INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 21, No. 1, p. 126-130, 2022

RESEARCH PAPER OPEN ACCESS

Evaluation of carrot (*Daucus Carota* L.) Genotypes for morphological yield and quality under Hadiya zone, Southern Ethiopia

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Key words: Cultivar, Haramaya I, Root quality, Root yield.

http://dx.doi.org/10.12692/ijb/21.1.126-130 Article published on July 28, 2022

Abstract

An experiment was conducted at Wachemo University College of Agricultural Science Lambuda research site to evaluate Carrot (*Daucus carota* L) genotypes for root yield and quality under irrigation condition. The experiment was set using Randomized Complete Block Design (RCBD) with three replications whereas four carrot varieties (Zorzi, Royal seed, Nantes 2 and Haramaya I) were used. Data was collected on leaf length, leaf width, Root diameter, Root length and Root weight. The results revealed that variety had significantly ($p \leq 0.01$) affected the yield and yield component parameters. Significantly the highest root yields and total marketable root yield mean (46.70 t ha^{-1} and 41.23 t ha^{-1}) were obtained in "Haramaya I" respectively whereas the lowest total yield and marketable mean root yields was obtained from Nantes 2 (14.51 t ha^{-1} and 12.81 t ha^{-1}) respectively. Among the study varieties, "Haramaya I" was only flowering and produce seed in study area (SNNPR). Moreover, "Haramaya I" root yield was found to be stable over seasons and locations. Therefore, it could be cultivated sustainably by smallholder farmers in the highlands of Hadiya Zone and in other places with similar agro-ecology.

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Introduction

Carrot (*Daucus carota* L.) is a widely grown root vegetable of the Apiaceae family. The first certain recorded use of carrot roots as a vegetable was in the 10th century in what is today known as Afghanistan. Orange carrots first appeared s a genetic variant in Europe in the 16th century and these more refined orange carrots quickly spread around the world, and by the early 20thcentury they became the predominate carrots in most growing regions of the world (www.seedalliance.org). Carrot is an important source of alpha-and beta-carotene, the precursors of vitamin A in human nutrition in many countries. The carotenoids contained in the edible portion of carrots can range from 6000 to more than 54,000 µg per 100g (60–540 ppm) (Simon and Wolff, 987). Although the exact time of introduction of carrots to Ethiopia is not known, the crop has been known since the early 1960s in the research system. Carrot research in Ethiopia was started at Alemaya College of Agriculture (now Haramaya University) using imported seeds of eight varieties from Kenya in the early 1960s. Among the eight varieties tested, Nantes and Chantenay were identified as high yielders (Kifle-Iyesus 1994, Kidanemariam, 1969). Carrot production has been expanding since then and the total production reached 12345.8 tonnes on 2215 hectares of land (CSA, 2010/11). On the other hand, vitamin A deficiency is widespread in the country. The prevalence is 2 to 15-fold higher than the World Health Organization (WHO) cut-off point (0.5%) for public significance.

Carrots are always direct seeded. Both raw and pelleted seed are used. Carrot seed vary from 175,000 to 400,000 per pound (80,000 to 180,000 per kg) and are sown at the rate of 0.9 to 1.3 million seeds per acre (0.4 to 0.5 million per ha). Higher densities are used for plantings for the cut and peel market. Seed within a lot vary significantly in size, maturity, vigor and germination time; emergence often occurs over several days. Seed are most commonly sown in six or eight lines in beds 40 inches (1 m) wide with three or four rows on each bed shoulder. Seed are placed in a narrow groove and are lightly covered. Carrot is grown from true seeds and its successful production is dependent up on a sustainable and satisfactory supply of good quality seed (Donald and Copeland, 1998; Lemma, 1998). However, the seed supply from the domestic production is not adequate and growers depend mainly on imported seeds that demand foreign currency and are of questionable sources with respect to germination and susceptibility to diseases. Thus, to improve the production and productivity of carrot domestically, the availability of quality seed is crucial (Dawit *et al.*, 2004). Carrot seeds are rarely produced in tropical conditions since mean day temperatures are less than 20°C. Experiences in Ethiopia have indicated that there are places in the country with optimum temperatures for seed production of carrot. Lemma (1998) reported that in the highlands of Ethiopia with elevation above 2000 m day and night temperatures of 15-25°C and 5-10°C,offer favourable conditions for vegetable cultivation.

