.029.	0.21	0.18	0.17
CD $_{(0.05)}$	1.10	2.20	3.60	0.91	0.75	0.062	0.46	0.38	0.37

Significant at 5% level respectively

Table.3 Effect of various organic manures with biofertilizers and their combinations on leaf diameter, root length and number of roots per plant at different stages

Treatment code	Leaf diameter (cm) ± SE(m)			Root length (cm) ± SE(m)			Number of roots per plant (cm) ± SE(m)		
	50 DAT	100 DAT	150 DAT	50 DAT	100 DAT	150 DAT	50 DAT	100 DAT	150 DAT
T_1	0.53 ± 0.06	0.68 ± 0.03	0.88 ± 0.03	5.10 ± 0.26	7.11 ± 0.23	8.15 ± 0.12	20.72 ± 0.31	42.67 ± 1.49	80.63 ± 0.29
T_2	0.67 ± 0.03	0.72 ± 0.00	1.31 ± 0.65	7.50 *± 0.13	8.18*± 0.14	10.50 *± 0.02	28.02 *± 0.25	70.78 *± 0.33	107.89 *± 1.69
T_3	0.73 ± 0.03	0.92 ± 0.03	1.41* ± 0.03	6.91*± 0.42	7.13 ± 0.54	9.38*± 0.03	25.25 *± 0.54	68.69 *± 0.86	104.15* ± 9.55
T_4	0.77 ± 0.03	0.93 ± 0.03	1.01 ± 0.03	6.41* ± 0.33	8.16*± 0.14	10.15 *± 0.03	24.33* ± 0.57	58.35 *± 8.95	100.92* ± 0.03
T_5	0.58 ± 0.03	0.87 ± 0.03	0.90 ± 0.03	6.40 *± 0.03	7.51± 0.03	9.80*± 0.23	23.49* ± 0.81	52.67 ± 3.83	99.26* ± 0.64
T_6	0.61 ± 0.03	0.80 ± 0.03	0.93 ± 0.03	5.68 ± 0.06	6.40 ± 0.02	9.40*± 0.29	24.64* ± 0.35	48.91 ± 0.29	94.87 *± 2.72
T_7	0.79* ± 0.31	0.97 ± 0.66	1.61* ± 0.03	7.05 *± 0.33	7.82 ± 0.09	10.14*± 0.02	25.76 *± 1.21	62.45* ± 3.53	102.00 *± 1.66
T_8	0.74 ± 0.02	0.92 ± 0.03	1.05 ± 0.01	7.16* ± 0.03	7.62 ± 0.34	8.91*± 0.04	21.05 ± 0.59	49.71 ± 0.31	99.44 *± 0.31
T_9	0.75 ± 0.03	0.96 ± 0.03	1.21 ± 0.03	7.20 *± 0.57	7.38 ± 0.31	9.41 *± 0.06	22.43 ± 0.59	52.27 ± 1.61	106.74* ± 0.30
± SE (d)	0.12	0.17	0.21	0.40	0.41	0.18	0.89	5.23	4.89
CD $_{(0.05)}$	0.25	0.33	0.60	0.87	0.88	0.40	1.91	11.19	10.45

Significant at 5% level respectively

Table.4 Effect of various organic manures with biofertilizers and their combinations on bulb length, polar diameter, equatorial diameter, neck length, neck thickness, number of scales per bulb, bulb weight, yield per hectare and total soluble solids at maturity

