



Animal &
Plant Health
Agency

United Kingdom Variety Lists / Plant Breeders' Rights Technical Protocol for Official Examination of Distinctness, Uniformity and Stability (DUS)

Carrot

Daucus carota L.

December 2022

Contents

Section A - General Information.....	1
1 Purpose.....	1
2 Scope.....	1
3 Responsibilities.....	1
4 Non-Compliance with the Protocol.....	2
5 Responsibility for GM Releases.....	2
6 Procedures for GM Varieties.....	3
7 Associated Documents.....	3
Section B - Application Requirements.....	4
1 Purpose.....	4
2 Scope.....	4
3 Responsibilities.....	4
4 Receipt of Applications.....	4
5 Receipt of Seed.....	4
6 Seed Quality Requirements.....	5
7 Seed Quantity.....	5
8 Labelling Requirements, Including Provisions for GM Varieties.....	5
Section C – Growing Test Procedures.....	7
1 Purpose.....	7
2 Scope.....	7
3 Responsibilities.....	7
4 Reference Varieties.....	7
5 Design of Tests.....	7

6	Records and Recording	9
7	Communication with the Applicant	10
Section D - Summary of DUS Characteristics to be Assessed, Method of Assessment and Standards Applied.....		11
1	Purpose.....	11
2	Scope	11
3	Responsibilities	11
4	Organisation.....	11
5	DUS Characteristics to be Assessed	12
5.2	Carrot Characteristics Routinely Recorded in DUS Tests.....	13
5.3	Previously Approved Characteristics Not Routinely Recorded in DUS Tests	19
5.4	New Additional DUS Characteristics.....	20
Section E - Reference Seed Stock Maintenance		21
1	Purpose.....	21
2	Scope	21
3	Responsibilities	21
4	Procedures for Reference Seed Stock Maintenance	21
5	Procedures for the Inclusion of New Common Knowledge Varieties into the Reference Collection.....	22
6	Release of Reference Samples for Authorised Purposes	23
Section F - Procedures for Assessment of New Additional DUS Characters.....		24
1	Purpose.....	24
2	Scope	24
3	Responsibilities	24
4	Reference Varieties.....	24

5	Procedures.....	25
Section G - Procedures for DUS Decisions.....		26
1	Purpose.....	26
2	Scope.....	26
3	Responsibilities.....	26
4	Reference Varieties.....	26
5	Distinctness.....	26
6	Uniformity.....	27
7	Stability.....	29
8	DUS Report and Variety Description.....	29
Appendix 1 – Reference Collection Varieties.....		30
1	Variety Listing and Plant Breeders’ Rights.....	30

Section A - General Information

1 Purpose

1.1 This Protocol sets out the procedures for conducting tests and assessments in relation to official examinations of DUS, maintenance of reference stocks of varieties of Carrot (*Daucus carota* L.) entered for Variety Listing (VL) Trials and Plant Breeders' Rights (PBR).

2 Scope

2.1 These procedures apply to all varieties of Carrot. Special procedures and responsibilities for Genetically Modified (GM) varieties are set out in Sections A5 and A6.

2.2 Except where specified in this protocol or authorised by the Plant Variety Rights Office for the UK, Animal and Plant Health Agency (APHA); only Variety List candidates, Plant Breeders' Rights candidates, candidates for Foreign Authorities and the reference varieties may be incorporated in the DUS tests.

3 Responsibilities

3.1 The growing tests and assessments in this protocol are carried out under the responsibility of the Secretary of State for Environment, Food and Rural Affairs, Scottish Ministers, Welsh Ministers and the Minister for Agriculture, Environment and Rural Affairs in Northern Ireland (the National Authorities).

3.2 They are supervised, on behalf of the National Authorities, by officials of the Testing Authorities, that is APHA; the Scottish Government (SG); the Department of Agriculture, Environment and Rural Affairs (DAERA); and the Welsh Government (WG).

3.3 This protocol is authorised by the Plant Variety and Seeds Committee (PVSC). It cannot be amended without its approval. Requests and suggestions for amendment of the protocol should be put in writing to APHA or the Test Centre.

