Animal &
Plant Health
Agency

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

Mustard

January 2023

Contents

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	**Plot yield** **Moisture content**
Behaviour with respect to factors in the physical environment.	Section C	**Maturity** **Standing ability** *Plant height* *Earliness of flowering*
Resistance to harmful organisms	Section D	None routinely recorded
Quality characteristics	Section E	None routinely recorded

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

Sowing date
Harvest date
Plot size
Bird damage (where present at a level which will affect results
Seed loss (where present at a level which will affect results)
Combine harvester losses (where present at level which will affect results)

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 APHA will notify the Seed Handling Operator of the DUS Test Centre to which a 50 g sample of each variety of mustard should be sent for authentication.

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 must be appropriate for a mustard crop to be grown, with a suitable break from cruciferous crops, in order to minimise the chance of club root incidence within the trial.

C.2.3 Soil type should be typical of those on which mustard would be grown locally. Soil fertility and texture should be uniform across the site. The soil should be sufficiently uniform with no substantial variations in previous cropping, ridges, furrows, etc.

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 grazing 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 wheeling compaction. Cultivations should follow best local practice.

C.3 Sowing the trial

C.3.1 **Plot size**

C.3.1.1 The harvested plot area per variety should be not less than 20 m² per replicate and four replicates must be used. Plots should be drilled to a greater length than required and cut back to the required length prior to harvest. The plot width for calculating harvested area is measured centre gap to centre gap with an inter-plot gap in the range 0.5 m to 0.8 m.

C.3.2 **Plant population**

C.3.2.1 The seed rate is 150 seeds/m². Seed may be supplied to trial sites either chemically treated in plot modules, or in bulks for packeting on site.

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.

C.3.3.3 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 one discard plot must 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 in the trial diary 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, advisory and regulatory guidelines. Application of fertilisers and sprays should be uniform. It is normally best to apply these across the direction of the plots. Application wheelings should not run through the harvested plot area.

C.4.2 **Fertiliser application**

It 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.4.3 **Herbicides**

The Trials Organiser should be consulted.

C.4.4 **Growth regulators**

Should not be used on mustard trials.

C.4.5 **Pest and disease control**

C.4.5.1 **Pest control**
Seed dressings will include an insecticide element. Where there is a risk of significant flea beetle attack Growing Trial Operators must ensure that adequate pre- and post-emergence control measures are taken. Assessments should be made wherever pest damage occurs since decisions have to be made on the validity of each plot affected. Grazing, particularly by pigeons, may be selective and control measures should be taken if necessary.

C.4.5.2 **Disease control**

Growing Trial Operators should be aware that severe outbreaks of Sclerotinia and Alternaria could threaten the validity of the trial, and should weather patterns favour the build-up of these diseases, then an appropriate fungicide should be applied at mid-flower for Sclerotinia or from mid-flower to pod senescence for Alternaria. Although the risks of Sclerotinia and Alternaria development are low in mustard damaging attacks could occur. Sclerotinia may develop if a flush of apothecia coincides with flowering and periods of wet weather; Alternaria may develop rapidly if warm and wet conditions occur during late flowering and pod development. If control measures were ineffective for any reason, and these diseases did develop, levels should be recorded. Other disease control should only be undertaken after agreement by the Trials Organiser.

C.4.6 **Irrigation**

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

C.4.7 **Pathways**

Internal pathways should be made after the risk of pigeon damage has passed.

C.5 Harvesting

C.5.1 **Timing of harvesting**

C.5.1.1 Date of harvesting will be determined by the Growing Trial Operator based on crop maturity and local weather conditions.

C.5.1.2 Plots should be trimmed to their final length prior to harvesting. The plot dimensions must be measured prior to harvesting. If it is necessary to reduce the size of any plot at harvest give clear details on the yield file. Individual harvested plot lengths should be recorded.

C.5.2 **Harvesting method:**

Trials can be swathed or desiccated and direct combined (using a translocated desiccant such as glyphosate).

C.5.3 **Samples**

C.5.3.1 Samples are required from all plots for moisture determination using the oven method. If additional samples are required, they will be notified to the Growing Trial Operator by the Trials Organiser. All samples should be labelled with the labels provided, giving variety name/breeders reference, AFP number, replicate number, and Growing Trial Operator identification number.

C.5.3.2 It is essential that all samples:

- Are representative of the variety/plot from which they are taken with minimal contamination. When sampling on-combine, it is essential to minimise the risk of contamination of grain from the previous plot.
- Are taken from the same source.
- Contain the weight of grain requested.

