



Animal &  
Plant Health  
Agency

# United Kingdom Variety List Trials: Trial Procedures for Official Examination of Value for Cultivation and Use (VCU) Harvest 2024

Forage and grain maize

April 2023

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# Section A – General Information

## A.1. Purpose

A1.1 This document sets out the approved procedures to be used for growing trials, tests and assessments as required by the current Protocol for Official Examination of Value for Cultivation and Use for Forage and Grain Maize.

## A.2. Scope

A.2.1 These procedures apply to all varieties of Forage and Grain Maize.

## A.3. Responsibilities

### A.3.1 Procedures Development Group

A.3.1.1 The Procedures Development Group is responsible for reviewing these procedures annually and making any amendments for which it has responsibility, in accordance with the provisions of the VCU Protocol.

### A.3.2 Organisers and Operators

#### A.3.2.1 Trials Organiser:

British Society of Plant Breeders Ltd (BSPB)  
BSPB House  
114 Lancaster Way Business Park  
Ely  
Cambs.                      Jeremy M:    07747 567351  
CB6 3NX                     Louise M:    07917 046705  
Email                         [jeremy.widdowson@bspb.co.uk](mailto:jeremy.widdowson@bspb.co.uk)

A.3.2.2 The Trials Organiser is responsible for ensuring that all VCU Protocol and Procedures requirements are followed and for liaison with all Operators carrying out trials and tests for Variety List purposes, including supply of seed and data handling.

#### A.3.2.3. Pathology Trials Operator

The Pathology Trials Operator appointed by APHA is responsible for carrying out inoculated trials for the assessment of disease in accordance with the VCU Protocol and these Procedures.

#### A.3.2.4 Data Handling Operator

The Data Handling Operator is responsible for trial design and data validation in accordance with the VCU Protocol and associated Procedures.

#### A.3.2.5 Growing Trial Operators, Seed Handling Operators and Quality Testing Operators.

The Trials Organiser is responsible for proposing to the NLSC, Growing Trial Operators and Quality Testing Operators to carry out trials and tests as determined by the Procedures Development Group annual review in accordance with the VCU Protocol, and these Procedures. The Trials Organiser is also responsible for finding Seed Handling Operators. Seed Handling Operators prepare trial seed for sowing by each Growing Trial Operator in accordance with the VCU Protocol and these Procedures.

A.3.2.6 A list of all approved Organisers and Operators is shown in Appendix 1.

### A.3.3 VCU Protocol and Procedures non-compliance

A.3.3.1 Where these procedures use the words “must” or “will” for any action then failure to carry out this action will result in non-compliance. Where the word “should” is used for any action then this is the method to be followed unless there are clear reasons not to, which can be justified by the operator as technically sound.

A.3.3.2 The Trials Organiser will forward any reports on VCU Protocol or Procedures non-compliance to APHA within 1 week of receipt. The Trials Organiser will obtain authorisation from APHA for any actions, including those necessary to remedy non-compliances, which are not within the requirements of the VCU Protocol. Such actions must be recorded as a non-compliance. Where emergency action is required and APHA staff are not available (e.g. evenings/weekends) the Trials Organiser should act, but report this to APHA at the earliest opportunity. Where GMOs are concerned the arrangements are as detailed in section 3.4.

### A.3.4 Procedures for GM varieties

A.3.4.1 The National Authorities and Trials Organiser will develop procedures for GM varieties if an application for a GM candidate variety is received.

### A.3.5 Handling of Trial Seed

A.3.5.1 The Trials Organiser is responsible for organising the handling of seed of candidate varieties submitted by the applicant, and seed of control, or other reference varieties, in accordance with the requirements set out in these Procedures and the current VCU Protocol. The Trials Organiser will ensure that any seed treatments or additives are fit for the purpose. The products are listed in Appendix 2.

### A.3.6 Dispatch of Seed

A.3.6.1 The Seed Handling Operator will arrange for seed to be dispatched by the agreed deadlines to the Growing Trial Operators, and, for authentication, to the DUS testing centres including, where appropriate, foreign testing authorities. Where seed will be kept until late summer for drilling seed should be kept in cold storage to prevent deterioration.

