Morphological Performance of Carrot (*Daucus carota*) Based on Seedbed Types in Uyo Local Government Area

Stephen Paulinus ROBERT; Saviour Okon NSA; Akam Eseme ETOKEREN; and Fidela UDOH
University of Uyo, Uyo, Akwa Ibom State

D.O.I: 10.56201/ijaes.v10.no3.2024.pg54.64

Abstract

The purpose of the study was to determine the morphological performance of carrot (Daucus carota) based on seedbed types in Uyo Local Government Area. Two specific objectives, two research questions and two hypotheses guided this study. This study adopted an experimental research design with the experimental layout of a Randomized Complete Block Design (RCBD). The population for this study consisted of 345 Thema cultivar of imperator variety of carrot seedlings from which the sample size of 103 carrot seedlings was used for the study. The experiment was layout in three blocks. Each block had one flat one sunken and one raised seedbeds of 1m by 1m and neighboring experimental units were separated by space of 0.5m. Data were collected through observation and recordings from standardized instrument used in measuring length of shoot and number of leaves. Data collected from the study were analyzed using mean to answer the research questions and Analysis of Variance (ANOVA) for testing of the null hypotheses at 0.05 level of significance. Findings on morphological performance showed that carrot grown on flat seedbed had the highest length of shoot and number of leaves followed by those cultivated on raised seedbed and sunken seedbed respectively. More so, findings showed that there was a significant difference in the length of shoot and number of leaves of carrot cultivated on raised seedbed, sunken seedbed and flat seedbed with flat seedbed being responsible for morphological differences. It was concluded that flat seedbed type highly supports morphological performance than other seedbed types (sunken and raised seedbeds). On the basis of the findings it was recommended among others that horticulturists raising carrots for aesthetic values should adopt flat seedbed type to obtain good shoot system development.

Key Words: *Carrot, leaves, morphology, performance, shoot, seedbeds.*

INTRODUCTION

Carrot is one of the major root vegetable crops grown throughout the world. It is an important economic vegetable as it is widely consumed and highly demanded due to its nutritive value. Rubatzky *et al.* (2019) asserted that carrot originated in South-West Asia and later spread throughout China and the Mediterranean basin. Sanders (2018) noted that carrots are among the top ten most economically important vegetable crops in the world in terms of area of production

and market value. The main reason for the widespread production of carrot is that they are a cheap source of vitamin A in the diets of many communities.

Morphologically, as a root vegetable, carrot is a biennial herbaceous plant with significant shoot and root systems. Carrot leaves are compound pinnate and have two or three lancet-shaped leaves (lines). An erect rosette of doubly compound, finely divided leaves develops above ground level normally in the first season. Each plant has 5-7 long petioles. The petioles are stiff and thick with a smooth surface, while the leaf blade is limp and thin. If carrot is left unharvested, the plant survives the winter and produces large, branched flower stalks the following growing season. Zdravkovska *et al.* (2016) noted that the tiny white or pinkish flowers are borne on large compound clusters (umbels) at the ends of the main stalk and branches. The flowers of carrot plants that grow at the end of the crop are double umbrella-shaped and white or pale pink in color. Flowers have short stalks, and the flower petals lie in the same plane. The spiny seeds are produced in small, segmented fruits called schizocarps. Seeds that are sold for planting have the spines removed. Zdravkovska *et al.* (2016) further added that the stems of carrots are so short and barely visible, unbranched, round, somewhat hard, and of a small diameter (approximately 1–1.5 cm).

Seed beds provide less effort than starting everything in pots, and of course some crops do not like being transplanted and are always sown where they will mature. This includes most root crops, such as carrots. It is tempting to locate a seedbed in a corner of the garden. Seedbeds can also be prepared in a greenhouse or in an open field. Akinbile and Suffian (2011) reported that tillage methods have a significant effect on biomass yield and the growth of vegetables. Loosening of the soil enables root enlargement and better uptake of nutrients below the surface due to the downward movement of the absorbing roots.

