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Influence of Integrated Nutrient Management in Beet Root (*Beta vulgaris* L.) Cv. Crimson Globe for Growth and Yield under Alkaline conditions

V. Mounika[1*], D. Lakshminarayana[2], J. Srinivas[3], G. Sathish[4] and P. Gouthami[5]
[1]M.Sc. Scholar, Department of Vegetable Science, SKLTSHU Mojerla, (Telangana), India.
[2]Associate Professor, Department of Floriculture and Landscaping, SKLTSHU, Rajendranagar, (Telangana), India.
[3]Assistant Professor Department of Vegetable Science, SKLTSHU Mojerla, (Telangana), India.
[4]Assistant Professor, Department of Agricultural Statistics, SKLTSHU Mojerla, (Telangana), India.
[5]Assistant Professor Department of Crop Physiology, SKLTSHU Mojerla, (Telangana), India.

(Corresponding author: V. Mounika)*
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ABSTRACT: The present investigation was conducted at College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Telangana State, India in rabi season of 2019-20 with set of eight treatments. The treatments included 75 per cent and 50 per cent recommended dose of nitrogen, phosphate and potassium, as well as Farm yard manure, vermicompost, and biofertilizers (azotobacter and phosphorus solubilizing bacteria). Among the treatments 75 per cent Recommended dose of Nitrogen Phosphorus potassium plus Farm yard manure (6 tons per hectare) plus vermicompost (1.5 tonnes per hectare) plus Azotobacter (10 kg per hectare) plus PSB (10 kg per hectare) is best for growth recorded as minimum number of days required for 80 per cent germination of seedlings (2.55 days), longer plant height (46.50 cm), more number of leaves per plant (22.54), maximum leaf area (1350.16 cm^2) and higher chlorophyll content index (24.24), and yield parameters as maximum root length (14.26 cm), root diameter (7.4 cm), root yield per plant (175.00 g) root yield per plot (7.70 kg), root yield per hectare (19.16 t), root to shoot ratio (4.00) and harvest index (0.92) with maximum availability of Nitrogen (352.37 kg ha^{-1}), Phosphorous (47.47 kg ha^{-1}), Potassium (365.95 kg ha^{-1}) and Organic carbon (0.60 %) after the harvest of the crop and the same treatment registered lowest pH (8.04) and EC (0.23 dSm^{-1}).

Keywords: INM, RDF, azotobactor, PSB, NPK content.

INTRODUCTION

Beetroot (*Beta vulgaris* L.) is recognized by many common names such as Beet, Chard, and Spinach Beet for its juice value and therapeutic benefits. (Yashwant, 2015). E162, a food colouring ingredient extensively used in manufacturing (Clifford *et al*., 2015), decreases coronary heart disease and cancer (Jurgen *et al*., 2015). Significantly lower systolic and diastolic blood pressure. Several publications highlight the ongoing discussion over the antihypertensive potential of beetroot (Lidder *et al*., 2013 and Kapil *et al*., 2014). Beet root is one of the real foods that stimulates energy in athletes because it contains one of the greatest levels of nitrates and sugar, (Yadav *et al*., 2016).

Fertilizer is one of the costliest crop inputs, therefore knowing how to use it wisely is critical (Dhakal *et al*., 2016; Kumar *et al*., 2020). While chemical fertilizer application aids in achieving maximum production, it must be interpreted in view of its detrimental effects on the environment as well as rising production expenses due to its expensive cost (Dadarwal *et al*. (2009; Ranjan *et al.*, 2013; Kannan *et al.*, 2013; Kumar *et al.*, 2014). To raise cropping system output, increase the efficiency of fertilizer input, and sustain soil health for a longer length of time, organic material coupled with inorganic fertilizers is applied to soils (Tambe *et al*., 2019). Organic manure treatments, according to Kler *et al*. (2002), result in a better physical, chemical, and biological environment.

FYM is the most often used organic manure. Apart from enhancing the physical characteristics of the soil, it provides macro and micronutrients (Sengar *et al*., 2000). In recent years, vermicompost has been discovered as one of the most important gears for transforming biodegradable organic material into useful manure. It's high in nitrogen, phosphate, potassium, calcium, vitamins, natural phytoregulators, and a well-balanced microbiome, all of which contribute to the soil's natural fertility being restored. (Banik *et al*., 2004). The use of organic manures, biofertilizers, and a lower dose of chemical fertilizers in combination helps to reduce pollution, boost product production and quality, and maintain soil health (Ahmad *et al*., 2016). With these considerations in mind, the current study proposes to investigate the influence of integrated nutrition management on beetroot (*Beta vulgaris* L.) cv. crimson globe growth and yield under alkaline circumstances.

