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EAST AFRICAN STANDARD

Fresh parsnips — Specification and grading



EAST AFRICAN COMMUNITY

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Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

In the preparation of this East African Standard, the following documents were consulted extensively:

United States Standards for Grades of Parsnips, Effective December 10, 1945 (Reprinted — January 1997)

Grades and standards for parsnips, Fresh Fruit and Vegetable Regulations, C.R.C., c. 285, May, 2009, Canada

CODEX STAN 193:1995 (Rev.5:2009), *General Standard for Contaminants and Toxins in Foods*

CODEX STAN 228:2001 (Rev.1:2004), *General methods of analysis for contaminants*

Codex Alimentarius website: http://www.codexalimentarius.net/mrls/pestdes/jsp/pest_q-e.jsp

USDA Foreign Agricultural Service website: <http://www.mrlsdatabase.com>

USDA Agricultural Marketing Service website: <http://www.ams.usda.gov/AMSV1.0/Standards>

USDA Plant Inspectorate Service website: http://www.aphis.usda.gov/import_export/plants

European Union: http://ec.europa.eu/sanco_pesticides/public

Assistance derived from these sources and others inadvertently not mentioned is hereby acknowledged.

This standard has been developed to take into account:

- the needs of the market for the product;
- the need to facilitate fair domestic, regional and international trade and prevent technical barriers to trade by establishing a common trading language for buyers and sellers.
- the structure of the CODEX, UNECE, USA, ISO and other internationally significant standards;
- the needs of the producers in gaining knowledge of market standards, conformity assessment, commercial cultivars and crop production process;
- the need to transport the product in a manner that ensures keeping of quality until it reaches the consumer;
- the need for the plant protection authority to certify, through a simplified form, that the product is fit for crossborder and international trade without carrying plant disease vectors;
- the need to promote good agricultural practices that will enhance wider market access, involvement of small-scale traders and hence making fruit and vegetable production a viable means of wealth creation; and
- the need to keep unsatisfactory produce from the market by allowing the removal of unsatisfactory produce from the markets and to discourage unfair trade practices e.g. trying to sell immature produce at the beginning of the season when high profits can be made. Immature produce leads to dissatisfaction of customers and influences their choices negatively, which disadvantages those traders who have waited until the produce is mature.

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Draft for comments only — Not to be cited as East African Standard

Fresh parsnips — Specification and grading

1 Scope

This East African Standard applies to parsnips of varieties (cultivars) grown from *Pastinaca sativa* to be supplied fresh to the consumer, parsnips with tops and parsnips for industrial processing being excluded.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CAC/GL 21, *Principles for the Establishment and Application of Microbiological Criteria for Foods*

CAC/RCP 1, *Recommended International Code of Practice — General Principles of Food Hygiene*

CAC/RCP 44, *Recommended International Code of Practice for the Packaging and Transport of Tropical Fresh Fruit and Vegetables*

CAC/RCP 53, *Code of Hygienic Practice for Fresh Fruits and Vegetables*

EAS 38, *Labelling of prepackaged foods — Specification*

CD/K/378:2010, *Horticultural industry — Code of practice*

3 Definitions

For the purpose of this standard the following definition shall apply:

3.1

well trimmed

the tops shall be cut back to within 19 mm from the crown of the parsnip; except that occasional uncut leaves or leafstems or new top growth exceeding this length which does not materially damage the appearance of the lot shall be permitted

3.2

fairly well formed

the parsnip is not turnip shaped or so forked or misshapen as to materially affect its appearance or cause a loss of more than 5 percent, by weight, in the ordinary preparation for use

3.3

fairly smooth

the parsnip is not rough, ridged, or covered with secondary roots to an extent which materially affects its appearance or causes a loss of more than 5 percent, by weight, in the ordinary preparation for use

3.4

fairly clean

individual parsnips are reasonably free from dirt, stain, or other foreign matter, and that the general appearance of the parsnips in the lot is not more than slightly affected by these causes

3.5

fairly firm

the parsnip is not soft, materially flabby, or shrivelled

3.6

damage

any defect, or any combination of defects, which materially detracts from the appearance, or the edible or marketing quality of the individual parsnip, or the parsnips in the lot; or which causes a loss of more than 5 percent, by weight, of the parsnip in the ordinary preparation for use

3.7

badly misshapen

the parsnip is so badly crooked, twisted, forked, or otherwise so misshapen as to seriously affect its appearance or cause a loss of more than 10 percent, by weight, of the parsnip in the ordinary preparation for use

3.8

serious damage

any defect, or any combination of defects, which seriously detracts from the appearance, or the edible or marketing quality of the individual parsnip or the parsnips in the lot; or which causes a loss of more than 10 percent, by weight, of the parsnip in the ordinary preparation for use

3.9

diameter

the greatest dimension of the parsnip measured at right angles to the longitudinal axis

3.10

clean

the produce is not affected by dirt, dust, spray residue, wax marks or other foreign material and is not contaminated or adulterated

4 Provisions concerning quality

4.1 General

The purpose of the standard is to define the quality requirements for parsnips at the market control stage, after preparation and packaging.

