Biological Forum – An International Journal **16(1): 319-322(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Influence of Organics Nutrient Management on Growth and Yield Attribute of Onion (*Allium cepa* L.)

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(Received: 16 November 2023; Revised: 15 December 2023; Accepted: 28 December 2023; Published: 15 January 2024)
(Published by Research Trend)

ABSTRACT: An experiment was conducted at Horticulture Research Farm, College of Horticulture, AAU, Anand during the three consecutive years 2016-17, 2017-18 and 2018-19 on onion cv. GAWO 3. 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}. The observations were recorded on different growth and yield attributes. The treatment T_6 (Soil application of 75% N from VC + NPK consortium 1 L ha^{-1}) recorded significantly, higher bulb weight (87.91g), bulb volume (90.75 cm^3), bulb yield (467 q/ha) and "A" grade bulbs (325.64 q/ha) in pooled analysis. Whereas, plant height at 40 and 80 DAP as well as yield of "B and C" grade bulbs were found non-significant.

Keywords: Organic manure, bulb yield, Bio NPK Consortium, onion.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial bulbous vegetable crops grown extensively throughout the country. It is popularly referred as "Queen of Kitchen" or "Poor Man's Kasturi" because of indispensable item in every kitchen as vegetable and condiment. It is one of the most important cash vegetable crop, among bulb crops with higher market demand and price due to its culinary, dietary and medicinal values. India is the second largest producer of onion in the world with a prominent production and export. Now-a-days white onion is widely used in dehydrated form (Hanley and Fenwick 1985). In addition to being consumed uncooked, onion serves as a very excellent raw material for the food preparation industries and it can be manufactured into rings, shreds, powder, or onion in vinegar or brine. India produces about 26,830 MT of onion from an area of 1,639 Mha with productivity of 16.36 metric tones (Anonymous, 2021). Maharashtra is the leading onion growing state and other important states are Madhya Pradesh, Gujarat, Bihar, Rajasthan, Andhra Pradesh, West Bengal, Haryana and Uttar Pradesh. Gujarat produces about 2109 MT of onion from an area of 821 Mha with productivity of 25.67 metric tonnes (Anonymous, 2021).

Fertilizer application proved to be a great success and production of vegetables crops. Continuous and liberal use of inorganic fertilizer alone affects soil health and thus resulting in lower yield with poor quality produce (Mamatha, 2006; Singh *et al.*, 2017). Use of organic manures and bioferilizers to meet the nutrient requirement of crop would be an inevitable practice in the years to come for sustainable agriculture. Organic manures and bio fertilizers generally improve the soil physical, chemical and biological properties along with conserving the moisture holding capacity of soil and thus resulting in enhanced crop productivity along with maintaining the quality of crop produce (Maheswarappa *et al.*, 1999). 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.

MATERIALS AND METHODS

The field experiment 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 with 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 pH of 7.11, organic carbon 0.65%, available N 240.00 kg/ha, available P_2O_5 87.10 kg/ha, available K 241.00 kg/ha. About six week old seedlings of white onion variety GAWO 3 was transplanted at spacing of 15 × 10 cm. 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 growth observations randomly five plants per plot was selected and tagged. Plant height was measured by measuring scale from ground level to tip of tallest leaf. Bulb diameter at centre portion was measure by vernier callipers. Five bulbs from randomly chosen tagged plants were weighed by weighing balance and after that the average value was calculated. All the data were analysis statically for individual years and pooled.

RESULTS AND DISCUSSION

Growth parameters of onion

Plant height (cm) at 40 and 80 DATP: The data revealed that the plant height at 40 and 80 DATP was found non-significant during the 2016-17, 2017-18, and 2018-19 and in pooled analysis (Table 1).

Yield parameters of onion

Bulb weight (g): The data pertaining to average bulb weight (g) is presented in Table 2. The result showed that the effect of different treatments on average bulb weight (g) after harvest of crop was found significant during 2016-17, 2017-18, 2018-19 as well as in pooled analysis. In pooled analysis treatment T_6 (75% N from VC + NPK consortium 1 L ha^{-1}) recorded significantly, higher bulb weight (87.91g) which, was statistically at par with treatment T_1 [RDF 100:75:75 NPK kg ha^{-1} (control)] and T_5 (75 % N from FYM + NPK consortium 1 L ha^{1}). It might be due to from vermicompost nutrients are easily available and application bio fertilizer (NPK consortium) made nutrients available from the soil as well as it is free nitrogen photosynthates fixer, thereby increase nitrogen level thus increase growth of the plant and photosynthesis, ultimately more food storage resulted increase bulb weight. The present results are in conformity with the findings of Patil *et al.* (2005); Singh *et al.* (2015); Rabari *et al*. (2016) in onion.

