RESEARCH FOR DEVELOPMENT

CSIR-CROPS RESEARCH INSTITUTE, CSIR-CRI, KUMASI

GHANA SWEETPOTATO IMPROVEMENT PROGRAMME

CSIR-CRI SWEETPOTATO IMPROVEMENT PROGRAMME (2011)

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Goal of Sweetpotato Improvement : Crop for *leading role* in Rural Socio-economic Development in West Africa Sub-region via Food Security, Poverty Reduction, Micronutrient Nutrition, Increased Incomes & Employment Creation

MAIN POINTS OF THIS SPECIFIC PRESENTATION.

- BACKGROUND
- IMPORTANT CONSTRAINTS
- PLANS TO TACKLE THE CONSTRAINTS
- ROUTINE ACTIVITIES 2011
- ACHIEVEMENTS

BACKGROUND

- **Sweetpotato**

- ✓ Is the third most important root and tuber crop after cassava and yam in Ghana.
- ✓ Has an estimated production of 200,000 metric tons.
- It has a unique and huge potential as
- ✓ an affordable source of energy.
- ✓ nutrients eg beta carotene for combating vitamin-A deficiencies.
- ✓ food security and raising incomes.

Orange flesh sweetpotato for vitamin

Sweet potato for Export

- **Has immense diversity and adaptability potentials. Could be used in wide range in W. Africa as**
- **food staple**
- **Industrial crop and as**
- **Alternate/additional food security crop**

These are yet to be explored & tapped in W. Africa.

CHALLENGES.

1. **Despite its acclaimed potential, it faces the challenge of assured markets with attendant implications along the commodity chain. The crust of the matter: People want to eat it 'part –time' in West Africa. We desire 'full-time' eating.**

2. **Major processing and industrial use is almost non-existent in the sub-region.**

3. ***Yield decline and wiping out and loss of some lines attributable to the sweetpotato virus complex. Fortunately the released varieties are tolerant though signs that this would not continue are there. Tolerance is key to any releases.***

Efforts to address these challenges, aside from the normal biotic and abiotic stresses, would be highlighted in the presentation.

One thing is clear: with climate change issues on the horizon, there is the need for attitude change to this crop!

Research Team

Name	Discipline
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Mr. E. Baafi	Breeder
Mr. K. Adofo	Breeder
Dr. Henry Asumadu	On-Farm Agronomist
Dr. E. Moses	Pathologist
Mrs. E. Adu-Kwarteng	Food Scientist
Mr. A. Aubyn	Tissue Culture Specialists
Mrs. M. Quain	Molecular Biologist
Mr. J. Asibuo	Breeder/Molecular
Dr. J.N.L. Lamptey	Virologist
	Socio-economist
Dr. G. Bolfrey-Arku	Weed Scientist
Mr. N. Asamoah Obeng	Chief Technician
Mr. Joseph Ewudzi	Chief Technican
Ms. F. Nyarko	Senior technician

Collaborating Persons

- Dr. Ted Carrey. Sweetpotato Action for Safety and Health in Africa (SASHA), CSIR-CRI, Fumesua. Collaborating Breeder
- Dr. Harrison Dapaah. Univ of Edu, Winneba, Mampong Campus. Collaborating Breeder

- CSIR-Plant Genetic Resources Research Institute (CSIR-PGRRI)
- Biochemistry and Biotechnology Dept., KNUST

- Ministry of Food and Agriculture (MOFA) – RTIMP and Extension and Crop Services Directorates
- Ministry of Health – Nutrition Dept.
- NGOs
- Farmers/FBOs/Farmer Groups
- International Potato Centre (CIP), Peru

Current Projects

CSIR-CRI SWEETPOTATO IMPROVEMENT PROGRAMME

A. Development of high and stable yielding consumer preferred and accepted sweetpotato varieties.

B. Production and distribution of healthy primary (breeder) planting materials for technology transfer.

C. Promotion of improved varieties for consumer acceptability and utilization.

A. DEVELOPMENT OF HIGH AND STABLE YIELDING CONSUMER ACCEPTED SWEETPOTATO VARIETIES.

Goal. Develop improved varieties with quality in terms of consumer acceptance, processing and nutritional value (high beta-carotene, dry matter and starch and flour contents).

