The Pharma Innovation Journal 2022; 11(4): 1822-1827

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(4): 1822-1827

www.thepharmajournal.com
Received: 02-01-2022
Accepted: 06-03-2022

Anita Yadav
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, COA, SKRAU, Bikaner, Rajasthan, India

RK Jakhar
Assistant Professor, Department of Soil Science and Agricultural Chemistry, COA, SKRAU, Bikaner, Rajasthan, India

Naresh Kumari
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, COA, SKRAU, Bikaner, Rajasthan, India

GN Yadav
Ph.D., Research Scholar, Department of Agronomy, SKNAU, Jobner, Rajasthan, India

Ravi Kant Sharma
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, COA, SKRAU, Bikaner, Rajasthan, India

SL Yadav
Assistant Professor, Department of Agronomy, AU Kota, Rajasthan, India

Hemant Kumar Meena
M.Sc. Scholar, Department of Vegetable Science, K. N. K. College of Horticulture, Mandsaur, University RVSKVV Gwalior Madhya Pradesh, India

Ankit Kumar Khandelwal
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, COA, SKRAU, Bikaner, Rajasthan, India

Corresponding Author:
Anita Yadav
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, COA, SKRAU, Bikaner, Rajasthan, India

Response of organic manures and fertilizers on yield and quality of carrot under sandy soil condition

Anita Yadav, RK Jakhar, Naresh Kumari, GN Yadav, Ravi Kant Sharma, SL Yadav, Hemant Kumar Meena and Ankit Kumar Khandelwal

Abstract
The present experimental trial was conducted at Instructional Farm, College of Agriculture, SKRAU, Bikaner, during *Rabi*, 2020-21 to estimate the response of organic manures and fertilizers on yield and quality of carrot under sandy soil condition. The treatments consisted four levels of organic manure (Control, Poultry manure @ 10 t ha^{-1}, Vermicompost @ 20 t ha^{-1} and FYM @ 20 t ha^{-1}) and fertilizers level (Control, 50, 75 and 100% RDF). The application of vermicompost @ 20 t ha^{-1} significantly increased yield attributes and yield of carrot and also enhanced all quality attributes (TSS, β-carotene and total chlorophyll content) over control. Further, yield attributes and yield as well as all quality attributes (TSS, β-carotene and total chlorophyll content) of carrot were also found significantly increased with the application of 100% RDF over control.

Keywords: Organic manures, fertilizers level, quality attributes and yield

Introduction
Vegetables are considered as an important supplement for supporting good health and also protect from some degenerative disorders. Carrot (*Daucus carota* L.) is a winter season vegetable crop belongs to family Apiaceae which is full of nutritive value and used for different purposes in daily human diet. Carrot is major vegetable crop of India. Haryana, Andhra Pradesh, Karnataka, Punjab and Uttar Pradesh are major carrot growing states of India. In India, carrot is cultivated on 106 thousand hectares with an annual production of 1875 thousand metric ton (Anonymous, 2020) [1] and productivity is 17689 kg ha^{-1} during 2019-20. In Rajasthan, carrot is cultivated on 1776 hectares with an annual production of 13318 metric ton (Anonymous, 2020) [1] and productivity is 7499 kg ha^{-1} during 2019-20.

Carrot roots are consumed boiled in vegetables and uncooked as salads and also soups and stews are prepared with various other vegetables (Anjum and Amjad, 2002) [2]. It has the highest content of beta carotene which is a precursor to vitamin A and it provides 17% of the total vitamin A consumption among the vegetables. Carrot is also important sources of carbohydrates and minerals like Ca, P, Cu, Na, Fe, Zn and Mg (Arscott and Tanumihardjo, 2010) [4]. Raw carrots contain 88% water, 9% carbohydrates, 0.9% protein, 2.8% dietary fiber, 1% ash and 0.2% fat. It also helps in decreasing post-menopausal breast cancer (Swamy *et al*., 2014) [23].