### A.3.7 Monitoring of VCU Growing Trial Operators and Seed Handling Operators – Documentation

A.3.7.1 The Trials Organiser will take any necessary action to enforce deadline dates and quality standards for required documentation.

A.3.7.2 The Trials Organiser will ensure Growing Trial Operators and the Seed Handling Operator have access to all current procedures relevant to them and that they are notified of any amendments.

#### **A.3.8 Seed Quantities**

A.3.8.1 The Trials Organiser will calculate the quantity of seed required for all VCU tests and trials in each annual series, including authentication, and will notify the applicant of quantities and delivery addresses.

#### **A.3.9 Labelling of Seed**

A.3.9.1 The Seed Handling Operator is responsible for ensuring all seed is clearly labelled with variety name/breeders' reference and AFP number.

#### **A.3.10 Seed Quality**

A.3.10.1 Seed submitted for VCU testing must meet the standards for the final generation of seed given in the appropriate seed regulations, in respect of germination, analytical purity and content of other seeds and any other impurities.

### **A.4. Summary of Growing Trials, Tests and Assessment Procedures**

A.4.1 The number of trials and site locations are as detailed in Appendix 4.

A.4.2 An additional test for characters not specified in these procedures may be requested by the applicant. APHA is responsible for liaison with the applicant and the Trials Organiser to produce a procedure for the conduct of a special test or trial. This procedure would require the approval of the National Authorities.

A.4.3 The Trials Organiser is responsible for informing the Growing Trial Operators of the additional approved characters, which must be recorded as and when requested by applicants, and any samples that may be required for analysis. Trials to be split by maturity and applicants to provide the FAO of the candidate to facilitate this.

#### A.4.4 VCU Characters which may be assessed

**Bold = Obligatory**

*Italics = Additional only if requested by the applicant*

Forage Maize & Grain Maize

| Type of character  | Reference | Description  |
|--|-----------|--|
| Yield  | Section C | <b>Dry matter yield (t/ha)</b><br><i>Grain yield (t/ha)</i>  |
| Behaviour with respect to factors in the physical environment. | Section C | <b>Early vigour (1-9 scale)</b><br><b>Lodging (%)</b><br><b>Brackling (%)</b><br><i>Green Snap (%)</i><br><b>Plant population (th/ha)</b><br><b>Leaf senescence (1-9 scale)</b>  |
| Resistance to harmful organisms                                | Section D | <b>Rust (%)</b><br><b>Eyespot (%)</b><br><b>Fusarium (%)</b><br><b>Smut (%)</b><br><b>Frit Fly (%)</b><br><b>Helminthosporium (%)</b>  |
| Quality characters   | Section E | <b>Dry Matter content (%)</b><br><i>Whole plant starch content (%)</i><br><i>Whole plant digestibility (%)</i><br><i>Cob ripeness (1-9 scale)</i><br><i>Cell wall digestibility (%)</i><br><i>Moisture content (%)</i> |

#### **A.4.5 Further measurements**

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

**Sowing date**  
**Harvest date**  
**Plot size**  
**Plot Fresh Weight Yield**  
**Sample Fresh Weight**  
**Sample Dry Weight**  
**Vegetative Lodging Damage**  
**Early population**  
**Oven controlled dry matter whole plant**

Where grain maize varieties are included, the following must be also be measured or recorded in addition for all grain maize plots, following procedures in Section C.

**Plot Fresh Grain Weight Yield**  
**Plot Dry Grain Weight Yield**  
**Dry Rachis Weight (hand harvesting only)**  
**Oven controlled dry matter of grain**

# Section B – Seed Handling Procedures

## B.1. Responsibilities

B.1.1 Seed Handling Operator/Growing Trial Operators are responsible for carrying out the following seed handling procedures.

## B.2. Seed Handling Procedures

B.2.1 Seed Handling Operator/Growing Trial Operators will receive a sowing list from the Trials Organiser, along with instructions as to which seed treatments or additives should be used. A list of products is at Appendix 2.

