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

Stephen Paulinus ROBERT; Akam Eseme ETOKEREN; and John Betiang ADIE
University of Uyo, Uyo, Akwa Ibom State.

DOI: 10.56201/ijee.v10.no3.2024.pg16.27

Abstract

The purpose of the study was to determine the yield 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 root and whole plant biomass. 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 showed that carrot grown on raised seedbed had the highest root length and whole plant biomass of carrot followed by those cultivated on flat seedbed and sunken seedbed respectively. More so, findings showed that there was a significant difference in the length of root and whole plant biomass of carrot cultivated on raised seedbed, sunken seedbed and flat seedbed with flat and raised seedbeds being responsible for the yield differences. It was concluded that raised seedbed type highly supports the yield parameters of carrots (root length and whole plant biomass) than other seedbed types (sunken and flat). On the basis of the findings it was recommended among others that root vegetable farmers who grow carrots for commercial purposes should utilize raised seedbeds to obtain improved whole plant biomass and fresh root weight which enhances high market value and profitability.

Key Words: *Carrot, performance, root, seedbeds, whole plant biomass, yield*

Introduction

Carrot, botanically called *Daucus carota* L., is a cool season crop and belongs to the family Apiaceae. The two types of carrots are found in the tropical and temperate zones. Chadha (2020) reiterated that carrot is one of the important and major root vegetables used as salad and cooked vegetables, canned pickles, sweets, carrot powders, kanji, an appetizing drink, and so on. Carrot roots are consumed uncooked in salads, steamed or boiled in vegetables, and may also be prepared

with other vegetables in the preparation of soups and sweets. United States Development Agency (2014) opined that besides being food, carrots have therapeutic importance as they enhance resistance against blood and eye diseases. It is also a good source of other vitamins, minerals, and fiber. Kelley and Phatak (2019) also noted that carrots contain high amounts of carotene (10 mg per 100 g), thiamin (0.04 mg per 100 g), and riboflavin (0.05 mg per 100 g). It also serves as a source of carbohydrate, protein, fat, minerals, vitamin C, and calories; thus, it can play a great role in preventing night blindness due to a severe deficiency of vitamin A, which is a problem of public health in developing countries. Although carrots can be grown throughout the year, both in the wet and dry seasons, primarily for the root, their yield may vary depending on environmental, varietal, and management practices.

Carrot yields can range from 30 to 100 t ha^{-1} in the major carrot growing countries of the world (Muendo *et al.,* 2014). In most developing countries, carrot yields per unit area still remain below the world average. For instance, the Food and Agricultural Organization (2016) reported that the average productivity of carrots was only 3.5 t ha^{-1} in Nigeria as compared to 36.5 t ha^{-1} for the world average. Low productivity is associated with so many factors, including poor soil fertility management practices, poor seedbed preparation, and unavailability of technological inputs, pests, and postharvest losses, among others.

Seedbeds 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. Raised beds are freestanding garden beds constructed above the natural terrain. Miernicki *et al.* (2018) noted that raised beds are usually 10–30 cm high and the best height depends mainly on soil texture and moisture considerations. Sunken beds are garden beds constructed below the natural terrain. According to Arizona Gardening (2022), sunken beds are always 15cm deeper than normal ground level. They also provide a little shelter from the blistering sun while keeping things cooler in hotter climates. They are most useful in areas where little rain occurs, such as desert-like climates or drought-stricken areas. Flat beds are used where water availability is adequate and there are no drainage problems. When compared to the ridge treatment, the furrow and flatbed treatments significantly increased yield (Arizona Gardening, 2022). Soil fertility may affect the growth parameters of carrots, such as plant height, number of leaves, photosynthetic area (leaf area), and root quality.

Rupesh and Jaswal (2020) conducted a study on the effect of different sowing depths and types of beds on growth and germination of moong bean and found that sunken bed showed late germination as well as has the poor vegetative growth performance compared to other types of seedbeds. Also, Adijat and Ajibola (2019) in a study on effects of seedbed types and weed control methods on the vegetative parameters of long cayenne pepper found raised bed and hoe weeding (RBT1) enhanced all the growth and yield parameters measured more than other treatment combinations by recording the highest mean value in all character and also proved to be more effective in reducing weed biomass than other weed control treatment combinations. Similarly, Anozie and Baiyeri, (2022) conducted a study on the effects of tillage methods and poultry manure rates on the production of Carrot (*Daucus carota L*) in Nsukka, South-East Nigeria and reported that tillage method influenced the growth and yield of carrot roots recommending the raised tillage

method due to its efficient use and ability to support root penetration. In the same vein Rohwer (2021) who in a study reported that raised seedbeds caused a 10.6% increase in total marketable weight.

