PHILIPPINE NATIONAL STANDARD

PNS/BAFS PAES 244:2018
ICS 65.060.99

Agricultural Machinery – Cassava Digger – Methods of Test

BUREAU OF AGRICULTURE AND FISHERIES STANDARDS
BPI Compound Visayas Avenue, Diliman, Quezon City 1101 Philippines
Trunkline: **(632) 928-8741 to 64 loc. 3301-3319**
E-mail: **info.dabafs@gmail.com**
Website: **www.bafs.da.gov.ph**

Foreword

The Philippine National Standard (PNS) for Agricultural Machinery – Cassava Digger – Methods of Test (PNS/BAFS PAES 244:2018) has been prepared by the Technical Working Group (TWG) for various Agricultural Machinery as per approved Department of Agriculture Special Order (SO) No. 1045 Series of 2016.

This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2.

The word “shall” is used to indicate mandatory requirements to conform to the standard.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

1 Scope

This standard specifies the methods of test for cassava diggers. Specifically, it shall be used to:

1.1 verify the mechanisms, dimensions, materials of the cassava digger and the list of specifications submitted by the manufacturer;

1.2 determine the performance of the implement;

1.3 evaluate the ease of handling and safety features; and

1.4 report the results of the test.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

PNS/BAFS PAES 243:2018, *Agricultural Machinery – Cassava Digger – Specifications*

PAES 103:2000, *Agricultural Machinery – Methods of Sampling*

3 Terms and Definitions

For the purpose of this standard, the terms and definitions given in PNS/BAFS PAES 243:2018 and the following shall apply.

3.1
actual field capacity
actual rate of harvesting in a given area per unit time

3.2
draft
total force parallel to the direction of travel required to move the implement

3.3
overall height
distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the cassava digger

3.4
overall length
distance between the vertical planes at the right angles to the median plane of the cassava digger and touching its front and rear extremities

3.5
overall width
distance between the vertical planes parallel to the median plane of the cassava digger; each plane touching the outermost point of the cassava digger on its respective side

3.12
running-in period
preliminary operation of the machine to make various adjustments prior to the conduct of test until the operation is stable

3.13
theoretical field capacity
function of speed and operating width expressed in hectares per hour

3.14
tilt angle
angle made by the digging blade with the vertical line

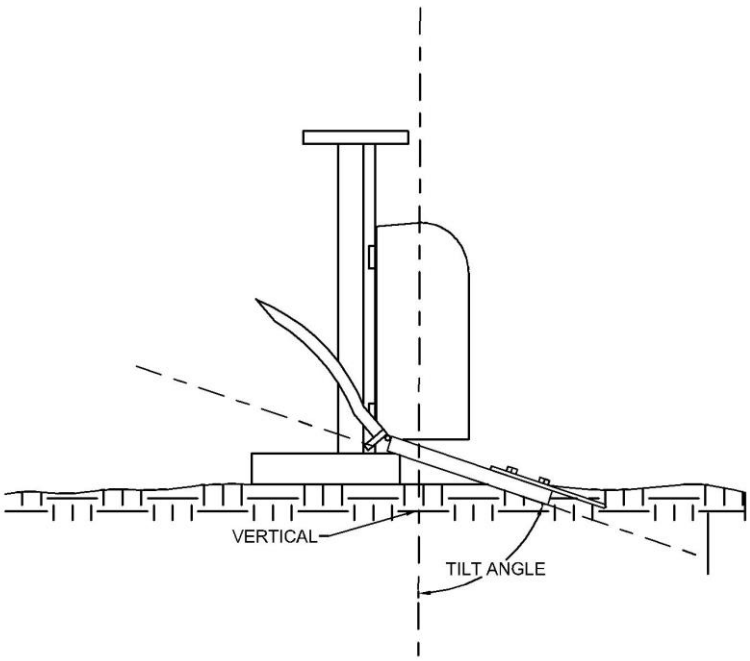


Figure 1 – Side view of the cassava digger

3.15
width of cut
transverse distance between the working edges of the digger

3.16
test applicant
manufacturer, direct importer, or any legitimate distributor, dealer, or end user of the machine

4 General Conditions for Test and Inspection

4.1 Selection of cassava digger to be tested

Cassava digger to be tested should be accordance with PAES 103:2000 or any other suitable method of selection.

