Descriptors for

wild and cultivated Carrots

(*Daucus carota* L.)

International Plant Genetic Resources Institute

IPGRI

IPGRI is a centre of the Consultative Group on International Agricultural Research (CGIAR)

List of Descriptors

Almond (revised) * (E)	1985
Apple (E)	1982
Apricot * (E)	1984
Avocado (E,S)	1995
Bambara groundnut (E)	1987
Banana (E,S,F)	1996
Barley (E)	1994
Beta (E)	1991
Black pepper (E,S)	1995
Brassica and *Raphanus* (E)	1990
Brassica campestris L. (E)	1987
Buckwheat (E)	1994
Capsicum (E,S)	1995
Cardamom (E)	1994
Cashew (E)	1986
Cherry * (E)	1985
Chickpea (E)	1993
Citrus (E)	1988
Coconut (E)	1992
Coffee (E,S,F)	1996
Colocasia * (E)	1980
Cotton (Revised) (E)	1985
Cowpea (E)	1983
Cultivated potato * (E)	1977
Echinochloa millet * (E)	1983
Eggplant (E,F)	1990
Faba bean * (E)	1985
Finger millet (E)	1985
Forage grass * (E)	1985
Forage legumes * (E)	1984
Grapevine (E,S,F)	1997
Groundnut (E,S,F)	1992
Kodo millet * (E)	1983
Lentil * (E)	1985
Lima bean * (E)	1982
Lupin * (E,S)	1981
Maize (E,S,F)	1991
Mango (E)	1989
Medicago (Annual) * (E,F)	1991
Mung bean * (E)	1980
Oat * (E)	1985
Oca * (S)	1982
Oil palm (E)	1989
Panicum miliaceum and *P. sumatrense* (E)	1985
Papaya (E)	1988
Peach * (E)	1985
Pear * (E)	1983
Pearl millet (E,F)	1993
Phaseolus acutifolius (E)	1985
Phaseolus coccineus * (E)	1983
Phaseolus vulgaris * (E)	1982
Pigeonpea (E)	1993
Pineapple (E)	1991
Pistacia (excluding *Pistacia vera*) (E)	1998
Pistachio (E,F)	1997
Plum * (E)	1985
Potato variety * (E)	1985
Quinua * (E)	1981
Rice * (E)	1980
Rye and Triticale * (E)	1985
Safflower * (E)	1983
Sesame * (E)	1981
Setaria italica and *S. pumilia* (E)	1985
Sorghum (E,F)	1993
Soyabean * (E,C)	1984
Strawberry (E)	1986
Sunflower * (E)	1985
Sweet potato (E,S,F)	1991
Tea (E,S,F)	1997
Tomato (E, S, F)	1996
Tropical fruit * (E)	1980
Vigna aconitifolia and *V. trilobata* (E)	1985
Vigna mungo and *V. radiata* (Revised) * (E)	1985
Walnut (E)	1994
Wheat (Revised) * (E)	1985
Wheat and *Aegilops* * (E)	1978
White Clover (E)	1992
Winged Bean * (E)	1979
Xanthosoma (E)	1989
Yam (E,S,F)	1997

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(*Daucus carota* L.)

International Plant Genetic Resources Institute
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The International Plant Genetic Resources Institute (IPGRI) is an autonomous international scientific organization, supported by the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of plant genetic resources for the benefit of present and future generations. IPGRI's headquarters is based in Rome, Italy, with offices in another 14 countries worldwide. It operates through three programmes: (1) the Plant Genetic Resources Programme, (2) the CGIAR Genetic Resources Support Programme, and (3) the International Network for the Improvement of Banana and Plantain (INIBAP). The international status of IPGRI is conferred under an Establishment Agreement which, by January 1998, had been signed and ratified by the Governments of Algeria, Australia, Belgium, Benin, Bolivia, Brazil, Burkina Faso, Cameroon, Chile, China, Congo, Costa Rica, Côte d'Ivoire, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Greece, Guinea, Hungary, India, Indonesia, Iran, Israel, Italy, Jordan, Kenya, Malaysia, Mauritania, Morocco, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

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CONTENTS

PREFACE

Descriptors for wild and cultivated Carrots *(Daucus carota* L.) was developed by Dr Taysir Badra. A draft version prepared in the internationally accepted IPGRI format for descriptor lists was subsequently sent to a number of experts for their comments and amendments. The UPOV Technical Guidelines for Carrot have been examined and where possible a standardized approach has been considered. A full list of the names and addresses of those involved is given in 'Contributors'.

IPGRI encourages the collecting of data for all five types of descriptors (see page 2, Definitions and Use of Descriptors), whereby data from the first four categories - *Passport, Management, Environment and Site,* and *Characterization* - should be available for any accession. The number of descriptors selected in each of the categories will depend on the crop and their importance to the crop's description. Descriptors listed under *Evaluation* allow for a more extensive description of the accession, but generally require replicated trials over a period of time.

Although the suggested coding should not be regarded as the definitive scheme, this format represents an important tool for a standardized characterization system and it is promoted by IPGRI throughout the world.

This descriptor list provides an international format and thereby produces a universally understood `language' for plant genetic resources data. The adoption of this scheme for data encoding, or at least the production of a transformation method to convert other schemes into the IPGRI format, will produce a rapid, reliable and efficient means for information storage, retrieval and communication, and will assist with the utilization of germplasm. It is recommended, therefore, that information should be produced by closely following the descriptor list with regard to: ordering and numbering descriptors, using the descriptors specified, and using the descriptor states recommended.

This descriptor list is intended to be comprehensive for the descriptors that it contains. This approach assists with the standardization of descriptor definitions. IPGRI does not, however, assume that each curator will characterize accessions of their collection utilizing all descriptors given. Descriptors should be used when they are useful to the curator for the management and maintenance of the collection and/or to the users of the plant genetic resources. However, highly discriminating descriptors are marked as highlighted text to facilitate selection of descriptors.

Annex I contains multicrop passport descriptors developed jointly by IPGRI and FAO, to provide consistent coding schemes for common passport descriptors across crops and aim to be compatible with both future IPGRI crop descriptor lists and the FAO World Information and Early Warning System (WIEWS) on plant genetic resources.

In Annex II, the reader will find a Natural key to the major subdivisions of the *Daucus carota* complex.

Any suggestions for improvement on the Descriptors for wild and cultivated Carrots will be highly appreciated by IPGRI.

INTRODUCTION

Carrot (*Daucus carota* L., 2*n*=18) is a cool-weather plant, but also cultivated in tropical and subtropical regions, especially at high elevations. It was domesticated in Afghanistan (primary centre of diversity) and from there it spread over Europe, the Mediterranean area and Asia. During this spread, it introgressed with local wild types.

Daucus carota sensu lato is widely considered to be the most problematic species in the Umbelliferae. Both wild and domesticated phases comprise numerous intergrading variants (see Annex II "Natural key to the major subdivisions of the *Daucus carota* complex" for details). The domesticated types are divided into two groups: (1) the "Eastern (or Asian) carrots" (var. *atrorubens* Alef.), with mainly purple and yellow roots; and (2) the "Western carrots" [var. *sativus* (Hoffm.) Arcangeli] with mainly orange roots. The purple types have a short storage time. In Turkey and Japan, hybrids between the two groups occur; in Turkey because the two groups grow in close proximity and hybridize naturally. Turkey is therefore a secondary centre of diversity. In Japan, breeders developed varieties from artificial crosses of these two groups.

Domesticated carrots have been taxonomically segregated from wild carrots at several ranks: *D. carota* var. *sativus* Hoffm. (Hoffmann 1791), *D. carota* subsp. *sativus* (Hoffm.) Arcangeli (Arcangeli 1882), and *D. sativus* (Hoffm.) Roehl (Roehling 1812). Wild types occur in Europe, Southwest and Central Asia and North Africa. These wild types have been grouped into two aggregates:

(1) subsp. agg. *gingidium* including former subsp. *gummifer* Hooker f., *commutatus* (Paol.) Thell., *hispanicus* (Goüan) Thell., *hispidus* (Arcangeli) Heywood, *gadecaei* (Rouy & Camus) Heywood, *drepanensis* (Arcangeli) Heywood and *rupestris* (Guss.) Heywood, and

(2) subsp. agg. *carota* with the former subsp. *carota*, *maritimus* (Lam.) Batt., *major* (Vis.) Arcangeli and *maximus* (Desf.) Ball.

The yellow and white carrots probably originated by mutation. The white mutants (*albus*) were used for fodder and did not participate in the development of the European carrot. After reaching Iran, carrot probably spread to China. The yellow carrot (*D. carota* L., 2*n*=18) is a wild species found from Afghanistan to the Mediterranean area. Although yellow carrots may have arisen in other areas where purple carrots were cultivated, it is thought that the true yellow carrots developed in the Mediterranean region from crosses with the wild *D. carota* L. subsp. agg. *carota* [syn. subsp. *maximus* (Desf.) Ball]. *Daucus carota* intercrosses freely with subsp. *carota* and other wild forms. It is an outbreeder.

The origin of white carrot (*D. carota* L., 2*n*=18) is not clear. It probably arose as a mutant from a yellow type, most likely in France.

The orange carrot (*D. carota* L., 2*n*=18) probably originated in the Netherlands. This type of carrot is now cultivated widely by people of European stock. It has suppressed the growth of the purple carrot, which colours soups and food preparations purple. The poor storage quality of the purple types may also have encouraged their replacement by other types. Even before the introduction of domesticated carrots, wild plants were grown in gardens as medicinal plants.

DEFINITIONS AND USE OF THE DESCRIPTORS

IPGRI uses the following definitions in genetic resources documentation:

Passport descriptors: These provide the basic information used for the general management of the accession (including the registration at the genebank and other identification information) and describe parameters that should be observed when the accession is originally collected.

Management descriptors: These provide the basis for the management of accessions in the genebank and assist with their multiplication and regeneration.

Environment and site descriptors: These describe the environmental and site-specific parameters that are important when characterization and evaluation trials are held. They can be important for the interpretation of the results of those trials. Site descriptors for germplasm collecting are also included here.

Characterization descriptors: These enable an easy and quick discrimination between phenotypes. They are generally highly heritable, can be easily seen by the eye and are equally expressed in all environments. In addition, these may include a limited number of additional traits thought desirable by a consensus of users of the particular crop.

Evaluation descriptors: The expression of many of the descriptors in this category will depend on the environment and, consequently, special experimental designs and techniques are needed to assess them. Their assessment may also require complex biochemical or molecular characterization methods. This type of descriptors includes characters such as yield, agronomic performance, stress susceptibilities and biochemical and cytological traits. They are generally the most interesting traits in crop improvement.

Characterization will normally be the responsibility of genebank curators, while evaluation will typically be carried out elsewhere (possibly by a multidisciplinary team of scientists). The evaluation data should be fed back to the genebank which will maintain a data file.

Highly discriminating descriptors are marked as highlighted text.

The following internationally accepted norms for the scoring, coding and recording of descriptor states should be followed:

(a) the Système International d'Unités (SI) is used;

(b) the units to be applied are given in square brackets following the descriptor name;

(c) standard colour charts, e.g. Royal Horticultural Society Colour Chart, Methuen Handbook of Colour, or Munsell Color Chart for Plant Tissues, are strongly recommended for all ungraded colour characters (the precise chart used should be specified in the section where it is used);

(d) many quantitative characters which are continuously variable are recorded on a 1-9 scale, where:

1	Very low	6	Intermediate to high
2	Very low to low	7	High
3	Low	8	High to very high
4	Low to intermediate	9	Very high
5	Intermediate		

is the expression of a character. The authors of this list have sometimes described only a selection of the states, e.g. 3, 5 and 7 for such descriptors. Where this has occurred, the full range of codes is available for use by extension of the codes given or by interpolation between them, e.g. in Section 10 (Biotic stress susceptibility), 1 = very low susceptibility and 9 = very high susceptibility;

(e) when a descriptor is scored using a 1-9 scale, such as in (d), '0' would be scored when (i) the character is not expressed; (ii) a descriptor is inapplicable. In the following example, '0' will be recorded if an accession does not have a central leaf lobe:

Shape of central leaf lobe

1 Toothed
2 Elliptic
3 Linear

(f) absence/presence of characters is scored as in the following example:

Terminal leaflet

0	Absent
1 (or +)	Present

(g) blanks are used for information not yet available;

(h) for accessions which are not generally uniform for a descriptor (e.g. mixed collection, genetic segregation), the mean and standard deviation could be reported where the descriptor is continuous. Where the descriptor is discontinuous, several codes in the order of frequency could be recorded; or other publicized methods can be utilized, such as Rana *et al.* (1991) or van Hintum (1993), that clearly state a method for scoring heterogeneous accessions;

(i) dates should be expressed numerically in the format YYYYMMDD, where

YYYY - 4 digits to represent the year
MM - 2 digits to represent the month
DD - 2 digits to represent the day.

PASSPORT

1. Accession descriptors

1.1 Accession number

This number serves as a unique identifier for accessions and is assigned when an accession is entered into the collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number should never be re-used. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system).