4.2 Minimum requirements

4.2.1 In all classes, subject to the special provisions for each class and the tolerances allowed, the parsnips must be:

- (a) be properly packed;
- (b) have similar varietal characteristics;
- (c) be not trimmed into the crown;
- (d) be firm but not woody in texture; and
- (e) be free from decay.

4.3 Classification

Radishes are classified in two classes defined below:

4.3.1 Class I

In addition to meeting the minimum requirements for all grades set out in 4.2, parsnips in Class I shall:

- (a) be reasonably clean and fairly smooth;

- (b) be not turnip-shaped or so forked or misshapen as to materially affect the appearance of the parsnips;
- (c) be free from secondary rootlets that materially affect the appearance of the parsnips;
- (d) be trimmed so that the length of the tops of 75 per cent by weight of the parsnips in a lot does not exceed 13 mm and the length of the tops of the other parsnips does not exceed 25 mm;
- (e) meet the following requirements in respect of diameter, namely,
 - (i) have a minimum diameter of 25 mm and a maximum diameter of 76 mm,
 - (ii) have a minimum diameter of 25 mm and
 - (A) conform to the diameter size range marked on the container or on a label attached thereto,
 - (B) be packed in a transparent container, or
 - (C) be in a bulk display in a retail store, or
 - (iii) have a minimum diameter of 44 mm or greater and be packed in a container on which is marked or marked on a label attached thereto the size designation "44 mm and up", or the greater minimum size designation that may be applicable;
- (f) where packed as prepackaged products, not vary by more than 38 mm in diameter;
- (g) have a minimum length of 127 mm; and
- (h) be free from any other damage or defect or combination thereof that
 - (i) materially affects the appearance, edibility or shipping quality of the parsnips, or
 - (ii) cannot be removed without a loss of more than five per cent of the weight of a parsnip.

4.3.2 Class II

In addition to meeting the standards for all grades set out in 4.2, parsnips graded Class II shall:

- (a) be not so badly forked or misshapen that the appearance of the parsnips is seriously affected;
- (b) be trimmed so that the tops do not exceed 25 mm in length;
- (c) have a minimum diameter of 25 mm and a minimum length of 102 mm; and
- (d) be free from any other damage or defect or combination thereof that
 - (i) seriously affects the appearance, edibility or shipping quality of the parsnips, or
 - (ii) cannot be removed without a loss of more than 10 per cent of the weight of a parsnip.

4.3.3 Unclassified

Unclassified consists of parsnips which have not been classified in accordance with any of the foregoing grades. The term "unclassified" is not a grade within the meaning of these standards but is provided as a designation to show that no grade has been applied to the lot.

5 Provisions concerning sizing

Unless otherwise specified, the diameter of each parsnip shall be not less than 38 mm.

6 Provisions concerning tolerances

Tolerances in respect of quality and size shall be allowed in each package for produce not satisfying the requirements of the class indicated.

6.1 Quality tolerances

6.1.1 Class I

Ten percent for parsnips in any lot which fail to meet the requirements of this grade, including therein not more than 5 percent for defects causing serious damage, including in this latter amount not more than 1 percent for parsnips affected by soft rot or wet breakdown.

6.1.2 Class II

Ten percent for parsnips in any lot which fail to meet the requirements of this grade, including therein not more than 1 percent for parsnips affected by soft rot or wet breakdown.

6.2 Size tolerances

6.2.1 Class I

Three percent for parsnips in any lot which fail to meet the specified minimum diameter and 10 percent for parsnips which fail to meet any specified maximum diameter.

6.2.2 Class II

Five percent for parsnips in any lot which fail to meet the specified minimum diameter and 10 percent for parsnips which fail to meet any specified maximum diameter.

6.3 Application of tolerances

The contents of individual packages in the lot, are subject to the following limitations:

- (a) For a tolerance of 10 percent or more, individual packages in any lot shall have not more than one and one-half times the tolerance specified: **Provided**, That at least one defective and one off-size specimen may be permitted in any package: **And provided further**, That the average for the entire lot is within the tolerance specified.
- (b) For a tolerance of less than 10 percent, individual packages in any lot shall have not more than double the tolerance specified: **Provided**, That at least one defective and one off-size specimen may be permitted in any package: **And provided further**, That the average for the entire lot is within the tolerance specified.

7 Provisions concerning presentation

7.1 Uniformity

The contents of each package must be uniform and contain only parsnips of the same origin, variety or commercial type and quality.

The visible part of the contents of the package must be representative of the entire contents.

7.2 Packaging

Parsnips must be packed in such a way as to protect the produce properly.

The materials used inside the package must be new¹, clean, and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly paper or stamps, bearing trade specifications is allowed provided the printing or labelling has been done with non-toxic ink or glue.

Parsnips shall be packed in each container in compliance with CAC/RCP 44.

8 Marking and labelling

8.1 Consumer packages

In addition to the requirements of EAS 38, the following specific provisions apply:

8.1.1 Nature of produce

If the produce is not visible from the outside, each package shall be labelled as to the name of the produce and may be labelled as to name of the variety and/or commercial type.

