



# AGRICULTURE AND FOOD AUTHORITY

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## HORTICULTURAL CROPS DIRECTORATE

Nairobi Horticultural Centre next to JKIA; P.O. Box 42601 – 00100; Telephone: 020-2088469, 020-2131560

Email: [directorhcd@afa.go.ke](mailto:directorhcd@afa.go.ke), [directorhcd@agricultureauthority.go.ke](mailto:directorhcd@agricultureauthority.go.ke) Website: [www.afa.go.ke](http://www.afa.go.ke)

## CARROT (*Daucus carota*) GROWERS MANUAL

## PREFACE

Kenya has been endowed with an enabling environment for production of horticultural crops that attracts high demand both in the domestic and international markets. Production is mainly by smallholder farmers, many of whom require skills and knowledge on good agricultural practices (GAP) to produce and handle the fresh produce. According to the Economic Survey 2022 published by the Kenya National Bureau of Statistics (KNBS), horticulture is among the leading sub sectors in agriculture. Therefore, enhancing the capacity of these producers could be of immense beneficial to the Kenyan economy.

Agriculture and Food Authority – Horticulture Crops Directorate (HCD) is a government agency mandated to Regulate, Promote and Develop the horticulture industry in Kenya. In carrying out its mandate, the Directorate through the Technical and Advisory Services department (TAS) has developed this grower’s manual for its stakeholders. The manual has been designed with a simple language and where necessary photos have been used to highlights all processes from plough to plate. HCD envisages that by using this grower’s manual, its stakeholders especially the smallholder farmers, extension staff and trainers would upgrade their knowledge and skills to enable them increase production of the crops thereby improving on food security, household health, as well as create employment and generate income.

The content has largely been developed from the TAS field staff experiences in the 26 stations spread across the country (*Collins & Dinah – Nairobi [NHC], Antonina – Nakuru, Miriam - Nandi, Grace – Homabay, Barnabas- Eldoret & Iten, Carol - Bungoma, Peter- Busia, Charles -Kisumu, Irene - Narok, Lal – Kisii, Victor – Mombasa, Crispin – Kibwezi, Esther Ngutho–Kitui, Esther Kabatha – Nyandarua, Susan – Taveta, Syphrosa – Machakos, Catherine – Yatta, James – Kitale, Julius – Kajiado, Amedeo & Brenda – Meru, Mary – Kericho, David & Delphina – Mwea, Fridah – Nyeri, Emma – Sagana, Sarah – Limuru*), some content were reviewed from literature and images used properly acknowledged. Technical editing and reviewing of the manuals were done by Mary Chacha, Syphrosa Wanyama, Barnabas Kiptum, Antonina Lutta, Carol Soita, Amedeo Muriungi, Peter Mwanja, Victor Omari, Emma Ndirangu, Esther Kabatha, David Makori, Dinah Karimi, Collins Otieno, Dr Jacqueline Oseko the acting Deputy Director, Technical and Advisory Services department and Director Benjamin Tito all of Horticulture Crops Directorate.

## **CARROT (*Daucus carota*) GROWERS MANUAL**

**Common Name: Karoti**



### **Introduction**

Carrot is a member of the *Apiaceae (Umbelliferae)* family, same as Celery and Parsley. It is grown for its orange tap-root which is eaten raw or cooked; alone or in combination with other vegetables. Carrots are consumed fresh or processed, mainly grown for domestic market but baby carrots are exported to international markets. It has high content of Carotene and Vitamin A. It is also a good source of Calcium, Phosphorus, Iron and Potassium. The main varieties include: Nantes, Super Kuroda, Oxheart, Chantney among others. In Kenya, the leading carrot growing areas include: Nyandarua, Nakuru, Nyeri, Kiambu, Uasin Gishu, Trans Nzoia, and Busia Counties.

### **Ecological Requirements:**

**Altitude:** above 1,200 m above sea level

**Rainfall:** Optimal 700 mm of rainfall annually

**Temperature:** Optimum: 16 – 25 °C.

**Soil:** Deep (0.5m) well drained sandy or silt loam soils. Optimal soil pH range is 6.5 – 7.5.

### **Good Agricultural Practices**

Horticulture industry in Kenya is guided by a code of practice (KS1758-2016 part II) which is a food standard for vegetables, fruits, herbs and spices for both local and export market. The standard aims at improving food safety, ensures environmental sustainability and social accountability by following good agricultural practices from production, processing, transportation and marketing of fresh produce. It is essential to maintain accurate farm records for all the operations for ease of traceability.

## **Soil testing**

Soil testing is recommended before planting to guide on fertilizer and manure use.

## **Land Preparation and Planting**

Soils should be prepared to a fine tilth to a depth of at least 30 cm and prepare shallow drills 1 foot (30cm) apart using a stick or hand.

At planting, the recommended seed rate is 2.5kg/Acre. NPK fertilizer is recommended at the rate of 50kg/Acre. Liming is recommended when pH is below 5.5.

