



Research Article

On Farm Demonstration of Improved Carrot (*Daucuscarota* L.) Variety in EmbaAlaje District, Northern Ethiopia

Kassa Melese*, Zeberhe Teklay, Abrihaley Shelema, Teklhaimanot G Michael, Hagos Kidane and Birtukan G Kiros

Alamata Agricultural Research Center, PO Box 56, Alamata, Ethiopia

Tigray Tigray Agricultural Research Institute, PO Box 492 Mekelle, Ethiopia

*Corresponding author: kassahu125@gmail.com

Article History: Received: November 21, 2018 Revised: January 15, 2019 Accepted: January 20, 2019

ABSTRACT

The study was undertaken to adapt and evaluate the growth and yield potential of different carrot (*Daucuscarota* L.) Varieties in Emba Alaje district, Northern Ethiopia. The commercially producing and the recently released carrot varieties of Nantes and Haramaya-I respectively were used in the study. The experiment was laid out in randomized complete block design (RCBD) with ten replications. The intra and inter row spacing of 5 cmx25 cm respectively were used as per the national recommendation for these varieties. The study showed that all phenology, growth and yield parameters except root base diameter, root cortex diameter, unmarketable yield and average root weight were significantly affected at 5% level of significance. The highest significantly different total root yield (53.17) and marketable root yield (51.56) t ha⁻¹ was obtained from Haramaya-I carrot variety. This variety also provided no disease incidence and severity symptoms that was higher in Nantes variety. Moreover, the perception score of farmers towards the two carrot varieties was significantly higher for haramaya-I than Nantes. Therefore, it is possible to boost the production and productivity of carrot in the district and beyond using Haramaya-I carrot variety.

Key words: Carrot, Haramaya, Nantes, Variety, Root

INTRODUCTION

Carrot (*Daucuscarota* L.) is extensively grown root vegetable of the Apiaceae family. The first certain record for the use of carrot roots as a vegetable was started in the 10th century in Afghanistan. Orange carrots first appeared as a genetic variant in Europe in the 16th century and these more refined orange carrots quickly spread around the world in the early 20th century (Wassu *et al.*, 2015). Carrot roots are a rich source of carotenoids and precursors of vitamin A. The carotenoids in the edible portion of the root can range from 6000-54,000 µg per 100 g (60-540 ppm) (Simon and Wolff, 1987). Worldwide production of carrot is more than 24 million tons (Singh *et al.*, 2012), that may be consumed as fresh (processed) forms such as mini carrots, grated carrots, baby food, and instant soups.

Yield potential of carrot in the world ranges from 100 to 120 t ha⁻¹; however, the productivity of carrot in Tigray is low due to different factors. Among the factors, lack of improved carrot varieties and their agronomic

managements and the prevalence of different pests respectively are the most important constraints.

The popular carrot variety under production in Ethiopia particularly in Tigray is Nantes. Despite the agroecological suitability of the study area, there are no other alternative varieties recommended for commercial production of carrot. However, Haramaya University research result indicated that Haramaya-I carrot variety developed by Haramaya university in 2014 is superior in yield and other yield component parameters than commercial Nantes variety. Accordingly, evaluation and Participatory varietal selection (PVS) comparing the commercially producing carrot variety (Nantes) with Haramaya-I variety in Emba Alaje district is found to be logical. Therefore, this study is initiated with following objectives

1. To adapt improved carrot varieties in the study area
2. To evaluate yield and growth response of different carrot varieties under improved management practices in the study area
3. To identify the best performing carrot varieties with participation of farmers research group.

Cite This Article as: Melese K, Z Teklay, A Shelema, TGMH Kidane and BG Kiros, 2018. On farm demonstration of improved carrot (*Daucuscarota* L.) variety in Emba Alaje District, Northern Ethiopia. Inter J Agri Biosci, 7(4): 218-221. www.ijagbio.com (©2018 IJAB. All rights reserved)

MATERIALS AND METHODS

Description of the Study Area

This study was conducted in northern Ethiopia of Emba Alaje Woreda. The specific site of the research was in highland area of Emba Alaje Woreda, particularly at Tekea. Emba Alaje Woreda is situated between 1422710 and 1439170 north latitude and 530543 and 560142 east longitude and lies at an altitude of 2,350 masl. Long-term meteorological data indicate that the mean annual rainfall for the area is 912 millimeters with a mean daily temperature ranging between 9–23 °C (Edris, 2016).

Farmers research group establishment

This PVS was carried out in ten farmer's field. Farmers Research Group (FRG) was established based on interest and willingness of the farmers to participate in the study. The farmers were grouped in to five members having two groups nominating a group leader. The group leader facilitates the other to evaluate the field performance once a week. Furthermore, the field day was arranged and farmers and other stakeholders participated in for evaluation.

