Azarian J. Agric. VOL (4) ISSUE 6, 2017: 200-205

Azarian Journal of Agriculture

www.azarianjournals.ir

Azarian Journals

Research article **ISSN:2383-4420**

Quality parameters of Carrot as affected by varieties and nutrient sources

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Article Info

Accepted:
15 Dec. 2017

Keywords:
Carrot, Nutrients, Parameters, Varieties, Quality

ABSTRACT

A field experiment was carried out from November 2014 to April 2015 in farmer's field, Fulbari, Chitwan, Nepal to access the influence of different varieties and nutrient sources on quality parameters of carrot. The experiment was laid out in two factorial randomized complete block design (RCBD) with three replications, consisting of three varieties i.e. Nepadream, New Kuroda and Early Nantes as factor A and five nutrient sources i.e. 1) RDF at the rate of 60:40:40 NPK kg ha^{-1} 2) FYM at the rate of 3t ha^{-1} 3) 50% RDF plus 50% FYM 4) 50% RDF plus 50% vermicompost 5) Vermicompost at the rate of 1.2t ha^{-1} as factor B. The quality parameters as core diameter, cortex diameter, core to cortex ratio and TSS were measured at harvest. The study revealed that core and cortex diameter were not influenced significantly by varieties while TSS content and core to cortex ratio were influenced significantly. Nepadream variety recorded higher TSS and lower core to cortex ratio than Open Pollinated (OP) varieties (New Kuroda and Early Nantes) due to which it was more acceptable in terms of quality. Similarly, core diameter was influenced non-significantly with nutrient sources while other parameters were influenced significantly. The combined effect of varieties with nutrient sources was non-significant with respect to all the quality parameters. Thus in general, the hybrid variety was found superior to local varieties. Likewise, the integration of organic and inorganic nutrient sources resulted in better quality carrot roots than the sole treatments.

INTRODUCTION

Carrot is one of the major vegetable crops cultivated worldwide (FAOSTAT 2015). It provides 17% of the total vitamin A consumption, making it the single major source of beta carotene among the vegetables (Arscott and Tanumihardjo 2010). They provide the major dietary fiber component of food and also a range of micronutrients and antioxidant compounds (Augspole et al. 2014). They have been used to control ulcers, eczema, boil and are used in cosmetic preparations to fight wrinkles (Ageless 2009).

The yield and quality of carrot are affected by the fertilizers and varieties (Win 2010). The potential quality of fruit is dependent on the cultivar type. Different cultivars are characterized by different quality parameters, making some more desirable to the producers and consumers. Further, the varieties may respond differently with different nutrient sources. Hybrids are basically of improved plant morphology, e.g. better root system or leaf canopy, which stress efficient uptake of mineral nutrients (Bairwa et al. 2008).

Carrot is a heavy feeder of nutrients, and very sensitive to nutrient and soil moisture (Sunanadarani and Mallareddy 2007). Major nutrients like Nitrogen (N), Phosphorus (P) and Potassium (K) play an important role in vegetative and reproductive phase of crop growth (Nadaf, 2007). Mostly, the carrot growers use chemical fertilizers as the major supply of nutrients in order to achieve higher yields and growth (Dauda et al. 2008). Even though an inorganic fertilization plays a vital role for the healthy plant growth and development, it does affect the soil health. On other hand, the organic source of nutrients provide consistent and slow release of nutrients, maintain ideal C: N ratio, improve water holding capacity and microbial biomass of soil profile, without any adverse residual effects (Yadav et al. 2010). Vermicompost is rich in both macronutrients and micronutrients, and is considered as a bio-fertilizer because of its richness in humus forming and N fixing microorganisms. Likewise, farmyard manure

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favorably or unfavorably affects the quality of carrot roots such as cortex-core ratio, forking, fibrousness, carotene content, and total soluble sugars (Kumar 2005). These organic nutrient sources not only reduce the amount of chemical fertilizers but also improve soil fertility (Chumyani et al. 2012). 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 fertilizer nor organic manure alone can help to achieve sustainable crop production. Instead of using inorganic fertilizers alone, combined usages of organic manures with inorganic fertilizers (i.e., INM practices) help to improve the yield and quality of carrot, and also aids to conserve the soil health (Mallareddy 2007).

