Effect of organic sources of nutrients on yield, quality, soil fertility statusand economics of onion (*Allium cepa* L.)

ABSTRACT

An experiment was carried out to study theeffect of organic sources of nutrients on yield, quality, soil fertility status and economics of onion (*Allium cepa* L.) at Horticulture Research Farm, College of Horticulture, AAU, Anand during the three consecutive years 2016-17, 2017-18 and 2018-19.The experiment was laid out in Randomized Block Design with three replications and ten treatments viz., T_1:RDF 100:75:75 NPK kg ha-1 (control), T_2:100 % N from FYM, T_3:100 % N from Vermicompost, T_4: 100 % N from Castor cake, T_5:75 % N from FYM + NPK consortium 1 L ha-1, T_6: 75% N from VC + NPK consortium 1 L ha-1, T_7: 75% N from CC + NPK consortium 1 L ha-1, T_8: 50% N from FYM + NPK consortium 1 L ha-1, T_9:50% N from VC + NPK consortium 1 L ha-1, T_{10}: 50% N from CC + NPK consortium 1 L ha-1. Soil application of 75% N from VC + NPK consortium 1 L ha^{-1} (T_6) and 75 % N from FYM + NPK consortium 1 L ha-1 (T_5) recorded significantly, higher bulb yield (467 and 417 q/ha) and also increase organic carbon as well as soil microbial population. Higher net return (₹445672)was observed in T_6whereas maximum BCR (5.96) recorded in T_5.

Key words: *Organic manure; TSS; Microbial count; BCR.*

1. INTRODUCTION

"Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops grown extensively throughout the country. It is the only vegetable in which India figures prominently in the world for its production and export. In India, total area under onion cultivation is 1.639 million hectares with total production of about 26.830 MT". (Anon., 2021)[1]."In Gujarat, total area under onion cultivation is 0.082 million ha with total production of 2.109 MT with productivity of 25.71 metric tonnes"(Anon., 2021)[2].

"The continuous chemical fertilizer uses deteriorated crop while organic manures improved these properties" (Mamatha, 2006).[8]"The farmers can in turn obtained good remuneration from the organically produced vegetables due to their heavy demands in national and international markets. Adoption of organic vegetable production would largely depend upon supplies of organic inputs, thoroughly backed up by well-proven production technologies. Judicious use of organic manures can maintain long term soil fertility and sustain higher productivity of crops" [1].Therefore, keeping in view the production of onion with judicial application of organic substances along with bio fertilizers is an integrated way to reduce health hazards, to protect environment as well as enhancing production of onion.

2. MATERIALS AND METHODS

The field experiment entitle "Effect of organic sources of nutrients on yield, quality, soil fertility status and economics of onion (*Allium cepa* L.)" was laid out during the three consecutive years 2016-17, 2017-18 and 2018-19 at Horticultural Research Farm, College of Horticulture, Anand Agricultural University, Anand, Gujarat, India, during the *Rabi* season. The experiment was laid out with ten treatments *i.e.,*T_1: RDF 100:75:75 NPK kg ha^{-1}(control), T_2:100 % N from FYM, T_3:100 % N from Vermicompost, T_4: 100 % N from Castor cake, T_5:75 % N from FYM + NPK consortium 1 L ha^{-1}, T_6: 75% N from VC + NPK consortium 1 L ha^{-1}, T_7: 75% N from CC + NPK consortium 1 L ha^{-1},T_8: 50% N from FYM + NPK consortium 1 L ha^{-1},T_9:50% N from VC + NPK consortium 1 L ha^{-1}, T_{10}: 50% N from CC + NPK consortium 1 L ha^{-1} in a Randomized Block Design with three replications and plot size of 3.0 × 2.0 m. The experiment was conducted in organic plot and the soil was light alluvial having sandy loam texture with 7.11 pH, 0.65% organic carbon, 240.00 kg/ha available N, 87.10 kg/ha available P_2O_5, 241.00 kg/ha available K. About six week old seedlings of white onion cv. GAWO 3 was transplanted at 15 × 10 cm spacing. The organic manures (FYM and Vermicompost) and bio-fertilizer (NPK Consortium@1 L ha^{-1}) were applied at the time of field preparation. Observation were recorded for different traits.

