



中国热带农业科学院
CHINESE ACADEMY OF TROPICAL AGRICULTURAL SCIENCES



Cassava Resources and their Utilization

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2022, 07, 07, Haikou Hainan, China.

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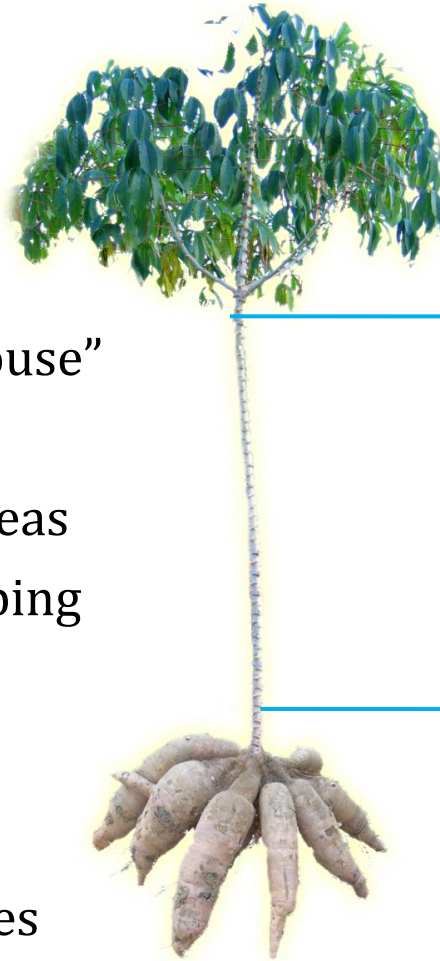


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CHINESE ACADEMY OF TROPICAL AGRICULTURAL SCIENCES

- 1. Background information**
- 2. How to identify cassava varieties**
- 3. How to get a new cassava variety**
- 4. Cassava products and food**
- 5. Training Course for Developing Countries**
- 6. International Cooperation**

Cassava is a wonder crop, the whole body is treasure.

- World's sixth biggest grain plant resource
- “King of Starch” and “Underground food storehouse”
- Basic food resource for 0.8 billion people in tropical areas
- Major cash crop for developing countries and areas
- Raw material for starch processing
- Plant for bio-energy reserves



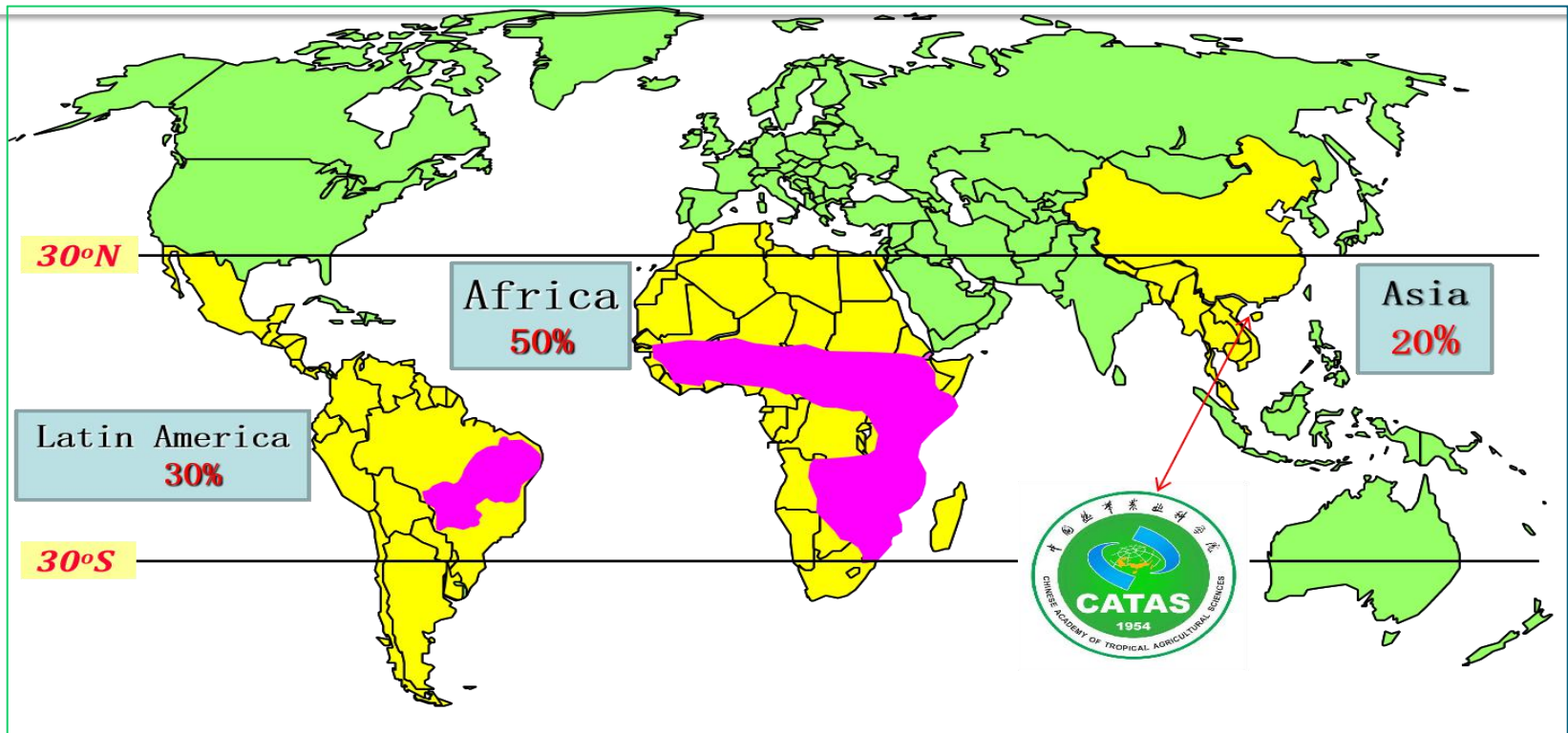
Usage of leaves: rich in protein. food、 feeding fish、 silage, feeding pigs, etc.

