CD/K/106:2010
ICS 67.080.10

EAST AFRICAN STANDARD

Bitter cassava — Specification and grading

EAST AFRICAN COMMUNITY

HS 0714.10.00

First Edition 2010

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that “Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose”.

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

East African Community

P O Box 1096

Arusha

Tanzania

Tel: 255 27 2504253/8

Fax: 255-27-2504481/2504255

E-Mail: eac@eachq.org

Web: www.each.int

Introduction

In the preparation of this East African Standard, the following sources were consulted extensively:

CODEX STAN --:2010, *Standard for Bitter Cassava*

ISO 9719:1995, *Root vegetables — Cold storage and refrigerated transport*

CODEX STAN 193:1995 (Rev.5:2009), *General Standard for Contaminants and Toxins in Foods*

CODEX STAN 228:2001 (Rev.1:2004), *General methods of analysis for contaminants*

Codex Alimentarius website: http://www.codexalimentarius.net/mrls/pestdes/jsp/pest_q-e.jsp

USDA Foreign Agricultural Service website: http://www.mrldatabase.com

USDA Agricultural Marketing Service website: http://www.ams.usda.gov/AMSv1.0/Standards

USDA Plant Inspectorate Service website: http://www.aphis.usda.gov/import_export/plants

European Union: http://ec.europa.eu/sanco_pesticides/public

Assistance derived from these sources and others inadvertently not mentioned is hereby acknowledged.

This standard has been developed to take into account:

— the needs of the market for the product;

— the need to facilitate fair domestic, regional and international trade and prevent technical barriers to trade by establishing a common trading language for buyers and sellers.

— the structure of the CODEX, UNECE, USA, ISO and other internationally significant standards;

— the needs of the producers in gaining knowledge of market standards, conformity assessment, commercial cultivars and crop production process;

— the need to transport the product in a manner that ensures keeping of quality until it reaches the consumer;

— the need for the plant protection authority to certify, through a simplified form, that the product is fit for crossborder and international trade without carrying plant disease vectors;

— the need to promote good agricultural practices that will enhance wider market access, involvement of small-scale traders and hence making fruit and vegetable production a viable means of wealth creation; and

— the need to keep unsatisfactory produce from the market by allowing the removal of unsatisfactory produce from the markets and to discourage unfair trade practices e.g. trying to sell immature produce at the beginning of the season when high profits can be made. Immature produce leads to dissatisfaction of customers and influences their choices negatively, which disadvantages those traders who have waited until the produce is mature.

Contents

Bitter cassava[1] — Specification and grading

1 Scope

This Standard applies to commercial bitter[2] varieties of cassava roots grown from *Manihot esculenta Crantz*, Sync. *Manihot utilissima* Pohl., of the *Euphorbiaceae* family, to be supplied fresh to the consumer, after preparation and packaging. Cassava for industrial processing is excluded.

Caution: The root of the bitter variety is very poisonous when raw. Cooking destroys the hydrocyanic acid; the cooking water must be discarded.

2 Normative references

The following referenced documents are indispensable for the application 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.

CAC/RCP 1, *Recommended International Code of Practice — General Principles of Food Hygiene*

CAC/RCP 44, *Recommended International Code of Practice for the Packaging and Transport of Tropical Fresh Fruit and Vegetables*

CAC/RCP 53, *Code of Hygienic Practice for Fresh Fruits and Vegetables*

EAS 38, *Labelling of prepackaged foods — Specification*

EAS 103, *Schedule for permitted food additives*

CD/U/07/2009, *Cassava and cassava products— Determination of total cyanogens — Enzymatic assay method*

3 Definitions

For the purpose of this standard the following definition shall apply:

3.1
decay
soft, mushy or leaking breakdown of the tissue, from any cause, and commonly known as “soft rot”;

3.2
diameter
the greatest width at right angles to the longitudinal axis

3.3
permanent defect
any defect of an unchangeable nature

3.4
properly packed
in respect of produce that is packed in a container, means that

[1] Commonly known in certain regions by: manioc, mandioca, tapioca, aipim, yucca, etc.

[2] Bitter varieties of cassava are those that contain more than 50 mg/kg of cyanides as hydrogen cyanide (fresh weight basis). In any case, cassava must be peeled and fully cooked before being consumed.

(a) the produce is packed in a manner that is not likely to result in damage to the produce during handling or transport, and

(b) the container contains not less than the net quantity of produce declared on the label;

4 Provisions concerning quality

4.1 General

The purpose of the standard is to define the quality requirements for produce at the marketing control stage, after preparation and packaging.

However, if applied at stages following export, products may show in relation to the requirements of the standard:

— a slight lack of freshness and turgidity

— a slight deterioration due to their development and their tendency to perish.

The holder/seller of products may not display such products or offer them for sale, or deliver or market them in any manner other than in conformity with this standard. The holder shall be responsible for observing such conformity.

4.2 Minimum requirements

4.2.1 In all classes, subject to the special provisions for each class and the tolerances allowed, the bitter cassava shall be:

(a) whole;

(b) sound, produce affected by rotting, mould or deterioration such as to make it unfit for consumption is excluded;

(c) clean, practically free of any visible foreign matter, except permitted substances[3] used to prolong its shelf life;

(d) practically free of pests affecting the general appearance of the produce;

(e) practically free of damage caused by pests;

(f) free of abnormal external moisture, excluding condensation following removal from cold storage;

(g) free of any foreign smell and/or taste;[4]

(h) firm;

(i) practically free of mechanical damage and bruising;

(j) free of loss of colour in the flesh.

The cut at the distal (narrow) end of the cassava should not exceed 2 cm in diameter.

The stalk end of the root should have a clean cut between 1 cm and 2.5 cm in length.

[3] In accordance with EAS 103.

[4] This provision allows for smell caused by conservation agents used in compliance with corresponding regulations.

4.2.2 The cassava must have been carefully harvested and have reached an appropriate degree of physiological development account being taken of the characteristics of the variety and the area in which they are grown.

The development and condition of the cassava must be such as to enable it:

— to withstand transport and handling; and

— to arrive in satisfactory condition at the place of destination.

4.2.3 Hydrogen cyanide content

When tested in accordance to CD/U/07/2009, sweet cassava roots shall have no more than 200 mg/kg of hydrogen cyanide (fresh weight basis)

4.3 Classification

Cassava is classified in three classes defined below:

4.3.1 Extra Class

Cassava in this class must be of superior quality. It must be characteristic of the variety and/or commercial type. It must be free of defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

4.3.2 Class I

Cassava in this class must be of good quality. It must be characteristic of the variety and/or commercial type. The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

— slight defects in shape;

— scarring or healed damage, not exceeding 5% of the surface area;

— scraped areas, not exceeding 10% of the surface area.

The defects must not, in any case, affect the flesh of the produce.

4.3.3 Class II

This class includes cassava which does not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified in 4.2. The following defects, however, may be allowed, provided the cassava retains its essential characteristics as regards the quality, the keeping quality and presentation:

— defects in shape;

— scarring or healed damage, not exceeding 10% of the surface area;

— scraped areas, not exceeding 20% of the surface area.

The defects must not, in any case, affect the flesh of the produce.

5 Provisions concerning sizing

Size is determined by the diameter at thickest cross-section of the produce, in accordance with the following table:

Size Code	**Diameter** (in centimeter)
A	3.5 – 7.5
B	7.6 – 10.0
C	> 10.0

In all cases, cassava must not be less than 300 g in weight nor less than 20 cm in length.

