Animal & Plant Health Agency

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

Soya Bean

April 2023

Changes to Procedures

- Updated year from 2022 to 2023
- C.3.2.1 Added seed counters formula

Contents

Section A – Summary of VCU trial assessments required

Type of character	Reference	Description of assessment - Obligatory	Description of assessment – Additional (Assessed only if requested by applicant.)
Yield	Section C	**Plot yield** **Moisture content**	
Impact of environment	Section C	**Standing ability** **Maturity**	*Straw length*
Resistance to harmful organisms	Section D		None routinely recorded
Quality characteristics (Laboratory Tests)	Section E	**Oil content**	
Quality characteristics (Laboratory Tests)	Section E	**Protein content**	

Further measurements

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

Sowing date
Plant population (where this affects the validity of the trial)
Harvest date
Plot size
Bird damage (where present at a 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 The Seed Handling Operator must forward 200 grams 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 must be appropriate for a soya bean crop to be grown. There should be at least a 3-year gap between soya bean and any other crop susceptible to sclerotinia.

C.2.3 Soil type should be typical of those on which soya beans are 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 birds, rabbits, hares, mice etc.

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 must not be less than 15 m² per replicate for trials with 4 replications and 25 m² per replicate for trials with 3 replications. Plots must 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 interplot gap in the range 0.5 m to 0.8 m.

C.3.2 **Plant population**

C.3.2.1 Seed is supplied to trial sites chemically treated in plot modules. The seed rate for conventional varieties will be 50 seeds/m². Bulks may be supplied on request, for which 1000 seed weights will be provided, so that plot packets can be prepared.

For operators using seed counters the following formula can be used to calculate required seed numbers per plot:

$$\text{Seeds per plot} = \frac{(\text{Target population} \times \text{Drilled plot area}) \times 10{,}000}{(\text{Establishment \%} \times \text{Germination \%})}$$

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 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 an appropriate control variety. 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.3.4.4 Soya bean is a legume and will fix nitrogen. However, nodulation will only occur if the correct Rhizobium strain is applied as a coating to the seed prior to drilling. This inoculant will be supplied by the Growing Trial Operator.

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 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. The location of these features should utilise the navigation platform What3Words.com
- 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 must be consulted.

C.4.4 **Growth regulators**

Chemicals should not be used on soya bean trials solely for the purpose of growth regulation.

C.4.5 **Pest and disease control**

C.4.5.1 **Pest control**

Trials should be protected against damage by birds and approved means should be used to prevent or minimise damage by other field pests.

C.4.5.2 **Disease control**

Disease control should only be undertaken after agreement by the Trials Organiser.

C.4.6 **Irrigation**

Irrigation is permitted to facilitate establishment.

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.5.2 **Harvesting method:**

Trials should be direct combined.

C.5.3 **Samples**

C.5.3.1 Samples are required from all plots for moisture content determination using the oven method, oil content determination and protein content determination. If additional samples are required, they will be notified to the Growing Trial Operator by the Trials Organiser.

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 A single 1 kg sample must be taken from each plot at harvest and sealed in a polythene bag for moisture content, oil content and protein content determination. Place one label on the inside of each bag and seal them by rolling over the top and securing the bags and the second labels with rubber bands.

C.5.3.4 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.5.3.5 All plot samples must be labelled with 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 the 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 appropriate 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.

2.* **Site data part 1** Including full location details:
1) map of site location showing nearby settlements and roads,
2) a sketch showing the layout of trials in the field with access points and
3) 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 appropriate 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 ensure that they lie within acceptable limits for the character recorded. Observations that have been identified 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 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 **YIELD** **from all plots** **(OBLIGATORY)** **(kg)**

The fresh seed yield must be recorded and returned with details of harvested plot dimensions. A corresponding sample will be assessed for moisture content as described in section F.

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

1 very poor
9 very good

This should be assessed on sequential occasions and MUST be recorded at harvest time (maturity).

C.6.3.3 *STRAW LENGTH* *from all plots* *(ADDITIONAL)* *(cm)*

Straw length should be measured on 5 or more randomly selected plants per plot after cessation of growth. The measurement should be the full length from ground level to the top of the extended main stem.

C.6.3.4 **MATURITY** **from all plots** **(OBLIGATORY)** **(1-9)**

Maturity should be judged by making a visual estimate of canopy senescence, where:

1 Stems and pods green
9 Stems and pods bleached and brittle, seeds hard

C.6.3.5 **SOWING DATE** **(OBLIGATORY)** **(Day/month/year)**

This is recorded in Part 1 of the Site Information Form

C.6.3.6 **PLANT POPULATION** **(OBLIGATORY)** **(plants/m^2)**

Plant counts should be taken soon after full emergence. Two methods can be used:

1. Take three or four random linear metre counts per plot from the middle rows. It is important that the row width and length measured (in metres) are entered after the character name so that the number of plants per m^2 can be calculated.

