CIP INTERNATIONAL POTATO CENTER

CGIAR

REPORT

# Root and Tuber Crops for Agricultural Transformation in Malawi (RTC-ACTION Malawi)

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# Root and Tuber Crops for Agricultural Transformation in Malawi (RTC-ACTION Malawi)

## Year 4 Annual Progress Report (1 October 2019–30 September 2020)

## November 2020

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## Acronyms

| | |
|---|---|
| AEDCs | Agricultural extension and development coordinators |
| AEDOs | Agricultural extension and development officers |
| AYTs | Advanced yield trials |
| BARS | Bvumbwe Agricultural Research Station |
| CADECOM | Catholic Development Commission |
| CBSD | Cassava brown streak disease |
| CIP | International Potato Center |
| CMD | Cassava mosaic disease |
| CRS | Chitedze Research Station |
| DARS | Department of Agricultural Research Services |
| DLS | Diffused light store |
| DNCC | District Nutrition Coordination Committee |
| EPA | Extension planning area |
| HH | Households |
| IITA | International Institute of Tropical Agriculture |
| MRTCs | Minor root and tuber crops |
| OFSP | Orange-fleshed sweetpotato |
| OFTs | On-farm trials |
| PYTs | Preliminary yield trials |
| RTB | Roots, Tubers and Banana (a CGIAR Research Program) |
| RTC-ACTION | Root and Tuber Crops for Agricultural Transformation in Malawi |
| RTCDT | Root and Tuber Crops Development Trust |
| RTCs | Root and tuber crops |
| SAH | Semi-Autotrophic Hydroponic System |
| SSU | Seed Services Unit |
| TC | Tissue culture |
| ToTs | Training of trainers |
| UYTs | Uniform yield trial |

## Executive summary

The International Potato Center (CIP), with funding from Irish Aid, is leading the implementation of a 5-year project, Root and Tuber Crops for Agricultural Transformation in Malawi (RTC-ACTION Malawi). The project's goal is to increase the contribution of root and tuber crops (RTCs) to food security, nutrition, and incomes in Malawi. During its 5-year duration, RTC-ACTION Malawi envisages that at least 160,000 farming households (HH) will benefit from improved technologies and practices. This narrative report presents the project's annual progress (1 October 2019–30 September 2020).

The project has four main crop components: potato, sweetpotato, cassava, and minor root and tuber crops (MRTCs). Led by CIP, the potato and sweetpotato components were in year 4 (Y4), whereas the cassava (led by the International Institute of Tropical Agriculture) and the MRTCs (led by the Department of Agricultural Research Services) crop components were brought on board in Y3 of implementation. During the reporting period, work plans were developed and collaborating agreements were signed. Partners, farmers, and other actors along the value chains were engaged in various meetings, trainings, technology demos, seed dissemination, nutrition, processing and value addition, marketing, and capacity building across the RTC value chains. However, some activities were partially or wholly affected by the COVID-19 pandemic. The affected activities are highlighted in the report.

To achieve objective 1 of the project (*Increased productivity, climate resilience, and nutritional value of RTC production systems*), seed systems of potato and orange-fleshed sweetpotato (OFSP) from tissue culture lab, screenhouses, and open-field multiplication were implemented to produce early-generation planting material. On decentralized RTC seed multiplication (including cassava), farmers were involved in the production of high-quality seed material that was disseminated to 35,287 beneficiary HH (of which 59% were women), representing 90% of the Y4 target HH (38,994). The performance against the project's life target (160,000 beneficiaries after five years) is at 79% (126,689 HH beneficiaries). Further on technology development, four high-yielding potato varieties that are tolerant to late blight were released in July 2020.

Under objective 2 (*Increased revenues, consumer-orientation, and nutrition outcomes of RTC value chains*), partners and actors worked to produce and develop products for use at HH level, schools, or commercial purposes. Successful field days from 22 out of 27 rainfed demo plots were conducted for the potato crop. Owing to closure of field work from March 2020, no field day on sweetpotato was conducted from rainfed mother (132) and schools (31) demo plots. This is because the crop was not ready for field days and cooking demos at the start of the pandemic. This affected our capacity to effectively impart agronomic and nutritional messages to respective beneficiaries. Cooking demos, step-down nutritional meetings and trainings, and counselling through care and farmer groups and schools were particularly affected. These venues will therefore receive special emphasis in Y5 of the project (e.g., at the 31 schools where lessons at harvest were to include vine preservation for sustainability and cooking demo of nutritious porridge using OFSP and available flours to complement homegrown initiatives).

Gross margin analysis revealed that the production of potato and sweetpotato is lucrative. Seed production is more profitable per hectare for both potato (net = Mk3,050,394) and sweetpotato (net = Mk2,278,469). Root production for sweetpotato (net = Mk843,837) is, however, less profitable than ware potato (net = Mk1.238,287). Other successes include the wide consumer acceptance of OFSP bread, which is available in Shoprite since July 2020. The project facilitated its promotion, resulting in increased demand and therefore an evident growth of the business and

growers' incomes. Key cassava products that are at an advanced stage of evaluation are cassava silage for dairy animals for increased milk productivity and cassava-based baby food.

Under objective 3 (*Effective policies and strengthened capacities for continued development of RTCs*), the Root and Tuber Crops Development Trust successfully mobilized funds from two other projects. Roots, Tubers and Bananas is a project managed by CIP–Nairobi in three countries: Uganda, Malawi, and Kenya. In Malawi the project is worth $30,000 and aims to promote the use of OFSP puree in baked and fried commercial products. A second project is PRIDE Malawi, worth $59,450. Its activities include support in policy and advocacy capacity building; information sharing; and enhancing increased investment for market development of the RTC value chains to address food security, nutrition, and industrial development for RTCs. On capacity building, the project has four students under higher learning.

