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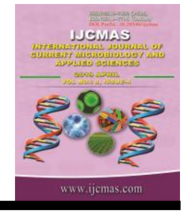

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Studies on the Influence of Integrated Nutrient Management (INM) on Quality Parameters and Economics of Carrot (*Daucas carota* L.) cv. Kuroda Improved under Southern Telangana Conditions

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A B S T R A C T

A field experiment was conducted during rabi 2017-2018 at Vegetable Research Block, College of Horticulture - Mojerla, SKLTS Horticultural University, Hyderabad, Telangana, India, to study the effect of integrated nutrient management (INM) on quality parameters and economics of carrot (*Daucas carota* L.) cv. Kuroda improved. The experiment was laid out in randomized block design with nine treatments and three replications. The results pertaining to quality parameters indicated that higher percentage of total soluble solids (12.40 %), ascorbic acid content (5.33 mg/100 g), carotene content (4.73 mg/100 g) and cortex to core ratio (0.90) were recorded in T_9 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria) while lower percentage of cracked roots (3.83 %) and forked roots (3.70%) were recorded in T_2 (FYM 12 t/ha) and T_3 (Vermicompost @ 6 t/ha) respectively. The highest gross return (Rs. 3,72,000), net return (Rs. 2,99,467) and best benefit cost ratio (4.13) were recorded in the treatment T_9 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria).

Introduction

Carrot (*Daucus carota* L.) is an important root vegetable, belongs to the family umbelliferae with diploid chromosome number 2n = 18. It is cultivated all over the world, during spring-summer in temperate countries and winter in tropical and sub-tropical countries. Carrot is an excellent source of carotene a precursor of vitamin A and fibre in the diet (Handelman, 2001). It also contains abundant amounts of nutrients such as protein, carbohydrates, fibre and sodium (Ahmad *et al.*, 2004). Carrot fleshy roots are used as a vegetable for salads, soups and are also steamed or boiled in other vegetable dishes (Amjad *et al.*, 2005). Besides the food value it has, different parts of carrot can be used for different medicinal purposes due to a wide range of reported pharmacological effects (Rossi *et al.*, 2007). Carrot is a heavy feeder of nutrients, which removes 100 kg N, 50 kg P_2O_5 and 180 kg K_2O per hectare and is very sensitive to nutrient and soil moisture (Sunanda Rani and MallaReddy, 2007). Nowadays Chemical fertilizers are the main source of nutrients used for carrot cropping. However, continuous dependence on chemical fertilizers causes nutritional imbalance and adverse effects on physico-chemical and biological properties of the soil. Integrated nutrient management (INM) is a better approach for supplying nutrition to the crop by including organic and inorganic sources of nutrients. Thus a combined use of organic manures, biofertilizers with a reduced dose of chemical fertilizers, not only pave the way for higher yield and quality produce but also help to maintain the soil health and reduce pollution problems. Keeping the facts in view, the present investigation was planned to find out the influence of integrated nutrient management on quality parameters and economics of carrot under Southern Telangana conditions.