2. Count the plants within three or four quadrats per plot. The quadrats should be 0.25m to 1m^2 in size. The size used must be quoted.

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

The date on which each plot is harvested must be recorded. The date should be given numerically as day, month, year.

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

1 severe damage
9 no damage

Assessments should be made as appropriate. Records of Bird Damage which affects the yield of the trial should accompany the yield data.

C.6.3.9 **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 estimate % 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. Include definitions of 1 to 9 on the scale.

C.6.3.10 **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 to 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 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 **Disease observation plots**

No disease observation plots are carried out routinely

D.1.2 **Naturally occurring disease in VCU growing trials**

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

D.1.3 **Diseases recorded**

Foliar disease should be recorded when the level of infection on the most affected variety is over 5% of the leaf area. Other pathogens should be recorded when more than 5% of plants are affected. The percentage of plants infected in each plot should be recorded. If disease infection persists, successive records should be made through the season.

D.1.4 **Recording methods**

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.

D.1.5 **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 105g sample of seed (±5g) is placed in the drier which must be at a temperature of 104°C with the air recirculator set in the range 80-100% recirculation in order to restore the temperature to 104°C as rapidly as possible. When the temperature is restored to 104°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 104°C for such time as is necessary for complete drying. Each sample is identified with a label.

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.

E.2.2 **Oil Content determination**

Analysis is performed using continuous emission NMR following ISO 5511:1992. Results are expressed as apparent oil as a percentage at 14% moisture.

The stability of the equipment is checked at two-hourly intervals through the working day by the use of weighed oil standards. A single determination is normally performed on each test sample.

E.2.3 **Determination of crude protein or total nitrogen content**

E.2.3.1 Hammer milling of grain prior to analysis

The mill must be a hammer mill fitted with a 1mm screen. 300 g of sample are milled, and the material must be totally removed from the receptacle. The sample must be spread thinly, either with a printer's roller or with a wide blade spatula. The sample must be re-formed into a pile and the process repeated four times.
After mixing, a representative sub-sample must be taken in the following manner:-

A sample jar of 250ml capacity should be filled in small stages re-mixing the bulk between stages and blending each stage within the jar. The sample jar must be filled and then sealed with a close-fitting lid.

E.2.3.2 Determination of crude protein or total nitrogen content

Determination of Crude Protein or Total Nitrogen Content must be by a chemical method, recognised by competent authorities (IBD, AOAC, ISO, etc) and which makes direct measurement of nitrogen content. Methods acceptable to the Testing Authority are currently total nitrogen determined by the Kjeldahl method and total nitrogen using the Dumas method. These methods are only acceptable where instrumentation used is capable of analysing sample sizes greater than 0.5 g.

Quality assurance of the analytical procedures should include regular analysis of a suitable test material - for example, a sample of flour maintained for that purpose.

Instrument drift in Dumas nitrogen should be controlled by standardisation against a suitable analytical standard (EDTA, Glycine), for which the nitrogen content is known.

Systematic errors in Kjeldahl nitrogen analysis should be controlled by the inclusion of blank analyses and by the analysis of a suitable analytical standard (Ammonium Sulphate, Methionine in a suitable bulking agent) for which the nitrogen content is known.

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:

1) 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.

2) 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, 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

F.4.1 Any additional or alternative designs required for the assessment of additional VCU characters not detailed in Annex B 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 soya bean

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 – Approved seed treatment products

To be advised.

Appendix 3 – Seed despatch deadline dates

VCU seed must be delivered to NIAB by 1 February

Appendix 4 – 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
Elsoms Seeds Ltd	NIAB	Spalding, Lincolnshire

Pathology Trials Operator

None

Appendix 5 – Control varieties for VCU assessments

ES Comandor
ES Navigator
Sculptor

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

Plot records to Data Handling Operator

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

Plot samples to Quality Testing Operator

Samples	Date
Plot samples for quality testing should be sent to Quality Testing Operator	Within 2 days of harvest