Organic sources of nutrients have the advantage of slow release of nutrients, maintaining ideal C:N ratio, increasing water holding capacity and microbial population of soil profile, without any hazardous residual effects on soil (Kiros *et al*., 2018 and Yadav *et al*., 2010) [12, 27]. Farm yard manure is a natural source of available nitrogen. It adds humus and slow releasing nutrients to the soil and restores soil fertility by improving a wide range of natural properties of soil. Vermicompost is a valuable organic fertilizer. Earthworm promotes rapid decomposition with increased rate of mineralization, humification of organic matter and increased microbial biomass that improves the quality of the final product (Atiyeh *et al.*, 2002) [5]. Poultry manure is a more concentrated source of crop *nutrients*, especially nitrogen, phosphorus, potassium and calcium. Organic manures play key role in transformation, availability and recycling of nutrients to the crop as well as enhance microbiological activities in soil (Collins *et al*., 1992) [6].

Inorganic fertilizers are nutrient-rich salts that dissolve quickly and provide essential nourishment immediately in the form of nitrogen, phosphorus and potassium.

The soils of Western Rajasthan are nutrient and water deficient. Organic carbon content is very low in this soil, so it is necessary to use organic manures for improving soil health by improving organic carbon, C:N ratio, water holding capacity and nutrient retention capacity of soil etc. Organic manure not only acts as nutrient source but also enhance microbial activities and biological properties of soil. But due to bulky nature, slow mineralization and lack of availability of organic manures, we have to use inorganic fertilizers also which readily available the nutrients by fast mineralization. The nutritional requirement of carrot is much higher for getting higher yield and productivity levels. Cultivation of carrot specifically in sandy soils with low organic matter and improper nutritional management leads to poor productivity and quality of carrot. Thus productivity of carrot could be sustained through combined use of organic and inorganic fertilizers.

Materials and Methods

The experimental trial was conducted at Instructional Farm, College of Agriculture, SKRAU, Bikaner during *Rabi*, 2020-21. It comes under hyper arid partially irrigated zone with an annual rainfall ranges from 200 to 300 mm. This area received more than 80% rainfall during the Southwest monsoon. During summer, the maximum temperature may go as high as 50 °C while in winter it may fall as low as 0 °C. This area is prone to high wind velocity and soil erosion. The soil of experimental field was sandy in texture containing 92.26, 14.62, 207 and 21.33 kg ha^{-1} available nitrogen, phosphorus, potassium and sulphur, respectively and micronutrients (Zn, Cu, Fe and Mn were 0.34, 0.22, 3.31 and 1.81 ppm) in 0-15 cm soil depth with bulk density 1.55 Mg m^{-3}, particle density 2.61 Mg m^{-3}, total porosity 40.61%, EC 0.13 dS m^{-1}, pH 8.30 and organic carbon content 0.15 per cent. The treatment combinations were setup as per recommended dose of fertilizer for carrot crop in Ic zone that is N:P:K, 60:40:120 Kg ha^{-1} respectively. The experiment was laid out in a factorial randomized block design (FRBD) with three replications and 16 treatment combinations comprising of four levels of organic manure *i.e.* control (M_0), poultry manure @ 10 t ha^{-1} (M_1), vermicompost @ 20 t ha^{-1} (M_2), FYM @ 20 t ha^{-1} (M_3) and four levels of fertilizer (0, 50, 75 and 100% RDF, *i.e.*, F_0, F_1, F_2 and F_3, respectively). The treatments were: T_1= Absolute control, T_2= 50% RDF, T_3= 75% RDF, T_4= 100% RDF, T_5= Poultry manure @ 10 t ha^{-1}, T_6= Poultry manure @ 10 t ha^{-1} + 50% RDF, T_7= Poultry manure @ 10 t ha^{-1} + 75% RDF, T_8= Poultry manure @ 10 t ha^{-1} + 100% RDF, T_9= Vermicompost @ 20 t ha^{-1}, T_{10}= Vermicompost @ 20 t ha^{-1} + 50% RDF, T_{11}= Vermicompost @ 20 t ha^{-1} + 75% RDF, T_{12}= Vermicompost @ 20 t ha^{-1} + 100% RDF, T_{13}= FYM @ 20 t ha^{-1}, T_{14}= FYM @ 20 tha^{-1} + 50% RDF, T_{15}= FYM @ 20 t ha^{-1} + 75% RDF, T_{16}= FYM @ 20 t ha^{-1} + 100% RDF.

Poultry manure, vermicompost and FYM were applied as per treatments before 30 days of sowing. Nutrient composition of organic manures is depicted in table 1.