Usage of stems: fuel, planting material, fibrous material

Usage of tuberous roots : tapioca flour, feedstuff, starch, alcohol, etc.

World Distribution Map of Cassava Growing Regions

- It is presently grown as an annual crop in subtropical and tropical regions of the world. more than **100** countries plant cassava.
- An total plant area of **18.56** million hectares.
- Total yield **238** million tons of fresh cassava.



Top 20 Cassava Producing Countries In The World

Rank	Area	Production Value Of Cassava (in tons)
1	Nigeria	47,406,770
2	Thailand	30,227,542
3	Indonesia	23,936,920
4	Brazil	21,484,218
5	Angola	16,411,674
6	Ghana	15,989,940
7	Democratic Republic of the Congo	14,611,911
8	Viet Nam	9,757,681
9	Cambodia	7,572,344
10	India	7,236,600
11	Malawi	4,813,699
12	United Republic of Tanzania	4,755,160
13	Cameroon	4,596,383
14	China, mainland	4,585,000
15	Mozambique	4,303,000
16	Benin	3,910,036
17	Sierra Leone	3,810,418
18	Madagascar	3,114,578
19	Uganda	2,979,000
20	Rwanda	2,948,121

Harvested cassava ready to be processed



Cassava is rich in various nutrients

- **Roots of the plant are starch-rich with small amounts of vitamin C, phosphorus, calcium, dietary fiber and other nutrients.**
 - **Proteins and other nutrients are present in negligible amounts.**
- However, leaves of cassava are a rich protein source but deficient in certain amino acids.**



Nutritional test report of cassava

 **Sample name :**

Fresh root of sweet Cassava SC9

 **Sample source :**

Danzhou Hainan China

 **Sampling time :**

In November 2013,

 **Planting time :**

Ten months


F 2012 20 0025

共 6 页 第 1 页
Page No.1 / 6

NO: P-WL1311021W

检 验 报 告

INSPECTION REPORT

样品编号: P-WL1311021W-33

样品名称: 鲜木薯 (SC9)
Name of Sample: _____

委托单位: 广西大学
Inspected Entity: _____

报告日期: 2013年11月18日
Issued Date: _____

广西壮族自治区分析测试研究中心
Guangxi Zhuang Autonomous Region Center for Analysis and Test Research



Nutritional test report of cassava

Mineral substances and other nutrient substance

Number	Inspection items	Unit	Detection Results	Inspection methods
1	phosphor (P)	mg / 100g	54.4	GB/T5009.87-2003
2	calcium(Ca)	mg / 100g	32.9	GB/T5009.92-2003
3	iron(Fe)	mg / kg	1.55	GB/T5009.90-2003
4	magnesium(Mg)	mg / 100g	20.0	GB/T5009.90-2003
5	manganese(Mn)	mg / kg	8.2	GB/T5009.90-2003
6	sodium(Na)	mg / 100g	5.21	GB/T5009.91-2003
7	kalium(K)	mg / 100g	344	GB/T5009.91-2003
8	protein	g / 100g	1.21	GB5009.5—2010
9	vitamine C	mg / kg	461	GB/T5009.83 -2003
10	dietary fiber	g / 100g	2.05	GB/T5009.88-2008
11	total amino acids	mg / 100g	684.45	GB/T5009.124—2003
12	β-carotene	mg / kg	1.80	GB/T5009.83-2003

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5. Training Course for Developing Countries
6. International Cooperation

Cassava varieties

┆ Cassava varieties are often described as being bitter or sweet. Although the description of bitter and sweet mainly refers to the taste of the raw roots, there is some correlation between high cyanogen/bitter roots and low cyanogen/sweet roots.

┆ Concentrations of cyanogens in roots, is however, affected by environmental growth conditions. This means that some varieties generally considered sweet can have a high cyanogenic potential under certain conditions.

Concentrations of cyanogens in roots, affected by environmental growth conditions

For example: South China series cassava varieties growing in different planting areas showed different levels of cyanide.

Sampling location: in Hepu county of Guangxi, Jiangxi dongxiang county, Baoshan city, Yunnan, Hainan Baisha county, Guangdong Zhanjiang, etc;

Planting time: 10 months


Sample processing: Fresh cassava root; peeled and cooked before determination.


Determination of time: in November 2010

79 different cassava varieties were detected; Hydrogen cyanide content value is 47.54 ~ 449.91.