6 Provisions concerning tolerances

Tolerances in respect of quality and size shall be allowed in each package for produce not satisfying the requirements of the class indicated.

6.1 Quality tolerances

6.1.1 "Extra" Class

Five percent by number or weight of cassava not satisfying the requirements of the class, but meeting those of Class I or, exceptionally, coming within the tolerances of that class.

6.1.2 Class I

Ten percent by number or weight of cassava not satisfying the requirements of the class, but meeting those of Class II or, exceptionally, coming within the tolerances of that class.

6.1.3 Class II

Ten percent by number or weight of cassava satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting or any other deterioration rendering it unfit for consumption.

6.2 Size tolerances

For all classes, 10% by number or weight of cassava corresponding to the size immediately above and/or below that indicated on the package.

7 Provisions concerning presentation

7.1 Uniformity

The contents of each package must be uniform in shape and contain only cassava of the same origin, variety and/or commercial type, quality and size. The visible part of the contents of the package must be representative of the entire contents.

7.2 Packaging

Cassava must be properly packed in such a way as to protect the produce. The materials used inside the package must be new[5], clean, and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications is allowed, provided the printing or labelling has been done with non-toxic ink or glue.

The containers shall meet the quality, hygiene, ventilation and resistance characteristics to ensure suitable handling, shipping and preserving of the cassava. Packages must be free of all foreign matter and smell.

Cassava shall be packed in each container in compliance with CAC/RCP 44.

[5] For the purposes of this Standard, this includes recycled material of food-grade quality.

8 Marking or labelling

8.1 Consumer packages

In addition to the requirements of EAS 38, the following specific provisions apply:

8.1.1 Nature of produce

Each package shall be labelled as to the name of the produce and type (**bitter**) and may be labelled as to the name of the variety.

8.1.2 Preparation instructions[6]

A statement indicating the following is required:

— cassava shall be peeled and fully cooked before consumption; and

— cooking or rinsing water must not be consumed or used for other food preparation purposes.

8.2 Non-retail containers

Each package[7] must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside, or in the documents accompanying the shipment:

8.2.1 Identification

The exporter, packer and/or dispatcher shall be identified by name and physical address (e.g. street/city/region/postal code and, if different from the country of origin, the country) or a code mark officially recognized by the national authority.[8]

8.2.2 Nature of produce

Name of the produce and type (**bitter**) if the contents are not visible from the outside. Name of the variety (optional).

8.2.3 Origin of produce

Country of origin or, where appropriate, countries and, optionally, district where grown or national, regional or local place name.

8.2.4 Commercial specifications

— Class;

— Size (size code or minimum and maximum diameter in centimetres);

— Net weight in accordance with legal metrology regulations;

— Preparation instructions (see 8.1.2).

---

[6] In the case of unpackaged bitter cassava, information on safe handling and preparation shall be made available to the consumer at the point of sale.

[7] Package units of produce prepacked for direct sale to the consumer shall not be subject to these marking provisions but shall conform to the national requirements. However, the markings referred to shall in any event be shown on the transport packaging containing such package units.

[8] The national legislation of a number of countries requires the explicit declaration of the name and address. However, in the case where a code mark is used, the reference "packer and/or dispatcher (or equivalent abbreviations)" has to be indicated in close connection with the code mark, and the code mark should be preceded by the ISO 3166 (alpha) country/area code of the recognizing country, if not the country of origin.

8.2.5 Official control mark (optional)

9 Contaminants

9.1 Pesticide residues

Bitter cassava shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity.

9.2 Heavy metals

Bitter cassava shall comply with those maximum levels for heavy metals established by the Codex Alimentarius Commission for this commodity. The current limits are as indicated below:

Metal	Unit of measurement	Maximum limit	Test method
Lead (Pb)	mg/kg wet weight	0.10	ISO 6633 (AAS)
Cadmium (Cd)	mg/kg wet weight	0.10	ISO 6561-1 or 6561-2

10 Hygiene

10.1 It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of CAC/RCP 1, CAC/RCP 53, and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

10.2 The produce should comply with any microbiological criteria established in accordance with CAC/GL 21.

Bitter cassava roots

Bitter cassava plant

Young cassava leaves

Cassava root

Cassava and yams in market

Freshly harvested cassava roots

Annex B
(informative)

Cold storage and refrigerated transport

B.1 Scope

This annex gives guidance on conditions for cold storage and refrigerated transport of fresh root vegetables.

It applies only to stemless root vegetables intended for long-term storage in large-capacity warehouses, or refrigerated transport. Requirements for the storage of root vegetables with leaves are considerably different and are applicable only to short-term storage.

B.2 Field of application

This annex applies to black radish *(Raphanus sativus),* blackroot *(Scorzonera hispanica),* carrot *(Daucus carota),* horseradish *(Armoracla rusticana),* parsley *(Petroselinum crispum* var. *tuberosum),* red beetroot *(Beta vulgaris* var. *cruenta)* and similar root crops.

B.3 Characteristics for storage

B.3.1 Vegetables intended for long-term storage should be intact and firm without any mechanical damage, and be free of frost damage, rot, mould, parasites and disease. Excessive moisture on the surface of the roots and the presence of foreign odours or flavours should be avoided. Total removal of leaves is recommended. It is permitted to cut eaves smoothly with tops of roots of carrots, parsley, celeriac and beetroot.

B.3.2 The vegetables may be stored in warehouses without preliminary cleaning or washing, however, the soil naturally adhering to the roots or bulb should not exceed 2 % of the root weight.

B.3.3 Reference to standards for quality requirements valid for the individual types of root vegetable will minimize storage losses

B.4 Putting into storage

B.4.1 Root vegetables may be stored in box pallets or individual wooden or plastic boxes, stacked on simple pallets to form handling units Individual boxes on pallets may be formed onto storage blocks suitable for forklift trucks.

B.4.2 The stacking height depends on the structure of the pallets and boxes but should conform to national standards for maximum loading. A common stacking height for individual boxes on pallets is 4 m, while that for box pallets is 6 m.

B.4.3 It is necessary to leave a minimum of 25 cm to 30 cm of free space between the stacks and the ceiling, and between the walls of the warehouse and the nearest stack

B.4.4 In order to facilitate the use of a fork-lift truck, a space of 25 cm to 30 cm is recommended between the stacks.

B.4.5 Root vegetables may also be loose (or bulk) piled. The warehouse should be provided with interior bulkheads at least 1 m from the interior walls. Bulk piling may not be suitable for vegetables with long roots because of possible damage during mechanical filling and removal.

B.5 Method of storage

B.5.1 Root vegetables should be packed in wooden or plastic boxes for storage and transport.

The sides and possibly the bottom of the individual containers should be provided with a sufficient number of ventilation holes to allow air circulation through the package.

Ventilation in the horizontal direction is preferred.

An evaporator should be located near the ceiling so that the cooled air, circulated by the evaporation fans above the stored vegetables, falls and is returned to the evaporator.

B.5.2 The following conditions should be applied:

— high relative humidity may be provided by installation of a mechanical humidifier;

— air should be circulated within the room at a rate of 30 air changes per hour;

— the rate of ventilation with outside air should be 0.5 air changes per hour;

— if the mechanical refrigeration system is out order, ventilation with outside air should be stopped so that the temperature within the room is maintained for as long as possible.

B.6 Optimum storage and transport conditions

For measurement of the physical quantities affecting storage, see CD/K/378:2010.

B.6.1 Root vegetables should be stored at

a) temperature 0 ℃ to 2 ℃;

b) relative humidity: 90 % to 95 %.