MATERIALS AND METHODS

The present study was conducted at the College of Horticulture, Mojerla, SKLH University, Mulugu, Telangana State, India. During the final week of October 2019 to the second week of January 2020, The farm is located at an elevation of 401 meters above MSL on 770.96' East longitude and 160.36' North latitude, with a semi-arid climate. The experiment, was designed in a randomized complete block design with eight treatments and three replications with eight treatments having three replications. The total eight treatments consist of i.e., T_1-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_2-75% Recommended dose of nitrogen phosphorus and potassium +Vermicompost (3 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_3-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_4-50 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_5-50 % Recommended dose of nitrogen phosphorus and potassium + Vermicompost (3 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha-1), T_6-50 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1})+ Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_7-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12t ha^{-1}) and T_8- 50 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12 t ha^{-1}).

Crimson Globe was the variety under investigation. To ensure spacing, seeds were seeded at a 45 cm × 15 cm spacing and thinning was done 10 days following sowing. Urea, SSP, and MOP were used to provide nitrogen, phosphorus, and potassium, respectively. As per treatment before planting, a full dose of P and K and half dose of N were applied as a basal dose, and the remaining half dose of N was provided 30 DAS. Prior to sowing, manures such as farmyard manure and vermicompost were mixed into the plots according to treatment. Seeds are treated with biofertilizers prior to sowing (Azotobacter and PSB). Growth and yield characteristics were recorded on five plants per treatment per plot in each. The minimum number of days required for seedlings to germinate at 80% of their potential, plant height, number of leaves per plant, leaf area, chlorophyll content index, root length, root diameter, root yield per plant, root yield per plot, root yield per hectare, root to shoot ratio, and harvest index were all recorded. The data were statistically examined using analysis of variance (ANOVA) for RBD according to Panse and Sukhatme's standard approach (1985).

A. Soil Nutrient Status

Soil samples were taken before the application of integrated nutrient sources to the experimental location to determine the soil's nutrient status. After the crop was harvested, soil samples were taken from each treatment plot at a depth of 30 cm using a screw auger equipment. The soil samples were collected, well mixed, and then air dried in the shade before being ground in a wooden mortar with a wooden pestle and sieved through a 2 mm sieve. After processing, the samples were stored in clearly labelled corrugated boxes and utilised to estimate available nitrogen, phosphate, potassium, pH, electrical conductivity, and organic carbon in the soil before and after crop harvest. The alkaline permanganate method was used to assess available nitrogen (kg ha^{-1}) (Subbaiah and Asija, 1956). Olsen's approach was used to calculate available phosphorus (kg ha^{-1}) (Olsen *et al*., 1954). Flame photometry was used to determine available potassium (kg ha^{-1}) (Jackson, 1967). The pH of the soil was determined using the Beckman pH metre glass electrode method (Jackson, 1967). The electrical conductivity of the soil (dS mol^{-1}) was determined using the Solubridge method (Jackson, 1967). The percentage of soil organic carbon was calculated using the Walkely and Black fast titration method (Walkley and Black 1934).

RESULTS AND DISCUSSION

A. Growth parameters

Beetroot Cv Crimson globe growth metrics were significantly affected by integrated nutrition management as shown in Tables 1 and 2. Among the integrated nutrient management treatments, T_3-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}) recorded minimum number of days required for 80 per cent germination of seedlings (2.55 days) with maximum plant height at 25, 50 and 75 days after sowing (16.65, 35, 46.50 cm respectively) with more number of leaves per plant and leaf area at 25, 50 and 75 days after sowing (9.33, 19.12, 22.54 respectively) and (854.20, 938.28, 1350.16 cm^2) respectively with highest chlorophyll content index at 25, 50 and 75 days after sowing (14.60, 18.36 and 24.24 respectively). Organic and inorganic fertilizers, nitrogen-fixing biofertilizers, and phosphorus-solubilizing bacteria worked together to increase the availability of all main and minor nutrients in the rhizosphere which helps in increasing the growth parameters. Reddy and Rao (2004) found similar results in bitter gourd.