4.2 Role of the test applicant

The test applicant shall submit specifications and other relevant information about the cassava digger. They shall abide with the terms and conditions set forth by the official testing agency, provide testing materials and shoulder other variable costs to carry out the test.

4.3 Role of the representative of the test applicant

An officially designated representative of the test applicant shall operate, demonstrate, adjust, repair as the case maybe and decide on matters related to the operation of the machine.

4.4 Suspension/Termination of test

If during the test, the machine stops due to breakdown or malfunction which may affect the performance of the machine, the test may be suspended. If the machine will not be able to continue operation, the test shall be terminated.

4.5 Selection of tractor to be used

The tractor to be used shall be compatible with the cassava digger in accordance with the manufacturer’s specification.

5 Test Preparation

5.1 Preparation of the cassava digger for testing

The representative of the test applicant and testing agency shall check the cassava digger so as to ensure that the machine has been assembled and installed in accordance with the instruction of the manufacturer.

5.2 Test instruments and other materials

The suggested list of minimum field and laboratory test equipment and materials needed to carry out the cassava digger test is shown on Annex A. These instruments should be calibrated regularly. Before and after each test, these instruments shall be physically checked for operation and shall be cleaned, respectively. A checklist of instruments and materials to be used before departure to and from the testing area shall be prepared.

5.3 Test site conditions

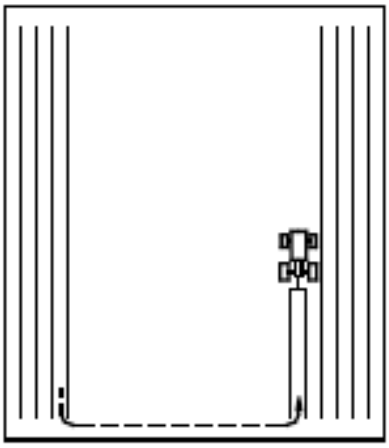
The cassava to be harvested shall be grown in a typical condition. Test site shall be ready for harvesting with cassava grown for at least 10-14 months after planting. The cassava plants should be trimmed to at most 20 cm above soil level before digging. Further, the site should be cleared to avoid obstruction on the implement and for the operator to see the cassava plant.

5.3.1 Size of the Area per Trial

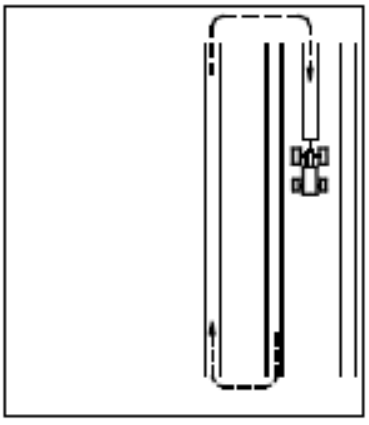
Each test, with three replications, shall be carried out in the rectangular field area with sides in the ratio of 2:1 as much as possible. The area should not be less than 1000 m^2.

5.3.2 Operational Pattern

Field capacity and field efficiency are influenced by field operational pattern which is closely related to the size and shape of the field and the kind and size of implement. The non-working time should be minimized as much as possible using the recommended field operational patterns.



(a) Headland pattern from boundaries



(b) Overlapping alteration pattern

Figure 2 – Suggested operational pattern

5.4 Running-in and preliminary adjustments

The cassava digger shall have undergone a running-in period before starting the test. During the running-in period, the various adjustments of the machine shall be made according to the recommendation of the manufacturer.

6 Pre-test Observation

6.1 Verification of specifications

The specifications claimed by the manufacturer and the physical details given in Annex B shall be verified by the testing agency. A stable and level surface shall be used as reference plane for verification of dimensional machine specifications.

6.2 Initial field and crop condition

Initial data such as field conditions and crop condition shall be collected before the test and shall be recorded in Annex C.

6.3 Estimated Yield of the Test Site

Before the test run, randomly select three 10 linear meter within the test plot and manually harvest the cassava tubers. The harvested cassava tubers shall be collected, weighed and recorded. The average potential yield per linear meter shall be computed

7 Performance Test

7.1 Operation of the cassava digger

The cassava digger shall be operated for sufficient duration with load at the test site by the official representative of the test applicant using the recommended setting of the manufacturer. The testing agency shall make all measurements, which form part of the test and take the prescribed samples.

NOTE No other adjustments shall be permitted during the test.