B.6.2 The storage room should be pre-cooled to 0 ℃ to 1 ℃ prior to loading; product loading should be completed in less than 7 days.

B.6.3 When removed from storage, any moisture which may condense on the surface of the vegetables may be removed by holding the vegetables at 10 ℃ to 20 ℃ with adequate air circulation.

B.6.4 Root vegetables should always be shipped in refrigerated transport maintained at a uniform temperature between 0 ℃ and 5 ℃.

Annex C
(informative)

Model certificate of conformity with standards for fresh fruits and vegetables

<table>
<tr><td>1. Trader:</td><td>Certificate of conformity with the Community marketing standards applicable to fresh fruits and vegetables

No. ……..

(This certificate is exclusively for the use of inspection bodies)</td><td>  </td></tr>
<tr><td rowspan="2">2. Packer identified on packaging (if other than trader)</td><td colspan="2">3. Inspection body</td></tr>
<tr><td>4. Place of inspection/country of origin ([1])</td><td>5. Region or country of destination</td></tr>
<tr><td colspan="2">6. Identifier of means of transport</td><td>7.
☐ Internal
☐ Import
☐ Export</td></tr>
<tr><td>8. Packages (number and type)</td><td>9. Type of product (variety if the standards specifies)</td><td>10. Quality Class</td><td>11. Total net weight in kg</td></tr>
<tr><td colspan="4">12. The consignment referred to above conforms, at the time of issue, with the Community standards in force, vide:

CD/K/106:2010, Fresh bitter cassava— Specification and grading

Customs office foreseen …….. Place and date of issue ……

Valid until (date): ……

Signatory (name in block letters): ……..

Signature Seal of competent authority</td></tr>
<tr><td colspan="4">13. Observations:</td></tr>
<tr><td colspan="4">([1]) Where the goods are being re-exported, indicate the origin in box 9.</td></tr>
</table>

Annex D
(informative)

Cassava — Fact sheet

D.1 *Manihot esculenta*

Authority	Crantz
Family	Magnoliopsida:Dilleniidae:Euphorbiales:Euphorbiaceae
Synonyms	Manihot utilissima Pohl, Janipha manihot (L.) Kunth, Jatropha manihot L., Manihot aipi Pohl, Manihot dulcis (J. F. Gmelin) Pax, Manihot manihot (L.) Cockerell, Manihot melanobasis Muell. Arg.
Common names	Cassava, Manihot, Manioc, Mhogo, Tapioca, Guacomote Yuca, Cassave, Kelala, Marachini, Maravalli, Simul Alu, Ubi Singkong, Mangahazo, Ubi Kayu, Mun Sumpalung, Boodin, Kaspe, Katela, Bodin, Obi Kajoe, Poohoong Kahoy, Kamoteng, Tentu Neskok, Muk Shue, Pok Fung, Cassada, Aipi, Aipim Ubi, Ketalla, Macaxiera (sweet varieties), Mandioca, Manoco, Ramu, Yautia, Mushu, Tapioka, Maniok, Macaxeira, Yuca, Aipim (Brazil), Pondu, Saka-saka.
Editor	
Ecocrop code	1420

D.2 Description

Botanically, cassava is a perennial woody shrub, although farmers usually harvest it during the first or second year. The plant grows up to 4 metres high or more. In farmers fields it is however rare to find casava much taller than 2 metres. It is propagated mainly from cuttings; however, under natural conditions, as well as in the plant breeding process, propagation by seed is quite common. The mature tuber may measure 1 m in length and weigh up to 2 kg. The cassava plant may be divided into two main parts: the shoot system, which consists of stem, leaves and reproductive structures or flowers; and the root system, which consists of feeder roots and tubers. The fleshy elongated tuberous roots or rhizomes, are very woody, only slightly thickened in wild varieties; under cultivation up to 2.5 m long and 10-15 cm in diameter, weighing up to 40 kg, averaging 4-7 kg; leaves usually deeply 3-7-parted with spatulate to linear-lanceolate acuminate lobes 7.5-15 cm long, glabrous, glaucous beneath and minutely puberulent along veins, long petioled; flowers in panicles, less than 1.2 cm long; capsules globose, about 1.2 cm across, with 6 winged angles; seeds 3 per capsule.

D.3 Uses

Cassava is one of the leading food and feed plants of the world. It ranks fourth among staple crops, with a global production of about 160 million tons per year. Most of this is grown in three regions: West Africa and the adjoining Congo basin, tropical South America and south and Southeast Asia.

Cassava is grown for its enlarged starch-filled roots, which contains nearly the maximum theoretical concentration of starch on a dry weight basis among food crops. Fresh roots contain about 30% starch and very little protein. Cassava roots are used in different forms of cooking throughout regions and countries. They are mainly used as an essential ingredient or complement to traditional meals. The cooking follows the peeling and may include, among others, boiling, baking, frying, grilling, roasting, stewing, etc. The boiled roots can replace boiled potatoes or plantains or made into purées, dumplings, soups, stews, gravies, etc. The fried roots (after boiling or steaming) can replace fried potatoes or plantains. Cassava roots can also be chopped, mashed or grated, rinsed, dried, pressed and boiled, fried and/or baked in the form of balls and cakes. Other preparations depend upon culinary traditions of the country. It is not recommended to eat cassava uncooked, because of

potentially toxic concentrations of cyanogenic glucosides that are reduced to innocuous levels through cooking. In traditional settings of the Americas, roots are grated and the sap is extracted through squeezing or pressing. The cassava is then further dried over a fire to make a meal or fermented and cooked. The meal can then be rehydrated with water or added to soups or stews. In Africa, roots are processed in several different ways. They may be first fermented in water. Then they are either sun-dried for storage or grated and made into a dough that is cooked. Alcoholic beverages can be made from the roots.

The young tender leaves are used as a potherb, containing high levels of protein (8-10% F.W) and vitamins C and A. The leaves are prepared in a similar manner as spinach, while eliminating toxic compounds during the cooking process.

There are hydrocyanic glucosides (HCN) in all parts of the plant that are poisonous. These glucosides are removed by peeling the roots and boiling in water.

It is mainly used for human consumption, less for animal consumption and for industrial purposes, though this may vary by country. The roots are rarely eaten fresh but are usually cooked, steamed, fried or roasted when fresh or after drying or fermenting. It is advisable to peel, boil, grind or cut, and dry the roots in order to diminish the contents of cyanogenic glucosides. All plant parts contain cyanogenic glucosides with the leaves having the highest concentrations. In the roots, the peel has a higher concentration than the interior. In the past, cassava was categorized as either sweet or bitter, signifying the absence or presence of toxic levels of cyanogenic glucosides. Sweet cultivars can produce as little as 20 mg of HCN per kg of fresh roots, while bitter ones may produce more than 50 times as much. The bitterness is identified through taste and smell. This is not a totally valid system, since sweetness is not absolutely correlated with HCN producing ability. In cases of human malnutrition, where the diet lacks protein and iodine, under processed roots of high HCN cultivars may result in serious health problems.

Cassava provides a major source of calories, because of its high starch content. With minimum maintenance, the farmers can dig up the starchy root of the cassava and eat it 6 months to 3 years after planting. In Africa, people also eat the leaves of the cassava as a green vegetable, which provide a cheap and rich source of protein and vitamins A and B. In Southeast Asia and Latin America, cassava has also taken on an economic role. Various industries use it as a binding agent, because it is an inexpensive source of starch.

