The Pharma Innovation Journal 2022; 11(12): 5789-5792

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(12): 5789-5792
© 2022 TPI
www.thepharmajournal.com
Received: 15-10-2022
Accepted: 25-11-2022

M Malavika
PG Scholar, Department of Vegetable Science, College of Horticulture, SKLTSHU, Rajendranagar, Hyderabad, Telangana, India

J Cheena
Senior Scientist (Hort.) and Head, MAPRS, Hyderabad, Telangana, India

K Venkatalaxmi
Scientist (Hort.) and Head, Grape Research Station, Rajendranagar, Hyderabad, Telangana, India

B Naveen Kumar
Scientist (SSAC), Grape Research Station, Rajendranagar, Hyderabad, Telangana, India

Corresponding Author:
M Malavika
PG Scholar, Department of Vegetable Science, College of Horticulture, SKLTSHU, Rajendranagar, Hyderabad, Telangana, India

Studies on the influence of integrated nutrient management on growth and yield of carrot (*Daucus carota* L.) Cv. Super Kuroda

M Malavika, J Cheena, K Venkatalaxmi and B Naveen kumar

Abstract
The present investigation entitled "Studies on the influence of integrated nutrient management on growth and yield of carrot (*Daucus carota* L.) Cv. Super Kuroda" was carried out at College of Horticulture, SKLTS Horticultural University, Rajendranagar, Hyderabad during Rabi 2021-2022. The experiment was laid out in Randomized Block Design with ten treatments and three replications. Treatments consisted of T_1 - 50% RDF + AMC (12.5 kg ha^{-1}), T_2 - 50% RDF + *Azospirillum* (10 kg ha^{-1}), T_3 - 50% RDF + PSB (10 kg ha^{-1}), T_4 - 75% RDF + AMC (12.5 kg ha^{-1}), T_5 - 75% RDF + *Azospirillum* (10 kg ha^{-1}), T_6 - 75% RDF + PSB (10 kg ha^{-1}), T_7 - 90% RDF + AMC (12.5 kg ha^{-1}), T_8 - 90% RDF + *Azospirillum* (10 kg ha^{-1}), T_9 - 90% RDF + PSB (10 kg ha^{-1}), T_{10} - 100% RDF (control). Results revealed that, treatment T_7 (90% RDF + AMC (12.5 kgha^{-1})) registered significantly higher plant height (55.93 cm), leaf length (41.72 cm), maximum number of leaves per plant (15.73), minimum number of days taken to harvest (75.61 days), maximum root length (18.76 cm), root diameter (4.03 cm), root weight (93.25 g), root yield per plot (10.94 kg) and root yield per ha (27.35 t ha^{-1}).

Keywords: Nutrient management, growth and yield, *Daucus carota* L.

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 subtropical countries. Carrot is an excellent source of carotene, a precursor of vitamin A and fibre in the diet (Handelman, 2001) [2]. The centre of origin of carrot is southwest Asia, that gradually got spread to Mediterranean region and China.

Carrot is a biennial crop but grown as an annual. The primary tap-root of the carrot develops into a tuberous structure with absorbent hairs but is without lateral roots. The roots can reach up to a maximum length of 20 cm and a diameter of 34 mm. It consists of a tender, dark external portion (cortex) and a fibrous central cylindrical inner core.

Carrots are grown over 1.1 lakh hectares in India with a production of about 1.9 million MT annually (NHB Database, 2021-22).

Carrot is a heavy feeder of nutrients and removes 100 kg N, 50 kg P_2O_5 and 180 kg K_2O per hectare (Sunanda Rani and Malla Reddy, 2007) [19]. The soil and ecology have been harmed by the continual and reckless use of inorganic fertilizers in modern agriculture. As a result, many farmers have shifted to organic farming in recent years in order to produce safe and nutrient-rich foods as well that would command higher market prices. As the root vegetables are an exhaustive crop, organic manures alone may not be able to supply the desired amount of nutrients to the crop. So, it has been found that neither the chemical fertilizers nor the organic manures alone can help to achieve sustainable crop production. Therefore, judicious and effective application of organic manure and biofertilizer is crucial for good yield and better quality of produce. Instead, combined usages of organic manures, biofertilizers, biological agents and inorganic fertilizers i.e., INM (Integrated Nutrient Management) practices will help to improve the soil health and nutrient availability while achieving sustainable crop production and also helps to improve the quality of carrot. It is the best method for making better use of the resources at hand and producing crops on a budget.