3.4 The procedures are administered by:

Plant Variety Rights Office for the UK
Animal and Plant Health Agency
Eastbrook
Shaftesbury Road
Cambridge

CB2 8DR

Email: pvs.helpdesk@apha.gov.uk

3.5 Test Centre

The DUS growing tests and assessments in this protocol are co-ordinated and carried out by the:

Vegetable DUS Test Centre

SASA

Roddinglaw Road

Edinburgh Tel No 0131-244 8890

EH12 9FJ Fax No 0131-244 8940

3.6 The Test Centre is responsible for providing the appropriate facilities.

4 Non-Compliance with the Protocol

4.1 Where the protocol uses the word “must” for any action then failure to carry out this action will result in non-compliance. Where non-compliance occurs or there are concerns regarding the validity of any data or tests this must be reported to APHA. Where this protocol uses the word “should” for any action this is the method to be followed unless there are clear technical reasons not to do so which can be justified by the Test Centre.

5 Responsibility for GM Releases

5.1 GM Release Consent Holders are responsible for GM releases. All parties involved in DUS work operating under a GM Release Consent must adhere to the instructions of the Release Consent where necessary, to comply with the relevant consent conditions. Where DUS protocol non-compliance occurs, this must be reported to the consent holder and the Test Centre who will notify APHA.

6 Procedures for GM Varieties

6.1 Applicants intending to enter GM candidates must consult APHA, well in advance of their application, about specific requirements under GM regulations.

6.2 The Test Centre must ensure that no test or trial sites are planted with GM candidates and/or varieties until APHA has given the specific clearances.

7 Associated Documents

The following documents are associated with this protocol:

Reference	Title
UPOV TG/49/8	Guidelines for the conduct of tests for Distinctness, Uniformity and Stability for Carrot (<i>Daucus carota</i> L.). 28/03/2007 + 25/03/2015. Corr.
UPOV TG/1/3	General Introduction to the Examination of Distinctness, Uniformity and Stability and the Development of Harmonised Descriptions of New Varieties of Plants. 19.04.2002
UPOV TGP/8/4	Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability. 01.11.2019.
UPOV TGP/9/2	Examining Distinctness. 29.10.2015.
UPOV TGP/10/2	Examining Uniformity. 01/11/2019.
GB and NI Variety Lists	The Seeds (National Lists of Varieties) Regulations 2001 (as amended) and The Seeds (Variety Lists) Regulations (Northern Ireland) 2020
Plant Varieties Act 1997	Plant Breeders' Rights Regulations 1998 and Plant Varieties Act 1997
Plant Breeders' Rights 2019	The Plant Breeders' Rights (Amendment etc.) (EU Exit) Regulations 2019 as amended by The Animal Health, Invasive Alien Species, Plant Breeders' Rights and Seeds (Amendment etc.) (EU Exit) Regulations 2019 and The Plant Breeders' Rights (Amendment) (EU Exit) Regulations 2020

Section B - Application Requirements

1 Purpose

1.1 The purpose of this section is to identify the specific requirements for Variety Listing and/or Plant Breeders' Rights applications, as appropriate.

2 Scope

2.1 These procedures apply to all applications.

3 Responsibilities

3.1 The applicants are responsible for ensuring that these procedures are complied with.

4 Receipt of Applications

4.1 The latest date for receipt of applications for Variety Listing and/or for Plant Breeders' Rights is stated on the GOV website (<https://www.gov.uk/national-lists-of-agricultural-and-vegetable-crops>).

4.2 The procedures for the submission of Variety Listing and Plant Breeders' Rights applications, Technical Questionnaires (TQ) and for payment of administration fees can be obtained from APHA PVS at the address shown in Section A or on the GOV.UK website at <https://www.gov.uk/national-lists-of-agricultural-and-vegetable-crops>

4.3 Applicants should note in the TQ, submitted with the application, any additional characteristics which may require examinations that are listed in the DUS characteristics section D, 5.2 or 5.3 (an additional fee may be required).

5 Receipt of Seed

5.1 The latest date for receipt of seed is stated in the Seed Gazette. In the absence of exceptional circumstances, seed submissions received after this date will be refused. Instructions for the delivery of seed will be made available to applicants by APHA (<https://www.gov.uk/national-lists-of-agricultural-and-vegetable-crops>).

