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Influence of integrated nutrient management on soil properties, nutrient content and uptake by ridge gourd (*Luffa acutangula* L.)

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Abstract
The experiment was conducted during the summer 2021 at Educational Farm, Polytechnic in Horticulture, Junagadh Agricultural University, Junagadh. There were eight treatment combinations replicated thrice in a randomized block design. Among the eight treatments combination tested, organic carbon was significantly higher (0.78%) in T_8 (100% N from FYM), available nitrogen was higher (303.4 kg/ha) in T_3 (50% N from vermicompost + 50%N from inorganic fertilisers), and P_2O_5 (44.10 kg/ha) and K_2O (376.4 kg/ha) in T_7 (100%t N from vermicompost). The highest N (2.21%, 2.07%), P (0.39%, 0.27%) and K (1.57%, 2.75%) content in fruits and stover respectively; maximum N (15.81 kg/ha, 23.14 kg/ha), P (2.80 kg/ha, 3.05 kg/ha) and K (11.22 kg/ha, 30.69 kg/ha) uptake in fruits and stover respectively in the treatment T_3 (50% N from vermicompost + 50%N from inorganic fertilisers). The combined use of organics along with the inorganic fertilizers increased nutrient use efficiency, apparent nutrient recovery and the available nutrient status of the soil.

Keywords: Nutrient management, soil properties, nutrient content, uptake, *Luffa acutangula* L.

Introduction
Ridge gourd belongs to family of 'Cucurbitaceae' and genus of "Luffa" (Loofah). The name luffa is given due to presence of gelatinous principle luffein. It is a vegetable of commercial importance and green immature fruits are cooked as vegetable and used as in preparation of chutney and curries. The chemical constituents of ridge gourd fruits include carbohydrates, carotene, fat, protein, phytin, flavonoids, saponin and amino acid. Ridge gourd thrives very well in warm hot climatic condition. Humid climate favors its best. Low temperature affects its growth adversely. Ridge gourd grown in wide range of soils. Loam, clay loam and silt soils with high organic matter are preferred for ridge gourd cultivation. Ridge gourd productivity in India is poorer than other vegetables such as brinjal and tomato, and demand is increasing day by the day. As a result, there is a great scope to enhance productivity. Fertilizer and organic manures play an important role in raising vegetable yields and improving quality.

The traditional method of farming and less use of organic manure reduces the quality of ridge gourd. For increasing the productivity an economical fertilizer package needs to be formulated which can provide all the essential elements through both organic and inorganic sources to get good quality, produce with higher production, keeping the production cost at sustainable level of an average farmer. Intensive use of only chemical fertilizers to achieve high production has created various problems. Continuous application of heavy doses of chemical fertilizers without organic manures has led to deterioration of soil health in terms of physical and chemical properties of soil, decrease in soil microbial activities, and also reduction in soil humus (Kumari and Tripathi, 2018) [4]. Intensive cultivation and improper fertiliser application lead nutrient deficiencies, leading to reduced crop yields. As a result, the usage of organic manure as a farm input has become important. Though manures are very bulky and expensive to transport, they are safe sources of nourishment since they are environmentally benign and deliver nutrients slowly and steadily to the crop in the field, triggering soil microbial activity (Eifediyi and Remison, 2010) [2]. Organic manure sustains cropping systems through better nutrient recycling and improvement in soil physical, chemical and biological properties (Geethu, *et al.,* 2018) [3]. The use of organic manures has been observed to have beneficial effect on soil texture and structure (Prativa and Bhattarai, 2011) [7].