8.2 Non-retail containers

Each package² must bear the following particulars in letters grouped on the same side, legibly and indelibly marked, and visible from the outside:

8.2.1 Identification

The exporter, packer and/or dispatcher shall be identified by name and physical address (e.g. street/city/region/postal code and, if different from the country of origin, the country) or a code mark officially recognized by the national authority.³

8.2.2 Nature of produce

— "Parsnips" if the contents are not visible from the outside.

8.2.3 Origin of produce

Country of origin and, optionally, district where grown or national, regional or local place name.

8.2.4 Commercial specifications

— Class.

8.2.5 Official control mark (optional)

9 Contaminants

9.1 Pesticide residues

Parsnip shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity.

¹ For the purposes of this Standard, this includes recycled material of food-grade quality.

² Package units of produce prepacked for direct sale to the consumer shall not be subject to these marking provisions but shall conform to the national requirements. However, the markings referred to shall in any event be shown on the transport packaging containing such package units.

³ The national legislation of a number of countries requires the explicit declaration of the name and address. However, in the case where a code mark is used, the reference "packer and/or dispatcher (or equivalent abbreviations)" has to be indicated in close connection with the code mark, and the code mark should be preceded by the ISO 3166 (alpha) country/area code of the recognizing country, if not the country of origin.

9.2 Other contaminants

Parsnip shall comply with those maximum levels for contaminants established by the Codex Alimentarius Commission for this commodity.

10 Hygiene

10.1 It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of CAC/RCP 1, CAC/RCP 53, and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

10.2 The produce should comply with any microbiological criteria established in accordance with CAC/GL 21.



Parsnip concept plant



Freshly lifted parsnips



Fresh market parsnips



Parsnip tops

Draft for comment

Draft



Fresh market parsnips



Parsnip with tops



Parsnips in field



Seeding parsnip plant



Parsnip plants and tops/leaves

Draft

Annex A
(informative)

Guide to storage

NOTE This annex is to be adapted to parsnips with relevant adjustments.

A.1 Scope

This annex describes methods for obtaining conditions for the successful conservation, with or without artificial cooling, of carrots of varieties of *Daucus carota* Linnaeus.

A.2 Application

It applies only to carrots produced for storage during the winter. See also the limits of application given in A.5.

A.3 Conditions of harvesting and putting into store

A.3.1 Harvesting

For storage purposes, it is recommended that carrots originating preferably from late sowing should be selected. The carrots should be harvested in good time and should not be overmature. The tops should be cut off at the level of the crown, without damaging the roots.

If harvesting is carried out in wet weather, the carrots should be dried for just as long as necessary before storage, avoiding excessive dehydration which adversely affects keeping.

Cultivation in soils which are too rich in assimilable nitrogen may adversely affect the keeping quality of the carrots during the storage period.

A.3.2 Quality characteristics for storage

Carrots intended for storage should be firm, sound, not run to seed, not frozen, free from abnormal external moisture, unwithered, whole, and free from bruises.

If carrots are harvested from heavy, wet soil, it is practically impossible and even inadvisable to remove the adhering earth mechanically. General experience has shown that carrots keep better with the earth adhering. Washing before storage is not recommended, whereas after storage there is no objection to washing and this may even be necessary.

A.3.3 Putting into store

The carrots should be put into store as soon as possible after being harvested.

Carrots should not be put into storage with other fruit and vegetables which produce ethylene.

A.3.4 Method of storage

The carrots may be stored in box-pallets, boxes or bags, or in bulk. If they are stored in bulk, the height of the layer of carrots should be specified according to the hardness of the variety of carrot, the quality of the lot and the condition of the ventilation device. The maximum recommended height is 2 to 3 m. In the case of bags, the maximum height is 3 m.

Perforated plastics films may be used, either as internal linings of boxes or for covering stacks of boxes.

A.4 Optimum storage conditions

For definitions and measurement of the physical quantities affecting storage, see CD/K/378:2010.

A.4.1 Temperature

The storage temperature should be kept between 0 and +5 °C. The optimum keeping temperature is between 0 and +1 °C.

A.4.2 Relative humidity

In refrigerated chambers where the temperature is maintained between 0 and +1 °C, the relative humidity should be maintained at 95 to 98 %; in chambers provided with fans (without artificial cooling), where the temperature varies from +1 to +5 °C, the relative humidity should be maintained at 90 to 95 %.

A.4.3 Air circulation

The air circulation should make it possible to keep the temperature and relative humidity constant and uniform within the limits mentioned in A.4.1 and A.4.2. The circulation should be particularly vigorous, i.e. 100 to 120 m³(t.h), when the carrots are stored in bulk and the height approaches the maximum value specified.

A.4.4 Storage life

The expected storage life is from 4 to 6 months.

A.5 Limits of application

This annex gives guidance of a very general nature only. Because of the variability of the product according to the time and place of cultivation, local circumstances may make it necessary to specify other conditions of harvesting or other physical conditions in the store.

These recommendations do not apply unreservedly, therefore, to all varieties in all climates, and each specialist will have to judge whether any modifications need to be made.

Moreover, this annex does not take into account the role played by ecological factors, and wastage during storage is not dealt with.

Subject to all possible restrictions arising from the fact that vegetables are living materials, the application of the guidance contained in this annex should enable much wastage in storage to be avoided and satisfactory keeping for long periods to be achieved in most cases.

