C

Multilocational Trial for the Post-Harvest Evaluation of Sweet Potato Varieties.

Methods Manual
1998

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Introduction

This manual has been written to set out the methods for a series of five trials conducted at A.R.I. Ukiriguru, MARTI-Uyole, Sugar Cane Research Institute (Kibaha), Dakawa (Chollima) and HORTI-Tengeru during 1998 as part of a project to evaluate sweet potato varieties for their quality and storability. The methods have been adapted from those used during a series of trials conducted at the same sites during 1996 and 1997.

The objectives of the trials are as follows

1. To determine whether there exists a range of storability within East African germplasm (If this is so, then we can breed varieties with longer shelf-life).

2. To identify characteristics associated with storability.

3. To determine the extent of location effects. i.e. does ranking of varieties change with environment?

4. To establish a methodology for post-harvest evaluation to be used standardly by the breeding programme. This should be simple, and should cover consumer acceptability of fresh roots and suitability for processing as well as storability.

This project is part of a collaboration between the Tanzanian National Root and Tuber Crops Programme and the Natural Resources Institute, Greenwich University, UK. Funding is provided through the Crops Post-Harvest Programme of the Department for International Development (DfID), UK.

Planting trials

Planting Uniform Yield Trials

(1) The trials are planted in the form of Uniform Yield Trials. Planting material should ideally be obtained using nursery beds on-station. During planting, standardise the cuttings used (e.g. 30 cm from apical and middle portion of the vines.)

(2) Use a randomized complete block design with 3 or 4 replicates. Each plot should consist of 6 rows of 6 m (3 plants/ m) [324-432 plants per variety] with 1 m between rows. Plant on ridges or flat ground depending on the common practice in the region. Plant a border (e.g. of SPN/O) around the trial.

(3) Record the information about how the trial was planted, and any observations. Use AYT form 1[1] to record data such as planting date, soil type, history of the land, and monthly meteorological data for the station. The meteorological data should be obtained from the month prior to planting until the completion of the trial.

(4) 3 weeks after planting, record establishment by recording the number of plants surviving in each plot (#. Estab, AYT form 2). Record foliage vigor (canopy cover and closure) using the following rating scale (1: very weak, 2: weak, 3: fair, 4: vigorous, 5: very vigorous) (AYT Form 2 Fol vigor).

(5) Additional material can be obtained by planting additional plots. In this case, the varieties should be planted in blocks to avoid bias of the final data as a result of the effects of land variability.

[1] *Forms for the assessment of production characteristics are included in a section of the Sweetpotato Germplasm Management Training Manual printed as an appendix to this Manual.*

Procedure to follow, and observations to be made during the harvesting of trials

In cases where a Uniform Yield Trial has been planted, and additional multiplication plots have also been planted, the Uniform Yield Trial should be harvested first, and used to collect the harvest data as described below.

Procedure for harvesting Uniform Yield Trial and recording harvest data.

(1) Harvest plants by up-rooting with foliage still attached. All plants from each plot should be harvested and used for data collection.

(2) For each plot, note the following parameters while the foliage is still attached to the roots. Record data on the CIP AYT Forms[1] as indicated:

(a) The number of plants harvested per plot (#.Plts.Harv. [AYT Form 3]).
(b) The number of plants without storage roots (#Plts.w/out Stor.Rts.) [AYT Form 3])
(c) An assessment of crown damage by *Cylas*. (1-5 scale see Table 1) (Crown damage, [AYT Form 2])
(d) A general evaluation of root appearance for each plot. (1-5 scale see Table 1) (Gen. eval. Stor. Rts. [AYT Form 3])

(3) Separate storage roots from crowns, and record the weight of foliage for each plot (Wt Tops [AYT Form 3]).

N.B. If roots are left exposed to hot sun for long, they will deteriorate much faster during storage. If the harvest is taking a long time for any reason, the storage roots may be taken under cover at this stage for further assessment, but the roots from each plot must be kept separate.

(4) Record the following data for the storage roots of each plot:

(a) Assess *Cylas* infestation by separating roots into 5 classes and calculating the mean root score as shown in Table 2 [AYT Form 2].
(b) The number of cracked, defective roots or rotten roots (Storage roots rots, pests and defects, [AYT Form 3], *N.B. label type of defect together with the number of roots*).
(c) An overall assessment of rough weevil damage by separating roots into 5 classes as for *Cylas*(1-5 scale see Table 1) ([AYT Form 2])

N.B. If the trial is suffering from a serious infestation or disease that is not included in the above, records should be taken of the severity of the problem for each replicate.

(5) For each plot record the number and total weight of storage roots. Then separate the storage roots into large (i.e. marketable size) and small. Record the number and total weight of each of both large and small roots separately for each plot [AYT Form 3].

N.B. the distinction between large and small roots, relates to those which are marketable and unmarketable and has been found to depend on the region and quality of storage roots harvested. Therefore when comparing varieties for yield potential the total yield should be used.

(6) Discard the small roots.

(7) Remove rotten and infested roots (Those scoring greater than 1). The roots remaining for each plot may be weighed and recorded as marketable yield on AYT Form 3, under comments

Harvesting multiplication plots

(8) Harvest the roots from additional multiplication plots as necessary. Keeping the varieties separate, sort the roots into large and small. The small roots should be discarded. In addition discard all roots that show rotting or infestation.

Characterisation of roots

(9) Pool the roots remaining from the Uniform Yield Trials and the multiplication plots (if planted) for each variety. These will be used for the trial. Take the roots inside or to a shaded place to continue assessment.

At this stage the roots could be left in tied sacks and the following assessment might be carried out on the next day.

(10) Assess the characteristics of the storage roots for each variety using the CIP descriptors and the CIP colour chart. Note the following characteristics using datasheet PHE1.

(a) Surface defects
(b) Cortex thickness ***[N.B. to be recorded in mm]***
(c) Skin colour
    Predominant skin colour
    Secondary skin colour
(d) Flesh colour
    Predominant flesh colour
    Secondary flesh colour
    Distribution of secondary colour

(11) Remove 15-20 medium to large roots for each variety to be used for taste testing. One taste test should be carried out as soon as possible, and another taste test conducted after 2 weeks. In locations where storage root shelf-life is long, a third taste test might be conducted after 4 weeks of storage. The roots to be used in the second taste test should be stored in a sack in the same location as the replicates of the trial (see Appendix B for method).

[1] *Forms for the assessment of production characteristics are included in a section of the Sweetpotato Germplasm Management Training Manual printed as an appendix to this Manual.*

Setting up Cultivar Post-Harvest Evaluation Trial.

(1) Obtain sufficient fertiliser-type sacks to allow for 6 per variety to be tested. If the sacks have been used previously, they should be washed with a low concentration of bleach, rinsed and dried.

(2) Select a location for the trials, (such as a clean room or shed).

(3) Two treatments will be used in this trial, one control (Treatment 1), and one damage treatment (Treatment 2). Therefore, for each variety select roots at random for 6 replicates (3 replicates of 2 treatments). Use 25 roots per replicate if possible, or less if there are not sufficient roots. Place the roots of each replicate into a fertiliser sack, labelled with variety, replicate number (1,2,3) and treatment (1,2).