Specific objectives

1. Collect and conserve local and exotic germplasm

2. Morphological and molecular characterization of germplasm

3. Hybridization of parental clones by introgression of desirable genes into adapted germplasm

4. Test the adaptability and acceptability, in multi-locational testing, of elite and promising sweetpotato genotypes through farmer participatory research to develop, generate and release new varieties that incorporate growers' and consumers' preferences

1 & 2. Characterization evaluation, conservation and selection of desirable genotypes for genetic improvement. Results (2010)

- **The sweetpotato improvement programme is continuing the process of broadening the genetic base of our germplasm for population development. and selection of desirable genotypes for genetic improvement (with special emphasis on OFSP)** Germplasm in our collection have been characterized and evaluated for (i) germplasm documentation (or data base development); (ii) For the identification of parental genotypes and (iii) development of elite lines based on specific desirable traits and incorporation of the desired traits into breeding populations.

Collection, characterization, eEvaluation and conservation of local and exotic germplasm and selection of desirable genotypes for genetic improvement

Treatments: In 2009 we had 84 clones/germplasm/elite genotypes/varieties collected locally (48) and introduced (36) that were characterized in 2010 and reported on.

Characterization is carried out as we receive new materials in our collection. Molecular characterization is at the molecular biology laboratory at CSIR-CRI.

Data collected (using the CIP/AVRDC/IBPGR (1991) Descriptor for Sweetpotato) if we receive new materials:

- **Morphological characteristics – plant type (total vine length), vine length/ branch, number of branches, vine girth, vine length from soil to first tuber, vine apex colour, pubescence, colour of young leaf, petiole colour, leaf vein colour, leaf shape, SPVD score, etc.**
- **Tuber characteristics- tuber skin colour, tuber shape, tuber flesh colour, tuber number/plant, tuber weight/plant, weevil score, dry matter.**
- **Physico-chemical analysis- sugar content, starch, flour, beta-carotene (for only OFSPs).**
- **Sensory evaluation – consistency, texture, sweetness, acceptability (mostly boiled and fried roots).**
- **Molecular characterization (to be carried out by CSIR-CRI Biotechnology team).**

- **The programme was to embark on targeted germplasm collection in the Central, Brong-Ahafo, the Upper East regions, where major sweetpotato cultivation takes place and the Upper West and Northern regions, where some minor cultivation takes place. This has not yet been done**

The process of acquisition of more orange-fleshed sweetpotato (OFSP), non-sweet or low sugary sweetpotato genotypes from CIP and other regional centres known for sweetpotato research (e.g Asia – especially China, Japan, Indonesia) on supply of germplasm is on going.

3. Hybridization of parental clones by introgression of desirable genes into adapted germplasm

Objectives:

a. To develop population/lines of suitable cultivars for different end user needs

b. To establish crossing blocks and undertake genetic crosses from suitable local, exotic and improved germplasm.

c. Specifically improve the dry matter content of the orange-fleshed sweetpotato varieties

d. Select for non-sweet or low sugar varieties

a. Develop distinct population groups (pools) of suitable cultivars for different end user needs. Current focus

1. Non sugar/Low sugar varieties for staple foods, industrial processing HQSPF and for food security

2. High sugar Traditional usage)

varieties for beverage confectonaries,pastries, desserts,snacks breakfast foods and as substitutes

High yield/ high DM/ Stable yield/ disease And pest tolerant Varieties released or targeted for release

3. High Beta-carotene Rich varieties To Combat Vit A deficiency --a Hidden hunger

THE NEED FOR THE NON-SUGAR/LOW SUGAR VARIETIES

- Major staple foods in Ghana : 1. Fufu, 2. Ampesi, 3. Kenkey, 4. Banku, 5. T.Z, 6. Gari, 7. Boiled Rice, are prepared almost exclusively from Plantain, cassava, yam, maize, sorghum & rice.

- They leave no sugary 'after taste' and are considered as preference in staple food preparations. Sweetpotato leaves a sugary 'after taste' acceptable in desserts but not in staple food preparations in Ghana and most parts of West Africa sub-region.

- The Major Challenge to the development and acceptance is for sweetpotato to be one of the above crops in our staple diet preparations for consumption for majority of the urban and rural population in Ghana and in West Africa.

b. Establish crossing blocks and undertake genetic crosses from suitable local, exotic and improved

Hand pollination

Sprouted seeds in Petri dish

Seedling transplanting

Sweetpotato crossing block undertaking genetic crosses from suitable local, exotic germplasm and improved varieties at Fumesua

Example of roots from 2009 crosses (seeds obtained from Kenya) planted in 2010 at Fumesua:
OTAOLA (High dry matter) X TAINUNG 65 (Beta-carotene)

Preliminary evaluation of F_1 lines or progenies

- F_1 lines or progenies are both controlled and open-pollinated (polycross) seeds from the crossing block established in 2008 and 2009; and seeds (both open-pollinated and controlled) from CIP-Uganda and NaCCRI-Uganda.