6 Seed Quality Requirements

6.1 The seed must satisfy the certification requirements for Basic Seed as laid down in the seed marketing legislation of the Devolved Administrations.

6.2 The seed must not be chemically treated. Seed treatment, where appropriate, will be undertaken by the Test Centre. The chemicals applied and rates of application will be determined by the Test Centre.

7 Seed Quantity

7.1 1st Test Cycle

5,000 or 35,000 seeds

7.2 2nd Test Cycle

30,000 seeds if 5,000 seeds were provided in the 1st test cycle.

No seed if 35,000 seeds were provided in the 1st test cycle.

Where a second sample has been provided, it will be authenticated against the original submission. An additional charge will be applied.

7.3 Shortfall in Seed Quantities

Where insufficient seed is available in the first instance a further stock must be supplied in the following year which will be authenticated against the original submission. An additional charge may be applied. This must be agreed in advance with APHA and the test centre.

8 Labelling Requirements, Including Provisions for GM Varieties

8.1 Applicants must clearly label their seed with the following information:

- Applicant
- AFP number (if known)
- Breeder's Reference number or name
- Quantity of seed

8.2 All packages of GM material must be labelled clearly as "GMO" or "Genetically Modified Organism".

Section C – Growing Test Procedures

1 Purpose

1.1 The purpose of this section is to provide details of the procedures used in the growing tests for DUS analysis.

2 Scope

2.1 These procedures apply to all varieties of Carrot (*Daucus carota* L.).

3 Responsibilities

3.1 The Test Centre is responsible for conducting these procedures.

3.2 The Test Centre will be responsible for ensuring that no material supplied to it is used for any other purpose than the conduct of these procedures or the release of reference samples for authorised purposes. (See Section E7).

4 Reference Varieties

4.1 The principles governing the selection of reference varieties are set out in Appendix 1.

4.2 Seed of reference varieties will be supplied by the DUS Test Centre.

5 Design of Tests

5.1 The DUS Test Centre is responsible for selecting a suitable site which should be on ground that has normally not had an Umbellifer crop in the previous five years but may be less where it has been determined the risk is negligible.

5.2 Field husbandry should follow best practice for all operations and particularly as regards cultivation, drilling, transplanting, fertiliser and spray application, use of irrigation and control of weeds, pests and diseases.

The number of plants per replicate and plants per variety is dependent on the root type and the corresponding interrow spacing, see table below:

Spacing (cm)	Approximate number of plants per replicate (based on a 4m plot)	Approximate number of plants per variety based on 3 replicates
5.0	320	960
7.5	208	624
10.0	160	480

Groups are randomised and varieties are randomised within groups.

5.7 Seed is sown in the field between May and early June according to a plan produced by the Test Centre and thinned to a stand to achieve the plant number per plot as indicated in C5.5. Varieties are coded by the Test Centre.

5.8 Any candidates with distinctness problems in the first test cycle of test may be grown side by side with their close controls in the second or third test cycles.

5.9 Recordings are taken on each trial from late August onwards. Characters recorded are listed in Section D.

6 Records and Recording

6.1 All records and plot data should be in a form determined and validated by the Test Centre.

6.2 Characters, recording details and instructions are given in Section D. Any variant and abnormal plants or plants resulting from an adverse reaction to husbandry practice are recorded but excluded from analysis.

6.3 In the first recording year, characters, as indicated in Section D 5.2, are recorded on all candidates and their close controls. The data for measured characters are analysed and used to determine the most similar reference varieties and assess the uniformity of the candidate. (For details see Section G).

6.4 In the second recording cycle, characters, as indicated in Section D 5.2, are recorded on all candidates and their close controls. The data for measured characters are analysed and, together with those from the first recording cycle, used to determine the most similar reference varieties and assess the uniformity of the candidate. (For details see Section G).

6.5 If a third test cycle is necessary, characters, as indicated in Section D 5.2, are recorded on all candidates and their close controls. The data for measured characters are analysed and, together with those from the first and second test cycles, are used to determine the most similar reference varieties and assess the uniformity of the candidate. (For details see Section G).

6.6 If the Test Centre notices unusual or novel characters in a candidate, a note must be made of these at any time and a photographic record made.

