

Effect of integrated nutrient management on growth, yield and quality of green onion

Abstract

A field experiment was conducted during *rabi* season of 2021-22 at College of Horticulture, S. D. Agricultural University, Jagudan, Dist. Mehsana, Gujarat to study the effect of integrated nutrient management (INM) on the growth, yield and quality of green onion. The experiment was laid out in Randomized Block Design (RBD) replicated thrice with 16 nutrient management treatments of different organic, bio-enhancer sources and inorganic sources. The maximum plant height (45.39 cm) at 30 days after planting (DAP) and at harvest (60.60 cm); number of leaves plant⁻¹ at 30 DAP (9.10) and at harvest (11.00) and neck thickness (1.65 cm) was observed with application of 100 % recommended dose of nitrogen (RDN) through vermicompost containing 1.12, 0.35 and 0.56 % of N, P₂O₅ and K₂O, respectively, applied at planting (4.46 t ha⁻¹) with NPK consortia (2.5 Lha⁻¹) i.e. T₆, while, the effect of different integrated nutrient management practices on days taken for harvesting was found non-significant. Treatment T₆ was also as good as the highest yield producing treatment. The maximum yield plant⁻¹ (58.72 g), yield plot⁻¹ (3.20 kg) and yield ha⁻¹ (66.67 t) were obtained with application of 100 % RDN through vermicompost + NPK consortia (T₆). In case of quality parameters, the maximum chlorophyll content a, b and total chlorophyll, 0.92, 0.70 and 1.59 mg g⁻¹, respectively and phosphorus uptake by plant (7.50 kg ha⁻¹) were recorded with application of 100 % RDN through vermicompost (4.46 t ha⁻¹) with VAM (2.5 kgha⁻¹) i.e. T₅. Combined application of organic sources of nutrients along-with NPK consortia improved the nutrient uptake by the crop. The maximum nitrogen uptake (16.75 kg ha⁻¹) and potassium uptake (11.74 kg ha⁻¹) were recorded with application of 100% RDN through vermicompost + NPK consortia (T₆).

Key Words: Green onion, Growth, INM, Nutrient uptake, Yield

Introduction

Green onion belongs to family Alliaceae having other vegetables including garlic, leek, shallots and chives. The bulbs of many *Allium* species are used as food, but

the green onion species is that they lack a fully developed bulb. Green onions have hollow, tubular green leaves growing directly from the bulb. The leaves at the base are overlapped forming as a stem. The plants are harvested when the bulbs are 1 to 2 cm in diameter and the leaves are tender, green and standing. Onion is one of the most important vegetable bulbous crop grown in India from ancient time. Onion is the “Queen of the kitchen”. Onion is preferred mainly because of its green leaves, immature and mature bulbs are either eaten raw or cooked as vegetables. It is popular as salad crop and mature onion bulbs are widely used as a cooked vegetable in soups stews and casseroles in addition to a flavouring agent in many additional dishes.

Onion also possesses nutritional and medicinal importance. Onion bulb is rich in minerals like phosphorus and calcium, and carbohydrates. It also contains proteins and vitamin C. The bulbs are acrid, sweet, aromatic, thermogenic, antiperiodic, antibacterial, stimulant, appetite, diuretic and tonic. Besides these, it has several medicinal properties such as useful against malarial fever, jaundice, asthma, vomiting, wounds, paralysis, skin disease, disorders of liver and respiratory tract. The outstanding characteristic of onion is pungency which is due to volatile oil known as Allyl-propyl-disulphide. It acts as a gastric stimulant and promotes digestion. It contains 87.5 percent water and provides energy to the extent of 4 g calories, 20 I.U. vitamin A, 0.12 mg riboflavin, 0.1 mg niacin, 1.2 mg albuminoides and 0.4 mg ash 100 g⁻¹ of fresh edible portion (Thompson and Kelley, 1957). The growth and yield of vegetable crops are mainly depending on the quality and quantity of fertilizers used. So, to increase the soil fertility and yield, inorganic fertilizers are often used. Frequent and high rate uses of inorganic fertilizer have been associated with some environmental pollution, alteration in soil textures and physical property of the soil. **Continuous application of chemical fertilizers alone over the years has resulted in loss of soil organic carbon and deteriorated soil environment.** India is the second leading onion producing country having an area, production, productivity of 1.62 million hectares, 26.64 million tonnes, 16.40 t ha⁻¹, respectively (Sable *et al.*, 2024). Organic manures act as sources of not only for macro nutrients but also micronutrients, but the quantity varies depending upon the its nature, sources and extent of decomposition. Generation of the information regarding the effect of different sources of organic manures, bio-enhancers, NPK consortia and inorganic fertilizers on the growth, yield, quality of green onion and nutrient uptake is important to the farmers. In view of this, an

