



Animal &
Plant Health
Agency

United Kingdom Variety List Trials: Trial Procedures for Official Examination of Value for Cultivation and Use (VCU) Harvest 2023

Fodder Radish

January 2023

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Section A – Summary of VCU trial assessments required

Bold = Obligatory *Italics = Additional*. Assessed only if requested by the applicant

Type of character	Reference	Description of assessment
Yield	Section C	Dry matter yield (t/ha)
Resistance to harmful organisms	Section D	Alternaria % <i>Club root</i> <i>Beet cyst nematode</i>
Behaviour with respect to factors in the physical environment.	Section C	Plant population <i>Flowering date</i> <i>Emergence (1-9)</i> <i>Establishment (1-9)</i> <i>Height (cm)</i> <i>Lodging (1-9)</i> <i>Bolting (1-9)</i> <i>Stem rotting (1-9)</i> <i>Leafiness (1-9)</i> <i>Winter hardiness (1-9)</i> <i>Re-growth (1-9)</i> <i>Vigour (1-9)</i> <i>Frost damage (1-9)</i>

Type of character	Reference	Description of assessment
Quality characteristics	Section E	Dry matter content % <i>D-value</i> <i>Protein content</i> <i>Ash content</i> <i>Germination %</i> <i>Glucosinolate</i>

Further measurements

The following must be measured or recorded in all trials, following procedures in Section C.

Sowing date

Harvest date

Plot size

Harvest losses (where present at levels which will affect results)

Fresh yield

Section B – Seed handling procedures

B.1 Seed handling procedures

B.1.1 See GENERAL INFORMATION, SECTION 5 - Minor Crop VCU Procedures Introduction.

B.2 Authentication of VCU seed

B.2.1 The Seed Handling Operator must forward 200 g of untreated sample of the seed submitted of every variety in the trial, for authentication by the DUS test centre by the date specified by APHA. The Trials Organiser will notify the minimum quantity required to Seed Handling Operators annually.

Section C – Growing trial procedures

C.1 Responsibilities

C.1.1 The Growing Trial Operators are responsible for conducting the trials according to these procedures.

C.2 Site suitability

C.2.1 The Growing Trial Operator will be responsible for providing a suitable site, which meets the following criteria:

C.2.2 Previous cropping should follow best practice i.e. no brassica species grown in the previous three years.

C.2.3 Soil type should be typical of those on which radish are grown locally. Soil fertility and texture should be uniform across the site. The soil should be sufficiently uniform to avoid variation in the growth of the trial.

C.2.4 The trial should be sited away from trees, hedges, headlands and other features, which are likely to cause uneven growth or encourage damage from wild fauna.

C.2.5 The trial area should be cultivated in the direction of ploughing and drilled across the direction of ploughing and cultivation such that each plot receives similar treatments. Cultivations should follow best practice.

C.2.6 The frequency, direction and approximate date of all cultivations carried out since the last crop should be recorded in the site details record sheet.

C.3 Sowing the trial

C.3.1 Plot size

C.3.1.1 Plot should be drilled to a greater length than required and then trimmed back to appropriate length. The outside rows of the plot should be discarded, and the plot size should be sown to allow a minimum target harvest plot after trimming, of 10 m². There will be at least three replicates sown.

C.3.2 Plant population

C.3.2.1 Drill at a rate of 10 kg/ha in order to achieve a target final uniform plant population of approximately 60-100 plants per m².

C.3.3 Trial layout

C.3.3.1 The Trials Organiser following consultation with APHA produces provisional sowing lists. The Trials Organiser will make final sowing lists available to Growing Trial Operators, along with the trial plans produced by the Trial Design and Data Handling Operator.

C.3.3.2 The trial should be sown according to the plan produced by the Trial Design and Data Handling Operator and may be an incomplete block design. In an incomplete block design, each replicate is split into a number of sub-blocks. Any splitting of replicates must be between sub-blocks and not through sub-blocks. Varieties can be moved within a sub-block but must not be moved from their sub-block. Varieties must not be moved around within the plan e.g. if drilling errors occur. If plots are moved out of their original sub-block they will have to be treated as missing plots. If there are any queries, please contact the Trials Organiser.