Cassava flour is used to make cookies, quick breads, loaf breads, pancakes, doughnuts, dumplings, muffins, bagels. Cassava extracted juice is fermented into a strong liquor called kasiri. The peeled roots of the sweet variety are usually eaten cooked or baked.

The juice can be concentrated and sweetened until it becomes a dark viscous syrup called kasripo (casareep). This syrup has antiseptic properties and is used for flavoring.

Livestock: Cassava leaves and stem meal are used for feeding dairy cattle. Both fresh and dried cassava roots are consumed by ruminants in different forms (chopped, sliced, or ground). Cassava bushes three to four months old are harvested as forage for cattle and other ruminants.

Ornamental: One clone with variegated leaves is known to be planted as an ornamental.

Commercial: Cassava starch is used in the production of paper, textiles, and as monosodium glutamate (MSG), an important flavoring agent in Asian cooking. In Africa, cassava is used as partial substitution for wheat flour.

D.4 MorphologyRoots: The cassava plant is established from hardwood cuttings. During the first 2 to 3 weeks of growth, adventitious roots develop at the base of the original stem cutting. These adventitious roots subsequently develop into fibrous roots which absorb water and nutrients from the soil. Some adventitious roots also develop at the base of the axillary buds or the newly formed shoots. About three months after planting some of the fibrous roots begin to thicken and store large quantities of starch in xylem parenchyma. The number of thickened roots and their size varies with variety and growing condition.

The cassava roots are economically the most important part of the plant, although the leaves are also harvested and used. The dry matter content of the roots is an important determinant of quality: it normally lies in the range of 30-40% with large varietal differences in dry matter content. The dry matter content also varies with age and growing conditions and decreases markedly with the onset of the rainy season. The root dry matter is over 90% carbohydrates, comprised mainly of starch.

Stems: Axillary buds on the original stem cutting develop into the shoots of the new plant. The stems show strong apical dominance which suppresses formation of side shoots. Side branches may occur and this type of branching is favored by low plant populations and by lodging. The typical branching, characteristic of the crop, occurs when the apex of the main shoot enters the reproductive phase. The apical dominance is broken and two to four of the axillary buds immediately below the apex develop into approximately equally sized branches. There is much variation in branching time with some varieties branching almost immediately after germination whilst some never branch. Each node on the stem subtends a leaf with an axillary bud at the leaf base. The node which subtends the leaf is raised and when the leaf abscises it leaves the characteristic protrusion on the woody stem.

Leaves: The leaves comprise a slender petiole and leaf lamina. The leaf blade is palmate normally with an odd number between three and thirteen lobes. The upper surface of the leaves is waxy and on almost all varieties there are no functional stomata on the upper leaf surface. The leaves of young plants are small with few lobes, later leaf size increases reaching a maximum about 4 months after planting (at lower temperatures maximum leaf size is reached later (Irikura et al 1979) and then decreases as the plant ages. During drought periods total leaf area per plant decreases due to both a slower rate of leaf production and smaller leaves. With the onset of rains a new flush of larger than normal (for the age of the plant) leaves is produced (Connor et al 1981).

Flowers: Cassava is monoecious with a small number of pistillate flowers and a larger number of staminate flowers borne on the same inflorescence. Flowering is frequent and regular in some cultivars, while in others it is rare or non-existent. Cassava flowers are borne on terminal panicles, with the axis of the branch being continuous with that of the panicle inflorence. The female flowers occur closer to the base; they have five petals and an ovary with three loci. The male flowers occur near the tip; they have ten stamens and open after the female flowers have bloomed.

Fruits: After pollination and subsequent fertilization, the ovary develops into the young fruit, which takes 70 to 90 days to mature. The mature cassava fruit is a globular capsule (diameter 1 to 1.5cm), with six narrow longitudinal wings. The woody endocarp contains three locules, each with one seed. However in practice seed set is normally less than three. When the fruit is dry, the endocarp splits explosively to release the seeds.

Seeds: The cassava seed is ellipsoidal and about 1.5cm long.It has a brittle testa which is grey and mottled with dark blotches. There is a large caruncle at the micropylar end of the seed.**AnatomyRoot:** In cross section the periderm of the tubercule has a few dead layers of cells which protect the schlerenchymatous layer.At high temperatures (24 to 30^{o}C), the time from appearence to full expansion of a given leaf is about 2 weeks. Leaf growth is greatly reduced at lower temperatures. The size of fully expended leaves increases with the age of the plant and reaches thier maximum size 4 to 5 months after planting, after which the size decreases. Leaf size is considerably reduced under adverse environmental conditions, such as nutrient or water stress.

The life of individual leaves is usually 60 to 120 days, but may be as long as 200 days, particularly at low temperatures. Drought and flooding both cause rapid leaf drop, resulting in shorter leaf life. Mutual shading greatly reduces leaf life. Leaf area index (LAI) in cassava ranges from 3 to 7, depending on variety. The highest LAI ever recorded in cassava is about 10. LAI increases as the number and size of leaves increase, reaching a peak 4 to 6 months after planting. Thereafter, leaf size and rate of production decrease and some leaves die; this marks the beginning of the declining phase of LAI.**D.5 Habitat***Climate zone:* The cassava crop is limited to the hotter areas of the world. In the more extreme areas where cassava is grown light frosts may occur. In the hotter lowland tropics it is found in areas as diverse as the Amazon jungle to the semi arid regions of the Sahel.

Dry season type: Found in areas with no dry season to areas with up to 7 months of dry season. The crop is also grown in areas where there are two dry and two wet seasons per year.

Terrain: Arable cropland.**D.6 EnvironmentLatitude:** Cassava is not found at latitudes greater than 30N-30S.

Altitude: Altitudinal range: 0-2000 metres close to the equator declining to close to sea level at 30 degrees of latitude.

Temperature: The limits of temperature on the cassava follow the altitude and latitude limits on cultivation. In areas with large seasonal temperature fluctuations cassava is found in those areas with annual mean temperatures of 20C or above. Cassava dies back when frosted and can only be grown in areas with light frosts. In the highland tropical zones cassava is not found when average temperature is below approximately 18C. At lower temperatures growth is reduced and ceases at about 10C. In the cool highland tropics the growth cycle of the crop is extended to 18 months or more. Germination requires a soil temperature of 18C or greater.

Killing temperature

May not tolerate 7℃ for prolonged periods and it i s easily killed by frost.

Growing period

Short-lived perennial. Mature leaves may be harvested 50-70 days from insertion of the cuttings. The 'sweet' cassavas mature in 180-270 days, the 'bitter' in 12-18 months. Growing period 6-24 months, depending on cultivar and conditions.

In general, the crop requires a warm humid climate. Temperature is important, as all growth stops at about 10ºC. Typically, the crop is grown in areas that are frost free the year round. The highest root production can be expected in the tropical lowlands, below 150 m altitude, where temperatures average 25-27℃, but some varieties grow at altitud es of up to 1 500 m.

The plant produces best when rainfall is fairly abundant, but it can be grown where annual rainfall is as low as 500 mm or where it is as high as 5,000 mm. The plant can stand prolonged periods of drought in which most other food crops would perish. This makes it valuable in regions where annual rainfall is low or where seasonal distribution is irregular. In tropical climates the dry season has about the same effect on Cassava as low temperature has on deciduous perennials in other parts of the world. The period of dormancy lasts two to three months and growth resumes when the rains begin again.

Cassava is drought resistant and grows well in poor soil. It is one of the most efficient producers of carbohydrates and energy among all the food crops.