Carrying out damage treatment (Treatment 2)

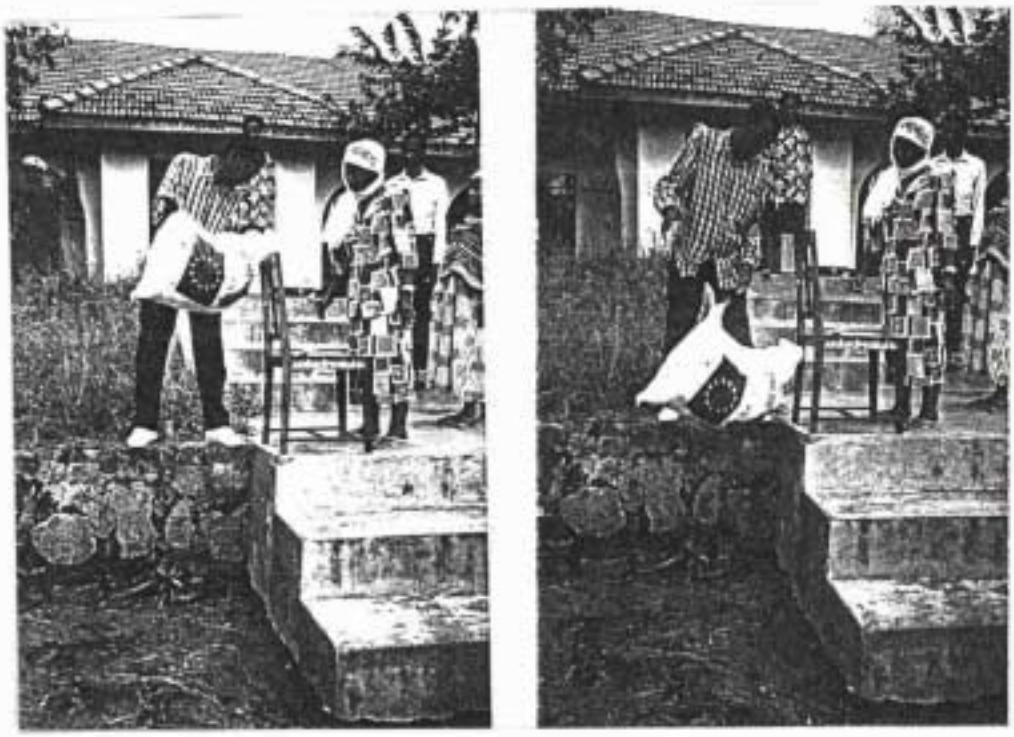
(4) Placed sufficient sacks of roots from replicate 1 into another outer sack until the total weight is approaching 20 Kg. Add extra "filler" roots to bring the weight to 20 Kg. Tie the outer sack closed so that the roots are tightly packed. Drop the sack four times from a height of 1.5 m onto earth or grass, turning the sack each time so that a different part hits the ground.

(5) Repeat this process until all the varieties of replicate 1 have been subjected to the damage treatment. Repeat for replicates 2 and 3.

(6) For each replicate assess the roots for damage (breakages and bruising) as indicated in Table 3.

Sufficient sacks of roots from replicate 1 are placed into another outer sack until the total weight is approaching 20 Kg. Extra "filler" roots tare added o bring the weight to 20 Kg

.The outer sack is tied closed so that the roots are tightly packed.



The sack is dropped from a height of 1.5 m onto earth or grass,

The sack is turned each time so that a different part hits the ground.

Assessment of roots in both treatments

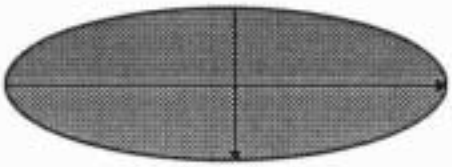
(7) Label copies of datasheet PHE2 with varieties, treatments and replicate number. (6 sheets will be needed for each variety).

(8) For each sack, select 6 roots at random and mark them 1-6 clearly with a marker pen. Record the length, circumference and weight of each root as accurately as possible on Datasheet PHE 2.

(9) Sample 2 random roots from each replicate (avoiding the marked roots) and assess for the following characteristics (Datasheet PHE 2)

(a) Fresh weight
(b) Rough weevil (Scale 1-5 see Table 2). This pest is serious at Ukiriguru, but may not be found at other sites - if so, there is no need to record this.
(c) 2 penetrometer readings should be taken halfway along the root on opposite sides. Remove the skin on the part of the root to be measured, before taking the reading.

Each root should then be cut transversely and longitudinally into four quarters as shown in the diagram. (Be careful to keep all parts together).



(d) By observation of one of the cut surfaces, the root should be assessed for latex production (1-5).
(e) By observation of all of the cut surfaces the root should be assessed for Internal rotting (Scale 1-5 see Table 2)
(f) A measurement should then be made of sugar content using a handheld refractometer (See Appendix C for methodology).

(11) For treatment 1 only keep the remaining parts of the roots in a closed paper bag for determination of dry matter. See Appendix A.

(12) Place the sacks of both treatments, with the tops closed in the trial location, grouped as replicates. One additional sack for each variety containing roots for taste testing, should also be there.

(13) After 2 days untie the top of all the sacks and roll the sides of the sack down to about half height to leave the top open.

The sacks are opened after 2 days and the sides rolled down to about half height.

Assessment of all replicates to be carried out at weekly intervals.

The following data should be recorded at weekly intervals (starting one week after the first assessment) on copies of Datasheet PHE 2

(1)For each replicate record an overall assessment of rotting (For scoring see Table 2)
Any roots scoring 4 or 5 in either case should be recorded, but then discarded.

(2) Record the fresh weight of the 6 marked roots.

(3) Sample 2 roots from each replicate and assess for the following characteristics. (If a marked root is chosen, return it and pick another, unless there are no unmarked roots remaining.)

(a) Fresh weight
(b) Rough weevil (Scale 1-5 see Table 2) (If this is a significant pest)
(c) Rotting (Scale 1-5 Table 2)

(d) The root should then be cut transversely longitudinally into four quarters, as described on the previous page. (Be careful to keep all pieces together if carrying out a measurement of dry matter -see below). By observation of the cut surfaces, the root should be assessed for Internal rotting (Scale 1-5 see Table 2)

(e) Sugar content using a refractometer (See Appendix C for methodology).

(3) Dry matter content should be measured for treatment 1 only after 2 weeks. In this case keep the remaining parts of the roots in a closed paper bag for determination of dry matter. See Appendix A.

Temperature and Humidity Measurements.

The temperature and humidity at the location of the trial should be measured at midday each day during the trial, using the wet-dry bulb thermometer. The data should be recorded on Datasheet PHE3.

Make sure that the plastic pot containing the wick of the wet bulb thermometer is at least 2/3 full. If it is low, fill it up and wait at least 30 minutes before recording data.

Fan the thermometers with your hand to make sure that air is circulating freely around the wick of the wet bulb thermometer.

Temperature and relative humidity will also be recorded inside certain sacks using electronic temperature and humidity probes attached to a data logger. This allows the values to be recorded automatically at regular intervals throughout the day.

Summary of Activities

Day 0	Harvest roots Measure harvest parameters Harvest additional roots (as nec) Select suitable roots Taste test (or day 1)
Day 1	Characterise roots Divide into replicates Carry out damage treatment Weigh 6 roots, sample 2 for destructive assessment Start measurement of dry matter contents Start storage
Day 3	Open sacks
Day 8	Assess for rotting etc Weigh 6 roots, sample 2
Day 15	Assess for rotting etc Weigh 6 roots, sample 2 Taste test Measurement of dry matter content.
Day 22	Assess for rotting etc Weigh 6 roots,sample 2
Day 29	Assess for rotting etc Weigh 6 roots, sample 2 Taste test

TABLE 1: SCORING SYSTEM FOR OBSERVATIONS MADE IMMEDIATELY FOLLOWING HARVEST TO ASSESS STATE OF WHOLE PLOTS.

	Scoring				
	1	2	3	4	5
Crown Damage	No Damage	V. little Damage	Moderate Damage	Severe Damage	V.Severe Damage
Root Appearance	V. poor	Poor	Fair	Good	Excellnt
Rough Weevil	Average % surface damage				
	0%	1-25%	26-50%	51-75%	76-100%

TABLE 2: SCORING SYSTEM FOR ROOTS.

a) External observations

	Scoring				
	1	2	3	4	5
Cylas infestation	% of surface showing infestation				
	0%	1-25%	26-50%	51-75%	76-100%
Mechanical damage	No Damage	Slight Damage (1-25% surface damage)	Moderate Damage (26-50% surface damage)	Severe Damage (51-75% surface damage)	V.severe Damage (76-100% surface damage)
Rough Weevil Damage	% of surface showing damage				
	0%	1-25%	26-50%	51-75%	76-100%