Materials and Methods

The present investigation was conducted to study the effect of integrated nutrient management (INM) on quality parameters and economics of carrot (*Daucas carota* L.) cv. Kuroda improved under Southern Telangana conditions at Vegetable Research Block, College of Horticulture – Mojerla, SKLTS Horticultural University, Hyderabad (Telangana) situated at 780 29' East longitude and 170 19' North latitude with an altitude of 542.3 m above the mean sea level. The location is characterized by semi arid climate. The carrot variety Kuroda improved used as experimental material and experiment was laid out in a randomized block design with nine treatments having three replications. The soil of the experimental site was sandy loam having soil pH 6.5, organic carbon 0.27 % and available N, P and K content of 206, 26.00 and 220 kg ha-1 respectively. The total nine treatments consist of T_1 - RDF (NPK @ 50:40:50 kg/ha), T_2 - FYM 12 t/ha, T_3 - Vermicompost @ 6 t/ha, T_4- Rhizosphere Bacteria (AZB + PSB each @ 7 kg/ha), T_5 -50 % RDF + 50 % FYM @ 6 t/ha, T_6 – 50 % RDF + 50 % Vermicompost @ 3 t/ha, T_7 - 50 % RDF + 50 % Rhizosphere Bacteria, T_8 - 25 % RDF + 50 % FYM @ 6 t/ha + 50%Vermicompost @ 3 t/ha, T_9 - 25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria. N, P and K were given through Urea, SSP and MOP respectively. Full dose of P and K and half dose of N were applied as basal dose, as per treatment before sowing and remaining half dose of N was given 30 days after sowing. Manures viz., FYM and vermicompost were incorporated as per treatment to respective plots prior to sowing. Biofertilizers (*Azotobacter* and PSB) were inoculated to seeds prior to sowing as seed treatment method. Seeds were sown at the spacing of 30 x 5cm and thinning was done 10 days after sowing to maintain spacing. The data were recorded on five plants per treatment per plot in each replication on quality parameters at harvest. Observations were recorded on total soluble solid (TSS) was determined by using hand refractometer and results expressed in ^{o}brix, ascorbic acid content was determined by 2, 6-dichlorophenol-indophenol visual titration method (Ranganna, 1986), carotene content was determined by spectrophotometer method (R.P. Srivastava and Sanjeev kumar 2002) and expressed in mg/100 g, root cracking, root forking and cortex to core ratio. The data were statistically analysed using analysis of variance (ANOVA) for RBD following the standard procedure as suggested by Panse and Sukhatme (1985). Economics of various treatments was computed on the basis of prevailing market price of inputs.

Results and Discussion

Quality parameters

The experimental results revealed that the quality parameters were significantly influenced by various treatments (Table 1). All the integrated nutrient management treatments had significant influence on total soluble solids and ascorbic acid content. Among the treatments, T_9 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria) reported significantly maximum total soluble solids per cent (12.40 %) which was due to the increased carbohydrate production resulted in improved physiological and biochemical activities of plant system. Similarly maximum ascorbic acid content (5.33 mg/100 g) was also recorded significantly under treatment T_9 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria). This might be due to presence of sufficient quantities of inorganic fertilizers and more quantities of FYM , Vermicompost and biofertilizers increased the more carbohydrates production , consequently synthesized more vitamin ‘C’ content . Similar observations were also reported by Singh *et al.,* (2017) in carrot and Sentiyangla *et al.,* (2010) in radish.

Carotene content of root was found to be significantly different among all the treatments. Maximum carotene content (4.73 mg/100 g) was recorded under T_9 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria) which was at par with the T_8 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha) (4.67 mg/100 g) and T_6 (50 % RDF + 50 % Vermicompost @ 3 t/ha) (4.53 mg/100 g) which was due to the readily availability of major and minor nutrients. These results were in accordance with the findings of Vithwel Kanaujia (2013) in carrot who reported that application of biofertilizers might have activated specific enzymes for the synthesis of carotene content.

Significant difference was observed among the integrated nutrient management treatments with respect to root cracking and root forking per cent. The minimum root cracking percent was recorded in T_2 (FYM 12 t/ha) (3.83 %) followed by T_4 Rhizosphere Bacteria (AZB + PSB @ 7 kg/ha each) (4.16 %) and were on par with each other which was due to low availability of nitrogen, resulted in less incidence of splitting and it was increased when the soil nitrogen increases (Netra Pal 2001). The results are in accordance with that of Mehedi *et al.,* (2012) in carrot.

Minimum root forking per cent was recorded in T_3 (Vermicompost @ 6 t/ha) (3.70 %) which was at par with T_4 Rhizosphere Bacteria (AZB + PSB @ 7 kg/ha each) (3.80 %) and T_9 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria) (4.03 %).

This might be due the increased levels of nitrogen through organic manures could be attributed to lower availability of nitrogen at rhizosphere. Similar results were reported by Kumar *et al.,* (2014) in carrot.

Cortex to core ratio of carrot cv. Kuroda improved differed significantly due to integrated nutrient management treatments. The highest value was recorded in T_9 (25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria) (0.90) and it was on par with T_8 (25 % RDF + 50 % FYM @ 6 t/ha + 50 %

Vermicompost @ 3 t/ha) (0.80). This may be due to increased availability of macro and micro nutrients by the application of organic manures, biofertilizers along with reduced dose of chemical fertilizers. The results were in accordance with that of Ashmita *et al.*, (2017) in carrot.