In this experiment, biofertilizers *viz*., Azospirillum, PSB and AMC are used in the different integrated nutrient management treatments. *Azospirillum* is a gram-negative motile bacterium, promotes plant growth by increasing the production of IAA, gibberellins and cytokinins and

has been shown to fix 2040 kg N/year when used in non-leguminous plants. Phosphorus, is essential for promoting crop growth and development (Soetan *et al*. 2010) [18]. Chemical fertilizers deliver inorganic phosphorus in precipitated form, which plants cannot absorb. By releasing a variety of organic acids, phosphobacteria have the capacity to convert phosphorus from an insoluble form to a soluble form and provide it to plants. Arka Microbial Consortium is a carrier based biofertilizer product which comprises of N Fixing, phosphorus and zinc solubilizing and plant growth promoting microorganism as a single formulation. It helps in early seed germination, early transplanting, increasing seed vigour, reduction of use of synthetic fertilizer. This study was conducted to study the effect of different biofertilizers, in combination with different percentages of RDF on growth and yield of carrot crop.

Material and Methods

The present investigation entitled "Studies on the influence of integrated nutrient management on growth and yield of carrot (*Daucus carota* L.) Cv. Super kuroda" was carried out during the rabi season of the year 2021-22 at College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Telangana. The area is characterised by a semi-arid tropical zone with average maximum and minimum temperatures of 30.6 ºC and 17.3 ºC respectively. The experiment was laid out in Randomized Block Design (RBD) with 10 treatments and three replications *viz*., T_1 - 50% RDF + AMC (12.5 kg ha^{-1}), T_2 - 50% RDF + *Azospirillum* (10 kg ha^{-1}), T_3 - 50% RDF + PSB (10 kg ha^{-1}), T_4 - 75% RDF + AMC (12.5 kg ha^{-1}), T_5 - 75% RDF + *Azospirillum* (10 kg ha^{-1}), T_6 - 75% RDF + PSB (10 kg ha^{-1}), T_7 - 90% RDF + AMC (12.5 kg ha^{-1}), T_8 - 90% RDF + *Azospirillum* (10 kg ha^{-1}), T_9 - 90% RDF + PSB (10 kg ha^{-1}), T_{10} - 100% RDF (control).

To achieve fine tilth, the experimental site was ploughed and harrowed for three to four times. A basal dose of well-decomposed FYM was applied @ 20 t/ha at the time of last ploughing. After levelling the field, 30 plots of 2 m × 2 m each were created from the experimental plot. The recommended dose of NPK (50:40:50 kg/ha) was applied in the form of urea, single super phosphate (SSP), and potash muriate (MOP). Urea was applied in two split doses, half dose of nitrogen was applied at the time of sowing as a basal dose and another dose at 30 days after sowing as top dressing. The recommended dose of Phosphorus (40 kg/ha) and Potassium (50 kg/ha) were applied as a basal dose.

Arka Microbial Consortium @ 12.5 kg/ha, *Azospirillum* and PSB @ 10 kg/ha each were applied. These biofertilizers are first taken in a container and mixed with FYM and water, and are covered with a moist gunny bag cloth. It was maintained wet by regularly moistening the cloth so as to enhance the multiplication of the bacteria and increase in number. After 1 week, these are incorporated in to the main field as per the treatments.

To ensure better germination, seeds of carrot were soaked in water for 12 hours. The seeds were mixed with sand and sown by using the dibbling method. Seeds were sown at a spacing of 30cm x 10 cm at a depth of 1.5 cm in rows as per the treatment. The field was irrigated immediately after sowing, by taking utmost care so that the seeds were not disturbed with flow of water. To prevent the spread of disease and pests, preventative plant protection measures were implemented on a regular basis.

Five plants were randomly selected from each plot and tagged. The readings of these tagged plants were taken at the time of harvesting and averages were computed and analyzed. The data was analysed statistically by following the analysis of variance (ANOVA) techniques appropriate for Randomized Block Design (RBD) as asserted by Panse and Sukhatme (1967) [10]. The treatment differences were tested for significance by "F" test. For the data in which treatment effect were significant, the appropriate standard error of mean (SEm±) and critical differences (CD) were worked out at 5 per cent level of significance.

Results and Discussion

Growth Parameters

Integrated nutrient management had significant effect on growth parameters of carrot. The data pertaining to vegetative growth parameters of carrot in response to INM are presented in the table-1. The highest plant height (55.93 cm) was recorded in T_7 treatment (90% RDF + AMC (12.5 kg ha^{-1})) may be attributed to the readily available form of nitrogen in sufficient quantities which improved the uptake of N. As, nitrogen being a constituent of amino acids, nucleotides, nucleic acids, a number of coenzymes, auxins, cytokinins and alkaloids, increased cell division, cell elongation and cell enlargement is observed in this treatment. In addition, biofertilizers are also involved in the secretion of plant growth promoting substances which resulted in the higher plant height. The results are in accordance with the findings of Singh *et al.* (2017) [16] and Kirad *et al.* (2010) [6] in carrot, Teja *et al*. (2021) [20] and Vikas *et al*. (2019) [21] in radish.