Freestanding garden beds built above the natural topography are called raised beds. According to Miernicki *et al.* (2018), raised beds are typically 10 to 30 cm high, with soil texture and moisture considerations determining the ideal height. Because raised bed gardens elevate plant roots above bad soil, they enhance the growing environment for plants. It is possible to improve the growing medium for plants, including ones that wouldn't normally flourish in the beds, by amending the soil. Also, the height of raised beds may make them easier to maintain. Garden beds built below the natural topography are known as sunken beds. In order to enable outside water to enter the bed area, it is typically constructed during the dry season. Arizona Gardening (2022) stated that sunken beds are always 15 cm below the surface of the ground. Additionally, in hotter climes, they keep things cooler while offering some shade from the scorching heat. They are most helpful in regions with low precipitation, including desert climates or regions experiencing drought. When there is sufficient water availability and no drainage issues, flat beds are utilized. The flatbed treatments greatly boosted yield in comparison to the ridge treatment (Arizona Gardening, 2022). Carrot growth characteristics, including plant height, leaf count, photosynthetic area (leaf area), and root quality, can be influenced by the structure of the seedbed used.

Akpan and Udo (2017) in a study to evaluate the effect of different tillage practices on the growth and yield of fluted pumpkin *Telfairia occidentalis* in Uyo, South-Eastern Nigeria reported that a significant difference in foliar yield between the no till method and other tillage methods. Similarly, Essien *et al.* (2021) in a study reported that flat tillage improved soil organic matter content by 4.37% and base saturation percentage by 89.49% over other systems and the interaction between tillage methods and potassium rate application showed that flat tillage with application of

200 kg ha-1 gave the highest mean of soil organic matter content by 46.49% above other rates of combination with tillage systems. Udounang *et al.* (2022) evaluated the influence of tillage on the growth and yield of Ginger (*Zingiber officinale* Rosc.) in Obio Akpa, Akwa Ibom State of Nigeria found that there is a significant differences ($P < 0.05$) in the leaf area, plant height and rhizome yield with the different tillage practices (mounds, ridge, flat and surface hoeing). The difference observed was attributed to the structural and natural stable conditions of flat seedbed type. Mulungu *et al.* (2016) submitted that flat seedbeds showed consistently good performance for many growth and yield performance parameters of groundnut such as number of branches plant^{-1}, pods plant^{-1}, pod length, seeds pod^{-1}, grain yield plant^{-1} and yield ha^{-1}. Therefore, seedbed types may influence the morphology performance of carrot either positively or negatively.

Statement of the Problem

The carrot (*Daucus carota*) is widely consumed in Akwa Ibom State in a variety of ways such as fresh, steamed, boiled, or fried in many kinds of dishes due to its nutritional value as a good source of vitamin A and a good antioxidant, among others. Carrots are propagated by seeds which are very sensitive to climatic and ecological factors.

Crop farmers utilizes different seedbed types is growing different crops in quest to secure high growth and yield performance. There is a scarcity of localized studies in Uyo Local Government Area that specifically address the influence of seed-bed types on carrot cultivation. The absence of such research hinders the development of tailored cultivation practices to optimize carrot production in the study area. With the current trend and emphasis on good seedbed technology as panaceas to soil degradation and low yields of food crops, maximizing the potentials of appropriate seedbed types in carrot production becomes pertinent. Understanding the correlation between seed-bed types and carrot performance is essential for optimizing the production process. Identifying the most suitable seed-bed type for carrot cultivation in Uyo Local Government Area can contribute to increased yields, better quality produce, and overall enhanced agricultural sustainability. The study is geared towards answering and providing clarity to this dazzling and astounding question: Which of the seedbed type would best support the morphological performance indices of carrot in Akwa Ibom State?

Purpose of the Study

The purpose of the study was to determine the morphological performance of carrot (*Daucus carota*) based on seedbed types in Uyo Local Government Area. Specifically, the study sought to determine:

1. the effect of raised seedbed, sunken seedbed and flat seedbed type on the length of shoot of *Daucus carota* in Uyo Local Government Area.
2. the effect of raised seedbed, sunken seedbed and flat seedbed type on the number of leaves of *Daucus carota* in Uyo Local Government Area.

Research Questions

The following questions were posed to guide this study:

1. What is the effect of raised seedbed, sunken seedbed and flat seedbed types on the length of shoot of *Daucus carota* cultivated in Uyo Local Government Area?
2. What is the effect of raised seedbed, sunken seedbed and flat seedbed types on the number of leaves of *Daucus carota* cultivated in Uyo Local Government Area?

Research Hypotheses

The following null hypotheses were formulated to guide this study:

H_{01} There is no significant difference in the length of shoot of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area.

H_{02} There is no significant difference in the number of leaves of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area.

Research Method

This study adopted an experimental research design with the experimental layout of a Randomized Complete Block Design (RCBD). Experimental design seeks to establish cause-effect relationships among variables (dependent and independent) by manipulating the independent variable while the effect of manipulation is observed and identified on the dependent variable (Amajuoyi and Joseph, 2016). The RCBD was adopted for the study on the basis that the field for the experiment is divided into uniform blocks to account for any variation so that observed differences are largely due to true differences between treatments (that is, carrot cultivated on raised seedbeds, sunken seedbeds and flat seedbeds).