# 1. Background

## 1.1 Introduction

The Root and Tuber Crops (RTCs) for Agricultural Transformation in Malawi (RTC-ACTION Malawi) project is aligned to Irish Aid's Strategy for Malawi (2016–20)[1] which is focused on improving food security, nutrition, and income for a target of 160,000 smallholder farmers in 22 districts across Malawi. RTC-ACTION Malawi is a 5-year (2016–2021) development project with a total budget of €8,500,000. Its focus is to provide support to smallholder farmers to access seeds of resilient and nutritious varieties of roots and tuber crops (RTCs)—specifically potato, sweetpotato, and cassava—and associated technical assistance to increase yields, access new high-value markets (through commercial processors), and promote consumption. The project also looks to advocate for, and directly support, the strengthening of policy and institutional capacities linked to the production and consumption of RTCs.

Led by the International Potato Center (CIP), the project is implemented by a consortium of partners, mainly the International Institute for Tropical Agriculture (IITA) and the Roots and Tuber Crops Development Trust (RTCDT). Key government collaborating partners are the departments of Agriculture Research Services (DARS) and Agricultural Extension Services (DAES) in the Malawi's Ministry of Agriculture.

## 1.2 Project Objectives

The project has now been running for four years with three specific objectives and a number of associated expected outcomes:

### *Objective 1: Increased productivity, climate resilience, and nutritional value of RTC production systems*

- Productive, climate-resilient, and nutritious varieties available for distribution (at least 10 released varieties and eight new varieties to be released)
- Effective seed systems improve access to quality seed by at least 160,000 farmers
- Improved crop management practices applied by male and female farmers across Malawi's agro-ecologies (at least 30,000 farmers increase productivity)
- An assessment of the importance of minor root and tuber crops (MRTCs) in production communities

### *Objective 2: Increased revenues, consumer-orientation, and nutrition outcomes of RTC value chains*

- Diversified and expanded utilization of potato, sweetpotato, and cassava for food security and improved nutrition (at least 80,000 women and 60,000 children under 5 years)
- Improved supply chains for commercial processing of RTC foods (at least 7,000 farmers selling profitably to commercial processors)
- Efficient markets linking potato, sweetpotato, and cassava producers with consumers and processors (at least 20,000 farmers realize 15% increases in RTC sales revenues)
- Improved postharvest handling, storage, and transport capacities and practices (at least 1,000 farmers and traders' benefit)

[1] https://www.irishaid.ie/media/irishaid/allwebsitemedia/30whatwedo/20170502-Malawi-CSP-FINAL-PUBLIC-VERSION-for-HQ-Publication.pdf

*Objective 3: Effective policies and strengthened capacities for continued development of RTCs*

- RTCDT effectively coordinates stakeholders for stronger policy support and more effective development investments in RTCs (at least one significant policy change, one planning improvement, and one service delivery improvement implemented)
- Human and institutional capacity strengthened to support continued innovation and development of RTCs (at least eight Malawian RTC researchers receive advanced degrees and RTC modules are integrated into public sector extension training programs)

## 1.3 The season in general

The rainfall season started on time in most parts of the country (November–December 2019). The planning meetings with partners in preparation for project implementation were also done during this time. The seed of planting materials for potato and sweetpotato was disseminated in December 2019–January 2020; for cassava it was done in January–February 2020.

However, some project activities planned for the project year were severely affected by the COVID-19 pandemic. Such affected activities have been highlighted in the report.

# 2. General project progress

This narrative report provides processes for achieving the indicators (see the indicator matrix for the project years 1–4 in Appendix 1). Further, Appendix 2 is a database of beneficiaries of potato, sweetpotato, and cassava seed material. The database includes a documentation of some trainings, meetings, and trials.

## 2.1 Objective 1: To increase productivity, climate resilience, and nutritional quality of RTC production systems

CIP, in collaboration with IITA and DARS, is working to ensure maintenance and propagation of popular varieties of RTCs. The goal is to adequately respond to demands for clean planting materials to seed multipliers for further multiplication and dissemination to farmers for production. The overall aim is to increase RTC productivity.

### 2.1.1 Outcome 1.1: Productive, climate-resilient, and nutritious varieties available for distribution

#### Output 1.1.1: Disease-free planting materials of all released cassava, sweetpotato, and potato varieties produced

**Regularly subculture material (3–6 months' variety dependent)**

Pathogen-tested pre-basic material of released varieties of potato and sweetpotato were maintained such that least 50 plantlets per variety are always in tissue culture (TC) at Bvumbwe Agricultural Research Station (BARS) as mother plants. Clean cassava plantlets were introduced in 2019. Owing to contamination, further tissue culturing was suspended until DARS staff are oriented on propagation principles for the crop, and efforts have been made to adjust the protocol. Cassava plants of key varieties were rejuvenated with all necessary agronomical requirements to control pests and diseases meant for *in vitro* establishment. Ex-plants of these varieties ('Mpale', 'Sagonja', and 'Kalawe') were then introduced in TC, and there is active growth and reduced contamination (Figures 1A and B, Table 1).

**Figure 1.** Cassava ex-plants undergoing surface sterilization (A) and *in vitro* growth at 11 days after initiation (B).

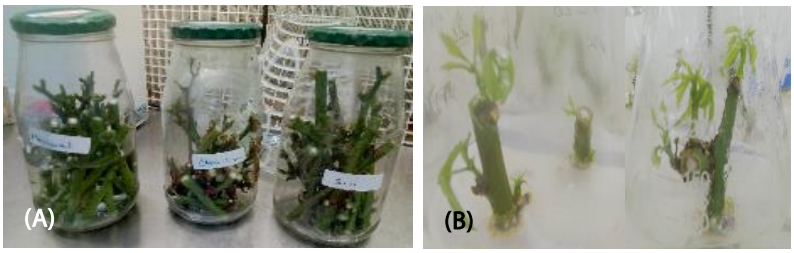


**Table 1.** Number of plantlets of three varieties introduced in TC

| Variety | No. Initiated | No. Contaminated | Status |
|---|---|---|---|
| Mpale | 18 | 2 | Active growth |
| Sagonja | 24 | 4 | Active growth |
| Kalawe | 12 | 4 | Active growth |

Introduction and propagation of clean, tissue cultured cassava plantlets by DARS have always been a challenge in cassava. Yet the success is a milestone of the project as it is building capacity of the national system on cassava cleaning for further *in vitro* propagation.

