International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 2357-2360

Received: 05-07-2018
Accepted: 10-08-2018

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Growth, yield and quality of ridge gourd as influenced by integrated nutrient management in coastal region of Maharashtra

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Abstract
A field experiment was conducted during *Kharif*-2016 to study the "Effect of integrated nutrient management on growth, yield and quality of ridge gourd." at Central Experiment Station, Wakawali, in Coastal region of Maharashtra. There were eight treatment combinations replicated thrice in a randornized block design. The result of the experiment showed that the growth, yield and quality of ridge gourd was significantly increased with integrated use of manure, fertilizers and bio-fertilizer. Among the various treatment tried, the treatment receiving an integration of manure, fertilizers and bio-fertilizer viz. 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1} seed inoculation was significantly superior and recorded maximum growth parameters, yield and quality of ridge gourd. However, the treatment consisting 50 per cent RDN + 50 per cent N through vermicompost + P and K + Azotobacter @ 250 g 10 kg^{-1} seed was at par with the earlier treatment in respect of above characters. On the basis of the results obtained during present investigation, it was observed that integrated use of 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250g 10 kg^{-1} seed is essential for improving growth parameter, yield and quality of ridge gourd grown in coastal region of Maharashtra.

Keywords: ridge gourd, integrated nutrient management, growth, yield and quality

Introduction
Ridge gourd (*Luffa acutangula* L.) is one of the most important cucurbitaceous vegetable crop which belong to genus Luffa. Ii is a vegetable of commercial importance and green immature fruits are cooked as vegetable and used as in preparation of chutney and curries. Fibre of mature dry fruits is used as bath sponge. Ridge gourd medically referred as *Luffa acutangula* as well as called turiya or even turai or beerakai or dodka in several languages in India. The chemical constituents of ridge gourd fruits include carbohydrates, carotene, fat, protein, phytin, flavonoids, saponin and amino acids. Kandlakunta *et al*. (2008) [8] reported that ridge gourd contains about 300 µg β-carotene and 1000 µg carotenoids per 100 g of fresh fruits. It has various pharmacological activities like hepatoprotective, antidiabetic, antioxidant, abortifacient and antifungal activity. Ridge gourd is a excellent blood purifier, possessing laxative properties, cure for jaundice, aiding weight loss, antinflammatory and antibiotic, fortifying the immune system, skin cure and good for stomach.

The continuous application of heavy doses of chemical fertilizers without organic manures or bio-fertilizers has lead to a deterioration of soil health in term of physical and chemical properties of soil, declining of soil microbial activities, reduction in soil humus, increased pollution of soil, water and air. Hence integrated supply of nutrients through organic, inorganic and bio-fertilizers is the need of the hour for sustainable productivity and to maintain better soil health. Application of eco-friendly bio-fertilizers and low cost input with organic and inorganic fertilizers play significant role in plant nutrition.

Integrated nutrient management involves judicious use of organic, inorganic and biofertilizers, which ultimately cause a significant reduction in chemical fertilizers. It also help in ecological safety, exploitation of local resources ensuring higher soil and crop productivity to overcome micronutrient deficiencies and increase efficiency of applied fertilizer (Johan *et al*., 2001) [6]. Though, the lateritic soil are best suited for cultivation of ridge gourd, the traditional method of farming and less use of organic manure reduces the magnitude and quality of ridge gourd. Therefore, the present in resignation was undertaken to study the effect of integrated

nutrient management on growth, yield and quality of ridge gourd in coastal region of Maharashtra.