7 Communication with the Applicant

7.1 The Test Centre will notify the applicant or the agent of any DUS problems at the earliest practical opportunity as they arise during the test. All such notifications must be copied to APHA.

7.2 In the case of distinctness problems, if confidentiality considerations allow, the applicant should be informed which variety is not distinct and be invited to submit any information which may help to distinguish them.

7.3 If DUS problems arise, applicants will be invited to visit the DUS tests by arrangement so that the material can be examined (if appropriate) and discussions held with the Test Centre.

7.4 After each test cycle the results are summarised and reported to the applicant and APHA by the Test Centre to the applicant.

Section D - Summary of DUS Characteristics to be Assessed, Method of Assessment and Standards Applied

1 Purpose

1.1 The purpose of this section is to summarise the characteristics to be assessed.

2 Scope

2.1 This section summarises characteristics, states of expression, methods of observation and standards required for DUS assessment.

3 Responsibilities

3.1 The Test Centre is responsible for co-ordinating the procedures in this summary of characteristics.

4 Organisation

4.1 The minimum duration of tests to assess characteristics is normally two independent growing cycles. Shorter durations may be applied for the assessment of additional characteristics. Proposed changes to the number of growing cycles must be approved by the NLSC.

5 DUS Characteristics to be Assessed

Routine Characteristics

The following table summarises the DUS characteristics to be routinely examined.

Note:

* a characteristic which must be examined according to UPOV Guidelines.

G a grouping characteristic

Type of observation of characteristics:

MG Single measurement of a group of plants or parts of plants

MS Measurement of a number of individual plants or parts of plants

VG Visual assessment by a single observation of a group of plants or parts of plants

VS Visual assessment by observation of individual plants or parts of plants

5.2 Carrot Characteristics Routinely Recorded in DUS Tests

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
1 QN VG	60 QN VG	Foliage: width of crown	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = narrow 5 = medium 7 = broad	Clear visual difference or 2 states	Visual Assessment
2 QN VG	70 QN VG	Leaf: attitude	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = erect 3 = semi-erect 5 = prostrate	Clear visual difference or 2 states	Visual Assessment
*3G QN VG/MS	20 QN VG/MS	Leaf: length (including petiole)	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	1 = very short 3 = short 5 = medium 7 = long 9 = very long	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment Or for measured samples COYU at 0.1%
*4 QN VG	45 QN VG	Leaf: division	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = fine 5 = medium 7 = coarse	Clear visual difference or 2 states	Visual Assessment
*5 QN VG	71 QN VG	Leaf: intensity of green colour	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = light 5 = medium 7 = dark	Clear visual difference or 2 states	Visual Assessment
*6 QL VG	24 QL VG	Leaf: anthocyanin coloration of petiole	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = absent 9 = present	1 state	Visual Assessment

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
*7G QN VG/MS	31 QN VG/MS	Root: length	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 4 replicates	Visual observation or visual score or measurements on single plants	1 = very short 3 = short 5 = medium 7 = long 9 = very long	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment or for measured samples COYU at 0.1%
*8G QN VG/MS	32 QN VG/MS	Root: width	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	3 = narrow 5 = medium 7 = broad	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment or COYU at 0.1%
*9 QN VG/MS	80 QN VG/MS	Root: ratio length/ width	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	1 = very small 3 = small 5 = medium 7 = large 9 = very large	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment or for measured samples COYU at 0.1%
*10G PQVG	36 PQ VG	Root: shape in longitudinal section	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = circular 2 = obovate 3 = obtriangular 4 = narrow obtriangular 5 = narrow obtriangular to narrow oblong 6 = narrow oblong	Clear visual difference or 2 states	Visual Assessment