Water: Under rainfed agriculture (cassava is rarely irrigated) the crop is grown in areas from 500 mm annual precipitation to more than 3500 mm. Most cassava is grown in areas with 1000-2500 mm of annual rainfall. Much of the original germplasm that was taken to Africa probably came from the higher rainfall coastal areas of Brazil and was not particularly well adapted to semi-arid conditions. South American germplasm crossed with African materials resistant to ACMD are now available in regions of Africa with both low and uncertain rainfall.

Radiation:

Range & intensity: The crop thrives in areas with high solar radiation, but is also well adapted to the cloudy conditions common in the hot humid lowland equatorial belt.

Photoperiodism: Branching and hence flowering are more profuse under long days. Long days skew the distribution of biomass to the production of tops rather than roots.

Soil

Physical: Cassava grows in a wide range of soils. It is not well adapted to heavy soils, particularly soils with cracking clays such as the vertisols which not only are not suitable for grwoing cassava but also make harvesting extremely arduous. Gravelly or rocky soils are not recommended. Low lying

water logged sites should be avoided wherever possible for cassava production. Light, well-drained soils are most suitable for cassava. Although cassava may be planted continuously, problems with root rots may build up, in which case crop rotation is recommended.

Chemical: It is particularly well adapted to acid soils.

Notes:

Susceptibilities: Cassava is severely stunted even on mildly saline or sodic soils. As stated above water logged or flooded conditions are not appropriate for cassava. The crop is susceptible to zinc deficiency when soil levels are low, but not so low as to cause problems in other crops such as sugarcane.

Tolerances: Cassava is tolerant of low pH and high levels of aluminium saturation. The critical level of pH is close to 4.7 with normal growth up to 80% aluminium saturation. Cassava has exceptional tolerance to low available phosphorous levels. There are also varietal differences in tolerance at low levels of phosphorous.**D.7 Distribution**Cassava originated in Brazil and Paraguay. Today it has been given the status of a cultigen with no wild forms of this species being known.

Cassava was introduced to the West coast of Africa more than 400 years ago by Portuguese traders. It was later independently introduced to East Africa and Madagascar in the 18th century. There appear to have been multiple introductions of cassava and it spread throughout tropical Africa from both coasts. Freed slaves, who returned to Africa from Brazil, probably took the farinha processing system to West Africa where it was modified to become Gari.

The introduction of cassava into Asia is not well documented. The Portuguese may have taken cassava to Goa in India in the early eighteenth century. At about the same time cassava was taken from Mexico to Indonesia and the Philippines. There is some evidence that it was then taken from Indonesia to Mauritius in the mid eighteen century. Later towards the end of the eighteenth century and in the first half of the nineteenth century various official importations were made from South America and the Caribbean. By the end of the nineteenth century cassava was firmly established in South and South East Asia as both a staple crop in some areas and as a source of starch for export in others.

D.8 Pollination

The female flowers open first, the male flowers about a week later. Under normal conditions, the stigma remains receptive for up to 24 hours after opening of the flower and dried pollen remains viable for about 6 days under controlled conditions. Both the stigma and pollen are sticky, and pollinisation is easily carried out by honey bees. Structurally and fuctionally, therefore, the cassava flower is well adapted to cross-pollination. Pollination can be done by hand using the male flower after removing the perianth. Pollen is collected early in the morning before 10.00h and pollination made before 13.00h. Both male and female flowers that are on the point of opening are used. When the anthers are mature, they change from green to yellow, and this change in color is a useful indication of when pollen can be collected. Mass pollinisation can be made by using an applicator, which is a stick with the tip covered with an adhesive piece of velvet-like material to which the pollen will readily adhere. Several flowers can be pollinated without recharging the applicator. The pollinated flowers are bagged with cloth or paper bags to protect them against bees or other insects carrying foreign pollen. The bags are removed 5 days later.**D.9 EthnobotanyEtymology:** The name cassava comes from 'casabi', the Arawak Indian word given to the root.**Food:** The roots are a rich source of carbohydrate. Most of the carbohydrate is in the form of starch (31% of fresh weight) with smaller amounts of free sugars (less than 1% of fresh weight). Cassava roots are low in protein (0.53%) and fat (0.17%) but have a high content of dietary fiber (1.48%).

The leaves, in contrast to the roots, are high in protein (5.1% on a fresh-weight basis), dietary fiber (5.1%) and fat (2.0%).In Samoa, cassava was used to induce abortion. The Amerindians use the brown juice, obtained during processing, for burns.

D.10 Toxicities

Cassava is famous for the presence of free and bound cyanogenic glucosides, linamarin and lotaustralin. They are converted to HCN in the presence of linamarase, a naturally occurring enzyme in cassava. Linamarase acts on the glucosides when the cells are ruptured. All plant parts contain cyanogenic glucosides with the leaves having the highest concentrations. In the roots, the peel has a higher concentration than the interior. In the past, cassava was categorized as either sweet or bitter, signifying the absence or presence of toxic levels of cyanogenic glucosides. Sweet cultivars can produce as little as 20 mg of HCN per kg of fresh roots, while bitter ones may produce more than 50 times as much. The bitterness is identified through taste and smell. This is not a totally valid system, since sweetness is not absolutely correlated with HCN producing ability. In cases of human malnutrition, where the diet lacks protein and iodine, underprocessed roots of high HCN cultivars may result in serious health problems.

D.11 Crop Culture (Agronomy/Horticulture)

D.11.1 Ecology

Cassava is a tropical root crop, requiring at least 8 months of warm weather to produce a crop. It is traditionally grown in a savanna climate, but can be grown in extremes of rainfall. In moist areas it does not tolerate flooding. In droughty areas it looses its leaves to conserve moisture, producing new leaves when rains resume. It takes 18 or more months to produce a crop under adverse conditions such as cool or dry weather. Cassava does not tolerate freezing conditions. It tolerates a wide range of soil pH 4.0 to 8.0 and is most productive in full sun.

D.11.2 Cultivars

Before the development of national and international breeding programs with cassava there were relatively few cultivars. This is because cassava is propagated vegetatively as clones. Recent releases from breeding programs include clones with resistance to many of the major diseases and pests. Specific cultivar names are mostly regional, with the exception of introductions from international research centers, which carry with them an institutional code. This code is often retained as the name of the cultivar. Cultivar classification is usually based on pigmentation and shape of the leaves, stems and roots. Cultivars most commonly vary in yield, root diameter and length, disease and pest resistance levels, time to harvest, cooking quality, and temperature adaptation. Some clones require 18 or months of growth before they can be harvested. Storage root color is usually white. A few clones have yellow-fleshed roots.

Most clones were selected by farmers from chance seedlings in their fields. Each growing region has its own special clones with farmers growing several different ones in a field.

D.11.3 Establishment and management

Cassava is a tropical root crop, requiring at least 8 months of warm weather to produce a crop. However, under adverse conditions such as cool or dry weather it can take 18 or more months to produce a crop. Cassava is traditionally grown in a savanna climate, but can be grown in extremes of rainfall; however, it does not tolerate flooding. In droughty areas it looses its leaves to conserve moisture, producing new leaves when rains resume. Cassava does not tolerate freezing conditions, but does tolerate a wide range of soil pH 4.0 to 8.0 and is most productive in full sun.

Propagation by seed: For agricultural purposes, cassava is propagated exclusively from cuttings because seed germination is usually less than 50 percent. Seedlings are raised from seed only for the purpose of selecting seedlings with fewer and smaller roots than those of the parents. Botanically seeds are used only for breeding purposes.