### Respond to demands from seed multipliers for foundation material for seed production

One of the key activities of the project is the promotion and dissemination of new improved varieties through a seed system that starts with clean planting materials from the TC lab to screenhouses, followed by onward field production of different seed classes, and for which not only DARS but other partners and farmers participate. For potato and sweetpotato, 14,480 and 1,248 plantlets, respectively, were propagated in the TC lab at BARS. Further, 87,685 potato minitubers were produced from aeroponic and sandponics at BARS. Of these minitubers, 32,816 were planted at Mbawa Research Station as 1$^{st}$ generation seed during the rainy season. Another 8,662 minitubers were further multiplied under screenhouse sandponics. The 36,207 tubers (harvested in the final quarter of Y4) will be planted at Mbawa during the coming rainy season. On sweetpotato, 29,400 vine cuttings were produced from screenhouse sandponics for further multiplication by farmers.

On cassava, the project is establishing facilities that will support the multiplication of early generation seed material. The technology is referred to as Semi-Autotrophic Hydroponic System (SAH), which was developed by Sahtecno Company (USA). The project's first SAH facility was installed at IITA's office premises at Chitedze Research Station (CRS) in 2019. As only disease-free materials can be multiplied in SAH, the unit is currently being used to multiply introduced germplasm for the breeding program (Figure 2). Mass propagation of released cassava varieties will be initiated once *in vitro* propagation is successful. A second SAH facility is for DARS-Chitedze in the Y4 project budget; installation of the laboratory shelves is underway.

**Figure 2.** SAH cassava plantlets under multiplication at IITA-CRS.

While waiting for TC-generated plantlets for the cassava seed system, however, some plants of the varieties 'Mbundumali', 'Sagonja', 'Sauti', 'Chinangwa 1', 'Chinangwa 2', and 'Chamandanda', whose samples tested negative for cassava brown streak disease (CBSD) and cassava mosaic disease (CMD), were collected and multiplied in a tunnel at CRS. A total of 4,918 plants are being multiplied (Figure 3) as pre-basic seed material.

**Figure 3.** Indexed cassava planting materials being multiplied in the tunnels at CRS.

### Conduct regular disease indexing protocols to ensure quality of released varieties

All laboratory consumables were procured to facilitate indexing of cassava planting materials. One indexing activity has been done so far on 157 visually non-symptomatic plant samples, which were collected from a CRS multiplication field. Out of the 157 samples analyzed, only 15 tested positive for CMD and none for CBSD. Disease-free plants are under multiplication in the tunnels. In potato and sweetpotato, indexed plants from the TC lab are multiplied further in screenhouses at BARS.

## Output 1.1.2: New improved varieties released

### Strengthening the germplasm base and crop improvement program for RTCs

In line with the project's objective to make available a wider choice of climate-resilient and nutritious varieties for farmers, CIP, IITA, and DARS work to strengthen the breeding programs of RTCs to release improved varieties that meet the needs of different users. Owing to the long-term nature of breeding work, the project is building on prior and other breeding efforts within and beyond the country for sources of breeding stocks and technical expertise. Sourcing appropriate germplasm with different required genetic traits is therefore a key project activity. In 2019–2020, the project established sweetpotato crossing block at BARS, where hybridization is done (Figure 4). A total of 245 seeds were from specific crosses and 14,614 were open pollinated seed.

**Figure 4.** Pollination of sweetpotato (*left*) and a manually pollinated flower (*right*).

A total of 7,442 botanical cassava seeds of specific crosses and open pollinated seed were collected from Chitedze crossing block. Another seed batch was received from Tanzania that comprised 410 crosses and 2210 open pollinated seeds. Additionally, six genotypes believed to have dual tolerance to CMD and CBSD were imported from the Kenya Plant Health Inspection Service in Kenya for evaluation. Malawi also received 107 plantlets of KBH/2016B/521, KBH/2016B/020, KBH/2016B/504, and KBH/2016B/185 from Zambia SAH lab from which 592

plantlets were multiplied by end of September. These materials also serve as pilot clones to test the functionality of the SAH unit at CRS.

### Conduct on-station and on-farm variety selection trials

Various on-farm and on-station RTC trials were implemented in Y4 as a process of developing improved, resilient, and nutritious varieties of potato, sweetpotato, and cassava. The DARS potato improvement program relies on introduced germplasm for adaptational evaluations and variety release. The attributes of these introductions include zinc biofortification, resistance to late blight (and resilience in general), high yield, and other processing traits. Different and respective sets of potato germplasm were evaluated in preliminary yield trial (PYTs), advanced yield trial (AYTs), uniform yield trial (UYTs), and on-farm trials (OFTs) in the 2019–2020 season. Fifty-four clones were selected from different evaluation trials and will be advanced to respective stages for wider assessments during the 2020–2021 growing season. From the OFTs, four potato genotypes (i.e., 398180/144, 398098/570, 'Pampean', and 'Newen') were released in July 2020 (Appendix 3). Potato seed bulking is in progress, as is the introduction of mother plantlets of the released varieties from Lima into the TC lab at BARS.

A total of 191 sweetpotato clones comprising introductions and locally sourced breeding stocks have been selected to respective stages after seedling, clonal, and PYT evaluations, respectively. Screening at these stages is done at Bvumbwe. Genotype entries comprise purple-, white-, and orange-fleshed. AYTs and UYTs were planted at seven research stations (i.e., Bvumbwe, Makoka, Chitedze, Chitala, Baka, Kasinthula, and Lunyangwa), and 26 OFTs were planted in 15 districts of the country. However, only five OFT sites were harvested due to the COVID-19 pandemic.