7.2 Measurement of Performance Parameters

The items to be inspected and measured shall be recorded in Annex C.

7.2.1 Field Capacity Determination

7.2.1.1 Operating Speed

Outside the longer side of the test plot, two poles 20 m apart, measured with a tape measure of at least 50 m in length (A, B) are placed approximately in the middle of the test plot (Figure 1). On the opposite side, two poles are also placed in similar position, 20 m apart (C, D) so that all four poles form corners of a rectangle, parallel to at least one long side of the test plot. The speed will be calculated from the time

required for the machine to travel the distance (20 m) between the assumed line connecting two poles on opposite sides AC and BD. The reference point of the machine should be selected for measuring the time.

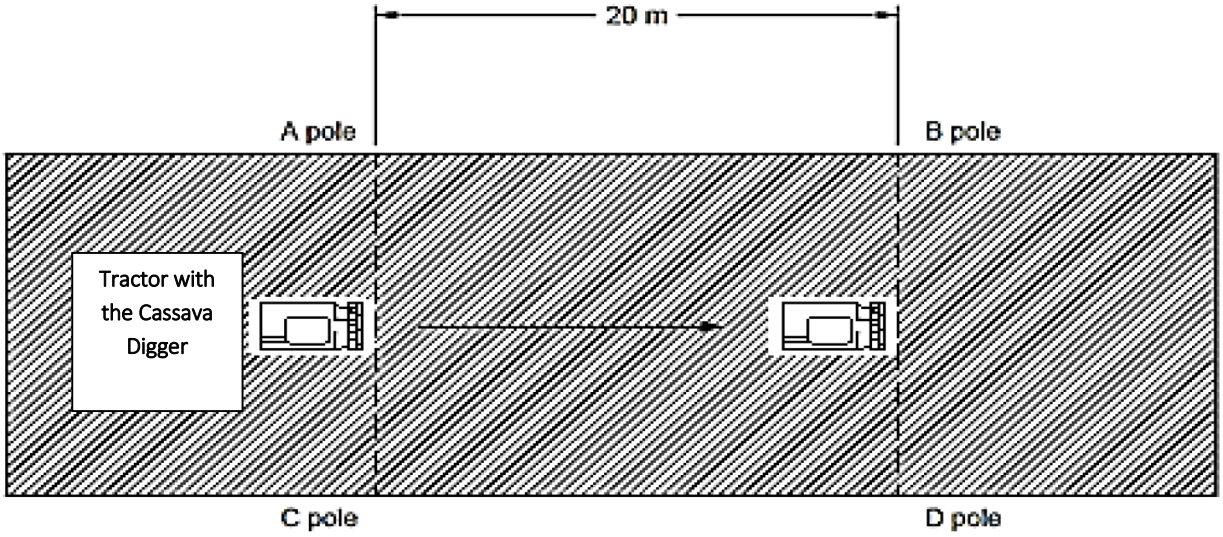


Figure 3 – Measurement of Operating Speed

7.2.1.2 Working Width Determination

Working width of the implement and the dimensions of the test field will also be quantified using the tape measure. Average row space shall be also observed tentatively.

7.2.2 Noise level measurement

The noise emitted by the tractor where the cassava digger is attached shall be measured approximately 50 mm away from the ear level of the operator using a noise level meter.

7.2.3 Fuel consumption

To get the amount of fuel consumed, the tank shall be filled to full capacity before the test. After the test, fill the tank with measured fuel to the same level before the test. When filling up the tank, careful attention shall be paid to keep the tank horizontal and not to leave empty space in the tank.

7.2.4 Total operating time

Total operating time shall be measured once the machine starts to harvest up to the last plant. The turning time of the tractor with the cassava digger shall be recorded. Unproductive time during adjustment, turning and machinery breakdown shall be deducted from the total operating time.

8 Soil Physical Property Analysis

8.1 The soil hardness shall be measured using penetrometer.

8.2 The soil texture and moisture content of the test area shall be determined by the recommended methods given in Annex D and shall be recorded in Annex C.

9 Presentation of results

Machine specifications and the result of the tests shall be presented in tabular form in which data shall be taken from Annexes B and C. Observations made on the machine while in operation shall be supported with photographs.

10 Formula

The formulas to be used during calculations and testing are given in Annex F.

11 Test Report Format

The test report shall include the following information in the order given.