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
11 QN MS/VG	81 QN VG	<u>Varieties scoring between 4 and 6 for characteristic 10 only</u> ; Root: tendency to conical shape	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = very weak 3 = weak 5 = medium 7 = strong 9 = very strong	Clear visual difference or 2 states	Visual Assessment
*12 PQVG	66 PQ VG	Root: shape of shoulder	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = flat 2 = flat to rounded 3 = rounded 4 = rounded to conical 5 = conical	Clear visual difference or 2 states	Visual Assessment
*13G QN VG	37 PQ VG	Root: tip (when fully developed)	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = blunt 2 = slightly pointed 3 = strongly pointed	Clear visual difference or 2 states	Visual Assessment
*14G PQ VG	54 PQ VG	Root: external colour	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = white 2 = yellow 3 = orange 4 = pinkish red 5 = red 6 = purple	Clear visual difference or 1 state	Visual Assessment
15 QN VG	55 QN VG	<u>Excluding varieties with white external root colour</u> ; Root: intensity of external colour	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = light 5 = medium 7 = dark	Clear visual difference or 2 states	Visual Assessment
16 QL VG	41G QL VG	Root: anthocyanin coloration of skin of shoulder	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = absent 9 = present	1 state	Visual Assessment

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
17 QN VG	35 QN VG	Root: extent of green colour of skin of shoulder	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = absent or very small 3 = small 5 = medium 7 = large 9 = very large	Clear visual difference or 2 states	Visual Assessment
18 QN VG	65 QN VG	Root: ridging of surface	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = absent or very weak 3 = weak 5 = medium 7 = strong 9 = very strong	Clear visual difference or 2 states	Visual Assessment
*19 QN VG	82 QN VG	Root: diameter of core relative to total diameter	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = very small 3 = small 5 = medium 7 = large 9 = very large	Clear visual difference or 2 states	Visual Assessment
*20 PQ VG	46 PQ VG	Root: colour of core	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = white 2 = yellow 3 = orange 4 = pinkish red 5 = red 6 = purple	Clear visual difference or 1 state	Visual Assessment
21 QN VG	49 QN VG	<u>Excluding varieties with white core:</u> Root: intensity of colour of core	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = light 5 = medium 7 = dark	Clear visual difference or 2 states	Visual Assessment
*22 PQ VG	39 PQ VG	Root: colour of cortex	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = white 2 = yellow 3 = orange 4 = pinkish red 5 = red 6 = purple	Clear visual difference or 1 state	Visual Assessment

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
23 QN VG	52 QN VG	<u>Excluding varieties with white cortex:</u> Root: intensity of colour of cortex	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = light 5 = medium 7 = dark	Clear visual difference or 2 states	Visual Assessment
24 QN VG	47 QN VG	Root: colour of core compared to colour of cortex	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = lighter 2 = same 3 = darker	Clear visual difference or 2 states	Visual Assessment
*25 QN VG	42 QN VG	Root: extent of green coloration of interior (in longitudinal section)	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = absent or very small 3 = small 5 = medium 7 = large 9 = very large	Clear visual difference or 2 states	Visual Assessment
26 QN VG	34 QN VG	Root: protrusion above soil	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	1 = absent or very small 3 = small 5 = medium 7 = large 9 = very large	Clear visual difference or 2 states	Visual Assessment
27 QN MS	83 QN MS	<u>Varieties with blunt tip only:</u> Root: time of development of rounded tip	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	3 = early 5 = medium 7 = late	COYD @ 5%	COYU at 0.1%

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
28G QN MS	84 QN MS	Root: time of coloration of tip	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	1 = very early 3 = early 5 = medium 7 = late 9 = very late	COYD @ 5% f	COYU at 0.1%
29 QN VG	48 QN VG	Plant: tendency to bolting	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = weak 5 = medium 7 = strong	Clear visual difference or 2 states	Visual Assessment
30 QN VG	90 QN VG	Plant: height of primary umbel at time of its flowering	DUS plot	At least 400 plants in total from 3 replicates	Visual observation or visual score	3 = short 5 = medium 7 = tall	Clear visual difference or 2 states	Visual Assessment
*31G QN VS	91 QN VS	Plants: proportion of male sterile plants	Single plants	At least 40 plants in total	Visual observation on single plants	1 = absent or very low 2 = intermediate 3 = high	Clear visual difference or 2 states	Visual Assessment
*32G QL VS	92G QL VS	Plant: type of male sterility	Single plants	At least 40 plants in total	Visual observation on single plants	1 = brown anthers 2 = petaloid anthers	1 state	Visual Assessment

5.3 Previously Approved Characteristics Not Routinely Recorded in DUS Tests

The following table summarises the additional characteristics which have been approved by the NLSC and can be examined at the request of the applicant where necessary to establish Distinctness. A fee may be charged for examination of these characteristics as advised by APHA, Plant Varieties and Seeds.