Annex B (informative)

Commercial production guide

NOTE This annex is to be adapted to parsnips with relevant adjustments.

B.1 History, Uses and Botanical Classification and Development

Carrot (*Daucus carota* var. *sativus*) is a member of the Umbelliferae family. Other vegetable crops and herbs in this family include celery, parsnip, parsley, dill, caraway, anise, coriander and fennel. Domestic carrots may have evolved from a wild form similar to its relative known in North America as Queen Anne's Lace. The family name comes from the flower form, which is an umbel. Characteristic of most of the family's plants, an umbel has individual flower stalks originating from the same point on the stem.

Carrots probably originated in Asia around northwest India. Cultivation of carrots for medicinal purposes began 2000 to 3000 years ago. They were used for a myriad of medicinal purposes including stomach ulcers, abscesses, bladder, liver and kidney problems, to aid in childbirth and even as aphrodisiacs. Cultivation of roots for consumption dates back to 600 A.D. when purple root types were grown in the area currently known as Afghanistan.

Yellow types were eventually selected and produced in Syria and Iran in the ninth or tenth century. Carrots were introduced to China by the thirteenth century and cultivation spread from the Middle East to Italy, Spain and throughout Europe by the fourteenth century. Eventually, white and orange types were selected. Orange types, first grown in the Netherlands during the seventeenth century, were brought to North America by early settlers. The root was popular with Native Americans and production currently exists worldwide.

One of the reasons production is so widespread is that carrots are the major single source of Vitamin A in the diets of many cultures. They are also a good source of other vitamins, minerals and fibre. Carrots are produced for a variety of uses. Fresh market production for retail sales is still an important market. Fresh packed articles include peeled baby carrots, carrot sticks, shredded carrots and salad mixes. Processing markets include baby food production, frozen and canned products. Carrots are popular as snack foods, for deli trays, in salads, cooked in casseroles, as main vegetable dishes as well as numerous other culinary creations.

Young carrots are characterized by a tight rosette of finely serrated leaves and a slender tap root with fine fibrous side roots. As the tap root enlarges and reaches maturity, the conductive tissue is distinguished as a light-coloured core (xylem) and the deeper orange cortex (phloem).

B.2 Carrot cultural management

B.2.1 Climatic requirements

Optimum temperatures are in the range of 15 to 21 °C, with daytime highs of 24 °C and nighttime lows of 13 °C ideal. Although the crop can be grown outside this range with little or no effect on tops, temperatures differing drastically from the above can adversely affect root colour, texture, flavour and shape. Lower temperatures from this range may induce slow growth and make roots longer, more slender and lighter in colour. Carrots with a root less than 2.5 cm in diameter are more susceptible to cold injury than larger roots.

Hot, sunny days can injure or kill young plants. Long periods of hot weather may depress carrot yields, cause strong terpinoid flavour and bitter taste in roots, and result in atypically short and blunt roots. Disease pressure also increases as temperatures warm in late spring and summer. Carrots need an ample supply of moisture from rainfall and/or irrigation throughout the growing season since they are not drought tolerant. A consistent moisture supply helps keep the crop growing and reduces the incidence of splitting from growth flushes.

B.2.2 Planting and spacing

Carrots are exclusively direct-seeded.

Carrots should be spaced 3.8 cm to 4 cm apart within the row. Carrot seed should be planted no deeper than 6.35 mm to 12.7 mm. A final stand of 14 to 18 plants per foot of twin row is ideal. Beds should be firmed and not freshly tilled before planting, and soil should be firmed over the seed at planting. A basket or roller attachment is often used to firm the soil over the seed as they are planted. Light irrigation will be required frequently during warm, dry periods for adequate germination.

Windbreaks are almost essential in areas with primarily sandy soils. Sand particles moved by wind can sever young carrot plants, severely reducing stand. Small grain strips planted between beds or at least planted between every few beds can help reduce this sandblasting injury.

B.3 Variety selection

There are four basic types of carrot cultivars that are generally distinguished by the shape of the root. Within each type there are many different varieties to select from. The carrot root consists of the phloem (or cortex) and the xylem (or core). More desirable varieties have a thicker phloem and a minimum of xylem. The phloem is deeper orange and flavourful. The xylem tends to be paler, tasteless and woody.

B.3.1 Taper-rooted or pointed

These roots decrease gradually in diameter from crown to tip and taper to a point.

B.3.2 Stump-rooted or blunt

As in the taper rooted types this root type also tapers from crown to tip but the tip is blunt instead of pointed.

B.3.3 Cylindrical

This type vary little from crown to tip and are somewhat blunt at the tip. As per the name of the type these carrots are virtually cylindrical in shape. They have a blunt end with a shoulder diameter of 3.8 cm inches and a length of 15 to 19 cm. The thick phloem is bright orange and the xylem is often hardly noticeable. They have little top growth but excellent quality.

B.3.4 Ball-shaped

Among this type of carrots are both round and stump-rooted varieties. The Amsterdam types have roots 12.7 mm to 19 mm in diameter and 6.35 cm to 7.5 cm long. Many are used for baby carrots, mixed vegetables and freezing. The more round shaped varieties, which are about 3.8 cm in diameter and length, perform well in heavy soils. They are best when harvested before full maturity and must be hilled to prevent green shoulders.