11.1 Name of testing agency

11.2 Test report number

11.3 Title

11.4 Summary of Results (including the performance compared with the criteria)

11.5 Purpose and scope of test

11.6 Methods of test

Table 1 – Machine specifications

11.7 Conditions of the Machine

11.8 Description of the Machine

11.9 Results and Discussions

Table 2 – Field performance test data

11.10 Observations (include pictures)

11.11 Name, signature and designation of test engineers

Annex A
(informative)

Minimum List of Field and Laboratory Test Equipment and Materials

A.1 Field Test Equipment and Materials

Equipment/Material		Quantity
A.1.1	Timers Accuracy: 1/10 sec	2
A.1.2	Penetrometer	1
A.1.3	Measuring tapes (3 m and 50 m)	2
A.1.4	Graduated cylinder At least 1-L capacity	1
A.1.5	Vernier caliper	1
A.1.6	Sound level meter (decibels)	1
A.1.7	Weighing scale Capacity: at least 100 kg Scale divisions: 0.5 kg	1
A.1.8	Digital camera	1
A.1.9	Four-wheel tractor	1
A.1.10	Marking pegs	10

A.2 Laboratory Test Equipment and Materials

Equipment/Material		Quantity
A.2.1	Laboratory oven	1
A.2.2	Digital Weighing Scale Sensitivity: 0.01 g	1
A.2.3	Labeling Tags which include: Date of Test Cassava Digger on Test Sample Source Variety Days after planting Trial Number	20

Annex B
(informative)

Specifications of Cassava Digger

Name of Applicant : _____
Address : _____
Tel. No. : _____

Name of Manufacturer : _____
Address : _____
Tel. No. : _____

GENERAL INFORMATION

Make : _____ Type : _____
Serial No. : _____ Brand/Model : _____
Date of Manufacture : _____
Testing Agency : _____ Test Engineer : _____
Location of Test : _____ Date of Test : _____

Items to be inspected*

No.	Item	Specification of the Manufacturer	Verification by the Testing Agency
B.1	**Main structure**		
B.1.1	Overall dimensions (mm)		
B.1.1.1	Length		
B.1.1.2	Width		
B.1.1.3	Height		
B.1.2	Weight (kg)		
B.3	**Width of cut, mm**		
B.4	**Depth of cut, mm**		
B.5	**Digging blade**		
B.5.1	Type		
B.5.2	Material		
B.5.3	Width, mm		
B.5.4	Thickness, mm		

*The parameter will be checked upon availability.

Annex C
(informative)

Field Performance Test Data Sheet

Test Trial No. : _____ Date : _____
Test Engineers : _____ Location : _____
Assistants : _____ Machine : _____
Test Applicant : _____ Manufacturer : _____

No.	ITEMS	TRIAL			
		1	2	3	Ave.
C.1	**Crop condition**				
C.1.1	Variety				
C.1.2	Date of planting				
C.1.3	Days after Planting				
C.1.4	Row spacing				
C.1.5	Hill spacing				
C.1.6	Plant population/ha				
C.2	**Field conditions**				
C.2.1	Location of test field				
C.2.2	General topography				
C.2.3	Area of test field				
C.2.4	Dimensions of field (L x W), m				
C.2.5	Shape of field				
C.2.6	Soil type (clay, clay loam, sandy, etc)				
C.2.7	Soil moisture content, %				
C.2.8	Soil hardness, kg/cm^2				
C.3	**Test conditions**				
C.3.1	Date of test				
C.3.2	Operating time				
C.3.3	Unproductive Time				
C.3.3.1	Turning, min				
C.3.3.2	Adjustments, min				
C.3.3.3	Minor repair, min				
C.3.3.4	Others (specify, min)				
C.3.4	Operating speed, kph (at least 5 trials)				
C.3.5	Effective width of cut, mm				
C.3.6	Depth of cut, mm				
C.3.7	Fuel consumed, L				
C.3.8	Fuel consumption rate, L/h				
C.3.9	Actual field capacity, ha/h				
C.3.10	Theoretical field capacity, ha/h				

No.	ITEMS	TRIAL			
		1	2	3	Ave.
C.3.11	Field efficiency, %				
C.3.12	Noise level				
C.4	Labor requirements				
C.5	**Cassava Digger**				
C.5.1	Weight of dug cassava, kg				
C.5.2	Weight of undug cassava, kg				
C.5.3	Digging efficiency, %				

C.6 Ease of cleaning the implement

_____
_____
_____

C.7 Ease of adjusting and repair of parts

_____
_____
_____

C.8 Ease of transporting the machine

_____
_____
_____

C.9 Safety

_____
_____
_____

C.10 Failure or abnormalities that may be observed on the implement or its component parts during and after the operation.