Treatment code	Bulb length at maturity (cm) ± SE(m)	Polar diameter at maturity (cm) ± SE(m)	Equatorial diameter at maturity (cm) ± SE(m)	Neck length at maturity (cm) ± SE(m)	Neck thickness at maturity (cm) ± SE(m)	Number of scales per bulb at maturity ± SE(m)	Bulb weight at maturity (g) ± SE(m)	Yield per plot at maturity (kg) ± SE (m)	Yield per hectare at maturity (q) ± SE(m)	Total soluble solids at maturity (0B) ± SE(m)
T_1	4.58 ± 0.19	4.52 ± 0.05	5.04 ± 0.03	3.48 ± 0.26	0.41 ± 0.05	9.03 ± 0.06	25.72 ± 0.13	1.61± 0.01	171.46 ± 0.88	10.09 ± 0.03
T_2	7.40 *± 0.09	6.18 *±0.38	6.65*± 0.02	4.74 *± 0.09	1.07*± 0.23	10.10 *±0.06	45.93 *± 0.19	3.39 ± 0.01*	306.20* ± 1.25	12.05*±0.24
T_3	7.97 *± 0.33	6.52* ± 0.05	7.01*± 0.31	5.55*± 0.03	1.10 *± 0.26	11.06*± 0.31	48.67* ± 0.43	3.46 ± 0.02*	324.46* ± 2.80	12.30*±0.63
T_4	6.55*± 0.66	5.48* ± 0.03	6.34 *± 0.08	4.61 *± 0.59	0.64 ± 0.03	9.52 ± 0.15	43.22 *± 0.11	3.30 ± 0.01*	288.13* ± 0.78	10.37± 0.14
T_5	7.38 *± 0.09	5.45 *± 0.02	6.14*± 0.31	4.54 *± 0.03	0.87 ± 0.26	9.69 *± 0.06	39.93 *± 0.03	3.19 ± 0.00*	266.20* ± 0.24	11.89*± 0.22
T_6	6.28*± 0.03	4.92 *± 0.10	5.35 ± 0.33	4.71*± 0.16	0.57 ± 0.03	9.80 *± 0.02	40.26 *± 0.09	3.23 ± 0.00*	268.40* ± 0.63	10.60 ± 0.34
T_7	7.52*± 0.35	6.01 *± 0.03	6.95*± 0.03	5.03*± 0.06	1.27 *± 0.38	10.54*± 0.06	46.75* ± 0.32	3.44 ± 0.02*	311.66 *± 0.61	12.18*± 0.37
T_8	6.73 *± 0.06	5.31* ± 0.05	6.11*± 0.09	4.95 *±0.06	0.61 ± 0.05	9.36 ± 0.33	40.77* ± 0.24	3.26 ± 0.01*	271.80* ±1.64	10.15 ± 0.03
T_9	7.38*± 0.14	6.02 ± 0.06	6.35*± 0.33	5.42*± 0.30	0.57 ± 0.08	10.46*± 0.06	43.55* ± 0.65	3.32 ± 0.02*	290.33 *± 4.37	11.57*± 0.11
± SE (d)	0.40	0.19	0.29	0.31	0.29	0.24	0.46	0.03	2.87	0.39
CD (0.05)	0.86	0.42	0.62	0.67	0.62	0.51	0.9	0.06	6.14	0.85

* Significant at 5% level respectively

Table.5 Effect of organic manure with biofertilizers and their combinations on economics of different treatments

Treatment code	Yield q/ha	Total cost of cultivation (Rs/ha)	Gross Income (Rs./ha)	Net return (Rs./ha)	C:B Ratio
T_1	171.46	59195.15	171460.00	112264.85	1:1.80
T_2	306.20	105505.15	306200.00	200694.85	1:1.92
T_3	324.46	72779.96	324460.00	251680.04	1:3.45
T_4	288.13	78555.15	288130.00	209574.85	1:2.66
T_5	266.20	120930.13	266200.00	145269.87	1:1.20
T_6	268.40	85340.68	268400.00	183059.02	1:2.14
T_7	311.66	99722.39	311660.00	211937.61	1:2.12
T_8	271.80	101406.19	271800.00	170393.81	1:1.68
T_9	290.33	96827.77	290330.00	193502.23	1:1.50

The increased availability of nitrogen, which is an important constituent of chlorophyll and protein thus causing more growth and favorable physical conditions of soil and availability of plant nutrients in sufficient quantities.