Cassava trials planted in the 2018–2019 season were harvested in January 2020 due to delays in the disbursement of funds to IITA. Clones with good yielding performance and a good level of tolerance to the major pests and diseases were selected and advanced for further evaluation in respective breeding stages. In the 2019–2020 season, seven on-station trials have been established. Data collection at three, six, and nine months after planting has been done, and one monitoring visit was made across the research stations. Results of the cassava UYTs showed that MM06/0045 yielded high (38.14 t/ha), exhibited good tolerance to pest and diseases across sites, and has been selected for further evaluation under farmer-managed trials in the 2020–2021 season. Highest yield was obtained at Mkondezi (53.15 t/ha) Research Station, followed by Makoka (44.81 t/ha). In general, some promising cassava clones have been identified for on-farm evaluations.

## Output 1.1.3 MRTCS research and development

MRTCs such as ground yam (Dioscorea species), coco yam (*Colocasia esculenta*), air yam (*Discorea* spp.), and Livingstone potato (*Plectranthus esculentus)* are still being underused in the country, despite their having potential for food security and high nutritive value. Lack of adequate information that is useful in breeding programs for the development of improved varieties is one of the key challenges. To remedy this situation, and with funding from Irish Aid through CIP, the Malawi Plant Genetic Resources Centre, in collaboration with the roots and tubers section in DARS, is evaluating the yam and Livingstone potato germplasm collection held by the national genebank for agronomic and yield-related traits. The information gathered provides the basis for utilization and improvement programs. Morphological characterization, agronomical trials, and seed multiplication of yams and Livingstone potato were done at respective sites. Agronomic studies focused on the effect of plant spacing on yield and yield components in yam production; a total of 12 treatments had varied tuber set sizes for cocoyam. The data for cocoyam trials are being processed.

Results from Livingstone potato characterization trials revealed variations among accessions in growth habit; namely prostate growth, others trailing to the ground, and erect and semi-erect

growth habits. Significant differences were observed in tuber yield across sites. However, yields were higher at Mbawa than at Bembeke. At Mbawa, CKNY 1 recorded highest yield (10,163 kg/ha), followed by CKNY 27, 28, and 30—each registered over 8,000 kg/ha. At Bembeke, the highest tuber yield was recorded for CKNY 23 (7,005 kg/ha), followed by CKNY 27 (6,328 kg/ha) and CKNY 1 (6,044 kg/ha). Cluster analysis of the qualitative and quantitative traits for the 20 genotypes grouped the accessions in five clusters, thereby confirming existence of variations among the genotypes (Figure 5).

**Figure 5.** Livingstone potato accession variations by root color.

A summary results of a diversity study on MRTCs is provided as Appendix 4. Other activities on MRTCs were affected by the COVID-19 pandemic (i.e., utilization promotion and recipe development as well as molecular analysis and training for capacity building on germplasm maintenance, agronomic, and multiplication). Wider promotion of MRTCs is meant to promote utilization beyond production areas.

### 2.1.2 Outcome 1.2: Effective seed systems improve access to quality seed by male and female farmers (at least 160,000 farmers)

#### Output 1.2.1: Early generation RTC seed production expanded

The goal of the project is to increase the contributions of RTCs to food security, nutrition, and incomes of Malawians.

The key activity to achieve output 1.2.1 was production of RTC quality seed and its dissemination to farmers as an entry point for the developmental activities across the value chains. This activity was reported in detail at nine months of Y4. Table 2 summarizes activities on seed dissemination, whereas Appendix 1 summarizes activities on both seed production and dissemination. In the project year, 35,287 beneficiaries (20,961 women) were reached (Table 2). Deliberate efforts were made to target children under 5 years of age with nutritious food. As a result, 23,079 HH with children under 5 were reached with RTC seed material.

**Table 2.** Number of RTC seed beneficiaries in 2019–2020

| Crop | No. of Districts | No. of EPAs* | No. of Sections | No. of Beneficiaries | No. of Females | No. of HH with Children under 5 |
|---|---|---|---|---|---|---|
| Potato | 10 | 23 | 73 | 9,638 | 5,221 | 6,024 |
| *Cumulative (4 years)* | | | | *33,987* | *16,319* | *16,618* |
| OFSP | 10 | 25 | 83 | 20,065 | 13,993 | 13,351 |
| *Cumulative (4 years)* | | | | *67,858* | *46,190* | *43,549* |
| Cassava | 5 | 12 | 54 | 5,584 | 3,033 | 3,704 |
| *Cumulative (3 years)* | | | | *24,844* | *11,418* | *17,014* |
| **Total beneficiaries in Y4** | | | | **35,287** | **20,961** | **23,079** |
| **Total beneficiaries of project life** | | | | **126,689** | **73,927** | **77,181** |

*EPAs = extension planning areas.

In preparation for an effective seed dissemination, a review and planning meeting was done in phases (Table 3). DAES is the key partner in seed dissemination at district level. Involving them from the start of the season has proved to be a key driver of success in project implementation.

**Table 3.** Participants during districts planning meetings in 2019–2020

| Meeting Venue | Date (all in 2019) | No. of Participants | | | Type of Participants |
|---|---|---|---|---|---|
| | | Males | Females | Total | |
| BARS | 27 November | 37 | 18 | 55 | DAES & CADECOM* |
| Lunzu RTC | 3 December | 43 | 19 | 62 | DAES |
| Thuchila RTC | 4 December | 36 | 18 | 54 | DAES |
| Dedza RTC | 28 November | 8 | 9 | 17 | DAES |
| Nathenje RTC | 20 November | 8 | 16 | 24 | DAES |
| Ntcheu | 9 December | 18 | 0 | 18 | DAES |
| Mchinji | 28 November | 10 | 3 | 13 | DAES |

* CADECOM = Catholic Development Commission.

On potato, three seed potato demo plots were planned and implemented in each of the 10 districts, totaling to 27 (three women). Of these, 22 field days were conducted which attracted a 2,055 farmers (1,092 women) across the districts. Mobilization of participating farmers to attend the field day was coordinated by the office of the district agricultural development officer, where agricultural extension development coordinators (AEDCs) and agricultural extension development officers (AEDOs) actively participated. Potato field days were conducted just before closure of field activities due to COVID-19. At some sites, the media were also invited (e.g., Zodiak Radio, Malawi Broadcasting Corporation, and the *Nation* newspaper). Since access to quality seed of the improved varieties is still a major challenge, especially in the new districts of the project and other areas of the country, the project is promoting seed production using various approaches. As a result, individual farmers or through cooperatives, irrigation schemes, and others are interested in seed production (Appendix 1).