Treatments and Experimental Design

The study was undertaken in irrigation using the commercially producing Nantes and newly released (2014 released) Haramaya-I carrot varieties as alternative treatments. Nantes carrot variety is widely cultivating carrot variety in the study area. Haramaya-I carrot variety is also an improved, high yielder carrot variety recommended in all agro ecologies where Nantes can be grown. The nationally recommended inorganic fertilizer application rates of 100kg ha⁻¹ NPSZnB and 100kg ha⁻¹ urea as well as the seed rate ha⁻¹ of four kg seed ha⁻¹ were considered in this experiment. The field experiment was conducted in a plot size of 10mx10m in ten farmers' field. The soil fertility gradient was considered as the source of variation to sow each variety. A spacing of 5cmx25 cm between plant and row spacing respectively were maintained. The spacing between plots and blocks were also 1mx1.5m respectively. There were 40 rows per plot in a plot size of 10mx10m and 200 spots having where 3-4 plants per spot were left during thinning.

Data Collected

Phenology data were collected from the entire plants observation. Growth characters of the crop were measured from ten randomly selected plants in the sample plot. Yield data; unmarketable, marketable and total root yields were collected from an area of 2mx2m in each plot. Others such as root cortex diameter, root length, root base diameter and average root weight were collected from 10 purposely selected (large, medium, small,) roots.

Table 2: Yield response of carrot varieties in Emba Alaje district

| Variety | Parameters | | | | | | |
|---------|------------|--------|----------|---------|-------------|---------------|------------|
| | RL(cm) | RD(cm) | RCD (cm) | RW (gm) | TRKY (t/ha) | UNMKRY (t/ha) | MKY (t/ha) |
| H1 | 15.79 | 2.786 | 2.248 | 104.92 | 53.17 | 1.616 | 51.56 |
| N | 12.41 | 2.922 | 2.405 | 91.40 | 39.50 | 1.657 | 37.84 |
| P<0.05 | 0.001 | 0.506 | 0.167 | 0.075 | 0.004 | 0.76 | 0.004 |
| T-test | 8.08 | 0.68 | 1.44 | 1.89 | 3.27 | 0.31 | 3.27 |

H1=Haramaya-I carrot variety, N=Nantes carrot variety.

Data analysis

Independent sample T-test (unpaired sample T-test) was performed following the procedure of Gomez and Gomez (1984) and GENSTATE software program version 16. The probability of null hypothesis at 5% level of significance was considered to draw conclusion.

RESULTS AND DISCUSSION

Growth and phenology parameters

The study revealed that there were significance difference ($P<5\%$) in response to days to emergence, days to maturity and plant height. The highest days to emergence (19.6 days) were observed from Haramaya-I carrot variety and the lowest (15.4 days) from Nantes. In contrast, the significantly longest days for root maturity were recorded from Nantes carrot variety. This might be due to that after emergence, the growth and root development potential of Haramaya-I carrot variety could be faster than Nantes. The dormancy period of Nantes carrot variety also could be less than Haramaya-I and as the result Nantes might germinate earlier.

Table 1: Response of carrot varieties to growth and phenology parameters

| Variety | Parameters | | |
|---------|-----------------------|------------------|-------------------|
| | Days to 50% emergence | Days to maturity | Plant Height (cm) |
| H1 | 19.6 | 121 | 52.15 |
| N | 15.4 | 132 | 31.56 |
| P<0.05 | 0.001 | 0.001 | 0.001 |
| T-test | 4.28 | 33.00 | 10.87 |

H1=Haramaya-I carrot variety, N=Nantes carrot variety.

Root Yield parameters

The study showed that root cortex diameter and root base diameter and average root weight were not significantly affected at ($P<5\%$) level of significance. However, the maximum root cortex and root base diameter and average root weight were recorded from Nantes and Haramaya-I carrot varieties respectively (Table 2). Significance variation in root length and total, unmarketable and marketable yields were observed for the two varieties. In this study, the longest highly significant root length was obtained from haramaya-I carrot variety. Furthermore, Haramaya-I carrot variety provided the highest and significantly different total and marketable root yields of 53.17 t ha⁻¹ and 51.56 t ha⁻¹ respectively (Table 2). Similarly, Wassuet *et al* (2014) research result indicated that Haramaya-I as superior to the commercial Nantes variety in terms of root and seed production potential.