Varietal name	Hydrocyanic Acid (HCN) (mg/kg)
SC5	80.17 ~235.98
SC6	205.6 ~304.71
SC7	107.80~278.44
SC8	47.54~255.87
SC9	92.5~255.87
SC10	157.36~264.43
SC205	109.20~245.49

Cassava Cyanogens

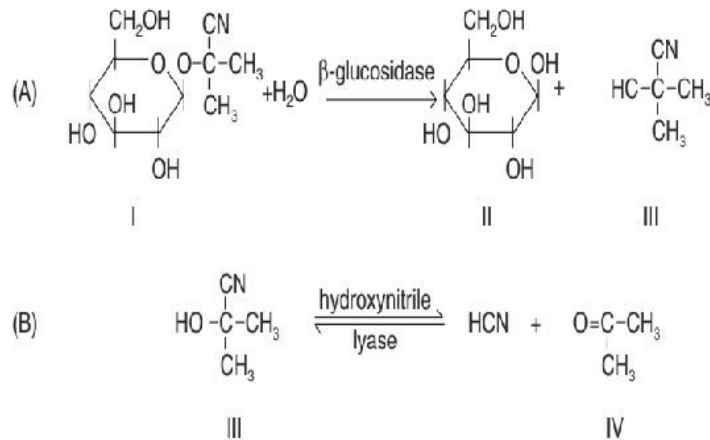
 **Cassava contains cyanogenic glucosides, which, together with their breakdown products (cyanohydrins and free HCN) formed during processing, can cause health problems.**

 **Acute intoxication, manifested as vomiting, dizziness or even death, can occur under very rare conditions. Such poisoning occurs when food shortage and social instability induce shortcuts in established processing methods, or when high cyanogen varieties are introduced into an area lacking appropriate processing techniques .**

Cyanogen removal during processing

🎁 The cyanogenic glucosides present in fresh cassava roots are linamarin (93%) and lotaustralin (7%) .

🎁 Linamarin is stored in the vacuoles of the cassava cells . It is hydrolysed to the corresponding ketone (acetone cyanohydrin) and glucose by the endogenous enzyme, linamarase, when cellular damage occurs Linamarase is situated in the cell wall physically separated from linamarin.



Enzymatic breakdown of linamarin, Compound 1 (from Conn, 1994). Compound III, (acetone cyanohydrin) also breaks down at a rate dependent upon pH and temperature.

- ✓ Grating of peeled roots and Fermentation
- ✓ Water soaking
- ✓ Fermenting
- ✓ Cooking
- ✓ Roasting
- ✓ Steaming
- ✓ Drying
- ✓ Industrial production of edible starch

Sweet Cassava or Bitter Cassava ?

There are two kinds of cassava varieties, one is sweet cassava and the other one is bitter cassava, CAC Standard is used to distinguish sweet cassava from bitter cassava.

Codex Stan 238	Standard for Sweet Cassava	Hydrogen Cyanide content <50mg/kg (on a fresh cassava weight basis, be peeled and cooked before determination)
Codex Stan 300	Standard for Bitter Cassava	Hydrogen Cyanide content ≥50mg/kg (on a fresh cassava weight basis, be peeled and cooked before determination)

CAC(Codex Alimentarius Commission) was found by FAO and WHO together, CAC Standards were generally recognized all over the world, and its aims to protect consumers health, enhance food fair trade, and draw up food standards together; has 165 member States, China is one of them.

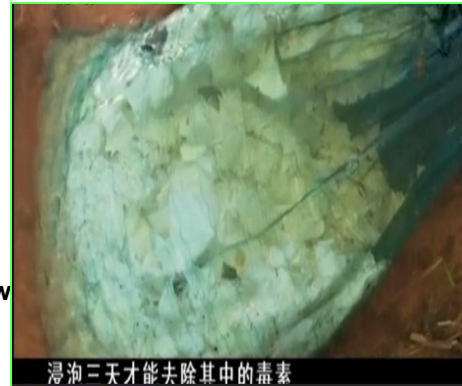
一、Introduction

Methods of traditional edible cassava

Sweet cassava: to skin layer 2, can be baked, boiled, Fried cooking methods, such as eating;



Bitter cassava: to skin layer 2 , the flow of water soaked in 3 ~ 7 days (or stacked natural fermentation in 7 days or so) by cooking before eating;



