

CASSAVA SEED INSPECTION AND CERTIFICATION PROTOCOL

*A Guide to the Inspection and Certification of Cassava
Planting Material (Seed) in Tanzania*



International Institute of Tropical Agriculture

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RESEARCH
PROGRAM ON
Roots, Tubers
and Bananas

Section A – Rationale and Procedures for Disease Assessment of Cassava Planting Material

Background and Rationale

Cassava brown streak disease (CBSD) and Cassava mosaic disease (CMD) are the major cassava viral diseases affecting cassava production in Eastern and Southern Africa. A cassava plant infected by cassava brown streak viruses (CBSVs) produces small tuberous roots, some with constrictions, and may also produce a dry necrotic rot in the roots. Cassava plants affected by cassava mosaic geminiviruses (CMGs), which cause CMD, produce a reduced number of small tuberous roots as a result of the chlorotic mosaic on the leaves and plant stunting. These two diseases cause significant losses to cassava production through most of East and Southern Africa. Cassava is a vegetatively-propagated crop, so in areas with high virus disease incidence, the cuttings obtained from farmers' fields sustain virus disease infection from one season to the next. If the stems are transported between regions or countries, virus can spread and lead to the development of new outbreaks. This highlights the importance of producing cassava planting material that is as near as possible to being virus-free.

Previously, there have been no stocks of virus-free cassava, other than the germplasm collections maintained by international organizations such as IITA (Ibadan, Nigeria) and CIAT (Cali, Colombia). These are not readily accessible to country-based producers, and although the collections maintain large numbers of cassava genotypes, these are in small quantities, and only a very small proportion of released varieties from countries in East and Southern Africa are represented. There is clearly a need to have locally available stocks of near-virus-free planting material of the released varieties in all countries in Africa where cassava is an important crop. To address this challenge, IITA has worked with partners in the National Agricultural Research Systems (NARS), seed certification agencies, NGOs and the private sector to develop a model for a country-level cassava clean seed system. This piloting work has been implemented through the 5CP project, which is financed by the Bill and Melinda Gates Foundation (BMGF). The approach builds on earlier efforts to develop a Quality Management Protocol (QMP) which was developed through USAID-supported projects in Uganda and five other countries of East and Central Africa.

The approach taken by the 5CP project has been to integrate tissue culture, greenhouse and field-based multiplication approaches in propagating healthy cassava planting material. A key component of this work has been the involvement of the Tanzania Official Seed Certification Institute (TOSCI) and seed system stakeholders in developing formal seed certification guidelines for cassava, which have been appended to the Seed Act of the Government of Tanzania. Four levels of seed production are recognized: pre-basic, basic, certified and quality declared seed. Sites have been established at each of these levels through the 5CP and the MEDA-led Muhogo Mbegu Bingwa (MMB) Projects. Pre-basic sites, managed by the Tanzania Agricultural Research Institute (TARI), have been established in four major cassava-growing regions of Tanzania (Mwele in Tanga; Hombolo in Dodoma; Nkenge in Kagera; and Mtopwa in Mtwara). Basic, certified and QDS producers have been assisted in establishing commercial seed supply businesses by the MMB Project. TOSCI provides inspection and certification services. Under the 5CP project, three released varieties were

initially multiplied through pre-basic sites, but in 2016 this number increased to more than ten.

Certification protocols were developed through stakeholder meetings involving researchers, seed inspectors, extension staff, ministry officials, NGOs, private seed companies and individual farmers. The disease tolerance levels and isolation distances proposed were derived from the latest research information on CBSD and CMD. A field validation process allowed the methods to be tested under field conditions. Based on these results some of the tolerance levels were modified. The objective of the tolerances is to minimize the chance for viruses, and other pests and diseases, to be propagated through the seed system, whilst at the same time ensuring that farmers who take care to follow good husbandry and disease management practice can succeed in producing cassava ‘seed’ that is certified.

This guide presents the methods developed for the inspection of cassava fields and certification at each of the four defined levels.