Maximum number of leaves per plant (15.73) was observed in T_7 treatment (90% RDF + AMC (12.5 kg ha^{-1})), because of the combined effect of inorganic fertilizers and biofertilizers. The nutrients supplied through inorganic fertilizers are readily taken up by the plant system, along with the production of growth promoting hormones through biofertilizers might have added to the increased vegetative growth of the crop. Arka Microbial Consortium being a carrier-based product which contains N fixing, P & Zn solubilizing and plant growth promoting microbes as a single formulation might have helped in increasing the nutrient uptake efficiency by exerting their synergistic effect with inorganic fertilizers. This could also have accelerated cell division and elongation as well as greater chlorophyll synthesis and higher metabolic activity. As a result, maximum number of leaves might have obtained. The obtained results were in accordance with Teja *et al.* (2021) [20], Vikas *et al.* (2019) [21] Pathak *et al.* (2018) [11] in radish, Roshni *et al.* (2019) [12] in carrot and Sai *et al.* (2022) [13] in muskmelon.

Maximum leaf length (41.72 cm) was observed in treatment T_7 (90% RDF + AMC (12.5kg ha^{-1})). This might be due to application of both inorganic and bio-fertilizers which releases nutrients thus enriching available nutrient pool of the soil, making the nitrogen readily available in the soil. Adding to it biofertilizers might have exerted a positive influence on amelioration of soil physio-chemical properties. Besides, increased leaf length might be due to rapid elongation and multiplication of cell in the presence of adequate quantity of nitrogen. This obviously indicated that, the integrated use of nutrients involved in cell elongation in meristematic region of plant besides, production of growth promoting substances might have brought improvement in plant height and leaf length as well. These findings are in line with the reports of

Kumar *et al*. (2014) [8], Shani *et al*. (2016) [14] in carrot and Teja *et al*. (2021) [20] in radish.

Yield Parameters

The experimental results revealed that the yield parameters were significantly influenced by various treatments. The data pertaining to vegetative growth parameters of carrot as effected by INM are presented in the table-2.

The minimum number of days taken to harvest (75.61 days) was recorded in T_7 (90% RDF + AMC (12.5 kg ha^{-1})) might be due to the better plant growth attained by the use of biofertilizers i.e., AMC. As a result, there may be an augmented photosynthesis and translocation of photosynthates towards the sink (roots) form the source (leaves) which might have resulted in early physiological maturity rather than other treatments. Similar results have been reported by Pathak *et al.* (2018) [11] in radish and Shanu *et al.* (2019) [15] and Singh *et al*. (2020) [17] in carrot.

The data pertaining to root length was recorded to be higher in treatment T_7 (90% RDF + AMC (12.5 kg ha^{-1})) (18.76 cm) might be due to the better vegetative growth which resulted in higher photosynthesis rate and improved tanslocation of photosynthates from leaves to roots, which finally resulted in the increased root length. Soil bacteria can improve plant growth by producing plant hormones which are involved in apical dominance, cell division and cell enlargement and shoot and root growth. Besides, applied fertilizers had a positive influence on the physical characteristics of soil which play an important role in increasing the root length. Similar results have been reported by Singh *et al.* (2017) [16], Kirad *et al.* (2010) [6] Vithwel and Kanaujia (2013) [22] and Kamalakannan and Manivannan (2002) [4] in carrot.

Treatment T_7 (90% RDF + AMC (12.5 kg ha^{-1})) recorded the maximum root diameter (4.03 cm), which was due to the similar reason studied for the root length. Similar results have been reported by Singh *et al.* (2017) [16], Kirad *et al.* (2010) [6], Vithwel Kanaujia (2013) [22] and Shanu *et al*. (2019) [15] in carrot.

Core thickness was found non-significant among all the treatments under integrated nutrient management. However, highest core thickness was recorded in treatment T_9 (90% RDF + PSB (10 kg ha^{-1})) (1.81 cm), while the lowest core thickness was recorded in treatment T_2 (50% RDF + *Azospirillum* (10 kg ha^{-1})) (1.66 cm). These results are in conformity with the findings of Roshni *et al*. (2019) [12] in carrot.