Disease Incidence and Severity

In the trail, carrot disease of powdery mildew was obtained. The incidence of powdery mildew was highly



Fig. 1: Field performance of Haramaya-I and Nantes carrot varieties where the green leaf is Haramaya-I and the foggy leaf that is attacked by *Alternaria* leaf blight is Nantes.



Fig. 2: The two carrot varieties during harvesting, the left haramaya-I and the right Nantes.



Fig. 3: color of the two carrot varieties, the left Haramaya-I and the right Nantes.

significant ($P < 0.001$) between the two varieties. The higher and the lower disease incidences (100%) and (0%) was observed from Nantes and Haramaya-I carrot varieties respectively (Table 3). Similarly, the severity of carrot powdery mildew showed highly significant variation ($P < 0.001$). The higher severity of powdery mildew was observed from Nantes and the lower from Haramaya-I carrot varieties. It is in line with Mohammed *et al.* (2014) who reported that during verification works to release Haramaya-I carrot variety, it has not been observed the symptom of any one of the major diseases of carrot.

Analysis of farmers' perception

Farmers themselves set parameters that could precisely describe the commodity from their experience. Hence, they compared the two carrot varieties (Haramaya-I and Nantes) based on yield, root uniformity, root shape preference, root size, disease/pest resistance capacity, marketability, color and taste/flavor attributes. The results

showed that except root color and taste preferences, Haramaya-I was perceived as better preferred variety as compared to Nantes as it had recorded the highest score values in most of the attributes used in the analysis. Furthermore, farmers perceived that Haramaya-I had best performed in terms of its root uniformity, root shape, yield and root length attributes. The roots for Haramaya-I were found to be more uniform in size and shape as compared to Nantes variety, which are assumed to be among the best determinant parameters for carrot marketing in the output market. Similarly, Haramaya-I had recorded a deep and thick rooted produce, which also contributes to a highest carrot output records in the output market. However, Nantes variety had found to have better taste/flavor and color as compared to Haramaya-I as it had recorded a deep red color and good flavor product. On the other hand, Haramaya-I had a light red color, which looks like almost a pink rooted product with less root flavor/taste as consumed in its fresh root product. Moreover, farmers

perceived that Haramaya-1 had recorded the highest score in terms of its resistance capacity to disease and pest attacks. Generally, farmers had preferred Haramaya-1 as better performing variety with the overall mean score of 6.222 (Table 4).

Table 3: Disease reaction of carrot varieties in EmbaAlage District

| Variety | Disease | |
|---------|---------------|--------------|
| | Incidence (%) | Severity (%) |
| H1 | 0 | 0.00 |
| N | 100 | 91.25 |
| P<0.05 | 0.001 | 0.001 |
| T-test | 13.42 | 66.99 |

H1=Haramaya-I carrot variety, N=Nantes carrot variety

Table 4: Farmers perception on Haramaya-1 and Nantes carrot varieties

| Attributes | Haramaya-1 | Nantes | SD | P value | T value |
|--------------------------|------------|--------|-------|---------|---------|
| Yield (root) | 8 | 2 | - | - | - |
| Root uniformity | 9 | 1 | - | - | - |
| Root shape preference | 9 | 1 | - | - | - |
| Thickness (root) | 7 | 3 | - | - | - |
| Disease/ pest resistance | 9 | 1 | - | - | - |
| Marketability (demand) | 7 | 3 | - | - | - |
| Color (being deep red) | 4 | 6 | - | - | - |
| Taste preference | 4 | 6 | - | - | - |
| Root length | 8 | 2 | - | - | - |
| Total score | 56 | 33 | - | - | - |
| Mean-score | 6.222 | 3.667 | 2.738 | 0.077 | 2.1206 |

Summary and Conclusion

Carrot (*Daucuscarota* L.) is the most important root vegetable of Apeaceae cultivated in many parts of the world. The commercially producing carrot variety distributing by EmbaAlajeWereda Office of Agriculture and rural development is Nantes. Therefore, this study was

undertaken to evaluate the phenology, growth and yield performance of improved carrot varieties in the study area. The result indicated that the performance of Haramaya-I carrot variety was superior from Nantes carrot variety in many of the parameters evaluated. Accordingly, this variety provided about 51.56 tones of marketable root yield per hectare. The lowest significantly marketable root yield (37.84 t ha⁻¹) was also obtained from the Nantes carrot variety. Moreover, farmers' significantly preferred Haramaya-I compared to Nantes based on their selection valuation criteria. Therefore, it is confidently advised to farmers to grow Haramaya-I carrot variety to boost production and productivity of carrot in EmbaAlajeWoreda. In addition, it should better if the office of agriculture and rural development of E/alajeWoreda further demonstrate the Haramaya-I variety.

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