Steps in the Inspection Process

1. Field inspector(s) shall identify five counts/quadrants in each one hectare field/field portion. He/she shall walk directly to the centre of the field to identify the first quadrant. The other four quadrants shall be identified by pacing or estimating a similar distance from the central count and the distance from the four edges of the field. The four quadrants obtained shall be between the central quadrant and the edge of the field (figure 1). Each quadrant shall constitute four to five adjacent rows. Each row shall not constitute more than 10 plants, but a total of 40 plants per quadrant shall be obtained.
2. The inspector(s) shall record all field information on the Field Data Sheet. Then, assessments will be made of varietal purity and pest/disease incidence/severity in each of the five quadrants. Results will be recorded in the Field Pest and Disease Scoring Sheet. A total of 200 plants shall be assessed in each hectare of the cassava seed field inspected.
3. The certification inspection will be done twice: at an early growth stage – from three months after planting (MAP) to 5MAP and at the mature stage before the stems are harvested (10-12 MAP).
4. Data for varietal purity, and pest and disease incidences shall be calculated and entered into the Inspection Summary Sheet. Descriptive data described in Section B shall be recorded on the Field Data Sheet.
5. Disease diagnostic data shall not be taken from an off-type plant.

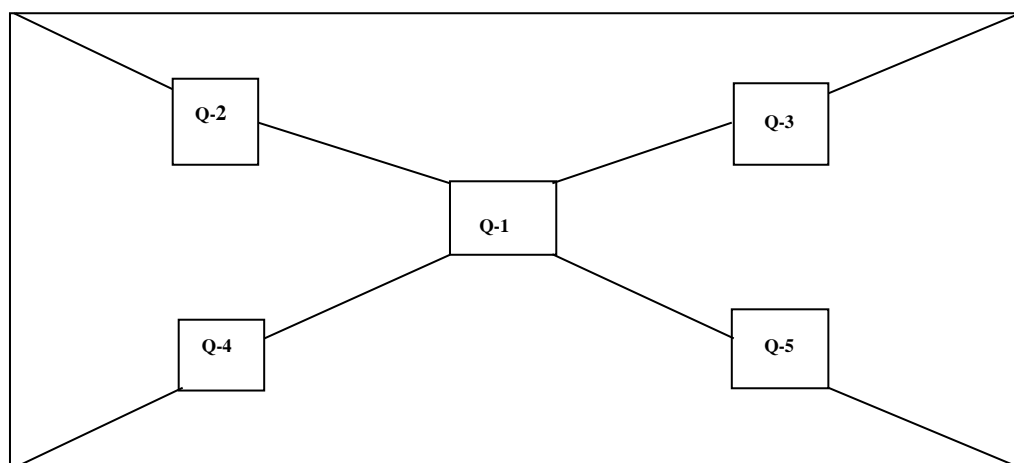


Figure 1: Layout for the five quadrants used for pest/disease assessments in the inspected cassava seed fields

Parameters Assessed Using the Field Pest and Disease Scoring Sheet

To ensure accurate diagnoses of pests and diseases, the field assessments shall be carried out only by persons trained in cassava pest and disease symptom recognition. For seed inspectors, they should have passed the Proficiency Test for Cassava Seed Inspectors. Assessors are additionally encouraged to use photo-based diagnostic aid sheets to help them with symptom recognition.

Incidences of CMD and CBSD

200 sampled plants shall be assessed for CMD and CBSD, and then their incidences shall be calculated as the percentage of symptomatic plants.

Incidence of cassava mealybug (CM)

200 sampled plants shall be assessed for CM, and the incidence calculated as the percentage of plants showing symptoms of cassava mealybug damage.

Incidence of cassava scale insects

200 sampled plants shall be assessed for cassava white scale, and the incidence calculated as the percentage of plants on which cassava white scales are present.

Incidence of varietal purity

200 sampled plants shall be assessed for varietal uniformity. The incidence of plants conforming to the correct variety's characteristics shall then be calculated.

Mean severity of cassava bacterial blight (CBB) and cassava green mite (CGM)

200 sampled plants shall be assessed for CBB and CGM, and the mean severity of plants showing symptoms of CBB and CGM will be separately calculated.

CBSD root necrosis symptoms

Four plants from each quadrant, making a total of 20 plants per hectare, will be assessed for CBSD root necrosis. Each root will be cut in cross-section five times to produce six evenly-sized slices. The severity of CBSD symptoms will be recorded for each cut, using the 1-5 scale as described in Annex 1.