1.2 Donor name

Name of institution or individual responsible for donating the germplasm

1.3 Donor number

Number assigned to an accession by the donor

1.4 Other number(s) associated with the accession

Any other identification number known to exist in other collections for this accession, e.g. USDA Plant Inventory number (not Collecting number, see descriptor **2.3**). Other numbers can be added as 1.4.3, etc.

1.4.1 Other number 1

1.4.2 Other number 2

1.5 Scientific name

1.5.1 Genus

1.5.2 Species

1.5.3 Subspecies

1.5.3.1 ***sativus***
1.5.3.2 **aggregate *gingidium***
1.5.3.3 **aggregate *carota***

1.5.4 Botanical variety

1.6 Pedigree
Parentage or nomenclature, and designations assigned to breeders' material

1.7 Accession

1.7.1 Accession name
Either a registered or other formal designation given to the accession

1.7.2 Local language
Language in which the accession name is given

1.7.3 Translation/Transliteration
Provide translation of the local accession name into English

1.7.4 Synonyms
Include here any previous identification other than the current name. Collecting number or newly assigned station name are frequently used as identifiers.

1.8 Acquisition date [YYYYMMDD]
Date on which the accession entered the collection

1.9 Accession size
Approximate number or weight of seeds of an accession in the genebank

1.10 Notes
Any additional information may be specified here

2. Collecting descriptors

2.1 Collecting institute(s)
Name and address of the institute(s) and individuals collecting/sponsoring the collection of the sample(s)

2.2 Site number
Number assigned to the physical site by the collector

2.3 Collecting number
Original number assigned by the collector(s) of the sample, normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates held in different collections. It should be unique and always accompany subsamples wherever they are sent.

2.4 Collecting date of original sample [YYYYMMDD]

2.5 Country of collecting

Name of the country in which the sample was collected. Use the three-letter abbreviations from the *International Standard (ISO) Codes for the representation of names of countries*, No. 3166, 4th Edition. Copies of these are available from DIN: Deutsches Institut für Normung e.V., 10772 Berlin, Germany; Tel. +30-2601-369; Fax +30-2601-1231, Tlx. 184 273-din-d; Web site URL: <http://www.din.de/set/de/DIN>.

2.6 Province/State

Name of the primary administrative subdivision of the country in which the sample was collected

2.7 Department/County

Name of the secondary administrative subdivision (within a Province/State) of the country in which the sample was collected

2.8 Location of collecting site

Distance in kilometers and direction from the nearest town, village or map grid reference point (e.g. CURITIBA 7S means 7 km south of Curitiba)

2.9 Latitude of collecting site

Degrees and minutes followed by N (North) or S (South) (e.g. 1030S). Missing data (minutes) should be indicated with hyphen (e.g. 10–S).

2.10 Longitude of collecting site

Degrees and minutes followed by E (East) or W (West) (e.g. 07625W). Missing data (minutes) should be indicated with hyphen (e.g. 076–W).

2.11 Elevation of collecting site [m asl]

2.12 Collecting source

The coding scheme proposed can be used at two different levels of detail: either by using the global codes such as 1, 2, 3, 4 (or by using the more detailed coding such as 1.1, 1.2, 1.3, etc.

- 0 Unknown
- 1 Wild habitat
  - 1.1 Forest/woodland
  - 1.2 Shrubland
  - 1.3 Grasslands
  - 1.4 Desert/tundra
- 2 Farm
  - 2.1 Field
  - 2.2 Orchard
  - 2.3 Garden

2.4 Fallow
2.5 Pasture
2.6 Store
3 Market
3.1 Town
3.2 Village
3.3 Urban area (around city)
3.4 Other exchange system
4 Institute/Research organization
99 Other (specify in descriptor **2.27 Collector's notes**)

2.13 Collecting source environment

Use descriptors **6.1.1 to 6.1.22** in section 6

2.14 Status of sample

0 Unknown
1 Wild
2 Weedy
3 Traditional cultivar/Landrace
4 Breeder's line
5 Advanced cultivar
99 Other (specify in descriptor **2.27 Collector's notes**)

2.15 Type of sample

Type of plant material collected. If different types of material were collected from the same source, each sample (type) should be designated with a unique collecting number and a corresponding unique accession number

1 Vegetative (root, steckling[1])
2 Seed
3 Pollen
4 Tissue culture
99 Other (specify which part of the plant is used in **2.27 Collector's notes**)

2.16 Number of seeds, stecklings, cultures collected

2.17 Weight of seeds/stecklings collected [g]

2.18 Associated flora

Other dominant crop/plant species, including other carrot species, cultivated species, found in and around the collecting site

[1] Steckling: a small plant of a biennial root crop (such as beet or carrot) that is dug and stored over winter and replanted the next season for seed production.

2.19 Cultural methods

2.19.1 Irrigation

1 Rain-fed
2 Irrigated
3 Both/alternate

2.19.2 Cropping system

1 Monoculture
2 Mixed with crops (specify crop in descriptor **2.27 Collector's notes**)
99 Other (specify crop in descriptor **2.27 Collector's notes**)

2.20 Local/vernacular name

Name given by farmer to crop and cultivar/landrace/clone/wild form. State language and dialect if the ethnic group is not provided

2.21 Ethnic group

Name of the ethnic group of the donor of the sample or of the people living in the area of collecting

2.22 Parts of plant used

1 Stalk/trunk
2 Branch/twig
3 Leaf
4 Bark
5 Rhizome
6 Flower/inflorescence
7 Fruit
8 Seed
9 Root
10 Tuber
11 Sap/resin
99 Other (specify in descriptor **2.27 Collector's notes**)

2.23 Plant uses

1 Food
2 Medicine
3 Beverage
4 Fibre
5 Timber
6 Craft
7 Forage/fodder
8 Building
9 Ornamental
99 Other (specify in descriptor **2.27 Collector's notes**)

2.24 Photograph

Was a photograph(s) taken of the accession or habitat at the time of collecting? If so, provide an identification number(s) in descriptor **2.27 Collector's notes**.

0 No
1 Yes

2.25 Herbarium specimen

Was a herbarium specimen collected? If so, provide an identification number and indicate in which place (herbarium) the carrot specimen was deposited, in descriptor **2.27 Collector's notes**.

0 No
1 Yes

2.26 Prevailing stresses

Information on associated biotic and abiotic stresses and the accession's reaction. Specify stresses in descriptor **2.27 Collector's notes**.

2.27 Collector's notes

Additional information recorded by the collector or any specific information on any state in any of the above descriptors

MANAGEMENT

3. Seed management descriptors

3.1 Accession number (Passport 1.1)

3.2 Population identification (Passport 2.3)
Collecting number, pedigree, cultivar name, etc., depending on the population type

3.3 Storage address
(Building, room, shelf numbers/location in medium- and/or long-term storage)

3.4 Storage date [YYYYMMDD]

3.5 Seed germination at storage (initial) [%]

3.6 Date of last seed germination test [YYYYMMDD]

3.7 Seed germination at the last test [%]

3.8 Date of next seed germination test [YYYYMMDD]
Estimated date when the accession should next be tested

3.9 Seed moisture content at harvest [%]

3.10 Seed moisture content at storage (initial) [%]

3.11 Amount of seed in storage(s) [g or number] (Passport 1.9)

3.12 Duplication at other location(s) (Passport 1.4)

4. Multiplication/regeneration descriptors

4.1 Accession number (Passport 1.1)

4.2 Population identification (Passport 2.3)
Collecting number, pedigree, cultivar name, etc., depending on the population type

4.3 Field plot number

4.4 Multiplication/regeneration site location

4.5 Collaborator

4.6 Sowing date [YYYYMMDD]

4.7 Plant density on the field

1 Low (<10 plants/m^2)
2 Intermediate (10 – 40 plants/m^2)
3 High (>40 plants/m^2)

4.8 Seedling vigour

Visual assessment at flowering. Based on observations from at least 20 plants

3 Low
5 Medium
7 High

4.9 Number of days from sowing to 50% flowering [d]

Without vernalization

4.10 Number of days from flowering to 50% maturity [d]

Without vernalization

4.11 Number of plants pollinated

4.12 Pollination method

100 or more plants are preferred

1 Selfing
2 Chain cross
3 Pair crossing
4 Bulk pollen
5 Isolation
6 Caged with insect pollination
99 Other (specify in descriptor **4.17 Notes**)

4.13 Previous multiplication and/or regeneration

4.13.1 Location

4.13.2 Sowing date [YYYYMMDD]

4.13.3 Plot number

4.14 Number of times accession regenerated

Number of regenerations or multiplications since original collection

4.15 Number of plants used in each regeneration/multiplication

4.16 Type of maintenance

1 Vegetative
2 Seed
3 Both (seed and vegetative)
4 Tissue culture
5 Cryogenic storage
99 Other (specify in descriptor **4.17 Notes**)

4.17 Notes

Any additional information may be specified here

ENVIRONMENT AND SITE

5. Characterization and/or evaluation site descriptors

5.1 Country of characterization and/or evaluation

(See instructions in descriptor **2.5 Country of collecting**)

5.2 Site (research institute)

5.2.1 Latitude

Degrees and minutes followed by N (North) or S (South) (e.g. 1030S). Missing data (minutes) should be indicated with hyphen (e.g. 10–S).

5.2.2 Longitude

Degrees and minutes followed by E (East) or W (West) (e.g. 07625 W). Missing data (minutes) should be indicated with hyphen (e.g. 076–W).

5.2.3 Elevation [m asl]

5.2.4 Name and address of farm or institute

5.3 Evaluator's name and address

5.4 Sowing date [YYYYMMDD]

5.5 First harvest date [YYYYMMDD]

5.6 Last harvest date [YYYYMMDD]

5.7 Evaluation environment

Environment in which characterization/evaluation was carried out

1 Field
2 Screenhouse
3 Glasshouse
4 Laboratory
99 Other (specify in descriptor **5.14 Notes**)

5.8 Field establishment [d]

Number of days from sowing to 50% field establishment

5.9 Sowing site in the field

Give block, strip and/or row/plot numbers as applicable, plants/plot, replication

5.10 Field spacing

5.10.1 Distance between plants in a row [cm]

5.10.2 Distance between rows [cm]

5.11 Environmental characteristics of site

Use descriptors **6.1.1 to 6.1.22** in section 6

5.12 Fertilizer

Specify types, doses, frequency of each and method of application

5.13 Plant protection

Specify pesticides and herbicides used, doses, frequency of each and method of application

5.14 Notes

Any other site-specific information

6. Collecting and/or characterization/evaluation site environment descriptors

6.1 Site environment

6.1.1 Topography

This refers to the profile in elevation of the land surface on a broad scale.
The reference is FAO (1990)

1	Flat	0 - 0.5%
2	Almost flat	0.6 - 2.9%
3	Gently undulating	3 - 5.9%
4	Undulating	6 - 10.9%
5	Rolling	11 - 15.9%
6	Hilly	16 - 30%
7	Steeply dissected	>30%, moderate elevation range
8	Mountainous	>30%, great elevation range (>300 m)
99	Other	(specify in appropriate section's Notes)

6.1.2 Higher level landform (general physiographic features)

The landform refers to the shape of the land surface in the area in which the site is located (adapted from FAO 1990)

1 Plain
2 Basin
3 Valley
4 Plateau
5 Upland
6 Hill
7 Mountain

6.1.3 Land element and position

Description of the geomorphology of the immediate surroundings of the site (adapted from FAO 1990). (See Fig. 1)

1 Plain level
2 Escarpment
3 Interfluve
4 Valley
5 Valley floor
6 Channel
7 Levee
8 Terrace
9 Floodplain
10 Lagoon
11 Pan
12 Caldera
13 Open depression
14 Closed depression
15 Dune
16 Longitudinal dune
17 Interdunal depression
18 Mangrove
19 Upper slope
20 Midslope
21 Lower slope
22 Ridge
23 Beach
24 Beachridge
25 Rounded summit
26 Summit
27 Coral atoll
28 Drainage line (bottom position in flat or almost-flat terrain)
29 Coral reef
99 Other (specify in appropriate section's Notes)

