

# A well-known lifesaver finds new promise

RIU

## Validated RNRRS Output.

Consumers and farmers in Africa will soon be able to benefit from the huge untapped potential of sweet potato thanks to a series of new findings. They include improved selection methods, guidelines for consumer tests, new breeding strategies, and knowledge of the factors that cause damage during handling and storage, among others. Sweet potato is considered the most under-exploited of the developing world's major crops. The new knowledge can be used in programmes across Africa to ensure that this crop will fulfil its promise in fighting hunger, contributing to livelihoods and combating vitamin A deficiencies among the poorest of the poor.

Project Ref: **CPH34:**

Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**

Lead Organisation: **Natural Resources Institute (NRI), UK**

Source: **Crop Post Harvest Programme**

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## Document Contents:

[Description](#), [Validation](#), [Current Situation](#), [Environmental Impact](#),

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## Description

**CPH34**

**A. Description of the research output(s)**

## Research into Use

NR International  
Park House  
Bradbourne Lane  
Aylesford  
Kent  
ME20 6SN  
UK

## Geographical regions included:

[Kenya](#), [Tanzania](#), [Uganda](#),

## Target Audiences for this content:

[Crop farmers](#),

1. *Working title of output or cluster of outputs.*

*In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.*

**Sweetpotato cultivars with improved storage root quality**

(Original title on RIU spreadsheet: Sweet potato storage and processing)

2. *Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.*

**Crop Post-harvest Programme**

3. *Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.*

R6507: The extension of storage life and improvement of quality in fresh sweetpotato through selection of appropriate cultivars and handling conditions. 1996 – 2000

R7520: Sweetpotato cultivars with improved keeping qualities for East Africa. 1999 - 2002

R6769: Investigating the potential of cultivar differences in susceptibility to sweetpotato weevil as a means of control. 1997 – 1999

Lead Institution: Natural Resources Institute, the University of Greenwich, UK

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LZARDI-Ukiriguru, Mwanza, Tanzania  
R. Amour, S.C. Jeremiah T. Ndengello E.J. Rwiza

Sugarcane Research Institute (Kibaha) Tanzania  
M. Muhanna, K. Mtunda, M. Kilima, H. Kiozya

HortiTengeru, Arusha, Tanzania  
T.Ndondi, M. Chottah

ARTI Uyole, Mbeya, Tanzania  
C.M. Mayona, D. Mende

Dakawa ARC, Morogoro, Tanzania  
D.N.V. Chilosa, A. Goa, A. Lipande, M. Kiteleki

Sokoine University of Agriculture, Morogoro, Tanzania  
L.B. Mbilinyi

Namulongwe Agriculture Research Organisation, Uganda  
B Odongo

Serere Agricultural and Animal Production Research Institute (SAARI), Uganda  
S. Kabi

Silsoe College, Cranfield University, UK  
J. Aked

U.S. Vegetable Laboratory, USDA-ARS, South Carolina, USA  
J. Bohac

*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? (max. 400 words). This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

**Sweetpotato (*Ipomoea batatas*)** is considered the most under-exploited of the developing world's major crops. **Breeding** initiatives for sweetpotato are at an early stage compared to other staple crops. Given the enormous **genetic diversity** of sweetpotato worldwide, and that breeding programmes of sweetpotato are relatively new, crop improvements are expected to be rapid. This cluster of outputs arises from projects undertaken to examine germplasm available in East Africa, the potential for breeding for specific post-harvest/quality traits, and to identify strategies to facilitate effective **cultivar selection**.

Many of the project activities were focused towards understanding the physiological basis for differences among germplasm. The resulting outputs of this cluster can feed into breeding strategies at two levels. On the one hand elucidation of the basis of cultivar differences at a physiological and molecular level allows development of hi-tech selection strategies such as the use of molecular markers. Such techniques are appropriate for international

breeding programmes such as that at CIP, but are largely beyond the scope of the RIU programme. On the other hand, the projects also resulted in identification of **selection techniques** suitable for National Programmes with more limited facilities.

Specifically, the outputs most relevant to RIU are:

- Identification of **farmer, trader and consumer criteria** for sweetpotato cultivars in east Africa and strategies to incorporate them into selection protocols during breeding.
- Methods developed for the use of consumer tests and trained taste panels to assess **sensory characteristics** of sweetpotatoes
- Breeding strategies to select for **extension of shelf-life**. Sweetpotato cultivars in East Africa have a wide range of shelf-life. We established that a key factor affecting shelf-life is the efficiency by which storage roots heal wounds at low humidity. Unfortunately high **wound-healing efficiency** is associated with lower dry matter content, although we do not know if this is a causative relationship. Simple strategies, appropriate for use by national programmes, to assess wound-healing efficiency using tissue staining methods, or weight loss measurements have been developed.
- Increased understanding of the effect of root shape on **susceptibility to damage** during handling.
- Increased understanding of the cultivar characteristics affecting long-term **storability**.
- Strategies to select for cultivars with canopy and rooting structures that confer reduced susceptibility to field infestation by insects, especially **Cylas spp**. This includes methods to assess appropriate root structures, and design of field trials with appropriate levels of insect pressure for most efficient cultivar selection.