The data on root weight (93.25 g) indicated that T_7 treatment (90% RDF + AMC (12.5 kg ha^{-1})) recorded maximum value which might be due to higher root length and root diameter resulted in higher fresh weight of root. Our results are comparable with the reports of Vithwel and Kanaujia (2013) [22] in carrot and Khalid *et al*. (2015) [5] in radish.

Among the treatments, treatment T_7 (90% RDF + AMC (12.5 kg ha^{-1})) recorded maximum root yield per plot (10.94 kg/plot) which was due to the application of biofertilizers in combination with FYM which gave better chance for microbes to multiply resulting in soil enrichment providing required quantities of nitrogen and phosphorus to the soil. FYM and AMC provide organic matter, macro and micronutrients. In addition, they increase the water holding capacity and provide aeration for better root formation. Primary nutrient requirements were fulfilled by NPK. The communal effect of 90% NPK (50:40:50 kg ha^{-1}) + AMC (12.5 kg ha^{-1}) is associated with higher vegetative growth, maximum photosynthates production and better establishment of source sink relationship resulting in higher root yield (Dass, 2004) [1].

Maximum yield per hectare (27.35 t/ha) was recorded in treatment T_7 (90% RDF + AMC (12.5 kg ha^{-1})) The immediate uptake of nutrients by the plants increases with the exogenous application of inorganic fertilizers, while biofertilizers assist in mobilising the nutrients and facilitating their easy availability to plants. The combined application of biofertilizers and inorganic fertiliser may have increased NPK availability and enhanced soil fertility, which in turn may have aided the plant in enhancing water uptake, better aeration and productivity, leading to an increase in yield and its attributing factors. The experimental findings are in accordance with Vithwel and Kanaujia (2013) [22] in carrot.

Table 1: Effect of INM on plant height (cm), number of leaves per plant and leaf length (cm) of carrot cv. Super Kuroda at harvest]

Treatments	Plant height (cm)	Number of leaves per plant	Leaf length (cm)
T_1	36.47	10.89	24.58
T_2	34.53	10.23	23.11
T_3	32.24	9.57	21.92
T_4	45.26	12.97	32.26
T_5	42.84	12.24	30.85
T_6	40.63	11.74	28.68
T_7	55.93	15.73	41.72
T_8	53.79	14.95	40.14
T_9	51.58	14.28	39.47
T_{10}	50.09	13.66	37.23
SEm±	0.88	0.19	0.56
CD at 5%	2.62	0.56	1.65

Table 2: Effect of INM on no. of days taken to harvest, root length (cm), root diameter (cm), core thickness (cm), root weight (gm), root yield/plot (kg/plot) and root yield/ha (t/ha) of carrot cv. Super Kuroda at harvest

Treatments	Number of days taken to harvest	Root length (cm)	Root diameter (cm)	Core thickness (cm)	Root weight (g)	Root yield/plot (kg/plot)	Root yield/ha (t/ha)
T_1	85.79	13.92	2.67	1.76	61.78	7.44	18.6
T_2	89.14	12.78	2.28	1.66	57.81	6.81	17.01
T_3	87.28	13.19	2.45	1.71	59.67	7.12	17.8
T_4	81.05	15.85	3.24	1.72	76.53	9.15	22.88
T_5	84.46	14.63	2.9	1.73	70.54	8.44	21.1
T_6	82.87	15.21	3.05	1.7	73.69	8.75	21.88
T_7	75.61	18.76	4.03	1.79	93.25	10.94	27.35
T_8	78.75	17.72	3.65	1.74	87.73	10.48	26.2
T_9	77.14	18.25	3.91	1.81	90.32	10.6	26.5
T_{10}	79.83	16.55	3.49	1.69	83.16	9.97	24.93
SEm±	0.92	0.30	0.05	0.02	1.27	0.12	0.33
CD at 5%	2.75	0.90	0.15	N.S	3.77	0.35	0.98

Conclusion

It could be concluded from the present investigation, that the integrated nutrient management had a significant influence on the growth and yield in carrot Cv. Super kuroda. Among the different levels of integrated nutrient management maximum, highest growth and yield of carrot were obtained from treatment T_7 (90% RDF + AMC (12.5 kg ha^{-1})). Treatment T_7 also reported to maintain the sound soil health including available nitrogen, phosphorous and potassium contents in the soil.