Table 1: Nutrient composition of organic manures used in field experiment

Nutrient	FYM	Vermicompost	Poultry manure
N (%)	0.51	1.58	3.04
P (%)	0.24	0.80	2.62
K (%)	0.47	1.05	1.39
S (%)	0.03	0.05	2.54
Fe (ppm)	955.33	3800	1400
Mn (ppm)	54.66	410	90
Zn (ppm)	41.26	95	210
Cu (ppm)	4.33	40	7.10

The dose of N, P_2O_5 and K_2O were applied through urea, single super phosphate and muriate of potash, respectively, as per treatment combination. The recommended dose of NPK was 0, 50, 75 and 100% RDF. 1/3rd dose of N and full dose of P_2O_5 and K_2O were applied as basal dose at the time of sowing under sprinkler irrigation. The remaining N was applied in 2 split doses at 30 and 45 days after sowing. Carrot crop (var. CBS – Anmol) @ 4 kg ha^{-1} was sown in the field on 10 October, 2020 and harvested from 30 January, 2021 to 21 March, 2021.

Before commencement of the field experiment, representative samples of leaves were taken from each plot at the time of harvesting, oven dried and grind separately in fine powder with wiley mill and quality attributes were determined by using standard methods. The roots of selected plants were crushed to form a homogenized sample and then the juice was extracted through muslin cloth. The extract was used for determination of TSS in °Brix by digital hand refractometer (A.O.A.C., 1960). β-carotene (µg g^{-1}) in roots was analysed by using water saturated butanol (WSB) with the help of Spectrophotometer at 440 nm (Pandey *et al.*, 2015) [19]. Chlorophyll content in leaf was worked out at 60DAS and excreted in DMSO. Transmittance of chlorophyll was recorded with spectrophotometer at 645 and 663 nm (Hiscox and Israelstam, 1979) [9]. Arnon's equation (1949) was used to work out chlorophyll content as here under:

$$\text{Chlorophyll "a" (Mg g}^{-1}\text{ fresh Weight of leaves)} = \frac{(12.7 \times A_{663}) - (2.69 \times A_{645})}{1000} \times \frac{\text{Volume of DMSO}}{\text{Weight of leaf sample}}$$

$$\text{Chlorophyll "a" (Mg g}^{-1}\text{ fresh Weight of leaves)} = \frac{(22.9 \times A_{645}) - (4.65 \times A_{663})}{1000} \times \frac{\text{Volume of DMSO}}{\text{Weight of leaf sample}}$$

Total chlorophyll content was worked out by adding chlorophyll "a" and chlorophyll "b" as under:

Total Chlorophyll (mg g^{-1} fresh weight of leaves) = Chlorophyll a + Chlorophyll b

Plant attributes such as plant height, root diameter, root length, total fresh weight of plant, total yield and dry matter yield of leaves were recorded plot-wise at maturity. The experimental data recorded in various field observations and laboratory studies were statistically analyzed with the help of Fisher's analysis of variance technique (Fisher, 1950) [7]. The critical difference (CD) for the treatment comparisons was worked out wherever the variance ratio (F test) was found significant at 5% level of significance.

Result and Discussion

The results obtained from the present investigation are presented in table 2 to 3.

Effect of organic manures

Yield attributes and yields of carrot

Data from table 2 spilled that all yield attributes (plant height, root diameter, root length, total fresh weight of plant), total yield and dry matter yield of leaves significantly improved by the application of organic manure and the highest was recorded under vermicompost @ 20 t ha^{-1} that was found statistically at par with poultry manure @ 10 t ha^{-1} except in case of dry matter yield of leaves.

Improved growth and yield attributes through vermicompost might be due to better soil moisture holding capacity and adequate availability of major and micro nutrients due to favourable soil condition and enhanced rate of photosynthesis that further increase vegetative growth and yield by providing more site for translocation of photosynthates. The results were in accordance with the findings of Kumar (2013), Rani *et al.* (2016) [20], Kumawat *et al.* (2018) [15] and Kushwah *et al.* (2019) [16]. Poultry manure contains uric acid having 60% nitrogen that rapidly changes to ammonia form causing its immediate availability and efficient utilization of nitrogen for carbohydrate production. Further, these carbohydrates get converted into reproductive sugars through hydrolysis and ultimately helped in increasing yield. These results were agreement with findings of Habimana *et al.* (2014) [8], Rani *et al.* (2016) [20] and Kumawat *et al.* (2018) [15]. FYM and other composts have the advantage of increasing the soil water and nutrient retention capacity and gradual release of nitrogen thus increasing top and root yield of crop. The results were in close conformity with Islam *et al.* (2011) [11] and Kumawat *et al.* (2018) [15].