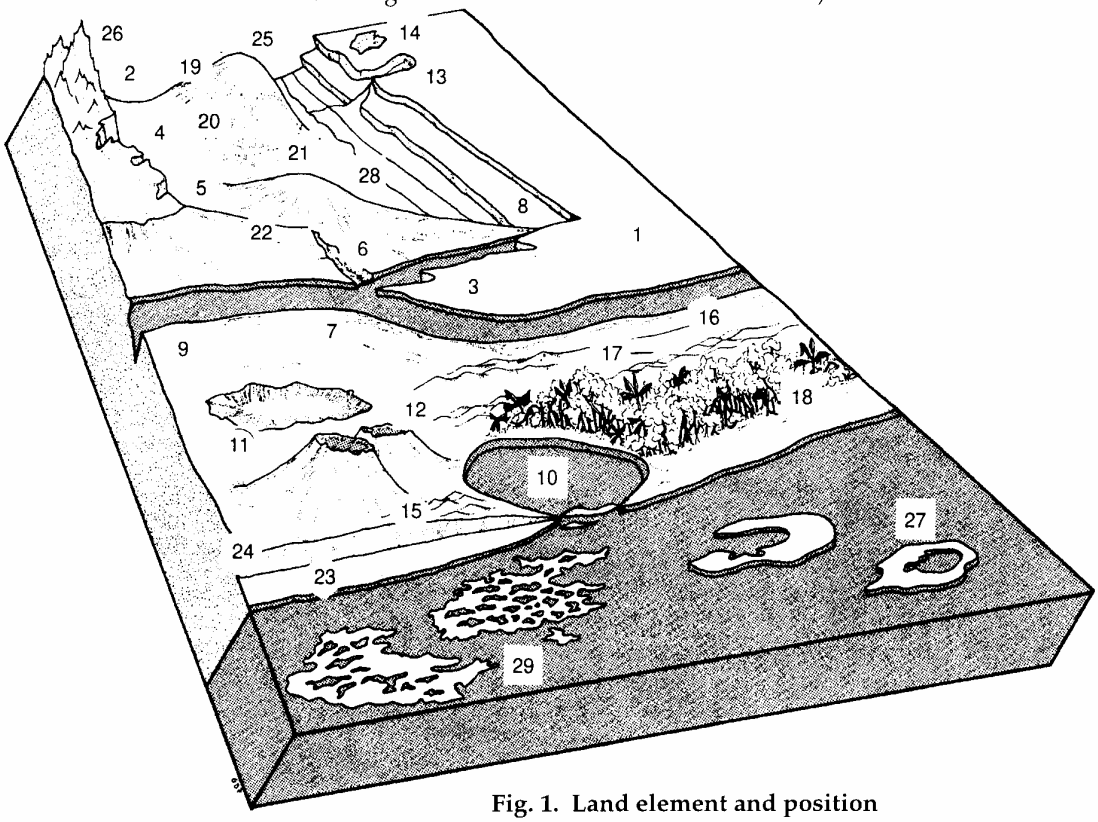

Fig. 1. Land element and position

6.1.4 Slope [°]

Estimated slope of the site

6.1.5 Slope aspect

The direction that the slope on which the accession was collected faces. Describe the direction with symbols N, S, E, W (e.g. a slope that faces a southwestern direction has an aspect of SW)

6.1.6 Crop agriculture

(From FAO 1990)

1 Annual field cropping
2 Perennial field cropping

6.1.7 Overall vegetation surrounding and at the site

(Adapted from FAO 1990)

1	Grassland	(Grasses, subordinate forbs, no woody species)
2	Forbland	(Herbaceous plants predominant)
3	Forest	(Continuous tree layer, crowns overlapping, large number of tree and shrub species in distinct layers)
4	Woodland	(Continuous tree layer, crowns usually not touching, understorey may be present)
5	Shrubland	(Continuous layer of shrubs, crowns touching)
6	Savanna	(Grasses with a discontinuous layer of trees or shrubs)
99	Other	(specify in appropriate section's Notes)

6.1.8 Soil parent material

(Adapted from FAO 1990)

Two lists of examples of parent material and rock are given below. The reliability of the geological information and the knowledge of the local lithology will determine whether a general or a specific definition of the parent material can be given. Saprolite is used if the *in situ* weathered material is thoroughly decomposed, clay-rich but still showing rock structure. Alluvial deposits and colluvium derived from a single rock type may be further specified by that rock type.

6.1.8.1 Unconsolidated material

1 Aeolian deposits (unspecified)
2 Aeolian sand
3 Littoral deposits
4 Lagoonal deposits
5 Marine deposits
6 Lacustrine deposits
7 Fluvial deposits
8 Alluvial deposits
9 Unconsolidated (unspecified)
10 Volcanic ash
11 Loess
12 Pyroclastic deposits
13 Glacial deposits
14 Organic deposits
15 Colluvial deposits
16 *In situ* weathered
17 Saprolite
99 Other (specify in appropriate section's Notes)

6.1.8.2 Rock type

(Adapted from FAO 1990)

1 Acid igneous/metamorphic rock
2 Granite
3 Gneiss
4 Granite/gneiss
5 Quartzite
6 Schist
7 Andesite
8 Diorite
9 Basic igneous/metamorphic rock
10 Ultra basic rock
11 Gabbro
12 Basalt
13 Dolerite
14 Volcanic rock
15 Sedimentary rock
16 Limestone
17 Dolomite
18 Sandstone
19 Quartzitic sandstone
20 Shale
21 Marl
22 Travertine
23 Conglomerate
24 Siltstone
25 Tuff
26 Pyroclastic rock
27 Evaporite
28 Gypsum rock
99 Other (specify in appropriate section's Notes)
0 Not known

6.1.9 Stoniness/rockiness/hardpan/cementation

1 Tillage unaffected
2 Tillage affected
3 Tillage difficult
4 Tillage impossible
5 Essentially paved

6.1.10 Soil drainage

(Adapted from FAO 1990)

3 Poorly drained
5 Moderately drained
7 Well drained

6.1.11 Soil salinity

1 <160 ppm dissolved salts
2 160 - 240 ppm
3 241 - 480 ppm
4 >480 ppm

6.1.12 Soil depth to groundwater table

(Adapted from FAO 1990)

The depth to the groundwater table, if present, as well as an estimate of the approximate annual fluctuation, should be given. The maximum rise of the groundwater table can be inferred approximately from changes in profile colour in many, but not all, soils.

1 0 - 25 cm
2 25.1 - 50 cm
3 50.1 - 100 cm
4 100.1 - 150 cm
5 >150 cm

6.1.13 Soil matrix colour

(Adapted from FAO 1990)

The colour of the soil matrix material in the root zone around the accession is recorded in the moist condition (or both dry and moist condition, if possible) using the notation for hue, value and chroma as given in the Munsell Soil Color Charts (Munsell 1977). If there is no dominant soil matrix colour, the horizon is described as mottled and two or more colours are given and should be registered under uniform conditions. Early morning and late evening readings are not accurate. Provide depth of measurement (cm). If colour chart is not available, the following states may be used:

1	White	7	Reddish brown	13	Greyish
2	Red	8	Yellowish brown	14	Blue
3	Reddish	9	Yellow	15	Bluish-black
4	Yellowish red	10	Reddish yellow	16	Black
5	Brown	11	Greenish, green		
6	Brownish	12	Grey		

6.1.14 Soil pH

Actual value of the soil within the following root depths around the accession

6.1.14.1 pH at 0-10 cm
6.1.14.2 pH at 11-15 cm
6.1.14.3 pH at 16-30 cm
6.1.14.4 pH at 31-60 cm
6.1.14.5 pH at 61-90 cm

6.1.15 Soil erosion

3 Low
5 Intermediate
7 High

6.1.16 Rock fragments

(Adapted from FAO 1990)
Large rock and mineral fragments (>2 mm) are described according to abundance

1 0 - 2%
2 2.1 - 5%
3 5.1 - 15%
4 15.1 - 40%
5 40.1 - 80%
6 >80%

6.1.17 Soil texture classes

(Adapted from FAO 1990)
For convenience in determining the texture classes of the following list, particle size classes are given for each of the fine earth fractions below. (See Fig. 2)

1 Clay
2 Loam
3 Clay loam
4 Silt
5 Silty clay
6 Silty clay loam
7 Silt loam
8 Sandy clay
9 Sandy clay loam
10 Sandy loam
11 Fine sandy loam
12 Coarse sandy loam
13 Loamy sand
14 Loamy very fine sand
15 Loamy fine sand
16 Loamy coarse sand
17 Very fine sand
18 Fine sand
19 Medium sand
20 Coarse sand
21 Sand, unsorted
22 Sand, unspecified

6.1.17.1 Soil particle size classes

(Adapted from FAO 1990)

1	Clay	< 2 µm
2	Fine silt	2 - 20 µm
3	Coarse silt	21 - 63 µm
4	Very fine sand	64 - 125 µm
5	Fine sand	126 - 200 µm
6	Medium sand	201 - 630 µm
7	Coarse sand	631 - 1250 µm
8	Very coarse sand	1251 - 2000 µm

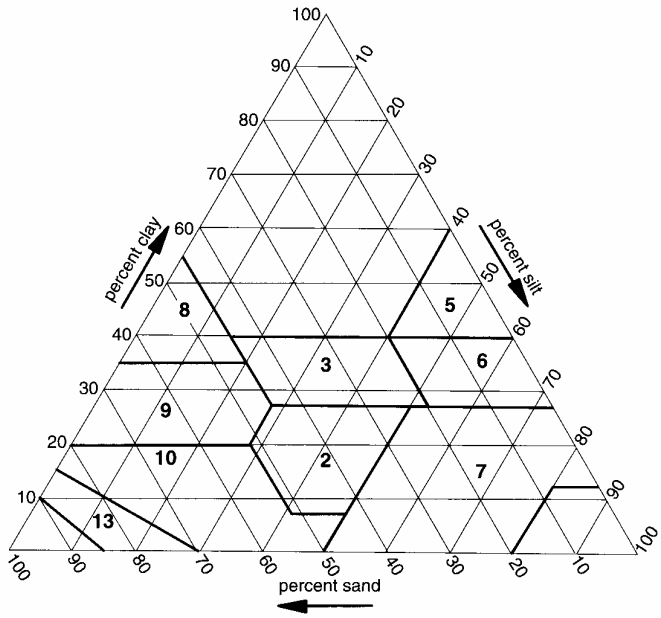

Fig. 2. Soil texture classes

6.1.18 Soil organic matter content

1 Nil (as in arid zones)
2 Low (as in long-term cultivation in a tropical setting)
3 Medium (as in recently cultivated but not yet much depleted)
4 High (as in never cultivated, and in recently cleared from forest)
5 Peaty

6.1.19 Soil taxonomic classification

As detailed a classification as possible should be given. This may be taken from a soil survey map. State class (e.g. Alfisols, Spodosols, Vertisols, etc.).

6.1.20 Water availability

1 Rain-fed
2 Irrigated
3 Flooded
4 River banks
5 Sea coast
99 Other (specify in appropriate section's Notes)

6.1.21 Soil fertility

General assessment of the soil fertility based on existing vegetation

3 Low
5 Moderate
7 High

6.1.22 Climate of the site

Should be assessed as close to the site as possible

6.1.22.1 Temperature [°C]

Provide either the monthly (mean, maximum, minimum) or the seasonal (mean, maximum, minimum)

6.1.22.2 Dry season length [d]

6.1.22.3 Rainfall [mm]

Annual average (state number of recorded years)

6.1.22.4 Wind [m/s]

Annual average (state number of years recorded)

6.1.22.4.1 Frequency of typhoons or hurricane force winds

3 Low
5 Intermediate
7 High

6.1.22.4.2 Date of most recent typhoons or hurricane force winds [YYYYMMDD]

6.1.22.4.3 Annual maximum wind velocity [m/s]

6.1.22.5 Frost

6.1.22.5.1 Date of most recent frost [YYYYMMDD]

6.1.22.5.2 Minimum temperature [°C]

Specify seasonal average and minimum survival temperature

6.1.22.5.3 Duration of temperature below 0°C [d]

6.1.22.6 Relative humidity

6.1.22.6.1 Relative humidity diurnal range [%]

6.1.22.6.2 Relative humidity seasonal range [%]

6.1.22.7 Light

1 Shady
2 Sunny

6.1.22.8 Daylength [h]

Provide either the monthly (mean, maximum, minimum) or the seasonal (mean, maximum, minimum)

CHARACTERIZATION

7. Plant descriptors

Observations should be made on at least 20 representative samples per accession. Record the average

7.1 First year (or juvenile) characteristics

(Unless otherwise specified)

7.1.1 Days from sowing to normal seedling [d]

(Seedlings with root hairs)

7.1.2 Plant diameter [cm]

Measure extremity of plant. Record at flowering (first umbel opened)

7.1.3 Length of basal primary leaflet [cm]

7.1.4 Number of segment tips on lower primary leaflet

7.1.5 Petiole thickness [mm]

Record at the thickest point, at the time of full development of the foliage. (See Fig. 3)

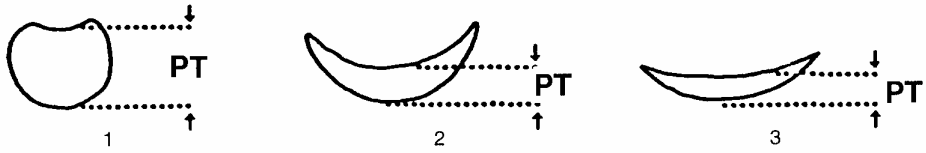

Fig. 3. Petiole thickness (PT) and shape in transverse section

7.1.6 Petiole shape in transverse section

(See Fig. 3)