B.2.2 The Seed Handling Operator must record receipt of seed from applicants by checking it off against the sowing list as it arrives. The Trials Organiser should be notified of any damage to the packaging, loss of seed or identification problems that would affect the validation of the trials. The Trials Organiser will notify APHA of any problems.

B.2.3 Once seed has been treated it must be kept safe until required for drilling, authentication and quality control. The Seed Handling Operator must retain a 200g untreated sample of the seed submitted of every variety in the trial, for authentication by the DUS test centre.

B.2.4 The Seed Handling Operator must record use of treatment chemicals in accordance with best practice and in full observance of all manufacturers' recommendations and relevant statutory obligations.

B.2.5 Any seed treatment equipment used should be fit for purpose, properly calibrated, set up and operated in accordance with the manufacturer's recommendation.

B.2.6 Cross contamination must be avoided by ensuring equipment is clean between weighing and treatments.

B.2.7 A record should be kept of chemicals used and date of treatment.

B.2.8 Seed treatment must take place as near to required drilling date as possible.

B.2.9 The Seed Handling Operator must retain a 100g treated sample of seed until one month after harvest.

## B.3. Authentication of VCU Seed

B.3.1 APHA will notify the Seed Handling Operator of the DUS Test Centre to which a 200 g sample of each variety should be sent for authentication.

B.3.2 All samples must be kept under suitable conditions for the authentication procedures required and must be clearly labelled and sealed.

B.3.3 If the level of uniformity recorded in DUS tests or VCU authentication for that candidate in that season is less than 90% the VCU will be considered invalid.

# 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 Operators are responsible for providing a suitable site, which meets the following criteria:

C.2.2 Previous cropping should be appropriate for a maize crop to be grown. Trials should not normally be drilled directly after a long term grass ley or continuous maize cropping where disease build up or herbicide resistant weeds are a concern.

C.2.3 Soil type should be typical of those on which maize crops 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 wheeling compaction. Cultivations should follow best practice.

## C.3. Sowing the Trial

### C.3.1 Plot Size

C.3.1.1 Four rows are to be drilled at between 0.7 m to 0.8 m row width with the same row width between plots. Where possible the centre two rows of the plot will be harvested for yield and the plot size must be sown to allow a minimum harvest plot, after trimming, of 13 m<sup>2</sup>. The outside two rows of the plot are to act as discard rows so should not be included in the harvest area. If it is decided to include one discard row in the harvest area the Trials Organiser must be informed. Plots must be drilled to a greater length than required and cutback to the required length at thinning. Three replicates will be sown.

### C.3.2 Plant population

C.3.2.1 The trials should be sown with a precision drill at a seed rate calculated to achieve a plant population after thinning of approximately 105,000 plants per hectare for forage maize and 94,000 plants per hectare for grain maize. Seed will be treated with an agreed seed treatment (Appendix 2). Growing Trial Operators are responsible for achieving the correct target populations and should advise the Trials Organiser if the establishment potential is likely to be different from the targets given above, in this case plots should be thinned to a lower population which should be agreed with the Trials Organiser to achieve the most consistent stand.

If the guard row has an established population greater than 120,000 plants/Ha, they should be thinned to around the target population.

### 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, along with the trial plans produced by the Data Handling Operator.

C.3.3.2 The trial must be sown according to the plan produced by the Data Handling Operator and must 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. If plots are moved out of their original sub-block, they will have to be treated as missing plots. The Trials Organiser must be informed immediately if there are any departures from the original plan or if there are any other anomalies.

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.3.3.4 A suitable pathway at the end of each plot is required to provide access for recording and a suitable break when harvesting. The pathways need to be sufficiently wide to allow spraying across the plots.

### 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 carryover of seed between plots. Drilling depth should be 7-9 cm, care should be taken about blanket drilling at 9 cm in relation to soil type/date of sowing/soil temperatures etc.

C.3.4.2 At least one discard plot should be drilled on either side of the trial with the same drill and at the same time that the trial is drilled. The whole trial should be surrounded by a minimum of eight continuous rows to act as a buffer.

C.3.4.3 Any missing rows or parts of rows must be noted on the drilling plan and returned to the Trials Organiser so that a decision on the viability on these and adjacent plots can be made.