Quality attributes

Data (Table 3) showed that different organic manures significantly improved all quality parameters (TSS, β-carotene and total chlorophyll content) of carrot. Maximum TSS content (8.17°Brix)) and β-carotene content (23.07 µg g^{-1}) in carrot roots and total chlorophyll content (2.61 mg g^{-1}) in carrot leaves were recorded with vermicompost @ 20 t ha^{-1} that was statistically at par to poultry manure @ 10 t ha^{-1} and significantly superior over control and FYM @ 20 t ha^{-1}.

TSS content (Table 3) showed significant increase with different organic manures because the organic manures particularly FYM and vermicompost contain fair amount of micronutrients especially ferrous. It is an essential constituent of the many respiratory enzymes like catalase, cytochrome A, B and C that are involved in the respiratory process of cell system. Through this respiration in plant system reserve food materials will be converted to simple soluble components that could be utilized for growth or maintenance. The present findings were good accordance with the results of Kumar and Ponnuswami (2013) [14], Wafaa (2013) [26] and Umuhoza *et al.* (2014) [24]. The significant increase in β-carotene content of roots (Table 3) with organic manures might be attributed to increased vegetative growth, which increases the efficiency of photosynthesis for manufacture of compounds such as polysaccharides, which, when analyzed, produce β- carotene dyes. The findings corroborate with the results of Umuhoza *et al.* (2014) [24] and Salman (2017) [21]. Total chlorophyll content in leaves (Table 3) enhanced significantly with various organic manures due to the fact that vermicompost and compost organic fertilizers provide good availability of water and nutrients such as potassium and nitrogen that are involved in the regulation of osmotic pressure. Therefore, glutamate is less in the synthesis of proline and is maintained total leaf chlorophyll content. Similar results were obtained by Zeid *et al.* (2015), Salman (2017) [21] and Hosseinzadeh *et al.* (2018) [10].

Effect of fertilizers level

Yield attributes and yields of carrot: Different fertilizers level significantly increased all yield attributes, total yield as well as dry matter yield of leaves up to 100% RDF (Table 2).

It is because of the fact that increased NPK levels, helps in leaf area expansion and chlorophyll content which further increase net photosynthetic rates and increase the supply of carbohydrates to plants. Nitrogen, phosphorus and potassium favour all the metabolic and auxin activities in plant that ultimately resulted in increased yield, biological yield, root length, root diameter and all yield attributing parameters. These findings were similar to those reported by Vithwel and Kanaujia (2013) [25], Kumawat *et al.* (2018) [15] and Kushwah *et al.* (2019) [16].

Quality attributes

The results (Table 3) showed that all quality attributes (TSS, β-carotene and total chlorophyll content) of carrot were significantly improved by increasing level of fertilizer dose. The highest TSS content (8.42 °Brix), β-carotene content (23.57 µg g^{-1}) in roots and total chlorophyll content (2.69 mg g^{-1}) in carrot leaves was observed with 100% RDF which was significantly higher over rest of treatments. However, 100% RDF was statistically at par with 75% RDF in case of TSS.

The data pertaining table 3 clearly showed that all quality attributes (TSS, β-carotene and total chlorophyll content) were significantly increased up to 100% RDF as compared to other treatments. Increased nitrogen through fertilizers apparently helped in vigorous vegetative growth and favoured photosynthetic activity for greater accumulation of food material *i.e.* carbohydrates that increased TSS content in plant. The results were in close conformity with Wafaa (2013) [26] and Mahala *et al.* (2018) [18]. The higher level of carotene with 100% RDF may be due to the action of specific soil nutrients that might be made more readily available for plant absorption as a result of mineral fertilizer for the synthesis of carotene in carrot. The findings were in accordance with Zakir *et al.* (2012) [28] and Vithwel and Kanaujia (2013) [25]. Total chlorophyll content is directly proportional to the availability of the nitrogen that plays an important role in the process of photosynthesis, also the increasing of nitrogen content and leaf area with inorganic fertilizers directly correlated with an increase in total chlorophyll content (Larimi *et al.*, 2014) [17]. The similar results were also found by Zeid *et al.* (2015) [29] and Schimidt *et al.* (2018).