- **Seeds collected from the hybridization block in 2009 and seeds obtained from Mozambique, Kenya and Uganda were scrarified and nursed at Fumesua (31st May 2010 and 14th June 2010). Cuttings at the nursery was done after one month and these F_1 lines were planted at three locations (Fumesua, Ejura and Ohawu). They are harvested. Data was collected on virus infestation, yield, flesh and skin colors. The superior materials have been planted in Preliminary Yield Trials (PYT) in 2011**

Table 3. Details of seed collection in the hybridization block at Fumesua, 2010, to be planted in 2011

Month	Total Crosses	Seeds Collected	Open Pollinated	Cross Pollinated
May	205	immature	-	
June	3,025	immature	-	
July	5,045	3,827	1,716	2,111
August	3,251	7,033	3,988	3,045
September	2,506	6,423	4,231	2,192
October	2,987	2,976	1,887	1,089
Total	**20,006**	**20,259**	**11,822**	**8,437**

seeds collected in the hybridization block at Fumesua, 2010, would be planted in 2011. WORK AT THE HYBRIDIZATION BLOCK IS CONTINUOUS AND WOULD CONTINUE IN 2011BEGINNING WITH REPLANTING

Testing adaptability and acceptability of sweetpotato genotypes through farmers participatory research, 2011

Varietal trial on-station. 2011

Objectives:

- test the adaptability and acceptability of elite sweetpotato genotypes by growers and consumers.
- assess the G x E interaction across the major agro-ecological zones
- select at least two of the best adaptable and acceptable elite genotypes and propose them for release to farmers

Design: **RCBD, 3 Reps; 4 rows, 4.8m long, 1m between rows, 30cm between plants, 17 plants/row, harvest 2 central rows.**
Locations: **Fumesua, Ejura, Pokuase, Ohawu and Kommenda.**

Entries: **14 entries (5 elite + 9 released varieties).**

	Genotype	RT. Skin color	RT.Flesh color	RTYLD	DM	Year released
	1. Mohc	*Cream*	*Light orange*			
	2. 199062.1	*Pale orange*	*Pale yellow*			
	3. Cemsa 74-228	*Cream*	*Pale yellow*			
	4. Kemp 37	*Purple*	*White*			
	5. Ningshu-1	*Purple brown*	*White*			
	6. Apomuden	Orange	Deep Orange	30(t/ha)	21.9%	2005
	7. Otoo	Cream	Light Orange	23	32.2	2005
	8. Ogyefo	Light purple	White	20	40.1	2005
	9. HI-Starch	Creamy brown	Cream	18	40.0	2005
	10. Sauti	Cream	Yellow	19	40.2	1998
	11. Faara	Deep purple	White	22	36.1	1998
	12. Okumkom	Light purple	White	20	30.7	1998
	13. Santom Pona	White cream	Light Yellow	17	34.4	1998
	14. Tek Santom	Cream	Yellow			
	15. Farmer Variety					

- *Data collected (CIP standard for all trials):*
- Stand (Establishment) count at 1 month after planting; No. of plants harvested
- Fresh vine weight (upper biomass yield)
- Number of marketable roots; Weight of marketable roots
- Number of non-marketable roots;Weight of non-marketable roots
- Storage root dry matter content (200 g root samples dried at 80^{o}C for 48 hours)
- Harvest index (HI) [(Total root wt.)/(Total root wt. + Fresh vine wt.)]
- Commercial harvest index (CHI) [(Wt. of marketable roots)/(Wt. of marketable root + Wt. of unmarketable roots) x 100)]
- Severity and incidence of SPVD (at 2, 3 and 4 Mnth after Planting & Harvest)
- Counts of cylas infestation – severity & incidence; Millipede damage - number and weight of tubers
- Skin colour; Flesh colour (use CIP colour chart)
- Alcidodes - Incidence & Severity; Rodent damage; No. of cracked tubers; Exposed tubers
- Sensory evaluation (appearance, consistency, texture, sweetness, acceptability)
- Ampesi (Boiled roots) - Fries (Deep fried root

4.Testing adaptability and acceptability of sweetpotato genotypes through farmers participatory research

4.3 Varietal trial on-farm 2011

Methodology: *Locations targeted:*

- **10 on-farm locations in Volta regon:**

  (Adidome, Akatsi, Ohawu, Ehi, Avalavi, Kudzordzikope, Xantroli, Hife Devego, Avelime).

- **10 on-farm locations in Central Region regon:**

  (Komenda, Koforidua, Dahia, Gomoa East (Afransi), Akroful, Winneba, Agona Swedru, Mankesim, Okyereko, Jukwa Krobo, Gomoa Potsin).