C.3.4.4 Growing Trial Operators should sow the trial as early as possible for their area without incurring undue risk of frost damage. However, it should be completed by 20<sup>th</sup> May. If not drilled by this date permission to continue must be sought from the Trials Organiser.

C.3.4.5 The trials co-ordinator will supply oven control varieties selected to represent the dry matter range being tested. Oven controls will be supplied to allow plots to be spaced throughout the trial field(s); however, care should be taken not to position oven control plots in the outside discard row. There should be at least 1 discard plot between oven control plots and the trial edge.

### **C.3.5 Confirmation of trial layout**

C.3.5.1 After the trial has been drilled, the Growing Trial Operators must:

- a) Confirm that the trial has been drilled according to the plan and provide the sowing date, by returning Site Data 1 and associated trials sketch to the Trials Organiser within the time schedules indicated in Appendix 6
  
- b) If any amendments to the plan have been made, return a copy of the plan to the Data Handling Operator and the Trials Organiser with any amendments clearly indicated.

### **C.4. Husbandry**

#### **C.4.1 Agronomy**

C.4.1.1 Where not specified in these procedures' agronomy should follow best local practice. All inputs should be reported to the Trials Organiser on Form Site Data 2. Best practice should include the following visits from Growing Trial Operators:

- An assessment of trial establishment and designated harvest rows should be made as soon as practically possible and within 3 weeks of drilling.
- An assessment of weed control should be carried out no later than 6 weeks after drilling.
- An assessment of the effectiveness of the post emergence herbicide sprays should be carried out within 2 weeks of any post emergence herbicide spray.
- An assessment of cob set and secure badger fencing should be carried out within 2 weeks of flowering.
- Crop maturity should be assessed in early September.

C.4.1.2 All spraying activities must take account of The Plant Protection Products (Sustainable Use) Regulations 2012.

#### **C.4.2 Fertiliser Application**

C.4.2.1 Application of fertilisers and sprays should be uniform. It is normally best to apply these across the direction of the plots, and account should be taken for 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. Applications of fertiliser must not contravene relevant nitrate and phosphate regulations.

#### **C.4.3 Herbicides**

C.4.3.1 Use of herbicides should be closely monitored to ensure they are not used on any variety which is known to be sensitive see Appendix 8. Application should be across the direction of drilling.

#### **C.4.4 Growth Regulators**

C.4.4.1 These must not be used on a maize trial.

## C.4.5 Pest and Disease Control

### C.4.5.1 Pest Control

C.4.5.1.1 If necessary, approved means should be used to prevent or minimise damage by pests. Trials must be fenced against badgers following tasselling.

### C.4.5.2 Disease Control

C.4.5.2.1 Maize trials are normally conducted without foliar fungicide treatment. Under certain conditions, however, severe disease infections can occur which threaten the trial. If disease is present and weather conditions favour further development (i.e. wet), a fungicide treatment should be applied. The Trials Organiser should be consulted to agree the appropriate treatment. Where *Aureobasidium zeae* (maize eyespot) is considered a threat fungicide should be applied as precautionary measure. Currently trials in the south are considered at risk. Use a high clearance sprayer whilst still able to pass through the crop.

## C.4.6 Irrigation

C.4.6.1 Irrigation is only permitted to facilitate establishment with the agreement of the Trials Organiser.

## C.5. Harvesting

### C.5.1 Timing of harvesting

C.5.1.1 Date of harvesting will be determined by the Growing Trial Operators based on crop maturity and local weather conditions. The aim is to harvest forage maize when the mean dry matter content of the control varieties is between 28-35% and grain maize when the mean dry matter cob content of the control varieties is above 68%.

This is achieved by additional rows of oven control varieties should be grown close to the trial and monitored for dry matter to aid the Growing Trial Operator in meeting this target. Seed of varieties with an appropriate range of dry matter levels will be supplied by the trials co-ordinator.

Care should be taken not to position dry matter sample plots in the outside discard row, there should be at least 1 discard plot between dry matter plots and the trial edge.