The availability of needed quantities of nitrogen, which is contained in amino acids, nucleotides, nucleic acids, a variety of coenzymes, auxins, cytokinin, and alkaloids, produced the highest rise in plant height, more leaves per plant, leaf area, and chlorophyll content. The use of FYM may have increased microbial activity in the root zone of the beet root crop, which could aid in nutrient transformation The findings are consistent with (Tovihoudji *et al*. (2015); Singh *et al*. (2017); Dhakal *et al*. (2016); Nagar *et al*. (2016) in their experiments.

Table 1: Influence of INM on number of days taken for 80 % germination of seedlings (days), plant height (cm) and No. of leaves per plant atdifferent growth stages of beet root Cv. Crimson Globe.

Treatments	Number of days required for 80% Germinationof seedling	Plant height (cm)			Number of leaves per plant		
		25 days after sowing	50 days after sowing	75 days after sowing	25 days after sowing	50 days after sowing	75 days after sowing
T_1	3.13^{ab}	13.89^{cd}	28.7^{bcd}	37.57^{cd}	8.37^{b}	17.83^{a}	18.64^{a}
T_2	2.97^{ab}	15.73^{ab}	30.7^{bc}	44.64^{ab}	8.53^{ab}	17.99^{a}	18.97^{a}
T_3	2.55^{a}	16.65^{a}	35.0^{a}	46.50^{a}	9.33^{a}	19.12^{a}	22.54^{a}
T_4	3.07^{ab}	12.49^{de}	26.6^{de}	37.80^{cd}	8.03^{bc}	15.41^{b}	18.30^{b}
T_5	3.67^{bcd}	14.92^{bc}	$27.6c^{de}$	40.63^{bc}	8.33^{bc}	17.67^{a}	19.01^{a}
T_6	2.87^{ab}	15.23^{abc}	32.2^{ab}	40.60^{bc}	8.07^{bc}	18.40^{a}	21.30^{a}
T_7	3.92^{cd}	11.85^{e}	24.9^{e}	34.53^{de}	7.45^{c}	15.45^{b}	18.24^{b}
T_8	4.22^{d}	10.19^{f}	19.9^{f}	32.07^{e}	6.17d	13.62^{b}	17.65^{b}
SEm±	0.27	0.48	1.19	1.73	0.29	0.62	0.60
CD at 5%	0.81	1.45	3.62	5.25	0.89	1.89	1.82

Table 2: Effect of integrated nutrient management on leaf area (cm^2) and chlorophyll content index at different growth stages of beet root Cv. Crimson Globe.

Treatments	Leaf area (cm^2)			Chlorophyll content index		
	25 Days after sowing	50 Days after sowing	75 Days after sowing	25 Days after sowing	50 Days after sowing	75 Days after sowing
T_1	763.62^{b}	856.54^{b}	1071.23^{bc}	10.39^{c}	14.35^{c}	19.27^{b}
T_2	807.15^{ab}	867.86^{ab}	1272.61^{a}	11.95^{b}	17.59^{ab}	22.75^{a}
T_3	854.20^{a}	938.38^{a}	1350.16^{a}	14.60^{a}	18.36^{a}	24.24^{a}
T_4	680.54^{c}	805.66^{bc}	1009.27^{cd}	9.40^{cd}	14.56^{c}	19.92^{b}
T_5	802.33^{ab}	856.86^{b}	1061.84^{bcd}	11.61^{b}	16.57^{b}	20.46^{b}
T_6	815.40^{ab}	876.22^{ab}	1161.91^{b}	13.56^{a}	17.13^{ab}	22.64^{a}
T_7	571.98^{d}	754.16^{cd}	1022.93^{cd}	9.79^{c}	13.43^{c}	16.99^{c}
T_8	520.58^{d}	725.90^{d}	960.13^{d}	8.38^{d}	11.52^{d}	15.11^{c}
SEm±	21.45	24.67	34.20	0.35	0.45	0.64
CD at 5%	65.06	74.83	103.74	1.08	1.36	1.95

B. Yield parameters

Root length and Root diameter (cm). The experimental results demonstrated that the various treatments listed in Table 3 had a significant effect on the yield characteristics.

Among the integrated nutrient management treatments, T_3-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}) recorded root length (14.26 cm) (Fig. 1), root diameter (7.4 cm) (Fig. 2). It's believed that improved plant growth in all aspects resulted in more photosynthate translocation from leaves (source) to roots (sink), resulting in increased root length and diameter. Similar results were also reported by Dlamini *et al.* (2020) in beet root.