Procedures for the collection of samples for laboratory testing of viruses

For pre-basic sites only, leaf samples shall be collected from 200 plants/ha to test for CBSVs, during the second certification visit, and at least one month before the date of harvesting the stems. The 200 plants are those assessed in the five quadrants of the hectare. For each sampled plant, the central leaflet shall be picked from the second fully-expanded leaf (counting from the shoot apex) and this leaflet shall be stuck onto a sheet of blank newsprint using masking tape. Newsprint sheets shall be labeled at the top with site details. Following the completion of sampling, sheets of newsprint with attached leaflets shall be placed into a herbarium press for storage through the duration of the assessment visit. In the whole process of sampling and storage, moisture must be avoided so that samples remain in good condition. Samples shall be stored in a cool dry shaded location in the laboratory prior to testing. Testing methodologies for both CBSVs are described in a separate document.

Section B - Field Information and Data Sheets

The following information shall be recorded on the Field Data Sheet provided in the table below.

1. Farmer and location information

1.1 Farmer's name

The name of the owner of the field where the assessment is done shall be recorded in the space provided in the data sheet. A 'farmer' can be an individual, a group of farmers or an institution.

1.2 GPS reading

The co-ordinates read from the GPS must be recorded in the data sheet. For latitudes and longitudes, the degrees and minutes must be indicated using the proper characters; ° for degrees and ` for minutes. Co-ordinates are given together with compass direction (N – north, S – south, E – east or W – west). This must be recorded together with the co-ordinates. The units denoted by the GPS for altitude must also be shown; **m.** for metres and **ft.** for feet.

Administrative levels (AL)

The administrative levels where the field is located shall be clearly recorded. In Tanzania, there are six administrative levels, but this document shall consider only four administrative levels.

1.3 Country

The name of the country where the assessed field is located is filled in the space provided.

1.4 Region

This is the first/highest administrative level in Tanzania.

1.5 District

This is the second administrative level in Tanzania.

1.6 Village

This is the fifth administrative level in Tanzania.

1.7 Sub-Village

This is the lowest administrative level in Tanzania

1.8 Name/institute of data recorder

The name of the data recorder and his/her institute shall be recorded in the space provided in the data sheet.

1.9 Date of assessment

The date on which the assessment is done shall be recorded in the space provided in the data sheet in the form of Day/Month/Year.

2. Field information

2.1 Crop age

The crop age may be in months old (Months after Planting – MAP). The crop age refers the time from planting to the date of assessment.

2.2 Planting date

The crop planting date shall be given in complete format: day, month and year.

2.3 Isolation distance

The distance from the nearest neighbouring cassava field shall be measured in metres.

2.4 Soil type

It is recommended that soil type should be determined by feel. There are three main types: sandy, clayey and loamy. It is good to check also if the soil is well or poorly drained and report accordingly.

2.5 Cassava variety

All cassava varieties assessed at the site shall be recorded.

2.6 Distance between varieties

If there is more than one variety in the field, the shortest distance between them shall be measured, in metres.

2.6 Crop combination

Crop combination refers to the crops that are intercropped with the cassava in the field. It is recommended that there should not be any intercropping, however in the case that it is encountered, these crops must be listed.

2.7 Source of planting material

All sources of planting material must be known. This means that the grower of the mother-plants where the cuttings planted were obtained should be identified.

2.8 Season prevailing during the visit

The season during the assessment shall be noted. The seasons may be 'Rainy' or 'Dry'.

3. Quantification

3.1 Size of cassava farm (Ha)

The size of the clean cassava seed field shall be estimated by pacing with a 1m pace (or if possible by tape-measuring) its width and length, multiplying these dimensions, then dividing by 10,000 to give the area in hectares.