_____
_____
_____

C.11 Ease of handling and stability when the machine is working and turning

_____
_____
_____

C.12 Other observations

_____
_____
_____

Annex D
(normative)

Laboratory Analysis

D.1 Soil Physical Property Analysis

D.1.1 Soil Texture Determination

D.1.1.1 This test is carried out to analyze the soil samples taken during the performance test to determine the soil texture of the test area.

D.1.1.2 Three soil samples shall be taken from the test area. Each soil sample shall be weighed and recorded.

D.1.1.3 Each soil sample shall then be passed through series of sieves.

D.1.1.4 The type of soil (i.e. sand, silt and clay) that is retained in a particular sieve shall be weighed. (see Table 1)

Table 1 – Grain Size for Different Soil Types

Soil Type	Grain Size Mm	Remarks
Sand	2.0 – 0.05	Passed through the 2 mm sieve but retained by the 0.05 mm sieve
Silt	0.05 – 0.002	Passed through the 0.05 mm sieve but retained by the 0.002 mm sieve
Clay	< 0.002	Passed through the 0.002 mm sieve

D.1.1.5 The relative composition of each soil type expressed in percent shall be computed as follows:

$$\%\, Sand = \frac{Weight\ of\ sand}{Total\ Weight\ of\ soil}\ x\ 100$$

$$\%\, Silt = \frac{Weight\ of\ silt}{Total\ Weight\ of\ soil}\ x\ 100$$

$$\%\, Clay = \frac{Weight\ of\ clay}{Total\ Weight\ of\ soil}\ x\ 100$$

D.1.1.6 The relative composition of the sand, silt and clay shall be used to determine the soil type using the soil texture triangle as shown in Figure 4.

EXAMPLE: If you have a soil with 20% clay, 60% silt and 20% sand, it will fall in the “silt loam” texture class.