Root yield. Among the treatments, T_3 treatment, 75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}) recorded highest root yield per plant (Fig. 3) (175.00 g) root yield per plot (7.70 kg), root yield per hectare (19.16 t) root to shoot ratio (4.00) and harvest index (0.92). Highest yield in all roots parameters which was due to the maximum root length and root diameter. The application of an ideal amount of NPK and organic manures aids the bio-physical activities of crop plants that convert proteins and carbohydrates into roots. The synergistic impact of NPK and FYM / vermicompost also improves growth metrics. and, as a result, yields. The results are in accordance with the findings of Das *et al*. (2015); Singh *et al.* (2017) in carrot and Paul *et al.* (2018); Dlamini *et al.* (2020) in beet root and Antil and Devraj (2019).

Fig. 1. Longest root length in T_3 treatment.

Fig. 2. Widest root diameter in T_3 treatment.

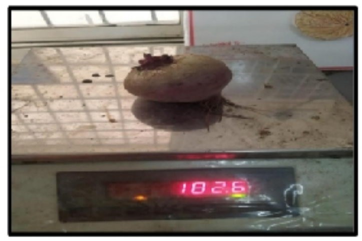

Fig. 3. Heaviest root weight in T_3 treatment.

T_3 treatment -75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1})

Table 3: Influence of INM on root length (cm), root diameter (cm), Root yield (g plant^{-1}), Root yield (kg plot^{-1}), Root yield (t ha^{-1}) of beet root Cv. crimson globe.

Treatments	Root length (cm)	Root diameter (cm)	Root yield (g plant^{-1})	Root yield (kg plot^{-1})	Root yield (t ha^{-1})	Root to shoot ratio	Harvest index
T_1	10.6^{cd}	5.94^{cd}	144.86^{c}	6.29^{c}	15.75^{de}	2.71^{cd}	0.74^{cd}
T_2	12.37^{b}	6.82^{ab}	162.34^{ab}	7.13^{b}	17.54^{bc}	3.58^{bc}	0.81^{bc}
T_3	14.26^{a}	7.44^{a}	175.00^{a}	7.70^{a}	19.16^{a}	4.00^{a}	0.92^{a}
T_4	9.49^{de}	5.31^{d}	146.13^{c}	5.73^{d}	14.33^{ef}	2.47^{d}	0.71^{de}
T_5	11.93^{bc}	6.37^{bc}	154.95^{bc}	6.35^{c}	15.90^{cd}	3.41^{ab}	0.76^{cd}
T_6	13.97^{a}	6.71^{abc}	173.06^{a}	7.35^{ab}	18.41^{ab}	3.27^{bc}	0.85^{b}
T_7	9.54^{de}	5.41^{d}	128.20^{d}	4.94^{e}	11.60^{fg}	2.24^{de}	0.73^{d}
T_8	8.60^{e}	4.43^{e}	104.71^{e}	4.39^{e}	10.31^{g}	1.78e	0.65^{e}
SEm±	0.47	0.26	4.43	0.18	0.49	0.22	0.02
CD at 5%	1.42	0.79	13.43	0.55	1.47	0.68	0.07

Soil nutrient status. Table 4 shows that the original soil sample from the experimental site had a pH of 7.52, 0.35 percent organic carbon, and accessible N, P, and K contents of 242.11, 28.2, and 242.3 kg ha^{-1}, respectively. The results obtained on soil nutrient status after the experiment reported in Table 5 revealed that, among the treatments, T_3 treatment 75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}) recorded maximum availability of Nitrogen (352.37 kg ha^{-1}), Phosphorous (47.47 kg ha^{-1}), Potassium (365.95 kg ha^{-1}) and Organic carbon (0.60 %) after the harvest of the crop and the same treatment registered lowest pH (8.04) and EC (0.23 dSm^{-1}).

The use of biofertilizers in combination with FYM and vermicompost reduced nitrogen loss and enhanced biological nitrogen fixation, resulting in the soil receiving more nitrogen, potassium, and organic carbon. Similar findings were reported by (Kafle *et al.*

2019).