C.3.3.3 Buffer plots may be required in some instances. The Trials Organiser will advise if this is the case.

C.3.3.4 If there is a need to replace a planned variety, e.g. if varieties are withdrawn, affected plots must be sown with any of the standard control varieties. Any such replacements must be agreed with the Trials Organiser. The control varieties are listed in Appendix 5.

C.3.4 Drilling

C.3.4.1 Care must be taken with drill settings and drilling speed to ensure satisfactory and uniform establishment and plant population from plot to plot. It is also important to ensure that there is no carry-over of seed between plots.

C.3.4.2 At least two rows of discard should be drilled on either side of the trial with the same drill and at the same time that the trial is drilled

C.3.4.3 Precautions must be taken to avoid any missing rows. Any missing rows or parts of rows must be noted on the drilling plan and reported to the Trials Organiser within one month of emergence.

C.3.5 Confirmation of trial layout

C.3.5.1 After full establishment and within one month of sowing the Growing Trial Operator must confirm that the trial has been sown to plan or give full details of any changes to plan. This should be done by clearly highlighting the changes in the electronic plan and returning it to the Trial Design and Data Handling Operator.

Return a completed site data 1 sheet including the following information:

- Site location details including how to get to the field.
- Sketch showing the layout of the trial in the field, in relation to other trials and showing access roads, gates, etc.
- Trial sketch showing plot numbers and variety codes and/or names.
- A short post-establishment report of the condition of the trial.

C.4 Husbandry

C.4.1 Agronomy

Where not specified in these procedures' agronomy should follow best local practice.

C.4.2 Fertiliser and spray application

Applications of fertilisers and sprays should be uniform. It is normally best to apply these across the direction of the plots. The precision application of chemicals post-drilling down the rows is permitted where appropriate, but wheelings within or between plots post drilling are not acceptable unless they consistently occur in the same place in each plot.

C.4.3 Fertiliser application

Applications of fertilisers should take into account inherent fertility, previous cropping, winter rainfall, the best local practice. All fertiliser applications should take account of the AHDB Nutrient Management Guide (RB209), the corresponding advisory publications in England, Wales, Scotland and Northern Ireland and past trialling experience.

C.4.4 Herbicides

The Trials Organiser must be consulted. Application should be across the direction of drilling.

C.4.5 Pest and disease control

C.4.5.1 Pest control

Appropriate seed dressings must be applied as approved by the Trials Organiser. The chemical seed treatment applied to the trial seed should control some soil-borne pests and may provide some early-season control of insect-borne-virus vectors. However, appropriate pesticide treatments should be undertaken to control virus vectors through the season. Precautions should be taken against attacks by, for example, birds, deer, rabbits, hares, mice and insects.

C.4.5.2 Disease control

Seedling diseases should be controlled by the routine seed-dressings used and viruses should be controlled by targeting their insect-vectors (see C.4.5.1 above).

C.4.6 Irrigation

Irrigation will not be permitted without the specific agreement of the Trials Organiser.

C.4.7 Pathways

A gap (pathway) at the end of each plot of at least 1m is required.

C.4.8 Plot assessment

Plots should be assessed at the time of the population count to determine whether they are suitable for harvest. Weak plots may occur due to mechanical or varietal problems. If the problem is considered to be varietal the plots must remain as part of the trial. If the problem is considered to be mechanical the plots should either be treated as missing or as half plots.

Plots affected should be notified to the Trials Organiser at the time of detection

C.4.8.1 Half plots - plots with gaps or poor uniformity may occur

If plots have gaps due to mechanical or agronomic problems, it may be necessary to eliminate the poor area by reducing the plot to a uniform length. Removal must be across all rows - whole rows cannot be discarded. These plots should be measured and pegged at the time of the population counts

C.4.8.2 Missing plots - plots with gaps or poor uniformity may occur

If plots are weak due to mechanical or agronomic problems throughout their entire length, it may be necessary to make the plots missing. These plots should be pegged at the time of the population counts and a symbol should be entered in subsequent data records (see C.6.2.5). The plots should be clearly indicated when the data is sent to the Trial Design and Data Handling Operator.