Propagation by cuttings: Propagate cassava by planting segments of the stem. Cut stems into 9-30 cm lengths; be sure to include at least one node. Segments can be buried vertically with 8-15 cm in the ground. The selection of healthy, pest-free cuttings is essential. Stem cuttings are sometimes referred to as 'stakes'. In areas where freezing temperatures are possible, plant cuttings as soon as the danger of frost has past. Cuttings can be planted by hand or by planting machines. Hand planting is done in one of three ways: vertical, flat below the soil surface or tilted. Under low rainfall conditions, vertical planting may result in the desiccation of the cuttings, while in areas of higher

rainfall; flat-planted cuttings may rot. In general, flat planting 5-10 cm below the soil surface is recommended in dry climates and when mechanical planting is used. Germination seems to be higher; tubers tend to originate from a great number of points and grow closer to the surface of the soil, making better use of fertilizers applied on the surface and also making harvesting easier.

Vertical planting is used in rainy areas and tilted planting in semi-rainy areas. Observing the polarity of the cutting is essential in successful establishment of the planting. The top of the cutting must be placed upright. Typical plant spacing is 1m by 1m. Cuttings produce roots within a few days and new shoots soon appear at old leaf petiole axes on the stem. Early growth is relatively slow, thus weeds must be controlled during the first few months. Although cassava can produce a crop with minimal inputs, optimal yields are recorded from fields with average soil fertility levels for food crop production and regular moisture availability.

Responses to macro-nutrients vary, with cassava responding most to P and K fertilization. *Vesicular-arbuscular* mycorrhizae benefit cassava by scavenging for phosphorus and supplying it to the roots. High N fertilization, more than 100 kg of actual N/ha, may result in excessive foliage production at the expense of storage root development. Fertilizer should only be applied during the first few months of growth.

In moist soil, sprouting takes place within the first week after planting. Within a month of the beginning of planting, the substitution of new cuttings to replace those that did not sprout is still possible. Cassava is grown mainly as a cash crop and farmers may for ten years or more grow cassava on the same land. However, if the price of cassava roots drops, the farmers may shift to another crop (e.g., sugarcane, maize or sorghum) until cassava again becomes the more profitable crop.

Management
General: Cassava is either planted as a single crop or intercropped with maize, legumes, vegetables, rubber, oil palm or other economic important plants. Mixed planting reduces the danger of loss caused by unfavorable weather and pests by spreading the risk over plants with different susceptibilities.

Cassava grows best on light sandy loams or on loamy sands which are moist, fertile and deep. It grows well on soils ranging in texture from the sands to the clays and on soils of relatively low fertility. Cassava can produce an economic crop on soils so depleted by repeated cultivation that they have become unsuitable for other crops. On very rich soils the plant may produce stems and leaves at the expense of roots. Cassava will grow on a wide range of soils, provided the soil texture is friable enough to allow the development of the tubers.

When cassava is grown as the first crop in forest land no further preparation is required than the clearing of the forest growth. When cassava is grown after other crops it often can be planted without further preparation of the soil, once the preceding crop has been harvested or the soil has been plowed two or three times until free from grass and other plants.

No fertilization is required when the land is freshly cleared or when there is enough land to enable growers to substitute new land for old when yields fall. Like all rapidly growing plants yielding carbohydrates, cassava has high nutrient requirements and exhausts the soil very rapidly. When cassava is grown on the land for a number of years in succession or in rotation the soil nutrients are reduced and must therefore be returned to the soil by fertilization. Large commercial farmers replace the nutrients lost by applying artificial fertilizers that are usually too costly for the small farmer. Small farmers replace the nutrient loss by using different kinds of organic manures, such as cattle or duck manure or garbage to replace the nutrients taken from the soil.

Cassava is frequently cultivated as a temporary shade plant in young plantations of cocoa, coffee, rubber or oil palm. When cultivated as a temporary shade plant, no special attention is given to the cassava plant. When grown alone, the plants require little maintenance after planting. Irrigation may be required if there is no rain, and hoeing of the earth helps preserve the subsoil humidity, especially in dry sandy soils. The chief problem is weed control which may be desirable to weed the crop two or three times until the plants are well developed and their shade prevents the growth of weeds.

Maturity differs from one variety to another, but for food the tubers can be harvested at almost any age below 12 months. From the standpoint of maximum starch production, the optimum age for harvest is 18-20 months. During this growth period both root and starch production increase rapidly to their maximum value, after which root production decreases slowly and starch production much more rapidly on account of the declining starch content of the tubers.

If the roots are left in the ground, starch content increases with age until, at a certain point; lignifications takes place, causing the roots to become tough and woody, so that they are harder to prepare for consumption and other uses.

D.11.4 Harvesting

Harvesting of cassava can be done throughout the year when the roots reach maturity. In regions with seasonal rains, harvesting is usually done in the dry season, during the dormant period of the plant; where rain prevails all year round, cassava is harvested throughout the year.

There is no mature stage for cassava; because plants are ready for harvest as soon as there are storage roots large enough to meet the requirements of the consumer. Under the most favorable conditions, yields of fresh roots can reach 90 t/ha while average world yields from mostly subsistence agricultural systems average 10 t/ha. Typically harvesting can begin as soon as eight months after planting. In the tropics, plants can remain un-harvested for more than one growing season, allowing the storage roots to enlarge further. However, as the roots age and enlarge, the central portion becomes woody and inedible.

Most cassava is harvested by hand, lifting the lower part of stem and pulling the roots out of the ground, then removing them from the base of the plant by hand. The upper parts of the stems with the leaves are removed before harvest. Levers and ropes can be used to assist harvesting. A mechanical harvester has been developed in Brazil. It grabs onto the stem and lifts the roots from the ground. Care must be taken during the harvesting process to minimize damage to the roots, as this greatly reduces shelf life. During the harvesting process, the cuttings for the next crop are selected. These must be kept in a protected location to prevent desiccation.

D.11.5 Processing

The shelf life of cassava is only a few days unless the roots receive special treatment. Removing the leaves two weeks before harvest lengthens the shelf life to two weeks. Dipping the roots in paraffin or a wax or storing them in plastic bags reduces the incidence of vascular streaking and extends the shelf life to three or four weeks. Roots can be peeled and frozen. Traditional methods include packing the roots in moist mulch to extend shelf life.

Dried roots can be milled into flour. Maize may be added during the milling process to add protein to the flour. The flour can be use for baking breads. Typically, cassava flour may be used as partial substitute for wheat flour in making bread. Bread made wholly from cassava has been marketed in the U.S.A. to meet the needs of people with allergies to wheat flour.

Fresh roots can be sliced thinly and deep fried to make a product similar to potato crisps. They can be cut into larger spear-like pieces and processed into a product similar to French fries.

Roots can be peeled, grated and washed with water to extract the starch which can be used to make breads, crackers, pasta and pearls of tapioca. Unpeeled roots can be grated and dried for use as animal feed. The leaves can add protein to animal feed.

Industrial uses where cassava is used in the processing procedures or manufacture of products include paper-making, textiles, adhesives, high fructose syrup and alcohol.

D.11.6 Germplasm

The largest germplasm collection is housed at the International Center for Tropical Agriculture (CIAT) in Cali, Colombia. The International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria maintains a germplasm collection for African needs. The largest national collection is in Brazil under the direction of the Brazilian Agricultural Research Network (EMBRAPA). All three institutions have breeding programs.

D.12 Pests and potential problems

Insects, diseases and other pest: In many regions, the cassava plant is not normally affected by diseases or pests. However, in others it may be attacked by the following:

— Virus diseases. Mosaic, the brown streak and leaf curl of tobacco may attack leaves, stems and branches. Many parts of Africa harbor these diseases and attempts are being made to select resistant varieties.