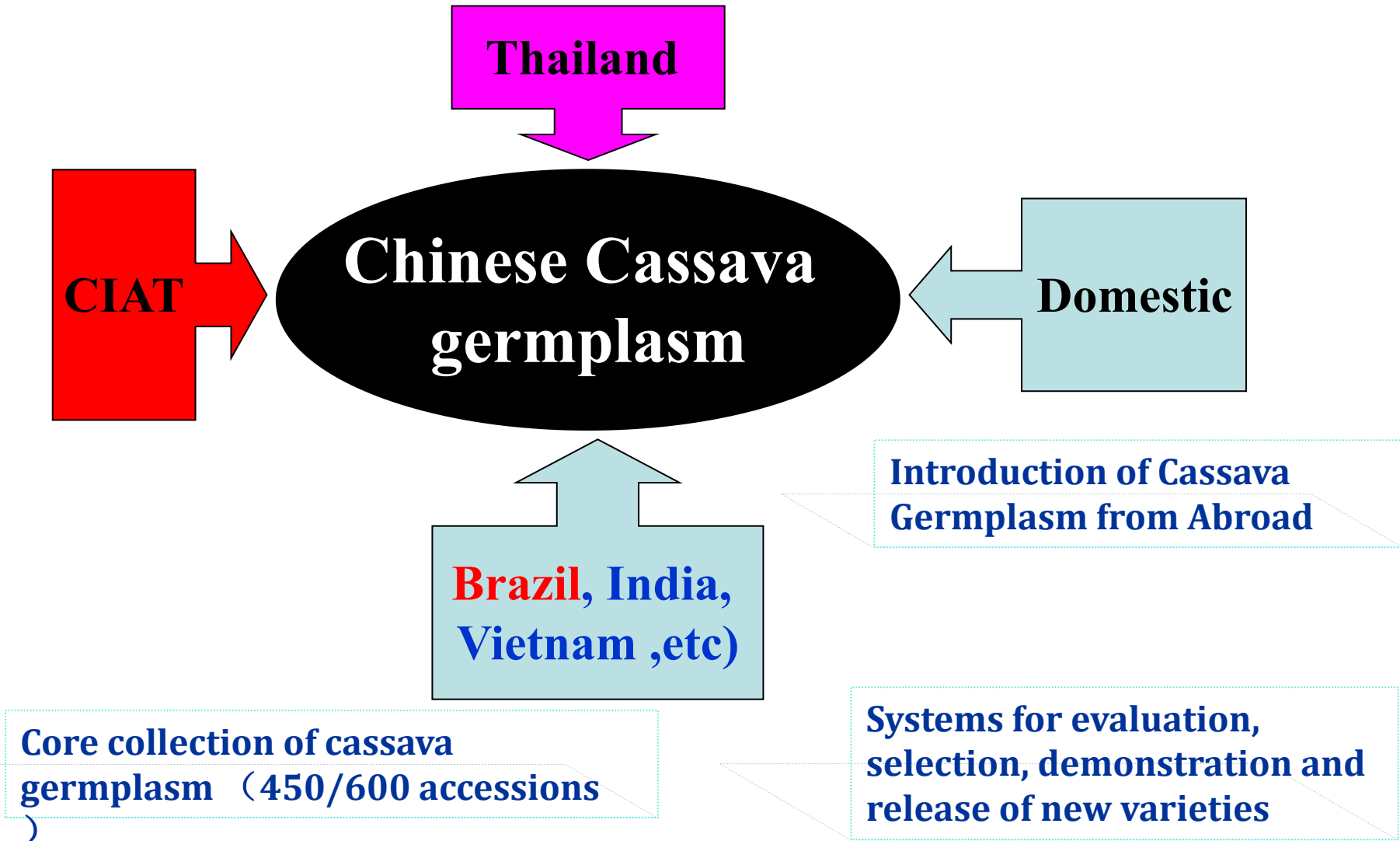
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1. Germplasm Collections and Conservation





Germplasm collection from CIAT (in vitro)

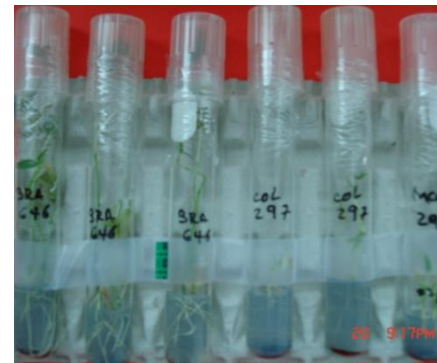
Germplasm collection from EMBRAPA (in vitro)



1. Germplasm Collections and Conservation

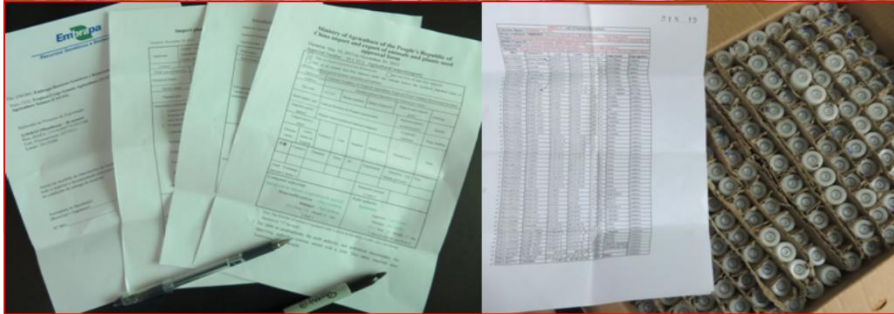


- Stake/stem
- Botanical seeds.
- Tissue culture seedlings
- Artificial seed



Tissue culture seedlings Botanical seeds.