Materials and Methods

The experiment was conducted at Educational Farm, Polytechnic in Horticulture, Junagadh Agricultural University, Junagadh during the summer 2021. The experimental soil medium black calcareous, soil pH (8.21), bulk density (1.57 g/cc), medium in organic carbon (0.61%), low available nitrogen (249 kg/ha), medium available phosphorus (35.28 kg/ha) and high available potassium (310.3 kg/ha). The experiment was laid out in Randomized Block Design (RBD) with three replications consist of eight treatments *i.e.*, T_1 (Control), T_2 (RDF-50: 25: 25 NPK kg ha^{-1}), T_3 (50% N from vermicompost + 50% N from inorganic fertilizers), T_4 (50% N from FYM + 50% N from inorganic fertilizers), T_5 (75% N from vermicompost + 25% N from inorganic fertilizers), T_6 (75% N from FYM + 25% N from inorganic fertilizers), T_7 (100% N from vermicompost) and T_8 (100% N from FYM). The field was thoroughly prepared and application of vermicompost, FYM, Single Super Phosphate (SSP) and Muriate of Potash (MOP) at the time of sowing. Nitrogen in the form of urea was applied in the two splits *i.e.*, 50% dose at sowing and 50% dose at 30 days after Sowing (DAS). Soil samples were collected to a depth of 0-20 cm treatment wise after the harvesting of crop. The collected soil samples were shade dried, ground in wooden pestle and mortar, sieved by passing through 2 mm sieve, mixed thoroughly and partitioned by quartering technique to get a composite working soil sample for its analysis. Nitrogen was estimated by Alkaline potassium permanganate method (Subbaiah and Asija, 1956) [12], phosphorus by Olsen's method and potassium by Flame Photometer method. The plants samples were collected randomly from each treatment at final picking stage. The plant samples after digestion were analysed for nutrients content by following standard procedure and nutrient uptake was computed. Nitrogen was estimated by Kjeldahl's digestion and distillation method, phosphorus by Vanadomolybdate method and potassium by Flame Photometer method.

Results and Discussion

Effect of INM on soil properties after harvesting of ridge gourd crop

During the investigation, eight different treatments combination tested, organic carbon was significantly higher (0.78%) in T_8 (100% N from FYM), available nitrogen was higher (303.4 kg/ha) in T_3 (50% N from vermicompost + 50%N from inorganic fertilisers), and P_2O_5 (44.10 kg/ha) and K_2O (376.4 kg/ha) in T_7 (100%t N from vermicompost). Application of 100% N from FYM observed the lower soil bulk density (1.47 g/cc) and soil pH (7.81) as compare to other treatments but result found non-significant (Table 1). Similar result found by Sreenivas *et al.* (2000), Narayanamma and Kameswari (2011) [6] and Rathod (2017) [8] in ridge gourd, Sharma *et al.* (2017) [9] and Singh and Tiwari (2019) [10] in okra.

Table 1: Effect of INM on soil properties after harvesting of ridge gourd crop

Treat. No.	Bulk density (g/cc)	pH	Organic carbon (%)	Soil available nutrients (kg/ha)		
				N	P_2O_5	K_2O
T_1	1.57	8.25	0.59	246.6	32.25	301.9
T_2	1.56	8.24	0.60	272.2	36.12	324.0
T_3	1.53	8.16	0.63	303.4	38.04	354.6
T_4	1.54	8.08	0.66	294.7	37.07	336.2
T_5	1.53	8.12	0.73	299.7	42.47	343.4
T_6	1.52	8.10	0.75	274.5	39.78	337.1
T_7	1.49	7.96	0.76	282.7	44.10	376.4
T_8	1.47	7.81	0.78	262.9	41.11	365.3
S. Em. ±	0.02	0.12	0.03	8.75	1.37	13.32
C. D. at 5%	NS	NS	0.08	24.93	3.90	37.90
C.V.%	2.37	2.53	6.88	5.43	6.11	6.74

The net increase in organic carbon was much higher with organic manures in combination with biofertilizers which might be due to increased microbial activities in the root zone which decomposed organic manures and also fixed unavailable form of mineral nutrients into available forms in soil thereby substantiated crop requirements and improved organic carbon level, Tekasangla *et al.* (2015) [13]. Increase in available N, P and K status of soil after harvest may be due to continuous symbiotic fixation by bio-organism. The growth promoting effect of vermicompost have been attributed to the presence of humic substance that have the ability to retain moisture and improve soil structure as well as to the diverse microbial population, which plays an important role in increasing soil fertility.