Statement of the Problem

The carrot (*Daucus carota*) is widely consumed in Akwa Ibom State in a variety of ways owing to its nutritional value and the roots of carrots are either eaten fresh, used as salad material, steamed, boiled, or fried in many kinds of dishes. Most of the carrots sold and consumed are imported from other states of the federation, particularly the Plateau, Kaduna, and Abia States. The dependency of consumers in Akwa Ibom State on importation has placed consumers at the mercy of importers and sellers, who sometimes hike the price of this vegetable in order to make up for the cost of transit.

Generally, farmers in Akwa Ibom State seem to believe that carrots are peculiar to northern Nigeria and can only thrive there. Meanwhile, just like any other crops such as cassava, sweet potato, yam, and cocoyam, carrot can be grown in Akwa Ibom State provided the soil conditions necessary for the growth and yield of the crop are met. Although soils in Akwa Ibom State are subject to erosion and leaching due to heavy annual rainfall, the soils prevalent in the study area could be improved and made rich in nutrients that could boost the production of carrots as well as provide seedbed structure that could foster efficient growth and development of carrot. The study is geared towards answering and providing clarity to this dazzling and astounding question: Which of the seedbed type would best support the root yield parameters 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 root length of *Daucus carota* in Uyo Local Government Area.
2. the effect of raised seedbed, sunken seedbed and flat seedbed type on the whole plant biomass 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 root length 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 whole plant biomass 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 root length 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 whole plant biomass of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types in Uyo Local Government Area.

RESEARCH METHOD

Design of the Study

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 it allows for a more precise estimation of treatment effects by reducing the variability caused by confounding factors thereby enhancing the validity of the conclusions that was drawn from the study.

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. Weight parameter that is, whole plant biomass and weight of fresh root were measured in grammes (g) using Hana Brand Weighing Scale.

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 root length of *Daucus carota* in Uyo Local Government Area?

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

	Number of Plants	**Root Length (cm)**			**Total**	**Mean root Length (cm)**
		R_1	**R_2**	**R_3**		
Raised seedbed	36	19.88	18.90	17.50	56.28	18.76
Sunken seedbed	24	10.30	13.22	12.15	35.67	11.89
Flat seedbed	43	16.95	18.90	18.75	54.60	18.20
Total	**103**	**47.13**	**51.02**	**48.40**	**146.55**	**16.28**

(Source: Field Experiment, 2023)

Results in Table 1 show effect of raised seedbed, sunken seedbed and flat seedbed types on the root length of *Daucus carota* in Uyo Local Government Area. It reveals that the mean score of root length of *Daucus carota* cultivated on raised seedbed of replicated one, two and three is 19.88cm, 18.90cm and 17.50cm respectively. Also, the mean score of root length of *Daucus carota* cultivated on sunken seedbed of replicated one, two and three is 10.30cm, 13.22cm and 12.15cm respectively while the mean score of root length of *Daucus carota* cultivated on flat seedbed of replicated one, two and three is 16.95cm, 18.90cm and 18.75cm respectively. Furthermore, the mean score of root length of *Daucus carota* cultivated on raised seed bed, sunken bed and flatbed is 18.76cm, 11.98cm and 18.20cm respectively. This implies that, on raised seedbed type highly support the root length of carrot followed by flat seedbed types and sunken bed showing the least performance in root length of carrot.

Research Hypothesis 1

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

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

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Group	800.45	2	400.22	174.00	.000
Within Group	230.01	100	5157.30		
Total	1030.46	102			

Result in the Table 2(a) indicated that the calculated F-value 6.77 and the F-Sig .001 at 2 and 297 degrees of freedom and 0.05 level of significance. Since the F-Sig value .001 is less than the p-value of .05 the null hypothesis which stated that there is no significant difference in the root length 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 root length 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 2(b).

Table 2(b): Scheffe Post Hoc Showing difference in the root length of *Daucus carota* cultivated in Uyo Local Government Area based on seedbed types.

(I) Categories	(J) Categories	Mean Difference	Std. Error	Sig.
Raised Seedbed	Sunken Seedbed	6.870*	.400	.000
	Flat Seedbed	.554	.343	.276
Sunken Seedbed	Raised Seedbed	-6.871*	.400	.000
	Flat Seedbed	-6.317*	.386	.000
Flat Seedbed	Raise Seedbed	-.554	.343	.276
	Sunken Seedbed	6.317*	.386	.000

* The mean difference is significant at the 0.05 level.