	Scoring					
	1	2A	2B	3	4	5
Rotting	% of surface showing rotting					
	0%	1-10%	11-25%	26-50%	51-75%	76-100%

b) Observations of cut roots

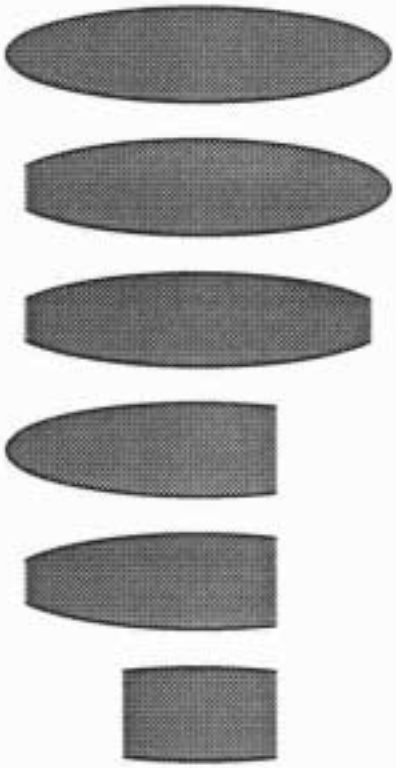
	Scoring				
	1	2	3	4	5
Latex production	No Latex	Low Latex	Moderate Latex	High Latex	V. High Latex
Cylas Infestation	% of cut surface showing infestation				
	0%	1-25%	26-50%	51-75%	76-100%

	Scoring					
	1	2A	2B	3	4	5
Rotting	% of surface showing rotting					
	0%	1-10%	11-25%	26-50%	51-75%	76-100%

TABLE 3: SCORING SYSTEM FOR DAMAGED ROOTS

a) breakages

Breakages are scored as follows:



= 0 (no breaks)

= 1 (one small break)

= 2 (two small breaks)

= 3 (one large break)

= 4 (one small and one large break)

= 5 (two large breaks)

b) bruising

	Scoring				
	1	2	3	4	5
Extent of damage	**No Damage**	**V. little Damage**	**Moderate Damage**	**Severe Damage**	**V.Severe Damage**

To calculate the overall score for a collection of roots

Count the number of roots in each class and calculate the mean root score as:

$$(n_1+2.n_2+3.n_3+4.n_4+5.n_5)/(n_1+n_2+n_3+n_4+n_5)$$

Where n_1 is the no. roots scoring 1, n_2 the no. of roots scoring 2 etc.

APPENDIX A

MEASUREMENT OF DRY MATTER CONTENT

The importance of dry matter measurements

Measurement of dry matter content of sweet potato storage roots is very important. When varieties are bred for high yield of storage roots, there appears to be a tendency for a decrease in dry matter content. However high dry matter is one of the main criteria for acceptability by consumers. It follows that measurement of dry matter content should be considered one of the most important aspects for assessing varieties.

Revisions of the methodology

Bearing in mind the importance of this measurement, the method described below has been revised from last year in order to increase the accuracy of measurements. There are two main alterations:

Firstly, samples are cut into smaller pieces. This increases the rate of drying, which is particularly important where electric ovens are not easily available, and some or all of the drying is carried out in the sun.

Secondly, in order to minimise errors arising as a result of parts of the samples being lost as samples are transferred between drying containers and scales, it is recommended that the samples are kept in the same container throughout drying and weighing. In this case it is important that the container used does not lose weight during drying. Thus paper bags are not suitable and containers made of aluminium foil are recommended.

(data sheet DRY WT)

Dry matter content will be measured at the start of the trial. Samples will be taken either for each field replicate, or for each replicate of the storage trial (using treatment 1 only) once it has been set up.
Ideally, each measurement should be made in duplicate.
A second measurement of dry matter content will be made for each replicate of treatment 1 after 2 weeks.

(1) For each variety and replicate, cut thin transverse slices of the root material. Cut the slices again into small sticks or "match sticks". If large roots are used, such that there is excess material, the slices should be taken from the central part of the root. Mix the pieces thoroughly.

(2) Each sample requires a suitable container (such as an aluminium foil tray or weighing tray). The container should be labelled with date, treatment, variety and an additional label such as ***a*** or ***b*** to distinguish samples wherever more than one measurement is taken for each replicate.

(3) Weigh the container [C].

(4) Add **approximately** 100 g of material and record the exact total weight [FW] +[C].

(5) If possible dry the samples in an oven at 70-80oC. If an oven is not available, sun dry until the weight is constant.

(6) After 48 hours of drying reweigh the sample in the container. [DW] + [C], and return the sample to the oven (or greenhouse). N.B. Do not remove the sample from its container

(7) Reweigh the sample in the container every 24 hours, recording the weight each time, until no further weight loss is seen.

(8) Calculate the dry weight as {[DW] +[C] - [C]}/{[FW] + [C] - [C]}.

See Datasheet PHE 2.

Foil trays provide suitable containers for drying sweet potato samples. If the samples are cut into small pieces, they will dry more quickly, which is particularly important if sun drying has to be used.

When samples are left on paper, without a container, there is a risk that samples will become mixed, which makes the dry matter determination inaccurate.

APPENDIX B

TASTE TEST.

The samples for taste testing at the start of the experiment should be taken from the roots selected for the trial, as described. For the samples to be used in taste tests after a period of storage, for each variety, 10 medium-large roots should be stored in an extra sack. These sacks should be kept closed for 2 days, and then opened, as are the other sacks.

An alternative method is to select good roots from the replicates of the trial.

Taste tests should be conducted at the start of the experiment, and after two weeks of storage. If it is possible, extra taste tests could be carried out.

A panel of tasters, consisting of at least 10 people, should be selected either from workers on the station, or local people. The same people should be used for all taste tests. It is important that the name of each taster be recorded on the data sheets.

Roots should be cooked and cut into slices. They should be presented to the tasters labelled only with letters, e.g. A-E.

TASTE TEST **DATE:_____** **NAME OF TASTER:_____**

A. Kinavyoonekana?

	1	2	3	4	5	6	7	8	9	10
1. Sikipendi kabisa										
2. Sikipendi										
3. Wastani										
4. Ninakipenda										
5. Ninakipenda sana										

B. Ladha

	1	2	3	4	5	6	7	8	9	10
1. Siyo nzuri kabisa										
2. Siyo nzuri										
3. Nzuri kiasi										
4. Nzuri										
5. Nzuri sana										

C. Kiasi cha unga?

	1	2	3	4	5	6	7	8	9	10
1. Hakina unga kabisa										
2. Hakina unga										
3. Kina unga kiasi										
4. Kina unga										
5. Kina unga sana										

D. Nyuzi

	1	2	3	4	5	6	7	8	9	10
1. Kina nyuzi sana										
2. Kina nyuzi										
3. Kina nyuzi kiasi										
4. Hakina nyuzi										
5. Hakina nyuzi kabisa										

E. Kukubalika?

	1	2	3	4	5	6	7	8	9	10
1. Hakikubaliki kabisa										
2. Hakikubaliki										
3. Wastani										
4. Kinakubalika										
5. Kinakubalika sana										

APPENDIX C

USE OF PENETROMETER TO MEASURE ROOT FIRMNESS

Penetrometers have been designed primarily to measure the firmness of the flesh of fruit, in order to determine ripeness. However, they can also be used to measure the firmness of other commodities such as sweet potato roots. We are planning to use penetrometers to measure any changes in the firmness of the sweet potato root following harvest.

METHOD

The penetrometer has been provided with two probes of differing diameter. In this case, the smaller probe should be used. The larger probes would be suitable for softer commodities.

For uniformity, measurements should be made halfway along the root.

Remove the skin, using a knife, or the peeler provided, at the point where the measurement is to be made.

Ensure that the penetrometer is reading zero, by pressing the release button.

Hold the root firmly in one hand, or against a firm surface, and the penetrometer in the other hand. Press the plunger against the fruit, and press with increasing strength until the plunger tip has penetrated up to the notch. Take care to apply a steady, continuous, non jerking motion to minimise variability.

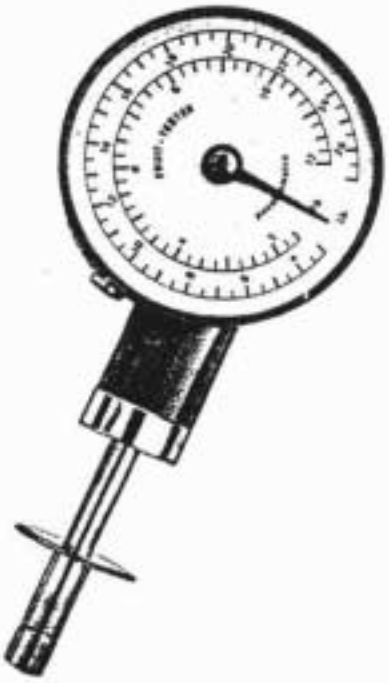
Record the reading in Kg (inner scale).