Carrot is an economically important horticultural crop that has drawn the wider attention of the consumers in recent decades due to its high nutritional value. Nowadays, the consumers are more concern about healthy foods, which are of better quality and more nutritious. Further, the demand for a quality product has increased due to the consumer awareness. So, the farmers need to aim at quality production rather than only voluminous production. Since the plant nutrition has a certain impact on the quality of crops produced, a proper fertilizer strategy is a must. The information about yield and quality of the local and hybrid carrot cultivars in response to the different fertilizer types would be a useful knowledge for the farmers. Hence, the study was undertaken to find out the influence of different cultivars and sources of nutrients to the quality parameters of carrot.

MATERIALS AND METHODS

The research was carried out from November 2014 to April 2015 in farmer's field, Fulbari, Chitwan, Nepal. The area has the humid sub-tropical type of climate. During the period of experimentation, the mean maximum temperature ranged from 20.97 °C to 34.56 °C and mean minimum temperature ranged between 5.94 °C and 15.96° C.

A composite soil sample was collected from 0-15 cm depth before imposing treatments. The physicochemical properties of soil sample were analyzed in the laboratory by adopting the appropriate method. The physico-chemical properties of the soil in the experimental site is presented in Table 1.

The research was laid out in a 3 × 5 factorial randomized complete block design with three replications. Factor A consisted of three varieties i.e. Nepadream (hybrid), New Kuroda and Early Nantes (Open pollinated) and factor B consisted of five nutrient sources (three sole treatments and two INM treatments) as 100 % RDF at the rate 60:40:40 NPK kg ha^{-1}, 100% FYM at the rate of 10 t ha^{-1} 3) 50% RDF plus 50% FYM, 50% RDF plus 50% vermicompost, and 100% vermicompost at the rate of 4t ha^{-1}. Only Nitrogen was taken into account, keeping P and K constant, so nutrient sources can be taken as nitrogen sources. There were altogether 45 plots with the individual plot size of 1.5 m × 2 m (3m2), having 5 rows with 100 plants per plot. The seeds were uniformly distributed in furrows at a depth of about 1 cm with a spacing of 30 cm between rows and covered with fine soil at about 2 cm thick. Farmyard manure and vermicompost were applied half month prior to the sowing of seeds by working out on their quantities based on the nutrient content. The plots were fertilized according to the treatment with nitrogen, phosphorus, and potassium at 60:40:40 kg/ha (DADO 2012) in the form of urea, single super phosphate, and muriate of potash. Half dose of nitrogen and a full dose of phosphorus and potash were applied as basal dose whereas the remaining dose of nitrogen was side-dressed after 40 days after sowing. Thinning was done at 20 days after emergence to a final spacing of 10 cm between plants.

Data recording and analysis

The quality parameters as core and cortex diameter, core to cortex ratio, and Total Soluble Solids (TSS) were recorded from five selected plants per plot, at harvest.

Core and cortex diameter

The roots of selected plants were measured at three points with the help of Vernier caliper, and the mean root diameter was recorded. Similarly to determine the core diameter, the root was cut transversely at three points and the mean value was obtained with the help of scale. The cortex diameter was calculated by subtracting the core diameter from the root diameter.

Cortex diameter (cm) = Root diameter - Core diameter

Core to cortex ratio

It was determined by using the formula given as:

Core: Cortex ratio = Diameter of core (cm)/ Diameter of cortex (cm)

Total soluble solids (TSS)

The roots of sample plants were chopped into small pieces and a composite sample was prepared. The juice was extracted from the composite sample and TSS was measured with the hand refractometer of brand ERMA MAKE.