Area of the Study

The study was conducted at the Agricultural Education Demonstration Farm, University of Uyo located in Uyo Local Government. Agricultural Education Demonstration Farm was established about two decades ago as a farm laboratory to provide Agricultural Education students with practical and hand-on the job experiences for skill development in crop and animal production. The study area lies between longitudes 7^0 49' 38E and 7^0 39' 42E and latitudes 5^0 2' 46N and 5^0 7' 48N. The location of the state North of the Equator and within the humid tropics and its proximity to the sea makes the state generally humid. On the basis of its geographical location, the climate of the State can be described as a tropical humid type which experiences abundant rainfall with very high temperature. The mean annual rainfall ranges from 2680.8 – 2700.1mm with a mean monthly relative humidity of 79.8% while the mean monthly atmospheric temperature range is 26. 88 – 27.00oC (Akpan and Udo, 2017).

Population of the Study

The population for this study consisted of 345 carrot seedlings of Thema cultivar of imperator variety. The carrot seedlings were raised from carrot seeds obtained from NextCrown Seeds located at Aka Itiam Street in Uyo Local Government Area of Akwa Ibom State East-West Seed International, Thailand. This variety was chosen for its assumed greater adaptability to the climate in the tropics compared to others and short growth cycle (90days).

Sample and Sampling Technique

The sample size of 103 carrot seedlings of Thema cultivar of imperator variety representing 29.86% of the population was used for the study. The sample size was selected using purposive sampling technique based on the planting distance and plant population. This was done by thinning from the germinated seedlings to maintain the planting distance of 20cm apart and 20cm between drills as well as the plant population of one seedling per stand. The thinning process was through observation to ensure that healthy carrot seedlings were selected for each of the treatment thereby, avoiding any form of bias that could distort the result of the study.

Instrumentation

To facilitate the assessment of length of shoot, measuring tape was used. Data on number of leaves of carrot was obtained through observation and counting.

Validation of Instrument

The instrument for measurement of length of shoot was a standard instrument (measuring tape), the researcher examined them to ensure it was functional and usable for the measurement of what they are intended to measure.

Experimental Procedure

The experiment was layout in three blocks. Each block had one flat bed, one sunken bed and one raised bed of 1m by 1m and neighboring experimental units were separated by space of 0.5m. Each block had the total of 16stands per seedbed type giving the grand total of 48stands per block. The area for each block was $6m^2$ and the area for the three blocks was $22m^2$.

Method of Data Analysis

Data collected from the study were analyzed using weighted mean for answering of the research questions and Analysis of Variance (ANOVA) for testing of the null hypotheses formulated to guide the study tested at 0.05 level of significance. Decision on the research questions was taken based on the mean difference. Treatment with high mean difference was assumed to have greater effect on the parameter measured otherwise lower effect. Decision on the hypotheses was taken by comparing the significant level on the SPSS sheet with .05 level of significance; where the significant level on the SPSS sheet was greater than .05 the null hypothesis was accepted otherwise rejected. Whenever the ANOVA result was significant ($P \leq 0.05$), a Post Hoc test (mean separation test) was performed using Scheffe test to measure the main effects and for the interaction effects.

Results

Research Question 1

What is the effect of raised seedbed, sunken seedbed and flat seedbed types on the length of shoot of *Daucus carota* cultivated in Uyo Local Government Area?

Table 1: Mean showing effect of seedbed types on length of shoot of *Daucus carota*

	Number of Plants	Total Length of Shoot (cm)	Mean Length of Shoot (cm)
Raised seedbed	36	79.90	2.22
Sunken seedbed	24	43.20	1.80
Flat seedbed	43	117.80	2.74
Total	**103**		

(Source: Field Experiment, 2023)

Results in Table 1 shows the effect of raised seedbed, sunken seedbed and flat seedbed types on the length of shoot in Uyo Local Government Area. It reveals that the total length of shoot of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed are 79.90cm, 43.20cm and 117.80cm respectively. It further indicates that the mean length of shoot of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed are 2.22cm, 1.80cm and 2.74cm respectively. This implies that, flat seedbed type highly supports the growth and development of length of shoot of carrot followed by raised seedbed type and sunken seedbed showing the least performance in length of shoot of carrot.

Research Hypothesis 1

There is no significant difference in the length of shoot of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area.