3.2 Plant spacing

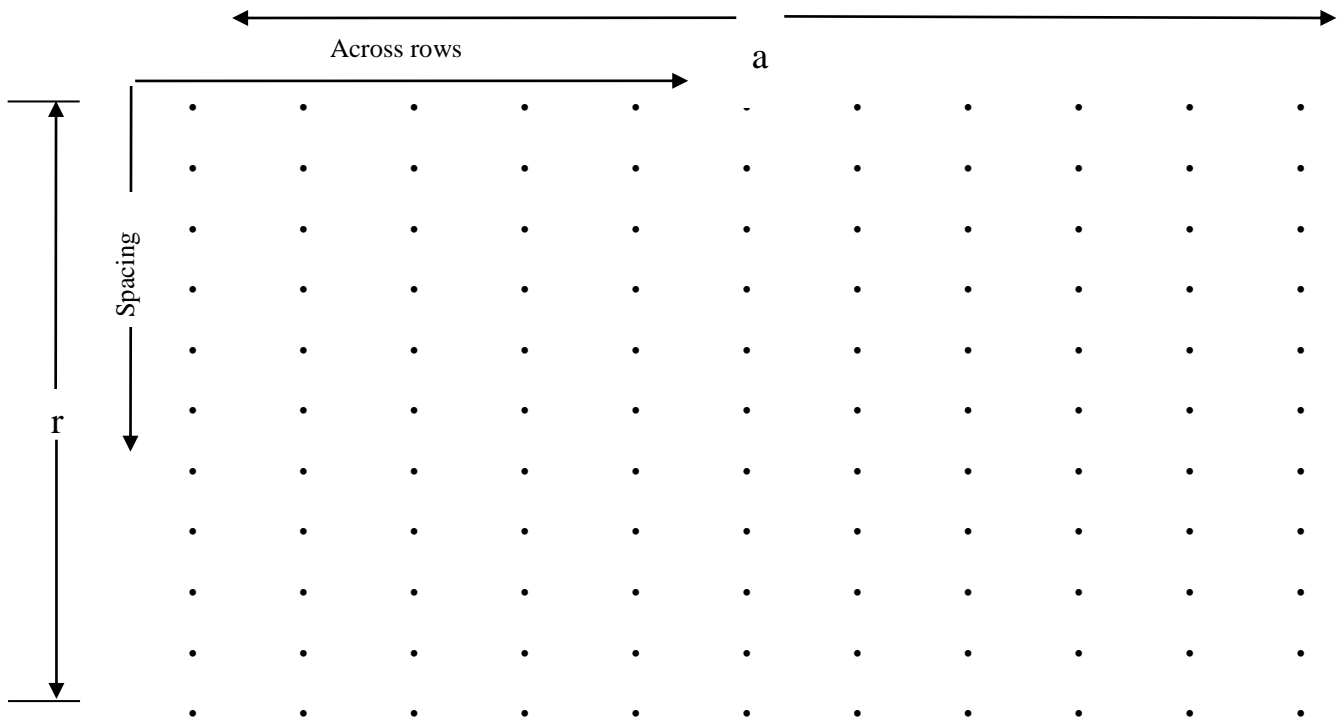
Plant spacing shall be recorded in the form of "a x b" where 'a' represents the distance between lines and 'b' represents the distance between plants in a line or vice versa. Both 'a' and 'b' are recorded in metres.

3.3 Approximate plant population per ha

The distance between 11 plants in a row (r) and between 11 plants across rows (a) shall be measured. The approximate plant population per hectare (P) is given by the formula:

$$P = 100/(a \times r) \times 10,000$$

Estimating Plant Population



Key:

- = Cassava plant
- r = distance between 11 plants in a row
- a = distance between 11 plants across rows

4. Management practices

4.1 Number of weedings

The farmer/institution shall inform the recorder how many weedings have been done from planting up until the date of assessment.

4.2 Cropping pattern

Cropping pattern means the way planting was done at the site i.e., on ridges, flat, using terraces or with soil mounding.

4.3 Stem harvest status

Stem harvest status is the growing stage at which the crop is at the time of assessment. There are three options; first crop, first ratoon and second ratoon. This information shall be provided by the grower. Put a tick against the appropriate crop stage in the space provided (1st crop....., 1st ratoon..... or 2nd).

Field Data Sheet (Sheet 1)

1	Farmer information	3	Quantification
1.1	Farmer's name.....	3.1	Size of cassava farm (Ha)
1.2	GPS reading:	3.2	Plant spacing.....
	Long.....		
	Lat.....	3.3	Plant population per ha.....
	Alt.....		
	Administrative levels in Tanzania		
1.3	Country.....		
1.4	Region.....		
1.5	District.....		
1.6	Village.....		
1.7	Sub-Village.....		
1.8	Name/institute of data recorder.....		
1.9	Date of assessment.....		
2	Field information	4	Management practices
2.1	Crop age	4.1	Number of weedings.....
2.2	Planting date.....	4.2	Cropping pattern.....
2.3	Isolation distance.....	4.3	Stem harvest status:
2.4	Soil type.....		1 st crop (.....)
2.5	Cassava variety:		1 st ratoon (.....)
	Variety 1 (sampled).....		2 nd ratoon (.....)
	Variety 2		
	Variety 3.....		
2.6	Variety 4		
2.7	Distance between varieties.....		
2.7	Crop combination:		
	Crop 1.....		
	Crop 2.....		
2.8	Source of cassava planting material.....		
2.9	Season prevailing during the visit.....		