Effect of INM on nutrient content in fruits and stover

The data pertaining to the effects of different treatments of INM on the nutrient content in fruit and stover of ridge gourd are presented in Table 2. The highest N (2.21%, 2.07%), P (0.39%, 0.27%) and K (1.57%, 2.75%) content in fruits and stover respectively, in treatment combination T_3 (50% N from vermicompost + 50% N from inorganic fertilizers) as compare to other treatments combination. The supplementary and complementary use of organic manure and inorganic chemical fertilizers augment the efficiency both the substance to maintain high level of soil productivity. Similar result was found by Rathod (2017) [8] in ridge gourd, Thriveni *et al.* (2015) [14] in bitter gourd, Mahale (2017) [5] in snake gourd.

Effect of INM on nutrient uptake in fruits and stover

Table 3 shows that combining 50% N from vermicompost with 50% N from inorganic fertilisers significantly maximum N (15.81 kg/ha, 23.14 kg/ha), P (2.80 kg/ha, 3.05 kg/ha) and K (11.22 kg/ha, 30.69 kg/ha) uptake in fruits and stover respectively as compare to other treatment combination. It is might be due to application of integrated nutrient management increase fertilizers use efficiency and longer time availability of plant nutrients. Similar result was observed by Thriveni *et al.* (2015) [14] in bitter gourd, Rathod (2017) [8] in ridge gourd, Chaitanya *et al.* (2013) [1] in tomato.

Table 2: Effect of INM on nutrient content in fruits and stover of ridge gourd

Treat. No.	Nutrient content in fruit (%)			Nutrient content in stover (%)		
	N	P	K	N	P	K
T_1	1.73	0.27	1.25	1.30	0.16	1.56
T_2	1.84	0.34	1.40	1.58	0.24	2.03
T_3	2.21	0.39	1.57	2.07	0.27	2.75
T_4	1.99	0.32	1.40	1.72	0.23	2.63
T_5	1.87	0.36	1.44	1.74	0.25	2.41
T_6	1.92	0.35	1.37	1.70	0.19	1.90
T_7	1.87	0.34	1.39	1.72	0.23	2.17
T_8	1.83	0.30	1.33	1.69	0.18	1.91
S. Em. ±	0.08	0.01	0.05	0.08	0.01	0.08
C. D. at 5%	0.21	0.04	0.16	0.22	0.03	0.21
C.V.%	6.78	7.37	6.75	7.73	7.64	5.99

Table 3: Effect of INM on nutrient uptake in fruits and stover of ridge gourd

Treat. No.	Nutrient uptake in fruit (kg/ha)			Nutrient uptake in stover (kg/ha)		
	N	P	K	N	P	K
T_1	5.31	0.82	3.81	10.98	1.34	12.98
T_2	7.65	1.42	5.83	15.47	2.32	19.83
T_3	15.81	2.80	11.22	23.14	3.05	30.69
T_4	11.39	1.85	8.00	18.61	2.46	28.49
T_5	11.42	2.20	8.80	18.79	2.67	25.80
T_6	10.01	1.82	7.02	17.77	2.02	19.76
T_7	8.58	1.56	6.43	16.71	2.21	21.15
T_8	7.05	1.16	5.11	16.26	1.70	18.27
S. Em. ±	0.50	0.10	0.35	1.08	0.13	1.19
C. D. at 5%	3.30	0.29	0.99	3.30	0.36	3.38
C.V.%	9.04	10.62	8.59	10.88	9.76	9.30

Conclusion

The result revealed that when vermicompost was applied in combination with integrated plant nutrient system along with recommended doses chemical fertilizers, the effect showed better performance on soil physico-chemical properties, nutrient use efficiency and apparent nutrient recovery rather than applying chemical fertilizers alone.

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