- **6 on-farm locations in Greater Accra Region:**

  (Sege area 6 locations------JJ farms; Amuyawkope; Ayisa; Sege and two other locations in Sege area).

5 ridges per plot (entry), 5.1m long, 1m between ridges, 30cm between plants, 17 plants/row, harvest 3 central ridges of 15plants/ridge

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On-Farm 2011

FARMER REP 1					
101 Kemb 37	102 199062.1	103 Mohc	104 Cemsa 74-228	105 Ningshu-1	106 Farmer Variety
FARMER REP 2					
201 Ningshu-1	202 Cemsa 74-228	203 199062.1	204 Kemb 37	205 Mohc	206 Farmer Variety

. Farmers assessing sweetpotato varieties on-farm

Farmer assessment of each Variety

For each Variety :Foliage cover, Disease resistance, Pest resistance, Drought tolerance, Early maturity, Root yields, Root shape, Root size, Skin appearance, Flesh appearance, General acceptance Rank

(Subjective ranking: 1 = very bad, 2 = bad, 3 = moderate, 4 = good, 5 = very good

Consumer acceptability attributes assessed:Assessment of cooked Sweetpotato.

For each Variety :Appearance, Taste, Flavor, Starchiness, Fibrousness, General acceptance, Rank

Subjective ranking: 1 = very bad, 2 = bad, 3 = moderate, 4 = good, 5 = very good

Post harvest assessment of Sweetpotato by adults and children.

For each Variety :Appearance, Taste, Flavor, Starchiness, Fibrousness, General acceptance, Rank

Subjective ranking: 1 = very bad, 2 = bad, 3 = moderate, 4 = good, 5 = very good

4.Testing adaptability and acceptability of sweetpotato genotypes through farmers participatory research

4.4 Varietal demonstration (Farmer managed) on-farm, 2011

- **Demonstration plots established at Central (Okyreko) and Volta (Ohawu) regions.**

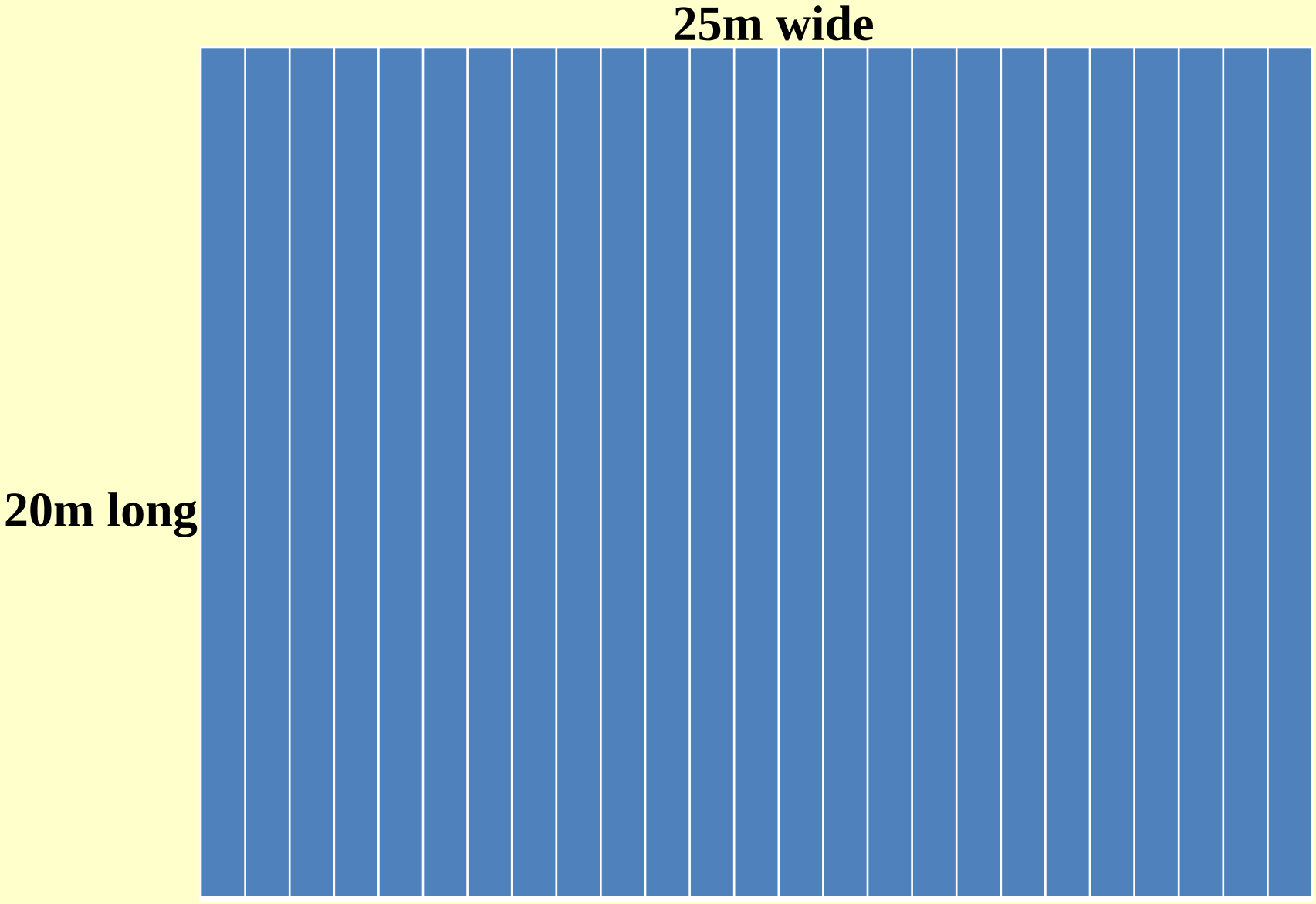
Mother trial at Okyreko and Ohawu (8 entries) for invited farmers to observe and make choices accordingly

