



Effect of Organic Manure and in Organic Fertilizer on Growth Yield and Quality of Onion (*Allium cepa* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment entitled "Effect of Organic manure and inorganic fertilizer on growth, Yield and Quality of Onion (*Allium cepa* L.)" was conducted at Horticulture research farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment framed was intended to study the effect of different organic manures, inorganic fertilizers on growth, yield and quality of onion. The results of the present investigation indicated that, the combined application of organic manures and inorganic fertilizers has significant influence the growth, yield and quality parameters of onion as regards to the treatment T8 (70 % RDN + 30 % FYM) was found superior for most of the traits under study and it was at with treatment T7 (70 % RDN + 30 % Vermicompost), T5 (80 % RDN + 20 % FYM) and T4 (80 % RDN + 20% Vermicompost). The maximum values of growth parameters like plant

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height (91.44 cm) and number of leaves (10.53) at harvest were recorded in treatment (T8). The yield contributing characters like diameter of bulb (8.70 cm), number of bulbs (41.33), yield per plot (5.07 Kg), yield per hectare (33.77q) were found to be maximum in T8. The parameters like weight of fresh bulb (181.70 g), weight of dry bulb (168.07 g) was high in T6 and T8 respectively. Hence, it can be concluded that, for getting optimum growth, higher yields the crop should be supplied with the 70 per cent recommended dose of N, P, K, fertilizers (100:50:50 kg/ha), in which the 30 per cent quantity of N should applied through farmyard manure.

Keywords: Recommended Dose of Fertilizer (RDF); Nitrogen – Phosphorous – Potassium (NPK); Farmyard Manure (FYM); Total Soluble Solids (TTS).

1. INTRODUCTION

Onion (*Allium cepa* L.) is one of the oldest bulb crops, known to mankind and consumed worldwide. It is one of the most important commercial vegetable crops grown in India. It is indispensable item in every kitchen as vegetable and condiment used to flavor many of the food stuffs. Therefore, onion is popularly referred as in cookery, hence it is called the “Queen of Kitchen.” by Germans. Onion is cultivated under an area of 3991.51 ha with a production of 76377.21 metric tons in the world.

India ranks first in area and is the second largest producer of onion in the world, next to China, accounting for 22.18 percent of the world area and 18.78 percent of the world production. In India, onion is being grown in an area of 1274 („000 ha) with production of 21717.70 („000 Mt) and the productivity is 17.04 t ha⁻¹ which is low. Productivity of onion were higher in the case of Turkey (34.3 Mt ha⁻¹) followed by Brazil (26.1 Mt ha⁻¹) Aditya et al. [1].

Due to lower yields, even though India has the highest area under onion, it stands second in the production of onion in the world. Hence, there is a lot of potential for increasing the production of onion by improving the yields. India is also the largest exporter of onion and hence, it is crucial to improve the yields for enhancing the export level, so that it helps in earning foreign exchange for the exchequer of the country. Productivity could be increased by use of suitable varieties, balanced nutrition, optimum water management as well as need-based plant protection measures. Among the many constraints for low productivity in onion, imbalanced nutrition is the main limiting factor (Priyanshu et al. [2]). Use of different organic manures like farmyard manure, vermicompost and Jeevamruth has become necessary in the recent year’s, use of

these organic manures for improving productivity of crops and maintaining soil fertility and productivity of soil is gaining prominences. The organic manuring has positive influence on soil texture and water holding capacity (Kale et al. 1991). It also provides food for soil microorganisms. It increases the activity of microbes which is in turn helps to convert unavailable plant nutrients into available form.

2. MATERIALS AND METHODS

The present investigation was carried out at the field experimentation center of Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Rabi-2021. The university is situated on the left side of Prayagraj-Rewa National Highway, about 5km from Prayagraj city. All types of facilities necessary for cultivation of successful crop including field preparation inputs, irrigation facilities were provided from the Department of Horticulture (Vegetable science), Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj.

The experiment was laid out in Randomized block design with three replications. The experiment consists of nine treatments. The seeds are sown on raised bed for transplanting in the field with spacing 10 X 15 m². During investigation, data were recorded on various growth, yield and parameters in respect to application of inorganic and organic fertilizer on onion. The experiment was laid out in Randomized Block Design (RBD) with nine treatment combinations of different organic manures, inorganic fertilizers (given in Table 1) comprise replicated thrice. The periodical observations on growth and yield parameters were recorded.