Table 2: Effect of organic manures and fertilizers level on yield attributes and yield of carrot

Treatments	Plant height (cm)	Root diameter (cm)	Root length (cm)	Total fresh weight of plant (g)	Total yield (kg ha^{-1})	Dry matter yield of leaves (kg ha^{-1})
Organic manures						
Control	39.44	2.09	15.98	113.94	26796	426
Poultry manure @ 10 t ha^{-1}	51.49	3.04	21.38	133.50	35208	724
Vermicompost @ 20 t ha^{-1}	54.13	3.18	22.82	139.84	35776	777
FYM @ 20 t ha^{-1}	47.92	2.61	19.83	124.33	31928	635
S.Em±	1.10	0.07	0.52	2.20	795	18
CD at 5%	3.19	0.19	1.50	6.34	2296	53
Fertilizers level						
Control	41.55	2.12	16.30	114.51	27516	445
50% RDF	46.89	2.64	19.31	124.78	31157	588
75% RDF	50.64	2.95	21.43	132.87	34231	713
100% RDF	53.90	3.21	22.97	139.45	36804	816
S.Em±	1.10	0.07	0.52	2.20	795	18
CD at 5%	3.19	0.19	1.50	6.34	2296	53

Table 3: Effect of organic manures and fertilizers level on TSS, β-carotene and total chlorophyll content in carrot leaves

Treatments	TSS (°Brix)	β-carotene (µg g^{-1})	Total chlorophyll content (mg g^{-1}) at 60 DAS
Organic manures			
Control	6.67	19.99	1.30
Poultry manure @ 10 t ha^{-1}	8.12	22.19	2.59
Vermicompost @ 20 t ha^{-1}	8.17	23.07	2.61
FYM @ 20 t ha^{-1}	7.83	21.62	2.47
S.Em±	0.10	0.33	0.04
CD at 5%	0.29	0.94	0.12
Fertilizers level			
Control	6.50	19.30	1.59
50% RDF	7.65	21.40	2.15
75% RDF	8.22	22.60	2.54
100% RDF	8.42	23.57	2.69
S.Em±	0.10	0.33	0.04
CD at 5%	0.29	0.94	0.12