Sampling should occur every 7-10 days once the earliest variety is deemed to be at 26% dry matter. Samples (6 plants) should be sealed in moisture proof bags between field and laboratory. Sample should be taken from several areas in the field if maturity differs across the field. Ensure cutting height of the plants corresponds to height they would be cut at harvest. The sample must be handled in a manner that provides representative dry matter measurement preferably chopped through a forage harvester.

Trials officers may dry the first samples taken at 100° C but once results indicate harvest is close the samples should be dried at 60°C until completely dry.

This is achieved by sample results being sent to trials organiser who will confirm harvest date with growing trials operator.

Even if target dry matter content has not been reached, any remaining forage maize trials should be harvested as soon as possible after 20 October.

C.5.1.2 If it is necessary to reduce the size of any plot at harvest, clear details on the yield file must be given. Individual harvested plot lengths must be recorded.

#### C.5.1.3 Frost damage

If the trial is frosted, it should be harvested within 48 hours of the frost occurring. If this is not possible then the trials organiser must be consulted before harvesting.

### C.5.2 Harvesting method

C.5.2.1 Forage maize plots should be harvested using a precision chop machine. Grain maize plots should be harvested by hand or by a combine harvester preferably fitted with a grain picker header.

### C.5.3 Samples

C.5.3.1 is essential that all samples:

Are representative of the variety/plot from which they are taken with minimal contamination. Are taken from the same source.

C.5.3.2 All bagged samples should be managed so that there is no deterioration between harvesting and drying.

C.5.3.3 Samples may not be required from every variety. The Trials Organiser will provide details of which varieties require samples, the quantities required and the tests to be carried out.

C.5.3.4 For forage maize Dry Matter Content is to be determined by the oven method. A sample of 500-750 g from each plot of forage maize must be taken at the time of plot weighing, weighed in the field, and sealed in a polythene bag.

For grain maize if harvested mechanically a sample of 500-750 g of grain from each plot of grain maize must be taken at the time of plot weighing, weighed in the field and sealed in a polythene bag. If hand harvesting grain maize, then all cobs must be weighed in the field and sealed in a polythene bag.

C.5.3.5 All dried samples must be labelled with unique identification numbers, replicate number, and Growing Trial Operator identification number.

C.5.3.6 For forage maize all dried samples must normally be retained for 4 months and must not be disposed of until the Trials Organiser gives approval.

### C.5.4 Submission of data

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

C.5.4.2 All plot records should be transmitted to the 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, if there are any queries or ambiguities, 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 Site details; including site sketch, map and location, previous cropping, soil analysis fertiliser applications
3. Site data part 2 Details of agrochemical applications and irrigation.
4. Plot records Plot data.

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 Data Handling Operator in an approved format using the AFP number, variety name and units as listed in Section 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 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 characters. All characters to be used in VL decision making for forage maize.

#### C.6.3.2 PLOT FRESH WEIGHT OF HARVEST ROWS (OBLIGATORY) (kg)

Enter 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 using the character names PLOT LENGTH and PLOT WIDTH

#### C.6.3.3 SAMPLE DRY WEIGHT (OBLIGATORY) (g)

See Section E.2.1

#### C.6.3.4 EARLY POPULATION (OBLIGATORY) (Number of plants)

Plant counts to be taken on each of the two harvest row lengths at the 2-4 leaf stage before thinning. This record should be kept in the trial notebook and sent to the Data Handling Operator immediately.

#### C.6.3.5 PLANT POPULATION (OBLIGATORY) (Number of plants)

Final population counts to be taken on each of the two harvest row lengths at the 2-6 leaf stage. All harvest rows should be thinned to the same plant density with an ideal target of 105,000/ha. It is important to send row length and width with this record, to the Data Handling Operator, so that the population can be calculated.

#### C.6.3.6 EARLY VIGOUR (OBLIGATORY) (1-9 Scale)

Recorded 5-7 weeks after drilling on the scale:

- 1 Stunted, yellow, poorly growing plants
- 9 Tall, green, vigorously growing plants

Record stage of growth of plants at each end of the scale.