For yield observation five bulbs from randomly tagged plants were weighed by weighing balance and after that the average value was calculated. The quality parameters *i.e.*, TSS and Total sugar were estimatedfrom bulbs. Soil fertility status and microbial count of soil measured at initial and after harvest of the crop. The pooled analysis was conducted in accordance with Panse and Sukhatme (1967) [9] to examine the average effect of various treatments over time.

3. RESULTS AND DISCUSSION

3.1 YIELDPARAMETERS OF ONION

3.1.1 Bulb yield (q/ha):

The data on bulb yield as influenced by different treatments is presented in Table 1. The results indicated that significantly, higher bulb yield was noted with treatment T_6 during 2016-17, 2017-18, 2018-19 and in pooled analysis. In pooled analysis treatment T_6 (75% N from VC + NPK consortium 1 L ha^{-1}) recorded significantly, higher bulb yield (467 q/ha) which was at par with treatment T_1 [RDF (100:75:75) NPK kg ha^{-1}] and T_5 (75 % N from FYM + NPK consortium 1 L ha^{-1}). The use of vermicompost and biofertilizer (NPK consortium) may be the cause of the plant's increased vegetative growth. Because of this, there is a rise in leaf surface area, which raises photosynthetic activity and chlorophyll synthesis. This, in turn, causes the bulb to grow larger and heavier as the carbohydrates are delivered to the underground bulb, increasing yield. Similar result were also reported by Singh *et al.* (2015), Rabari *et al.* (2016) and Vaghela*et al.* (2019)[15,11,17]in onion.

3.2 QUALITY PARAMETERS OF ONION

3.2.1 Total soluble solids (^{0}Brix):

The data on Total soluble solids (^{0}Brix)influenced by different treatments is presented in Table 1 and results revealed that effect of different treatments on Total soluble solids (^{0}Brix) was found non-significant during the 2016-17, 2017-18, 2018-19 and in pooled analysis.

3.2.2Total sugar (%):

The data on Total sugar (%) influenced by different treatments is presented in Table 1 and results revealed that effect of different treatments on Total sugar (%) was found non-significant during the 2016-17, 2017-18, 2018-19 and in pooled analysis.

3.3 SOIL PARAMETERS AFTER HARVEST OF ONION

Data on soil chemical parameters as influenced by different treatments are presented in Table 2. Difference between treatments was found significant for soil EC, organic carbon, available P_2O_5 and K_2O. Whereas, soil organic carbon was found significantly higher with treatment T_3 (0.72) statistically followed by treatment T_2, T_5, T_9 and T_{10}.Higher direct incorporation of organic materials may have led to increased soil organic carbon content through subsequent decomposition of these materials, which may have contributed to the rise in organic carbon content in vermicompost applied plots. These results also collaborate with the findingsof Sharma *et al.* [14], Sharma *et al.*[13], Baskar *et al.*[3] and Tolanur and Badanur[16]. Soil EC (0.40) was recorded statistically the highest with treatment T_8, while available P_2O_5 and K_2O were found statistically superior with treatment T_1 (90.50 kg/ha and 260.07 kg/ha, respectively) over rest of the treatments.

The increase in available phosphorus content of soil due to the incorporation of organic manures may be attributed to the direct addition of phosphorus as well as solubilization of native phosphorus through release of various organic acids during the decomposition of organic matter, similar results were obtained by Kumar *et al.* (2003) [7] and Jamir *et al.* (2013) [6] and Desai *et al.* (2009) [4] also reported that “the application of PSB was effective when applied with inorganic P. While Increase in available K due to organic manures application may be attributed to the direct addition of potassium to the available pool of soil”. “The beneficial effect of vermicompost and farmyard manure on available K might also be attributed to the reduction in fixation and release of K due to interaction of organic matter with clay besides the direct K addition to the available K pool of soil”sharma*et al.* (2003)[12].

3.4 MICROBIAL COUNT AFTER HARVEST OF ONION

The data pertaining to average microbial count after harvest influenced by different treatments is presented in Table 3 and results revealed that the treatments T_5 to T_{10} receiving inoculation of Bio NPK consortium showed higher microbial population as compared to T_1 to T_4. Specifically, T_5 to T_{10} showed 2 fold increase in *Azospirillum*and *Azotobacter* population as well as 3 fold increase in PSB and KMB population as compared to their respective controls *i.e.* T_2 to T_4.It might be due to slow releasing of nutrients from vermicompost and farm yard manure is a carrier of organic carbon and organic dry matter ultimately microbial count improved in soil with the application of vermicompost and farm yard manure alone or in combination with biofertilizers. Similar trends of results were reported Dilpreet *et al.* (2017) [5].