Take a second reading in the same way on the opposite side of the root from the first reading.

FRUIT PRESSURE TESTER

mod. FT 327 (3-27 Lbs.)
(apples and pears)

mod. FT 011 (0-11 Lbs.)
citrus fruit, plums etc.



In divising this fruit tester our firm has asked the cooperation and advice of the « ISTITUTO di COLTIVAZIONI ARBOREE » of the University of Milan. This small and very manageable tool is perfectly fit to detect proper picking maturity and control fruit softening during cold storage.

It measures the pressure necessary to force a plunger of specified size into the pulp of the fruit, Such pressure is measured in pounds and Kilograms.

Minimum size, direct control of correctness, double set of readings (Kg. and Lb.) on the dial, button commanded indicator hand, and extreme accuracy of execution make it one of the most practical and accurate fruit-testers in Italy and abroad.

PREPARING SAMPLES

About ten days before normal picking time, control pulp firmness, repeat control each 6-7 days for winter pome-fruits, each 2-3 days for summer pome-fruits, and stone fruits. Take samples from several plants and several spots of each plant as a random sample will be more representative of the lot.

A suitable sample will be composed of 15-20 fruits; 2 measures have to be taken on each fruit at opposite sides, at the middle point of each side, after removing 1/2"-3/4" diameter disc of peel (see fig. 3).

USING THE FRUIT-TESTER

Hold the fruit firmly in the left hand, hold the fruit-tester between thumb and forefinger of the rigth hand, push button-commanded indicator hand, place the plunger against the fruit and press with increasing strenght until the plunger tip has penetrated into the pulp up to the notch (1).

Slow penetration of the plunger is essential. Sharp movements and sudden pressure application may impair your measurements. In order to avoid mistakes and to assure slow penetration of the plunger, make sure that the hand holding the fruit is firm, leaning it on the table, and keep the arm rigid (see fig. 1).

In the pamphlet some pressure values are given for the best picking stage of pome and stone fruits.

Fig. 1

ISTITUTO PER LA VALORIZZAZIONE DEI PRODOTTI AGRICOLI

DUREZZE DI RACCOLTA CONSIGLIATE

		Kg.
KIWI	puntale piccolo	8
Pere Conference	»	5 - 6.5
» Guyot	»	3.5 -
» Packham's	»	5.5 - 6.5
Mele Annurca	grande	9.5 - 10
» Golden del.	»	7 - 7.5
» Granny Smith	»	6 - 6.5
» Rome Beauty	»	5 - 6.0
» Granvenstein	»	7 - 7.5

Notre instrument a été mis au point en collaboration avec le « ISTITUTO di COLTIVAZIONI ARBOREE » de l'Université de Milan. Il représente un index valable pour déterminer la période la plus favorable de la récolte des fruits et une aide efficace pour la conservation en refrigérateur par le contrôle au cours de la maturation (attendrissement de la pulpe).
La forme à manomètre, l'encombrement minime, la possibilité d'en contrôler directement l'exactitude, la lecture de l'index en Kg. et en Lb., le retour à bouton de l'aiguille, le travail soigné, en font un des plus parfaits penetrometer du moment.

PRÉPARATION DES ÉCHANTILLONS

Environ dix jours avant la période normale de la récolte commencer le relevé de la dureté de la pulpe, qui doit être répété tous les 6-7 jours pour les fruits d'hiver et tous les 2-3 jours pour les fruits d'été et pour les drupes.
Les échantillons doivent être pris de plusieurs plantes et de différents points de la plante, puis qu'ils doivent représenter la partie à cueillir.
L'essai doit être fait sur 15-20 fruits; sur chaque fruit on doit faire deux relevés en des points opposés et placés à peu près sur le centre de chaque moitié. Au préalable on aura coupé une mince couche de peau et de pulpe du diamèter de 12-15 mm. (voir fig. 3).

EMPLOI DU « PENETROMETRO »

Saisir l'instrument entre le pouce e l'index de la main droite, pousser le bouton de retour-aiguille (6), appuyer l'embout sur le fruit au point choisi et pousser progressivement jusqu'à ce qu'il pènétre dans la pulpe du fruit jusqu'au cran (1) de l'embout.

L'embout doit pénétrer dans la pulpe progressivement et non tout d'un coup, sous peine d'erreurs de mesure.

Pour éviter des possibles erreurs personnelles de mesure et pour mieux contrôler la pénétration de l'embout, il est conseillable d'appuyer la main gauche avec le fruit à un mur ou par terre, et pendant que le bras droit demeure rigide appuyer sur l'instrument de tout son corps (voir fig. 1).

La valeur moyenne des évaluations représente la dureté moyenne des fruits de la partie; la comparaison de cette valeur avec celle indiquée par les Instituts de recherche pour la même cultivar permet d'établir si la récolte doit être faite ou bien si elle doit être atermoyée.

Fig.1

Questo penetrometro, costruito dalla nostra ditta, è stato messo a punto in collaborazione con l'ISTITUTO di COLTIVAZIONI ARBOREE della UNIVERSITA' DI MILANO esso fornisce un valido indice per la determinazione del periodo più opportuno in cui raccogliere la frutta e un valido aiuto durante la conservazione frigorifera attraverso il controllo dell'andamento della maturazione (intenerimento della polpa).

La particolare forma a manometro, appositamente studiata, il minimo ingombro, la possibilità di controllarne direttamente l'esattezza, la lettura dell'indice sia in Kg. che in Lb., il ritorno a pulsante della lancetta, l'accurata esecuzione, ne fanno uno dei più perfetti penetrometri oggi i n commercio.

PREPARAZIONE DEI CAMPIONI

Circa dieci giorni prima del normale periodo di raccolta iniziare il rilevamento della durezza della polpa, che va ripetuto ogni 6-7 giorni per le pomacee invernali ed ogni 2-3 giorni per quelle estive e per le drupacee. I frutti campione vanno raccolti da più piante e da più punti della pianta, poiché devono essere rappresentativi della partita da raccogliere.

La prova deve essere eseguita su 15-20 frutti, su ogni frutto si debbono fare due determinazioni in punti opposti e siti pressapoco a metà di ogni guancia, previa asportazione di un sottile dischetto di buccia e polpa del diametro di 12-15 mm. (fig. 3).

USO DEL PENETROMETRO

Prendere fra pollice e indice della mano destra il penetrometro, premere il bottone ritorno lancetta, appoggiare il puntale al frutto nel punto appositamente approntato e premere progressivamente fino a farlo penetrare nella polpa del frutto fino alla tacca chiaramente visibile sul puntale.

Il puntale deve entrare nella polpa progressivamente e non di scatto, pena errori di misurazione.

Per evitare possibili errori personali di misurazione e controllare meglio la penetrazione del puntale, è bene poggiare la mano sinistra col frutto ad una parete o al suolo, e mentre il braccio destro rimane rigido premere sul penetrometro con tutto il corpo (vedi fig. 1).

Il valore medio delle varie letture rappresenta la durezza media dei frutti della partita: il confronto di questo con quello indicato dagli Istituti di ricerca per la stessa specie e cultivar permette di stabilire se la raccolta deve essere eseguita oppure procrastinata.

Ed ecco i valori ritenuti optimum per la raccolta di frutta destinata alla Frigoconservazione (Pomacee) ed alla esportazione (Drupacee).

Mele	**puntale**	**Lb.**
Delicious	grande	15 -18
Abbondanza	grande	19 -22
Imperatore	grande	16 -20
Stayman Winesap	grande	13,5-16
Pere		
Passacrassana	piccolo	10 -13
Kaiser	piccolo	13,5-15,5
William	piccolo	18 -21
Pesche		
Hale	piccolo	10 -13
Elberta	piccolo	11 -14
Red Haven	piccolo	10 -13
Early Crawford	piccolo	12 -15
Susine		
Goccia d'Oro	piccolo	11
Santa Rosa	grande	15 -16
Satsuma	grande	10
Satsuma	piccolo	6

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Pere	**puntale**	**Kg.**
Max Red Bartlett	piccolo	7-
Decana del comizio	piccolo	4-4,5
Kaiser	piccolo	6
Abate Fetel	piccolo	5
Passacrassana	piccolo	6

HANDHABUNG DES PENETROMETERS

Man halte des Penetrometer zwischen Daumen und Zeigefinger der rechten Hand und man drücke auf den knopf der Nullstellung. Den Bolzen (2) auf die vorbereitete Stelle der Frucht aufsetzen und langsam in das Fruchtfleisch bis zum eingekerbten (1) Zeichen des Bolzens drücken.