B.3.5 Variety selection criteria

Qualities that are important for commercial carrot production include yield, colour, top growth, core diameter, length and uniformity.

Although yield is an important criteria, it should not be the only selection criteria. Good top growth is essential since most mechanical harvesters utilize the tops to extract carrots from the soil. Rich orange colour and a small diameter core are essential fresh market characteristics. Acceptable length, uniformity and maturity are also important for packing efficiency and maximum yield. Certainly good flavour and high sugar content are desirable characteristics and are a marketing point for carrots. However, flavour is not always the most important factor in variety selection as visual appearance, yield and harvesting and packing factors often take priority. Basically a variety must be adaptable to the area, produce a competitive yield and be acceptable to buyers. Although disease

resistance is not a major factor in carrot varieties, as resistant varieties are developed, this should be considered as well.

B.4 Soil and nutrition management

B.4.1 Soil requirements

Muck soils or loose, friable sandy loam soils are ideal for carrot production. Although heavier soils are not ideal, carrots can successfully be grown on heavy-textured soils under irrigated conditions. Short, blunt types are often grown on heavier soils. Sandy loam soils allow proper growth and development of a long, smooth, straight root. Soils cannot have excessive stones, pebbles and debris since this can cause forked or misshapen roots. Soils should also be well drained as carrots will not perform well under water-logged conditions. Sites should be selected that have loose, friable soils to a depth of 30-35 cm without pebbles. Deep sandy soils can also be used although they may require more frequent irrigation. Drain tiles should be installed on flatwood type soils that are subject to water-logged conditions. Preparing high beds to avoid wet conditions in these soils is not recommended since under drier circumstances these beds will dry out and cause damage to carrot tops and shoulders.

B.4.2 Land preparation

Proper land preparation should begin by deep turning soils to bury any litter and debris and breaking soils to a depth of 30 – 35 cm. Compacted soils or those with tillage pans can benefit from subsoiling to break the compacted areas. If uncorrected, compact soil or tillage pans can result in restriction of root expansion. It is best to apply lime after deep turning to prevent turning up acid soil after lime application. Carrots should be planted on a slightly raised bed (5 – 7.5 cm) to improve drainage. After beds are tilled and prepared for seeding, it is best to allow the beds to settle slightly before planting. Avoid other tillage practices that can increase soil compaction.

B.4.3 Fertilization and nutrition management

Carrot fertilization is one of the most critical components of successful production. Carrots have a medium requirement for nitrogen, however, timing of applications is just as critical as amount of fertilizer used. Carrots require a pH of between 6.0 and 6.5 for optimum growth. Acquire soil test recommendations several months prior to planting in order to make needed lime applications two to three months in advance of planting. If soil tests indicate magnesium is required use dolomitic lime.

Apply potassium and phosphorous according to soil test results.

Nitrogen requirements for carrots will be from 41 to 55 kg per acre. **It is imperative that nitrogen be applied in small quantities.** These spoon fed applications allow the crop to better utilize nitrogen and helps to prevent splitting from growth spurts. Incorporate one-sixth to one-fourth of the recommended nitrogen into the bed prior to planting. Apply remaining nitrogen in four to six sidedress applications. Never apply more than 7 kg of nitrogen per acre at any one time. Additional applications may be necessary if leaching rains occur. Since carrots may remain in the field from 110 to 130 days, nitrogen applications should be spread out over the length of the growing season by making applications every two to three weeks, depending on rainfall.

Calcium, boron and magnesium should be applied according to soil test recommendations. However, the use of foliar applications of these nutrients may be beneficial to maintain proper growth.

Although plant tissue analysis is a good tool to use in all vegetable crops, in carrots it is almost essential. The use of tissue analysis to keep track of nutritional status can help avoid problems before they become yield limiting.

B.5 Disease management

Disease management in carrot production is necessary to produce high yields of high quality carrots. The major concern is the production of a disease-free and cosmetically clean carrot root. The main problems associated with carrot production are root-knot nematodes and diseases caused by fungi

and bacteria. Carrots should be planted in well-drained, litter-free, deep turned soils. Certain crops like tobacco should be avoided because of the slow decomposition of the crop stubble. Also, nematode control in tobacco stubble is difficult to achieve because nematodes can withstand treatment as they are embedded in the root system and may not be exposed to the fumigant. Several root diseases will be discussed in this section.

Also, certain foliage diseases can affect carrots. In most cases, these never require any type of fungicide or bactericide application. However, under certain weather conditions, fungicide applications may be necessary. Basically, adequate fungicides and bactericides for managing the above ground diseases are available.