Carrot crops are established by direct seeding, and poor stands may occur when sowing is done during extremely low or night temperatures. Many publications relate the negative effects of low temperature on carrots and establishment (Corbineau *et al.*, 1994). However, night temperatures (35 to 40°C) may also delay or inhibit carrot seed germination in the field and reduce uniformity. In tropical areas, carrot production is vulnerable to loss from thermal stress (heat) during stand establishment, and most commercial carrot cultivars have reduced seed germination at high temperatures. Carrot seeds germinate over a range from 0 to 35°C (Rubatzky *et al.*, 1999) with an optimal range of 25 to 30C (Corbineau *et al.,* 1994). The Association of Official seed Analysts recommends an alternating day/night regimen of 30to 20C (8/16 h) as the standard protocol for carrot seed germination tests (Association of Official Seed Analysts, 1993).

The carrot related research was not done at the area. The shortage of information was due to null research work on carrot up on concerning yield and physical quality. Therefore, this study aimed to identify the

best performing carrot (*Daucus carrota* L.) varieties for root yield and quality performance at the study area.

Materials and methods

Description of the study area

The experiment were carried out at Lembuda site in Lemo district in 2017-2018, located in Southern part of Ethiopia, 230 km south of Addis Ababa at 7°07'-7°92'N and 37°29'-38°13'E longitude with altitude 1501-2500 meters above sea level (ma.sl). The area receives an average annual rain fall of 1000-1200 mm, and the average maximum and minimum temperatures of 20°C and 15.1°C, respectively.

Experimental design and treatments

The study was conducted under irrigation during 2017 - 2018 Cropping seasons at Lambuda farm site of Wachemo University. Four carrot varieties (Zorzi, Royal seed, Nantes 2 and Haramaya I) were used for the experiment. The seeds of those varieties were collected from Ethio Falcon Traders, EAR Private Ltd, Hortus, and Haramaya University.

The experiment was laid out in RCB Design within three replications. The whole experimental area was 40mx8m, which was divided into three blocks. Each block was again divided into four plots hence there were 12 (4x3) unit plots. The treatments were assigned randomly in each block separately. The size of unit plot was 2.0m x 1.5 m. The distance between two adjacent block and plots was 1.0m and 0.5m respectively. Land preparation, manuring and intercultural operations were done properly.

The seed was sown in nine rows with in a recommended spacing of 20cm x 10cm and cover lightly with fine soil before irrigation.

The crop was harvested periodically for data collection. Randomly selected ten plants were harvested each time from each unit plot at 10 days interval. The harvesting was started after 105 days after sowing when most of the roots of carrot shown sign of maturity.

Methods of data analysis

Data collected were analysed statistically by using one- way analysis of variance (ANOVA) techniques and treatment means were subjected to SAS software for comparison at 5% Least significance difference (LSD) Yuen *et al.* (1996).

Results

Analysis of variance revealed that Leaf length, Leaf width, Root diameter, Root length and Root weight varied significantly ($p \leq 0.01$) among the carrot varieties studied (Table 1).

Table 1. The evaluation of edible carrot roots for morphological properties.

Cultivars (Treatment)	Leaf length	Leaf width	Root diameter	Root length	Root weight
Zorzi	16.443b	4.3833b	1.8033 b	8.440 b	42.44 b
Royal seed	12.217b	3.7177b	1.5667 b	8.107b	35.49 b
Nantes 2	18.330b	4.8867b	1.6367 b	9.220ab	29.02 b
Haramaya I	43.107a	8.2167a	3.3667 a	13.777a	91.39 a
LSD (0.05)	1.8387	1.8387	0.4646	4.6473	28.691
CV(%)	25.17827	17.36120	11.10776	23.52944	28.96108

Means within the same column followed by different letter are significantly different at $p \leq 0.05$, LSD: Least significant difference, CV: Coefficient of variation.