3.5 ECONOMICS OF ONION

Data on economics given in Table 4 reveled that higher bulb yield (467 q/ha) and net return (₹ 542661/____) was observed with application of 75% N from VC + NPK consortium 1 L ha^{-1} but higher BCR 5.96

was observed with application of 75 % N from FYM + NPK consortium 1 L ha^{-1}.These results are in line with findings of Dilpreet *et al.* (2017)[5] in onion.

4. CONCLUSION

From the pooled results of three years, it can be concluded that applicationof 75% N from VC + NPK consortium 1 L ha^{-1} or 75 % N from FYM + NPK consortium 1 L ha^{-1}gave higher bulb yield and also increase organic carbon as well as soil microbial population. Higher net return (₹445672) was observed in 75% N from VC + NPK consortium 1 L ha^{-1} whereas maximum BCR (5.96) recorded in 75 % N from FYM + NPK consortium 1 L ha-1.

ACNOWLEDGEMENTS

The Authors are highly thankful to the Anand Agricultural University, Gujarat for firm support, funds and facilities provided**.**

COMPETING INTERESTS

Authors have declared that no competing interests exist.

Treatments	Bulb yield (q/ha)				Total soluble solids (^{0}Brix)				Total sugar (%)			
	2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled
T_1	401^{ab}	381^{abc}	510^{a}	431^{bc}	13.8	13.7	13.3	13.6	5.40	5.48	5.34	5.41
T_2	373^{bc}	352^{abcd}	497^{a}	408^{bcd}	13.2	13.2	13.6	13.3	5.35	5.30	5.34	5.33

Table 1: Effect of organic sources of nutrients on yield and quality parameter of onion

T_3	390^{abc}	371^{abc}	468^{ab}	410^{bcd}	13.2	13.2	13.5	13.3	5.36	5.32	5.30	5.33
T_4	314^{c}	290^{d}	439^{ab}	348^{f}	12.5	12.6	13.8	12.9	5.34	5.25	5.36	5.32
T_5	417^{ab}	415^{ab}	513^{a}	448^{ab}	12.6	12.7	13.7	13.0	5.36	5.34	5.42	5.37
T_6	459^{a}	429^{a}	511^{a}	467^{a}	13.5	13.5	13.5	13.5	5.36	5.35	5.29	5.33
T_7	362^{bc}	341^{bcd}	427^{ab}	377^{def}	13.4	13.3	13.5	13.4	5.37	5.39	5.45	5.40
T_8	370^{bc}	350^{bcd}	430^{ab}	383^{def}	13.7	13.7	13.3	13.6	5.36	5.33	5.44	5.37
T_9	387^{abc}	366^{abc}	427^{ab}	393^{cde}	13.6	13.5	13.4	13.5	5.38	5.43	5.43	5.42
T_{10}	355^{bc}	333^{cd}	399^{b}	362^{ef}	13.6	13.5	13.4	13.5	5.39	5.44	5.43	5.42
SEm (T)	23.43	22.47	25.25	13.27	NS	NS	NS	0.28	NS	NS	NS	0.02
SEm (Y X T)	-	-	-	35.20	-	-	-	0.27	-	-	-	0.05
F Test (T)	Sig.	Sig.	Sig.	Sig.	NS	NS	NS	NS	NS	NS	NS	NS
F (Y X T)	-	-	-	NS	-	-	-		-	-	-	NS

Note: Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Rang Test at 5% level of Significance

Table 2: Effect of organic sources of nutrients on soil parameters after harvest of crop