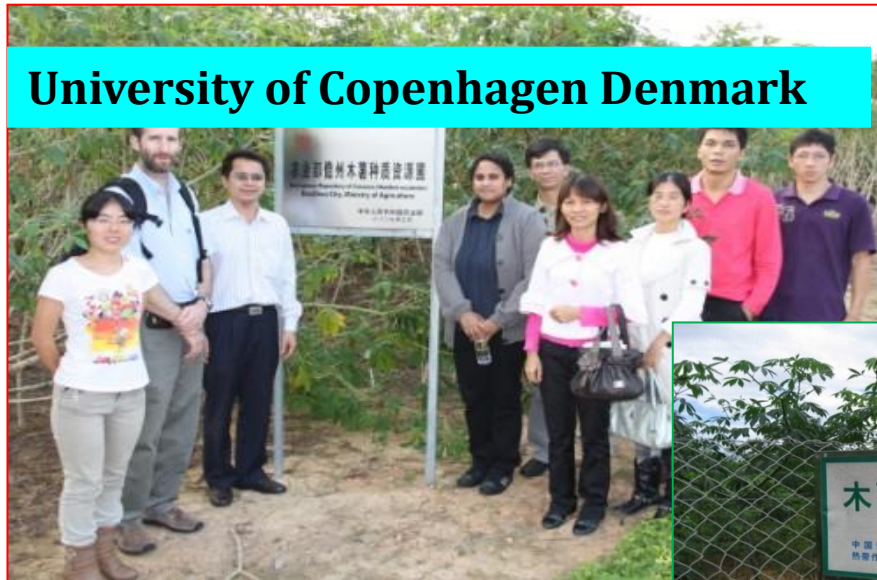
Cassava *In vitro* genebanks at the lab of CRC



Chinese Cassava Genetic Resource Garden



Chinese Cassava Genetic Resource Garden



2. Setting up a breeding program

Objectives of Cassava Variety Improvement in China

- High root yield, high dry matter content, high starch content (**28~30%** \Rightarrow **32%, 34%**) .
- Early harvesting(**6-7 MAP**).
- Adaptation to unfavorable conditions (**cold weather , drought, leanness, etc**).
- High resistance to diseases and pests (**CBB, mite, etc**)
- High tolerance to low temperature (**near by the 30 degrees of north latitude**)
- High converting rate to alcohol /ethanol. (**e.g,with higher percentage of amylose>35%**)

Parents with complementary traits were selected to carry out cross pollination and obtain sufficient number of hybrid seeds.



a (♂) × b (♀)

OR

a (♀) × b (♂)



FEMALE

Pollination



MALE

Fruits and botanical seed



Germination of seed
produced from crosses
between elite germplams
[F1 STAGE]



Clonal evaluation trials



Harvest index measurement



Starch determination

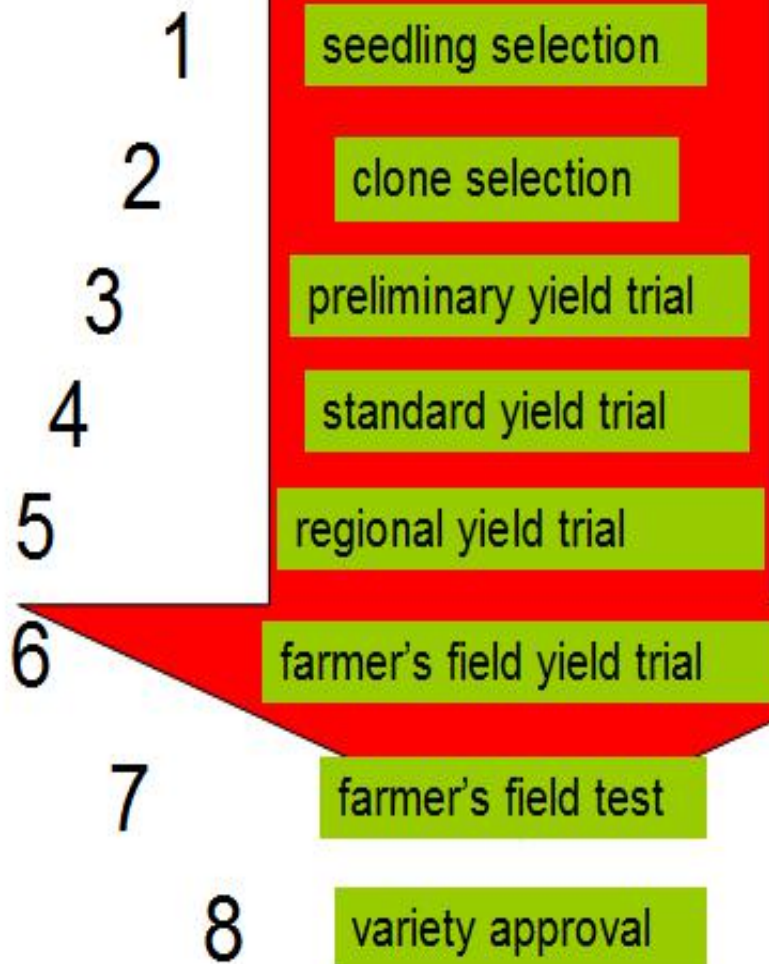


Cassava Variety Improvement Flow

Conventional cross-breeding

Collection, Introduction

Hybridization



flower



pollination



seeds



generation



fruits



F1

3. Several New varieties Introduce

Approval year	Variety	Yield (t/ha)	Remark
2015	SC13	55	Grow fast /high starch content
2014	SC12	40	Food and industrial application
2011	SC11	45	broadly adaptable
2006	SC10	45	broadly adaptable
2005	SC9	30	Sweet for food/ early harvest
2004	SC8	45	fast maturing
2004	SC7	45	with high protein in leaves
2001	SC6	45	anti-wind
2000	SC5	60	broadly adaptable/early harvest
1994	SC8013	35	broadly adaptable / for food
1994	SC8002	35	broadly adaptable/ for food
1988	SC124	45	broadly adaptable/cold tolerance
1960	SC6068	30	Sweet for food /cold tolerance

18 cassava varieties have been released and cultivated over 11 million Ha during 30 years.