A total of 132 orange-fleshed sweetpotato (OFSP) mother (demo) plots at 64 sections in 20 extension planning areas (EPAs) were planned, of which 39 plots were hosted by female farmers and three plots were hosted by groups of farmers at implementation. However, field days on sweetpotato were not conducted due to COVID-19. On cassava, the 2018–2019 demo plots were due for harvest in December 2019; however, due to delays in disbursement of funds, most farmers harvested the plots on their own. Only three of the 35 demo plots were harvested in February 2020. In Kasungu, a palatability (preference) evaluation of cooked and uncooked cassava roots was conducted involving 24 farmers (14 women, 10 men).

### Output 1.2.2: Onward decentralized multiplication networks expanded

#### Trainings for enhanced seed production, dissemination, and crop management

One of the deliverables of the RTC-ACTION project is to build and strengthen capacity of the national agricultural research system, mainly DARS and DAES, on RTC production in general. A training of trainers (ToTs) was done to build the capacity of AEDOs and their supervisors (AEDCs and crops/horticulture officers) so that they impart the acquired knowledge to RTC farmers (Table 4). ToTs on potato seed production by CIP and extension staff (DAES) in various districts were not done. Further, where done, step-down trainings to farmers were not implemented (Table 4).

**Table 4.** Number of successful and failed trainings and trainees in 2019–2020 season

| Subject Matter | Lead Organization | Trainees | No. Trained | Females | No. of Failed ToTs | No. of Failed Step-down Trainings |
|---|---|---|---|---|---|---|
| OFSP step-down multiplication | CADECOM | Multipliers | 37 | 3 | | |
| ToT OFSP multiplication | CADECOM | Extension staff | 38 | 6 | | |
| Sweetpotato vine multiplication | CIP | Multipliers | 14 | 5 | | |
| Potato seed multiplication | CIP | Extension staff | | | 20 | 2,500 |
| Potato seed multiplication | DAES | Multipliers | | | 14 | |
| Potato seed multiplication | DARS | Extension staff | 34 | 15 | | 2,500 |
| Cassava production | IITA | Extension staff | 60 | 19 | | 5,000 |
| Cassava seed multiplication | IITA | Farmers | 18 | 3 | | |
| **Total trained** | | | **201** | **51** | | |

Further, at seed distribution points, all beneficiary farmers present are trained by extension workers in respective districts and crop components.

### Output 1.2.3: Seed quality control standards implemented

In addition to training seed growers and extension staff, the project facilitates the registration of seed growers with the Seed Services Unit (SSU) of DARS to ensure quality seed dissemination to the farming community through quality control structures. All of the 18 (14 new) cassava and seven out of the 32 potato seed multipliers were registered with the SSU. These registrations were done before offices were closed in March 2020; however, on the ground, old multipliers continued to multiply seed. CIP provided technical services on seed production through phone calls, and at present seed multipliers are being registered.

### Output 1.2.4: Improved seed markets and delivery systems

On seed production, CIP, IITA, DARS, CADECOM, and RTCDT worked together with other stakeholders to ensure sustainable supply of quality seed to the farming community. The project also provided training on business and linked farmers to markets. Seed sales were adequately reported at nine months.

### Output 1.2.5: Improved seed management by farmers

This output is aimed at building capacity of all seed production actors to ensure the dissemination of quality RTC seed. Postharvest potato seed handling and storage are crucial to enhance sprouting while preserving quality. Specific structures are recommended for on-farm seed storage. During the reporting period, three (male) farmers out of 30 planned (three/district for 10 districts) constructed diffused light storage (DLS) facilities for potato seed. And although CIP provided the technical design and construction, restrictions due to the pandemic affected further supervisions to facilitate construction.

A sweetpotato seed production manual was finalized and released in November 2019 (Appendix 5). The manual is handy for use by all actors engaged in seed production. Fifty copies for use by SSU seed inspectors were printed.

### 2.1.3 Outcome 1.3: Improved crop management practices of RTCs applied by farmers across Malawi's agro-ecologies

#### Output 1.3.1: Viable options for soil fertility improvement tested and promoted

The RTCs in Malawi are considered to be underperforming in terms of yield per hectare. One reason for this is because of marginalized soils. It has been hypothesized that yields can be improved by soil amendment with inorganic fertilizer. However, the optimal combination of these fertilizers for the maximum and cost-effective yield response has not yet been ascertained with empirical data. Fertilizer trials were thus implemented for OFSP and cassava, both on-station and on-farm, using different combinations of fertilizers. OFSP trials were planted at BARS, Makoka, and CRS and at Zomba and Mulanje for OFTs. Cassava was planted at Mkondezi and Makoka Research Stations. For both crops, there were no significant differences on root yield due to fertilizer treatments against controls. For cassava, the yield ranged from 22.07 to 38.46 t/ha, while the figure for the control was 26.35 t/ha. Thus, some fertilizer treatments had unexpectedly lower yields than the control treatment. For sweetpotato, OFTs were not harvested due to the pandemic. On-station data for the past three years are being processed.

On plant spacing, experiments for seed and ware potato production were conducted in order to develop recommendations for maximum utilization of production land area for both seed and ware potato. The experiment was carried out at BARS, Mbawa, and Bembeke Research Stations during the 2019–2020 rainy season. The treatments evaluated for both table and seed potato were four ridge spacings and four within-ridge spacings. Promising results suggest that the spacings of 90 x 20 cm and 100 x 20 cm are suitable for seed and table potato optimum yields, respectively. In seed potato production, the primary management objective is to maximize yields while limiting tuber development to the medium sizes. In table potato, however, the ideal is to have more of bigger tubers. The trials are continuing to gather more data and ultimately generate conclusive findings and recommendations for seed and table potato production.