Similarly, PSB solubilizes insoluble p in to soluble form, resulted in availability of more phosphorus content in the soil after harvest of the crop. Due to the combined effect of organic, inorganic and biofertilizers led to maintain optimum pH in the soil rather than other treatments. These findings are according to Ambede *et al*. (2008) and Rai *et al*. (2016).

Table 4: Physical and chemical characteristics of the soil before experiment.

Particulars	Values	Method of analysis
Physical properties		
Sand (%)	72.3%	Bouyoucos hydrometer (Piper, 1950)
Silt (%)	7.2%	
Clay (%)	21.6%	
Textural class	Sandy Loam	
Chemical Properties		
pH (1:2.5 soil: water suspension)	7.52	Beckman pH meter glass electrode method (Jackson, 1967)
Electrical conductivity (dS mol^{-1})	0.18	Solubridge method (Jackson, 1967)
Organic carbon (%)	0.35	Walkley and Black (1934)
Available Nitrogen (kg ha^{-1})	242.11	Alkaline permanganate method (Subbaiah and Asija, 1956)
Available Phosphorus (kg ha^{-1})	28.2	Olsen's method (Olsen *et al*., 1954)
Available potassium (kg ha^{-1})	242.3	Flame photometry (Jackson, 1967)

Table 5: Influence of INM on available NPK (Kg ha^{-1}), soil pH, EC (dS/mol) and Organic carbon (%) in soil after harvest of the beet root cv. crimson globe.

Treatments	Available Nitrogen (Kg ha^{-1})	Available Phosphorus (Kg ha^{-1})	Available potassium (Kg ha^{-1})	soil pH	Electric conductivity (dS/mol)	Organic carbon (%)
T_1	283.03^{c}	38.16^{cde}	321.31^{de}	8.33^{de}	0.32^{b}	0.42^{de}
T_2	307.75^{b}	42.12^{bc}	340.69^{bc}	8.17^{bc}	0.30^{ab}	0.49^{c}
T_3	352.37^{a}	47.47^{a}	365.95^{a}	8.04^{a}	0.23^{a}	0.60^{a}
T_4	253.67^{d}	36.18e	314.95^{de}	8.36^{e}	0.36^{bc}	0.41^{ef}
T_5	305.08^{b}	41.79^{bcd}	332.74^{cd}	8.23^{cd}	0.33^{b}	0.46^{cd}
T_6	339.30^{a}	43.93^{ab}	352.73^{ab}	8.10^{ab}	0.27^{a}	0.54^{b}
T_7	240.35^{d}	37.75^{de}	307.99^{e}	8.38^{ef}	0.35^{b}	0.38^{f}
T_8	216.08^{e}	34.45^{e}	307.68^{e}	8.50^{f}	0.38^{c}	0.33^{g}
SEm±	5.28	1.35	6.01	0.04	0.02	0.01
CD at 5%	16.01	4.11	18.24	0.12	0.06	0.04

T_1-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_2-75% Recommended dose of nitrogen phosphorus and potassium +Vermicompost (3 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_3-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_4-50 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_5-50 % Recommended dose of nitrogen phosphorus and potassium + Vermicompost (3 t ha^{-1}) + Azotobacter (10 kg ha^{-1}) + Phosphorus solubilizing bacteria (10 kg ha-1), T_6-50 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + Azotobacter (10 kg ha^{-1})+ Phosphorus solubilizing bacteria (10 kg ha^{-1}), T_7-75 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12t ha^{-1}) and T_8- 50 % Recommended dose of nitrogen phosphorus and potassium + Farm yard manure (12 t ha^{-1})

CONCLUSION

According to the results of these experiments, beet root with 75 percent recommended dose of NPK plus Farm yard manure (6 t ha^{-1}) plus Vermicompost (1.5 t ha^{-1}) plus Azotobacter (10 kg ha^{-1}) plus Phosphorus solubilizing bacteria (10 kg ha^{-1}) followed by treatment 50 percent RDNPK plus Farm yard manure (6 t ha^{-1}) plus Vermicompost (1.5 t ha^{-1}) plus Azotobacter (10 kg ha^{-1}) plus Phosphorus solubilizing bacteria (10 kg ha^{-1}) appears to be a viable combination for improving beetroot Cv. Crimson Globe growth and yield characteristics under alkaline conditions.

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Conflict of Interest. None.

REFERENCES

Anonymous (2017-18). HAPIS (Horticulture Area and Production Information System), Final advanced estimate of area and production of horticultural crops. 2017-2018. https://aps.dac.gov.in.