— Bacterial disease. Bacteria such as *Phytomonas manihotis* (in Brazil), *Bacterium cassava* (in Africa) and *Bacterium solanacearum* (in Indonesia) may attack roots, stems or leaves of cassava plants.

— Mycoses. There are kinds which attack roots, stems, or leaves of cassava plants and cause various diseases.

— Insects. Some insects affect the plant directly (locusts, beetles and ants); others affect the plant indirectly by the transfer of virus (aphids).

— Animals. Rats, goats and wild pigs are probably the most troublesome; they feed on the roots, especially in areas adjacent to forests

Annex E
(informative)

Cassava — Codex, EU and USA pesticide residue limits

Users are advised that international regulations and permissible Maximum Residue Levels (MRL) frequently change. Although this International MRL Database is updated frequently, the information in it may not be completely up-to-date or error free. Additionally, commodity nomenclature and residue definitions vary between countries, and country policies regarding deferral to international standards are not always transparent. This database is intended to be an initial reference source only, and users must verify any information obtained from it with knowledgeable parties in the market of interest prior to the sale or shipment of any products. The developers of this database are not liable for any damages, in whole or in part, caused by or arising in any way from user's use of the database.

Results Key

MRL values in *{Italics}* are more restrictive than US
--- indicates no MRL value is established.
Cod, EU, etc. indicates the source of the MRL and EXP means the market defers to the exporting market.
All numeric values listed are in parts per million (ppm), unless otherwise noted

	US *1*	**Cod**	**EU *2***
2,4-D	0.1	---	*{0.05}*
	1. United States does not maintain a specific MRL for the 2,4-D/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	2. European Union does not maintain a specific MRL for the 2,4-D/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US *3*	**Cod**	**EU *4***
Acetamiprid	0.01	---	0.01
	3. United States does not maintain a specific MRL for the Acetamiprid/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	4. European Union does not maintain a specific MRL for the Acetamiprid/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Root and tuber vegetables" group.		
	US *5*	**Cod**	**EU *6***
Azoxystrobin	0.03	---	0.05
	5. United States does not maintain a specific MRL for the Azoxystrobin/Cassava, Roots combination, but does maintain an MRL of 0.03 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	6. European Union does not maintain a specific MRL for the Azoxystrobin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Tropical root and tuber vegetables" group.		
	US *7*	**Cod**	**EU**
Beta-cyfluthrin	0.01	---	---
	7. United States does not maintain a specific MRL for the Beta-cyfluthrin/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	US	**Cod**	**EU *8***
Bifenazate	0.1	---	*{0.01}*
	8. European Union does not maintain a specific MRL for the Bifenazate/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Root and tuber vegetables" group.		
	US *9*	**Cod**	**EU *10***
Bifenthrin	0.05	---	0.05
	9. United States does not maintain a specific MRL for the Bifenthrin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 10. European Union does not maintain a specific MRL for the Bifenthrin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Root and tuber vegetables" group.		
	US *11*	**Cod**	**EU *12***
Boscalid	0.05	---	0.5
	11. United States does not maintain a specific MRL for the Boscalid/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	12. European Union does not maintain a specific MRL for the Boscalid/Cassava, Roots combination, but does maintain an MRL of 0.5 PPM for its "Tropical root and tuber vegetables" group.		

	US *13*	**Cod**	**EU *14***
Captan	0.05	---	*{0.02}*
	13. United States does not maintain a specific MRL for the Captan/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	14. European Union does not maintain a specific MRL for the Captan/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Tropical root and tuber vegetables" group.		
	US *15*	**Cod**	**EU**
Carbaryl	2	---	*{1}*
	15. United States does not maintain a specific MRL for the Carbaryl/Cassava, Roots combination, but does maintain an MRL of 2 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	US *16*	**Cod**	**EU *17***
Carfentrazone-ethyl	0.1	---	*{0.01}*
	16. United States does not maintain a specific MRL for the Carfentrazone-ethyl/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	17. European Union does not maintain a specific MRL for the Carfentrazone-ethyl/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU *18***
Clethodim	1	---	*{0.1}*
	18. European Union does not maintain a specific MRL for the Clethodim/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Tropical root and tuber vegetables" group.		
	US *19*	**Cod**	**EU *20***
Clomazone	0.05	---	*{0.01}*
	19. United States does not maintain a specific MRL for the Clomazone/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetable, Tuberous and Corm, Except Potato, Subgroup 1D" group.		
	20. European Union does not maintain a specific MRL for the Clomazone/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		
	US *21*	**Cod**	**EU *22***
Cyfluthrin	0.01	---	0.02
	21. United States does not maintain a specific MRL for the Cyfluthrin/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	22. European Union does not maintain a specific MRL for the Cyfluthrin/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Root and tuber vegetables" group.		
	US	**Cod**	**EU *23***
Deltamethrin	0.04	---	0.05
	23. European Union does not maintain a specific MRL for the Deltamethrin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Root and tuber vegetables" group.		
	US *24*	**Cod**	**EU *25***
Difenoconazole	0.01	---	0.1
	24. United States does not maintain a specific MRL for the Difenoconazole/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Tuberous and Corm, Except Potato, Subgroup 1D" group. 25. European Union does not maintain a specific MRL for the Difenoconazole/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Tropical root and tuber vegetables" group.		
	US *26*	**Cod**	**EU *27***
Dimethenamid	0.01	---	0.01
	26. United States does not maintain a specific MRL for the Dimethenamid/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 27. European Union does not maintain a specific MRL for the Dimethenamid/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		
	US *28*	**Cod**	**EU *29***
Fenamidone	0.02	---	0.02
	28. United States does not maintain a specific MRL for the Fenamidone/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	29. European Union does not maintain a specific MRL for the Fenamidone/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Root and tuber vegetables" group.		

	US *30*	**Cod**	**EU *31***
Flonicamid	0.2	---	*{0.05}*
	30. United States does not maintain a specific MRL for the Flonicamid/Cassava, Roots combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	31. European Union does not maintain a specific MRL for the Flonicamid/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Tropical root and tuber vegetables" group.		
	US *32*	**Cod**	**EU *33***
Fludioxonil	3.5	---	*{0.05}*
	32. United States does not maintain a specific MRL for the Fludioxonil/Cassava, Roots combination, but does maintain an MRL of 3.5 PPM for its "Vegetable, Tuberous and Corm, Except Potato, Subgroup 1D" group.		
	33. European Union does not maintain a specific MRL for the Fludioxonil/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Tropical root and tuber vegetables" group.		
	US	**Cod**	**EU *34***
Flumioxazin	0.02	---	0.05
	34. European Union does not maintain a specific MRL for the Flumioxazin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US *35*	**Cod**	**EU *36***
Fluopicolide	0.02	---	*{0.01}*
	35. United States does not maintain a specific MRL for the Fluopicolide/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Tuberous and Corm, Except Potato, Subgroup 1D" group.		
	36. European Union does not maintain a specific MRL for the Fluopicolide/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Tropical root and tuber vegetables" group.		
	US	**Cod**	**EU *37***
Fluoxastrobin	0.01	---	0.05
	37. European Union does not maintain a specific MRL for the Fluoxastrobin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US *38*	**Cod**	**EU *39***
Glyphosate	0.2	---	*{0.1}*
	38. United States does not maintain a specific MRL for the Glyphosate/Cassava, Roots combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	39. European Union does not maintain a specific MRL for the Glyphosate/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Tropical root and tuber vegetables" group.		
	US *40*	**Cod**	**EU *41***
Imidacloprid	0.4	---	*{0.05}*
	40. United States does not maintain a specific MRL for the Imidacloprid/Cassava, Roots combination, but does maintain an MRL of 0.4 PPM for its "Vegetable, Root and Tuber, Group 1" group. 41. European Union does not maintain a specific MRL for the Imidacloprid/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Tropical root and tuber vegetables" group.		
	US *42*	**Cod**	**EU *43***
Indoxacarb	0.01	---	0.02
	42. United States does not maintain a specific MRL for the Indoxacarb/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 43. European Union does not maintain a specific MRL for the Indoxacarb/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Root and tuber vegetables" group.		
	US *44*	**Cod**	**EU *45***
Lambda Cyhalothrin	0.02	---	0.02
	44. United States does not maintain a specific MRL for the Lambda Cyhalothrin/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 45. European Union does not maintain a specific MRL for the Lambda Cyhalothrin/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Tropical root and tuber vegetables" group.		
	US *46*	**Cod**	**EU *47***
Mandipropamid	0.01	---	0.01
	46. United States does not maintain a specific MRL for the Mandipropamid/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	47. European Union does not maintain a specific MRL for the Mandipropamid/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Root and tuber vegetables" group.		