1 Round
2 Semi-round
3 Flat
99 Other (specify in descriptor **7.11 Notes**)

7.1.7 Anthocyanin colouration in petiole

Observe on the inside of the petiole

3 Slightly coloured
5 Intermediate
7 Strongly coloured

7.1.8 Petiole hairiness

3 Sparse
5 Intermediate
7 Dense

7.1.9 Number of mature leaves per plant

7.1.10 Mature leaf length [cm]
(Excluding petiole)

7.1.11 Mature leaf width [cm]
Recorded at the widest point

7.1.12 Leaf growth habit (attitude)

3 Prostrate
5 Semi-erect
7 Erect

7.1.13 Leaf hairiness

3 Sparse
5 Intermediate
7 Dense

7.1.14 Leaf type

1 Celery
2 Normal
3 Parsley or Fern

7.1.15 Leaf dissection
(See Fig. 4)

3 Slightly dissected
5 Intermediate
7 Highly dissected

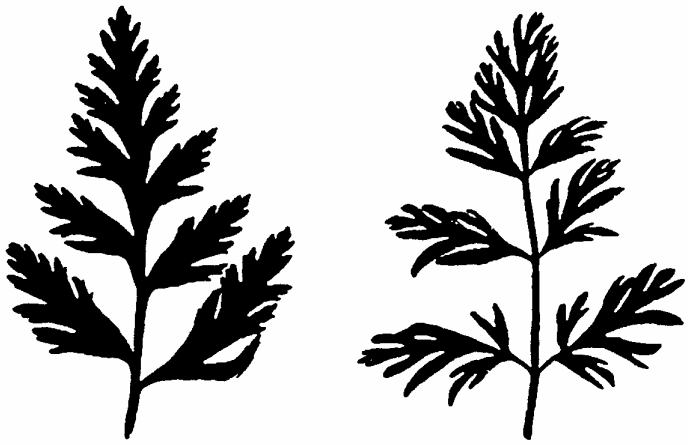

Fig. 4. Leaf dissection

7.1.16 Leaf colour

1 Yellow green
2 Green
3 Grey-green
4 Purple green
99 Other (specify in descriptor **7.11 Notes**)

7.1.16.1 Leaf colour intensity

3 Light
7 Dark

7.1.17 Foliage coverage

Covering the ground. Observe at the time of full development of the foliage

3 Sparse (with little protection of roots against sun-scorch)
5 Intermediate
7 Dense (with adequate protection of roots against sun-scorch)

7.1.18 Foliage width (crown)

Observe at the time of full development of the foliage

3 Narrow
5 Intermediate
7 Wide

7.1.19 Stem development in first year

1 Stem consists of a small plate-like crown (almost stemless)
2 Stem elongates and forms branches

7.2 First year bolting

7.2.1 Bolting tendency

Bolting is a sudden and premature shift to stem elongation before the root has thickened properly. Bolting often occurs if temperature is too low, especially when carrots are grown under subtropical winter conditions. Carrots are very prone to bolting at the 5 to 8-leaf stage, whereas the risk is much smaller at the 3 to 4-leaf stage and after the 8-leaf stage

3 Low
5 Intermediate
7 High

7.2.2 Bolting rate

3 Slow
5 Intermediate
7 Fast

7.2.3 Percentage of bolters [%]

7.2.4 Number of days to internode extension (bolting) [d]

From sowing

7.3 Second-year (or pre-flowering) characteristics

7.3.1 Foliage growth habit

3 Prostrate
5 Semi-erect
7 Erect

7.3.2 Foliage density

3 Low
5 Intermediate
7 High

7.3.3 Mean stem length [cm]

7.3.4 Mean stem diameter [mm]

Recorded at stem base

7.3.5 Stem colour

1 Yellow green
2 Green
3 Grey-green
4 Purple green
5 Red
99 Other (specify in descriptor **7.11 Notes**)

7.3.5.1 Stem colour intensity

3 Light
7 Dark

7.3.6 Stem ridging

3 Slight
5 Intermediate
7 Conspicuous/pronounced

7.3.7 Stem hairiness

3 Sparse
5 Intermediate
7 Dense

7.3.8 Stem growth habit

3 Prostrate
5 Semierect
7 Erect

7.3.9 Number of branches per plant

7.3.10 Mean branch length per plant [cm]

7.3.11 Number of stem leaves per plant

7.3.12 Mean stem length of leaves developed on stem [cm]

7.4 External root characteristics (cortex)

7.4.1 Root size uniformity in accession

3 Low uniformity
5 Moderate uniformity
7 High uniformity

7.4.2 Root position in soil

Observed at maturity

3 Shallow
5 Medium
7 Deep

7.4.3 Root axis

1 Not straight
2 Straight

7.4.4 Lateral (secondary) root growth in accession

To be observed in the absence of aster yellows

3 Low
5 Medium
7 High

7.4.5 Emergence of lateral (secondary) roots on fleshy taproot

0 None
1 Mostly on upper portion
2 Mostly on lower portion
3 All over

7.4.6 Root length

		Example varieties
3	Short	(Chantenay)
5	Intermediate	(Nantaise)
7	Long	(Berlikumer)

7.4.7 Root diameter

Recorded at the widest point of the root

3	Narrow	(Amsterdam)
5	Intermediate	(Nantaise)
7	Wide	(De Colmar, Parijse)

7.4.7.1 Root diameter of core relative to total diameter

3 Small
5 Intermediate
7 Large

7.4.8 Root ratio length/diameter

		Example varieties
1	Very small	(Amsterdam, Imperator)
3	Small	(Nantaise)
5	Intermediate	(Chantenay)
7	Large	(Davanture)
9	Very large	(Parijse Markt)

7.4.9 Root diameter at shoulder [mm]

Measure at 2-3 cm below the leaf attachment

7.4.10 Root weight [g]

7.4.11 Root surface

1 Smooth
2 Coarse
3 Dimpled
4 Ridged
99 Other (specify in descriptor **7.11 Notes**)

7.4.12 Root branching

(See Fig. 5)

0 Absent
3 Sparse
5 Intermediate
7 Dense

Fig. 5. Root branching

7.4.13 Root splitting/cracking tendency

State in descriptor **7.11 Notes** whether unfavourable conditions (climatic or edaphic) were present

3 Low
5 Intermediate
7 High

7.4.14 Root shape

In longitudinal section. (See Fig. 6)

1 Round
2 Obovate
3 Obtriangular
4 Oblong
5 Tapering
99 Other (specify in descriptor **7.11 Notes**)

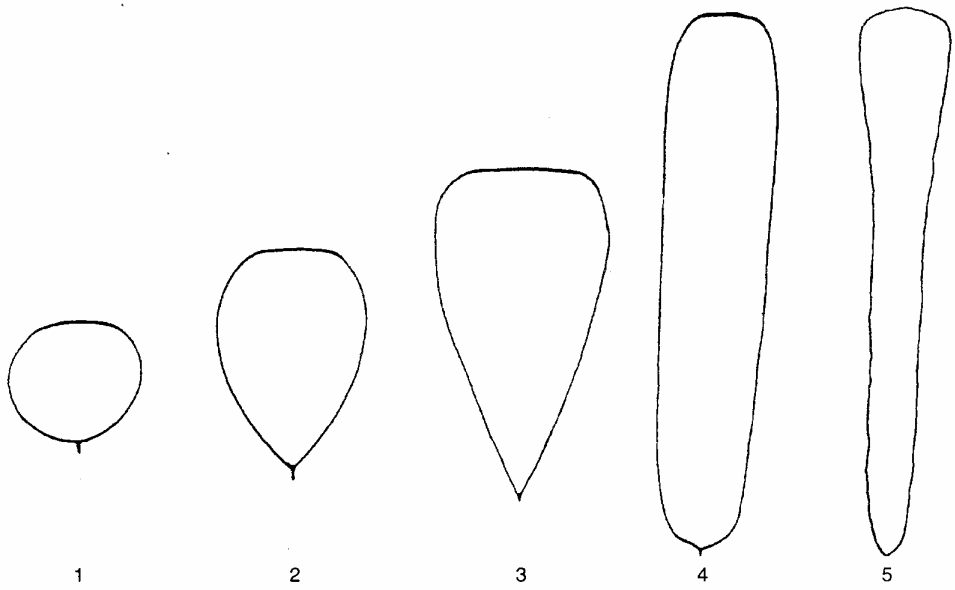

Fig. 6. Root shape

7.4.15 Root shape uniformity in accession

3 Low uniformity
5 Moderate uniformity
7 High uniformity

7.4.16 Root shoulder shape

1 Flat
2 Flat to rounded
3 Rounded
4 Rounded to conical
5 Conical
99 Other (specify in descriptor **7.11 Notes**)

7.4.17 Extent of green colour of skin on shoulder

		Example varieties
3	Low	(Scarla)
5	Intermediate	(De Colmar)
7	High	(Touchon)

7.4.18 Extent of red colour of skin on shoulder

3 Low
5 Intermediate
7 High

7.4.19 Root type grouping

(See Fig. 7)

1 Imperator
2 Gold Pak
3 Nantes
4 Chantenay
5 Danvers
6 Amsterdam
7 Feonia-Berlicum
8 Flakkeer
9 Paris
10 Oxheart (not illustrated)
11 Saint Valery (not illustrated)
99 Other (e.g. wild or forage carrots, specify in descriptor **7.11 Notes**)

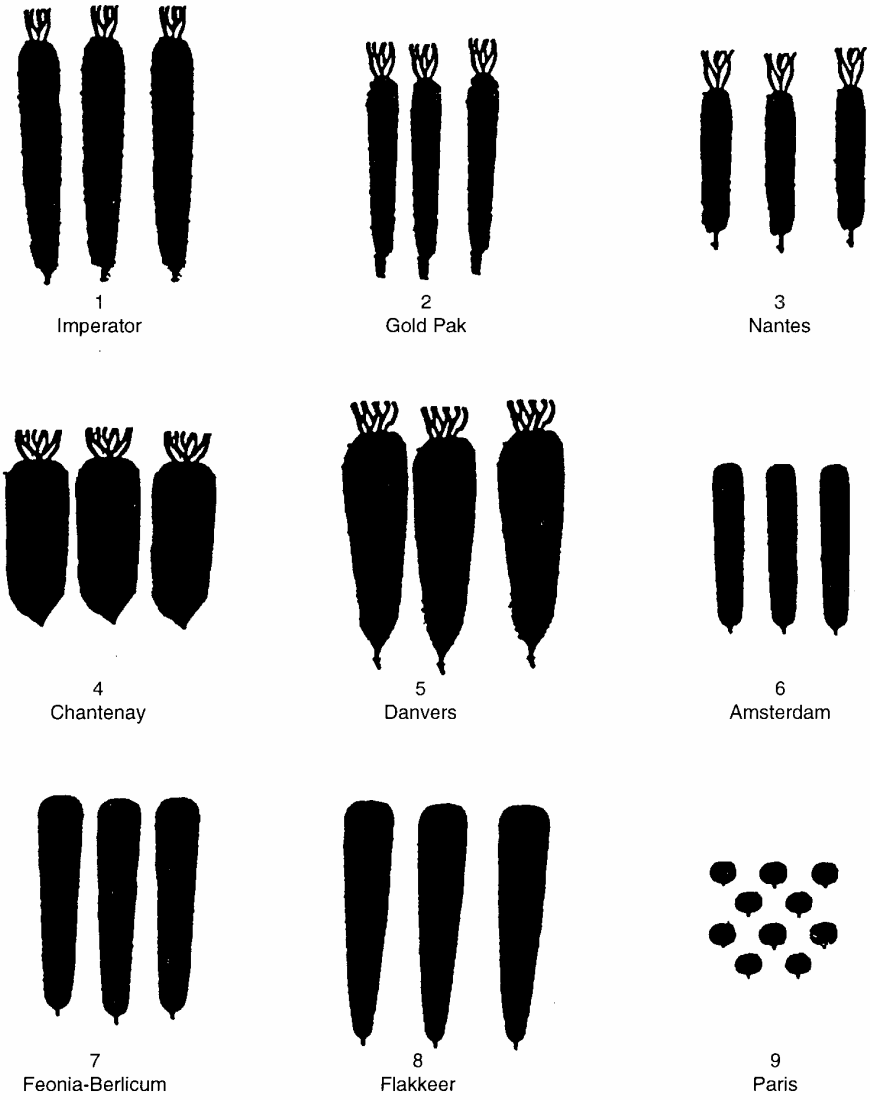

Fig. 7. Root type grouping

7.4.20 Root tapering

0 Absent
1 Slight
2 Intermediate
3 Acute

7.4.21 Root tip/end shape

1 Blunt
2 Rounded
3 Pointed
99 Other (specify in descriptor **7.11 Notes**)

7.4.22 Root skin pigmentation/colour

1 White
2 Yellow
3 Orange
4 Red
5 Purple
99 Other (specify in descriptor **7.11 Notes**)

7.4.22.1 Root skin colour intensity

3 Light
7 Dark

7.5 Internal root characteristics (Core)

A cross-section of the root shows two distinct regions: (a) an outer core of phloem, composed of a thin periderm — a layer of corm cells — and a wide band of secondary phloem, parenchyma cells, and (b) an inner core consisting of secondary xylem and pith

7.5.1 Outer core diameter at shoulder

3 Narrow
5 Intermediate
7 Wide

7.5.2 Outer core thickness at shoulder [mm]

7.5.3 Homogeneity of core pigmentation/colouring throughout root length

3 Low
5 Intermediate
7 High

7.5.4 White colour in outer core

0 Absent
1(or +) Present

7.5.5 Outer core pigmentation/colour

Observe pigmentation/colour at maximum diameter

1 White
2 Yellow
3 Orange
4 Red
99 Other (specify in descriptor **7.11 Notes**)

7.5.6 Inner core diameter at shoulder [mm]

Recorded at the widest point

7.5.7 Inner core pigmentation/colour

Observe pigmentation/colour at maximum diameter

1 White
2 Yellow
3 Orange
4 Red
99 Other (specify in descriptor **7.11 Notes**)

7.5.7.1 Green colouration of interior of the top

In longitudinal section

3 Weak
7 Strong

7.6 Flesh (outer and inner core combined)

7.6.1 Flesh colour distribution in transverse section

(See Fig. 8)

1 Indistinctly uniform throughout outer and inner cores
2 Colour in two distinct outer and inner cores
3 Colour radially distributed in stellate pattern
4 Colour radially distributed from inner core
99 Other (specify in descriptor **7.11 Notes**)

Fig. 8. Flesh colour distribution in transverse section

7.6.2 Homogeneity of flesh colouring throughout root length

3 Low
5 Intermediate
7 High

7.6.3 Flesh colour intensity

3 Pale/dull
5 Intermediate
7 Bright/intense

7.6.4 Green colour of flesh (outer and inner) at shoulder

0 Absent
1 Present

7.6.5 Flesh palatability

Particularly important with wild and cultivated genotypes

3 Low
5 Intermediate
7 High

7.7 Flowering

Observe descriptors at 50% flowering. Descriptors should be scored on plants grown under normal cropping with no artificial vernalization[2] or hormonal treatments given

7.7.1 Accession longevity (lifespan)

1 Annual
2 Biennial
3 Both

7.7.2 Number of days to flowering [d]

From sowing to when 50% of plants start to flower

7.7.3 Flowering synchrony among plants

1 Low (flowering spread over several weeks)
2 Intermediate
3 High (all plants flowering within a few days)

7.7.4 Flowering pattern within plants

1 Determinate
2 Indeterminate

[2] Vernalization: to hasten the flowering and fruiting by treating seeds, storage root, or seedlings by a method (such as exposing sometimes partially sprouted seed to low or high temperatures for a period) that induces a shortening of the vegetative period.