Design: **Normally for each entry, the plot would have been 50m wide by 20m long (1/4 acre/ variety) but due to numbers, we are opting for 25m wide by 20m long (1/8 acre/variety) in the demonstration. With 1m wide between ridges, each variety would have =25 ridges, 20m long. Harvest all 25 ridges/ variety or demarcate an area.**

- **'Baby trial (demonstration) of 3 entries + Farmer variety/ farmer We give each farmer Apomuden and Faara and in addition each farmer has to select one other variety he or she approves the most to go to plant on his farm so others could see and also make choices**

4.4 Varietal demonstration (Farmer managed) on-farm, 2011

Location	Common Varieties			
FR1	*Apomuden*	*Faara*	*Farm. Var.*	*Santom Pona*
FR2	*Apomuden*	*Faara*	*Farm. Var.*	*Okumkom*
FR3	*Apomuden*	*Faara*	*Farm. Var*	*Sauti*
FR4	*Apomuden*	*Faara*	*Farm. Var*	*HI-Starch*
FR5	*Apomuden*	*Faara*	*Farm. Var*	*Ogyefo*
FR6	*Apomuden*	*Faara*	*Farm. Var*	*Otoo*
FR7	*Apomuden*	*Faara*	*Farm. Var*	*Santom Pona*
FR8	*Apomuden*	*Faara*	*Farm. Var*	*Okumkom*
FR9	*Apomuden*	*Faara*	*Farm. Var*	*Sauti*
FR10	*Apomuden*	*Faara*	*Farm. Var*	*HI-Starch*
FR11	*Apomuden*	*Faara*	*Farm. Var*	*Ogyefo*
FR12	*Apomuden*	*Faara*	*Farm. Var*	*Otoo*


25m wide
20m long

B. PRODUCTION AND DISTRIBUTION OF HEALTHY PLANTING MATERIALS

- ***Objectives:***
- produce and supply healthy planting materials of released varieties
- improve vine conservation and multiplication methods
- train farmers in the techniques for conserving and multiplying planting materials
- ***Methodology:***
- Establish primary planting material multiplication fields (at least 1 acre at each location) of the eight released varieties multiplied at Fumesua, Ejura Okyereko and Ohawu.

It is anticipated that in 2011, we should be able to supply RTIMP, if funding permits, planting material to plant 2 acres for each of our released varieties.

Normally ¼ acre of a variety gives us 3,333 cuttings, each 20cm long. For 2 acres= 24,666=25,000 cuttings each for the 8 released varieties given to RTIMP by close of minor season 2011 to be multiplied through minor season and dry season (at irrigation sites) and supplied to farmers for major season planting in 2012

C. PROMOTION OF IMPROVED VARIETIES FOR CONSUMER ACCEPTABILITY AND UTILIZATION.

- Household utilization campaigns: - identify and assess culturally acceptable OFSP-based recipes and promote utilization in these various household recipes.
- Train household members in preparation of OFSP-based foods and appropriate feeding practices
- Small-scale processing – household and community levels
- Establish community-based food production programmes to introduce OFSPs (link to Primary Health Care, School Feeding Programmes, nutrition education)

SOME OF THE ABOVE WE DO OURSELVES, SOME WE COLLABORATE WITH THE POST-HARVEST AT CSIR-CRI