investigation was planned to study the effect of integrated nutrient management (INM) on growth, yield and quality of green onion.

Materials and Methods

A field experiment was conducted during *rabi* season of 2021-22 at College of Horticulture, S. D. Agricultural University, Jagudan, Dist. Mehsana, Gujarat to study the effect of integrated nutrient management (INM) on the growth, yield and quality of green onion. The experiment was laid out in Randomized Block Design (RBD) replicated thrice with 16 nutrient management treatments of different organic, bio-enhancer sources and inorganic sources viz. T₁: Control 100 % RDF (50:25:25 kg NPK ha⁻¹), T₂: 50 % RDF + 50 % RDN through vermicompost, T₃: 50 % RDF + 50 % RDN through neem cake, T₄: 50 % RDF + 50 % RDN through FYM, T₅: 100 % RDN through vermicompost + VAM, T₆: 100 % RDN through vermicompost + NPK consortia, T₇: 100 % RDN through vermicompost + *Jeevamrut*, T₈: 100 % RDN through vermicompost + Novel culture, T₉: 100 % RDN through neem cake + VAM, T₁₀: 100 % RDN through neem cake + NPK consortia, T₁₁: 100 % RDN through neem cake + *Jeevamrut*, T₁₂: 100 % RDN through neem cake + Novel culture, T₁₃: 100 % RDN through FYM + VAM, T₁₄: 100 % RDN through FYM + NPK consortia, T₁₅: 100 % RDN through FYM + *Jeevamrut*, T₁₆: 100 % RDN through FYM + Novel culture. Planting of healthy, uniform and medium size onion (variety Agrifound Light Red) bulbsets at 10 cm x 7.5 cm was done on 3rd week of October 2021 at evening hours. In this experiment combinations of organic manures (FYM, neem cake and vermicompost) with bio-enhancers (NPK consortia, VAM, *jeevamrut* and novel culture) and chemical fertilizers embedded under the study along with control. The organic manures and its quantity were applied according to the treatments and their nitrogen content, respectively. All the organic manures were analyzed for available NPK analysis at Soil Science Laboratory, Department of Natural Resource Management, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan (Table 1). Organic manures (FYM, vermicompost and neem cake) were applied according to the treatments at the time of planting as a basal dose. After organic manures application, according to the chemical fertilizers treatments, full dose of P, K and half dose of N were applied at planting, while, remaining half dose of N was applied at 30 DAP. Common full dose of P and K (25 kg ha⁻¹) were applied at planting. Urea, single super phosphate (SSP) and muriate of potash (MOP) were the source of NPK of chemical fertilizers. The bio-fertilizers like VAM (2.5 kg ha⁻¹) and

NPK consortia (2.5 L ha⁻¹) were given through organic manures, whereas, *jeevamrut* and novel organic liquid nutrient were sprayed at @ 5 % and 3%, respectively at 30 DAP.

Table 1: Chemical properties of organic manures used in experiment

Sr. No.	Organic manures	N (%)	P ₂ O ₅ (%)	K ₂ O (%)
1.	FYM	0.51	0.26	0.54
2.	Neem cake	5.17	1.16	1.45
3.	Vermicompost	1.12	0.35	0.56

Recommended dose of fertilizer (RDF): 50:25:25 kg NPK ha⁻¹.