C.5 Harvesting

C.5.1 Timing of harvesting

C.5.1.1 Date of harvesting will be according to a schedule which will be drawn up by the Trials Organiser after consultation with the Growing Trial Operators.

C.5.1.2 Plots should be trimmed to their final harvest length as described in C.4.7 above. The plot dimensions must be measured prior to harvesting. If it is necessary to reduce the harvest size as described in C.4.8.1 above give clear details with the yield file. Individual harvested plot lengths should be recorded.

C.5.2 Harvesting method

C.5.2.1 All trials will be harvested by harvesting equipment approved by the Trials Organiser.

C.5.3 Samples

C.5.3.1 A sample of the chopped material (minimum 500 g) should be taken for dry matter analysis from each plot. A composite sample from all rows should be taken. Make every attempt to ensure that the sample is well mixed and representative of the plot.

C.5.3.2 All samples should be labelled with the labels provided by the Trials Organiser.

C.5.3.3 The samples should be delivered to the appropriate Quality Testing Operator as soon as practical after harvest.

C.5.3.4 All plot samples must be labelled with the trial identification number, variety name/breeders' reference, AFP number, plot number and Growing Trial Operator identification number.

C.5.4 Submission of data and samples

C.5.4.1 Appendix 6 lists the records, with deadlines, to be sent to the Trials Organiser. Diary sheets and any other field records should be returned to the Trials Organiser within 5 working days of harvest.

C.5.4.2 All plot records should be transmitted to the Trial Design and Data Handling Operator following the deadlines set out in Appendix 6. The Growing Trial Operator should ensure that data are free from errors before transmission. After scrutiny, copies of results will be returned to the Growing Trial Operator for action as agreed by the Trials Organiser.

C.5.4.3 All samples should be sent to the Quality Testing Operator following the deadlines set out in Appendix 6.

C.6 Records

C.6.1 There are four components:

1. Diary: Field notes of trial status, recording and inspections
2. Site data part 1:
 - a. A map of site location showing nearby settlements and roads
 - b. A sketch showing the layout of trials in the field with access points
3. Site data part 2*: Details of agrochemical applications and irrigation
4. Plot records: Plot data

*Template available from Trials Organiser

C.6.1.1 An entry in the Diary sheet should be made on every trial visit and any observations relevant to variety performance should be recorded. If the trial is in good condition, with no problems, this should be recorded.

C.6.2 Plot records

C.6.2.1 Plot data may be recorded direct onto a data logger using a system approved by the Trials Organiser or recorded on paper then entered and validated onto a computer using an approved system. A system of ensuring that data are recoverable, in the event of loss of original data, must be implemented, e.g., copy and safe storage. Whichever method is used, individual plot data will only be accepted by the Trial Design and Data Handling Operator in an approved format using the measure names and units as listed in Section C.6.3.

C.6.2.2 All observations should be checked at the time of recording to ensure that they lie within acceptable limits for the character recorded. Observations that have been designated as exceptional by the recorder should be identified with a note on the approved data file or hard copy medium describing the possible causes together with a recommendation for their exclusion or inclusion in the trial analysis.

C.6.2.3 Plot numbers on record sheets must correspond with the numbering on the field plan.

C.6.2.4 If a character is not recorded or is missing the Growing Trial Operator should indicate in the diary or on the recording sheet the reason why it has been excluded.

C.6.2.5 Where a plot record is missing the Growing Trial Operator should record this in any data file or hard copy medium as a symbol thereby indicating there is no recorded value associated with this plot.

C.6.2.6 Specific plot records must be made as counts or on the scales shown for each character. Only the character names as listed may be used. All records should be returned to the Data Handling Operator as soon as possible after they are completed.