References

1. Dass DK. Introductory Soil Science. Kalyani Publishers, New Delhi; c2004. p. 417-433.
2. Handelman GJ. The evolving role of management on growth, yield and quality carotenoids in human biochemistry of carrot (*Daucus carota* L.). Nutrition. 2001;17:818-822.
3. Kalra CL, Kulkarni SG, Berry SK. The carrot—A most popular root vegetable. Indian food packer. 1987;41(6):46-73.
4. Kamalakannan S, Manivannan K. Influence of phosphobacteria and vesicular arbuscular mycorrhizae on growth parameters of radish (*Raphanus sativus* L.). Research on Crops. 2002;13(1):138-141.
5. Khalid M, Yadav BK, Yadav MP. Studies on the effect of integrated nutrient management on growth and yield attributes of radish (*Raphanus sativus* L.). Annals of Horticulture. 2015;8(1):81-83.
6. Kirad KS, Barche S, Singh DB. Integrated nutrient management on growth, yield and quality of carrot. Karnataka journal of agricultural sciences. 2010;23(3):542-543.
7. Kochar GK, Sharma KK. Fibre content and its composition in commonly consumed Indian vegetables and fruits. Journal of food science and technology (Mysore). 1992;29(3):187-188.
8. Kumar S, Maji S, Kumar S, Singh HD. Efficacy of organic manures on growth and yield of radish (*Raphanus sativus* L.) Cv. Japanese white. International Journal of Plant Sciences. 2014;9(1):57-60.
9. National Horticulture Board. National Horticulture Database. Ministry of Agriculture, Government of India, Gurgaon, India; c2021-22.
10. Panse VG, Sukhatme PV. Statistical methods for Agricultural workers. Indian Council of Agricultural Research, New Delhi; c1967.
11. Pathak M, Tripathy P, Dash SK, Sahu GS, Pattanayak SK. Efficacy of bio-fertilizer, organic and inorganic fertilizer on yield and quality of radish (*Raphanus sativus* L.). International Journal of Chemical Studies. 2018;6(4):1671-1673.
12. Roshni P, Narasimha Murthy DK, Salomi DR. Studies on biofertilizers and inorganics on growth and yield of carrot. Journal of Pharmacognosy and Phytochemistry. 2019;8(2):1559-1562.
13. Sai RA, Cheena J, Venkatalaxmi K, Goud CR, Kumar BN. To study the effect of integrated nutrient management on quality of muskmelon (*Cucumis melo* L.). The Pharma Innovation Journal. 2022;11(8):310-313.
14. Shani K, Sanjay K, Sutanu M, Pandey VK. Effect of inorganic fertilizers and bio-fertilizers on growth, yield and quality of radish. International Journal of Plant Sciences. 2016;11(1):71-74.
15. Shanu V, Lakshminarayana D, Prasanth P, Naik DS. Studies on the Effect of Integrated Nutrient Management (INM) on Growth and Yield Parameters of Carrot (*Daucus carota* L.) cv. Kuroda Improved under Southern Telangana Conditions. International Journal of Current Microbiology and Applied Sciences. 2019;8(4):2786-2791.
16. Singh DP, Kumar S, Maji S, Pandey VK. Studies on integrated nutrient management on growth, yield and quality of carrot (*Daucus carota* L.). International Journal of Agriculture Sciences. 2017;8(51):2187-2188.
17. Singh S, Mishra A, Greene A. Assessment of Growth, Yield and Quality of Carrot (*Daucus carota* L.) var. Pusa Kesar under Integrated Nutrient Management. International Journal of Current Microbiology and Applied Sciences. 2020;9(07):1086-1093.
18. Soetan K, Olaiya C, Oyewole O. The importance of mineral elements for humans, domestic animals and plants-A review. African journal of food science. 2010;4:200–222.
19. Sunandha Rani N, Malla Reddy K. Effect of different organic manures and inorganic fertilizers on growth, yield and quality of carrot (*Daucus carota* L.). Karnataka Journal of Agricultural Sciences. 2007;20(3):686-88.
20. Teja GS, Nayak MH, Prasanth P, Mamatha A, Praneeth S. Influence of inorganic nutrients and biofertilizers on growth and yield of tropical radish (*Raphanus sativus* L.) Cv. Pusa Chetki. The Pharma Innovation Journal. 2021;10(11):1810-1812.
21. Vikas, Thaneshwari, Sharma R, Thakur N, Kumari P, Sahare H. Effect of inorganic fertilizers and bio-fertilizers on growth and root yield of Radish (*Raphanus sativus* L.) cultivar 'Safed Mooli – 2' under Punjab condition. Think India journal. 2019;22(34):0971-1260.
22. Vithwel, Kanaujia SP. Integrated nutrient management on productivity of carrot and fertility of soil. SAARC Journal of Agriculture. 2013;11(2):173-181.