Will man Messfehler vermeiden, darf der Bolzen nur langsam, auf keinen Fall ruckweise in das Fruchtfleisch eindringen.

Um das Eindringen des Bolzens genau zu kontrollieren, ist es angezeigt, die linke Hand mit der Frucht an einer Mauer oder am Boden anzulhnen. Während der rechte Arm steif bleibt, mit dem ganzen Körper auf den Druckmesser drücken (Abb. 1).

Der Durchschnittswert der verschiedenen Ablesungen gibt die durchschnittliche Festigkeit der Früchte der Partie an. Der Vergleich dieses Wertes mit den von Instituten für die gleiche Art und Sorte erarbeiteten, erlaubt festzulegen, ob sofort geerntet werden muß oder ob die Ernte noch verschoben werden kann.

Diesel, von unserer Firma hergestellte Penetrometer ist in Zusammenarbeit mit. der «ISTITUTO di COLTIVAZIONI ARBOREE» del Universität Mailand entwickelt worden. Das Gerät liefert zuverlässige Angaben zur Bestimmung des günstigsten Erntezeitpunktes für Obst und hilft während der Kühllagerung, den Reifungsverlauf zu Kontrollieren (Weichwerden des Fruchtfleisches).

VORBEREITUNG DER PROBEMUSTER

Ungefähr 10 Tage vor dem Erntebeginn mit den Ermittlungen der Fruchtfleischhärte anfangen. Alle 6-7 Tage bei Winteräpfeln und- Birnen wiederholen. Bei Sommersorten und Steinobst alle 2-3 Tage.

Die Früchte zur Druckprobe werden von mehreren Pflanzen und an verschiedenen Punkten des Baumes genommen; außerdem sollen diese Früchte rappresentativ für die zu erntende Obstpartie sein.

Die Druckprobe soll auf 15-20 Früchten wiederholt werden. An jeder Frucht sind zwei Messungen vorzunehmen, nämlich in der Mitte der Fruchtbacke und auf der gegenüberliegenden Seite; vorher muß eine Scheibe von 12-15 mm Durchmesser der Fruchtschale (Abb. 3) entfernt werden.

Stamp. by: EFFEGI

APPENDIX D

THE USE OF THE REFRACTOMETER TO MEASURE SUGAR CONTENT.

The concentration of a solution effects its REFRACTIVE INDEX (the extent to which it deflects light). It is possible to use this principle to measure the concentration of sugar solutions using a REFRACTOMETER. Handheld refractometers have been provided so that measurements can be made on the sweet potato varieties included in these trials, in order to detect changes in sugar content during storage.

Previous studies have indicated that the sugar content is not constant along the length of the root, but is higher at the stem end. For this reason it is important that the root tissue used for the measurement is sampled from the same part of the root in each case.

METHOD

Take a root that has been cut across the centre and grate a small amount of the root across the surface.

Squeeze 2 drops of liquid from the sample using the small press onto the centre of the glass surface of the refractometer. Avoid air bubbles

Close the lid of the refractometer. Be sure to hold it closed during the subsequent measurement. This may be done by using light pressure at the edge of the lid being careful not to obscure the light, or by placing an elastic band around the instrument.

Look through the eyepiece and direct the instrument towards the light. A blue circle should be observed divided into a light and dark portion. If the line between light and dark is not distinct, rotate the instrument until it becomes distinct. Note the position of the line on the scale.

The refractometer should be cleaned and dried carefully between measurements. Avoid scratching the glass surface.

INTERPRETATION OF RESULTS

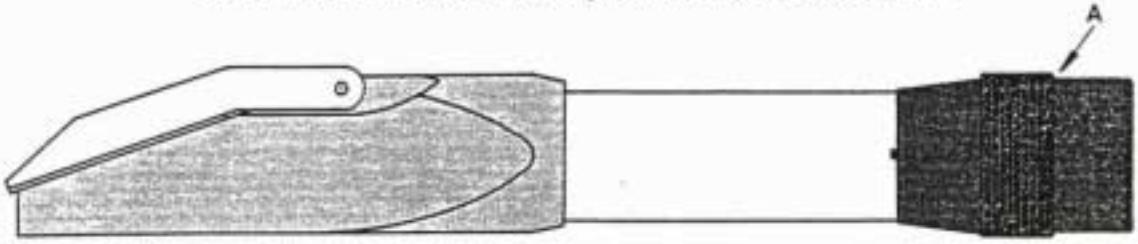
Refractometer measurements have been used successfully to indicate changes in sugar content of sweet potatoes during storage trials carried out in Uganda. However, for comparison between cultivars, the measurement will be effected not only by sweetness, but also by moisture content, and the presence of other substance dissolved in the sap. For this reason, further studies will be carried out at NRI to provide extra information that will help the interpretation of these results at the end of these trials.

DAVID BISHOP
INSTRUMENTS

Instructions for the use of the

FIELD REFRACTOMETER

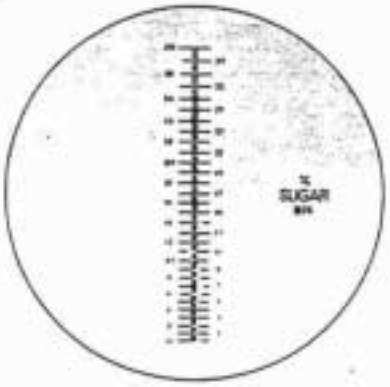
These instructions cover the complete range of refractometers



Place a drop or two of the liquid to be tested on to the PRISM. Close the ILLUMINATOR PLATE and direct the instrument towards a convenient light source, such as the sky or an electric lamp. A circular field will be observed through the eye piece with a vertical SCALE. It will also be seen that the field is divided horizontally into light and dark portions. The position at which the demarcation line crosses the scale gives the desired reading. (See illustration) If the field shows no demarcation line then the instrument might be of incorrect range for the sample — where the whole field is dark then a lower range instrument is required and conversely if the field is completely light.

To focus on the scale give the eyepiece a slight twist and then push or pull the assembly until the scale is sharp. The eye-piece lens may be removed for cleaning by unscrewing the eye-cap at point "A". The scale is calibrated in accordance with published tables and reads correctly at 20°C. For temperatures other than 20°C a correction may be applied.

The instrument can also be used for testing solid substances such as: apples, melons, grapes, sugarbeet, potatoes. With the illuminator flap hinged back a slice of the substance concerned should be cut to about 2mm thick and slightly smaller than the prism area and apply to the surface of the prism taking care to obtain a good contact.



GENERAL HINTS ON USAGE.

Because optical glass is relatively soft, suitable applicators should be used such as plastic. Metal spatulas or glass rods will easily damage the prism surface. Samples should be washed off the instrument as soon as practicable. A prism surface is susceptible to alkalis and acids if left in contact for any length of time. Wash samples off with suitable solvents and dry the prism box area. Try to confine liquids to the prism box end of the instrument. It is an advantage if the prism is wiped at intervals with alcohol to remove any oils from the prism surface.