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
N/A	12 QN VG/MS	Leaf: length excluding petiole	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	3 = short 5 = medium 7 = long	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment Or for measured samples COYU at 0.1%
N/A	21 QN VG/MS	Leaf: width	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	3 = narrow 5 = medium 7 = wide	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment Or for measured samples COYU at 0.1%

UPOV TG/49/8	UK	Character	Material examined	Number of plants or sample size for assessment	Method of assessment and recording	States of expression	D Method and Minimum distance required	U Method and Standard applied
N/A	33 QN VG/MS	Root: length of widest point to crown	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	3 = narrow 5 = medium 7 = wide	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment Or for measured samples COYU at 0.1%
N/A	50 QN VG/MS	Root: core diameter	DUS plot or single plants	At least 400 plants in total from 3 replicates or at least 40 plants in total from 3 replicates	Visual observation or visual score or measurements on single plants	3 = narrow 5 = medium 7 = wide	Clear visual difference or 2 states or COYD @ 5%	Visual Assessment Or for measured samples COYU at 0.1%

5.4 New Additional DUS Characteristics

Applicants can suggest new additional characters on the TQ for testing DUS or after notification by the DUS Test Centre of distinctness problems. (For procedures see Section F).

Section E - Reference Seed Stock Maintenance

1 Purpose

1.1. This section sets out the procedures for reference seed stock maintenance and VCU seed stock authentication (if applicable).

2 Scope

2.1 These procedures apply to all reference collection varieties.

3 Responsibilities

3.1 The Test Centre is responsible for conducting these procedures.

4 Procedures for Reference Seed Stock Maintenance

4.1 The seed sample submitted with the successful or pending application is considered to be the definitive stock of the variety. Subject to meeting the required certification standards a small portion of the seed is sown for observation and measurement. The remainder is stored under controlled and monitored storage conditions as part of the official reference collection.

4.2 If during the normal tests there is any evidence that a seed stock is deteriorating in storage, or that stocks have low quantity, a request will be made to the maintainer asking for a replacement stock of the variety. This replacement stock must be authenticated, by comparing plots established from the replacement seed with that of the definitive seed, over a maximum of two recording cycles.

4.3 Plots will be established from any replacement reference seed sample to be authenticated and compared visually with the definitive seed over a maximum of two test cycles. Plots must be examined through all stages of growth and development. If the new seed sample cannot be visually distinguished from the existing definitive seed, it will be accepted as representing the variety. It will then be considered as the definitive seed and substituted for the existing seed in the reference collection. These procedures may be modified, where, in the opinion of the technical officer, differences are the result of environmental or cultural factors.

4.4 In the event of the replacement sample not meeting the required acceptance standards set out in 4.3, an additional replacement sample will be requested. Plots will be established from any additional replacement seed sample and compared over a maximum of two recording cycles. If the additional replacement sample does not meet the standards, APHA will be informed, and the variety will be deleted from the reference collection and the Variety Lists will be reviewed.

5 Procedures for the Inclusion of New Common Knowledge Varieties into the Reference Collection

5.1 When a new variety enters into common knowledge, it must be included in the reference collection, if seed is available. A request for seed will be sent by the Test Centre to the maintainer of the variety and an official description will be requested from the Testing Authority which registered the variety. If an official description is provided, seed received will be assumed to be definitive if the seed conforms to the official description. Small differences in the expression of quantitative characters are likely to be the result of recording in a different environment and will be considered as conforming to the description. If no official description is available, seed will be assumed to be definitive.

5.2 If the seed does not conform to the official description, a request for definitive seed will be sent to the Testing Authority that added the variety to its Variety Lists or granted Plant Breeders' Rights. This seed will then be used to validate the sample of seed from the maintainer. The standards for this validation will be as for authentication of replacement seed (see E4).

6 Release of Reference Samples for Authorised Purposes

6.1 Seed of reference samples can be supplied by the Test Centre, on request, to UK and UPOV DUS Testing Authorities and UK and OECD Seed Certification Agencies, provided the recipient is notified in writing that this material, or any material derived from it, must not be supplied to a third party or used for any other purpose than as a reference for official DUS testing or seed certification.