The present findings are in line with the results of (Reddy and Reddy, 2005) in onion, Mamta and Rao (2012) in brinjal, Kumar *et al.,* (2014) in radish, Thanunathan *et al.,* (1997), Shah *et al.,* (2016) and Giraddi (1993). maximum leaf length (22.49 cm, 42.48 cm and 51.27 cm), leaf diameter (0.79cm, 0.97cm and 1.61cm) was recorded at different stages 50,100 and 150 days after transplanting by the application of FYM, Vermicompost and Neem cake (T_7) and Vermicompost (T_2).

This might due to the soil application of FYM might be due to the presence of mg might have helped in chlorophyll synthesis which in turn increase the rate of photosynthesis resulted in higher leaf lengthThe present findings are in line with the results of Sundharaiya *et al.,* (2016) in onion, Premsekhar and Rajashree (2009) in okra and Kumari *et al.,* (2011) in tomato.

Yield attributing characters

Significant variation was recorded among different treatments combinations for yield and its attributing traits (Table 4). In the present investigation, Maximum bulb length (7.97cm), polar diameter (6.52cm), Equatorial diameter (7.01cm), neck length (5.55cm), number of scales per bulb (11.06), Bulb weight (48.67g), Yield per plot (3.46 kg/ha) and Yield per hectare (324.46 q/ha) was recorded in treatment T_3 (FYM). Neck thickness (1.27cm) was recorded in treatment T_7 (Vermicompost + FYM +Neem cake). This increased yield might be due to increased yield attributing characters like photosynthetic number of scales, polar and equatorial diameter. The present results are in conformity with the findings of Alkaff *et al.,* (2002), Patil *et al.,* (2005), Aswini*et al.,* (2005). It is relevant to note that, farmyard manure seems to be directly responsible in increasing crop yields either by accelerating the respiratory process by increasing cell permeability by hormone growth action or by combination of all these processes. It supplies nitrogen, phosphorus and potassium of which phosphorus is involved in cell division, photosynthesis and metabolism of

carbohydrates whereas potash regulates proper translocation of photosynthates and stimulates enzyme activity which in turn might have increased the rate of growth and positive development in yield characters leading to high bulb yield of onion. Chetna *et al.,* (2015) and Shah *et al.,* (2016). Maximum total soluble solids (12.30 ^{0}B) recorded in treatment T_3 (FYM).

Economics

The perusal of data pertaining to cost benefit ratio (Table 5) revealed that maximum C: B ratio (1:3.45) was obtained with the treatment T_3 (FYM) due to higher yield and lower cost of cultivation. These results are in line with findings of Premsekhar and Rajashree (2009) in okra.

On other hand, minimum C.B ratio (1:1.20) was obtained with the T_1 (control) due to reduced yield, lesser gross income ultimately lesser net return. Hence, taking into consideration all aspects, treatment T3 (FYM) due to its persistent performance for yield (324.46q/ha), gross income (Rs.324460.00), net returns (Rs.251680.04) and higher cost benefit ratio (1:3.45). Hence, treatment T3 (FYM) can be recommended for the cultivation of onion.

In conclusion, among the different treatments applied best Growth and Yield parameters were found from the plants grown in the plots applied with Vermicompost and FYM respectively whereas, some of the parameters viz. Leaf diameter Leaf length and neck thickness were seen superior in the combination of FYM + Vermicompost + Neem cake. Under organic cultivation of onion, maximum Cost Benefit ratio was seen in Farmyard manure i.e., 1:3.45 with a total net return of Rs. 251680.04. Thus, it can be concluded that use of FYM (2.8kg/1.2m^2) can be recommended for the cultivation of onion.

Highlight

- FYM at the rate of 2.8kg/1.2m^2 can be recommended for cultivation of onion in hilly region of Uttarakhand.
- FYM solely can produce C:B ratio greater than one and more net return per unit area.

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