3. TREATMENTS DETAILS

Table 1.

Sl. No.	Treatment Symbols	Treatment combinations
1	T ₀	100% RDN (Control)
2	T ₁	90% RDN + 10% vermicompost
3	T ₂	90% RDN + 10% FYM
4	T ₃	90% RDN + 10% Jeevamruth
5	T ₄	80% RDN + 20% Vermicompost
6	T ₅	80% RDN + 20% FYM
7	T ₆	80% RDN + 20% Jeevamruth
8	T ₇	70% RDN + 30% Vermicompost
9	T ₈	70% RDN + 30% FYM
10	T ₉	70% RDN + 30% Jeevamruth

4. RESULTS AND DISCUSSION

The results of the investigation have been presented in the table and bar – diagrams wherever required. The results obtained from the experiment has been under the chapter. During investigation, data were recorded on various growth, yield and quality parameters in respect to application of inorganic and organic fertilizer on onion.

4.1 Growth Characters

The growth contributing characters were recorded for the following variables namely plant height, number of leaves/plants, days to maturity.

4.1.1 Plant height

The data recorded on height of plant at different growth stages are presented in the Table 2. The maximum plant height of onion i.e., at 30 days. 28.33 cm, 25.63 cm, 25.53cm, 25.50 cm, 32.05 cm and 21.67 was recorded under T₈, T₄, T₁ and T₃. At 60 days after sowing, the maximum plant height 79.63 cm under T₈, followed by T₇ (74.83 cm) and T₉ (73.30 cm). The minimum plant height (56.13) was recorded under control (T₀). In case of 90 days after sowing, the plant height was maximum in T₈ (91.44 cm) which was at par with T₇ (90.03 cm), T₅ (88.00 cm). While minimum plant height was obtained in T₀ (71.53 cm). The plant height

was recorded maximum under T₈ (70% of recommended dose of nutrient + 30% vermicompost) that give the full opportunity to plant for optimum growth and development might be due to the increase in cell size and enhancement of cell division, which ultimately resulted in increased plant height. Similar findings were drawn by Adeyeye et al. [3], Ahmed et al. [4].

4.1.2 Number of leaves/plants

The number of leaves/plants counted at stages of crop maturity showed non-significant differences (Table 2). Number of leaves/plants ranged from 8.17 to 10.53 with the mean of 8.98. Based on means, the maximum number of leaves / plants was observed in T₈ (10.53) followed by T₇ (9.47), T₅ (9.43) and T₄ (9.10). The minimum number of leaves / plants was counted in T₀ (8.17). The number of leaves per plant was high when 70% RDN + 30% FYM had applied to plant. It also showed high number when applied with vermicompost. Thus, it is revealed that combination of RDN, FYM, vermicompost may complement in increasing growth of onion. Similar findings were drawn by Adeyeye et al. [3], Ahmed et al. [4].

4.1.3 Days to maturity

The number of days to maturity was counted from date of sowing till full maturity of the bulbs. This trait showed significant difference between the treatments (Table 2). The number of days to maturity ranged from 63 days to 86 days with the mean of 79 days. The minimum number of days to maturity was observed in T₈ (63.33 days) followed by T₇ (71 days), T₉ (73 days), T₄ (74 days). Rest of the treatments took more days to maturity when compared with mean. The T₀ control (86 days) took maximum number of days to maturity. From the above results it is understood that when 70% RDN + 30% FYM had applied to plant matured fast than rest of the treatments. This may be due to the readily available nutrients in RDN and FYM may boost the morphological growth. Similar findings were drawn by Adeyeye et al. [3], Ahmed et al. [4].

Yield Characters: The yield characters were recorded for the following variables namely bulb diameter, number of bulbs per kg, yield per plot, yield per hectare.