C.6.2.7 All records must be returned as soon as reasonably possible and when complete for the whole trial. Indicative deadlines are given in Appendix 6. All records must be returned by the final deadlines.

C.6.3 Procedures for recording characters

C.6.3.1 The following procedures must be followed for measuring all characters to be used in NL decision-making.

C.6.3.2 **SOWING DATE** (OBLIGATORY) (Day/month/year)

This is recorded in Part 1 of the Site Information Form

C.6.3.3 **PLOT SIZE** (OBLIGATORY) (m²)

This is recorded in Part 1 of the Site Information Form

C.6.3.4 *GERMINATION* from all plots (ADDITIONAL) (%)

C.6.3.5 **PLANT POPULATION** from all plots (OBLIGATORY) (Count)

Record the number of plants in the plot after emergence. Record the plot length counted and indicate any rows that have a low population.

C.6.3.6 HARVEST DATE (OBLIGATORY) (Day/month/year)

This is recorded in Part 2 of the Site Information Form

C.6.3.7 HARVEST LOSSES (OBLIGATORY) (%)

C.6.3.8 FRESH YIELD from all plots (OBLIGATORY) (kg)

Enter the total harvested weight in kg per plot and provide the harvested plot dimensions with the record. If the plot lengths or widths are not constant then these must also be entered as records.

C.6.3.9 DRY MATTER YIELD from all plots (OBLIGATORY) (kg)

Assessed by agreed Protocol.

C.6.3.10 DRY MATTER CONTENT from all plots (OBLIGATORY) (%)

A detailed protocol for the assessment of dry matter content is given in Section E. Also specify the fresh weight taken for the sample. If the figures are DM% then enter the fresh weight of sample as 100.

C.6.3.11 D VALUE from all plots (ADDITIONAL)

A detailed protocol for the assessment of digestibility is given in Section E.

C.6.3.12 PROTEIN CONTENT from all plots (ADDITIONAL) (%)

C.6.3.13 ASH CONTENT from all plots (ADDITIONAL) (%)

C.6.3.14 EMERGENCE from all plots (ADDITIONAL) (1-9)

- 1 No emergence
- 9 100% emergence

C.6.3.15 ESTABLISHMENT from all plots (ADDITIONAL) (1-9)

- 1 Very thin
- 9 Very thick

C.6.3.16 VIGOUR from all plots (ADDITIONAL) (1-9)

- 1 Poor
- 9 Excellent

C.6.3.17 *LEAFINESS* *from all plots (ADDITIONAL)* (1-9)

- 1 Least leafy
- 9 Most leafy

C.6.3.18 *BOLTING* *from all plots (ADDITIONAL)* (1-9)

- 1 100% bolting
- 9 No bolting

C.6.3.19 *LODGING* *from all plots (ADDITIONAL)* (1-9)

Record the % plants in the plot that are bent over from the root at more than 30°.

- 1 Plants lodged
- 9 No lodging

C.6.3.20 *HEIGHT* *from all plots (ADDITIONAL)* (cm)

Estimate the average canopy height for each plot, 70 days after sowing.

C.6.3.21 *HARDINESS* *from all plots (ADDITIONAL)* (1-9)

- 1 Complete loss
- 9 No damage

C.6.3.22 *STEM ROTTING* *from all plots (ADDITIONAL)* (1-9)

- 1 All stems rotting
- 9 No stems rotting

C.6.3.23 *RE-GROWTH* *from all plots (ADDITIONAL)* (1-9)

Record the incidence of axillary side shoots where:

- 1 None
- 9 Extensive

C.6.3.24 *FROST DAMAGE* *from all plots (ADDITIONAL)* (1-9)

- 1 complete loss
- 9 no damage

C.6.3.25 Site factors

Any factors which may have affected the yield of the trial or individual plots must be noted and accompany the yield data. Where varietal differences are seen in pest or disease attack, records should be made either as an estimated % of plants affected, or as % leaf area attacked in accordance with the procedure in Section D for disease.