	US *48*	**Cod**	**EU *49***
Metalaxyl	0.5	---	*{0.05}*
	48. United States does not maintain a specific MRL for the Metalaxyl/Cassava, Roots combination, but does maintain an MRL of 0.5 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	49. European Union does not maintain a specific MRL for the Metalaxyl/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Tropical root and tuber vegetables" group.		
	US *50*	**Cod**	**EU *51***
Methoxyfenozide	0.02	---	0.02
	50. United States does not maintain a specific MRL for the Methoxyfenozide/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Tuberous and Corm, Except Potato, Subgroup 1D" group.		
	51. European Union does not maintain a specific MRL for the Methoxyfenozide/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Root and tuber vegetables" group.		
	US	**Cod**	**EU *52***
Novaluron	0.05	---	*{0.01}*
	52. European Union does not maintain a specific MRL for the Novaluron/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Tropical root and tuber vegetables" group.		
	US *53*	**Cod**	**EU *54***
Oxamyl	0.1	---	*{0.01}*
	53. United States does not maintain a specific MRL for the Oxamyl/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	54. European Union does not maintain a specific MRL for the Oxamyl/Cassava, Roots combination, but does maintain an MRL of 0.01 PPM for its "Root and tuber vegetables" group.		
	US *55*	**Cod**	**EU *56***
Pymetrozine	0.02	---	0.02
	55. United States does not maintain a specific MRL for the Pymetrozine/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 56. European Union does not maintain a specific MRL for the Pymetrozine/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Root and tuber vegetables" group.		
	US *57*	**Cod**	**EU *58***
Pyraclostrobin	0.04	---	*{0.02}*
	57. United States does not maintain a specific MRL for the Pyraclostrobin/Cassava, Roots combination, but does maintain an MRL of 0.04 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 58. European Union does not maintain a specific MRL for the Pyraclostrobin/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Tropical root and tuber vegetables" group.		
	US *59*	**Cod**	**EU *60***
Pyrimethanil	0.05	---	0.05
	59. United States does not maintain a specific MRL for the Pyrimethanil/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 60. European Union does not maintain a specific MRL for the Pyrimethanil/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Tropical root and tuber vegetables" group.		
	US *61*	**Cod**	**EU *62***
Pyriproxyfen	0.15	---	*{0.05}*
	61. United States does not maintain a specific MRL for the Pyriproxyfen/Cassava, Roots combination, but does maintain an MRL of 0.15 PPM for its "Vegetable, Root and Tuber, Group 1" group. 62. European Union does not maintain a specific MRL for the Pyriproxyfen/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Root and tuber vegetables" group.		
	US *63*	**Cod**	**EU *64***
S-metolachlor	0.2	---	*{0.05}*
	63. United States does not maintain a specific MRL for the S-metolachlor/Cassava, Roots combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group. 64. European Union does not maintain a specific MRL for the S-metolachlor/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US *65*	**Cod**	**EU *66***
Sethoxydim	4	---	*{0.1}*
	65. United States does not maintain a specific MRL for the Sethoxydim/Cassava, Roots combination, but does maintain an MRL of 4 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	66. European Union does not maintain a specific MRL for the Sethoxydim/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Tropical root and tuber vegetables" group.		

	US *67*	**Cod**	**EU *68***
Spinetoram	0.1	---	*{0.05}*
	67. United States does not maintain a specific MRL for the Spinetoram/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	68. European Union does not maintain a specific MRL for the Spinetoram/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Root and tuber vegetables" group.		
	US *69*	**Cod**	**EU *70***
Spinosad	0.1	---	*{0.02}*
	69. United States does not maintain a specific MRL for the Spinosad/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Root and Tuber, Group 1" group.		
	70. European Union does not maintain a specific MRL for the Spinosad/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Root and tuber vegetables" group.		
	US *71*	**Cod**	**EU *72***
Spiromesifen	0.02	---	0.02
	71. United States does not maintain a specific MRL for the Spiromesifen/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	72. European Union does not maintain a specific MRL for the Spiromesifen/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Root and tuber vegetables" group.		
	US *73*	**Cod**	**EU *74***
Spirotetramat	0.6	---	*{0.1}*
	73. United States does not maintain a specific MRL for the Spirotetramat/Cassava, Roots combination, but does maintain an MRL of 0.6 PPM for its "Vegetable, Tuberous and Corm, Subgroup 1C" group.		
	74. European Union does not maintain a specific MRL for the Spirotetramat/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Root and tuber vegetables" group.		
	US *75*	**Cod**	**EU *76***
Tebufenozide	0.015	---	0.05
	75. United States does not maintain a specific MRL for the Tebufenozide/Cassava, Roots combination, but does maintain an MRL of 0.015 PPM for its "Vegetable, Tuberous and Corm, Except Potato, Subgroup 1D" group.		
	76. European Union does not maintain a specific MRL for the Tebufenozide/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Root and tuber vegetables" group.		
	US *77*	**Cod**	**EU *78***
Thiamethoxam	0.02	---	0.05
	77. United States does not maintain a specific MRL for the Thiamethoxam/Cassava, Roots combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Tuberous and Corm, Except Potato, Subgroup 1D" group.		
	78. European Union does not maintain a specific MRL for the Thiamethoxam/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Tropical root and tuber vegetables" group.		
	US	**Cod**	**EU *79***
Trifluralin	0.05	---	0.5
	79. European Union does not maintain a specific MRL for the Trifluralin/Cassava, Roots combination, but does maintain an MRL of 0.5 PPM for its "Tropical root and tuber vegetables" group.		
	US *80*	**Cod *81***	**EU *82***
Zeta-Cypermethrin	0.1	*{0.05}*	*{0.05}*
	80. United States does not maintain a specific MRL for the Zeta-Cypermethrin/Cassava, Roots combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Root and Tuber, Group 1" group. 81. The MRL is established for the sum of cypermethrin and zeta-cypermethrin. Codex does not maintain a specific MRL for the Zeta-Cypermethrin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Root and tuber vegetables" group. 82. European Union does not maintain a specific MRL for the Zeta-Cypermethrin/Cassava, Roots combination, but does maintain an MRL of 0.05 PPM for its "Root and tuber vegetables" group.		