Statistical analysis

Data was systematically arranged on the basis of various observed parameters in Microsoft excel. To determine the significance of differences between means of treatments, analysis of variance was done on every parameter by using MSTAT program. The significant difference between treatments means was compared by using Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSIONS

Core diameter

The core diameter of carrot root responded non-significantly to varieties treatment (Table 1). Early Nantes obtained the highest core diameter (1.22 cm) while the lowest by Nepadream although the differences were non-significant. This might be due to the varietal characteristics. The variety with a small core and larger outer cortex is supposed for good quality. The small core is preferred because of worse taste and lower biological value of core as compared to cortex (Kjellenberg 2007).

The core diameter was non-significantly affected by different nutrient sources and their combinations. A similar finding was obtained by Jepto et al. (2013). However, a slight increase in this trait was found in the plants treated with 100% FYM (1.20 cm) as compared to other treatments. While the lowest value for this trait was obtained with the plants treated with half RDF and half Vermicompost (1.06 cm). Thus, it can be easily stated that both the varieties and nutrient sources responded non-significantly with respect to core diameter. Similarly, the nutrient treatments interacted non-significantly with varieties of carrot with regards to core diameter.

Cortex diameter

The varieties did not differ significantly with respect to cortex diameter; however, Nepadream produced slightly higher cortex diameter (1.29 cm) as compared to other varieties, which might be due to genetical makeup. The nutrient sources had a significant effect on cortex diameter. Among the sole treatments, 100% RDF recorded thickest cortex diameter (1.26 cm) followed by 100% vermicompost (1.25 cm) and 100% FYM (1.12cm), all being at par. Further, the cortex diameters obtained by sole applications were similar to INM treatments except for 100% FYM alone. While the INM treatments differed non-significantly with respect to cortex diameter, however; the combination of 50% RDF and 50% FYM obtained slightly higher (1.38 cm) cortex diameter than the combination of 50% RDF and 50% vermicompost (1.29 cm). The different nutrient sources interacted non-significantly with the varieties with respect to cortex diameter.

Core to cortex ratio

The varieties had a significant effect with respect to the core to cortex ratio. The hybrid variety (Nepadream) recorded lower core to cortex ratio as compared to OP varieties. Similarly, the nutrient sources had also a significant effect on core to cortex ratio. Among all nutrient treatments, 100% FYM gave the highest value for this trait. The combination of 50% RDF and 50% FYM had a lower core to cortex ratio compared to other nutrient treatments. It was worthy to mention that the application of 50% RDF along with 50% vermicompost came under second-best treatment with regard to their effect on core to cortex ratio. This might be due to the increased availability of micronutrients by application of vermicompost along with RDF than RDF alone. The different nutrient sources interacted non-significantly with the varieties on account of core to cortex ratio

Table 1. Initial Physico-chemical properties of the soil in the experimental site

S.N	Soil properties	Value	Scale	Method/instrument employed
1.	**Physical properties**			Pipette method (Jennings, 1922)
	Sand (%)	42.90		
	Silt (%)	49.00		
	Clay (%)	8.10		
2.	**Chemical properties**			
	Soil PH	5.52	Acidic	Beckman Glass Electrode pH meter (Wright, 1939)
	Soil organic matter (%)	3.80	medium	Walky and Black method (1934)
	Total Nitrogen (%)	0.149	medium	Kjeldhal digestion (Kjeldahl, 1883)
	Available Phosphorus (Kg ha^{-1})	45	medium	Spectrophotometer (Olsen et al., 1954)
	Available potassium (Kg ha^{-1})	250.96	medium	Ammonium acetate method (Black, 1965)
3.	**Texture**		Loam	

Table 2. Core diameter, cortex diameter, core: cortex ratio and total soluble solid of carrot as influenced by varieties and different nutrient sources