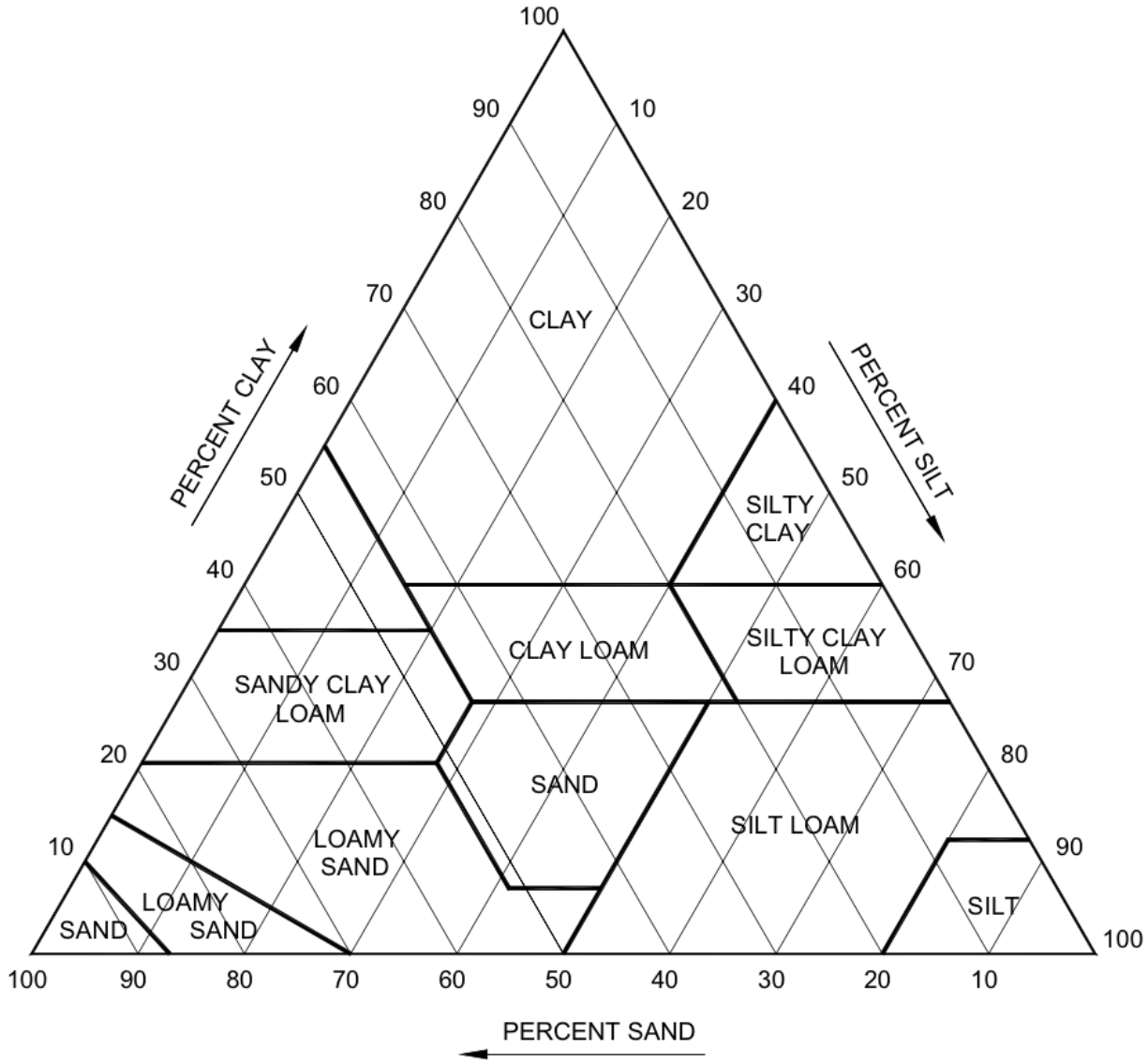


Figure 4 – Soil Texture Triangle showing Relative Composition of texture class
[Source: Soil classification scheme adopted by USDA, Agricultural Engineering Handbook, 1961]

D.1.2 Soil Moisture Content Determination

D.1.2.1 Oven Method

D.1.2.1.1 This test is carried out to analyze the soil samples taken during the performance test to determine the soil moisture of the test area.

D.1.2.1.2 Three core soil samples in at least three different locations of test plots shall be taken randomly from the test area. Each soil sample shall be weighed and recorded as initial weight.

D.1.2.1.3 The samples shall be dried using a convection oven maintained at 105 °C

for at least eight hours.

D.1.2.1.4 The oven-dried samples shall then be placed in a desiccator. Each soil sample shall be weighed and recorded as oven-dried weight.

D.1.2.2 Moisture Meter

The soil moisture content can also be measured using a soil moisture meter.

D.2 Crop Analysis

D.2.1 Cassava Tubers Measurements Determination

D.2.1.1 This test is carried out to analyze the cassava tubers samples taken during the performance test to determine its dimensions.

D.2.1.2 Ten (10) cassava tubers samples taken randomly from the samples used in determining the estimated yield shall be used.

D.2.1.3 The widest diameter and the longest length of sample cassava tubers shall be measured and recorded using a Vernier caliper and tape measure, respectively.

D.2.2 Cassava Tubers Moisture Content Determination

D.2.2.1 This test is carried out to analyze the cassava tubers samples taken during the performance test to determine the moisture content.

D.2.2.2 The same samples used in determining the dimensions of the cassava tubers shall be used.

D.2.2.3 The samples shall be reduced to chip sizes using a chipper. Place three (3) 100-gram samples in an aluminum container. These samples shall then be dried using a convection oven maintained at 105 °C for at least eight hours.

D.2.2.4 The oven dried sample shall then be placed in a desiccator. Each sample shall be weighed and recorded as oven-dried weight.

Annex E
(informative)

Laboratory Analysis Data Sheet

E.1 Estimated Yield of the Test Site

Sample No.	Sample Weight per sample area, kg /10m^2	Sample Weight per area, kg/m^2
1st 10 meters		
2nd 10 meters		
3rd 10 meters		
Ave.	-	
Estimated Yield, kg		

E.2 Soil Physical Property Analysis

E.2.1 Soil Texture

Sample No.	Soil Sample Weight, g	Sand		Clay		Silt	
		Weight (g)	Percentage (%)	Weight, (g)	Percentage (%)	Weight (g)	Percentage (%)
1							
2							
3							
Ave.							