The highest Leaf length, Leaf width, Root diameter, Root length and Root weight were observed in '*Haramaya I*' (43.10 cm, 8.21 cm , 3.36 cm, 13.777 cm and 91.39 g) respectively (Table 1). Among the study varieties, '*Haramaya I*' was only flowering and produce seed in study area (SNNPR). Variety (*Haramaya I)* can be grown medium to high altitudes in eastern Ethiopia (1600-2400 metres above sea

level) and similar areas of the country either under rain-fed or irrigation. It has a deep orange root color. It has attractive root size and shape, long roots with small cores. The higher marketable and total mean root yields (46.70 t ha^{-1} and 41.23 t ha$^{-1)}$ were obtained in *Haramaya I* respectively than commercial Nantes variety (Table 2).

Discussion

Phonological growth

Analysis of variance revealed that Leaf length, Leaf width, Root diameter, Root length and Root weight varied significantly ($p \leq 0.01$) among the carrot varieties studied (Table 1). The highest Leaf length, Leaf width, Root diameter ,Root length and Root weight were observed in *Haramaya I* (43.10 cm, 8.21cm , 3.36cm, 13.777cm and 91.39 g) respectively (Table 1). This is attributed to the fact that '*Haramaya I*' had large Leaf length, Leaf width, Root diameter, Root length and Root weight than the other varieties. On the other hand, the lowest value of Leaf length, Leaf width, Root diameter and Root length (12.21cm, 3.71cm, 1.56cm and 8.10cm were recorded in treatment royal seed respectively. But Root weight (29.02g) smallest nantes2 variety, followed by royal seed (35.49 g) and zorzi (42.44 g) both of which were not statistically different from one another (Table 1). However, as indicated in (table 1) Leaf length, Leaf width, Root diameter, Root length and Root weight at varieties Zorzi, Royal seed and Nantes 2 did not statically difference. The finding is in line with that reported by (Karklelienė *et al*., 2012), who indicated the It was established that the edible carrot cultivar 'Tito' produced significantly biggest (206.6 g) roots among the investigated cultivars and hybrids. The carrot hybrids 'Noveno' F1 (118.0 g) and 'Bolero' F1 (125.7g) produced significantly smallest roots. The edible carrot cultivar 'Tito' was distinguished for the longest (23.6 cm) roots. The roots of 'Vaiguva' and 'Skalsa' F1 had significantly biggest diameter (4.7 and 4.6 cm, respectively), compared with other hybrids and cultivars; this also agrees with earlier research done at the Lithuanian Institute of Horticulture. During the experimental years, the hybrid 'Noveno' F1 and cultivar 'Magi' produced the roots of small diameter (3.2 cm).

Table 2. External quality parameters of carrot Varieties.

	Parameter						
Varieties (treatment)	Root yields (t ha^{-1})	Marketable root Yield t ha^{-1}	Proportion of small size roots (%)	Proportion of cracked roots (%)	Proportion of forked roots (%)	Proportion of hairy roots (%)	Proportion of twisted roots (%)
Haramaya I	46.70	41.23	31.47	0.23	2.45	7.99	18.55
Royal seed	17.75	15.66	67.22	1.89	6	12.67	25.22
Nantes 2	14.51	12.81	46	2	3	5.66	22.23
Zorzi	21.22	18.74	45	1	4	9.53	11.25

Root yield and yield component of carrot

The higher marketable and total mean root yields (46.70 t ha^{-1} and 41.23t ha$^{-1)}$ were obtained in *Haramaya I* respectively than commercial Nantes variety (Table 2). . Total carrot yield obtained in the present experiment as well as yield structure were similar to the results reported by other authors (Manosa, 2011), who report that the edible carrot hybrids 'Bolero' F1 and 'Noveno' F1 produced the highest total yield 74.7 and 61.7 t ha-1, respectively, compared with the other hybrids tested. The cultivar 'Garduolės' produced the highest total yield (65.0 t ha-1) of all the cultivars studied. 2. The Lithuanian carrot hybrid 'Svalia' F1 produced average total yield 53.6 t ha-1, but distinguished itself among the investigated carrot genotypes for high marketability (marketable yield – 87.5%). It accumulated the largest amount of carotene (19.6 mg 100 g-1) and dry soluble solids (14.1%). 'Svalia' F1 produced roots 19.6 cm in length, 3.9 cm in diameter and 166.8 g in weight on average.