The required cultural practices and plant protection measures were followed as per recommended package of practices. Observations on growth parameters *viz.* plant height (cm), number of leaves plant⁻¹(30 DAP and harvest); yield parameters *viz.* yield per plot⁻¹ (kg) and yield (t ha⁻¹) at harvest and quality parameters *viz.* total soluble solids (°Brix), chlorophyll content a, b and total chlorophyll (mg g⁻¹) and nitrogen, phosphorus and potassium uptake by plant (kg ha⁻¹) were recorded, data was statistically analysed by adopting the standard procedures described by Panse and Sukhatme (1985). Least significant difference at 5 % level was used for finding the significant differences among the treatment means.

Results and discussion

Growth parameters

Plant height

Plant height (cm) (45.39 cm and 60.60 cm, respectively) of green onion was higher in the treatment 100 % RDN through vermicompost + NPK consortia (T₆) which was at par with treatments T₅, T₁₀ and T₉ at 30 DAP and T₁₀, T₅, T₉, T₁₄, T₁₃ and T₈ at harvest (Table 2). While, the minimum plant height (35.13 cm and 46.70 cm) was recorded in the treatment 50 % RDF + 50 % RDN through FYM (T₄) at 30 DAP and at harvest, respectively. This may be due to better moisture holding capacity, supply of nutrients due to favourable soil conditions. These results also corroborate the findings of Prabhakar *et al.* (2012) and Dhaker *et al.* (2017) in onion.

Number of leaves plant⁻¹, the maximum number of leaves plant⁻¹ at 30 DAP (9.10) and at harvest (11.00) were recorded in the treatment 100% RDN through vermicompost + NPK consortia (T₆) which was on par with treatments T₅, T₁₀ and T₉ at 30 DAP and T₁₀, T₅, T₉, T₁₄, T₁₃ and T₈ at harvest respectively (Table 2). While, the minimum number of leaves plant⁻¹ at 30 DAP (7.23) and at harvest (9.00) was recorded with treatment 50 % RDF + 50 % RDN through FYM (T₄). The increase in number of leaves plant⁻¹ maybe due to increased plant growth parameters i.e. plant height, leaf

length also affects number of leaves (Hatungimana *et al.* 2024). Similar findings were earlier reported by Meena *et al.* (2017), Atal *et al.* (2019) in broccoli and Kaur *et al.* (2019) in onion.

Neck thickness (cm), the maximum neck thickness at harvest (1.65 cm) was recorded in the treatment 100 % RDN through vermicompost + NPK consortia (T₆) which was at par with treatment T₁₀, T₅ and T₉, while, the minimum neck thickness (1.31 cm) was recorded in the treatment 50 % RDF + 50 % RDN through FYM i.e. T₄ (Table 2). This might be due to the increase in nitrogen levels cause more vegetative growth resulting enhancement in cell multiplication and cell elongation, and also increase number of leaves and leads to increase neck thickness of the bulb (Hewitt and Smith, 1974). Similar results have also been reported by Mandal *et al.* (2013) and Kaur *et al.* (2019) in onion.

Days taken for harvesting, table 2 proved that the effect of different integrated nutrient management treatments on days taken for harvesting of green onion was found non-significant.

Yield parameters

Yield plant⁻¹ (g)

Table 3 showed that different integrated nutrient management practices significantly influence green onion yield parameters viz. yield plant⁻¹ (g), yield plot⁻¹ (kg) and yield (t ha⁻¹) at harvest. The maximum yield plant⁻¹ (58.72 g) was obtained in the treatment 100 % RDN through vermicompost + NPK consortia (T₆), whereas, the minimum yield plant⁻¹ (45.20 g) was obtained in the treatment 50 % RDF + 50 % RDN through FYM (T₄). This might be due to application of biofertilizer which improve nitrogen status of the soil and also it is free nitrogen fixer, thereby increasing the nitrogen level, major nutrient availability is supplied by inorganic fertilizer will be utilized quickly and other essential secondary nutrient slowly released by organic substances and also vermicompost increase physical and biological condition of soil which helps to increase vegetative growth of plant and due to high rate of photosynthesis, chlorophyll synthesis and translocation of more photosynthates to the storage organ resulting good bulb yield. Similar findings have been reported by Rabari *et al.* (2016) and Vaghela *et al.* (2019).