B.5.1 Root-knot nematode



Figure B.1 — Root-knot galling

By far, the most destructive problem is root-knot nematodes caused by *Meloidogne* sp. Root-knot nematodes are small eel-like worms that live in the soil and feed on plant roots. Since the root of the carrot is the harvested portion of the plant, no root-knot damage can be allowed. Root-knot causes poor growth and distorted or deformed root systems, which results in a non marketable root. Root-knot damage also allows entry for other diseases such as *Fusarium*, *Pythium*, and *Erwinia*. (Figure B.1)

Soil assay is the best way to determine the numbers and kinds of nematodes to be dealt with in carrot production. Nematode populations are usually at a peak at about crop maturity. Thus, the most accurate numbers can be obtained during this period. If any root-knot nematodes are found, treatment is recommended. Good success has been obtained using field soil fumigation to eradicate root-knot nematodes in the root zone of carrots.

B.5.2 Soil-borne root diseases

Depending on the cropping history of the field, *Pythium*, *Southern Blight* and *Sclerotinia* may cause problems. It is advisable to avoid fields where these diseases have been identified in the previous crop. Deep turning is also necessary to help prevent root diseases.

Pythium Blight

Pythium Blight is usually characterized by flagging foliage indicating some root damage is occurring. Under wet conditions, *Pythium* may cause serious problems to the root causing a white mycelium mat to grow on the infected area that rapidly turns to a watery soft rot. Forking of the root system is also a common symptom associated with *Pythium* infection. Rotation is considered a major factor in reducing *Pythium* along with the use of fungicides. (Figures B.2, B.3)



Figure B.2 — Root forking caused by *Pythium*



Figure B.3 — Stunting caused by *Pythium*

Southern Blight

Southern blight is caused by the fungus *Sclerotium rolfsii* and can cause serious damage to carrots. This disease is usually associated with carrots remaining in the field after the soil begins to warm in the spring. This disease causes a yellow top to develop with a cottony white fungal growth associated with the upper part of the carrot root. The top of the root and the surrounding soil may be covered with a white mycelium with tan sclerotia developing as the disease progresses. Southern Blight is best controlled by using rotation and deep turning. (Figures B.4, B.5)



Figure B.4 — Above ground symptoms and signs of infection caused by *Sclerotium rolfsii*



Figure B.5 — White mycelium of *Sclerotium rolfsii* on carrots

Sclerotinia Blight

Sclerotinia blight is caused by the fungus *Sclerotinia sclerotiorum* and can cause serious damage to the roots of carrots. This disease is usually worse under wet soil conditions. This is the same disease that causes the familiar raisin head in cabbage. White mycelium forms around the infected area and, later, dark sclerotia develop on the white mycelium, which is a good indicator of *Sclerotinia* rot. This disease causes a progressive watery soft rot of the carrot root tissue and is considered a potential problem in the production of carrots. Rotation and deep turning of the soil are recommended to reduce losses to this disease.

Rhizoctonia

This disease is caused by *Rhizoctonia* species and is associated with the carrot root. It causes brown to black lesions to develop on the sides of the carrot root. The disease is much worse under cool, wet conditions. Saturated soil conditions often enhance all soil-borne diseases, which are potential problems in carrot production. Rhizoctonia damage can be minimized by using rotation and good cultural practices. Soil fumigation will prevent damage with any of the soil inhabiting fungi, however

soil fumigation is expensive and cultural practices may be used to reduce the injury without the expense of fumigation. (Figure B.6)



Figure B.6 — Symptoms caused by *Rhizoctonia*

B.5.3 Foliar diseases

Bacterial Blight

Bacterial Blight caused by the bacterium *Xanthomonas carotae* causes irregular brown spots on the leaves and dark brown streaks on the petioles and stems. The lesions on the foliage begin as small yellow areas with the centres becoming dry and brittle, with an irregular halo. The bacterium affects the leaflets, stems and petioles as the disease progresses. Some of these lesions may crack open and ooze the bacteria. These bacteria may be washed down to the crown of the plant causing brown lesions on the top of the root. The earlier the infection the more damage to the root. The bacterium is spread by splashing water and takes about 10-12 days before symptoms appear after inoculation. The bacterium progresses rapidly between 25 degrees and 30 degrees C. Rotation is a major factor in controlling Bacterial Blight. (Figures B.7, B.8)



Figure B.7 — Foliar symptoms caused by *Xanthomonas carota*



Figure B.8 — A comparison of symptoms caused by *Alternaria dauci* (right) and *Xanthomonas carota* (left)

Alternaria Blight

Alternaria blight is caused by the fungus *Alternaria dauci*. This disease causes small dark brown to black spots with yellow edges forming mostly on the leaf margins. The spot increases as the disease progresses and in some cases entire leaflets may be killed. In moist weather, the disease can move so rapidly it resembles frost injury. Such conditions can reduce the efficiency of mechanical harvesters which require strong healthy tops to remove the carrot from the soil. *Alternaria* may also cause damping off of seedlings and a black decay of roots. The spores and mycelium are spread by splashing rains, contaminated soil, or on cultivation tools. The disease can manifest itself in about 10 days after infection. The optimum temperature for *Alternaria* blight is 28 °C. (Figure B.9)



Figure B.9 — *Alternaria dauci* on seedling carrots.

Cercospora Leaf Blight

Cercospora blight is caused by the fungus *Cercospora carotae*. This disease causes lesions to form on the leaves, petioles and stems of the carrot plant. The symptoms appear to mimic that of *Alternaria* blight but can be separated using a compound microscope. *Cercospora* blight progresses in warm, wet weather and spots appear in about 10 days after infection. The youngest leaves are usually more susceptible to *Cercospora* infection.