Materials and Methods

An experiment was conducted during *kharif* season of the year 2016 at Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli with variety Konkan Harita following the randomized block design with eight treatments which were replicated thrice. The treatments were T_1-Absolute control, T_2- Recommended dose of fertilizer (RDF) 100:50:50 N: P_2O_5: K_2O kg ha^{-1}, T_3-75 per cent recommended dose of nitrogen (RDN) + 25 per cent N through FYM + P and K + Azotobacter @ 250 g 10 kg^{-1} seed, T_4 – 75 per RDN + 25 per cent N through Vermicompost + P and K+ Azotobacter @ 250 g 10 kg^{-1} seed, T_5 – 75 per cent RDN + 25 per cent N through Poultry manure + P and K+ Azotobacter @ 250 g 10 kg^{-1} seed, T_6 – 50 per cent RDN + 50 per cent N through FYM + P and K + Azotobacter @ 250 g 10 kg^{-1} seed, T_7 -50 per cent RDN + 50 per cent N through Vermicompost + P and K+ Azotobacter @ 250 g 10 kg^{-1} seed and T_8 – 50 per cent RDN+50 per cent N through Poultry manure+ P and K+ Azotobacter @ 250 g 10 kg^{-1} seed. The field was thoroughly prepared and the full dose of single super phosphate and muriate of potash were applied at the time of sowing. Nitrogen in the form of urea was applied in the three splits i.e. 50 per cent dose at sowing, 25 per cent at 30 days after sowing (DAS) and remaining 25 per cent at 60 DAS. Azotobacter was applied as seed treatment @ 250 g 10 kg^{-1}.Farm yard manure, vermicompost and poultry manure were applied as per treatment schedule. The observations regarding the growth parameters, yield contributing characters and fruit yield were recorded from five representative plants from each plot. The ridge gourd fruits were harvested at 12-15 days interval. Fresh weight of ridge gourd fruit was calculated on the basis of yield per plot and the fruit yield was expressed in quintal $ha^{-1.}$ The quality parameters such as moisture content in fruit was estimated on oven dry basis (Ranganna, 1986) [11] and was expressed in percentage. TSS was estimated by using hand refractometer method (Ranganna, 1986) [11] and (A.O.A.C., 1975) [1]. The crude protein content of the fruit was estimated by multiplying its nitrogen content in percentage with 6.25 and expressed in percentage (Lorenz and Maynard, 1980) [9]. The ascorbic acid content in the fruit was estimated by using 2, 6-dichlorophenol indophenols titration method (Ranganna, 1986) [11]. The reducing and non-reducing sugars content in the fruit was estimated by using Lane and Eynon method (Ranganna, 1986) [11]

Results and Discussion

Initial Soil characteristics

The experimental soil was sandy clay loam in texture having P^H 5.53 indicated moderately acidic nature of soil and electrical conductivity 0.257 dS m^{-1} indicated low electrical conductivity of the soil. These results are in accordance with the results reported by Shinde *et al.* (2010) [14] in lateritic soil of Konkan and Salvi *et.al* (2015) [15] in coastal region of Maharashtra. The organic carbon content was13.8 g kg^{-1} which indicated high content of organic carbon in soils. It might be attributed to luxurious growth of grasses and vegetation due to heavy rainfall and addition of organic matter through litter, residues and cover crops there by subsequently increased the humification. Besides, it might be due to low mineralization rate of organic matter because of low temperature and humid climate of the region. Almost similar finding have been reported by Salvi *et al.* (2017) [12] who reported high content of organic carbon in cashew growing gardens in Sindhudurg district of Konkan region. The available N content was 316.73 kg ha^{-1}, available P_2O_5 was 9.33 kg ha^{-1} and available K_2O content was 228.48 Kg ha^{-1}. However, the exchangeable Ca^{2+} content was 2.6 Cmol (P) +kg^{-1}, exchangeable magnesium content was 2.4 Cmol (P+) kg^{-1} and available sulphur content was 2.14 mg kg^{-1}. As far as the micronutrients were concerned, the soil indicated the iron content 20.14 mg kg^{-1}, manganese content 35.22 mg kg^{-1}, copper content 3.40 mg kg^{-1} and zinc content was 1.12 mg kg^{-1}. As regards the microbial population, the initial soil sample showed the bacterial population of 10.50 x 10^{-6} cfu g^{-1}, fungi population of 6.00 x 10^{-6} cfu g^{-1} and actinomycetes population was 1.50 x 10^6 cfu g^{-1}.

Growth parameters

The data pertaining to the effects of different treatments of integrated nutrient management on the growth parameters of ridge gourd are presented in Table 1. Maximum vein length (435.56 cm) was noticed with application of 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1} seed. The treatment T_5 consisting 75 per cent RDN + 25 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1} required minimum days (62.40 days) for fruit picking. However, the control treatment required maximum days (70.60) for fruit picking means the same treatment indicated late fruiting of ridge gourd. The treatment T_8 consisting 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1} seed recorded significantly highest number of leaves (89.73) $plant^{-1}$ as compared to all other treatments. Similarly length of internode (21 cm) and number of laterals (13.67) were highest due to application of 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1} as compared to all other treatments. The lowest growth attributing characters were found in control treatment.