6.2 Provision of reference samples, other than in 6.1, to any other parties must be authorised by APHA.

Section F - Procedures for Assessment of New Additional DUS Characters

1 Purpose

1.1 This section sets out the procedures for assessment of new additional DUS characters for varieties of Carrot entered for Variety Listing and/or Plant Breeders' Rights trials.

2 Scope

2.1 These procedures apply to applications where additional DUS characteristics which have not been previously approved by the NLSC are requested for use in the examination of DUS.

3 Responsibilities

3.1 The Test Centre is responsible for liaising with the applicant to produce a proposed procedure for the conduct of new tests. This procedure must ensure that Distinctness, Uniformity and Stability requirements will be met.

3.2 All new additional characteristics must be authorised by the NLSC in consultation with the PVSC

4 Reference Varieties

4.1 The reference varieties will include only those varieties from which the candidate variety is not distinct, as well as other varieties for control purposes.

4.2 Seed of reference varieties will be supplied by the Test Centre.

5 Procedures

- 5.1 Details of the proposed special test or assessments will be submitted to the NLSC.
- 5.2 The NLSC may commission a test or trial to further investigate a proposal. The applicant will be advised by APHA of arrangements and costs.
- 5.3 Where the test for a character is approved by the NLSC it should be subsequently listed in Section D 5.2 or 5.3 as appropriate.

Section G - Procedures for DUS Decisions

1 Purpose

1.1 This section sets out the standards used to assess distinctness, uniformity and stability of varieties of Carrot.

2 Scope

2.1 These procedures apply to all varieties of Carrot (*Daucus carota* L.) entered for Variety Listing and/or Plant Breeders' Rights tests and those being tested for Foreign Authorities.

3 Responsibilities

3.1 The Test Centre is responsible for applying the criteria for DUS, set out in this procedure.

3.2 The Test Centre is responsible for producing the DUS reports in accordance with these procedures and for ensuring that they are in accordance with UPOV guidelines.

4 Reference Varieties

4.1 Appendix I sets out which varieties are considered as reference varieties for these procedures.

5 Distinctness

5.1 Distinctness is normally assessed in two independent test cycles, but a candidate variety could be considered distinct after one test cycle if there are no other similar varieties. A third independent test cycle may be undertaken if distinctness is not established after two test cycles.

5.2 In accordance with associated document UPOV TG/1/3 varieties can be considered distinct where they have a different expression in a grouping character.

5.3 The distinctness standard applied for qualitative characters is a difference of one state unless otherwise indicated in Section D. For pseudo-qualitative characters the distinctness standard is a difference of 1, 2 or 3 states depending on the characteristic.

- 5.4 If a candidate is clearly different in a visually observed quantitative character, it is considered to be distinct, without the need for a repeated observation.
- 5.5 Where varieties are grown in close proximity under the same conditions, and a direct comparison can be made, a candidate is considered to be distinct if a clear visual difference is observed in a quantitative character.
- 5.6 Where varieties are not grown in close proximity, a candidate is considered to be distinct if a difference of at least two states (see table in section D 5.2) is recorded in a visually observed quantitative character.
- 5.7 The standard for measured or counted quantitative characters, is, at least, a 5% ($P=0.05$) significant difference in one character over two or three growing cycles in a Combined Over Years Distinctness (COYD) analysis. Please see associated document UPOV TGP/8/1 for details.
- 5.8 Where COYD cannot be applied, alternative methods should be considered.
- 5.9 When the number of varieties grown does not provide sufficient degrees of freedom for use of the standard COYD analysis, alternative methods should be adopted. If there is sufficient historical data (at least 5 years and sufficient degrees of freedom) then the long-term LSD is applied. This LSD is calculated using up to 10 years of the most recent data. If there is insufficient historical data, the 2 x 1% method should be used.
- 5.10 Where the candidate has a full complement of data for two test cycles, but there is only data for control varieties for one test cycle, the use of FITC (Fitted Constant program in DUST) may be applied. This situation may arise due to the loss of plant material within plots in any one year or where suitable control varieties were not grown in both test cycles. The standard applied for Distinctness in such cases is $P=0.01$.