The highest small root size proportion percentage (67.22), Proportion of hairy roots (12.67%) and Proportion of twisted roots (25.22%) were recorded with in Royal Seed, while the lower small root size

proportion (31.47) was also obtained *Haramaya I. The highest* Proportion of cracked roots (2%) was recorded in Nantes 2 and, on other hand the lowest was recorded with in *Haramaya I* (Table 2). The above observation is fully confirmed by the results of the present study.

Conclusion and recommendation

It is concluded that the study has significantly different among the carrot varieties evaluated. Accordingly, the carrot variety (*Haramaya I*) was only the superior as compared to other carrot varieties with regard to Leaf length, Leaf width , Root diameter, Root length, Root weight, marketable and total mean root yields. Further it may be concluded that the genotypes favorite, all season Royal seed, Nantes 2 and Zorzi are treat with flower initiation hormone to produce seed and compatible with standard varieties and perform well rest of genotypes.

Acknowledgements

We would like to thank Wachemo University for the funding our study.

References

Amsalu A,Victor AS, Bezabih E, Fekadu FD, Tesfaye B, Milkessa T. 2012. Analysis of Vegetable Seed Systems and Implications for Vegetable Development in the Humid Tropics of Ethiopia. International Journal of Agriculture and Forestry 2012 **4(4),** 325-337.

Association of Official Seed Analysts. 1993. Rules for testing seeds. Journal of Seed Technology **16,** 1–113.

Corbineau F, Picard MA, Come D. 1994. Effects of temperature, oxygen and osmotic pressure on germination of carrot seeds: Evaluation of seed quality. Acta Horticulture **354**, 9–16.

CSA. 2010/11. Agricultural sample surveys 2004/5 – 2010/11. Reports on area and production of crops (private peasant holdings, Meher season), Addis Ababa.

Dawit A, Abera D, Lemma D, Chimdo A. 2004. Domestic vegetable seed production and marketing. Research report No 57, EARO. Addis Ababa.

Hart JM, Butler MD, Martens BR, Camp- bell CK. 2003. Seed carrot above ground biomass and nutrient accumulation, 2001/2002 growing season. Central Oregon Research Center 2002 Annual Report, Special Report **1046,** 162–165.

Joubert TG, Boelema BH, Daiber KC. 1994. A.2 The production of carrots. Vegetable and Ornamental Plant Institute, Agricultural Research Council- Roodeplaat.

Kidanemariam H. 1969. Vegetable production guide for Eastern Ethiopia. Experiment Station Bulletin No. 62. College of Agriculture, Haile Sellassie I University.

Kifle I. 1994. Horticultural development in peasant agriculture. p. 29-36. In: Herath E. and Lemma Dessalegne (eds) Horticultural Research and development in Ethiopia. Proceedings of the second national horticultural workshop of Ethiopia. 1-3 Dec. 1992. Institute of Agricultural Research and Food and Agriculture Organization. Addis Ababa, Ethiopia.

Lemma D. 1998. Seed production guideline for tomatoes, onion, and hot pepper. Institute of Agricultural Research, Addis Ababa, p 22.

Donald MB, Copeland LO. 1998. Seed production and principles and practices CBS publishers and distributers, Darya Ganj, New Delhi. **11**, 749.

Rubatzky VE, Quiros CF, Simon PW. 1999. Carrots and related vegetable Umblelliferae. CABI Publishing, New York.

Simon PW, Wolff XY. 1987. Carotenes in typical and dark orange carrots. Journal of Agricultural and Food Chemistry

35, 1017-1022.Yuen J, Twengstrom E, Sigуald R. 1996. Calibration and verification of risk algorithms using logistic regression. European Journal of Plant Pathology **102,** 847-854.