B.6 Insects

Carrots are subject to attack by numerous insect pests. Soil insects, if present, may damage the roots and should be controlled with cultural practices and incorporation of soil insecticide. Some fumigants may provide some control of soil insects. Other pests that primarily attack the foliage can be monitored and treated as needed with foliar insecticides.

B.6.1 Soil insects

Wireworms, mostly *Conoderus* spp., white grubs, *Phyllophagus* spp., and the granulate cutworm, *Feltia subterranea*, may be partially controlled with good cultural practices. Soil should be deep turned in sufficient time prior to planting to allow destruction of previous crop residue that may harbour soil insects. When possible, avoid planting just after crops slow to decompose, such as tobacco and corn. Avoid planting behind peanuts and root crops such as sweet potatoes and turnips. If a field has a history of soil insect problems, either avoid these or broadcast incorporate a soil insecticide prior to planting. Plantings in fields recently in permanent pasture should be avoided as should fields recently planted to sod/turf, although these are not as critical. Fields with a history of whitefringed beetle larvae, *Graphognathus* spp., should not be planted to carrots because there are no currently registered insecticides effective on this pest. (Figures B.10, B.11, B.12, B.13)

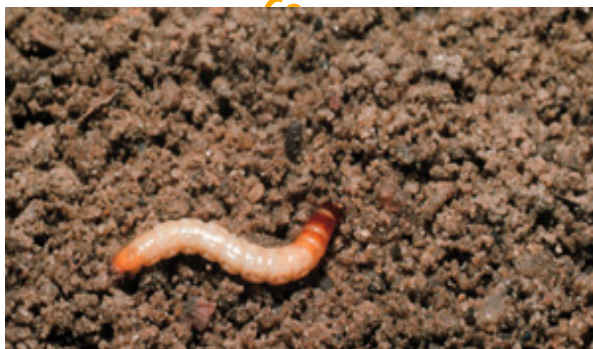


Figure B.10



Figure B.11



Figure B.12

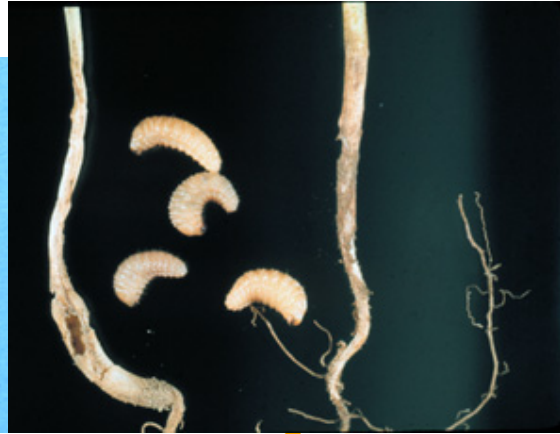


Figure B.13

Flea beetle larvae, *Systema* spp., can damage roots by feeding on the surface to the cortex. The damage will take on the appearance of narrow s-shaped canals on the surface. Flea beetle larvae can be prevented easily with soil insecticides.

The seedcorn maggot, *Hylemya platura*, is an opportunistic pest that takes advantage of crops that are under stress or where there is decaying organic matter. Plants may be considered under stress for several reasons such as freeze damage, nutritional deficiencies, herbicide injury, drought, wind and sand injury and diseases to mention a few. At-planting soil insecticides will prevent the development of maggot infestations for several weeks after planting, however, as residues decrease late season infestations may develop, especially from late January through April. Seedcorn maggots cannot be effectively controlled after the infestation begins. If plants become stressed during the period of high root maggot potential, preventive applications of insecticides should be sprayed every seven days until the stress is minimized. (Figure B.14)

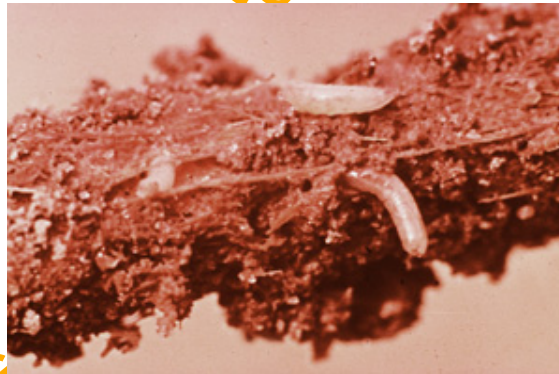


Figure B.14

B.6.2 Foliar Insects

Foliar insect pests may be monitored and insecticides applied as needed. Very often carrots may be grown without the addition of any foliar insecticides. Carrots should be scouted at least once per week for developing populations of foliage pests.

B.6.3 Aphids

Several species of aphids may develop on carrots with the most common aphids being the green peach aphid, *Myzus persicae* and the cotton or melon aphid, *Aphis gossypii*. Both of these aphids may infest carrots after other cultivated hosts, such as cotton and vegetables, are harvested. There are no treatment thresholds for making control decisions. Often parasitic wasps and fungal diseases

will control these aphids. If populations persist and colonize plants rapidly over several weeks and honeydew or sooty mould is observed readily, then foliar insecticides are justified.