6 Uniformity

- 6.1 Uniformity is assessed for all characteristics used to establish Distinctness.

Uniformity based on the assessment of 'Off-types'

- 6.2 The assessment of Off-types is undertaken in both test cycles and the total number of 'off-types' combined should not exceed the number allowed using the population standards.
- 6.3 Off-type plants in the glasshouse or field are identified and marked for exclusion from recording.

6.4 For cross-pollinated varieties, relative uniformity should be applied. For the characteristics “external colour of root” (UPOV characteristic 14) and colour of core of root (UPOV characteristic 20), the number of off-types should not exceed the level indicated in UPOV TGP/8/1 for a population standard of 2% and a 95% acceptance probability. In a population of 640 plants, 19 off-types are allowed.

6.5 For single cross hybrids and inbred lines, the number of off-types should not exceed the level indicated in UPOV TGP/8/1 for a population standard of 2% and a 95% acceptance probability. In a population of 640 plants, 19 off-types are allowed.

6.6 Where the number of off-types in the first test cycle exceeds 19 but is less than 35, the applicant may submit a new seed sample (Resubmission) in the second test cycle with the aim of meeting the off-type standard. Distinctness will be assessed on data from the original seed submitted in the first test cycle and on data from the resubmitted seed in the second test cycle. The resubmitted seed will be authenticated against the original seed in side-by-side plots.

6.7 In addition, the number of aneuploid or inbred plants allowed in F1 hybrids should not exceed the numbers indicated in UPOV TGP/8/1 for a 3% population standard and a 95% acceptance probability.

6.8 After the variants have been excluded, the characteristics listed in Section D5 are used to assess the uniformity of the remaining plants, according to the methods described.

Uniformity based on the assessment of general variation where no measurements are recorded:

6.9 Uniformity of continuous variation (quantitative characters) is visually assessed according to the following scale:

Score 1-5 unacceptable (1 is worst)

Score 6-9 acceptable (9 is best)

A candidate with a visual uniformity score of 6 or more is satisfactory.

Uniformity based on the assessment of general variation where measurements are recorded:

6.10 Provided a variety meets the off-type standard, it can be considered sufficiently uniform after two test cycles if, for all measured characters necessary for distinctness, the combined Over years Uniformity (COYU) analysis is not significantly greater than that of the reference varieties at the 0.1% ($P=0.001$) significance level. In all cases an examination of data from individual test cycles is carried out to investigate the uniformity problem indicated by the COYU result. Decisions on whether any outlier plants (off-types) identified by data analysis should be excluded from the calculation of variety means and standard deviations, should be taken by the Test Centre.

7 Stability

7.1 A variety is considered sufficiently stable when there is no evidence to indicate that it lacks uniformity or fails to conform to the essential characteristics of its description in different submissions or in different tests.

8 DUS Report and Variety Description

8.1 Upon completion of the DUS examination the DUS Summary Report will be submitted to APHA and will be discussed at the relevant DUS Test Centre Meeting. This report will specify all non-routine characteristics used for establishing distinctness.

8.2 The final DUS report, including the full variety description for positive reports, will be submitted to APHA. The characteristics to be used in the description are identified in Section D.

Appendix 1 – Reference Collection Varieties

1 Variety Listing and Plant Breeders' Rights

1.1 The DUS reference collection, for any given category of plant variety comprises the following at the time when the application for the candidate is made:

1.1.1 All other candidate varieties already in DUS test in the UK or entering testing at the same time as the candidate.

1.1.2 All varieties with the UK PBR.

1.1.3 All varieties on the OECD variety list that are listed by countries with comparable climatic conditions to the UK.

1.1.4 All varieties protected under National PBR (UPOV contracting parties) with comparable climatic conditions to the UK

1.1.5 Any varieties nominated by the applicant as being comparable i.e., known to be similar.

1.1.6 Any other varieties considered to be comparable i.e., known to be similar by the appropriate Test Centre or DUS Centre Group.

1.1.7 Other available comparable varieties in common knowledge.



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The Animal and Plant Health Agency (APHA) is an executive agency of the Department for Environment, Food & Rural Affairs, and also works on behalf of the Scottish Government and Welsh Government.