5. What is the type of output(s) being described here?

Please tick one or more of the following options.

Product	Technology	Service	Process or Methodology	Policy	Other Please specify
			X		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

The main commodity focus is sweetpotato.

Some of the principles established such strategies to incorporate farmer/trader/consumer criteria into the selection process and the relationship between shelf-life and wound-healing efficiency, might be applicable to other root crops.

7. What production system(s) does/could the output(s) focus upon?

Please tick one or more of the following options. Leave blank if not applicable

<b>Semi-Arid</b>	<b>High potential</b>	<b>Hillsides</b>	<b>Forest-Agriculture</b>	<b>Peri-urban</b>	<b>Land water</b>	<b>Tropical moist forest</b>	<b>Cross-cutting</b>
X	X	X	X	X			

8. What farming system(s) does the output(s) focus upon?

Please tick one or more of the following options (see Annex B for definitions).

Leave blank if not applicable

<b>Smallholder rainfed humid</b>	<b>Irrigated</b>	<b>Wetland rice based</b>	<b>Smallholder rainfed highland</b>	<b>Smallholder rainfed dry/cold</b>	<b>Dualistic</b>	<b>Coastal artisanal fishing</b>
X	X		X			

9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

The outputs described here should be combined with research outputs produced by the International Potato Center relating to sweetpotato improvement as well as those of “**Superior sweet potato cultivars identified through a decentralised farmer-participatory approach**” R5878, R6617, R7492, R8040, R8041, R8167, R8243, R8457 Richard Gibson.

## Validation

### B. Validation of the research output(s)

10. **How** were the output(s) validated and **who** validated them?

Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the “who” component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation (**max. 500 words**).

Criteria (production and post-harvest) by which farmers (primarily women) select sweetpotato varieties were established by surveys conducted between 1990 and 1995 in all the zones of Tanzania where sweetpotato production is significant (Lake, Western, Eastern, Southern Highlands, Southern). The accuracy of the criteria

identified was confirmed by reference to the characteristics of the most popular varieties grown by farmers at that time. The breeding programme within Tanzania has found that the best way to incorporate farmer criteria in the selection of new cultivars is firstly, to use farmer groups to assess early trials on-station, and secondly, to carry out on-farm trials of the more advanced cultivars. This is a procedure that has been used successfully in Tanzania and throughout East Africa since the start of the work described here. The fact that it is part of the strategy that has been used to release several successful new cultivars in East Africa, especially orange fleshed varieties through the VITAA programme, is firm validation of the strategy.

Trader and consumer criteria were initially established by surveys in Mwanza, Meatu and Ukerewe Districts of Tanzania between 1995 and 1997. Compared to farmer testing, it is less easy to test these criteria directly with traders and consumers, until a late stage of cultivar selection. True validation of these findings would be through release and successful uptake of cultivars by all the end users. As for the farmer criteria, the trader/consumer criteria and consumer testing have been part of the strategy that has been used to release several new varieties in East Africa. The consumer testing techniques developed by this cluster have subsequently been used to assess cultivars during work in the VITAA initiative, coordinated by CIP.

The work on farmer/trader/consumer criteria has also been subjected to peer review when published in scientific journals and presented at international conferences, such as the International Society of Tropical Root Crops, Arusha 2003.

The observations relating to wound-healing efficiency, its key role in controlling shelf-life and its tendency to relate to low dry matter content have been confirmed through work conducted by UK and Tanzanian researchers on several different groups of cultivars with different regional origins. Thus genetic susceptibility to water loss was identified as the main driving force for root deterioration in trials conducted in 1997 and 1998 across 5 contrasting sites of Tanzania (Ukiriguru, Kibaha, Chollima-Dakawa, Uyole and Hort-Tengeru). The control of water loss by wound-healing efficiency, and its relationship with dry matter content was confirmed through trials on three separate sets of germplasm (East African, North American and a range of international cultivars supplied by CIP) conducted between 1999 and 2002. The scientific arguments relating to root susceptibility to damage and wound-healing efficiency have also been validated through peer reviewed scientific papers in international journals.

Relationships between canopy structure/root form and susceptibility to weevil infestation were derived during trials conducted by NRI and Ugandan Scientists in on-station trials in Uganda and Tanzania. Despite the importance of these findings, additional validation has not been undertaken.

**11. *Where and when have the output(s) been validated?***

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above (**max 300 words**).*

The criteria by which farmers (primarily women) select sweetpotato varieties were initially established by survey work conducted between 1990 and 1995 in all the zones of Tanzania where sweetpotato is a significant crop (Lake, Western, Eastern, Southern Highlands and Southern).