SC5



SC6



SC7



SC8

South China 5

Origin

selected from hybrid of
ZM8625 × SC8013

Average yield

30-45 t/ha

Starch content

30%~32%

Maturation time

8-12 months after planting



South China 8

Origin

selected from hybrid of
CMR38-120

Average yield

30-45 t/ha.

Starch content

32%~33%

Maturation time

8-12 months after planting



GR891

Origin

selected from hybrid seeds
introduced from CIAT

Average yield

30-45 t/ha

Starch content

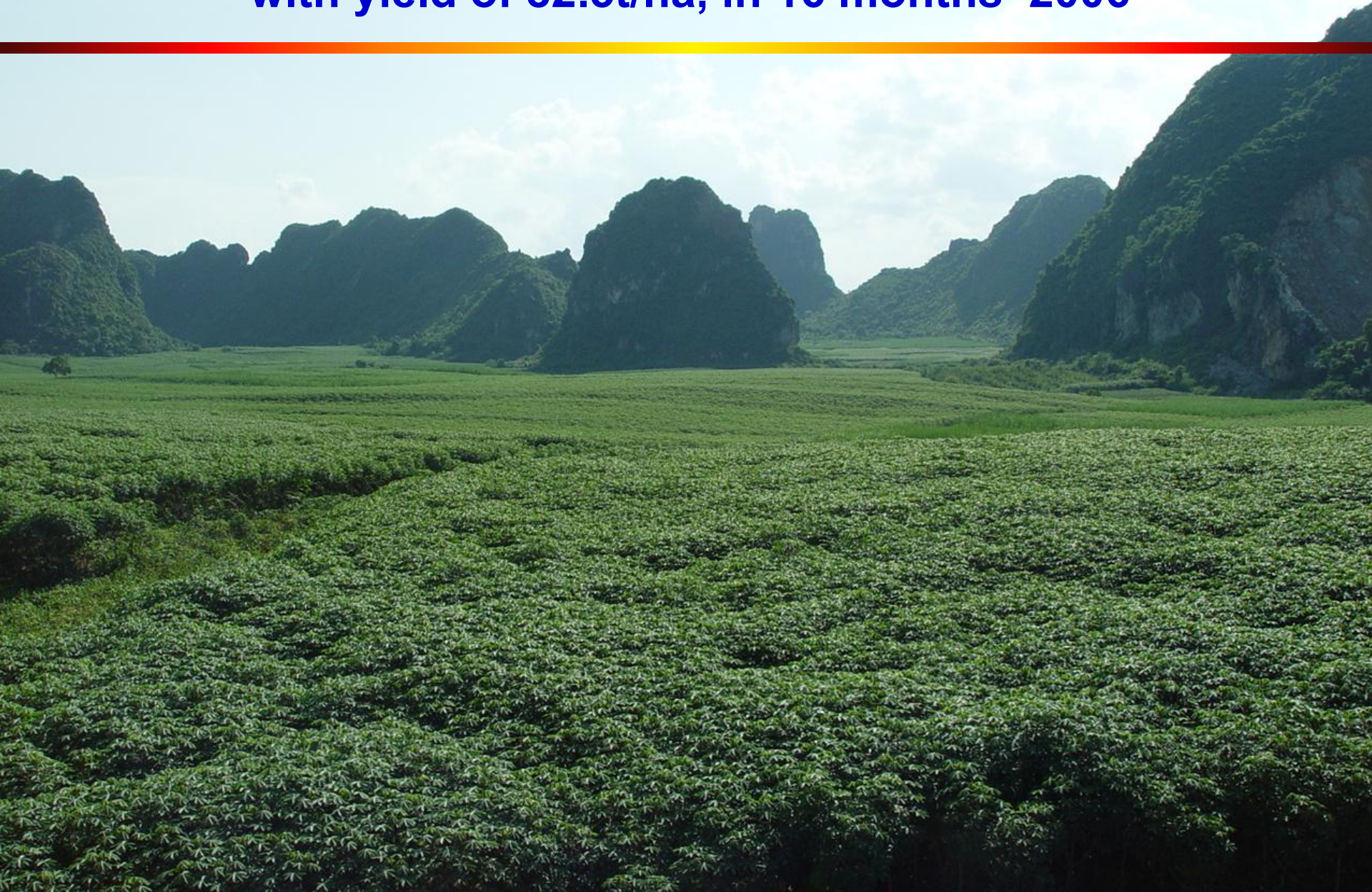
about 28%

Maturation time

8-12 months after planting



**Cassava grown under better soil condition in Guangxi
with yield of 82.5t/ha, in 16 months 2006**



Cassava planted in sand soil lower land, had over 45t/ha yielding in 200 ha area in Hainan island, 2004-2006



2005 7 9

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Main processed products of cassava

Sweet Cassava or Bitter Cassava?

If Cassava for Industrial Processing Is Excluded!

- ✓ **Cassava starch**
- ✓ **Edible cassava starch**
- ✓ **Cassava modified starch**
- ✓ **Cassava based feed**
- ✓ **Cassava alcohol** (including edible alcohol 、 fuel ethanol)
- ✓ **Others: Starch Sugar, Degradable Plastic, etc**



Main processed products of cassava

In China: More than 90% of cassava planted in China is bitter cassava and for industrial processing purpose.