Ahmad, I., Ahmad, B., Ali, S., Fang, H.Q., Liu, T., Kamran, M., Wu, Y., Rahman M. U. and Faisal, S. (2016). Organic and Inorganic Fertilization Influenced on Yield and Quality of Sugar Beet Genotypes. *Russian Agricultural Sciences, 42*(3-4): 218–223.

Ambede, P. A. (2008). Studies on effect of integrated nutrient supply system on yield and nutrient uptake by bitter gourd (*Momordica charantia* L.) and changes in properties of lateritic soil. M.Sc. (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli.

Antil, R. S. and Devraj (2019). Integrated nutrient management for sustainable crop production and improving soil health. *Nutrient dynamics for sustainable crop production*, 69−101.

Banik, P., Bejbaruah, R., and Farm, A. E. (2004). Effect of vermicompost on rice (*Oryza sativa*) yield and soil-fertility status of rainfed humid sub-tropics. *Indian Journal of Agricultural Sciences, 74*(9): 488-491.

Clifford, T., Stevenson, E. J., Howatson, G. and West, D. J. (2015). The potential benefits of red beetroot supplementation in health and disease. *Journal of Nutrients*, *7*: 2801- 2822.

Das, D., Dwivedi, B. S., Meena, M. C., Singh V. K. and Tiwari, K. N. (2015). Integrated nutrient management for improving soil health and crop productivity. *Indian Journal of Fertilizers, 11*(4): 64−83.

Dadarwal, R. S., Jain N. K. and Singh, D. (2009). Integrated management in baby corn (*Zea mays*). *Indian Journal of Agricultural Sciences*, *79*(12): 1023−1025.

Dhakal, Y., Meena R. S. and Kumar, S. (2016). Effect of INM on nodulation, yield, quality and available nutrient balance in soil after harvest of green gram. *Legume Research*, *39*(4): 590−594.

Dlamini, V. C., Nxumalo, K. A., Masarirambi, M. T., Wahome, P. K., Oseni T. O and Zwane, M. G. (2020). Effects of Cattle Manure on the Growth, Yield, Quality and Shelf Life of Beetroot (*Beta vulgaris* L.) Cv. Detroit Dark Red). *Journal of Experimental Agriculture International, 42*(1): 93-104.

Gairola, S., Umar S. and Suryapani, S. (2009). Nitrate accumulation, growth and leaf quality of spinach beet as affected by NPK fertilization with special reference to potassium. *Indian Journal of Science and Technology, 2*: 35-39.

Jurgen, W., Gundula, W., Stefan, H., Pinar, U., Peter L. and Ulrike, M. (2015). Composition characteristics of commercial beetroot products and beetroot juice prepared from seven beetroot varieties grown in Upper Austria. *Journal of Food Composition and Analysis*, *42*: 46-55.

Kannan, R.L., Dhivya, M., Abinaya, D., Krishna R. L. and Kumar, S. K. (2013). Effect of integrated nutrient management on soil fertility and productivity in maize. Bulletin of Environment, *Pharmacology and Life Sciences, 2*(8): 61−67.

Kafle, K., Shriwastav C. P. and Marasini, M. (2019). Influence of Integrated Nutrient Management Practices On Soil Properties and Yield of Potato (*Solanum tuberosum*. L) in an Inceptisol of Khajura, Banke *Int. J. Appl. Sci. Biotechnol., 7*(3): 365-369.

Kameswari, L. P., Narayanamma, M., Ahmed, S. R. and Chaturvedi, A. (2011). Influence of integrated nutrient management in ridge gourd (*Luffa acutangula* (Roxb.) L.) *Vegetable Science*, *38*(2): 209-211.

Kapil, V., Weitzberg E., Lundberg J. O. and Ahluwalia A. (2014). Clinical evidence demonstrating the utility of inorganic nitrate in cardiovascular health. *Nitric Oxide*, *38*: 45–57.

Kumar, A., Meena, R. N., Yadav, L. and Gilotia, Y. K. (2014). Effect of organic and inorganic sources of nutrient on yield, yield attributes and nutrient uptake of rice cv. PRH-10. *The Bioscan*, *9*: 595−597.

Kumar, M., Singh, S. K. and Bohra, J. S. (2020). Cumulative Effect of Organic and Inorganic Sources of Nutrients on Yield, Nutrients Uptake and Economics by Rice–Wheat Cropping System in Indo-Gangetic Plains of India. *Communications in Soil Science and Plant Analysis, 51*(5): 658-674.