Bulb volume (cm^3): The data presented in Table 2 revealed that the effect of different organic nutrient treatments on bulb volume was found significant during the 2016-17, 2017-18, 2018-19 and in pooled analysis. In pooled analysis treatment T_6 recorded significantly, higher bulb volume (90.75 cm^3) 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}). It might be due to application of vermicompost and bio fertilizer supplies macro and micro nutrient to the plant which involved in cell division and elongation as well as metabolism of carbohydrates. Macro nutrients regulates proper translocation of photosynthesis and enzyme activity which might have hasten the rate of growth and bulb volume. Similar result were also reported by Chetna *et al.* (2015); Shah *et al.* (2016) in onion.

Bulb yield (q/ha): The data on bulb yield as influenced by different organic nutrient treatments is presented in Table 2. 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}). It might be due to application of vermicompost and bio fertilizer (NPK consortium) there is increase in the vegetative growth of the plant. Hence, the leaf surface area increase resulting in high photosynthetic activity and chlorophyll synthesis which in turn increase the bulb size and weight as the carbohydrate are transported to the underground bulb ultimately increased yield. Similar result were also reported by Kumar *et al.* (2011); Mandal *et al.* (2013); Singh *et al.* (2015); Rabari *et al.* (2016); Vaghela *et al.* (2019) in onion.

Grade of bulb: The data presented in Table 3 showed the effect of different treatments on grade of bulb during the 2016-17, 2017-18, 2018-19 and in pooled analysis. The results indicated that only "A" grade bulb shows the significant effect during three years as well as in pooled analysis. Treatment T_6 (75% N from VC + NPK consortium 1 L ha^{-1}) recorded significantly, higher number of A grade bulbs during 2016-17, 2017-18, 2018-19 and in pooled analysis. This might be due to bigger size bulb and more volume of bulb. The result of "B and C" grade bulbs was found non-significant during three years as well as in pooled analysis.

Table 1: Effect of different treatment on growth parameter of onion.

Treatments	Plant height at 40 DATP				Plant height at 80 DATP			
	2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled
T_1	28.10	26.24	25.68	26.67	60.10	56.51	57.58	58.06
T_2	26.17	24.31	25.25	25.24	56.80	53.21	55.58	55.20
T_3	26.53	24.68	25.28	25.50	60.10	56.51	54.58	57.06
T_4	25.17	23.31	24.62	24.37	56.17	52.58	56.91	55.22
T5	25.50	23.64	24.43	24.52	58.83	55.24	55.58	56.55
T6	27.67	25.81	23.20	25.56	60.90	57.31	59.25	59.15
T7	26.50	24.65	25.54	25.56	58.50	54.91	55.58	56.33
T8	24.13	22.28	25.68	24.03	56.47	52.87	54.58	54.64
T9	25.50	23.64	24.91	24.68	59.63	56.04	58.58	58.09
T10	24.07	22.21	25.48	23.92	55.40	51.81	49.92	52.37
SEm (T)	1.15	1.41	1.28	0.69	3.04	4.73	3.30	1.69
SEm (Y × T)	-	-	-	1.80	-	-	-	4.02
F Test (T)	NS	NS	NS	NS	NS	NS	NS	NS
F (Y × T)	-	-	-	NS	-	-	-	NS
C V %	7.67	10.11	8.87	12.50	9.04	14.98	10.25	12.39

Table 2: Effect of different treatment on yield parameters of onion.

Treatments	Bulb weight (g)				Bulb volume (cm^3)				Bulb yield (q/ha)			
	2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled
T_1	82.13^{abc}	73.14^{abc}	89.82^{abc}	81.70^{abc}	84.20^{a}	80.20^{ab}	93.48^{ab}	85.96^{a}	401^{ab}	381^{abc}	510^{a}	431^{bc}
T_2	81.07^{abc}	71.98^{abc}	84.73^{abc}	79.26^{bcd}	77.13^{ab}	73.14^{abc}	85.83^{ab}	78.70^{b}	373^{bc}	352^{abcd}	497^{a}	408^{bcd}
T_3	81.73^{abc}	72.70^{abc}	81.90^{abcd}	78.78^{bcd}	79.67^{ab}	75.67^{ab}	82.78^{ab}	79.37^{b}	390^{abc}	371^{abc}	468^{ab}	410^{bcd}
T_4	71.73^{cd}	61.83^{cd}	80.08^{abcd}	71.21^{ef}	62.33^{b}	58.34^{c}	80.89^{abc}	67.19^{d}	314^{c}	290^{d}	439^{ab}	348^{f}
T_5	84.67^{ab}	75.89^{ab}	92.29^{a}	84.28^{ab}	85.20^{a}	81.21^{ab}	94.95^{a}	87.12^{a}	417^{ab}	415^{ab}	513^{a}	448^{ab}
T_6	90.03^{a}	81.73^{a}	91.96^{ab}	87.91^{a}	91.07^{a}	87.07^{a}	94.11^{a}	90.75^{a}	459^{a}	429^{a}	511^{a}	467^{a}
T_7	80.53^{abc}	71.40^{abc}	79.13^{bcd}	77.02^{cde}	62.60^{b}	58.61^{c}	80.08^{abc}	67.10^{d}	362^{bc}	341^{bcd}	427^{ab}	377^{def}
T_8	78.80^{abcd}	69.51^{abcd}	79.77^{abcd}	76.03^{cde}	72.43^{ab}	68.44^{bc}	80.04^{abc}	73.64^{c}	370^{bc}	350^{bcd}	430^{ab}	383^{def}
T_9	77.23^{bcd}	67.81^{bcd}	78.63^{cd}	74.56^{de}	75.73^{ab}	71.74^{abc}	76.38^{bc}	74.62^{bc}	387^{abc}	366^{abc}	427^{ab}	393^{cde}
T_{10}	68.67^{d}	58.49^{d}	70.20^{d}	65.79^{f}	61.93^{b}	57.94^{c}	65.54^{c}	61.80^{e}	355^{bc}	333^{cd}	399^{b}	362^{ef}
SEm (T)	3.59	3.75	3.84	2.041	5.88	4.98	5.11	2.50	23.43	22.47	25.25	13.27
SEm (Y × T)	-	-	-	4.157	-	-	-	5.91	-	-	-	35.20
F Test (T)	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
F (Y × T)	-	-	-	NS	-	-	-	NS	-	-	-	NS
C V %	7.82	9.22	8.04	9.27	13.54	12.10	10.62	13.83	10.59	10.71	9.45	15.13