Table 2(a): Analysis of Variance showing difference in the length of shoot of *Daucus carota* based on seedbed types.

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig-value
Between Group	14.67	2	7.23	17.68	.000
Within Group	40.90	100	.41		
Total					

Result in the Table 2(a) indicates that the calculated F-value is 17.68 and the Sig-value is .000 at 2 and 100 degrees of freedom and 0.05 level of significance. Since the Sig-value .000 is less than the p-value of .05, the null hypothesis which stated that there is no significant difference in the length of shoot of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area is rejected. Hence, there is difference in the length of shoot of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area.

Since there is a significant difference, a post hoc analysis was employed using Scheffe Post Hoc multiple comparison analysis. The result of the analysis is presented in Table 2(b).

Table 2(b): Scheffe Post Hoc Showing difference in the length of shoot of *Daucus carota* based on seedbed types.

(I) Categories	(J) Categories	Mean Difference	Std. Error	Sig.
Raised Seedbed	Sunken Seedbed	.419*	.169	.050

	Flat Seedbed	-.522*	.144	.002
Sunken Seedbed	Raised Seedbed	-.419*	.169	.050
	Flat Seedbed	-.942*	.163	.000
Flat Seedbed	Raise Seedbed	.522*	.144	.002
	Sunken Seedbed	.942*	.163	.000

* The mean difference is significant at the 0.05 level.

Result in Table 2(b) indicated that the category of flat seedbed had the greatest mean effect on length of shoot. Thus, flat seedbed was responsible for the significant effect in the length of shoot.

Research Question 2

What is the effect of raised seedbed, sunken seedbed and flat seedbed types on the number of leaves of *Daucus carota* cultivated in Uyo Local Government Area?

Table 3: Mean showing effect of seedbed types on number of leaves of *Daucus carota*

Category	**Number of Plants**	**Number of Leaves**			**Total**	**Mean Number of Leaves**
		6WAG	**8WAG**	**10WAG**		
Raised seedbed	36	5.60	10.55	14.02	30.17	10.06
Sunken seedbed	24	5.30	9.80	11.90	27	9.00
Flat seedbed	43	5.80	12.83	21.90	40.53	13.51
Total	**103**	**16.7**	**33.18**	**47.82**	**97.70**	**10.86**

(Source: Field Experiment, 2023)

Results in Table 3 shows the effect of raised seedbed, sunken seedbed and flat seedbed types on the number of leaves of *Daucus carota* in Uyo Local Government Area. It reveals that the mean score of number of leaves of *Daucus carota* cultivated on raised seedbed at sixth weeks, eight and tenth weeks after germination is 5.60, 10.55 and 14.02 respectively. Also, the mean score of number of leaves of *Daucus carota* cultivated on sunken seedbed at sixth weeks, eight and tenth weeks after germination is 5.30, 9.80 and 11.90 respectively while the mean score of number of leaves of *Daucus carota* cultivated on flat seedbed at sixth weeks, eight and tenth weeks after germination is 5.80, 12.83 and 21.90 respectively. Furthermore, the mean score of number of leaves of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed is 10.06, 9.00 and 13.51 respectively. This implies that, on flat seedbed type highly support the number of

leaves of carrot followed by raised seedbed types and sunken seedbed showing the least performance in number of leaves of carrot.

Research Hypothesis 2

There is no significant difference in the number of leaves of *Daucus carota* cultivated on raised seed bed, sunken seed bed and flat seed-bed types in Uyo Local Government Area.

Table 4(a): Analysis of Variance showing difference in the number of leaves of *Daucus carota* based on seedbed types.

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Group	392.80	2	196.40	127.01	.000
Within Group	154.63	100	1.55		
Total	547.44	102			

Result in the Table 4(a) indicated that the calculated F-value 127.01 and the F-Sig .000 at 2 and 100 degrees of freedom and 0.05 level of significance. Since the F-Sig value .000 is less than the p-value of .05 the null hypothesis which stated that there is no significant difference in the number of leaves of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area is rejected. Hence, there is difference in the number of leaves of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area.

Since there is a significant different, a post hoc analysis was employed using Scheffe Post Hoc comparison analysis. The result of the analysis is presented in 4(b).

Table 4(b): Scheffe Post Hoc Showing difference in the number of leaves of *Daucus carota* based on seedbed types.