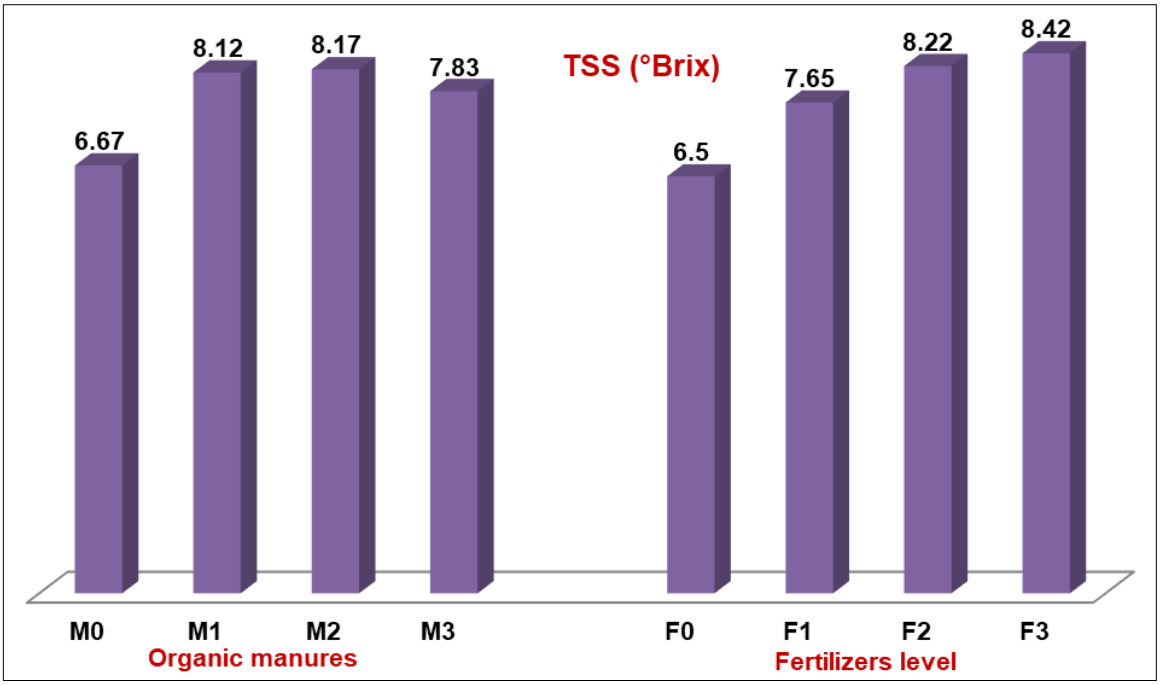

Fig 1: Effect of organic manures and fertilizers level on TSS content in carrot roots

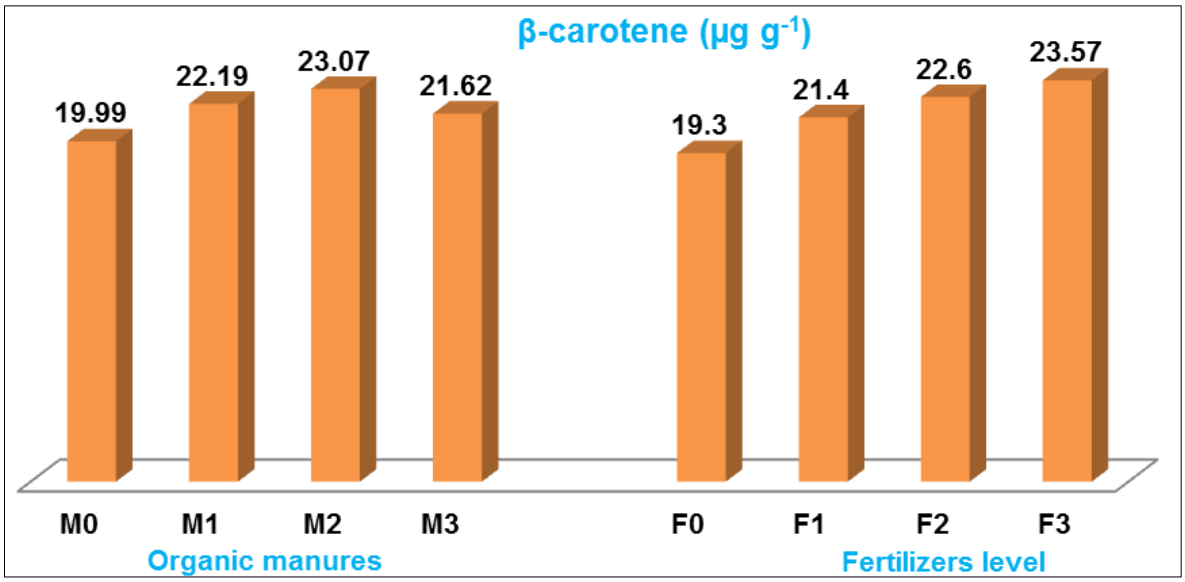

Fig 2: Effect of organic manures and fertilizers level on β-carotene content in carrot roots