In general, it was observed that the treatment consisting 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azolobacter @ 250 g 10kg-1 seed recorded significantly highest vine length of ridge gourd over rest of the treatments at harvest which might be due to the slow release of nutrients through the poultry manure for longer period. Further, urea fertilizers in split doses might have helped to the requirement of the crop which resulted into the increase in the length of the vine. Similar findings were also reported by Kameswari *et al*. (2011) [7]. The possible reason for this acceleration of growth might be due to the activation of cell division and cell elongation in the axillary buds, which had a promoting effect in increased vein length, length of internode and number of laterals might be due to well established root system in addition to increased plant height and number of branches and leaves. Das *et al.* (2008) reported significant increase in number of leaves due to combined application of chemical fertilizers and organic fertilizers.

Yield contributing characters and yield

Application of 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1} brought significant improvement in yield attributing characters of ridge gourd followed 50 per cent RDN + 50 per cent N through vermicompost + P and K + Azotobacter @ 250 g 10 kg^{-1} resulted in higher number of fruits $vine^{-1}$, fruit weight $plot^{-1}$, yield (t ha^{-1}), dry matter yield of fruit (q ha^{-1}) and stover yield (q ha^{-1}). The lowest number of fruits $vine^{-1}$,

fruit weight plot^{-1}, yield (t ha^{-1}), dry matter yield of fruit (q ha^{-1}) and stover yield (q ha^{-1}) was observed in the control treatment. These findings are similar to those of Prabhu *et al.* (2006) [10] and Kameswari *et al.* (2011) [7] in cucumber and ridge gourd, respectively. As far as the fruit yield of ridge gourd is concerned, it differed significantly between different treatments. Application of 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1} resulted in significant improvement in yield (16.64 t ha^{-1}), however it was at par with 50 per cent RDN + 50 per cent N through vermicompost + P and K + Azotobacter @ 250 g 10 kg^{-1} as compared to RDF alone (14.86 t ha^{-1}). These results clearly indicated that only inorganic sources cannot maintain instant flow of nutrients in increasing crop yield. There is a need to use organic, chemical fertilizers and biofertilizers in combinations so as to increase crop productivity. The increase in the fruit yield (96. 14 q ha^{-1}) due to application of 50 per cent recommended dose + biofertilizers (PSB + Azotobacter @ 250 g 10 kg^{-1} seed) was also reported by Dodake *et al.* (2015). These results who are also in conformity with the results obtained by who reported the highest fruits (16.51 t ha-1) due to application of 50 per cent RDF through inorganic + 50 per cent RDN through poultry manure.

Quality parameters

The treatment receiving 50 per cent RDN + 50 per cent N through vermicompost + P and K + Azotobacter @ 250 g 10 kg^{-1} resulted in significantly highest TSS (7.10 ^{0}B), reducing sugar (7.28 %) and total sugars (10.17 %) as compared to all other treatments. Similar finding of increased TSS, reducing and total sugar content of ridge gourd with combined application of organic and inorganic fertilizers have been reported by Kameshwari *et al*. (2011). The ascorbic acid and protein content was significantly highest with the application of 50 per cent RDN + 50 per cent N through poultry manure + P and K + Azotobacter @ 250 g 10 kg^{-1}, however, it was at par with the application of 50 per cent RDN + 50 per cent N through vermicompost + P and K + Azotobacter @ 250 g 10 kg^{-1}. The lowest quality parameters were observed in control. Shinde *et.al* (2010) [14], Das *et al.* (2015) [4] and also reported lowest quality parameters due to control treatment in okra, ridge gourd, bottle gourd and bitter gourd, respectively.

Table 1: Effect of integrated nutrient management on growth parameter of ridge gourd.

Tr. No.	Treatments	Vine length (cm)	Days of picking	Number of leaves per plant	Length of internode	Number of laterals
T_1	Absolute control	317.52	70.60	65.40	13.67	7.33
T_2	Recommended dose of fertilizer (100:50:50 N:P_2O_5:K_2O kg ha^{-1})	413.18	63.51	74.87	16.33	10.00
T_3	75 % RDN + 25% N through FYM + P and K + Azotobacter	347.29	68.00	76.40	16.00	8.33
T_4	75 % RDN + 25% N through vermicompost + P and K + Azotobacter	363.38	64.17	79.40	17.00	10.33
T_5	75 % RDN + 25% N through poultry manure + P and K + Azotobacter	432.79	62.40	81.13	18.67	12.00
T_6	50 % RDN + 50 % N through FYM+ P and K + Azotobacter	381.58	63.53	79.07	17.67	11.33
T_7	50% RDN + 50% N through vermicompost + P and K + Azotobacter	434.38	62.46	86.47	19.00	13.00
T_8	50 % RDN + 50% N through poultry manure + P and K + Azotobacter	435.56	62.42	89.73	21.00	13.67
	Mean	390.71	64.64	79.06	17.42	10.75
	S.E.±	1.088	0.145	0.458	0.411	0.292
	C.D. (P=0.05)	3.300	0.439	1.389	1.246	0.886

Table 2: Effect of integrated nutrient management on yield and yield contributing characters.