7.8 Inflorescence

The main shoot of carrot terminates in an inflorescence which is designated the primary umbel. Lateral shoots terminate in umbels of higher order. Each individual shoot bears umbels up to the fourth or fifth order. The inflorescence is a compound umbel; comprising several umbellets, each composed of several flowers

7.8.1 Umbel type

(See Fig. 9)

1 Simple
2 Compound
3 Both

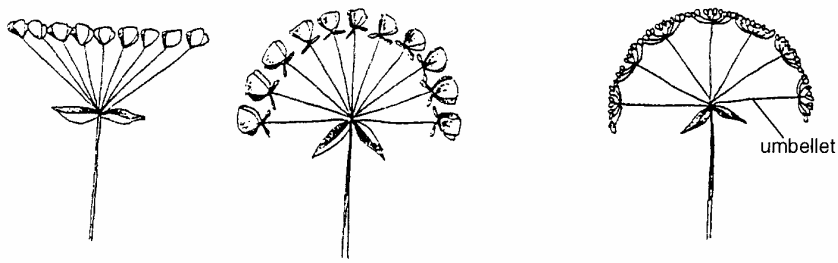

Fig. 9. Umbel type

7.8.2 Total number of umbels per plant

7.8.3 Width of primary open umbel [cm]

7.8.4 Number of leaves below the primary umbel

7.8.5 Umbel shape

Observed at full development. (See Fig. 10)

1 Convex, nest-like umbel with curved rays
2 Flat-topped umbel with straight rays
3 Concave (Not illustrated)

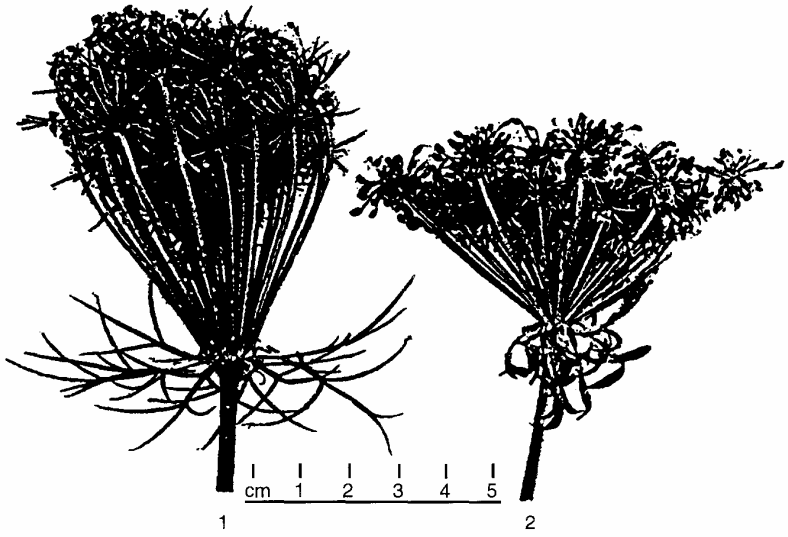

Fig. 10. Umbel shape

7.8.6 Type of ultimate involucral bracts on primary umbel
(See Fig. 11)

1 Relatively branched (foliose) bract
2 Relatively unbranched bract
3 Comparatively broad ultimate segments
99 Other (specify in descriptor **7.11 Notes**)

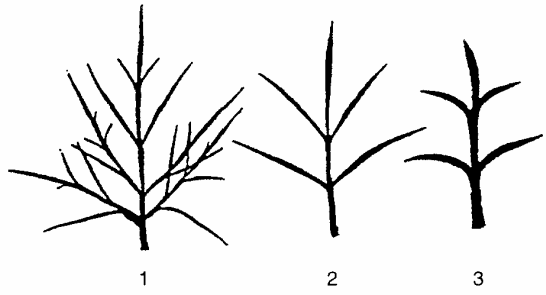

Fig. 11. Type of involucral bracts

7.8.7 Position of involucral bracts on primary umbel

1 Deflexed
2 Not deflexed

7.8.8 Average number of umbellets per umbel
(See Fig. 12)

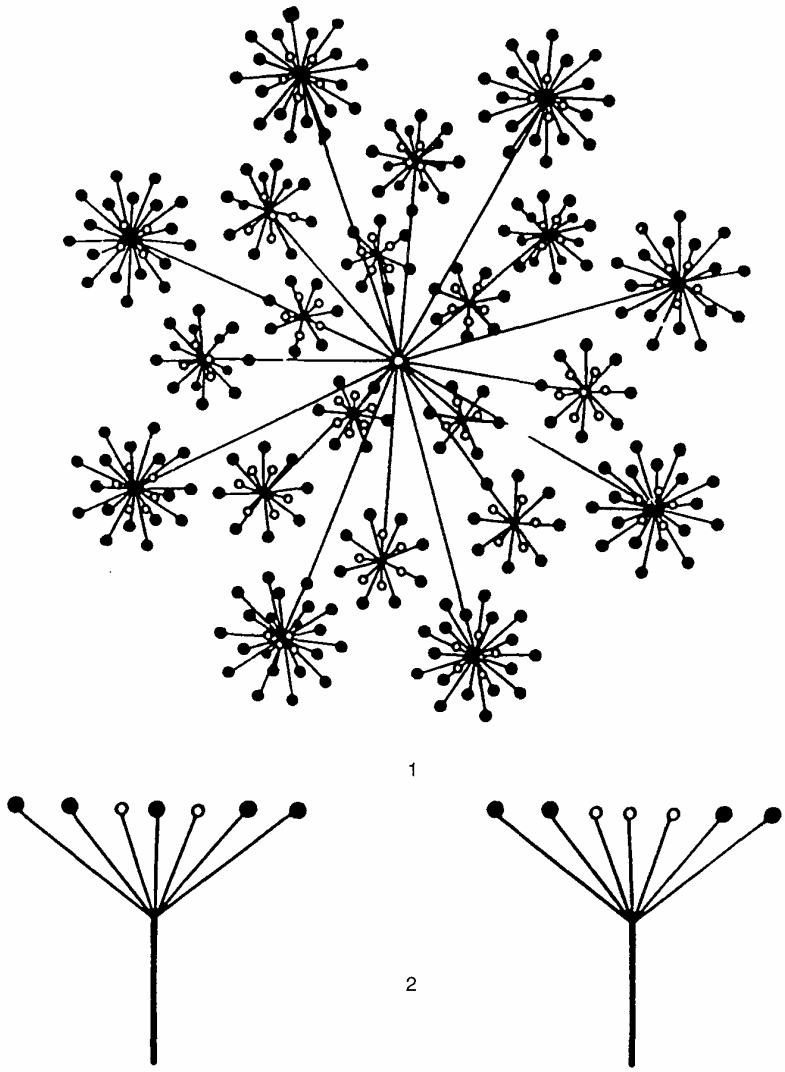

Fig. 12. Diagrammatic representation of umbel (1) and umbellets (2)

7.8.9 Average umbellet open diameter [mm]

7.8.10 Average number of umbellets per plant

7.8.11 Density of flowers in umbels

3 Low
5 Intermediate
7 High

7.8.12 Number of flowers per umbel

Assess on average number on the following order umbels

7.8.12.1 Primary umbel
7.8.12.2 Secondary umbel
7.8.12.3 Tertiary umbel
7.8.12.4 Quaternary umbel
7.8.12.5 Fifth order umbels

7.8.13 Hermaphrodite and staminate flowers (floral sex ratio) in subsequent umbel order

Carrot plants bear hermaphrodite and staminate flowers on the same inflorescence; hermaphrodite (Fig. 12: filled circles) flowers occupy the periphery and their staminate (Fig. 12: open circles) counterparts the centre. The central flower of the umbellets is hermaphrodite in primary and secondary umbels.

The central umbellet is reduced to one or a few white or red flowers. The two kinds of flowers (male and female) are borne in varying proportions in umbels of different orders. Overall, the floral sex ratio of the total plant also varies with regard to genotype. Score these descriptors on the same umbels of descriptor 7.8.12

7.8.13.1 Hermaphrodite and staminate flowers on primary umbels [%]
7.8.13.2 Hermaphrodite and staminate flowers on secondary umbels [%]
7.8.13.3 Hermaphrodite and staminate flowers on tertiary umbels [%]
7.8.13.4 Hermaphrodite and staminate flowers on quaternary umbels [%]
7.8.13.5 Hermaphrodite and staminate flowers on fifth order umbels [%]

7.8.14 Flower colour

1 White
2 Whitish
3 Yellow
4 Green
5 Rosy/red
6 Pink
7 Purplish
99 Other (specify in descriptor **7.11 Notes**)

7.8.15 Flower colour variability in accession

3 Low
5 Intermediate
7 High (many colours)

7.8.16 Colour of the central flower of the umbellet

1 White
2 Red
3 Green
4 Pink
5 Purple
99 Other (specify in descriptor **7.11 Notes**)

7.8.17 Symmetry of peripheral flowers

(See Fig. 13)

1 Symmetrical (actinomorphic) with relatively small distal petals
2 Asymmetrical (zygomorphic) with relatively large distal petals

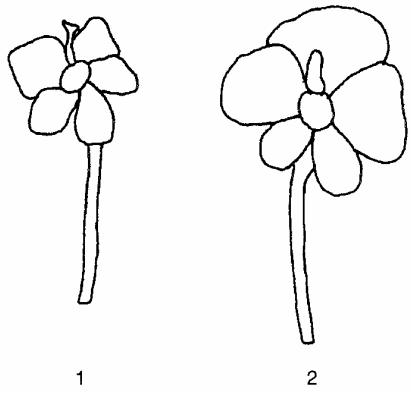

Fig. 13. Symmetry of peripheral flowers

7.8.18 Maximum length of distal petals [mm]

7.8.19 Anther colour

1 Purple
2 Yellow
3 Brown
99 Other (specify in descriptor **7.11 Notes**)

7.8.20 Duration of stigma receptivity [d]

Assess on first, second and third order umbels at regular intervals. Determine receptivity after fixing stigmas of different ages in acetic alcohol (1:3), staining with aniline blue and mounting in lactophenol. Stigmas bearing germinating pollen on their surface should be considered receptive

7.8.21 Fertility

1 Male-sterile/brown anther
2 Fertile
3 Female-sterile
4 Male-sterile/petaloid anther
5 Sterile

7.9 Fruit (immature seed)

To be scored on the fruit/immature seed structure

7.9.1 Percentage fruit/seed set [%]

Assess in bagged and open-pollinated umbels.