Appendix 7 – Growth Stages of Soya Bean

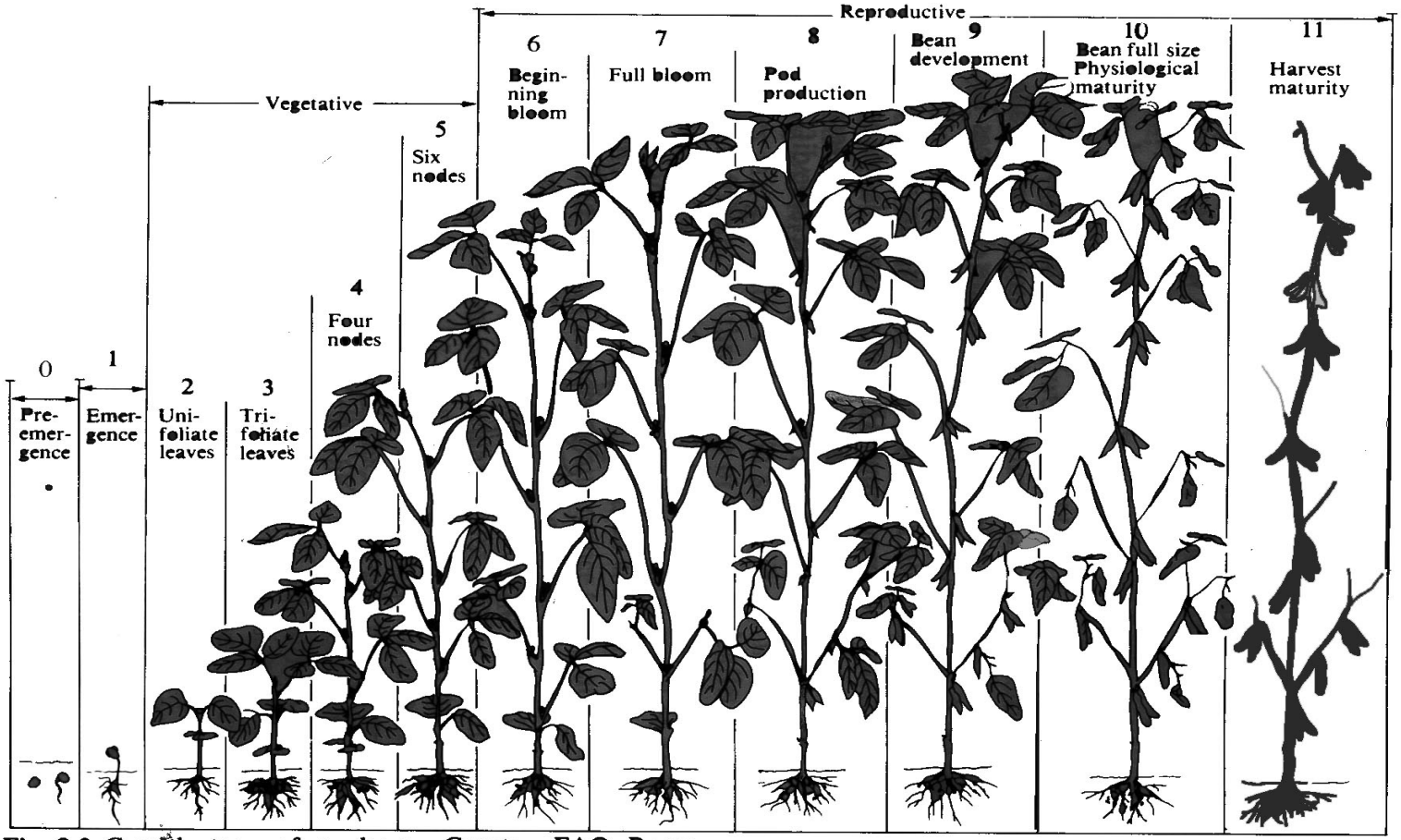

Fig. 8.2 Growth stages of soyabean – Courtesy FAO. Rome.

Appendix 7: Diagram illustrating the growth stages 0 to 11 of soyabean.

Appendix 8 – Assessment of soya bean diseases

Instructions

1. Examine all 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

Infection disease severity description

Infection	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.

Other disease assessments:

Stem canker

Stem canker may be assessed by examining 30 stems per plot. Stems should be pulled at random throughout the plot. Appropriate sampling times are usually from the middle of June onwards. If sampling is not carried out prior to harvest, it must be done ***as soon as possible afterwards, within a maximum of 2 days.*** The external symptoms only should be assessed by assigning stem base symptoms on each of the 30 stems to one of the following categories:

	no infection observable
1	<25% girdling of the stem
2	26-50% girdling
3	51 -75% girdling
4	76 -100% girdling
5	100% girdling + stem weakness
6	100% girdling + stem death

Any records made should be submitted on the standard record sheet enclosed with this protocol as soon as they are made to the testing authority, showing clearly the number of plants per plot in each disease category. “Five bar gate” tally systems are most appropriate. A disease index (DI) on a 0-100 scale will be calculated by the Information Technology and Statistics Department at NIAB using the formula

$$\frac{(0xa + 1xb + 2xc \text{ etc})}{(a + b + c + \text{etc})} \times \frac{100}{6}$$

where a, b, c etc are the number of plants in each disease category

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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.