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

Research Question 2

What is the effect of raised seed bed, sunken seed bed and flat seed-bed types on the whole plant biomass of *Daucus carota* in Uyo Local Government Area?

Table 3: Mean showing effect of seedbed types on whole plant biomass of *Daucus carota*

Category	**Number of Plants**	**Whole Plant Biomass (g)**			**Total**	**Mean of Whole Plant Biomass (g)**
		R_1	**R_2**	**R_3**		
Raised seedbed	36	183.5	194.5	152	530.00	176.67
Sunken seedbed	24	100.2	86.4	66.4	253.00	84.33
Flat seedbed	43	180	186	137	503.00	167.67
Total	**103**	**463.70**	**466.90**	**355.4**	**1286**	**142.89**

(Source: Field Experiment, 2023)

Results in Table 3 shows the effect of raised seedbed, sunken seedbed and flat seedbed types on the whole plant biomass of *Daucus carota* in Uyo Local Government Area. It reveals that the whole plant biomass of *Daucus carota* cultivated on raised seedbed of replicated one, two and

three is 183.5g, 194.5g and 152g respectively. Also, the whole plant biomass of *Daucus carota* cultivated on sunken seedbed of replicated one, two and three is 100.2g, 86.4g and 66.4g respectively while the whole plant biomass of *Daucus carota* cultivated on flat seedbed of replicated one, two and three is 180g, 186g and 137g respectively. Furthermore, the mean whole plant biomass of *Daucus carota* cultivated on raised seed bed, sunken bed and flatbed is 176.67gm, 84.33gm and 167.67gm respectively. This implies that, on raised seedbed type highly support the whole plant biomass of carrot followed by flat seedbed types and sunken bed showing the least whole plant biomass.

Research Hypothesis 4

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

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

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Group	15550.89	2	7775.44	15.40	.004
Within Group	3030.00	6	505.00		
Total	18580.89	8			

Result in the Table 4(a) indicated that the calculated F-value 15.40 and the F-Sig .004 at 2 and 6 degrees of freedom and 0.05 level of significance. Since the F-Sig value .004 is less than the p-value of .05 the null hypothesis which stated that there is no significant difference in the whole plant biomass 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 whole plant biomass 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 whole plant biomass of *Daucus carota* cultivated in Uyo Local Government Area based on seedbed types.

(I) Categories	(J) Categories	Mean Difference	Std. Error	Sig.
Raised Seedbed	Sunken Seedbed	92.333*	18.348	.007
	Flat Seedbed	9.000	18.348	.889
Sunken Seedbed	Raised Seedbed	-92.333*	18.348	.007

	Flat Seedbed	-83.333*	18.348	.011
Flat Seedbed	Raise Seedbed	-9.000	18.348	.889
	Sunken Seedbed	83.333*	18.348	.011

* The mean difference is significant at the 0.05 level.

Result in Table 4(b) indicated that the categories of raised seedbed had the greatest mean effect on whole plant biomass. Thus, raised seedbed was responsible for the significant effect in the whole plant biomass.

DISCUSSION

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

Findings of the study indicated that raised seedbed greatly support the root length of *Daucus carota,* followed by flat seedbed and sunken seedbed respectively. It also showed that there was a significant difference in the root length of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seedbed types. The results could be attributed to the fact that raised seedbeds are more pulverized with less obstructed soil depth that allows for easy penetration of carrot roots. The top soils of raised seedbed are properly worked and have more depth when compared to flat seedbeds. On the contrary, the basis soil components derived from the drained top-soils which support plant growth and root development are lacking. Furthermore, sunken showed least support for root length which may be due to the fact that the seedbed is prune to waterlogging, soil compaction, poor aeration, delayed warming of the soil and nutrient runoff which hampers proper root development.

The finding is in agreement with the findings of Rupesh and Jaswal (2020) who conducted a study on the effect of different sowing depths and types of beds on growth and germination of moong bean and found that sunken bed showed late germination as well as has the poor vegetative growth performance compared to other types of seedbeds. The findings also affirmed the outcome of the study by Rohwer (2021) who reported that raised seedbeds caused roots to grow to lengths more than 127 mm long.