Main processed products of cassava

Adding value through processing and business development

鲜薯
650-700元/吨



淀粉 (鲜薯4吨)
3800元/吨
产值提升35.7%



食品用变性淀粉 (淀粉1.05吨)
6000元/吨
产值提升104.1%



Main processed products of cassava

Adding value through processing and business development

食用鲜薯
600-700元/吨



木薯粉 (鲜薯4吨)
8000元/吨
产值提升185.7%



木薯粉系列食品
(木薯年糕为例, 500个/吨)
15000元/吨
产值提升435.7%



木薯年糕

HQCF, High Quality Cassava Flour

Inspection Report of Cassava starch and HQCF nutrients

TEST INDEX	UNIT	HQCF (GR891)	Cassava starch
Hydrocyanic acid	mg/kg	1.6	0.077
phosphorus (P)	mg/100g	18.43	9.58
calcium (Ca)	mg/100g	2708	61.5
magnesium (Mg)	mg/100g	163	2.39
manganese (Mn)	mg/100g	5.90	0.24
sodium (Na)	mg/100g	31.1	0.99
iron (Fe)	mg/100g	37.0	1.60
potassium (K)	mg/100g	401	20.6
Dietary fiber (TDF)	g/100g	4.82	0.34
Total amino acid	g/100g	671.7	0.03
β -carotene	mg/kg	0.92	Did not check out
tryptophan	g/100g	0.09	0.01
protein	g/100g	1.84	0.50
Vitamin C	mg/100g	2.08	1.59

HQCF, High Quality Cassava Flour

Advantages of HQCF in the food industry

(not-direct edible)

➤ Comprehensive nutrition

keep most of the drying matters of cassava: mineral substance, dietary fiber, protein, vitamin, amino acid, microelement, non-starch polysaccharide, etc;

➤ Special flavour

keep mostly the flavours of cassava;

➤ Wide usage in foods

could meet process and application requirements;

➤ Easier storage

convenient and safe storage and transportation, long shelf life;

It is better to develop nutritional, functional foods, low sugar, low salt, low fat, low calorie and high fiber foods.

4 Cassave based food in China



4 Cassave based food in China



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4 Cassave based food in China



Taste the cassava food!



Taste the cassava food!



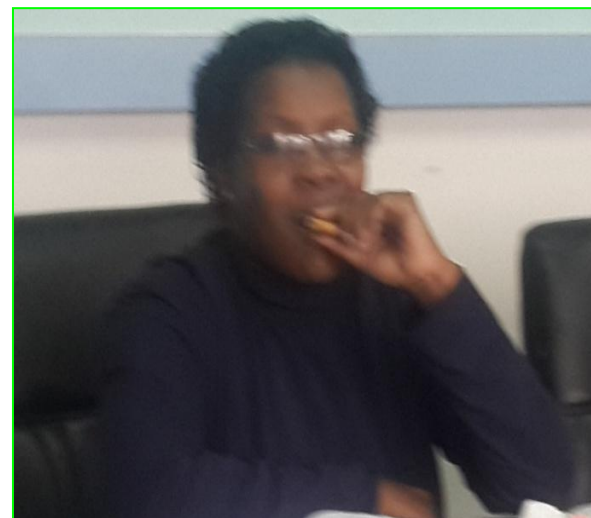
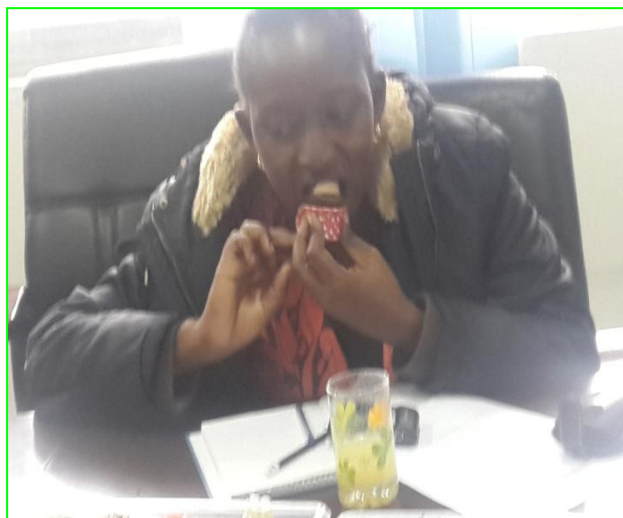
Taste the cassava food!



Taste the cassava food!



Taste the cassava food!



Taste the cassava food!



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5. Training Course for Developing Countries



5. Training Course for Developing Countries



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B

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D

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6. International Cooperation

- Setting up long-term and friendly cooperation relationship with CIAT, Embrapa, IITA, ISTRC, FAO, UOG, BMGF...



6. International Cooperation



Setting up long-term and friendly cooperation relationship with CIAT、Embrapa、IITA、ISTRC、FAO、UOG、BMGF...