Soil Texture: _____

E.2.2 Soil Moisture Content

Sample No.	Initial Weight, g	Final Weight, g	% Soil Moisture
1			
2			
3			
Ave.	-	-	

E.3 Crop Analysis

E.3.1 Cassava Tubers Dimensions

Sample No.	Widest Diameter, mm	Longest length, mm
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Ave.		

E.3.2Cassava Tubers Moisture Content

Sample No.	Initial Weight, g	Final Weight, g	% Soil Moisture
1			
2			
3			
Ave.			

Annex F
(normative)

Formula Used During Calculations and Testing

F.1 Actual field capacity

$$AFC = \frac{A_T}{T_T}$$

where:

AFC is the actual field capacity (ha/h)
A_T is the area covered during test (ha)
T_T is the total operating time (h)

F.2 Theoretical field capacity

$$TFC = \frac{W_C S_A}{10}$$

where:

TFC is the theoretical field capacity (ha/h)
W_C is the working width (m)
S_A is the average operating speed (km/h)

F.3 Field efficiency

$$Eff = \frac{AFC}{TFC} \times 100$$

where:

Eff is the field efficiency (%)
TFC is the theoretical field capacity (ha/h)

F.4 Digging efficiency

$$\mathrm{DE} = \frac{D}{UD} \times 100$$

where:

DE is the digging efficiency (%)
D is the dug cassava tubers, kg
UD is the undug cassava tubers, kg

F.5 Fuel consumption rate

$$FCR = \frac{F}{T}$$

where:

FCR is the fuel consumption rate (L/h)
F is the amount of fuel consumed (L)
T is the total time of operation (h)

F.6 Soil Moisture Content (% dry weight basis)

$$\%\ \text{Soil Moisture} = \frac{Wi - Wf}{Wf}\ x\ 100$$

where:

W_i is the initial weight of the soil, kg
W_f is the oven-dried (final) weight of the soil, kg

F.7 Cassava Tuber Moisture Content (% wet weight basis)

$$\%\ \text{Moisture Content} = \frac{Wi - Wf}{Wi}\ x\ 100$$

where:

W_i is the initial weight of the cassava tubers, kg
W_f is the oven-dried (final) weight of the cassava tubers, kg

Bibliography

PNS/PAES 148:2010, *Agricultural Machinery – Field Cultivator – Methods of Test*

PNS/PAES 132:2004, *Agricultural Machinery – Disc /Moldboard Plow – Methods of Test*

Department of Agriculture
Bureau of Agriculture and Fisheries Standards

Technical Working Group (TWG) for the Development of Philippine National Standard for Agricultural Machinery – Cassava Digger

Chairperson

Engr. Cristy Cecilia P. Polido
Bureau of Agricultural and Fisheries Engineering

Co-chairperson

Dr. Aurelio A. Delos Reyes Jr.
Agricultural Machinery Testing and Evaluation Center

Members

1 Romulo E. Eusebio
2 Darwin C. Aranguren
3 Fatima Joy J. Raytana
Agricultural Machinery Testing and Evaluation Center

4 Victor A. Rodulfo Jr.
Center for Agri-Fisheries and Biosystems Mechanization

5 Triniza Jardin-Millare
Department of Agriculture – Regional Field Office – IVA

6 Peachie B. Melendez
Philippine Council for Agriculture and Fisheries

7 Janice P. Vargas
8 Jessa Rica P. Pandiño
9 Arjay P. Sabasaje
10 Rose Ann C. Arienda
Bureau of Agricultural and Fisheries Engineering

11 Donald V. Mateo
Philippine Center for Postharvest Development and Mechanization

12 Dennis I. Tactac
Department of Agriculture – Regional Field Office – I

Project Manager
Lara V. Navarro
John Gregory V. Aquino
Abbygail M. Jaylo
Charmine Diann S. Mejia
Melanie R. Lorenzo

Advisers
Vivencio R. Mamaril
Karen S. Bautista

Bureau of Agriculture and Fisheries Standards

BUREAU OF AGRICULTURE AND FISHERIES STANDARDS

BPI Compound Visayas Avenue, Diliman, Quezon City 1101 Philippines
T/ (632) 928-8741 to 64 loc. 3301-3319
E-mail: info.dabafs@gmail.com
Website: www.bafs.da.gov.ph