7.9.1.1 Fruit/seed set in bagged umbels [%]

For bagged umbels, package the umbels individually and record the fruit set within the bags to assess within-umbel autogamy (=self-fertilization)

7.9.1.2 Fruit/seed set in open-pollinated primary umbel [%]

For open-pollinated umbels, assess fruit (seed) set in umbels of different orders

7.9.2 Fruit length [mm]

7.9.3 Fruit width [mm]

7.9.4 Length of secondary rib spines [mm]

(See Figs. 14 and 15)

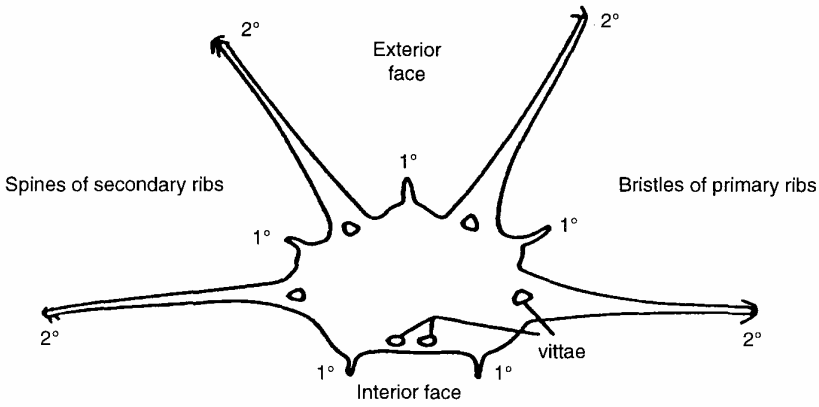

Fig. 14. Mericarp (outline drawing of cross-section)

7.9.5 Size of spines on secondary rib

(See Fig. 15)

3 Small

7 Large

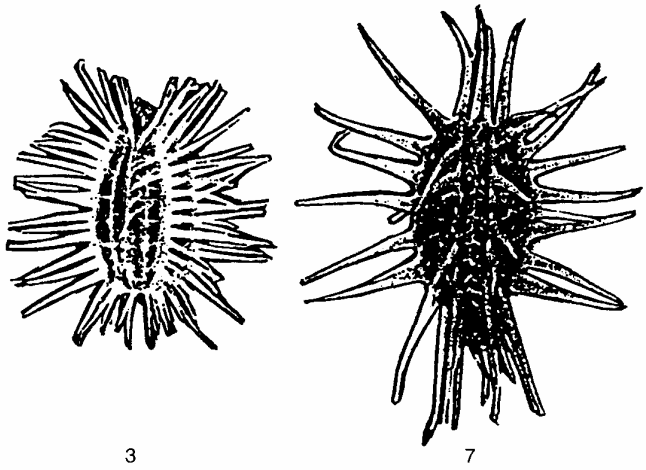

Fig. 15. Mericarp (exterior/dorsal surfaces)

7.9.6 Number of spines on secondary rib

3 Few

7 Many

7.9.7 Spine confluency

Degree of fusion of fruit spine bases

1 Separate
2 Confluent

7.9.8 Spine curvature

1 Straight
2 Curved

7.9.9 Hairiness at the base of primary spine

0 Absent
1(or +) Present

7.9.10 Barbs at tips of spines

Number of terminal spine glochidia (barbed hairs or spines)

3 Few
7 Many

7.9.11 Fruit stalks when ripe

Observe when stretched

3 Short
7 Long

7.10 Mature seed

7.10.1 Time to maturity [d]

Number of days from sowing to when 90% of the plants are ready for seed harvest

7.10.2 Seed length [mm]

7.10.3 Seed diameter

1 Narrow (1.25-1.5 mm)
2 Intermediate (1.6-2 mm)
3 Wide (>2 mm)

7.10.4 Number of seeds per umbel

3 Few
5 Intermediate
7 Many

7.10.5 100-seed weight [mg]

According to ISTA (International Seed Testing Association) rules: 5-6% moisture content

7.10.6 Seed shattering

3 Low
5 Intermediate
7 High

7.10.7 Seed yield [g/m²]

7.10.8 Seed colour at maturity

1 Brownish
2 Greyish
99 Other (specify in descriptor **7.11 Notes**)

7.11 Notes

Any additional information, especially in the category of "other" under various descriptors above, may be specified here

EVALUATION

8. Plant descriptors

8.1 Biochemical traits

All leaf and root analyses should be carried out on mature tissues

8.1.1 Polyacetylenes in leaves [µg/g DW]

8.1.2 Coumarins in leaves [µg/g DW]

8.1.3 Umbelliferone content [µg/g DW]

8.1.3.1 Umbelliferone in leaves [µg/g DW]

8.1.3.2 Umbelliferone in mature root [µg/g DW]

8.1.4 Phenyl-propanoid compounds in leaves [µg/g DW]

8.1.5 Volatile terpenoids [ppm FW]

The Direct Solvent Extraction (DE] method is preferred to the standard Simultaneous Distillation-Extraction (SDE) and the Headspace Sampling methods. Quantify limonene, terpinolene, β-caryophyllene, bornyl acetate, β-pinene, α-phellandrene, α-terpinene, E-γ-bisabolene and myrcene in 50 g of fresh samples:

8.1.5.1 Amount in leaves [ppm FW]

8.1.5.2 Amount in root [ppm FW]

8.1.6 Pigments in upper root portion [µg/g DW]

Assess the following pigments in the upper third portion

8.1.6.1 Anthocyanin [µg/g DW]
8.1.6.2 Anthochlor [µg/g DW]
8.1.6.3 Carotenoid [µg/g DW]
8.1.6.4 Carotene [µg/g DW]
8.1.6.5 Xanthophyll [µg/g DW]
8.1.6.6 Lycopene [µg/g DW]

8.1.7 Petroselinic fatty acid in seed endosperm [µg/g DW]

8.1.8 Petroselidic fatty acid in seed endosperm [µg/g DW]

8.1.9 Nutritional characteristics

8.1.9.1 Water content [g/100 g DW]
8.1.9.2 Dry matter content [g/100 g DW]
8.1.9.3 Ash content [g/100 g DW]
8.1.9.4 Total soluble solids [%]

8.1.9.5 Sugars [g/100 g DW]
Assess fructose, glucose, sucrose and total sugars

8.1.9.6 Total acids [g/100 g DW]
8.1.9.7 Total carbohydrates [g/100 g DW]
8.1.9.8 Crude protein [g/100 g DW]
8.1.9.9 Crude fat [g/100 g DW]
8.1.9.10 Crude fibre [g/100 g DW]
8.1.9.11 Digestible fibre [g/100 g DW]

8.1.9.12 Nitrogen-free constituents [g/100 g DW]
The difference between the sum of the other constituents (crude protein, crude fat and crude fibre) and the original dry weight. In other words, what remains (sugars, starches, etc.) after the other groups of components have been detected by analysis

8.1.9.13 Total digestible nutrients [g/100 g DW]
Sum up crude protein, crude fat, crude fibre and nitrogen-free constituents

8.1.9.14 Energy [kcal/100 g]

8.1.9.15 Macro- and microelements composition [mg/100 g or µg/g DW]
Amounts of macro- and microelements in, as appropriate (potassium, magnesium, calcium, manganese, iron, cobalt, copper, zinc, nickel, chromium, molybdenum, phosphorus, sulphur, chloride, fluoride, iodide, boron, selenium)

8.1.9.16 Amino acid composition [µg/g DW]
Estimate asparatic, threonine, serine, glutamic, proline, glycine, alanine, cysteine, valine, methionine, isoleucine, leucine, tyrosine, phenylalanine, histidine, lysine, arginine, tryptophan, asparagine, glutamine, soluble proteins

8.1.9.17 Vitamin content [mg/100 g DW]
Quantify beta-carotene (retinol), biotin (water-soluble vitamin B), thiamine (Vitamin B1), riboflavin (vitamin B2 or G), niacin (vitamin B3), pyridoxine (vitamin B6), ascorbic acid (vitamin C), vitamin E, vitamin K

8.1.10 Anti-nutritional characteristics

Levels of nitrate/nitrite vary considerably with regard to the genotype, environment and genotype x environment interactions. Lower light intensities in winter or in the greenhouse, the use of nitrogen fertilizers, plant diseases, insect damage, exposure to herbicidal treatments, drought, soil deficiency in molybdenum or potassium, rich peat content in soil, marginal maturity at harvest time, storage at higher temperatures, processing, or even freezing, etc. have been defined as important factors resulting in higher uptake and accumulation of nitrate/nitrite in plant tissues. Oxalate and phenol concentrations are similarly enhanced. Every care should be taken in designing evaluation trials, the standardization of cultural procedures and more adequate collection of data. Assess the following anti-nutritional factors on root samples harvested in the early morning, when nitrate concentration is at its highest, but photosynthesis and assimilation are lowest. Determine contents in the outer and inner cores of the upper third of the edible tap root separately.

8.1.10.1 Sodium content [mg/100 g DW]

8.1.10.2 Nitrate and nitrite amounts [mg/100 g DW]
8.1.10.2.1 Nitrate amount [mg/100 g DW]
8.1.10.2.2 Nitrite amount [mg/100 g DW]

8.1.10.3 Oxalates
8.1.10.3.1 Composition [mg/100 g DW]
Estimate soluble, insoluble and total concentrations. Give in absolute values and percentage of total. A large percentage in the soluble form is harmful
8.1.10.3.2 Soluble oxalate ratios
Compute the ratio of Ca, Mg, K and Na concentration, and their summed-up content, to soluble oxalate

8.1.10.4 Saponin [µg/g DW]
Any of the numerous glycosides that occur in many plants that are characterized by their properties of foaming in water solution and producing hemolysis when solutions are injected into the bloodstream, and that on hydrolysis yield a triterpenoid or teroid sapogenin and one or more sugars (such as glucose, galactose, or xylose)

8.1.10.5 Trypsin Inhibitor Units (TIU)

Trypsin inhibitor units are those inhibitors of proteolytic enzymes from the pancreatic juice which are used chiefly in the body as a digestive and lytic agent. Trypsin converts proteins into peptones. Estimate TIU and express as TIU/mg of soluble proteins

8.1.10.6 Accession's gain/loss of anti-nutritional constituents on storage

Difference (±) in content before and after storage in absolute values and percentage. Assess concentrations on reasonable regular basis (e.g. every 72 hours), stating storage method and conditions, and period at assessment

8.1.10.6.1 Accession's gain/loss of sodium on storage

8.1.10.6.2 Accession's gain/loss of nitrate/nitrite on storage

8.1.10.6.3 Accession's gain/loss of oxalates on storage

Soluble, insoluble and total oxalates. A large percentage in the soluble form is harmful

8.1.10.6.4 Accession's gain/loss of certain cations on storage

Estimate Ca, Mg and K

8.1.10.6.5 Status of cation/oxalate ratio on storage

The ratios of Ca, Mg, K and Na concentrations, and their total content, to soluble, insoluble and total oxalate contents

8.1.10.6.6 Accession's gain/loss of saponin on storage

8.1.10.6.7 Accession's gain/loss of Trypsin Inhibitor Units (TIU) on storage

8.2 Notes

Chemical probes now exist for many compounds, e.g. protein, lipids, starch, lignin, DNA, RNA, as well as specific probes, e.g. radioisotopic and immunofluorescent protein probes. Distribution of many of these compounds is potentially important for stress resistance, quality and yield factors. Specify here any other additional information

9. Abiotic stress susceptibility

Scored under artificial and/or natural conditions, which should be clearly specified. These are coded on a susceptibility scale from 1 to 9, viz.:

1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high

9.1 Reaction to low temperature

9.1.1 Seed germination

9.1.2 *In vitro* development

9.2 Reaction to high temperature

9.3 Reaction to drought

9.4 Reaction to high soil moisture

9.5 Reaction to high salinity

9.6 Reaction to high acidity

9.7 Reaction to alkalinity

9.8 Notes

Specify any additional information here

10. Biotic stress susceptibility

In each case, it is important to state the origin of the infestation or infection, i.e. natural, field inoculation, laboratory. Record such information in descriptor **10.7 Notes**. These are coded on a susceptibility scale from 1 to 9, viz.:

1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high

Organisms marked with an asterisk (*) and boldface are those found to be of major importance in recent literature.