Records for other scores should be taken as % plants affected or on a 1 to 9 scale. Include definitions of 1 to 9 on the scale.

C.6.3.26 Trial inspection

All trials will be inspected by the Trial Inspection and Technical Validation Operator and, in some cases, it may be necessary to visit on more than one occasion.

The requirements for Growing Trial Operators in respect of inspections are to:

1. Give inspectors reasonable access to trials and provide full location and site details (if not already given with site data 1)
2. Provide the inspector with information (for example pesticide sprays applied etc) within 7 days of a request
3. Co-operate with the inspector in making any non-routine assessments required to establish the validity of the trial (for example population counts)
4. Carry out any action agreed in consultation with the inspector. In particular it is important that any requirement to shorten plots is undertaken. *The data on plots* that the trials operator and inspector agree to exclude should not be submitted.

Section D – Disease testing procedures

D.1 Assessment of natural infection

D.1.1 The Growing Trial Operator is responsible for carrying out these procedures.

D.1.2 Naturally occurring disease in VCU growing trials

D.1.2.1 Naturally occurring disease is normally recorded in the growing trials. Confirmation of the identity of a disease should be obtained from an appropriate plant pathologist if required.

D.1.2.2 Recording methods

D.1.2.3 Diseases are assessed using the timings and appropriate assessment keys given in Appendix 7. All disease records to be sent to the appropriate Trial Design and Data Handling Operator as soon as they are made.

Section E – Quality testing procedures

E.1 Responsibilities

E.1.1 The Quality Testing Operator appointed by the Trials Organiser is responsible for conducting approved quality tests according to these procedures. The Growing Trial Operators are responsible for producing representative samples for quality assessment as indicated in Section C.

E.2 Quality assessment methodology for obligatory and additional tests

E.2.1 Dry Weight Determination

The treatment of samples and the time interval between cutting and weighing should be such that there is no significant moisture loss between the weighing of the plot fresh yield and the weighing of the fresh weight of the sample.

A fully representative sub-sample (500 – 750 g) of well chopped fresh material is accurately weighed, or an accurately recorded catch weight (500 - 750 g recorded to one decimal place) taken. Although in some instances all of the sampling and weighing of fresh material may be carried out in the field, it is acceptable for samples to be brought to the laboratory for weighing. If the latter option is followed the representative sample is immediately sealed in a 500 gauge polythene bag and kept out of direct sunlight and as cool as possible until transported to the laboratory. Each sample is identified with a label.

The sample is placed in the drier which must be at a temperature of $100\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ with the air recirculator set in the range 80-100% recirculation in order to restore the temperature to $100\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ as rapidly as possible. When the temperature is restored to $100\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ the air regulator is set at 80% recirculation i.e. 20% fresh hot air. The air regulator is critical for even rapid drying. The samples are dried $100\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ for such time as is necessary for complete drying.

The dried sample is carefully removed from the drier as soon as the sample is cool enough for accurate weighing. The dry weight is recorded to one decimal place.

E.2.2.2 Digestibility analysis

The Dry Organic Matter Digestibility (DOMD or D-value) of all the samples taken for quality must be determined according to an agreed protocol.

The samples are milled using a Foss Tecator 1093 Cyclotec sample mill fitted with a 1 mm screen. The screen and grinding ring should be inspected for wear frequently and replaced at appropriate intervals, at least annually. It is important that all samples are milled through a **single** Cyclotec mill to maintain the precision of the analysis.

The milled samples are scanned and the spectral data stored using a FOSS NIR systems 5000N scanning instrument or equivalent. A 'Digestibility Analysis (de Boever)' calibration, (supplied by Departement Qualite des Productions Agricoles, Belguim) is used to convert the spectral data for each sample to D-value units. The calibration has been shown to relate NIRS spectra to D-values as assessed by wet chemistry techniques eg (pepsin cellulase method). The NIRS calibration models are maintained and validated on an annual basis, whereby a set of control samples are analysed using the NIRS technique and the respective laboratory methodology. A comparison of the results from the two techniques are compared to ensure the accuracy of the NIRS calibration model.