6. International Cooperation



“椰岛奖纪念奖” Kawano 博士（中）与现任中国热带农业科学院副院长、
国家木薯产业技术体系首席科学家李开绵研究员（右）在木薯基地工作留影。



SINCE 1982, established and strong working relationships with the International Center for Tropical Agriculture (CIAT)



6. International Cooperation



The image shows a screenshot of the CATAS website. At the top left is the CATAS logo, a circular emblem with 'CATAS' and 'INTERNATIONAL SCIENCES' text. To its right, the main header reads '开放办院 特色办院' in large red characters. Below this is a dark blue navigation bar with white text: '科学院概况', '院领导', '组织机构', '科研管理', '科研条件', and '国际交流'. Underneath is a '重要新闻' (Important News) section with a blue banner for the article '国际热带农业研究中心主任一行访问我院'. Below the banner, the author is listed as '国际合作处' and the publication date as '2009-01-21', with a click count of '626'.



In August 2009, Dr. Ruben Echeverria, the DG of CIAT, with a group of 5 people visited CATAS

International cooperative platforms



中国-巴西蛋白质组学联合实验室

China-Brazil Joint Proteomics Laboratory





中国-尼日利亚木薯中心 China-Nigeria Cassava Center





China -Aided the Republic of Congo Agricultural Demonstration Center (CCADC)



- A, The review of CCADC blueprint in Congo (Brazzaville);
 B, Mr. Hui Liangyu Vice Premier of China and Mr. Denis Sassou-Nguesso President of Congo (Brazzaville) attended the unveiling ceremony of CCADC in Sept 4, 2012;
 C, Vice president of CATAS, prof. Liu Guodao answered the questions issued from reporters in CCADC.

中国--刚果（布）农业试验站 China-Congo Agro-Exp. Station



Screening germplasm that tolerance to CMD



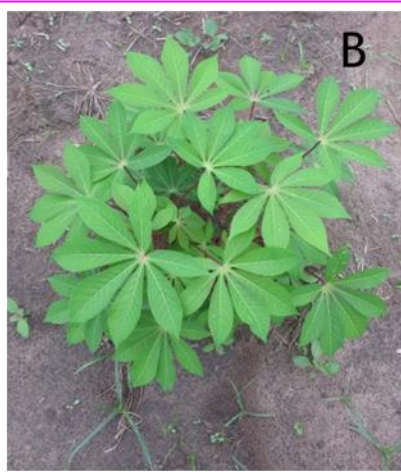
The Republic of Congo

Sensitive to CMD

Tolerance to CMD

Screening lines

Line K265



- Result: *Line K265 and line 193 have a very good ability to tolerance CMD.*
- South China series of cassava varieties infected Mosaic virus (data from 薛茂富)。

International cooperative platforms

China Cassava Variety in Africa



Democratic Republic of the Congo

International cooperative platforms

中国—英国—乌干达木薯项目

China-UK-Uganda cooperative Project



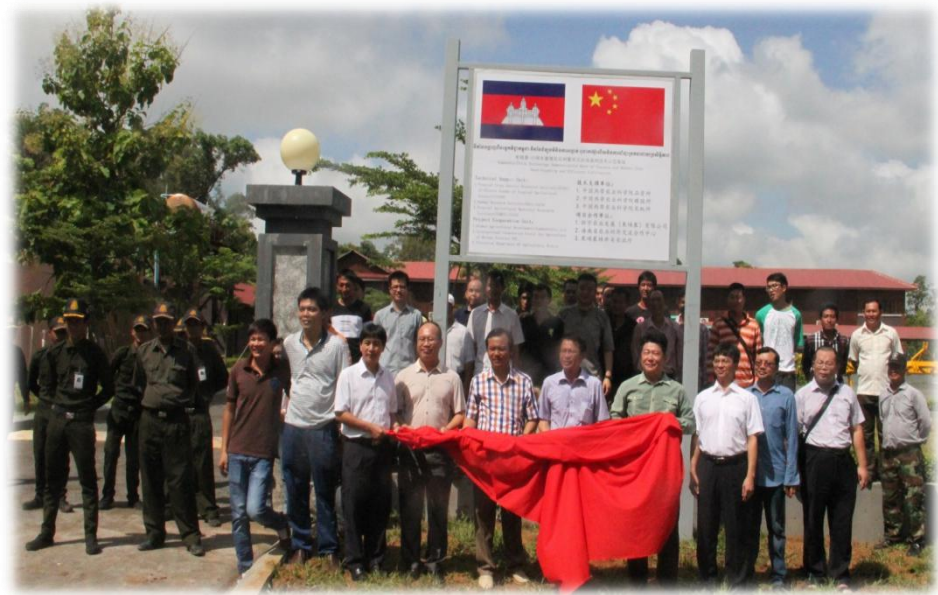
Project Planning meeting for AgriTT RCF Project held from 21-22 May, 2014 at the headquarters of AII in Kampala, Uganda



September 2016, Dr. Xie Caifeng, an expert in cassava processing, has been to Makerere University in Uganda to jointly carry out research and development on miniaturization technology of cassava flour production.



In October 2016, cassava planting experts (Xue Maofu and Jian Chunping) went to Uganda Cassava Production Demonstration Park to provide technical assistance for mechanized production and harvest of cassava.



中国-柬埔寨农业试验站 China-Cambodia Agro-Exp. Station





中国-柬埔寨农业试验站 China-Cambodia Agro-Exp. Station



CATAS has a very strong cassava research team

Research areas include collection, conservation, identification and evaluation of cassava germplasm resources, breeding, cultivation, processing, disease and pest control, bioinformatics and market information; Through many years of research has achieved fruitful results.



**Thanks for your attention and
look forward to future cooperation!**