10.1 Viral and phytoplasmal aberrations

***10.1.1 Aster Yellows Mycoplasm (AYM)**
10.1.2 Beet Curly Top (BCTV)
10.1.3 Carrot Mosaic (CtMV)
***10.1.4 Carrot Motley Dwarf Disease (CMDV)**
10.1.5 Carrot Mottle (CMoV)
10.1.6 Carrot Red Leaf (CRLV)
10.1.7 Carrot Thin Leaf (CTLV)
10.1.8 Carrot Yellow Leaf (CYLV)
10.1.9 Celery (Western) Mosaic (CeMV)

10.1.10	Cucumber Mosaic (CMV)
10.1.11	Hemlock (Poison) Ringspot Virus (HRV)
10.1.12	Parnisp mosaic (ParMV)
10.1.13	Lettuce Infectious Yellow (LIYV)

10.2 Bacteria

	Causal organism	Common name
***10.2.1**	***Actinomyces scabies, Streptomyces scabies***	**Leaf scab**
***10.2.2**	***Agrobacterium tumefaciens***	**Crown gall**
10.2.3	*Bacillus carotovorus*	Carrot decay
***10.2.4**	***Erwinia carotovora***	**Bacterial soft rot**
10.2.5	*Pseudomonas maculicola*	Bacterial leaf spot
10.2.6	*Pseudomonas solanacearum*	Bacterial brown rot
***10.2.7**	***Xanthomonas campestris* pv. *carotae***	**Bacterial blight of carrots**

10.3 Fungi

	Causal organism	Common name
***10.3.1**	***Alternaria dauci***	**Alternaria blight of carrots**
10.3.2	*Alternaria radicina*	Carrot black rot
10.3.3	*Aphanomyces cochlioides, Thielaviopsis basicola, Aspergillus niger, Aspergillus* spp.	Black root rot
10.3.4	*Botrytis cinerea*	Grey mould
10.3.5	*Centrospora acerina*	Centrospora black crown rot, Licorice rot
***10.3.6**	***Cercospora carotae***	**Cercospora leaf blight of carrot, Leaf spot**
10.3.7	*Chalara thielavioides*	Root rot, Storage rot
10.3.8	*Colletotrichum* spp., *Gloeosporium* spp.	Anthracnose
10.3.9	*Cylindrocarpon* spp.	Root rot
10.3.10	*Diplodia* spp., *Fusarium* spp., *Macrosporium carotae, Phoma* spp., *Sclerotinia* sp.	Damping-off
10.3.11	*Erysiphe* spp., *Leveillula* taurica	Powdery mildew
10.3.12	*Fusarium roseum*	Fusarium dry rot
10.3.13	*Fusarium solani, Fusarium oxysporum, Fusarium* spp.	Fusarium root rot
10.3.14	*Gliocladium aureum*	Hard rot
10.3.15	*Macrosporium carotae*	Leaf blight
10.3.16	*Macrophomina phaseolina*	Ash grey, Charcoal rot
10.3.17	*Mycocentrospora acerina*	Carrot liquorice rot
10.3.18	*Olpidium brassicae*	Black leg
10.3.19	*Penicillium* spp.	Penicillium rot, Blue-green mould
10.3.20	*Peronospora* spp., *Plasmopara nivea*	Downy mildew
10.3.21	*Phomopsis dauci*	Phomopsis blight and rot of carrot
10.3.22	*Phymatotrichopsis omnivora*	Texas root rot
10.3.23	*Phytophthora capsici*	Phytophthora blight

10.3.24	*Phytophthora cactorum, Phytophthora megasperma*	Root rot
10.3.25	*Puccinia* spp., *Uromyces* spp.	Leaf rust
10.3.26	*Pyrenochaeta terrestris*	Pink root
10.3.27	*Pythium debaryanum*	Wilt, Soil rot, Damping-off
***10.3.28**	***Pythium* spp.**	**Rubbery slate rot**
10.3.29	*Pythium violae*	Cavity spots
10.3.30	*Rhizoctonia carotae*	Carrot crater rot
***10.3.31**	***Rhizoctonia crocorum***	**Violet root rot**
10.3.32	*Rhizoctonia microsclerotia*	Web blight
10.3.33	*Rhizopus nigricans, Rhizopus* spp.	Rhizopus soft rot (wooly rot)
***10.3.34**	***Rhizoctonia solani***	**Bottom rot, crown rot**
10.3.35	*Septoria carotae*	Septoria blight of carrot
10.3.36	*Sclerotinia* spp.	Sclerotinia disease, Cottony rot
***10.3.37**	***Sclerotinia sclerotiorum***	**Watery soft rot**
10.3.38	*Sclerotium rolfsii*	Southern Sclerotium blight
***10.3.39**	***Stemphylium radicinum, Stemphylium herbarum***	**Stemphylium root rot of carrot**
10.3.40	*Typhula* spp.	Buckshot-rot of carrots
10.3.41	*Zygorhynchus* spp., *Mucor* spp.	Whisker rot

10.4 Nematodes

	Causal organism	Pest or common name
10.4.1	*Ditylenchus destructor*	Potato rot nematode
10.4.2	*Ditylenchus dipsaci*	Bloat, Rot nematode
10.4.3	*Helicotylenchus* spp.	Spiral nematode
10.4.4	*Hemicycliophora* spp.	Sheath nematode
10.4.5	*Heterodera carotae*	Carrot cyst nematode
10.4.6	*Longidorus maximus*	Needle nematode
***10.4.7**	***Meloidogyne hapla***	**Root-knot nematode**
10.4.8	*Nacobbus batatiformis*	False root-knot nematode
10.4.9	*Pratylenchus* spp.	Lesion nematode, Pin nematode
10.4.10	*Radopholus similis*	Burrowing nematode
10.4.11	*Rotylenchulus reniformis*	Reniform nematode
10.4.12	*Rotylenchus robustus*	Boxwood spiral nematode
10.4.13	*Trichodorus teres*	Stubby root nematode
10.4.14	*Tylenchorhynchus* spp.	Stunt nematode

10.5 Mites

10.5.1	*Eriophyes peucedani*	Carrot bud mite
10.5.2	*Petrobia latens, Oliqonychus (Homonychus) peruvianus*	Brown wheat mite
10.5.3	*Tetranychus desertorum*	Desert spider mite
10.5.4	*Tetranychus turkestani, Tetranychus* spp.	Strawberry spider mite

10.6 Insects

10.6.1	*Acyrthosiphon pisum*	Pea aphid
10.6.2	*Agriotes lineatus, Agriotes* spp.	Wireworm
10.6.3	*Agrotis segetum*	Cutworm
10.6.4	*Autoserica castanea*	Asiatic garden beetle
10.6.5	*Bactrododema* sp.	Stick and leaf insects
10.6.6	*Bothynus gibbosus*	Carrot beetle
10.6.7	*Brachytrypes membranaceus*	Giant African cricket
10.6.8	*Epicauta vittata, Epicauta* spp.	Striped blister beetle
10.6.9	*Cicadulina* sp.	
10.6.10	*Circulifer* (= *Eutettix*) *tenellus*	Beet leafhopper
10.6.11	*Calosoma scrutator, Phyllotreta* spp.	Ground beetle
10.6.12	*Cotinis texana*	Fig beetle
10.6.13	*Depressaria heracliana*	Parsnip webworm
10.6.14	*Empoasca fabae*	Potato leafhopper
10.6.15	*Forficula auricularia*	Earwigs
10.6.16	*Gryllotalpa gryllotalpa, Gryllotalpa africana* *Phaneroptera nana spasa, Zonocerus variegatus*	Mole cricket
10.6.17	*Hylemya antiqua*	Onion bulb fly
10.6.18	*Kakothrips robustus, Frankliniella pisivora*	Bean thrips
10.6.19	*Limonius agonus*	Eastern field wireworm
10.6.20	*Liriomyza sativae, Liriomyza* spp.	Leaf miners
10.6.21	*Listronotus oregonensis, Listronotus texanus*	Carrot weevil
10.6.22	*Listroderes obliquus*	Vegetable weevil
10.6.23	*Locusta migratoria*	Migratory locust
10.6.24	*Loxostege sticticalis*	Beet webworm
10.6.25	*Loxostege commixtalis*	Alfalfa webworm
10.6.26	*Macrosteles fascifrons*	Aster leafhopper
10.6.27	*Myzus persicae, Myzus* spp.	Spinach aphid
10.6.28	*Nematus* spp.	Sawflies
10.6.29	*Nomadacris septemfasciata*	Red locust
10.6.30	*Orthops* spp., *Lygus lineolaris, Lygus* spp.	Hemipteran (or Heteropterous) bugs
10.6.31	*Papilio polyxenes asterius*	Carrot worm
***10.6.32**	***Psila rosae***	**Carrot fly**
10.6.33	*Semiaphis dauci, Semiaphis heraclei* *Semiaphis carotae*	Carrot aphid
10.6.34	*Schistocerca gregaria*	Desert locust
10.6.35	*Sminthurus viridis*	Spring tails
10.6.36	*Spodoptera* spp.	Army leaf worm
10.6.37	*Trioza viridula*	Carrot leaf flea
10.6.38	*Trialeurodes vaporariorum*	Greenhouse whitefly
10.6.39	*Thrips tabaci, Thrips communis* *Thrips pisivora*	Onion thrips

10.7 Notes
Specify here any additional information

11. Biochemical markers

11.1 Isozyme
For each enzyme, indicate the tissue analyzed and the zymogram type. A particular enzyme can be recorded as 11.1.1; 11.1.2, etc. according to the international nomenclature system for enzymes

11.2 Other biochemical markers
(e.g. anthocyanins and carotenoids)

12. Molecular markers
Describe any specific discriminating or useful trait for this accession. Report probe-enzyme combination analyzed. Below are listed some of the basic methods most commonly used

12.1 Restriction fragment length polymorphism (RFLP)
Report probe/enzyme combination (approach can be used for nuclear, chloroplast or mitochondrial genomes)

12.2 Amplified fragment length polymorphism (AFLP)
Report primer pair combinations and accurate molecular size of products (used for nuclear genomes)

12.3 DNA amplification fingerprinting (DAF); random amplified polymorphic DNA (RAPD); AP-PCR
Accurately report experimental conditions and molecular size of products (used for nuclear genomes)

12.4 Sequence-tagged microsatellites (STMS)
Report primer sequences, and accurate product sizes (can be used for nuclear or chloroplast genomes)

12.5 PCR-sequencing
Report PCR primer sequences, and derived nucleotide sequence (can be used for single copy nuclear, chloroplast or mitochondrial genomes)

12.6 Other molecular markers

13. Cytological characters

13.1 Chromosome number

13.2 Ploidy level
(2x, 3x, 4x, etc.)

13.3 Meiosis chromosome associations
Average of 50 microspore mother cells, observed during metaphase 1

13.4 Other cytological characters

14. Identified genes
Describe any known specific mutant present in the accession

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ANNEX I. Multicrop Passport Descriptors

This list of multicrop passport descriptors has been developed jointly by IPGRI and FAO to provide consistent coding schemes for common passport descriptors across crops. These descriptors aim to be compatible with future IPGRI crop descriptor lists and with the descriptors to be used for the FAO World Information and Early Warning System (WIEWS) on plant genetic resources.

The list should NOT be regarded as a minimum descriptor list, since many additional passport descriptors are essential for the description of crops and need to be recorded. This document lists an initial set of common passport descriptors at the multicrop level. At a later stage the list could be expanded with additional multicrop descriptors. For example, descriptors dealing with the use of germplasm are currently not included, but their suitability for inclusion at the multicrop level will be investigated. Future expansion could even result in the development of more specialized lists of common descriptors at the crop group level.

Printed here is the latest version of the list (1997) which contains two sections. The latter one (FAO WIEWS DESCRIPTORS) lists a number of optional descriptors used in the FAO WIEWS. The list provides descriptions of content and coding schemes, but also provides *suggested* fieldnames (in parentheses) that can assist in the computerized exchange of this type of data.

MULTICROP PASSPORT DESCRIPTORS
1. Institute code (INSTCODE) Code of the institute where the accession is maintained. The codes consist of the 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym.
2. Accession number (ACCENUMB) This number serves as a unique identifier for accessions and is assigned when an accession is entered into the collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number should never be reused. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system).
3. Collecting number (COLLNUMB) Original number assigned by the collector(s) of the sample, normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identify-ing duplicates held in different collections. It should be unique and always accompany subsamples wherever they are sent.
4. Genus (GENUS) Genus name for taxon. Initial uppercase letter required.
5. Species (SPECIES) Specific epithet portion of the scientific name in lowercase letters plus authority[1]. Following abbreviation is allowed: "sp."
6. Subtaxa (SUBTAXA) Subtaxa can be used to store any additional taxonomic identifier plus authority[1]. Following abbreviations are allowed: "ssp." (for subspecies); "var." (for variety); "convar." (for convariety); "f." (for form).
7. Accession name (ACCNAME) Either a registered or other formal designation given to the accession. First letter uppercase. Multiple names separated with semicolon.
8. Country of origin (ORIGCTY) Name of the country in which the sample was originally collected or derived. Use the ISO 3166 extended codes, (i.e. current and old 3 letter ISO 3166 country codes)
9. Location of collecting site (COLLSITE) Location information below the country level that describes where the accession was collected starting with the most detailed information. Might include the distance in kilometers and direction from the nearest town, village or map grid reference point, (e.g. CURITIBA 7S, PARANA means 7 km south of Curitiba in the state of Parana)
10. Latitude of collecting site (LATITUDE) Degrees and minutes followed by N (North) or S (South) (e.g. 1030S). Missing data (minutes) should be indicated with hyphen (e.g. 10–S).

[1] Authority is only provided at the most detailed taxonomic level

11. Longitude of collecting site (LONGITUDE)

Degrees and minutes followed by E (East) or W (West) (e.g. 07625W). Missing data (minutes) should be indicated with hyphen (e.g. 076–W).

12. Elevation of collecting site [m asl] (ELEVATION)

Elevation of collecting site expressed in meters above sea level. Negative values allowed.

13. Collecting date of original sample [YYYYMMDD] (COLLDATE)

Collecting date of the original sample where YYYY is the year, MM is the month and DD is the day.

14. Status of sample (SAMPSTAT)

1	Wild	0	Unknown
2	Weedy		
3	Traditional cultivar/Landrace	99	Other (Elaborate in REMARKS field)
4	Breeder's line		
5	Advanced cultivar		

15. Collecting source (COLLSRC)

The coding scheme proposed can be used at 2 different levels of detail: Either by using the global codes such as 1, 2, 3, 4 or by using the more detailed coding such as 1.1, 1.2, 1.3 etc.

1	Wild habitat	2	Farm	3	Market	4	Institute/Research organization
1.1	Forest/ woodland	2.1	Field	3.1	Town		
		2.2	Orchard	3.2	Village		
1.2	Shrubland	2.3	Garden	3.3	Urban	0	Unknown
1.3	Grassland	2.4	Fallow	3.4	Other exchange system	99	Other (Elaborate in REMARKS field)
1.4	Desert/ tundra	2.5	Pasture				
		2.6	Store				

16. Donor institute code (DONORCODE)

Code for the donor institute. The codes consist of the 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym.