#### C.6.3.7 HARVEST DATE (OBLIGATORY) (Day/Month/Year)

**SOWING DATE (OBLIGATORY) (Day/Month/Year)**

**PLOT SIZE (OBLIGATORY) (m<sup>2</sup>)**

#### C.6.3.8 LODGING/BRACKLING

#### C.6.3.8.1 VEGETATIVE LODGING DAMAGE (OBLIGATORY) (No of plants)

Record for all plots. Lodging is defined as plants bent over from the roots at greater than 30° to the vertical.

Lodging that is scored either before 1 September, or greater than 20 days before harvest, whichever is earlier, should be recorded but submitted as a record for vegetative lodging.

**C.6.3.8.2 LODGING (OBLIGATORY) (No of plants)**

Lodging is defined as plants bent over from the roots at greater than 30° to the vertical.

A record should be made for all plots but before the dry matter content of the controls reaches 35%. If harvesting is delayed beyond 35% dry matter a second record should be made at harvest if any more lodging has occurred. Note the approximate dry matter of crop when lodging occurred and send as a note in the data file with the recording.

**C.6.3.8.3 BRACKLING (OBLIGATORY) (No of plants)**

Brackling is defined as stems buckled below point of ear attachment.

A record should be made for all plots but before the dry matter content of the controls reaches 35%. If harvesting is delayed beyond 35% dry matter a second record should be made at harvest if any more brackling has occurred. Note the approximate dry matter of crop when brackling occurred and send as a note on the data file with the recording.

**C.6.3.8.4 GREEN SNAP (OBLIGATORY IF PRESENT) (No of plants)**

Green snap is defined as the breakage of stems during rapid growth, usually due to wind damage.

**C.6.3.9 FUSARIUM (OBLIGATORY IF PRESENT) (%)**

Estimate the number of plants with stalk rot caused by *Fusarium spp.* Count or estimate the number of plants with stalk rot and express as a percentage of plot population. Confirmation of the disease should be obtained from a qualified plant pathologist.

**C.6.3.10 FRIT FLY (OBLIGATORY IF PRESENT) (%)**

Record only if present when levels of damage are greater than 5% of plants in the worst plots. Estimate percentage of plants affected.

**C.6.3.11 SMUT (OBLIGATORY IF PRESENT) (%)**

Estimate the number of plants with common smut. Record at harvest if the worst plots have more than 5% of plants effected by common smut. Count the number of infected plants and convert to a percentage using the thinned plant population. Confirmation of the disease should be obtained from a qualified plant pathologist.

**C.6.3.12 RUST (OBLIGATORY IF PRESENT) (%)**

Caused by *Puccinia sorghi*. Record if the worst variety has over 5% of the leaf area affected using the foliar disease assessment key in Appendix 7. Confirmation of the disease should be obtained from a qualified plant pathologist.

**C.6.3.13 EYESPOT (OBLIGATORY IF PRESENT) (%)**

Eyespot caused by *Aureobasidium zeae*. Record if the worst variety has over 5% of the leaf area affected using the foliar disease assessment key in Appendix 7. Confirmation of the disease should be obtained from a qualified plant pathologist.

**C.6.3.14 HELMINTHOSPORIUM (OBLIGATORY IF PRESENT) (%)**

Record if the worst variety has over 5% of the leaf area affected using the foliar disease assessment key in Appendix 7. Confirmation of the disease should be obtained from a qualified plant pathologist.

**C.6.3.15 LEAF SENESCENCE (OBLIGATORY) (1-9 scale)**

To be scored at harvest on the scale:

- 1 Much senescence (plants dry and brittle)
- 9 No senescence (plants green and lush)

**C.6.3.16 COB RIPENESS (ADDITIONAL) (1-9 scale)**

Estimate the cob ripeness when the earliest varieties have a score of 8 or at the time of harvest, whichever is earliest, on the scale:

- 1 Ear barely formed
- 2 Grain barely formed
- 3 Grain watery
- 4 Grain milky
- 5 Grain soft dough
- 6 Grain firm dough
- 7 Grain firm
- 8 Grain hard
- 9 Grain hard and mature

The easiest way of scoring cob ripeness is to use two people to score the two harvest rows. Each selects a cob and determines the ripeness of the kernels at the base of the cob using a fingernail or knife. If they both agree then the value is accepted, if not then another two plants are selected. This continues until both agree on the cob ripeness score.