Table 2. Growth parameter effect of organic manures and inorganic fertilizers on growth parameter

Treatment Combinations	Plant height (30 DAS)	Plant height (60 DAS)	Plant height (90 DAS)	Number of Leaves
T0-100% RDN	22.17	56.13	71.53	8.17
T1-90%RDN+10%VERMICOMPOST	25.50	62.47	74.17	8.53
T2- 90%RDN+10%FYM	24.40	66.03	77.30	8.80
T3-90%RDN+10%JEEVAMRUT	21.67	67.96	76.17	8.33
T4-80%RDN+20%VERMICOMPOST	25.63	69.27	84.00	9.10
T5-80%RDN+20%FYM	24.70	71.40	88.00	9.43
T6-80%RDN+20%JEEVAMRUTH	23.70	68.23	78.97	8.57
T7-70%RDN+30%VERMICOMPOST	25.53	74.83	90.03	9.47
T8-70%RDN+30%FYM	28.93	79.63	91.44	10.53
T9-70%RDN+30%JEEVAMRUTH	24.50	73.30	87.00	8.90
Mean	24.67	68.93	81.86	8.98
S. E. (d) (±)	0.51	0.97	1.43	0.12
C.D. at 5%	1.51	2.87	4.21	0.35
CV	5.721	1.214	1.194	1.829

Bulb diameter (cm): The bulb diameter showed significant difference between the treatments. (Table 3).

The bulb diameter ranged from 5.85 cm to 8.70 cm with the mean of 6.77 cm. the maximum bulb diameter was observed in T8 (8.70 cm) followed by T9 (7.61 cm), T7 (7.55 cm). While the minimum bulb diameter was observed in T0 (5.85 cm). The maximum bulb diameter in T8 (70% RDN + 30% FYM) may be due to contribution to the balanced C: N ratio and enhanced availability of plant nutrients hence increased rate and efficiency of metabolic activities resulting in increasing cell division, high assimilation of protein and carbohydrates. Similar findings were drawn by Bdulla et al. [5], Ahmed et al. [4], Adeyeye et al. [3].

4.1.4 Weight of fresh bulb (g)

The results of weight of dry bulb showed significant difference between the treatments. (Table 3). This trait also followed the similar pattern followed by other traits. Weight of dry bulb ranged from 96.13 g to 168.07 g with the mean of 135.39 g. The weight of fresh bulb was found to be high in T8 (168.07g) followed by T5 (159.59g), T2 (147.73g) and T6 (141.86g). This is due to differences among genotypes in their adaptability to the specific environment and nutrient use efficiency. Similar findings were drawn by Adeyeye et al. [3].

4.1.5 Number of bulbs

The bulb diameter showed significant difference between the treatments (Table 3). The number of bulbs ranged from 29.67 to 41.33 with the mean

of 35. The maximum number of bulbs were found in the treatment 8 (41.33) followed by T7 (37), T5 (35). Rest of the treatments had a smaller number of bulbs than mean. These increase in number of bulbs may be due to the interactive influence of mineral nutrients and FYM on growth characters due to improved physio-chemical and biological properties of soil results in effective nutrient uptake. Similar findings were drawn by Bdulla et al. [5], Ahmed et al. [4], Adeyeye et al. [3].

4.1.6 Yield per plot (kg)

The yield per plot showed significant difference between the treatments. (Table 3). Yield per plot ranged from 3.08 kg to 5.07 kg with the mean of 3.69 kg. T8 (5.07 kg) highest yield per plot compared to other which was followed by T7 (4.18 kg), T9 (4.07 kg). whereas the minimum yield per plot was observed in T0 (3.08 kg), T3 (3.20 kg), T1(3.27 kg). Increased levels of FYM along with combination of chemical fertilizers was found significant for yield per plot. Similar findings were drawn by Bdulla et al. [5], Ahmed et al. [4], Adeyeye et al. [3].

4.1.7 Yield / hectare (q)

The results of yield per hectare showed significant difference between the treatments (Table 3). This trait also followed the similar pattern followed by another trait. Yield per hectare ranged from 20.53q to 33.77q with mean of 24.57q. The maximum yield per hectare was observed in the treatment T8 (33.77q), followed by T7 (27.88q), T9 (27.13q). whereas the minimum yield per hectare was observed in T0 (20.53q), T3(21.30q), T1 (21.79q).