Treatments	EC (dS/m)	pH	OC %	Available N (kg/ha)	Available P_2O_5 kg/ha	Available K_2O (kg/ha)
Initial	**0.34**	**7.11**	**0.65**	**240.0**	**87.10**	**241.90**
T_1	0.33^{bcde}	7.11	0.63^{e}	261.0	90.50^{a}	260.07^{a}
T_2	0.31^{de}	7.11	0.70^{abc}	251.2	80.70^{bc}	240.30^{b}
T_3	0.30^{e}	7.15	0.72^{a}	255.9	82.30^{b}	242.47^{b}
T_4	0.32^{cde}	7.11	0.66^{cd}	252.9	80.10^{bc}	238.97^{b}
T_5	0.35^{bc}	7.15	0.70^{ab}	258.8	78.60^{cd}	243.07^{b}
T_6	0.34^{bcd}	7.20	0.68^{bcd}	255.7	80.30^{bc}	240.77^{b}
T_7	0.36^{b}	7.30	0.65^{de}	258.8	82.70^{b}	245.63^{b}
T_8	0.40^{a}	7.25	0.67^{bcd}	257.4	75.30^{e}	243.43^{b}
T_9	0.33^{bcde}	7.28	0.70^{abc}	250.5	78.90^{cd}	242.27^{b}
T_{10}	0.35^{bc}	7.18	0.69^{abc}	246.0	76.10^{de}	239.93^{b}
SEm	0.01	0.13	0.01	8.15	0.91	3.74
F Test	Sig.	NS	Sig.	NS	Sig.	Sig.

Note: Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Rang Test at 5% level of Significance

Table 3: Effect of organic sources of nutrients on soil microbial population (cfu/g of soil) after complition of experiment

Treatments	Soil microbial population (cfu/g of soil)				
	PSB	**Azotobacter**	**Azospirillum**	**KMB**	**Total**
Initial	**2.4×10^3**	**1.2×10^2**	**1.1×10^2**	**1.1×10^2**	**1.9×10^3**
T_1:RDF (100:75:75) NPK kg/ha	6.6×10^3	2.4×10^2	4.9×10^2	6.0×10^2	2.9×10^4
T_2: 100 % N from FYM	9.6×10^4	1.7×10^3	2.5×10^3	2.8×10^3	6.3×10^5
T_3: 100 % N from Vermicompost	5.0×10^4	3.6×10^3	3.9×10^3	3.6×10^3	4.7×10^5
T_4:100 % N from Castor cake	2.1×10^4	1.6×10^3	1.5×10^3	1.2×10^3	1.9×10^5
T_5:75 % N from FYM + NPK consortium 1L/ha	5.2×10^7	5.3×10^5	4.2×10^5	5.9×10^6	6.4×10^9
T_6: 75 % N from VC + NPK consortium 1 L/ha	4.5×10^7	5.4×10^5	4.9×10^5	5.3×10^6	4.3×10^9
T_7: 75 % N from CC + NPK consortium 1 L/ha	3.3×10^7	4.1×10^4	2.9×10^4	1.8×10^6	1.9×10^9
T_8: 50 % N from FYM + NPK consortium 1L/ha	4.7×10^7	5.2×10^5	3.6×10^5	5.7×10^6	6.0×10^9
T_9: 50 % N from VC + NPK consortium 1 L/ha	3.5×10^7	5.2×10^5	4.7×10^5	5.2×10^6	4.1×10^9
T_{10}: 50 % N from CC + NPK consortium 1L/ha	2.8×10^7	2.5×10^4	2.7×10^4	1.4×10^6	1.6×10^9

Table 4: Effect of organic sources of nutrients on economics of onion

Treatments	A grade (q/ha)	B grade (q/ha)	C grade (q/ha)	Total onion bulb yield (q/ha)	Gross income (₹/ha)	Common cost (₹/ha)	Treatment cost (₹/ha)	Total cost (₹/ha)	Net return (₹/ha)	BCR
T_1	282	117	32	431	413037	70165	7911	78076	334962	5.29
T_2	265	113	30	408	472279	70165	21780	91945	380334	5.14
T_3	262	115	34	410	473791	70165	34754	104919	368872	4.52
T_4	212	103	33	348	400924	70165	27732	97897	303027	4.10
T_5	299	116	34	449	520391	70165	17180	87345	433046	5.96
T_6	326	110	31	467	542661	70165	26824	96989	445672	5.60
T_7	237	106	35	377	435211	70165	21460	91625	343586	4.75
T_8	236	113	36	384	442184	70165	12002	82167	360017	5.38
T_9	245	117	32	394	454621	70165	18311	88476	366145	5.14
T_{10}	201	122	40	363	415302	70165	14622	84787	330515	4.90

Selling price of onion:
Chemical: A grade- ₹ 1000/q, B grade- ₹ 900/q, C grade- ₹ 800/q
Organic: A grade- ₹ 1200/q, B grade- ₹ 1100/q, C grade- ₹ 1000/q

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