Yield (kg plot⁻¹) and yield (t ha⁻¹)

The significantly highest yield plot⁻¹ (3.20 kg) and yield hectare⁻¹ (66.67 t) was recorded with treatment 100 % RDN through vermicompost + NPK consortia (T₆). The

increasing yield in green onion might be due to better nutrient supply by specific combination of integrated nutrient management treatments. Use of vermicompost improves the soil aeration, nutrient status and biological properties. The results confirm findings of Thriveni *et al.* (2017), Kaur *et al.* (2019) and Vani *et al.* (2019).

Table 2: Influence of integrated nutrient management on growth parameters

Treatments	Plant height (cm)		No. of leaves plant ⁻¹		Neck thickness (cm)	Days taken for harvesting
	At 30 DAP	At harvest	At 30 DAP	At harvest		
T ₁	36.47	49.20	7.57	9.27	1.35	50.57
T ₂	36.20	48.76	7.40	9.20	1.33	50.77
T ₃	35.51	48.60	7.33	9.10	1.32	51.10
T ₄	35.13	46.70	7.23	9.00	1.31	51.30
T ₅	43.57	59.36	8.40	10.87	1.55	46.20
T ₆	45.39	60.60	9.10	11.00	1.65	45.03
T ₇	38.93	51.35	8.00	9.60	1.39	49.23
T ₈	39.11	53.55	8.03	9.77	1.43	48.10
T ₉	42.37	57.81	8.34	10.77	1.52	46.50
T ₁₀	44.16	59.72	8.57	10.93	1.60	45.23
T ₁₁	38.65	50.64	7.94	9.53	1.39	49.43
T ₁₂	38.46	51.70	7.97	9.70	1.42	48.53
T ₁₃	39.42	54.13	8.03	10.37	1.44	47.40
T ₁₄	39.55	54.40	8.10	10.50	1.45	47.07
T ₁₅	37.36	50.11	7.60	9.40	1.36	49.53
T ₁₆	37.41	51.37	7.62	9.70	1.40	48.67
S.Em. ±	1.68	2.51	0.34	0.43	0.07	2.01
C.D. (P=0.05)	4.85	7.26	0.98	1.24	0.19	NS
C.V. (%)	7.42	8.21	7.41	7.50	8.07	7.18

Table 3: Influence of integrated nutrient management on yield parameters

Treatments	Yield plant ⁻¹ (g)	Yield plot ⁻¹ (kg)	Yield hectare ⁻¹ (t)
T ₁	46.39	2.20	45.83
T ₂	45.78	2.07	43.06
T ₃	45.70	2.06	42.85
T ₄	45.20	1.93	40.14
T ₅	51.37	2.83	58.89
T ₆	58.72	3.20	66.67
T ₇	47.08	2.39	49.79
T ₈	49.80	2.61	54.31
T ₉	50.98	2.82	58.75
T ₁₀	52.25	2.84	59.10
T ₁₁	46.91	2.28	47.50
T ₁₂	49.32	2.54	52.99
T ₁₃	49.95	2.64	55.07

T₁₄	50.27	2.80	58.33
T₁₅	46.90	2.27	47.22
T₁₆	47.09	2.40	50.00
S.Em. ±	2.12	0.12	2.44
C.D. (P=0.05)	6.11	0.34	7.04
C.V. (%)	7.48	8.13	8.13

Quality parameters

Chlorophyll content a, b and total (mg g⁻¹)

Significantly maximum chlorophyll (a, b and total) content of 0.92, 0.70 and 1.59 mg g⁻¹, respectively were observed in the treatment 100 % RDN through vermicompost (4.46 t ha⁻¹) + VAM (2.5 kg ha⁻¹) (T₅) which was on par with treatment T₉ and T₁₃. Whereas, minimum chlorophyll (a, b and total) content 0.79, 0.47 and 1.26 mg g⁻¹, respectively were recorded in the treatment Control i.e. T₁ (100 % RDF= 50:25:25 kg NPK ha⁻¹). This might be due to the VAM fungi found to be most efficient in colonizing the roots and showed high content of chlorophyll (Haripriya and Shekharan, 2002). It helps in absorption of mineral nutrients from the soil and provide to the growing plant due to which there is an increase in growth parameters and photosynthetic pigments. Darade, (2014) also reported similar results.