Mix seeds with sand, to allow for even distribution, before sowing along the drills and cover with light soils. Recommended depth of planting is 0.5-1cm. Mulching encourages germination. Germination starts after 7 days.

Thinning is recommended for dense population for proper spacing.

## **Irrigation**

Carrots require uniform supply of water throughout the growing season. Frequency of irrigation depends upon soil type, season and variety. Irrigation should stop 2-3 weeks before harvesting to increase color and sweetness. Water stress causes cracking of the roots (deformities) while over irrigation leads to misshape, short carrots with light color and excessive hair.

## **Nutrition**

Carrots are generally good nutrients scavengers due to their deep taproots. CAN or Urea are recommended top-dress fertilizers. Top-dress applications can be split twice. 1<sup>st</sup> top-dressing should be done 5 weeks after planting at the rate of 4-9 grams per m<sup>2</sup>. ...2<sup>nd</sup> top-dress should be 3 weeks after the first top dress at the rate of 4g per m<sup>2</sup>. Apply potassium at 20 – 40 kg/acre. Care should be taken to top-dress CAN at the right time and with right quantities to avoid excessive vegetative growth at expense of root formation.

## **Mulching and weeding**

Mulching keeps the weeds down, regulates soil temperature and improves soil fertility. Carrot plants need to be established before mulching as spreading the mulch over the seed bed will smother the carrot seeds and prevent germination. It is recommended to leave 2 to 3 inches of space around each plant for the mulch to prevent rot and mildew while also keeping away pests around the stem. Fields should be kept weed free as much as possible to avoid competition for nutrients, sunlight, and moisture. Herbicides are often used (*Metribuzin* 480g/L).




## Earthing-up




The soil is earthed up covering the top of developing roots to prevent loss of color of the tops. The tops become green and toxic when exposed to sunlight. It should be done 60 to 70 days after sowing to help in the development of roots.


## Pests Management

Integrated Crop Management (ICM) is the best option for food safety. These methods include scouting for pests, field hygiene, proper spacing and physical methods like use of traps, pheromones, biological methods and others that will only give an option of using pesticides as a last option.



## Carrot pests and diseases


Pest (Insect)	Symptoms	Control
<p><b>Cutworms (<i>Agrotis spp</i>)</b></p>  <p><a href="https://www.ruralsprout.com/carrot-pests/">https://www.ruralsprout.com/carrot-pests/</a></p>	<p>Grey to black caterpillars feed at night and either bites out the side of the stem at ground level causing the plant to fall over. They are often found hiding in soil near the cut seedlings. They are more active during the dry spell.</p>	<ul style="list-style-type: none"> <li>-Hand removal from the damaged plant</li> <li>-Ploughing to expose caterpillars to predators and the sun</li> <li>-Early weeding before planting</li> <li>-Spread ash thickly around seedling</li> <li>-Flooding</li> </ul>
<p><b>Leaf Eating Caterpillar (<i>Papilio polyxenes</i>)</b></p>  <p><a href="https://stock.adobe.com">https://stock.adobe.com</a></p>	<p>It is the larvae stage of black swallow-tail butterfly. Full grown is striking green with yellow and black stripes</p>	<ul style="list-style-type: none"> <li>-Hand picking</li> </ul>
Common Diseases		
<p><b>Leaf blight (<i>Alternaria ducus</i>)</b></p>  <p><a href="https://www.growveg.co.uk">https://www.growveg.co.uk</a></p>	<p>Dark brown to black spots along leaf margins and stem making them to shrivel and die. More serious on older leaves and plants especially during warm moist weather.</p>	<ul style="list-style-type: none"> <li>-Rotation program for 2 to 3 years</li> <li>-Use of certified seeds</li> <li>-No or little N-fertilization</li> <li>-Use of fungicides <i>Mancozeb</i> (750g/kg)</li> </ul>

<p><b>Powdery mildew (<i>Erysiphe cichoracearum</i>)</b></p>  <p><a href="https://mtvernon.wsu.edu/path_team/carrot.htm">https://mtvernon.wsu.edu/path_team/carrot.htm</a></p>	<p>Young leaves develop small circular white spots which may enlarge to cover leaflet. Affected leaves become chlorotic and die. Older leaves are covered in white powdery growth.</p>	<p>Maintain good plant vigor Good field hygiene Use fungicides- <i>Mancozeb</i> (800g/kg)</p>
<p><b>Bacterial Soft rot (<i>Erwinia chrysanthemi</i>)</b></p>  <p><a href="https://www.greenlife.co.ke/bacterial-soft-rot-of-carrot/">https://www.greenlife.co.ke/bacterial-soft-rot-of-carrot/</a></p>	<p>This is a soil borne bacterial disease It enters the root through various wounds caused by cultivation, harvest bruises and insect openings. In the field, it usually follows a period of water logging in low areas due to over irrigation/excessive rainfall. High humidity favors spread of the disease It is a serious storage/transit disease if affected carrots are not discarded.</p>	<p>Good drainage Avoid practices which cause wounds.</p>
<p><b>Aster Yellow (<i>Candidatus phytoplasma asteris</i>)</b></p>  <p><a href="https://www.ipmimages.org">https://www.ipmimages.org</a></p>	<p>The disease is caused by Aster Yellow Phytoplasma It affects both above ground and below ground parts of the crop. Aster leafhopper transmits the disease Yellowing and vein clearing of leaves. Development of new shoots with bunchy appearance</p>	<p>Control Aster leafhopper with appropriate insecticide</p>