Trader and consumer criteria were initially established by surveys in Mwanza, Meatu and Ukerewe Districts of Tanzania between 1995 and 1997.

Further validation of the farmer/trader/consumer criteria and the consumer testing techniques developed during these projects have subsequently been used during work of the VITAA initiative in Uganda, Kenya and Tanzania.

The observations relating to wound healing efficiency, its key role in controlling shelf-life and its tendency to relate to dry matter content have been confirmed through work on several different groups of cultivars with different regional origins. Thus genetic susceptibility to water loss was identified as the main driving force for root deterioration in trials conducted in 1997 and 1998 across 5 contrasting sites of Tanzania (Ukiriguru, Kibaha, Chollima-Dakawa, Horti-Tengeru, Uyole). The control of water loss by wound-healing efficiency, and its relationship with dry matter content was confirmed through trials on three separate sets of germplasm (East African, North American and a range of international cultivars supplied by CIP) conducted between 1999 and 2002.

The production systems where the outputs were validated were “forest-agriculture” and “high potential” (“semi-arid” for the work on susceptibility to sweetpotato weevil).

The agricultural system where the outputs were validated was “smallholder rainfed humid”

## Current Situation

### C. *Current situation*

#### 12. **How and by whom** are the outputs currently being used? Please give a brief description (**max. 250 words**).

The outputs of this project cluster are being used by sweetpotato breeders and agricultural researchers during selection programmes for sweetpotato cultivars conducted by national agricultural programmes across East Africa, by CIP and also within the VITAA programme (coordinated by CIP) in Uganda, Kenya and Tanzania.

The outputs have also been disseminated widely across Africa, through distribution of the book “Sweetpotato post-harvest assessment: experiences from East Africa.” And through the coordinating activities of CIP and the Potato and Sweetpotato Improvement Network in Eastern and Central Africa (PRAPACE). It is therefore likely that the information is being used to assist other breeding programmes across Africa, but it is difficult to assess to what extent this is happening.

#### 13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used (**max. 250 words**).

As described in (12), confirmed use of the outputs is localised to Tanzania, Uganda and Kenya. The outputs have been disseminated widely across other parts of Africa, but it is difficult to assess to what extent.

The production systems where the outputs are currently being used are “forest-agriculture” and “high potential”  
The agricultural system where the outputs are currently being used is “smallholder rainfed humid”

**14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading (max 250 words).**

With no mechanism of continual assessment in place, it is difficult to be sure of the scale of uptake/use of the outputs. So far the outputs are being used primarily wherever there is sweetpotato cultivar selection in East Africa. Given that this cluster involved a number of breeder, that communication among sweetpotato breeders is good (often mediated by CIP, PRAPACE and by the DFID CPHP East Africa office) usage was established rapidly. Firm evidence that usage is spreading outside East Africa is not extensive.

**15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? (max 350 words).**

The outputs described in this cluster are primarily for use by sweetpotato breeding programmes (national and international) and by programmes involved in selection of existing cultivars for dissemination. For successful promotion and adoption of new ideas, good networking among extensionists and agricultural scientists, both within the national agricultural programmes and from the higher education sector is essential. As local funds are often very scarce, the existence of networking organisations, with funding to organise regional meetings and exchange visits is very important. Generally over the past decade, such networking has been successful. A very important role has been played by network organisations such as PRAPACE (Potato and sweetpotato improvement network in Eastern and Central Africa) and SARRNET (Southern Africa Root Crops Research Network). CIP interacts strongly with the national programmes, playing a vital role in the promotion of international interactions, and knowledge transfer. Fora such as the 13<sup>th</sup> International Conference for the ISTRC held in Arusha also provide an opportunity for communication. More recently, the East Africa office of the Crop Post-harvest Programme has also been very effective at promoting outputs of the CPHP.

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## Environmental Impact

### **H. Environmental impact**

**24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? (max 300 words)**

*This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.*

The outputs of this project cluster will have a positive environmental impact through the promotion of sweetpotato production, and through reduction of post-harvest losses. Sweetpotato is a crop that does not require high inputs, and is relatively drought tolerant, and so does not generally require irrigation. As it is relatively pest and disease resistant it is usually grown by small farmers with no chemical applications. It does not tend to lead to depletion of soil fertility. With improved cultivars, production will increase while post-harvest losses will decrease. Poorer sectors of the community will have a more secure food supply and will become capable of income generation, Thus there will be a decrease in the movement of populations into urban centres.

*25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? (max 100 words)*

Very few adverse environmental impacts can be identified. There is a possibility of an increase in the land area under cultivation, which could impact on conservation of wild areas.

*26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? (max 200 words)*

Yes. As the crop is relatively tolerant to marginal agricultural conditions, it will help communities cope with greater climatic extremes. Food supply will increase resilience. Increased income generation both through local and national markets will provide communities with capital which provides the necessary flexibility to increase resilience to natural disasters.

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