Table.1 Influence of INM on quality parameters of carrot cv. Kuroda improved

Treatment	Total soluble solids (%)	Ascorbic acid (mg/100 g)	Carotene (mg/100 g)	Root cracking (%)	Root forking (%)	Cortex to core ratio
T_1	9.10 [e]	2.93 [e]	3.57 [c]	7.17 [e]	8.00 [f]	0.42 [c]
T_2	10.50 [c]	4.23 [c]	3.10 [d]	3.83 [a]	4.60 [b]	0.23 [d]
T_3	10.53 [c]	4.50 [c]	3.30 [cd]	5.57 [c]	3.70 [a]	0.39 [c]
T_4	10.43 [cd]	4.13 [c]	3.13 [d]	4.16 [ab]	3.80 [a]	0.35 [cd]
T_5	9.80 [cde]	3.60 [d]	4.10 [b]	6.57 [d]	7.26 [e]	0.60 [b]
T_6	9.60 [de]	3.63 [d]	4.53 [a]	6.20 [d]	5.66 [c]	0.63 [b]
T_7	9.30 [e]	3.33 [d]	3.67 [c]	6.43 [d]	6.50 [d]	0.56 [b]
T_8	11.46 [b]	4.93 [b]	4.67 [a]	5.20 [c]	4.53 [b]	0.80 [a]
T_9	12.40 [a]	5.33 [a]	4.73 [a]	4.63 [b]	4.03 [ab]	0.90 [a]
CD at 5%	0.90	0.39	0.42	0.52	0.62	0.14
SEm±	0.30	0.13	0.14	0.17	0.20	0.05

Note: T_1 - RDF (NPK @ 50:40:50 kg/ha), T_2 - FYM 12 t/ha, T_3 - Vermicompost @ 6 t/ha, T_4- Rhizosphere Bacteria (AZB + PSB each @ 7 kg/ha), T_5 -50 % RDF + 50 % FYM @ 6 t/ha, T_6 – 50 % RDF + 50 % Vermicompost @ 3 t/ha, T_7 - 50 % RDF + 50 % Rhizosphere Bacteria, T_8 - 25 % RDF + 50 % FYM @ 6 t/ha + 50%Vermicompost @ 3 t/ha, T_9 - 25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria.

Table.2 Economics of integrated nutrient management in carrot

Treatment	Common cost (Rs/ha)	Treated cost (Rs/ha)	Total cost of cultivation (Rs/ha)	Yield (t/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B: C ratio
T_1	56712	1504	58216	14.43	288600	230384	3.95
T_2	56712	6600	63312	7.53	150600	87288	1.38
T_3	56712	24000	80712	9.43	188600	107888	1.34
T_4	56712	700	57412	8.76	175200	117788	2.05
T_5	56712	4052	60764	12.00	240000	179236	2.95
T_6	56712	12752	69464	12.66	253200	183736	2.64
T_7	56712	1102	57814	12.33	246600	188786	3.26
T_8	56712	15676	72388	16.53	330600	258212	3.57
T_9	56712	15821	72533	18.60	372000	299467	4.13

Note: T_1 - RDF (NPK @ 50:40:50 kg/ha), T_2 - FYM 12 t/ha, T_3 - Vermicompost @ 6 t/ha, T_4- Rhizosphere Bacteria (AZB + PSB each @ 7 kg/ha), T_5 -50 % RDF + 50 % FYM @ 6 t/ha, T_6 – 50 % RDF + 50 % Vermicompost @ 3 t/ha, T_7 - 50 % RDF + 50 % Rhizosphere Bacteria, T_8 - 25 % RDF + 50 % FYM @ 6 t/ha + 50%Vermicompost @ 3 t/ha, T_9 - 25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria.

Economics

From the present investigation (Table 2) it was found that the application of 25 % RDF + 50 % FYM @ 6 t/ha + 50 % Vermicompost @ 3 t/ha + 50 % Rhizosphere Bacteria (T_9) recorded the highest gross return (Rs. 3,72,000), net return (Rs. 2,99,467) and best benefit cost ratio (4.13) which might be due to higher root yield per hectare as compared to other treatments.

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