Effect of Seedbed Types on the Whole Plant Biomass of *Daucus carota*

Findings of the study showed that whole plant biomass of *Daucus carota* cultivated on raised seedbed showed the greatest weight followed by flat seedbed and sunken seedbed respectively**.** It also indicated that there was a significant difference in the whole plant biomass of *Daucus carota* cultivated on raised seedbed, sunken seedbed and flat seed-bed types in Uyo Local Government Area. The findings point to the fact that raised seedbeds are less prone to soil compaction, which can inhibit the growth roots. Carrots require loose soil for proper root expansion, and reduced compaction in raised seedbeds allows for unimpaired taproot development. Raised seedbeds allow for better control over soil composition which promotes robust root development. On the other hand, sunken seedbeds showed least support for whole plant biomass due to accumulated compacted soil, limiting the ability of carrot roots to penetrate and expand

thus, hampering the development of healthy root system, leading to stunted vegetative growth and reduced yield parameter.

The finding is in agreement with the findings of Adijat and Ajibola (2019) who reported that raised bed and hoe weeding (RBT1) enhanced all the growth and yield parameters measured more than other treatment combinations by recording the highest mean value in all character and also proved to be more effective in reducing weed biomass than other weed control treatment combinations. The finding is also in support of the findings of Anozie and Baiyeri, (2022) who reported that tillage method influenced the growth and yield of carrot roots recommending the raised tillage method due to its efficient use and ability to support root penetration. The finding is equally supported by the findings of Rohwer (2021) who in a study reported that raised seedbeds caused a 10.6% increase in total marketable weight. Raised seedbed types enhances the plant biomass of carrots than other seedbed types.

Conclusion

Obtaining yield performance of carrot is influence by the structure and composition of soils which could be defined by the nature and structure of the seedbed used. Based on the findings of this study, it is concluded that raised seedbed type highly supports the yield parameters of carrots (root length and whole plant biomass, fresh root weight and root girth) than other seedbed types (sunken and flat).

Recommendations

The following were recommended based on the findings of the study:

i. Root vegetable farmers who raise carrot for food should adopt raised seedbed type for high root quality and improved root length.
ii. Root vegetable farmers who grow carrots for commercial purposes should utilize raised seedbeds to obtain improved whole plant biomass and fresh root weight which enhances high market value and profitability.
iii. Extension agents should use raised seedbed in small plot demonstration farm for production of carrot with improved girth as this will foster the adoption of innovation and improved technologies by farmers.

References

Adijat, T. and Ajibola, A. A. (2019). Effects of seed bed types and weed control methods on the vegetative parameters of long cayenne pepper (*Capsicum frutesens* L). *Acta fytotechn zootechnology* 22(3): 90–100

Amajuoyi, I. J. and Joseph, E. U.(2016). *Research report writing: A concise approach.* Windmill Publishing Company, Abia State.

Anozie, C.C. and Baiyeri, K.P. (2022). Effects of tillage methods and poultry manure rates on the production of Carrot *(Daucus carota* L*)* in Nsukka, Southeast Nigeria. *Journal of Horticulticulture and Forestry,* 14(4):42-48

Arizona Gardening (2022). A permaculture garden design. retrieved from https://www.reformstead.com/arizona_gardening_a_permaculture_garden_design.html on 18th March, 2023

Chandy, K. T. (2020). Carrot. Vegetable production: VPS – 35. India: Agricultural and Environmental Education. Booklet No. 178.

Food and Agricultural Organization (2016). Food and Agricultural Organization Statistics online. Rome: Food and Agricultural Organization of United Nations: Economic and Social Department: The Statistical division; 2016. Available from: www.http:faostat.fao.org/site/567/.

Kelley, W. T., and Phatak, S. C. (2019). Commercial production and management of carrots. USA: University of Georgia Extension Office.

Miernicki, E.A., Lovell, S.T. and Wortman, S.E. (2018). Raised beds for vegetable production in urban agriculture. Urban Agric. Reg. Food Syst. 3:180002. doi: 10.2134/urbanag 2018.06.0002

Muendo, K. M, Tschirley, D., and Weber, M. T. (2014). Improving Kenya's domestic horticultural production and marketing system: current competitiveness, forces of change, and challenges for the future. Vol. 1. Tegemeo Institute of Agricultural Policy and Development.

Rohwer, C. L. (2021). Carrot Yield and Shape Altered by Seeding Rate and Raised Beds in Clay-loam Soil. Retrieved from https://doi.org/10.21273/HORTSCI15823-21 on 10th February, 2023

Rupesh, S. and Jaswal, A. (2020). Effect of different sowing depth and different types of seed bed on germination and growth performance of field experiment of mung-bean. *International Journal of Advance Research in Science and Engineering,* 9(10): 90-99

USDA(2014). "Nutrition facts for carrots, raw [Includes commodity food A099], per 100 g, USDA Nutrient Database for Standard Reference, version SR-21". Conde Nast. 2014. Retrieved 10 March 2023.