#### Output 1.3.2: Use of irrigation technology expanded, including for seed multiplication

Potato is one of the high value crops in Malawi with high levels of inputs, including fertilizers, chemicals against pests and diseases, and irrigation during the dry season. RTC-ACTION is implementing several trials to support increased productivity of the crop. On irrigation, a study aimed at determining crop water requirement for potato and validate crop coefficient to develop irrigation scheduling for optimum tuber yield and quality under irrigation is in progress at Kasinthula and Mbawa Research Stations. Further, the trial will identify the most suitable potato varieties under irrigation. At the time of reporting, the plants were at flowering stage. Timely implementation was affected by the pandemic.

#### Output 1.3.3: Locally available and affordable eco-friendly options for control of major RTC pests/diseases

Termites are a well-known pest of cassava. The problem is exacerbated by climate change, which has caused an increased frequency of prolonged dry spells/droughts. DARS successfully set up the research trial on evaluation of neem extracts (*Azadirachta indica A. Juss*) and locally available chemical pesticides for the management of termites in cassava. The objectives of the experiment are twofold: (1) evaluate the performance of neem extracts and Gaucho in controlling termites in cassava and (2) investigate the performance of neem extracts in controlling termites based on plant parts used (leaf, kernel, and bark). In the 2019–2020 season, the trial was planted at Chitedze, Chitala, and Makoka with five treatments: extracts from neem bark, seeds, and leaves, Confidor, and a control (no treatment). The results of the 2018–2019 trial have shown that termite activity is significantly lowered with chemical treatment of the cuttings, with Confidor giving relatively consistent results during the evaluation period. Although neem leaf extracts showed some good

levels of protection, its performance was not consistent over time and across sites. Results of this study also showed that termite activity varied with season: termite activity was high during the dry season compared to rainy season. There was, however, no direct impact on damage caused (such as lodging of the plants) based on the available data.

In potato, most of the fertilizer chemicals for screenhouse seed production are introduced from Kenya. For sustainability, an experimental trial is being conducted to assess locally available nutrient combinations for seed production in aeroponic and sandponics screenhouses. The variety being used is 'Thandizo' in six nutrient combinations. Owing to the effects of COVID-19, the trial was delayed, and is at vegetative stage at point of reporting.

A study on the prevalence and distribution of sweetpotato virus disease was done in June 2019. Results revealed a wide distribution of the disease in 13 of 19 districts. The high prevalence is attributed to use of infected planting materials. This is so because of low populations of insect vectors as well as no correlation between insect vectors and disease incidences. This is not surprising, as farmers in Malawi recycle planting materials and share them freely without sanitary control measures. Furthermore, this is confirmed with the low disease incidences and severities in vine multipliers' fields. These are commercial and registered vine multipliers who access clean planting materials from government and CIP. On the basis of these findings, dissemination of quality vines is critical for increased productivity.

#### Output 1.3.4: Infrastructure improvement in support of Objective 1

The project, through the DARS budget, supported the construction of a DLS at Bembeke experimental site. Potato seed (also referred to as "breeder seed") harvested from experiments could not be stored together with "actual" seed meant for ware production. This DLS will therefore help seed meant for experiments to be stored at the station. Further, water tanks have been installed at BARS that will support the multiplication of RTC breeder seed. In addition, solar power has been installed at the aeroponics where seed production has been costly in times of electricity black out due to use of generators. Further, in the TC lab, solar power was installed in the growth rooms to provide light. In 2018 the project lost almost all sweetpotato plantlets due to prolonged hours of darkness in growth rooms. Lighting growth rooms, even in times of blackouts, will sustain maintenance of *in vitro* plants in the lab.

## 2.2 Objective 2: To increase profitability, consumer orientation, and nutrition outcomes of RTC value chains

Under four outcomes, this objective aims to increase the profitability, consumer orientation, and nutrition outcomes through RTC value chains. Key actors therefore include producers, traders, processors, consumers, and existing national structures on nutrition and production.

### 2.2.1 Outcome 2.1: Diversified and expanded utilization of RTCs for healthy diets and improved nutrition

In terms of nutrition outcomes, the RTC-ACTION project planned to reach out to at least 80,000 women and 60,000 children aged under 5 in project areas to incorporate and use diverse forms of potato, sweetpotato, and/or cassava and leaves into their daily diets, resulting in improved diet diversity and diet quality. The project is targeting HH with children under 5 and pregnant and lactating mothers with nutrition education and demos. During the reporting period, at least 23,079 under-5 children and 20,961 women HH directly benefited nutritionally from the project interventions (Appendix 1).

### Output 2.1.1: RTCs effectively integrated into local diets, with an emphasis on vulnerable HH

Activities on this output were partially or wholly affected by the COVID-19 pandemic as they entailed planning meetings at district level, trainings of ToTs, step-down trainings, and cooking demos, all of which could not possibly be carried out under the circumstances.

The project conducted three out of four planned District Nutrition Coordination Committee (DNCC) members orientation meetings in Kasungu, Mzimba, and Mchinji districts. There, 65 (20 women) members participated in planning for the promotion and integration of RTCs in local diets and nutrition for the year. The DNCC was cancelled in Dowa.

In Nsanje the project reached out to 2,255 HH with under-5 children with nutrition education and counselling, through 154 caregivers (cluster leaders) on improved nutrition knowledge and child-feeding practices. In other districts, a total of 950 care groups givers/nutrition volunteers were not trained as per plan. Further support of these volunteers to reach to 9,500 respective care group members was also not done. Fifty counseling sessions were cancelled and carried over to Y5.

The project supported HH nutrition education at district level through the development of food calendars. The seasonal food availability calendars were developed for TA Kadulu, Mwanza, TA Nazombe, Phalombe, TA Mlolo, Nsanje, and TA Chekucheku, Neno. Printing of these awaits further contribution and consultations by members of the DNCC from the respective districts, an activity which was also affected.