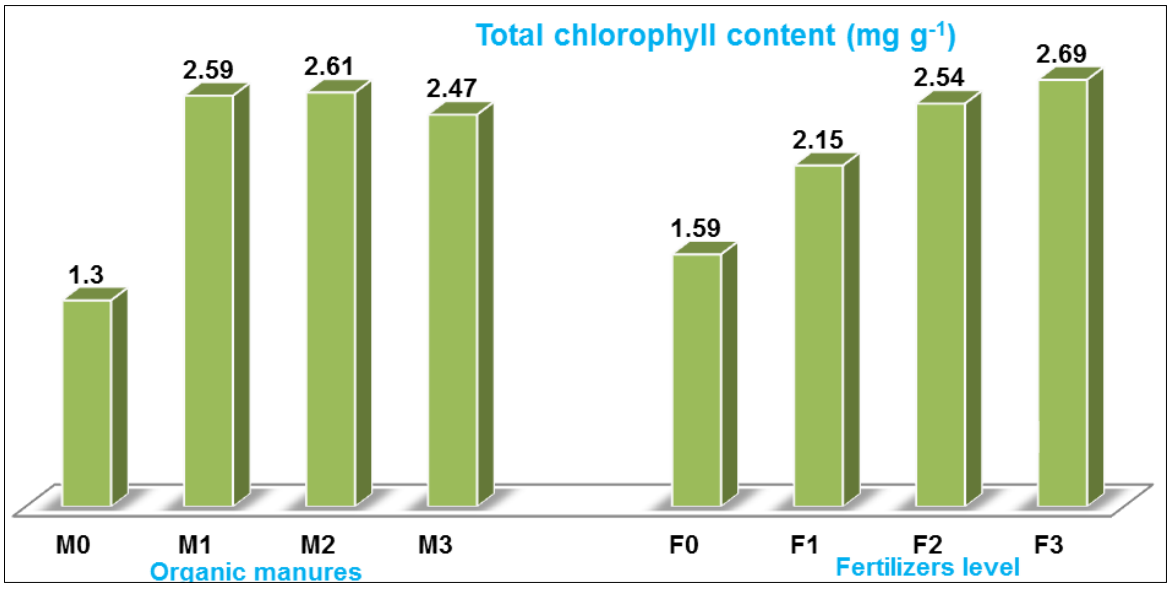

Fig 3: Effect of organic manures and fertilizers level on total chlorophyll content in carrot leaves

Conclusion

On the basis of present experiment, it can be concluded that yield of *rabi* carrot can be maximized by the application of 20 t ha^{-1} vermicompost along with 100% recommended dose of NPK fertilizers that gave significantly higher yield attributing characters, total yield as well as all quality parameters (TSS, β-carotene and total chlorophyll content) of carrot. However, these results are only indicative and require further experimentation for conformation before making the final recommendation to farmers.

Reference

1. AOAC. Official and tentative methods of analysis. 9th edition Washington, O.C. 1960.
2. Anjum MA, Amjad M. Influence of mother root size and plant spacing on carrot seed production. Journal of Resource Science. 2002;13(2):105-112.
3. Anonymous. Horticultural statistics at a glance. Horticulture statistics division, Department of Agriculture, Cooperation and Farmers welfare. 2020.
4. Arscott SA, Tanumihardjo SA. Carrots of many colours provide nutrition & bio-available phytochemicals acting as a functional food. Comprehensive Reviews in Food Science and Food Safety. 2010;9(2):223-239.
5. Atiyeh RM, Lee S, Edwards CA, Arancon NQ, Metzger JD. The influence of humic acid derived from earthworm-processed organic wastes on plant growth. Bioresources Technology. 2002;84:7-14.
6. Collins HP, Rasmussen PE, Doughlas CL. Crop rotation and residue management effect on soil and microbial dynamics. Soil Science Society of America Journal, 1992;56:783-788.
7. Fisher RA. Statistical methods for research workers. Oliver and Boyd Edinburgh, London. 1950.
8. Habimana S, Uwamahoro C, Uwizerwa JB. Influence of chicken manure and NPK (17-17-17) fertilizer on growth and yield of carrot. Net Journal of Agricultural Science. 2014;2(4):117-123.
9. Hiscox JD, Israelstam GF. A method for the extraction of chlorophyll from leaf tissue without maceration.