Kumari, R., Kumar, S., Kumar, R., Das, A., Kumari, R., Chaudhary, C. D. and Sharma, R. P. (2017). Effect of long term Integrated Nutrient Management on crop yield, nutrition and soil fertility under Rice- Wheat system. *Journal of Applied Natural Sciences*, *9*: 1801-1807.

Lidder, S. and Webb A. J. (2013). Vascular effects of dietary nitrate (as found in green leafy vegetables and beetroot) via the nitrate-nitrite-nitric oxide pathway. *Br. J. Clin. Pharmacol.*, *75*: 677–696.

Nagar, G., Abraham, T. and Kumar, D. (2016). Effect of tillage and Farm Yard Manure on growth and yield of soybean. *Advance Research Journal of crop Improvement*, *7*(1): 56−59.

Olsen, S. R., Cole, C. V., Watanabe, F. S. and Dean, L. A. (1954). Estimation of available phosphorus by extraction with sodium bicarbonate. *United States Department of Agriculture*, *Circ*. No. *939*: 1-19

Paul, S. K., Paul, S.C., Sarkar, A. R. and Hossain, Md. S. (2018.) Influence of integrated nutrient management on the growth, yield and sugar content of tropical sugarbeet (*Beta Vulgaris* L.). *Pakistan Sugar Journal*, *33*(2): 11-22.

Piper, C. S. (1950). *Soil and plant analysis*. Hans Publishers, Bombay.

Rai, S., Rani, P., Kumar, M., Rai, A. and Kumar, S. (2016). Effect of integrated nutrient management on nutrients uptake and productivity of onion. *Int. J. Environ. Pollut,* 2(15): 573-577.

Ranjan, J. K., Ahmed, N., Das, B., Ranjan, P. and Mishra, B. K. (2013). Green technology for production of baby corn (*Zea mays* L.) under north-west Himalayan conditions. International *Journal of Chemical Technology Research*, 5(2): 880−885.

Reddy, K. P. and Rao, V. P. (2004). Growth and yield of bitter gourd (*Momordica charantia* L.) as influenced by vermicompost and nitrogen management practices. *The Journal of Research ANGRAU* 32(3), 15-20.

Samant, T. K. and Patra, A. K. (2016). Effect of tillage and nutrient management practices on yield, economics and soil health in rice-green gram cropping system under rain fed condition of Odisha. *Indian Journal of Agronomy*, *61*(2): 148−153.

Sengar, S. S., L. J. Wade., S. S. Beghel., R. K. Singh. and Singh, G. (2000). Effect of nutrient management on rice (Oryza sativa) in rainfed low land of south east Madhya Pradesh. *Indian J. Agron*., *45*(2): 315-322

Singh, D. P., Kumar, S., Sutanu, M. and Vijay, P. K. (2017). Studies on integrated nutrient management on growth, yield and quality of carrot (*Daucus carota* L.). *International Journal of Agriculture Sciences*, *51*(8): 2187-2188.

Subbaiah, B. V. and Asija, G. L. (1956). A rapid procedure for determination of available nitrogen in soil. *Current Science*, *25*: 259-260.

Tambe, A.D., Surva, U. S. and Kumbhkar, J. S. (2019). Integrated Nutrient Management in soybean -wheat cropping system. *Journal of Agroecology and Natural Resource Management, 6*(4), 160-162.

Tovihoudji, G. P., Djogbenou, C. P., Akponikpe, P. B. I., Kpadonou, E., Agbanga, C. E. and Dagbenonbakin, D. G. (2015). Response of jute mallow (*Corchorus olitorius* L.) to organic manure and inorganic fertilizer on a ferruginous soil in North Eastern Benin. *Journal of Applied Biological Sciences, 92*: 8610-861

Walkley A. J. and Black C. A. (1934). An estimation of method for determining soil organic matter and proposed modification of the chromic acid titration method. *Soil Science*, 37: 29-38.

Yadav, M., Chawla, H., Parle, M. and Sharma, K. (2016). Beetroot: A health promoting functional food. *Inventi Rapid: Nutraceuticals*. (1), 1-5

Yashwant, K. (2015). Beetroot: A super food. *International Journal of Engineering Studies and Technical Approach*. 01.

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