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 different treatments on weight of 'A, B and C' grade bulbs (q/ha).

Treatments	'A' Grade bulbs (q/ha)				'B' Grade bulbs (q/ha)				'C' Grade bulbs (q/ha)			
	2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled	2016-17	2017-18	2018-19	Pooled
T_1	245.56^{ab}	238.33^{abc}	362.67^{abc}	282.19^{bc}	110.55	113.33	125.77	116.55	45.00^{b}	30.00	22.33	32.44
T_2	218.33^{bc}	213.89^{bcd}	363.63^{abc}	265.28^{bcd}	112.22	115.00	110.43	112.55	42.67^{b}	23.89	23.83	30.13
T_3	221.67^{bc}	212.22^{bcd}	351.10^{abc}	261.66^{cd}	124.44	126.11	93.20	114.58	44.44^{b}	32.78	24.03	33.75
T_4	157.22^{c}	153.89^{d}	324.17^{bcd}	211.76^{ef}	107.22	108.89	93.40	103.17	50.00^{ab}	27.78	22.20	33.33
T_5	260.56^{ab}	260.56^{ab}	376.10^{ab}	299.07^{ab}	116.67	117.78	114.20	116.22	40.55^{b}	37.22	23.23	33.67
T_6	301.67^{a}	295.00^{a}	380.27^{a}	325.64^{a}	116.67	107.78	106.20	110.21	40.56^{b}	26.67	24.73	30.65
T_7	197.22^{bc}	194.44^{cd}	317.90^{cd}	236.52^{de}	115.00	116.11	85.97	105.69	50.55^{ab}	31.11	23.70	35.12
T_8	196.11^{bc}	193.89^{cd}	317.07^{cd}	235.69^{de}	123.89	123.89	89.73	112.50	50.55^{ab}	32.22	24.03	35.60
T_9	210.56^{bc}	208.33^{bcd}	317.20^{cd}	245.36^{d}	131.11	132.78	86.57	116.82	45.67^{b}	25.56	23.83	31.69
T_{10}	160.55^{c}	160.55^{d}	281.30^{d}	200.80^{f}	136.67	138.89	91.23	122.26	58.33^{a}	34.44	26.77	39.85
SEm (T)	19.59	19.17	16.26	10.10	8.39	8.37	9.98	4.63	3.52	6.15	2.23	2.18
SEm (Y × T)	-	-	-	24.26	-	-	-	11.71	-	-	-	5.73
F Test (T)	Sig.	Sig.	Sig.	Sig.	NS	NS	NS	NS	Sig.	NS	NS	NS
F (Y × T)	-	-	-	NS	-	-	-	NS	-	-	-	NS
C V %	15.64	15.58	8.31	16.39	12.17	12.07	17.34	17.95	13.01	35.33	16.18	29.52

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

CONCLUSIONS

From the three years of field study, it can be concluded that application of 75% N from VC + NPK consortium 1 L ha^{-1} or 75 % N from FYM + NPK consortium 1 L ha^{-1}recorded maximum bulb weight, bulb volume and bulb yield as well as "A" grade bulb in onion cv. GAWO 3.

Acknowledgement. We are thankful to the Director of Research & Dean P.G. Studies and Principal & Dean, College of Horticulture, Anand Agricultural University, Anand for

provided necessary facilities for our research problem to carry out.

Conflict of Interest. None.

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How to cite this article: C.H. Raval, B.N. Satodiya, A.J. Patel and D.D. Parekh (2024). Influence of Organics Nutrient Management on Growth and Yield Attribute of Onion (*Allium cepa* L.). *Biological Forum – An International Journal*, *16*(1): 319-322.