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TABLE 1

International Temperature Correction Table (1974) for refractometer above and below 20°C

PER CENT. SUCROSE

Deduct from the % Sucrose

Temp °C	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
10.0	0.53	0.56	0.59	0.62	0.65	0.67	0.69	0.71	0.72	0.73	0.74	0.75	0.75	0.75	0.75	0.75	0.74	0.73
11.0	0.49	0.52	0.54	0.57	0.59	0.61	0.63	0.64	0.65	0.66	0.67	0.68	0.68	0.68	0.68	0.67	0.67	0.66
12.0	0.44	0.47	0.49	0.51	0.53	0.55	0.56	0.57	0.58	0.59	0.60	0.60	0.61	0.61	0.60	0.60	0.60	0.59
13.0	0.40	0.41	0.43	0.45	0.47	0.48	0.50	0.51	0.52	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52
14.0	0.34	0.36	0.38	0.39	0.40	0.42	0.43	0.44	0.44	0.45	0.45	0.46	0.46	0.46	0.46	0.45	0.45	0.44
15.0	0.29	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.37	0.37
16.0	0.24	0.25	0.26	0.27	0.28	0.28	0.29	0.30	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.30	0.30	0.30
17.0	0.18	0.19	0.20	0.20	0.21	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22
18.0	0.12	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
19.0	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07
Add to the % Sucrose																		
21.0	0.06	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07
22.0	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15
23.0	0.20	0.21	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.22
24.0	0.27	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.31	0.31	0.31	0.30	0.30
25.0	0.34	0.35	0.36	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.38	0.37
26.0	0.42	0.43	0.44	0.45	0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.46	0.46	0.46
27.0	0.50	0.51	0.52	0.53	0.54	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.55	0.55	0.54	0.53	0.52
28.0	0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.64	0.64	0.65	0.65	0.64	0.64	0.64	0.63	0.62	0.61	0.60
29.0	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.73	0.73	0.73	0.73	0.72	0.72	0.71	0.70	0.69	0.68
30.0	0.74	0.75	0.77	0.78	0.79	0.80	0.81	0.81	0.81	0.82	0.81	0.81	0.81	0.80	0.79	0.78	0.77	0.75

TABLE 2

Table connecting Refractive Indices with Sugar Concentration at 20° in accordance with 1974 I.C.U.M.S.A.

% Sucrose	N D	% Sucrose	N D	% Sucrose	N D	% Sucrose	N D
0	1.332 99	24	1.370 60	48	1.415 91	72	1.470 37
1	1.334 42	25	1.372 33	49	1.417 99	73	1.472 85
2	1.335 86	26	1.374 06	50	1.420 09	74	1.475 35
3	1.337 82	27	1.375 81	51	1.422 20	75	1.477 87
4	1.338 97	28	1.377 58	52	1.424 32	76	1.480 40
5	1.340 26	29	1.379 36	53	1.426 47	77	1.482 95
6	1.341 75	30	1.381 15	54	1.428 62	78	1.485 52
7	1.343 25	31	1.382 95	55	1.430 80	79	1.488 10
8	1.344 77	32	1.384 78	56	1.432 99	80	1.490 71
9	1.346 29	33	1.386 61	57	1.435 20	81	1.493 33
10	1.347 82	34	1.388 49	58	1.437 43	82	1.495 97
11	1.349 37	35	1.390 32	59	1.439 67	83	1.498 62
12	1.350 93	36	1.392 20	60	1.441 93	84	1.501 29
13	1.352 50	37	1.394 09	61	1.444 20	85	1.503 98
14	1.354 08	38	1.396 00	62	1.446 50	86	1.506 69
15	1.355 68	39	1.397 92	63	1.448 81	87	1.509 41
16	1.357 29	40	1.399 86	64	1.451 13	88	1.512 15
17	1.358 91	41	1.401 81	65	1.453 48	89	1.514 90
18	1.360 54	42	1.403 78	66	1.455 84	90	1.516 68
19	1.362 18	43	1.405 76	67	1.458 22	91	1.520 46
20	1.363 84	44	1.407 76	68	1.460 61	92	1.523 27
21	1.365 51	45	1.409 78	69	1.463 03	93	1.526 09
22	1.367 20	46	1.411 81	70	1.465 46	94	1.528 93
23	1.368 89	47	1.413 85	71	1.467 90	95	1.531 78

The Official Table does not extend beyond 85%

Post-Harvest Evaluation Trial **Data sheet PHE 1** **Characterisation of storage roots at harvest**

Date of harvest:

Variety											
Root surface defects											
Cortex thickness [mm]											
Predominant skin colour											
Secondary skin colour											
Predominant flesh colour											
Secondary flesh colour											
Distribution of Secondary colour											

Post-Harvest Evaluation Trial **Data sheet PHE 1b**

Assessment of damage

Cultivar: **Replicate:**

Root	Breaks (0-5)	Surface damage (1-5)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

Post-Harvest Evaluation Trial **Data sheet PHE 2**

Cultivar: **Treatment:** **Replicate:**

Overall assessment of rotting (number of roots per sack)					
Date → / ↓ Score					
1					
2A					
2B					
3					
4					
5					
Total roots removed during trial (accumulative)					
Overall Score					

	Root dimensions		*Fresh weight of 6 marked roots*				
Date → / ↓ Root number	length [cm]	Circ. [cm]					
1							
2							
3							
4							
5							
6							

Assessment of two sampled roots										
Date										
	a	b	a	b	a	b	a	b	a	b
Fresh Weight										

surface observations										
Rough Weevil										
Rotting										
Penetrometer. 1										
2										

observations of cut roots										
Latex										
Internal rotting										
Cortex thickness										
Refractometer Index										

Post-Harvest Evaluation Trial **Data sheet PHE 3**

Environmental information

Station: **Site:**

Date and Time	Dry bulb temperature	Wet bulb temperature	Relative Humidity

Post-Harvest Evaluation Trial **Data Sheet PHE4**

Dry Matter Content

			Date and time of measurement			
Variety and Rep	Weight of Container [C] (g) *X*	Fresh Weight of contaiiner and sample [FW]+[C] (g) *Y*	Dry Weight of container + sample [DW]+[C] (g)	Dry Weight of container + sample [DW]+[C] (g)	Dry Weight of container + sample [DW]+[C] (g)	Dry Weight of container + sample [DW]+[C] (g) *Z*

Dry matter content =(DW - C)/(FW - C) [(*Z-X)/(Y-X)*]

VH-764

Section 3.2

Procedures for the evaluation of pathogen-tested sweetpotato clones

Edward E. Carey, Daniel M. Reynoso

Introduction

The selection of new varieties is an important aspect of sweetpotato crop improvement. New varieties can provide farmers with improved yields, earliness, control of diseases and pests, and quality characteristics, at little or no additional cost. Those interested in the selection of new varieties include agricultural researchers, development and extension workers, and, of course, farmers.

The starting material for a sweetpotato variety selection program may be either sexual seed or previously existing clones. Sweetpotato is a vegetatively (also called clonally or asexually) propagated crop, but new varieties come principally

from seeds produced by cross-pollination. While large populations of seeds are the starting material used by established breeding programs, the process of their initial evaluation takes longer and is thus more expensive than the evaluation and selection of previously existing clones. Previously existing clones are the logical first step for evaluation and selection by newly-established variety selection programs, and are also valuable to established breeding programs as a source of potential new parental material and varieties.

Several sources of previously existing clonal germplasm are available for testing, including experimental clones and varieties released from breeding programs, as well as farmer-selected landrace varieties. Within a country, sources of clones for testing may include breeding programs, germplasm collections (gene banks), and farmers, or clones may be obtained internationally. CIP maintains a large collection of pathogen-tested sweetpotato clones available for international distribution and testing (CIP, 1996). This collection includes important landrace and released varieties from many countries, and elite experimental clones from leading sweetpotato breeding programs around the world.

The decision on which source(s) of clonal germplasm to use and how to proceed with their evaluation should be based on an understanding of current and previous sweetpotato varietal selection efforts in your target area.

This document outlines procedures recommended for the evaluation of CIP pathogen-tested clones. It provides data collection forms for initial field evaluations, and makes suggestions for data processing and evaluation. Recipients of sweetpotato germplasm from CIP are requested to use these forms to provide us with information on the performance of pathogen-tested sweetpotato clones.

Procedures

Multiply clones for trial and verify their identities

Pathogen-tested sweetpotato clones may be distributed internationally as in vitro plantlets, or in some cases, as cuttings. In vitro plantlets are delicate and require special care when being transferred to in vivo. Procedures for the transfer of in vitro plantlets to in vivo are outlined by Dodds et al. (1991).

Upon receipt, clones should be multiplied to produce planting materials for initial trials. Locally important or standard "check" varieties with which the introduced materials will be compared should be included in multiplication plots to provide uniform planting materials for trials. You should try to ensure that planting materials for any trial come from a single source (Wilson et al., 1989).

Take care to verify and maintain the identity of clones during the process of multiplication and evaluation. This can be done through careful labelling of clones and checking of identities using morphological descriptors. To guard against errors, it is a good idea to identify CIP clones using both names and CIP numbers, because errors often occur during labelling and it is more difficult to detect numerical errors than spelling errors. For example, 440027 can easily become 420027, but there is no possibility of confusing the names — Ning Shu 1 and Zapallo— of the two clones.