Table 3. Effect of various organic manure and inorganic fertilizer on days yield parameters of onion

Treatment Combinations	Days to Maturity	Bulb Diameter	Weight of Fresh Bulb	Weight of Cured Bulb	Number of Bulbs	Yield per plot	Yield per ha
T0-100% RDN	86.33	5.85	100.25	96.13	29.67	3.08	20.53
T1-90%RDN+10%VERMICOMP OST	83.00	6.19	129.07	120.15	34.00	3.27	21.79
T2- 90%RDN+10%FYM	84.67	6.29	151.57	147.73	33.33	3.42	22.77
T3-90%RDN+10%JEEVAMRUT	86.00	6.03	137.09	112.15	32.67	3.20	21.30
T4-80%RDN+20%VERMICOMP OST	77.33	6.44	144.58	134.30	35.67	3.51	23.41
T5-80%RDN+20%FYM	79.00	6.61	171.27	159.59	36.34	3.63	24.17
T6-80%RDN+20%JEEVAMRUT H	81.33	6.42	146.54	141.86	34.00	3.45	22.97
T7-70%RDN+30%VERMICOMP OST	71.00	7.55	142.82	138.17	37.33	4.18	27.88
T8-70%RDN+30%FYM	63.33	8.70	181.70	168.07	41.33	5.07	33.77
T9-70%RDN+30%JEEVAMRUT H	73.67	7.61	140.38	135.72	35.67	4.07	27.13
Mean	78.57	6.77	144.53	135.39	35.00	3.69	24.57
S. E. (d) (\pm)	1.06	0.10	2.05	2.22	0.52	0.06	0.35
C.D. at 5%	3.14	0.31	6.06	6.55	1.54	0.18	1.03
CV	0.769	1.104	1.173	0.291	2.654	1.567	1.563

Table 4. Effect of various organic manure and inorganic fertilizer on quality parameters in onion

Treatment Combinations	TSS	Ascorbic Acid
T0-100% RDN	8.47	12.31
T1-90%RDN+10%VERMICOMPOST	8.80	11.50
T2- 90%RDN+10%FYM	9.37	12.44
T3-90%RDN+10%JEEVAMRUT	8.83	13.00
T4-80%RDN+20%VERMICOMPOST	9.54	13.34
T5-80%RDN+20%FYM	9.77	14.33
T6-80%RDN+20%JEEVAMRUTH	9.43	14.00
T7-70%RDN+30%VERMICOMPOST	10.83	14.70
T8-70%RDN+30%FYM	11.33	12.47
T9-70%RDN+30%JEEVAMRUTH	10.30	11.85
Mean	9.67	12.99
S. E. (m) (±)	0.18	0.16
C.D. 5%	0.54	0.48
CV	2.259	0.258

4.1.8 Total soluble solids (°Brix)

The results of Total Soluble Solids showed significant difference between the treatments. (Table 4). Total Soluble Solids ranged from 8.47 to 11.33 with the mean of 9.67. The maximum TSS was observed in T₈ (11.33) followed by T₇ (10.83), T₉ (10.30), T₅ (9.77). While the minimum TSS was observed in T₀ (8.47), T₁ (8.80), T₃ (8.83). Functional activity of root for longer duration under this T₈ (70% RDN + 30% FYM) seems to increase the Total soluble solids in Onion. TSS content significantly increased with the nitrogen application nitrogen helped in vigorous vegetative growth and imparted deep green colour to the foliage which favored photosynthetic activity of the plants so there was greater accumulation of food material i.e., carbohydrates in the bulb which synthesized to saccharides and there was increased in TSS content. Similar findings were concluded by Basim and Maath [6].

4.1.9 Ascorbic acid content in the bulb (%)

The results of Ascorbic acid content showed significant difference between the treatments (Table 4). Ascorbic acid content ranged from 11.50% to 14.70% with the mean value of 12.99%. Ascorbic acid content in onion bulbs was found to be highest in T₇ (14.70%) followed by T₅ (14.33%), T₆ (14%), T₄ (13.34%), T₃ (13%). While, the minimum ascorbic acid content was observed in T₁ (11.50%), T₉ (11.85%), T₀ (12.39).

As the application of nitrogen increases which in turn increase the vigorous vegetative growth imparted deep green colour to the foliage which favored photosynthetic activity of the plants so

there was greater accumulation of food material and other components. This may be the reason for increased ascorbic acid content.

5. CONCLUSION

Among the various combinations, overall performance of the treatment T₈ which received 70 percent NPK through chemical fertilizer along with 30 percent Farmyard manure per hectare as organic manure enhanced yield, vegetative growth, and quality of onion. The treatment T₉ which received 70 percent NPK through fertilizer along with 30 percent Jeevamruth receives highest Benefit cost ratio which was superior overall treatments. These results are based on one season and for confirmation few more experimental trails are needed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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