(I) Categories	(J) Categories	Mean Difference	Std. Error	Sig.
Raised Seedbed	Sunken Seedbed	1.056*	.328	.007
	Flat Seedbed	3.456*	.281	.000
Sunken Seedbed	Raised Seedbed	-1.056*	.328	.007
	Flat Seedbed	-4.512*	.317	.000
Flat Seedbed	Raise Seedbed	3.456*	.281	.000
	Sunken Seedbed	4.512*	.317	.000

* The mean difference is significant at the 0.05 level.

Result in Table 4(b) indicated that the categories of flat seedbed had the greatest mean effect on number of leaves. Thus, flat seedbed was responsible for the significant effect in the number of leaves.

DISCUSSION

Effect of Seedbed Types on the Length of Shoot of *Daucus carota*

Finding of the study revealed that there was a difference in the length of shoot of *Daucus carota* based on seedbed types with flatbed recording the highest length of shoot followed by raised bed and sunken bed in Uyo Local Government Area. It also indicated that there was a significant difference in the length of shoot of *Daucus carota* cultivated in Uyo Local Government Area based on seedbed types with flat seedbed being responsible for the significant difference. The finding points to the fact that flat seedbeds allow for better soil aeration and drainage preventing waterlogging and excessive moisture buildup, which is beneficial for carrot growth. Additionally, flatbeds can help retain moisture in the soil, reducing water evaporation and providing a more consistent water supply to the carrots. More so, flat seedbed tends to provide the natural uniform soil conditions that foster the length of shoot of carrot.

The finding is in agreement with the findings in the work of Essien *et al.* (2021) who assessed tillage methods and potassium effect on soil properties and yam yield on soils of southeastern Nigeria and reported that flat tillage improved soil organic matter content by 4.37% and base saturation percentage by 89.49% over other systems. Findings also affirmed the findings of Udounang *et al.* (2022) who evaluated the influence of tillage on the growth and yield of Ginger (*Zingiber officinale* Rosc.) in Obio Akpa, Akwa Ibom State of Nigeria and reported that there is a significant differences ($P < 0.05$) in the leaf area, plant height and rhizome yield with the different tillage practices (mounds, ridge, flat and surface hoeing). The difference observed is attributed to the structural and natural stable conditions of flat seedbed type. Mulungu *et al.* (2016) submitted that flat seedbeds showed consistently good performance for many growth and yield performance parameters of groundnut such as number of branches plant^{-1}, pods plant^{-1}, pod length, seeds pod^{-1}, grain yield plant^{-1} and yield ha^{-1}. This implies that flat seedbed foster the development of the shoot of carrot

Effect of Seedbed Types on the Number of Leaves of *Daucus carota*

Findings of the study showed that flatbed had the greatest support for number of leaves of *Daucus carota* followed by those raised on seedbed then sunken seedbed in Uyo Local Government Area. It further showed that there was a significant difference in the number of leaves of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types. The finding may be due to the fact that flat seedbeds facilitate more uniform water distribution across the planting area. This ensures that each carrot seedling receives a consistent water supply, promoting uniform germination and growth. Adequate and consistent moisture levels are crucial for vegetative development especially the development of leaves.

The findings is in tandem with the findings in the work of Akpan and Udo (2017) who in a study to evaluate the effect of different tillage practices on the growth and yield of fluted pumpkin

Telfairia occidentalis in Uyo, South-Eastern Nigeria reported that a significant difference in foliar yield between the no till method and other tillage methods. The finding is also supported by the findings of Essien *et al.* (2021) who showed that flat tillage improved soil organic matter content by 4.37% and base saturation percentage by 89.49% over other systems and the interaction between tillage methods and potassium rate application showed that flat tillage with application of 200 kg ha-1 gave the highest mean of soil organic matter content by 46.49% above other rates of combination with tillage systems. The uniformity and stability of flat seedbed type in terms of soil structure, nutrient distribution, aeration and water retention capacity may have triggered the observed difference.

Conclusion

Obtaining a good morphological of carrot is influence by the nature and structure of the seedbed used. Thus, seedbeds that provide soil nutrients retention, better drainage, good soil aeration are likely to support the morphological performance of carrot. Based on the findings of this study, it is concluded that flatbed has a natural and more uniform structure which favours the distribution of water and nutrient to carrot thus highly supports morphological performance (length of shoot, number of leaves and leaf length) than other seedbed types (sunken and raised seedbeds).

Recommendations

On the basis of the findings and conclusion drawn from this study, the following recommendations are made:

i. Horticulturists raising carrots for aesthetic values should adopt flat seedbed type to obtain good shoot system development.
ii. Students of Agriculture who are interested in the morphology of carrot leaf particularly number of leaves should adopt flat seedbed for prominent and significant number of leaves.

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