In Y3 the project successfully piloted the integration of OFSP into school-feeding under home-grown initiatives. In Y4 the project had planned to scale up to 31 school-feeding programs identified in Mwanza (five schools), Neno (six schools), Blantyre (two schools), Chiradzulu (five schools), Phalombe (five schools), Mulanje (two schools), and Zomba (six schools). In collaboration with the Ministry of Education Science and Technology through the district education offices and facilitated by the schools health and nutrition coordinators, vines were successfully distributed and planted (Figure 6) for root production in school gardens. However, schools were closed in March 2020, which affected follow-up interventions that included vine preservation for sustainability, implying that even vines were not preserved by schools. The activity is considered not done and therefore carried to Y5.

**Figure 6.** Pupils planting OFSP as part of agriculture and nutrition lessons.

### 2.2.2 Outcome 2.2: Improved supply chains for commercial processing of RTC foods and products

#### Output 2.2.1: RTC products developed and promoted

Data collection on milk production increase as attributed to cassava silage was not finalized. Upon validation of this attribution, the technology will be widely upscaled in collaboration with other stakeholders to ensure sustainable linkages amongst various players along the value chain, including the smallholder cassava producer.

In addition, an enriched cassava-based baby food was developed and its nutritive value assessed. Sensory evaluation has been postponed to Y5.

On MRTCs, the project, coordinated by DARS and in collaboration with Chancellor College, had planned to develop recipes for inclusion in the RTC cookbook. In collaboration with CIP, the college had planned to develop and profile commercial/instant baby food products from OFSP and potato. The work has been carried over to Y5.

#### Output 2.2.2: RTC producer organizations strengthened for production and marketing

**Provide producer groups with basic skills to engage in commercial production practices with agro-processing industries**

Training sessions with OFSP and potato farmers mainly focused on refreshing and supporting the capacity-building efforts to enhance their business and marketing skills. Planned follow-up training sessions in collaboration with respective district agribusiness officers that aimed to strengthen the capacity of the producers to engage in commercial production were carried over to Y5.

**Facilitate negotiations and contractual agreements between producers and major supermarkets and gastronomic sector for promoting nutritious RTC**

Another important arrangement that was considered during this year is to bring together prospective buyers/processors for both potato and OFSP for business agreements. One of the most outstanding concerns raised by one of the processors (Tehilah Bakeries) during the interface meeting in Nsanje was related to marketable root sizes and shapes, as these have been of great concern to almost all the processors buying roots. It was agreed during the meeting that the company has resolved to offer premium prices to producers who will be grading the size of their roots.

As for potato, potential farmer groups with promising crop stands and capacity to be engaged in the negotiations with prospective markets were identified. On the buyer side, a number of outlets, including supermarkets, hotels, and other institutional buyers, were also identified. One of the companies that showed serious interest in the arrangement was Limbe Leaf Company. The company intended to buy potato varieties like 'Mwai', 'Chuma', and 'Violet' to be used in their cafeteria as a way to reduce their import bill for rice by replacing it with potato. The company proposed a minimum of 60 t/week to serve in their cafeteria during the tobacco-buying season. This market opportunity was shared widely with the project beneficiaries and the districts to get organized for this lucrative business. This activity was, however, halted due to COVID-19. The opportunity will be reviewed in due course.

On cassava, the producer, Ziwawo Starch Factory, was linked to Joeclean Investments, the company based in Blantyre that uses starch as an ingredient for its tomato sauce. After a series of negotiations, 1,000 kg of cassava starch was sold for MK800,000 ($1,067). There are prospects that they will be ordering more as they are pleased with the quality of the product.

### Improve the crop revenue of farmers selling into improved market chains

During the year the project supported Tehilah Bakeries to secure an opportunity to sell OFSP products in Shoprite and other outlets after conducting a series of sensitization and awareness campaigns within the city of Blantyre to create demand. The support has managed to boost the business of the bakery, as they have tripled their daily sales from an average of 90 loaves to an average of 300 loaves per day; on some days sales go up to 560 loaves per day. This business opportunity has created an opportunity for OFSP producers, especially during winter when the crop is in short supply, as they are able to sell their roots to Tehilah at a premium price.

### Estimating the crop revenue from RTC farmers selling to improved markets

As reported at nine months, the project engaged RTC producers to estimate production costs, revenue, and gross margin in addition to tracking farmgate and retail prices for the crops. This was done to guide producers when negotiating with prospective markets (see results in Table 4 above). The gross margins in Table 5 reveal that potato and sweetpotato production are generally lucrative businesses worth investing in.

**Table 5.** Potato and sweetpotato yield, income, and gross margin for the 2019–2020 rainfed season

| Crop | Average Yield (t/ha) | Average Price (MK) | Estimated Income (MK) | Variable Costs (MK) | Gross Margin (/ha) | Break-even Yield (t/ha) | Break-even Price (/kg) |
|---|---|---|---|---|---|---|---|
| Table potato | 13,422 | 154 | 2,068,602 | 830,315 | 1,238,287 | 5,531 | 62 |
| Seed potato | 15,021 | 299 | 4,447,519 | 1,397,125 | 3,050,394 | 4,731 | 94 |
| OFSP roots | 12,374 | 105 | 1,299,270 | 455,433 | 843,837 | 4,337 | 37 |
| OFSP vines | 11,238 | 270 | 3,034,350 | 755,881 | 2,278,469 | 2,800 | 67 |

Note: Trending US dollars to Malawi Kwacha is 1:750.

Tracking of market prices for potato was another important activity. Data were collected from a number of markets and months. The prices ranged from MK165 at Lizulu market to MK555 in Blantyre.

### Facilitating registration of producer cooperatives

The project is organizing and strengthening production and marketing groups across the RTC value chains. In 2018–2019, IITA facilitated a training of a farmers' group from Lilongwe East by the Ministry of Industry and Trade to support their registration as a cooperative in the 2018–2019 project year. As of 31 March 2020, the group is registered under the name of Katunga Farmers' Cooperative. Carry-over activity to Y5 is for IITA to provide further support on successful business. Further, CIP facilitated the registration of Chongoni Potato Cooperative. The COVID-19 pandemic affected the finalization of the registration of Umodzi Association into a cooperative in Nsanje, an activity carried to Y5.