Tr. No.	Treatments	Number of fruits vine^{-1}	Weight of fruits per plot (kg)	Fruit girth (cm)	Fruit length (cm)	Average weight of fruit(g)	Fruit Yield (t ha^{-1})	Dry matter yield of fruit (q ha^{-1})	Stover yield (q ha^{-1})
T_1	Absolute control	4.60	11.27	11.32	32.43	204.16	9.39	5.74	12.38
T_2	Recommended dose of fertilizer (100:50:50 N:P_2O_5:K_2O kg ha^{-1})	6.60	17.84	14.11	35.13	225.27	14.86	11.52	17.70
T_3	75 % RDN + 25% N through FYM + P and K + Azotobacter	5.70	13.50	13.29	32.47	208.94	11.24	6.23	14.62
T_4	75 % RDN + 25% N through vermicompost + P and K + Azotobacter	6.60	16.98	11.73	32.79	214.44	14.15	8.36	15.63
T_5	75 % RDN + 25% N through poultry manure+ P and K + Azotobacter	6.67	17.40	14.30	38.58	217.33	14.48	14.33	18.62
T_6	50 % RDN + 50 % N through FYM + P and K + Azotobacter	5.60	14.10	12.77	34.80	209.85	11.74	8.44	16.66
T^7	50 % RDN + 50 % N through vermicompost + P and K + Azotobacter	7.10	19.49	13.39	39.08	228.75	16.24	14.68	19.70
T_8	50 % RDN + 50 % N through poultry manure+ P and K + Azotobacter	7.23	19.96	13.44	39.27	230.10	16.64	14.89	19.81
	Mean	6.26	16.32	13.04	35.57	217.35	13.59	10.52	16.89
	S.E.±	0.047	0.330	0.288	0.229	0.678	0.273	0.253	0.160
	C.D. (P=0.05)	0.143	1.000	0.874	0.694	2.056	0.828	0.768	0.484

Table 3: Effect of integrated nutrient management on quality parameter

Tr. No.	Treatments	TSS (^{0}B)	Moisture %	Protein %	Ascorbic acid mg/100 g	Reducing sugar %	Total sugar %
T_1	Absolute control	2.63	90.89	0.70	10.00	4.32	5.41
T_2	Recommended dose of fertilizer	2.80	90.24	1.27	10.83	6.43	8.26
T_3	75 % RDN + 25% N through FYM + P and K + Azotobacter	2.67	90.96	1.25	10.90	4.50	6.48
T_4	75 % RDN + 25% N through vermicompost + P and K + Azotobacter	3.03	90.55	1.26	12.23	5.83	8.25
T_5	75 % RDN + 25% N through poultry manure + P and K + Azotobacter	2.87	90.46	1.29	13.03	5.61	7.44
T_6	50 % RDN + 50 % N through FYM + P and K + Azotobacter	2.77	89.90	1.28	10.70	6.38	7.66
T_7	50 % RDN + 50 % N through vermicompost + P and K + Azotobacter	3.10	89.74	1.31	12.17	7.28	10.17
T_8	50 % RDN + 50 % N through poultry manure + P and K + Azotobacter	3.07	89.22	1.32	13.20	6.88	9.71
	Mean	2.87	90.24	1.21	11.63	5.90	7.92
	S.E.±	0.068	0.139	0.002	0.352	0.111	0.133
	C.D. (P=0.05)	0.208	0.423	0.007	1.067	0.336	0.402

Conclusion

On the basis of results obtained during the present investigation, it was observed that the integrated use of 50 per cent RDN + 50 per cent N through poultry manure + P and K as per recommendation + Azotobacter @ 250 g 10 kg^{-1} seed inoculation is essential for improving growth, yield and quality parameters of ridge gourd in coastal region of Maharashtra.

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