The identity of clones in multiplication plots should be confirmed by comparing the appearance of each clone against the morphological characteristics on CIP's pathogen-tested list (CIP, 1996). This comparison should be done with the realization that the environment influences several of the morphological descriptors of sweetpotato, particularly with respect to the intensity of pigmentation. Therefore, you should not expect published descriptors (taken in Lima, Peru) for a particular clone to be identical to the observed descriptors for the same clone undergoing multiplication at a different location, but you should expect them to be very similar. If the published and observed descriptors, including pigmentation of foliage and roots, and especially leaf shape, coincide or are similar, you can feel comfortable that the clone is correctly identified. If published and observed descriptors vary markedly for a particular clone, a mix-up has likely occurred. In this case, the clone can still be entered in trials, but it should be renamed, so that you will not provide CIP and others with incorrect information on the performance of that pathogen-tested clone.

Conduct preliminary evaluations of adaptation and acceptability

Although some introduced clones will probably perform well in your target environment, many will probably not, due to poor adaptation to climate, soils or agronomic practices, or to susceptibility to diseases and pests. In addition, introduced clones may not have desired root or foliage quality characteristics. We therefore recommend that you initially evaluate introduced clones in observational trials with small plots, replicated once or twice, under agroecological and agronomic conditions representative of your target environment. This could mean that you should evaluate introduced clones in more than one production region (agroecology) or season. Promising clones from

your initial observational trials should be selected for inclusion in more advanced trials with larger plot sizes and more replications at each location.

In many countries, sweetpotato has been an under-researched crop and variety selection criteria have not been clearly defined by researchers. Although yield and disease and pest resistance will always be important selection criteria, a number of additional factors may be equally important. For example, in places where sweetpotato is an important food crop, taste will be important, and selection should be based on the tastes of local consumers. If the breeder-agronomist involved in variety selection is not sure of selection criteria, it is probably a good idea to ask experienced farmers for their evaluation of the introduced clones at the harvest of the adaptation trials. To accomplish this, you might evaluate introduced clones in on-farm trials, or invite farmers to your harvests on experiment stations (Fonseca et al., 1993).

Incorporate clones into a routine selection scheme

If you have an ongoing breeding program, we suggest that you incorporate introduced clones directly into your standard trial scheme. Examples of sweetpotato selection schemes are provided by Hahn (1982), Martin, (1983), Jones et al. (1986), Wilson et al. (1989), Kukimura et al. (1990), and Saladaga et al. (1991).

In our sweetpotato breeding program for the lowland humid tropics at Yurimaguas, Peru, we incorporated introduced pathogen-tested clones in our routine breeding trials at an early stage of selection —the **"observational trial" (OT)**. To gain an idea of the earliness of clones, we routinely planted two blocks, which were harvested at early and later dates (normally 90 and 120 or 150 days after planting). Each clone was planted at random only once in each block, in a single-row, 10-plant plot. Trials were bordered by planting guard rows on all four sides of each block, to provide competition to all entries.

Clones selected from the OT advanced to the next stage of evaluation, the **"preliminary trial" (PT)**. At this stage, we normally used single-row, 20- to 30-plant plots with two replications, and two dates of harvest. Trials were planted in a randomized complete block design (RCBD). A point which probably deserved greater attention was the reduction of inter-plot competition effects, which are highest when single-row plots are used. These effects can be reduced by planting the same number of cuttings, but in shorter two-row plots, or by grouping clones according to their growth habit.

Clones selected from the PT advanced to the **"advanced trial" (AT)**. At this stage, we used three-row, 60-plant plots with three

replications and one date of harvest (120 days), also planted as an RCBD. These trials were repeated over seasons. The best clones were advanced to multilocational trials, having a similar design to the ATs, and were also incorporated in our hybridization blocks.

Collect and report data

We are very interested in receiving information on the performance of CIP pathogen-tested clones. This will help us to improve our knowledge about their yield and end-use potential, range of adaptation and reaction to pests and diseases, and to improve the targeting of future germplasm shipments. To assist with uniform collection and reporting of data on the performance of introduced clones, we have developed a set of forms, which are included in this guide. The forms provide space for filling in detailed information about the conditions under which your trials are conducted, the performance of the experimental clones in your trials, and whether they are selected. Instructions for their use are given in the next section.

Analyze data and select clones

To facilitate analysis and decision-making, raw data should be transformed into reference units of general acceptance. For instance, the number of harvested plants divided by the number of planted cuttings gives rise to survival; yield measured in kg/plot can be converted into t/ha, etc. Then, sorting, ANOVA, and mean comparisons become useful tools for clonal selection.

Description of data collection forms and instructions for their use

For most evaluations that involve rating scales, we use a scale of 1 to 9, where 1 indicates the lowest possible value of the trait being evaluated and 9 indicates the highest possible value. Thus, for reactions to diseases and pests, 1 indicates absence of the problem, and for hedonic (like/dislike) evaluations, 1 is the worst value. Instructions for rating specific traits are provided below. **Note: In some places, established breeding programs may have already developed different rating scales, for example, 1 to 5. In such cases, please use your rating scale and indicate the scale used when returning data to CIP.**

Form 1: General trial information

This form provides spaces for essential information on trials, such as location, plot size, and trial management practices.

It also provides space for the results of soil analyses and meteorological data which, if available, may help in the interpretation of trial results.

Form 2: Planting, establishment, foliage vigor, and foliar disease and pest evaluations

a) To be filled out at time of planting:

- Plot #	= Plot number.
- Rep #	= Replication number of plot (if trial is replicated).
- Name (CIP #)	= Name of clone (and CIP number, if a CIP clone).
- # Cuttg Pltd.	= Number of cuttings planted.

b) Data to be taken during the growing season, prior to harvest:

- Estab (3 wks)	= Number of cuttings established 3 weeks after planting.
- Fol. Vigor (6 wks)	= Assessment of foliage vigor using a 1 to 3 scale, where 1 is low vigor, 2 is intermediate and 3 is high foliage vigor.

Diseases and pests vary with location and season, and may not even occur in some trials. Form 2 provides spaces for up to six disease or pest evaluations during the growing season. The name of the disease or pest evaluated should be noted at the head of the column, and the date of evaluation noted at the foot. Disease or pest reaction of each clone should be noted using a standard 1 to 9 reaction scale (see note above on rating scales).

The comments column may be used for any additional observations.

Form 3: Agronomic data

a) To be filled out at time of planting:

- Plot #	= Plot number.
- Rep #	= Replication number of plot (if trial is replicated).

- Name (CIP #) = Name of clone (and CIP number, if a CIP clone).

b) To be taken at time of harvest:

- Wt. Tops (kg) = Fresh weight of foliage (in kg).
- # Plts. Harv. = Number of plants harvested.
- # Plts. w/out Stor. Rts. = Number of plants without storage roots.
- Gen. Eval. Stor. Rts. = General evaluation of storage roots. A subjective evaluation of the attractiveness and uniformity of the storage roots of the plot, using a 1 to 9 scale, where 1 is very poor, 9 is excellent and 2 through 8 represent increasingly favorable intermediate evaluations.
- Large Roots, # + Wt.(kg) = Total number and weight of large roots harvested.
- Small Roots, # + Wt. (kg) = Total number and weight of small roots harvested.

Root size classes should be defiined by the researcher. We classify as small, roots with a diameter of less than 2.5 cm.

- Storage root rots, pests or defects (Name and score). Problems of storage root rots, pests or defects should be noted here, identifying the problem and rating it using a 1 to 3 scale of severity, where 1 slight, 2 is moderate and 3 is severe. Common defects include sprouting, cracking and uneven shapes. Please indicate type of pest (e.g., *Cylas* weevil).

The comments column may be used for any additional observations.

Form 4: Postharvest quality evaluations

Clones with acceptable agronomic performance should be evaluated for postharvest quality traits of importance in your target region. These may include eating quality and dry matter content.

Form 4 also provides space for the evaluation of storage root skin and flesh color, which are more accurately determined in the laboratory following washing of the roots, than in the field.