**C.6.3.17 WHOLE PLANT DIGESTIBILITY (ADDITIONAL) (%)**

See Section E.2.2

**C.6.3.18 WHOLE PLANT STARCH CONTENT (ADDITIONAL) (%)**

See Section E.2.2

**C.6.3.19 CELL WALL DIGESTIBILITY (ADDITIONAL) (%)**

See Section E.2.3

**C.6.3.20 GRAIN WEIGHT** *(OBLIGATORY for grain maize) (kg)*

The weight of grain can be derived from two separate mechanisms, either hand or mechanical harvesting. The hand harvesting procedure involves C.6.3.21 – C.6.3.23 (current sub sections) inclusive to derive the weight of grain. Mechanical harvesting procedures involves C.6.3.2 and C.6.3.3

**C.6.3.21 PLOT COB FRESH HARVEST WEIGHT OF ROWS**  
*(ADDITIONAL/OBLIGATORY for grain maize – HAND HARVESTING) (kg)*

Enter harvested cob weight in kg per row harvested and provide the harvested plot dimensions with the record. The fresh weight should be the weight of only the cob, with no leaf etc remaining.

**C.6.3.22 COB DRY WEIGHT**  
*(ADDITIONAL/OBLIGATORY for grain maize – HAND HARVESTING) (kg)*

Specify the fresh weight taken for the sample, then record weight after drying. Calculate DM% using fresh weight as 100%

**C.6.3.23 DRY RACHIS WEIGHT**  
*(ADDITIONAL/OBLIGATORY for grain maize – HAND HARVESTING) (g)*

Strip cobs after drying and record the weight of the remaining rachis.

**C.6.3.24 Site Factors**

Any factors which may have affected the yield of the trial or individual plots e.g., drought stress must be noted and accompany the yield data.

**C.6.3.25 Trial Inspection**

All trials will be inspected by the Trial Inspection and Technical Validation Operator. The first inspection shall take place after emergence is confirmed and the second inspection just prior to harvest.

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

1. Give inspectors reasonable access to trials.
2. Provide the inspector with information (for example pesticide sprays applied etc) at the time of inspection if requested.
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 change harvest rows, at first inspection, or shorten plots is undertaken and that missing values are returned for any plots excluded from the trial.

## Section D – Disease Testing Procedures

### D.1. Assessment of Natural Infection

D.1.2. The Growing Trial Operator is responsible for carrying out these procedures.

D.1.3. The precise timing for assessment is best judged in relation to the development of disease in the trial, with the aim being to achieve the assessment, which shows the most differentiation between varieties. In practice, this usually means that two or three sequential assessments are necessary.

D.1.4. Rust, Eyespot and *Helminthosporium* should be assessed using the NIAB foliar Key given in Appendix 7.

D.1.5. Assessments should be made on a “whole plot” basis, i.e., by making an overall assessment in a small (approx. 1 m<sup>2</sup>) area of the plot and repeat at a minimum of 3 points in each plot. All replicates in the trial should be recorded.

D.1.6. All disease records should be sent to the Data Handling Operator as soon as they are made.

### D.2. Inoculated Disease Tests

D.2.1 No inoculated disease tests are carried out routinely.

# Section E – Quality Testing Procedures

## E.1. Responsibilities

E.1.1 The Quality Testing Operator(s) appointed by the Trials Organiser are responsible for conducting the trials according to these procedures. The Growing Trial Operators are responsible for Dry Matter Content determination only and supply of dried milled samples to the Quality Testing Operators.

## E.2. Quality Assessment Methodology for Obligatory and Additional Tests

### E.2.1 Dry Matter Content determination (Forage maize only) (OBLIGATORY)

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 or catch weight (500-750 g recorded to one decimal place) of well chopped fresh material is accurately weighed. 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 an AFP site ID label and plot number.

Samples may be air dried prior to placement in the oven which must be at a temperature not in excess of 60 °C with the air re-circulator set in the range 80-100% recirculation in order to restore the temperature to 60 °C as rapidly as possible. When the temperature is restored to 60 °C the air regulator is set at 80% recirculation i.e. 20% fresh hot air. The regulator is critical for rapid drying. The samples are dried at 60 °C for such time as is necessary for complete drying, usually 48hrs.