Treatments	Quality parameters			
	Core Diameter (cm)	Cortex Diameter(cm)	Core: cortex ratio	Total soluble solid (%)
Varieties (A)				
Nepadream	1.11	1.29	0.87b	12.83a
New Kuroda	1.22	1.25	1.00a	11.77b
Early Nantes	1.18	1.24	0.97ab	12.00b
LSD (5%)	NS	NS	0.11	0.66
SEm	0.04	0.03	0.04	0.22
Nutrients sources (B)				
RDF100%	1.18	1.26ab	0.95ab	11.79b
FYM100%	1.20	1.12b	1.07a	11.67b
RDF50% + FYM50%	1.15	1.38a	0.83b	12.43ab
RDF50% + VC50%	1.06	1.29a	0.84b	13.11a
VC100%	1.24	1.25ab	1.02a	11.99b
CD (0.05)	NS	0.14	0.15	0.84
SEm±	0.05	0.05	0.05	0.29
CV%	14.16	12.04	16.77	7.21
Interaction A×B				
CD (0.05)	NS	NS	NS	NS
SEm	0.096	0.087	0.091	0.507
Grand mean	1.17	1.26	0.94	12.19

Means followed by the same letter (s) within a column are non-significant at 5 % level of significance as designed by DMRT .Note: DAS (days after sowing); RDF (recommended dose of fertilizer); FYM (farmyard manure); VC (vermicompost); A (Varieties-Nepadream, New Kuroda, Early Nantes) and B (Nutrients-RDF 100%, FYM 100%, RDF50%+FYM50%, RDF50%+VC50%, VC 100%)

Total soluble solid (TSS)

The total soluble solids of a pure aqueous sucrose solution measured in Brix degree. The Brix is usually considered equivalent to the percentage of sucrose (sugar) in the solution. Sweet and bitter taste in carrots is greatly influenced by both genetic and environmental factors (Win 2010).

The varieties differed significantly with respect to total soluble solid (Table 1). Nepadream recorded the maximum TSS content (12.83%). New Kuroda and Early Nantes were at par; however, minimum TSS content (11.7%) was obtained by New Kuroda. The superiority of the variety Nepadream may be attributed to the varietal genetical make up. Koley et al. (2013) also reported significant difference in TSS content among different varieties.

Likewise, the nutrient treatments also had significant influence on TSS content. All the sole treatments were at par with respect to the TSS content. However, 100% vermicompost recorded higher TSS (11.99 %) over other sole treatments. This may be due to higher and easy availability of micro-nutrients through vermicompost than from RDF and FYM (Lakshmi et al. 2013). The sole treatments obtained significantly lower TSS content as compared to INM treatments. The higher TSS content in INM treatments especially 50% RDF and 50% vermicompost may be attributed to the supply of various micro nutrients and growth and quality promoting phyto-hormones. This result indicated that the application of organic manures alone was not sufficient enough for improving TSS content in carrot. It also revealed that the application of RDF along with organic fertilizers positively influenced TSS contents in carrot. These results were partially compatible with the findings of Mallareddy (2007). The interaction effects between sources of nutrients and varieties with respect to TSS content were found non-significant.

CONCLUSIONS

The above analysis concluded that the application of INM treatments is more favorable for improving quality of carrot, and further, it is more economically and environmentally suitable. The application of either of the INM treatments i.e, 50% RDF along with 50% vermicompost or 50% FYM would be wise, depending on the availability of the organic sources. Similarly, when concern about the varietal effect on quality attributes, Nepadream was found to be the best variety. However, the combined effect of varieties with nutrient sources was non-significant with all the quality parameters.

REFERENCES

Ageless. (2009) Properties and therapeutic uses of carrots, ageless, URL: www.ageless.co.za/herb-carrot.htm [Accessed 25 October 2017]

Arscott S.A. Tanumihardjo S.A. (2010) Carrots of many colors provide basic nutrition and bioavailable phytochemicals acting as a functional food. Comprehensive Review on Food Science and Food Safety, 9: 223-239.

Augspole I. Rackejeva T. Kruma Z. Dimins F. (2014) Shredded carrots quality providing by treatment with Hydrogen peroxide. In LLU 9th. Conference on "Food for Consumer Well - Being" FOODBALT. Jelgava, Latvia 8-9 May.

Bairwa L.N. Fageria M.S. (2008) Effect of Zinc and integrated use of nitrogen on seed production of bottle gourd var. Pusa Naveen. Indian Journal of Horticulture, 65: 506-508.