<p><b>Cottony soft rot (<i>Sclerotinia sclerotiorum</i>)</b> It is a serious field and storage problem</p>  <p><a href="https://www.greenlife.co.ke/cottony-soft-rot-of-carrot/">https://www.greenlife.co.ke/cottony-soft-rot-of-carrot/</a></p>	<p>-Development of soft, watery rot of leaves, crowns and roots. -Affected areas become covered with white cottony fungal growth in which black, irregular fungal resting bodies (sclerotia).</p>	<p>-Crop rotation using cereals and forage grasses -Soil flooding -Do not pack and store damaged /diseased roots -Use clean containers in storage.</p>
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### Physiological Disorders

DISORDER	SYMPTOM/CAUSE	CONTROL
<p><b>Bitterness</b></p>	<p>Ethylene gas from ripening fruits or rotting plant debris causes the bitterness in carrots</p>	<p>-Storing carrots away from ripening fruits or decomposing plant debris -Minimize carrot injuries -Store away from ethylene loss</p>
<p><b>Elongated root/Forking</b></p>  <p><a href="https://savvygardening.com/snapped-good-carrots-gone-wrong/">https://savvygardening.com/snapped-good-carrots-gone-wrong/</a></p>	<p>Carrots produces forked roots It is caused by excess moisture during the root development Use of fresh manure also causes forking</p>	<p>-Balanced irrigation/reducing moisture</p>
<p><b>Root splitting</b></p>  <p><a href="https://www.123rf.com/photo_55851419_photographed-closeup-of-a-mature-carrot-root-cracked-carrots.html">https://www.123rf.com/photo_55851419_photographed-closeup-of-a-mature-carrot-root-cracked-carrots.html</a></p>	<p>High ammonium compounds in the soils are the main cause of splitting Wider spacing also leads to splitting of carrots</p>	<p>-Proper management, right spacing -Use other sources of Nitrogen other than ammonium compounds</p>

<p><b>Cavity spot</b></p>  <p><a href="https://extension.usu.edu/vegetableguide/root-crops/cavity-spot">https://extension.usu.edu/vegetableguide/root-crops/cavity-spot</a></p>	<p>Deficiency of Calcium, caused by high uptake of potassium which blocks Calcium uptake</p>	<p>-Use of high Calcium products</p>
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### **Harvesting and Harvesting Techniques.**

Harvesting should be done between 90 to 120 days after sowing depending on the agro-ecological zone and intended market.

### **Harvesting Method**

Harvested manually by pulling the roots by the leaves when the soil is moist. The field is irrigated once a day for three days before harvesting to facilitate harvest. The soil may be loosened with a spade or similar tool such as fork or under cutter bar that lifts carrots to avoid damage.

### **Expected Yields**

11 to 14 tons/acre depending on variety, crop husbandry and the intended market.

### **Postharvest Activities**

After harvesting carrots, the tops are trimmed back to 2cm since leaving the tops on dries the roots quickly and reduces the marketing period. Cut off the tops, wash to remove dirt under running water.

Carrots are then packed in baskets or gunny bags of 50kg placed before washing with disinfectant and water then sorted by size before packaging.

Carrots can remain fresh up to 3 to 4 months or 100 days if stored at 0 to 4.4 degree Celsius.

### **Transportation after Harvesting**

Packaging of harvested produce should be done to maintain quality, preferably in crates and transported in closed trucks as per the Crops (Horticultural Crops) Regulations, 2020.



### 13. GROSS MARGIN ANALYSIS-1 acre

<b>1 acre 2.5kg seed Yield: 10 tonnes</b>	<b>Units</b>	<b>Quantity</b>	<b>Cost ksh/unit</b>	<b>Total</b>
Gross income	Kgs	10,000kg	40	400,000
<b>Variable costs</b>				
Land preparation	days	30 days	500	15000
Seeds		50	200	5000
Fertilizer NPK	Kgs	50kg,	120	6000
CAN		50kg	120	6000
Foliar fertilizer (potassium)	ml	500ml		2500
Insecticides	ml	500ml	500 x 3	1500
Fungicides	ml	500ml	400 x 5	2,000
Planting	Mds	8 Days	500	4000
Spraying	Mds	4 days	500	2000
Top dressing	Mds	2days	500	1000
Weeding	Mds	8 days	500	4000
Harvesting	Mds	10 days	500	5000
<b>Total variable costs</b>				<b>53,000</b>
<b>Gross margin (gross income – total variable costs)</b>				<b>400,000–53,000= 347,000=</b>

### References

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