17. Donor number (DONORNUMB)

Number assigned to an accession by the donor. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system)

18. Other number(s) associated with the accession (OTHERNUMB)

Any other identification number known to exist in other collections for this accession. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system). Multiple numbers can be added and should be separated with a semicolon

19. Remarks (REMARKS)

The remarks field is used to add notes or to elaborate on descriptors with value "99" (=Other). Prefix remarks with the field name they refer to and a colon (e.g. COLLSRC: roadside). Separate remarks referring to different fields are separated by semicolons.

FAO WIEWS DESCRIPTORS
1. Location of safety duplicates (DUPLSITE) Code of the institute where a safety duplicate of the accession is maintained. The codes consist of 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym. Multiple numbers can be added and should be separated with a semicolon.
2. Availability of passport data (PASSAVAIL) (i.e. in addition to what has been provided) 0 Not available 1 Available
3. Availability of characterization data (CHARAVAIL) 0 Not available 1 Available
4. Availability of evaluation data (EVALAVAIL) 0 Not available 1 Available
5. Acquisition type of the accession (ACQTYPE) 1 Collected/bred originally by the institute 2 Collected/bred originally by joint mission/institution 3 Received as a secondary repository
6. Type of storage (STORTYPE) Maintenance type of germplasm. If germplasm is maintained under different types of storage, multiple choices are allowed, separated by a semicolon (e.g. 2;3). (Refer to FAO/IPGRI Genebank Standards 1994 for details on storage type) 1 Short-term 2 Medium-term 3 Long-term 4 *In vitro* collection 5 Field genebank collection 6 Cryopreserved 99 Other (elaborate in REMARKS field)

Please forward your feedback on the use of this list to:

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ANNEX II. Natural key to the major subdvisions of the *Daucus carota* complex*

1. Plants possessing at least five of the following attributes: (a) upper portions of fruiting umbel rays not markedly curved toward axis, thereby not producing conspicuously nest-like umbels; (b) flowering plants less than 3 dm tall; (c) length of secondary fruit spines less than half of width of mericarp; (d) secondary fruit spines curved toward styles: (e) flowering stalk evidently flexuous, often zig-zag; (f) ultimate foliage segments ovate or lanceolate (not linear-lanceolate) and roots white or yellowish-white; (g) foliage and stems conspicuously pubescent and roots white or yellowish-white; (h) cauline foliage not conspicuously less dissected than basal foliage and involucral bracts wider than 1 mm at base; (i) fresh foliage shiny, and (or) producing exudate on wounding; (j) plants of Old World sea coasts near or in maritime habita .....subsp. agg. *gingidium* (informal name)

1. Plants not possessing at least five of above attributes
.....subsp. agg. *carota* (informal name)

2. Fresh roots flexible, fibrous-textured; white to whitish-yellow, unpalatable; transition of storage organ and shoot indistinct externally; rosette foliage often prostrate; umbels often with central purple flower(s); often annual
.....wild plants (various subspecies have been proposed)

2. Fresh roots brittle, flesh-textured, conspicuously pigmented (or rarely white), palatable; shoot and storage organ transition sharply demarcated by expanded storage organ; rosette foliage usually conspicuously erect; umbels rarely with central purple flower(s); usually biennial .....domesticated plants: subsp. *sativus*

3. Fresh foliage glaucous; ultimate leaf segments lanceolate to ovate, penultimate segments cleft less than two-thirds toward midrib; leaves pubescent (more than 50 hairs/mm^2 on either abaxial petiole or abaxial leaflet); roots usually yellow, often with purple exterior due to water-leachable pigments in cytoplasm; usually found in Asia .....'eastern carrot': var. *atrorubens*

3. Fresh foliage bright green, often slightly yellowish; ultimate leaf segments linear-lanceolate, penultimate segments cleft more than two-thirds toward midrib; leaves not conspicuously pubescent (less than 50 hairs/mm^2 on either abaxial petiole or abaxial leaflet); roots usually orange or yellow (occasionally white) with pigments plastid-bound and not leaching into water; ubiquitous cultivars
.....'western carrot': var. *sativus*

* Adapted from "A numerical taxonomic analysis of the *Daucus carota* complex" by E. Small, Can. J. Bot. 56:248-276 (1978).

The domesticated carrot

Daucus carota L. subsp. *sativus* (Hoffm.) Arcangeli, Compend. Fl. Ital. 299. 1882. Synonymy of this subspecies is presented under the two varieties recognized in this paper.

This taxon of *Daucus* is easily recognized by the possession of highly pigmented, fleshy, edible, brittle roots. Cultivated carrots with white roots are rarely encountered; the roots of these, in comparison with wild carrots, are relatively palatable and brittle, and are not branched.

The 'Western carrot' (*Daucus carota* subsp. *sativus* var. *sativus*)

Daucus carota L. subsp. *sativus* (Hoffm.) Arcangeli var. *sativus* (Hoffm. Deutsch. Fl. ed. 1. 94. 1791. *D. carota* subsp. *sativus* (Hoffm.) Arcangeli, Compend. Fl. Ital. 299. 1882. *D. carota* subsp. (*occidentalis* Rubasch. convar. *sativus* Krasochkin *et al.*, Kul'turnaya Fl. SSSR 19:281. 1971.

D. carota (vars.) *alba, sulfurea, aurantia, pellucida, saalfeldensis, hollandica, noisetti*, Alef., Landwirth. Fl. 160-162. 1866.

D. carota subsp. *sativa* subvar. *globosus* Thell. in Hegi, III. Fl. Mitteleur. 5: 1516-1518. 1926.

Daucus carota subsp. *sativus* may have orange, yellow or white storage organs, and is best characterized by yellowish-green 'highly dissected' foliage (ultimate segments linear-lanceolate to linear, penultimate segments cleft more than two-thirds toward midrib) which is relatively unpubescent (less than 50 hairs/mm2 on either abaxial petiole or abaxial leaflets). The 'western carrot' is grown ubiquitously, and except in Asia is the predominant variant encountered.

The 'Eastern carrot' (*D. carota* subsp. *sativus* var. *atrorubens*)

Daucus carota subsp. *sativus* var. *atrorubens* Alef. Based *on D. carota* subvar. gr. *longa* (var.) *atrorubens* Alef., Landwirth. Fl. 160-166. 1866. (The names var. *atrorubens* and var. *violacea* were published simultaneously by Alefeld: *atrorubens* is chosen as the correct name for the 'eastern' taxon.)

D. carota var. *boissieri* Schweinf. ex Wittmack, Festschrift P. Ascherson, 327. 1904.

D. carota subsp. *sativus* vars. *vavilovii, schavrovii, roseus*, Mazk., Trudy Prikl. Bot. 20:517-558. 1929.

D. carota (subsp. *orientalis* Rubash. (*sensu amplo*) var. *zhukovskii* Setch. in Krasochkin, Sechkarev *et al.* Kul'turnaya Fl. SSSR 19: 283. 1971. (excl. convar. *orientalis*; incl. convar. *afganicus* = *nom. nud.*).

Daucus carota subsp. *sativus* var. *atrorubens* usually has purple and (or) yellow storage organs. Rarely, reddish or yellowish-orange roots are also encountered. This taxon is best discriminated by greyish-green (glaucous), relatively poorly dissected foliage (ultimate segments lanceolate to ovate, penultimate segments cleft less than two-thirds toward midrib) which is relatively pubescent (more than 50 hairs/mm^2 on either abaxial petiole or abaxial leaflets).

The 'eastern carrot' is common only in Asia, although it has been introduced elsewhere. This type of carrot presents such interesting colour variants that one might expect it to be of market value in the western world, at least as a novelty. However, the fact that the purple pigments are water-soluble, like the pigments of beets, appears to have militated strongly against its widespread use. Also, it is extremely difficult to store such carrots because they are highly susceptible to decay.

'Eastern ' x 'Western' hybrids

D. carota var. *sativa* f. *japonicus* Zagorodskikh *ex* Hiroe, Acta Phytotax. Geobot. 20:97. 1962.

D. sativus subsp. *japonicus* Zagorodskikh, Compt. Rend. (Dokl.) Acad. URSS, 25:520. 1939. *nom. nud.*

D. carota var. *sativa* formae *sapporoensis* et *kintoki* Hiroe, Acta Phytotax. Geobot. 20:97. 1962.

Extensive hybridization of the 'eastern' and 'western' carrots has occurred in Asia and intermediates are frequently encountered here. Also, carrot breeders have created hybrids of the two varieties, and one of these, 'Kintoki' (*D. carota* f. *kintoki*), is in widespread commercial use in the 'western' world. Such carrots may be identified *as D. carota* var. *sativus* x var. *atrorubens* or perhaps preferably simply not identified down to the varietal level.

COLLECTING FORM for wild and cultivated carrots (*Daucus carota* L.)

ACCESSION No. (1.1):

COLLECTOR NAME(S) / INSTITUTE(S) (2.1):

ACCESSION IDENTIFICATION

COLLECTING No. (2.3): PHOTOGRAPH No. (2.24):

COLLECTING DATE [YYYYMMDD] (2.4):

DONOR NAME (1.2):

GENUS (1.5.1): SPECIES (1.5.2):

TYPE OF SAMPLE (2.15):

1. Vegetative (root, steckling) 2. Seed 3. Pollen
4. Tissue culture 99. Other (specify)

ETHNOBOTANICAL DATA

LOCAL/VERNACULAR NAME (2.20):

ETHNIC GROUP (2.21):

PARTS OF PLANT USED (2.22):

1. Stalk/trunk	2. Branch/twig	3. Leaf	4. Bark
5. Rhizome	6. Flower/inflorescence	7. Fruit	8. Seed
9. Root	10. Tuber	11. Sap/resin	99. Other (specify):

PLANT USES (2.23):

1. Food	2. Medicine	3. Beverage	4. Fibre
5. Timber	6. Craft	7. Forage/fodder	8. Building
9. Ornamental	99. Other (specify):		

ASSOCIATED FLORA (2.18):

CHARACTERIZATION

PLANT DESCRIPTORS

Anthocyanin colouration in petiole (7.1.7):
Mature leaf length [cm] (7.1.10):
Leaf growth habit (7.1.12):
Leaf hairiness (7.1.13):
Leaf type (7.1.14):
Leaf dissection (7.1.15):
Leaf colour (7.1.16):

FIRST YEAR BOLTING

Bolting tendency (7.2.1):

EXTERNAL ROOT CHARACTERISTIC (CORTEX)

Root length (7.4.6):
Root diameter (7.4.7):
Root ratio length/diameter (7.4.8):
Root branching (7.4.12):
Root shape (7.4.14):
Root shoulder shape (7.4.16):
Extent of green colour of skin on shoulder (7.4.17):
Root tip/end shape (7.4.21):
Root skin pigmentation/colour (7.4.22):

INTERNAL ROOT CHARACTERISTICS (CORE)
Outer core pigmentation/colour (7.5.5):

FRUIT (IMMATURE SEED)
Size of spines on secondary rib (7.9.5):
Number of spines on secondary rib (7.9.6):

SAMPLE

No. OF SEEDS, STECKLINGS, CULTURES COLLECTED (2.16):

STATUS OF SAMPLE (2.14):
0. Unknown 1. Wild 2. Weedy 3. Traditional cultivar/Landrace
4. Breeder's line 5. Advanced cultivar 99. Other (specify):

PREVAILING STRESSES (2.26):
Mention the types of major stresses, i.e. abiotic (drought), biotic (pests, diseases, etc.)

COLLECTING SITE LOCATION

COUNTRY (2.5):

PROVINCE/STATE (2.6): DEPARTMENT/COUNTY (2.7):

LOCATION (2.8): km: direction: from:

LATITUDE (2.9): LONGITUDE (2.10): ELEVATION (2.11): m asl

ACCESSION AND COLLECTING SITE ENVIRONMENT

COLLECTING SOURCE (2.12):
0. Unknown 1. Wild habitat 2. Farm 3. Market
4. Institute/Research organization 99. Other (specify):

HIGHER LEVEL LANDFORM (6.1.2):
1. Plain 2. Basin 3. Valley 4. Plateau 5. Upland 6. Hill 7. Mountain

SLOPE [°] (6.1.4): ASPECT (6.1.5): (code N,S,E,W)

SOIL FERTILITY (6.1.21): (code: 3=Low ; 5=Moderate; 7=High)

SOIL TEXTURE CLASSES (6.1.17):
State class (e.g. Clay, Loam, Silt)

SOIL TAXONOMIC CLASSIFICATION (6.1.19):
State class (e.g. Alfisols, Spodosols, Vertisols)

WATER AVAILABILITY (6.1.20):
1. Rain-fed 2. Irrigated 3. Flooded 4. River banks
5. Sea coast 99. Other (specify):

RAINFALL (6.1.22.3): Annual mean: |_____| mm

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly mean [mm]:	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|

TEMPERATURE (6.1.22.1): Seasonal mean: |_____| °C

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Monthly mean [°C]:	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|	|__|

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