Black C.A. Evans D.D. White J.L. Ensminger L.E. Clark F.E. Dinauer R. C. (1965) Methods of soil analysis. American Society of Agronomy, 1572 p.

Chumyani S. P. Kanaujia A. K. Singh V. B. (2012) Effect of integrated nutrient management on growth, yield and quality of tomato (*Lycopersicon esculentum*). Journal of Soil and Crops, 22: 5-9.

DADO, 2011/2012. *Barsik krisi bikash karyakram tatha tathanka eak jhalak*. District agriculture development office, Bharatpur, Chitwan, Nepal.

Dauda S. N. Ajayi F. A. Ndor E. (2008) Growth and yield of water melon (*Citrullus lanatus*) as affected by poultry manure application. Journal of Agriculture and Social Science, 4: 121-124.

FAOSTAT. (2015) Food and Agriculture Organization of the United Nations. URL: http://www.fao.org/statistics/en/ [Accessed 25 October 2017]

Jennings D.S. Thomas M.D. Gardner M. (1922). A new method of mechanical analysis of soil. Soil science, 14: 485-499.

Jeptoo A. Aguyoh J.N. Saidi M. (2013) Improving carrot yield and quality through the use of Bio-Slurry manure. Sustainable Agriculture Research, 2(1): 164-172.

Kjeldahl J. (1883) New method for the determination of nitrogen in organic substances. Analytical and Bioanalytical Chemistry, 22 (1): 366-383.

Kjellenberg L. (2007) Sweet and bitter taste in organic carrot. Introductory paper at the faculty of landscape planning, Horticulture and Agricultural Science, 2007:2.

Koley T. K. Singh S. Khemariya P. Sarkar A. Kaur C. Chaurasia S. N. S. Naik P. S. (2013) Evaluation of bioactive properties of Indian carrot (*Daucus carota* L.). Food Research International, Pp 1-10.

Kumar A. (2005) Effect of crop residues and FYM on yield and quality of carrot roots (*Daucus carota* L.). Masters Dissertation, Haryana Agricultural University. India.

Lakshmi C. S. R. Rao P. C. Sreelatha T. Madahvi M. Padmaja G. Rao P. V. Sireesha A. (2013) Manurial value of different vermicompost and conventional composts. Global advanced research journal of agricultural science, 2(2): 059-064.

Mallareddy K. Rani S. N. (2007) Effect of different organic manures and inorganic fertilizers on growth, yield and quality of carrot (*Daucus carota* L.). Department of Horticulture, Karnataka Journal of Agricultural Science, 20(3): 686-688.

Nadaf K. A. (2007) Department studies on seed production in carrot Cv. *Pusa Kesar*. Ms. Dissertation, Department of Seed Science and Technology, College of Agriculture, Dharwad.

Olsen S.R. Cole C.V. Watanabe F.S. Dean L.A. (1954) Estimation of available phosphorous in soils by extraction with sodium bicarbonate. Department of Agriculture, Washington, D.C.

Sunandarani N. and Mallareddy K. (2007). Effect of different organic manures and inorganic fertilizers on growth, yield and quality of carrot (*Daucus carota* L.). Karnataka Journal of Agricultural Science, 20(3): 686- 688.

Vasanthi D. Kumaraswamy K. (1996) Efficacy of vermicompost on the yield of rice and on soil fertility'. In: Abstracts of Seminar on Organic Farming for Sustainable Agriculture, October 9-11, p. 40.

Walkley A.J. 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.

Win L. L. (2010) Agronomic characteristics and nutritional quality of carrot (*Daucus carota* L.) cultivars from Myanmar and Germany as affected by mineral and organic fertilizers. Ph.D. thesis, Faculty of Agricultural science, Georg-August-University Göttingen, Germany.

Wright R.J. (1989) Soil aluminum toxicity and plant growth. Communications in Soil Science and Plant Analysis, 20: 1479-1497.

Yadav S.K. Khokar U.V. Yadav R.P. (2010) Integrated nutrient management for strawberry cultivation. Indian Journal of Horticulture, 67: 445-49.