Field Pest and Disease Scoring Sheet (Sheet 2)

Plant	CBSD	CMD	CGM	CM	CBB	Scale
	+/-	+/-	Sev.	+/-	Sev.	+/-
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Plant	CBSD	CMD	CGM	CM	CBB	Scale
no.	+/-	+/-	Sev.	+/-	Sev.	+/-
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Plant	CBSD	CMD	CGM	CM	CBB	Scale
no.	+/-	+/-	Sev.	+/-	Sev.	+/-
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Plant	CBSD	CMD	CGM	CM	CBB	Scale
no.	+/-	+/-	Sev.	+/-	Sev.	+/-
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Number of off-types.....

Section C – Decision Matrix

Inspection Summary Sheet (Sheet 3)

Class of the field (circle the field class inspected)	Pre-Basic		Basic		Certified 1 & 2		QDS	
Disease	Inc (%)	Mean Sev	Inc (%)	Mean Sev	Inc (%)	Mean Sev	Inc (%)	Mean Sev
CBSD								
CMD								
CBB								
Pests	Inc (%)	Mean Sev	Inc (%)	Mean Sev	Inc (%)	Mean Sev	Inc (%)	Mean Sev
CGM								
CM								
Cassava white scale								
Other parameters								
Number of rotations								
Isolation distance (m)								
Distance between varieties (m)								
Number of ratoons								
Varietal purity								
Number of inspections								

Section D – Certification Guidelines

In Tanzania, the Tanzania Official Seed Certification Institute (TOSCI) is the only agency authorized to certify cassava planting material that is to be sold commercially. TOSCI (or officers accredited to TOSCI) has the mandate to carry out inspections and offer certificates to cassava ‘seed’ producers whose fields meet the required standards. For a field to be inspected, a producer is required to present a request to TOSCI. TOSCI then conducts the inspection, for an officially determined fee. Two inspections are required for each field – during the early growth stage (3-5 MAP) and shortly before harvest (10-12 MAP). If the field passes the second certification, a certificate is issued, and the producer is authorized to sell the cassava planting material.

Guidelines for the certification of cassava seed approved by the Government of Tanzania

Factor	Class			
	Pre-Basic	Basic	Cert 1/2	QDS
Land history				
Minimum rotation (years/seasons)	2	2	2	2
Minimum number of inspections	2	2	2	2
Minimum isolation (m)	300	200	100	50
Minimum distance between varieties (m)	3	3	3	3
Maximum permitted ratoons	2	2	2	2
Maximum shoots per ratoon	3	3	3	3
Off-types (%) (5x40 counts/ha)	0	1	1	1
Diseases				
Cassava mosaic disease – Max incidence (%)	1	2	3	5
Cassava bacterial blight – Max mean severity	2.5	2.5	2.5	3.5
Cassava brown streak disease – Max incidence (%)	2	4	7	10
Cassava brown streak disease – Lab testing (Max %)	4	-	-	-
CBSD – Lab testing – tissue culture plantlets (Max %)	0	0	-	-
Pests:				
Cassava mealybug – Max incidence (%)	1	2	4	8
Cassava green mite – Max mean severity	2.5	3.0	3.5	3.5
Scale insects – Max incidence (%)	1	2	4	8
Postharvest seed standard				
Harvesting age – new crop	8-18mth	8-18mth	8-18mth	8-18mth
Harvesting age – ratoon crop	6-12mth	6-12mth	6-12mth	6-12mth
Minimum length of cutting	20cm	20cm	20cm	20cm
Minimum diameter of cutting	2cm	2cm	2cm	2cm
Minimum number of nodes/cutting	5	5	5	5
Maximum damaged nodes	20%	20%	20%	20%
Validity of certification	2	2	2	2

- **Pre-basic seed:** Produced by Research Institutes
- **Basic seed:** Produced by the Agricultural Seeds Association (ASA), Private Companies
- **Certified seed 1/2:** Produced by Private Companies, Farmers, NGOs, CBOs
- **Quality Declared Seed (QDS):** Produced by Farmers, Farmer Groups