Root Color.- Skin or flesh may be evaluated as follows(if other scales are used, please describe them):

Root Skin Color	Root Flesh Color
1 = White	1 = White
2 = Cream	2 = Cream
3 = Yellow	3 = ark cream
4 = Orange	4 = Pale yellow
5 = Brownish orange	5 = Dark yellow
6 = Pink	6 = Pale orange
7 = Red	7 = Intermediate orange
8 = Purple-red	8 = Dark orange
9 = Dark purple	9 =Strongly pigmented with anthocyanins

Storage root dry matter content

This determination requires an oven and a balance that is accurate to 0.1 g. Our recommended procedures are described below.

1. It is desirable to carry out the initial steps of dry matter determination within 24 hours after harvest. This is to avoid postharvest changes in dry matter content prior to dry matter determination.

2. Thoroughly chop the medial sections of 3 undamaged, marketable-sized roots into small cubes. Mix thoroughly and take a 200g sample.

3. Place the sample in an open-topped drying container, such as a paper bag, and dry at 60 ^{o}C for 72 h, or until weight is stable. Note: failure to completely dry samples will result in overestimation of dry matter content.

4. Weigh dried sample, making sure not to include the weight of the drying container, and record weight.

5. Percent Dry Matter = (dry weight/fresh weight) x 100.

Note: Dry matter content of sweetpotato tops can be determined using similar procedure to those for storage roots. However, care

must be taken to process samples immediately after harvest (to avoid postharvest dehydration). Care must also be taken to obtain a representative sample, including both basal and apical vine sections for drying. To do this, several vines should be taken and thoroughly chopped, prior to taking a sample (200 g) for drying.

Eating quality

An evaluation of eating quality of boiled or steamed roots, leaves, or any other products made from the sweetpotatoes is requested, if appropriate. Several consumers should be asked to evaluate samples, and form 4 should be used to report mean results. Evaluators should be asked to give a general evaluation of appearance, taste and overall acceptability (final assessment) by answering the question "How do I like this sample?" Use a 1 to 9 scale, where 1 = very bad, 9 = excellent, and 2 through 8 represent intermediate values. For adequate evaluations of eating quality, it may be advisable to seek the assistance of a food scientist.

Form 5: Summary of clonal evaluation

Use this form to indicate whether experimental clones have been rejected, or selected, and to provide additional summary information on clones evaluated.

List clones and indicate whether the clone has been rejected (will not be evaluated again) or selected for further evaluation. Please note whether you consider that selected clones have potential for varietal release, or for use as parents in a breeding program. In addition, please use the comments column to note the main end-use purpose - table, industry, animal feeding, or other - for which you think a selected clone has potential. Important strengths or weaknesses of clones should also be noted in the comment column.

Suggestions for data analysis and clonal selection

To qualify for selection, a clone should show superiority over the currently important local check cultivars for traits of importance to farmers, traders, processors, and consumers. Because of the small plot sizes and lack of replication in observational trials, it is not appropriate to extrapolate yield data to tonnes per hectare. In fact, yields should not be taken into account in OTs except for a rough classification (e.g., high, medium or low-yielding clones). The inclusion of more than one check plot may be helpful for proper comparisons.

In replicated trials, it is appropriate to extrapolate to yields per hectare. A common error, which can lead to overestimated yields, is to multiply yield per plant by the theoretical number of plants per hectare. This should be avoided. Rather, yields per hectare should be estimated by extrapolating from yields per plot. It is generally unadvisable to make yield comparisons on the basis of yield per plant, particularly when the number of plants harvested per plot is variable.

A number of variables which may be useful in evaluating the performance of clones, can be calculated from the raw data of agronomic trials These include:

Percent establishment = (Number of cuttings established/Number of cuttings planted) x 100.

Percent survival = (Number of plants harvested/Number of cuttings established) x 100.

Percent of plants without storage roots = (Number of plants without storage roots/Number of plants harvested) x 100. A high percentage of plants without storage roots indicates lack of adaptation or lateness of a clone.

Large root yield (t/ha) = (Weight of large roots in kg/Plot area in m^2) x 10.

Small root yield (t/ha) = (Weight of small roots in kg/Plot area in m^2) x 10

Total root yield (t/ha) = Small root yield (t/ha) + Large root yield (t/ha)

Foliage yield (t/ha) = (Weight of tops in kg/Plot Area in m^2) x 10.

Root dry matter yield (t/ha) = (Storage root percent dry matter x Total root yield)/100.

Fresh biomass yield (t/ha) = Foliage yield (t/ha) + Total root yield (t/ha).

No. of large roots per plant = Number of large roots/Number of plants harvested.

No. of small roots per plant = Number of small roots/Number of plants harvested. Large numbers of small roots may indicate potential for higher yields at later harvest dates.

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DATA COLLECTION FORMS FOR TESTING OF SWEETPOTATO CLONES

Form 1. **General trial Information**

1. Trial Code _____ Name and institute of researcher(s) _____
2. Trial location _____ Agroecological zone _____
   Latitude _____ Longitude _____ Altitude (m) _____
3. Trial type _____ Design _____ No. reps _____ Total No. clones _____ No. Checks _____
   Name(s) of check clone(s)_____
4. Date of planting _____ Date of harvest _____ Duration (days)_____ Season _____
5. Plot size: No. cuttings _____ No. rows _____ Length (m) _____ Spacing between and within rows(m) _____x____
6. Trial planted on ridges, mound, or flat? _____ Irrigation date(s)/volume(s) _____
   Fertilization _____ Previous crop _____
7. Soil type _____
   Texture _____ pH _____ Organic matter % _____ CEC meq/100 g _____
   Aluminium saturation % _____ EC mmhos/cm _____ $CaCO_3$ % _____
   Nutrient analysis _____
8. Meteorological data during trial (means by month or fraction of month):

Meteorological data	Month					
	1	2	3	4	5	6
Mean Temperature (°C)						
Mean Max. Temperature (°C)						
Mean Min. Temperature (°C)						
Rainfall (mm)						
Radiation (MJ/m^2)						

10. Other _____

DATA COLLECTION FORMS FOR TESTING OF SWEETPOTATO CLONES

Form 2. Planting, establishment, foliage vigor, and foliar disease and pest evaluations

Trial code: _____ Trial location _____

Date of planting: _____

Plot #	Rep #	Name (CIP #)	# Cuttg Pltd.	# Estab. (3 wks)	Fol. Vigor (6 wks)	Disease or pest evaluated. Indicate name at head of column, and date of eval. at foot						Comments
Date of Evaluation:												

DATA COLLECTION FORMS FOR TESTING OF SWEETPOTATO CLONES

Form 2. (revised version) Planting, establishment, foliage vigor, and foliar desease and pest evaluations

Plot #	Rep #	Name (CIP #)	# Cuttg Pltd	# Estab. (3 wks)	Fol. Vigor (6 wks)	Virus evaluation			Crown Damage	*Cylas* damage Number of roots with rating					Rough weevil damage number of roots with rating					Comments
										1	2	3	4	5	1	2	3	4	5	
Date of evaluation																				

DATA COLLECTION FORMS FOR TESTING OF SWEETPOTATO CLONES

Form 3. **Agronomic Data**

Trial code: ___________ Trial location ______________________________

Date of planting: ______________________ Date of harvest: ______________________

Plot #	Rep #	Name (CIP #)	Wt. Tops (kg)	# Plts. Harv.	# Plts. w/out Stor. Rts.	Gen. Eval. Stor. Rts.	Large Roots		Small Roots.		Storage root rots, pests and defects (Name and score)	Comments
							#	Wt. (kg)	#	Wt. (kg)		

DATA COLLECTION FORMS FOR TESTING OF SWEETPOTATO CLONES

Form 4. **Postharvest Quality Evaluations**

Trial code: _____ Trial location _____
Date of harvest: _____

Plot #	Rep #	Name (CIP #)	Storage root color		Storage root dry matter			Eating quality evaluation			Comments
			Skin	Flesh	Fresh wt. (g)	Dry wt. (g)	(%)	Ap-pear.	Taste	Overall	
Date of evaluation:											

DATA COLLECTION FORMS FOR TESTING OF SWEETPOTATO CLONES

Form 5. **Summary of clonal evaluation**

Trial code: __________ Trial location ____

		Selected		
Name (CIP #)	Rejected	Varietal	Breeding	Comments on potential uses, strengths and weaknesses