C.5.3.3 Two samples must be taken from each plot at harvest. A 200 g sample must always be taken at the time of plot weighing and sealed in a polythene bag for dry matter and oil content determination. In addition, a 100 g sample is taken and sealed in a cloth bag for glucosinolate analysis. One label should be placed inside the bag, and this sealed by rolling over the top and securing the bag and the second label with rubber bands. At sites where higher moisture levels are frequently experienced and dry matters are determined immediately in the trial operator's laboratory a single sample of 500g per plot and subsequently divided may be taken for dry matter, oil and glucosinolate content.

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.6 Records

C.6.1 There are four components:

1. **Diary** Field notes of trial status.

2.* **Site data part 1** Including full location details:
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 and
c) trial layout, showing plot numbers and variety codes/names.

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 trials 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 AFP number, variety name and units as listed in Sections C and D.

C.6.2.2 All observations should be checked at the time of recording to identify any unusual plot performance. These observations should be noted by the recorder and any possible causes identified, together with a recommendation for whether the data should remain in the analysis or should be excluded.

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 should 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 Trial Design and 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**

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

C.6.3.1 **PLOT YIELD AND MOISTURE CONTENT (OBLIGATORY) (kg)**

The following information must accompany the yield data:

The moisture content % of the harvested grain, determined by oven method.

Plot length: the plot length harvested in metres.
Plot width: the width of the harvested plot in metres from outer row to outer row plus half of the inter-plot gap on either side. The adjustment for the inter-plot gap should be no greater than 0.8 m.
If these are not the same for every plot a separate record must be submitted.

Growth stage: usually 9.9 at harvest. The Growth Stage Chart for mustard is at Appendix 7.

Yield (in kilograms). Note clearly any tare weight to be subtracted.
Yield , moisture content, plot length, plot width and harvest date should be sent to appropriate data handling centre within 5 days of harvesting the trial.

C.6.3.2 **MATURITY from all plots (OBLIGATORY) (1-9)**

Maturity should be judged by making a visual estimate of canopy senescence, where.
1 all pods green
9 all pods bleached and brittle

Unrepresentative areas of the plot should be avoided when making assessments, for example, localised diseased infections.

C.6.3.3 **STANDING ABILITY from all plots (OBLIGATORY) (1-9)**

1 completely lodged
9 no lodging

The aim of this score is to describe the canopy structure at harvest. A score of 5 can describe half the plot completely flat or the whole plot leaning at 45 degrees.

C.6.3.4 *PLANT HEIGHT from all plots (ADDITIONAL) (cm)*

Record average plot height at the end of flowering before leaning or lodging takes place. If lodging has occurred, choose a representative area of the plot, lift a number of plants against the measuring pole and record an average height.

C.6.3.5 *EARLINESS OF FLOWERING from all plots (ADDITIONAL) (1-9)*

1 very late
9 very early

Record when the earliest variety is in full flower and score all varieties relative to this. An assessment on one occasion is normally sufficient. Estimate the date of full flowering for the earliest control variety.

C.6.3.6 **SOWING DATE of each trial (OBLIGATORY) (Day/month/year)**

This is recorded in Part 1 of the Site Information Form.

C.6.3.7 **HARVEST DATE (OBLIGATORY) (Day/month/year)**

This is recorded in Part 2 of the Site Information Form.

C.6.3.8 **BIRD DAMAGE from all plots (OBLIGATORY IF PRESENT) (1-9)**

1 all plants severely damaged
9 no plants damaged

This must be recorded where present at a level which will affect results

Indicate the cause of damage and, in the Diary section, what action has been taken to minimise further damage.

C.6.3.9 **RESISTANCE TO SEED LOSS from all plots (OBLIGATORY IF PRESENT) (1-9)**

1 severe seed loss
9 no seed loss

This must be recorded where present at a level which will affect results.

Base scores either on observation of pod shattering or counts of seed on the ground if shedding is thought to be serious. Seed loss is easier to assess before combining. Ensure that combines are set correctly to minimise losses at harvest. Estimate the number of seeds lost per m² for the plot(s) with the most losses so that the approximate yield loss can be estimated.

C.6.3.10 **COMBINE LOSSES from all plots (OBLIGATORY IF PRESENT) (1-9)**

This must be recorded where there is evidence of combine losses at a level which will affect results.

9 = no combine losses. Combine losses should be assessed if the losses are thought sufficient to exclude the yield data from results. Indicate the estimated number of grains lost per m^2 for the lowest score given on the 1 to 9 scale.

C.6.3.11 **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 in accordance with the procedure in Section D for disease.

Records for other scores should be taken as plants affected on a 1 to 9 scale. Include definitions for each rating on the 1 to 9 scales.

C.6.3.12 **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 supplied with site data 1).
2. Provide the inspector with information (for example pesticide sprays applied etc) within seven 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 **Disease observation plots**

No disease observation plots are grown routinely.