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 reported to the Growing Trial Operator electronically using the character names given in Section C.6.3. When the dry weights are reported as a percentage, the fresh weight should be reported as 100.

### E.2.2 Moisture Content determination (Grain maize only) (OBLIGATORY)

The treatment of samples and the time interval between harvesting and weighing should be such that there is no significant moisture loss. Following harvest all cobs from a harvested plot should be used for yield and dry matter determination. It is acceptable for samples to be brought to the laboratory for weighing. If the latter option is followed the sample must be kept out of direct sunlight and as cool as possible. Each sample is identified with an AFP site ID label and plot number.

The fresh sample is weighed and then the sample is placed in the drier. Samples may be air dried prior to placement in the oven which must be at a temperature of 100 °C with the air-circulator set in the range 80-100% re-circulation in order to restore the temperature to 100 °C as rapidly as possible. When the temperature is restored to 100 °C the air regulator is set at 80% re-circulation i.e., 20% fresh hot air. The air regulator is critical for even, rapid drying. The samples are dried for 24 hours at 100 °C or such time as is necessary for complete drying.

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

If the trial has been harvested by hand the dried cob samples are stripped using a hand operated grain stripper. All cobs from a plot (sample) are stripped to remove the grains. Then the remaining rachis is collected and weighed.

When all samples from a given trial have been recorded, the fresh and dry cob weights and the dry rachis weight are reported to the Growing Trial Operator electronically using the character names given in Section C.6.3. When the dry weights are reported as a percentage, the fresh weight should be reported as 100.

When harvesting by machine: plot weights should be taken on the harvester. Moisture content must be determined by the oven method, as described C.5.3.4 and previous sections of E.2.2.

When all samples from a given trial have been recorded, the fresh weight and moisture content are reported to the Data Handling Operator electronically using the character names given in Section C.6.3

### *E.2.3 Starch content and whole plant digestibility determination and Cell Wall Digestibility (Forage maize only) (ADDITIONAL)*

Samples used for dry matter determination in E.2.1 are course milled at 3.0 mm apertures, using a hammer mill, on site or dispatched to:

NIAB Forage Crop Centre  
Heltor Business Park  
Old Newton Road  
Heathfield  
Newton Abbot  
Devon  
TQ12 6RW

for hammer milling. The milled samples must be absolutely dry. This is achieved either by milling immediately after weighing out of the dryer or by re-heating dried samples to 60 °C for 1 hour before milling. All samples are then milled at 1 mm apertures using a Cyclotec mill at NIAB Newton Abbot.

Near infra-red spectroscopy (NIRS) is used to measure the characteristics. This analysis requires a carefully prepared sample whose absorption of near-infra red light is measured. In NIRS analysis the same samples are used for both digestibility and starch determinations.

The NIRS calibrations are maintained and calibrated on a yearly basis by parallel NIRS scans of a series of control samples for which the characteristic contents has been determined by chemical analysis. The Walloon Agricultural Research Centre (CRA-W) is sent samples of the previous year's maize harvest for wet chemistry (digestibility – Aufrere method and starch content – Ewers method) and NIRS analysis. The NIRS estimates of the test samples are adjusted in line with the data received from CRA-W.

# 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 appropriate Data Handling Operator.
- b) If any amendments to the plan have been made, return a copy of the plan with any amendments clearly indicated to the appropriate Data Handling Operator.

F.1.3 The 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 for the characters and using the methods 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 varieties.

F.3.2 A list of the agronomic, yield and disease varieties, 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(s) 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 Appendix 3 of the VCU TRIAL PROTOCOL for Forage and Grain Maize will be added to these Procedures as and when approved by the NLSC.

# Supporting Document for Appendices

Appendices for this main procedure are stored in a separate document, which is updated closer to the start of the growing trial to include the latest information on controls and trial organisers. This will be published on [VCU protocols and procedures for testing agricultural crops - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/614221/vcu_protocols_and_procedures_for_testing_agricultural_crops.pdf).



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