Canadian journal of botany. 1979;57(12):1332-1334.
10. Hosseinzadeh SR, Amiri H, Ismaili A. Evaluation of photosynthesis, physiological and biochemical responses of chickpea (*Cicer arietinum* L. cv. Pirouz) under water deficit stress and use of vermicompost fertilizer. Journal of integrative agriculture. 2018;17(11):2426-2437.
11. Islam MM, Karim A, Jahiruddin M, Majid NM, Miah MG, Ahmed MM. Effects of organic manure and chemical fertilizers on crops in the radish-stem Amaranth- Indian spinach cropping pattern in homestead area. Australian Journal of Crop Science. 2011;5(11):1370-1378.
12. Kiros A, Kebede W, Fikreyohannes G. Effect of inorganic NP fertilizers and vermicompost on growth, seed yield and yield components of onion *(Allium cepa* L.*)* at Maitsebri, Northern Ethiopia. Journal of Horticulture and Forestry. 2018;10(6):89-96.
13. Kumar GS. Effect of organic manures on growth, root yield and quality of carrot *(Daucus carota* L.*).* Master thesis submitted to Dr. Y.S.R. Horticultural University. 2013.
14. Kumar SM, Ponnuswami V. Effect of different water regimes and organic manures on quality parameters of noni (*Morinda citrifolia*). African Journal of Agricultural Research. 2013;8(27):3534-3543.
15. Kumawat S, Soni A, Sharma D, Soni V. Effect of organic manures and fertility levels on yield attributes of carrot (*Daucus carota* L.*)* cv. Pusa Rudhira. International Journal of Chemical Studies. 2018;6(5):1613-1616.
16. Kushwah G, Sharma RK, Kushwah SS, Mishra SN. Effect of organic manures, inorganic fertilizers and varieties on growth, yield and quality of tropical carrot. Indian Journal of Horticulture. 2019;76 (3):451-456.
17. Larimi SB, Shakiba M, Mohammadinasab AD, Vahed MM. Changes in nitrogen and chlorophyll density and leaf area of sweet basil (*Ocimum basilicum* L.) affected by biofertilizer and nitrogen application. International Journal of Biosciences. 2014;5(9):256-265.
18. Mahala P, Chaudhary MR, Garhwal OP. Yield and quality of rabi onion (*Allium cepa* L.) influenced by integrated nutrient management. International journal of current microbiology and applied sciences. 2018;7(5):3313-3321.
19. Pandey V, Chura A, Pandey HK, Nasim M. Estimation of ascorbic acid, ß carotene, total chlorophyll, phenolics and antioxidant activity of some European vegetables grown in mid hill conditions of western Himalaya. Journal on New Biological Reports. 2015;4(3):238-242.
20. Rani R, Malek MA, Robbani M. Effect of organic manures and mulching on growth and yield of carrot. Journal of Agro forestry and Environment. 2016;10(1):155-160.
21. Salman AD. Effect of intercropping agriculture and organic fertilization on yield quantitative and qualitative of carrot plant and production in the unit area with sustainable agriculture system. International Organization of Scientific Research Journal of Agriculture and Veterinary Science. 2017;10(10):29-35.
22. Schmidt L, Sorg S, Tittmann S, Max J, Zinkernagel J. Do extended cultivation periods and reduced nitrogen supply increase root yield and anthocyanin content of purple carrots? Horticulturae. 2018;4(7):1-13.
23. Swamy KR, Nath P, Ahuja KG. Vegetables for Human Nutrition and Health. In: Nath, P., Ed., The Basics of Human Civilization-Food, Agriculture and Humanity, Volume-II-Food, Prem Nath Agricultural Science Foundation (PNASF), Bangalore & New India Publishing Agency (NIPA), New Delhi, 2014, 145-198.
24. Umuhoza JNK, Sylvestre H, Philippe S. Nutritional quality of carrot (*Daucus carota* L.) as influenced by farm yard manure. World Journal of Agricultural Sciences. 2014;2(5):102-107.
25. Vithwel, Kanaujia SP. Integrated nutrient management on productivity of carrot and fertility of soil. SAARC Journal of Agriculture. 2013;11(2):173-181.
26. Wafaa HM. Yield, quality and micronutrients uptake of carrot (*Daucus carota* L.) and some soil properties as affected by organic fertilizers and elemental sulphur application. Egyptian Journal of Soil Science. 2013;53(4):537-554.
27. Yadav SK, Khokar UV, Yadav RP. Integrated nutrient management for strawberry cultivation. Indian Journal of Horticulture. 2010;67(4):445-449.
28. Zakir HM, Sultana MN, Saha KC. Influence of commercially available organic vs inorganic fertilizers on growth yield and quality of carrot. Journal of Environmental Science and Natural Resources. 2012; 5(1):39-45.
29. Zeid HA, Wafaa HM, Seoud AE, Alhadad WAA. Effect of organic materials and inorganic fertilizers on the growth, mineral composition and soil fertility of radish plants (*Raphine's sativus*) grown in sandy soil. Middle East Journal of Agriculture Research. 2015;4(1):77-87.