B.6.4 Flea beetles

Flea beetle adults, *Systema* spp., may cause severe damage to the foliage on occasion. If carrots are attacked during the seedling stage and infestations persist over time, an insecticide application may be necessary. Minor feeding is no cause for alarm. If plants are in the cotyledon to first true leaf stage, treatments should be made if damage or flea beetles are observed on more than 5 per cent of the plants. After plants are well established, flea beetles should be controlled only if foliage losses are projected to be moderate to high, e.g., 15 percent or more.

B.6.5 Vegetable weevil

The adult and larvae of the vegetable weevil, *Listroderes difficilis*, may attack carrots. The adult and larvae feed on the foliage. Vegetable weevil larvae often will feed near the crown of plants and, if shoulders are exposed at the soil surface, larvae will feed on tender carrots. Treatments are justified if adults or larvae and damage are easily found in several locations. [Figures B.15 (larvae), B.16 (adult)]



Figure B.15

Figure B.16

B.6.6 Armyworms

The armyworm, *Pseudaletia unipuncta*, is another cause of damage to carrots. Armyworms may move from grain crops or weeds into carrots or adults may lay eggs directly on carrot plants. Armyworms are easily controlled with foliar insecticides. There are no action thresholds but, if foliage is excessive, an insecticide application may not be justified. (Figure B.17)



Figure B.17

B.6.7 Beet Armyworm

The beet armyworm, *Spodoptera exigua*, infests carrots but natural predators and especially parasites regulate beet armyworm populations below economically damaging levels.

B.6.8 Whiteflies

The silverleaf whitefly, *Bemisia argentifolii*, may be a problem during the early seedling stage of fall plantings. Silverleaf whitefly migrate from agronomic crops and other vegetables. Infestation may become severe on carrots grown in these production areas. Often whiteflies may be controlled by several natural enemies and diseases and therefore treatments may not be justified. However, if whiteflies develop generally heavy populations, treatment on young plantings is justified. (Figure B.18)

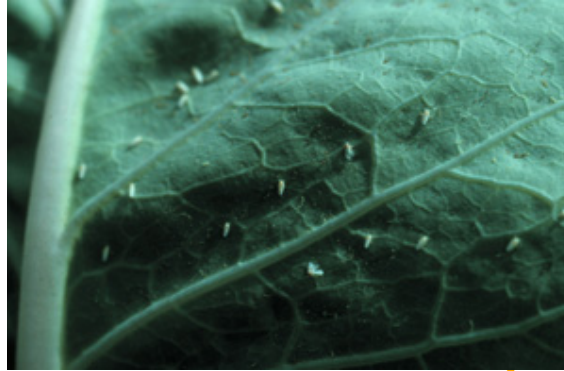


Figure B.18

B.7 Managing weeds in carrots

Weed control in carrots is an essential component of producing a high-yielding and high-quality crop. Weeds compete with carrots for light, water, nutrients, and physical space. In addition, many weeds may impair the harvesting process, either through improper digging or contamination of the harvested crop. Weeds can also harbour deleterious insects and diseases. The presence of plant residue from weeds or other plants during fumigation can also decrease the effectiveness of most soil fumigation materials, thus increasing the problems associated with nematodes.

Prevention is the first step in managing weeds in carrots. Avoid areas that contain heavy infestations of perennial weeds such as bermudagrass and nutsedge. Proper tillage, insect and disease control and fertility will help to ensure a healthy crop. Planting density will also allow the carrots to out-compete many weeds. Mechanical cultivation is generally not used in carrot production due to the tight row spacing (several rows on a bed). However, mechanical cultivations will help control weeds between rows particularly during early planting.

Chemical weed control in carrots relies heavily on the herbicide linuron (Lorox, others). Linuron provides excellent control of most weeds found in carrots and is used postemergence over-the-top. Although good control of large weeds can be achieved with this product, it is critical to eliminate the weeds at an early stage to reduce the deleterious effects of competition. The lower rate should be used on smaller carrots (tops <5-10 cm) and during warmer weather. A crop oil may be added to improve control of larger weeds, although this may increase the chance of crop injury. The best rule of thumb is to avoid the use of crop oil on smaller carrots.

Sencor (metribuzin) can also be used for post-emergence weed control but certain varieties may be injured by this herbicide. Trifluralin can also be used as a pre-plant incorporated treatment for the control of most annual grasses and several small-seeded broadleaf weeds. This herbicide should be applied before planting and soil incorporated to a depth of 5 – 7.5 cm. Trifluralin may provide early season weed suppression, allowing the carrots to emerge and begin seedling growth in the absence of heavy weed competition. Fluzifopmethyl (Fusilade) can be used for post-emergence weed control and provides good control of most annual and perennial grasses.

One of the worst weeds in carrots, as in most crops, is nutsedge. Most infestations are limited to yellow nutsedge (*Cyperus esculentus*). Linuron and metribuzin may provide some temporary suppression, while trifluralin and fluzifop have no effect. Nutsedge causes the greatest problem during carrot emergence and seedling growth. This limits the use of higher rates of linuron for some