## 2.2.4 Outcome 2.4: Improved postharvest handling, storage, and transport capacities and practices

### Engage producers on the introduction and promotion of packaging materials and distribution for use by selected producers and retailers

The activity was part of the briefing meetings that were arranged with a number of OFSP and potato producer groups in the targeted districts in order to share with farmers the available market opportunities and challenges. During the discussions it became clear that one way of addressing such challenges is to come up with a strategy of grading and packaging their produce in a way that meets the requirements of prospective buyers. Producers were encouraged to start thinking of coming up with some innovative and creative ways of grading the size of their produce to attract premium prices offered for such products.

IITA facilitated the designing of logos for the small and medium enterprises. The designs have been used in the production of printed woven sacks for two such businesses: Chibwaka Investments based in Nkhata Bay and Ziwawo Starch Factory. Also, IITA facilitated the production of 10,000 printed bags: 5,000 for Chibwaka Investments to be used to pack fermented cassava flour (Kondowole), and another 5,000 for Ziwawo Starch Factory for packing cassava starch.

#### Simple technologies for reducing postharvest losses identified and promoted

In-ground storage trials continued to be evaluated in the current study at Bvumbwe, Makoka, and Chitala Research Stations where data are being processed. Postharvest OFSP storage chambers in Mulanje were loaded with four varieties. The experiment, now in its fourth month, is in progress.

## 2.3 Objective 3: Effective policy and strengthened capacity for continued development of RTC value chains

### 2.3.1 Outcome 3.1: RTCDT effectively coordinates stakeholders for stronger policy support and more effective development investments in RTCs

#### Output 3.1.1: Secretariat facilitating regular stakeholder meetings

In addition to the pandemic, activities to do with policy changes in support of RTCs were affected by staffing challenges at RTCDT, where the coordinator resigned. Planned activities included (1) review of available policies related to RTC development; (2) facilitate and participate in annual policy review meetings with the Ministries of Agriculture, Forestry and Natural Resources, Trade, and Industry, and relevant parliamentary committee in order to identify gaps that limit RTC inclusion for development in these entities; and (3) conduct partners and stakeholder workshops, conferences, or meetings to harmonize interventions and to sensitize policymakers on the importance of RTCs and their value chains. These will be implemented in Y5.

#### Output 3.1.2: RTCDT providing effective information services to stakeholders

During the reporting period, RTCDT conducted advocacy campaigns to promote RTC production in line with its role to coordinate stakeholders for stronger policy and more effective development investment. Eighteen radio programs linking RTC seed multipliers to farmers in 10 districts were done through Mudziwathu, Bembeke, Sapitwa, and Gaka community radio stations and three TV programs on Malawi Broadcasting Corporation, Zodiak, and Times (see Appendix 6 for news articles on potato promotion). Further, RTCDT activated its information communication technology-based information exchange for RTC value chains through a database on its website (https://www.rtcdtmw.org/).

### 2.3.2 Outcome 3.2: Gender-integrated formal training/educational institutions meeting the human resource needs of RTCs

Currently, there are two long-term interns, one attached to MRTCs and the other attached to DARS Bvumbwe. Long-term interns were preferred over short-term ones by DARS for specific deliverables. On long-term trainings, four active students studying for higher degrees are in their second year at Lilongwe University of Agriculture and Natural Resources and Chancellor College (see Appendix 7).

# 3. Project management

**Project financing.** The funding in the year improved as funds to CIP were received in November 2019. Funds to IITA, however, were delayed due to an amendment which required Irish Aid's approval. The amendment was granted but only after the Christmas holidays. Implementation of activities on the cassava component therefore started around mid-January 2020.

**Monitoring and evaluation.** Review and planning meetings for the RTC-ACTION project were conducted by specific crop components before implementation of Y4 activities for review and planning for effective implementation. While joint monitoring and evaluation activities within districts were implemented in some districts, the activity was suspended in most districts. A joint field visit to sites was also affected in Y4, and an annual assessment was done soon after Y4 project closure. Some of the results were used to update the achievements on indicators provided in Appendix 1.

### Lessons learned

- Partners must have their budgets complete at submission to avoid the repeat of delayed implementation of activities, citing the cassava component. There has been an improvement for Y5.
- After March 2020, meetings, international travels, trainings, and other gatherings were suspended due to risks associated with COVID-19. Office work continued from respective homes, where virtual meetings were a better communication tool for project partners, an indication that some meetings can be fulfilled at less cost.
- The project disseminated adequate vines to schools and care groups in preparation for field days and utilization demos. Thus, some activities which were partially done will have to start again in Y5. Distribution of relevant flyers and leaflets are important for information in case of a repeat of the pandemic where some activities cannot be finalized. Such activities have become costly as the whole process has to start again.
- In general, affected activities of Y4 have been incorporated into the Y5 work plan. It is anticipated that overall, the key project deliverables will be met. However, although effort is to ensure 100% project delivery, some elements on marketing and nutrition which were phased by location and year may not be completely fulfilled in some districts and locations.
- Despite the remote supervision of seed multipliers for potato and sweetpotato, an assessment reveals that there is a lot of seed that has been produced for the coming season, although most of the multipliers were not registered. This indicates that our seed systems work results in sustainable RTC seed availability even when project support diminishes (though without close supervision multipliers may relax on certification standards). As long as a market is available and consistent, RTC seed will be assured. However, there has been an overwhelming demand for potato seed for the coming season, an indication that the crop is becoming more and more important in Malawi and expanding into nontraditional growing areas.

CIP is a research-for-development organization with a focus on potato, sweetpotato and Andean roots and tubers. It delivers innovative science-based solutions to enhance access to affordable nutritious food, foster inclusive sustainable business and employment growth, and drive the climate resilience of root and tuber agri-food systems. Headquartered in Lima, Peru, CIP has a research presence in more than 20 countries in Africa, Asia and Latin America.
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