D.1.3 **Naturally occurring disease in VCU growing trials**

D.1.3.1 Light leaf spot and stem canker should be recorded when the level of infection on the most affected variety is over 5% or a score of 4 of the leaf area of infected plants.

D.1.3.2 Other naturally occurring disease is not normally recorded in the growing trials. However, if disease levels increase to more than 5%/score 4 of the leaf area (or 5% /score 4 of infected plants as appropriate for the diseases) on the most affected variety a score should be made on the whole trial and sent to the Trial Design and Data Handling Operator. Confirmation of the identity of a disease should be obtained from an appropriate plant pathologist if required.

D.1.3.3 **Recording methods**

D.1.3.4 Appropriate assessment keys are given in Appendix 8. All disease records to be sent to the Trial Design and Data Handling Operator as soon as they are made.

Disease data should be received by 31st August

D.2 Inoculated disease tests

No inoculated disease tests are carried out routinely.

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.

E.2 Quality assessment methodology

E.2.1 **Moisture content determination**

The following procedure must be followed.

A 105 g sample of seed *(*± 5g) is placed in the drier which must be at a temperature of 100°C ±4 °C with the air re-circulator set in the range 80-100% recirculation in order to restore the temperature to 100°C ± 4°C as rapidly as possible. When the temperature is restored to 100°C ± 4°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 at 100°C ± 4°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.

When all samples from a given trial have been recorded, the fresh and dry weights are immediately reported to the Trials Organiser. When the dry weights are reported as a percentage, the fresh weight should be reported as 100.

Moisture content determination by conductance moisture meter is not acceptable to the Testing Authority.

Section F – Trial design and data handling procedures

F.1 Plan validation and storage

F.1.2 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.1.3 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, seed rates, soil details and fertiliser 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

F4.1 Any additional or alternative designs required for the assessment of additional VCU characters not detailed in Annex I 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 for mustard

Activity	Organisers/Operators Responsible
Trials Organiser	BSPB
Seed Handling Operator	NIAB
Trial Design and Data Handling Operator	NIAB
Pathology Trials Operator	None
Trial Inspection and Technical Validation Operator	BSPB
Quality testing Operator	NIAB
Data Review and Standard Setting Operator	NIAB

Appendix 2 - Seed treatment products for use on NL trials

none

Appendix 3 – Seed despatch deadline dates

VCU seed must be delivered to NIAB by 20th January.

Appendix 4 - VCU Growing Trial Operators and trial locations

Growing Trial Operators/Seed Handling Operators

Growing Trial Operator	Seed Handling Operator (if not trial operator)	Location of trial
NIAB		Cambridge
NIAB		Headley Hall, Yorkshire

Pathology Trials Operator

Pathology Trial Operator	Location of trial
Not applicable	

Appendix 5 - Control varieties for VCU assessments

Brown mustard

Sutton

White mustard

Tilney

Appendix 6 - Dates by which records should be submitted

To Trials Organiser

Record	Latest date of receipt by Trials Organiser
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 Trials Organiser that trial has been harvested within 2 days of harvest

To Data Handling Operator

Record	Date
Plot records should be sent to Data Handling Operator	Within 10 days of record being taken

Appendix 7 - Growth Stages of Mustard

Growth Stage		
Germination and emergence	0.0	Dry seed
Leaf production	1.0	Both cotyledons unfolded and green
	1.1	First true leaf emerged
	1.2	Second true leaf emerged
	1.3 etc	Third true leaf emerged
Stem extension	2.0	No internodes (rosette)
	2.5	About five internodes
Flowerbud development	3.0	Only leaf buds present
	3.1	Flower buds present but enclosed by leaves
	3.3	Flower buds visible from above ('green bud')
	3.5	Flower buds raised above leaves
	3.6	First flower stalks extending
	3.7	First flower buds yellow ('yellow bud')
Flowering	4.0	First flower opened
	4.1	10% all buds opened
	4.3	30% all buds opened
	4.5	50% all buds opened
Pod development	5.3	30% potential pods
	5.5	50% potential pods

Growth Stage		
	5.7	70% potential pods
	5.9	All potential pods
Seed development	6.1	Seeds expanding
	6.2	Most seeds translucent but full size
	6.3	Most seed green
	6.4	Most seed green-brown mottled
	6.5	Most seeds brown
	6.6	Most seed dark brown
	6.7	Most seed black but soft
	6.8	Most seed black and hard
	6.9	All seeds black and hard
Leaf senescence	7.0	
Stem senescence	8.1	Most stem green
	8.5	Half stem green
	8.9	Little stem green
s	9.1	Most pods green
	9.5	Half pods green
	9.9	Few pods green

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