Total soluble solids (°Brix), effect of different INM practices on TSS was found non-significant (Table 4).

Nutrient uptake by plant (kg ha⁻¹)

Nitrogen uptake

The maximum uptake of N (16.75 kg ha⁻¹) was recorded under treatment 100 % RDN through vermicompost + NPK consortia (T₆) which was at par with treatment T₁₀, T₅ and T₉, whereas, the minimum N uptake (12.02 kg ha⁻¹) was recorded in the treatment T₄ i.e. 50 % RDF + 50 % RDN through FYM (Table 4). This might be due to the beneficial effect of combined use of organic manure with biosource which enhanced the nutrient availability. Enhanced microbial activities in the root zone, decomposes organic manures and also fixed unavailable form of mineral nutrients into available forms in soil, which might have resulted in larger NPK uptake by plant (Edwards *et al.* 2011).

Phosphorus uptake

The maximum uptake of phosphorus (7.50 kg ha⁻¹) was recorded with treatment 100 % RDN through vermicompost + VAM (T₅) which was at par with treatment T₉ and T₁₃, whereas, minimum uptake of phosphorus (4.02 kg ha⁻¹) was found

under treatment 50 % RDF + 50 % RDN through FYM i.e. T₄ (Table 4) (Mengel and Kirby, 2001). Mycorrhiza helps plants with such shallow sparse root system to increase phosphorus uptake (Deressa and Schenk, 2008).

Potassium uptake

The maximum uptake of potassium (11.74 kg ha⁻¹) was recorded with treatment 100% RDN through vermicompost + NPK consortia (T₆) which was at par with treatment T₁₀, T₅, T₉, T₁₄ and T₁₃, whereas, minimum uptake of potassium (8.44 kg ha⁻¹) was found with treatment 50 % RDF + 50 % RDN through FYM i.e. T₄ (Table 4).

Conclusion

Combined application of organic sources of nutrients along-with NPK consortia improved the nutrient uptake by the crop. The maximum nitrogen uptake (16.75 kg ha⁻¹) and potassium uptake (11.74 kg ha⁻¹) were recorded with application of 100% RDN through vermicompost + NPK consortia (T₆).

Table 4: Influence of integrated nutrient management on quality parameters

Treatments	Chlorophyll content (mg g ⁻¹)		NPK uptake by plant (kg ha ⁻¹)			TSS (°Brix)
	'a'	'b'	Total chlorophyll	N uptake	P ₂ O ₅ uptake	

T ₁	0.79	0.47	1.26	13.08	5.31	9.51	7.36
T ₂	0.82	0.50	1.31	12.76	5.12	9.18	7.45
T ₃	0.80	0.50	1.30	12.54	5.09	8.46	7.42
T ₄	0.80	0.49	1.28	12.02	4.02	8.44	7.37
T ₅	0.92	0.70	1.59	15.67	7.50	11.18	8.18
T ₆	0.85	0.60	1.44	16.75	6.40	11.74	8.30
T ₇	0.83	0.58	1.40	14.12	5.60	9.84	7.55
T ₈	0.84	0.59	1.43	15.07	6.02	10.49	7.84
T ₉	0.90	0.66	1.56	15.62	6.92	11.00	8.08
T ₁₀	0.84	0.60	1.44	16.56	6.51	11.49	8.22
T ₁₁	0.82	0.55	1.37	13.91	5.58	9.63	7.50
T ₁₂	0.83	0.59	1.42	14.73	5.97	10.37	7.63
T ₁₃	0.90	0.65	1.54	15.25	6.91	10.73	8.01
T ₁₄	0.84	0.59	1.43	15.29	6.18	10.87	8.04
T ₁₅	0.82	0.51	1.33	13.69	5.57	9.60	7.46
T ₁₆	0.83	0.58	1.41	14.38	5.72	10.13	7.62
S.Em. ±	0.02	0.02	0.03	0.47	0.20	0.38	0.48
C.D. (P=0.05)	0.06	0.05	0.07	1.36	0.59	1.10	NS
C.V. (%)	4.00	5.64	3.12	5.64	5.97	6.49	5.48

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