Inconsistent or apparently anomalous results must be repeated. The final data values must be sent to the Testing Co-ordinator in an approved form. The laboratory must be prepared to immediately undertake any repeat analyses requested by the Testing Co-ordinator, which may be individual varieties or even whole trials.

Section F – Trial design and data handling procedures

F.1 Plan validation and storage

F.1.1 After the trial has been drilled, the Growing Trial Operator must:

- a) Confirm that the trial has been drilled according to plan and provide the sowing date, by returning site data 1 and associated trial sketch to the Trial Design and Data Handling Operator.
- b) If any amendments to the plan have been made, return a hard copy of the plan to the Trial Design and Data Handling Operator with any amendments clearly indicated. Alternatively, amendments may be notified electronically with the agreement of the Trial Design and Data Handling Operator.

F.1.2 The Trial Design and Data Handling Operator will check these for statistical validity and, once this has been done, will load the plan on the database.

F.2 Data recording

F.2.1 Data are recorded using the methods and characters given in Sections C, D and E.

F.2.2. Site information is recorded for each trial including, for example, data on previous cropping, cultivations, soil details, fertiliser and agrochemical applications.

F.2.3 Details of any agrochemical applications are also recorded and forwarded to the Trials Organiser.

F.3 Data processing

F.3.1 Processing of individual agronomic and disease variates

F.3.2 A list of the agronomic, yield and disease variates, which may be recorded and processed, are specified in Sections C, D and E. After scrutiny, copies of the results will be returned to the Growing Trial Operator for action as agreed by the Trials Organiser.

F.4 Other tests and trials

F.4.1 Any additional or alternative designs required for the assessment of additional VCU characters not detailed in Annex E of the **MINOR CROPS VCU TRIAL PROTOCOL** will be added to these **Procedures** as and when approved by the NLSC.

Appendix 1 – Approved Trial Organisers/Operators

Activity	Organisers/Operators responsible
Trials Organiser	BSPB
Trial Design and Data Handling Operator	NIAB
Growing Trial Operator	DLF Seeds Ltd
Seed Handling Operator	NIAB
Trial Inspection and Technical Validation Operator	BSPB
Quality Testing Operator	DLF Seeds Ltd
Data Review and Standard Setting Operator	NIAB

Appendix 2 – Seed treatment products for use on VL trials

None

Appendix 3 – Seed despatch deadline dates

VCU seed must be delivered to the Seed Handling Operator by 15th February.

Appendix 4 – Growing Trial Operators and trial locations

Growing Trial Operator	Seed Handling Operator (if not trial operator)	Location of trial
DLF Seeds Ltd	NIAB	Gloucestershire

Appendix 5 – Control varieties for VCU assessments

The control varieties are:

Serum

Contra

Appendix 6 – Dates by which records Should be sent to Data Handling Operator

Record	Latest date of receipt by Data Handling Operator
Site data part 1 (including site sketch)	Within 1 month of drilling trial
Site data part 2	By the time trial is harvested
Plot records (in approved electronic format)	Growing Trial Operator should notify Data Handling Operator that trial has been harvested within 2 days of harvest

Appendix 7 – Assessment keys for radish diseases

1 Leaf diseases

1. Examine leaves in 3 areas of each plot.
2. Include all necrosis and chlorosis attributable to disease to be assessed.
3. Estimate % infection using the description below, interpolating values if necessary.
4. Record the average % infection from the 3 areas.

2 Infection disease severity description

Description	
0	No infection observed.
0.1	Older leaves with a trace of infection, other leaves uninfected.
1	Older leaves with up to 10% infection, other leaves largely uninfected.
5	Older leaves with up to 25% infection, middle aged leaves with a trace of infection.
10	Older and middle aged leaves with up to 25% infection, young leaves largely uninfected.
25	Leaves of all ages appear 50% infected 50% green on average.
50	Leaves of all ages appear more infected than green on average.
75	Very little green tissues left.
100	No green tissue left.



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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.