Scientific Progress Report

Gender Equitable Positioning, Promotion and Performance – RTBfoods Scientific Progress Report for Period 3 (Jan-Dec 2020)

Montpellier, France, 2020

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This report has been written in the framework of RTBfoods project.

To be cited as:

Gérard NGOH NEWILAH, Béla TEEKEN, Alexandre BOUNIOL, Jolien SWANCKAERT, (2021). *Gender Equitable Positioning, Promotion and Performance – RTBfoods Scientific Progress Report for Period 3 (Jan-Dec 2020),* Montpellier France: RTBfoods Scientific Progress Report, 44 p.

Ethics: The activities, which led to the production of this manual, were assessed and approved by the CIRAD Ethics Committee (H2020 ethics self-assessment procedure). When relevant, samples were prepared according to good hygiene and manufacturing practices. When external participants were involved in an activity, they were priorly informed about the objective of the activity and explained that their participation was entirely voluntary, that they could stop the interview at any point and that their responses would be anonymous and securely stored by the research team for research purposes. Written consent (signature) was systematically sought from sensory panellists and from consumers participating in activities.

Acknowledgments: This work was supported by the RTBfoods project https://rtbfoods.cirad.fr, through a grant OPP1178942: Breeding RTB products for end user preferences (RTBfoods), to the French Agricultural Research Centre for International Development (CIRAD), Montpellier, France, by the Bill & Melinda Gates Foundation (BMGF).

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Béla TEEKEN (IITA) Eglantine FAUVELLE (CIRAD) Jolien SWANCKAERT (CIP) Alexandre BOUNIOL (CIRAD) Gérard NGOH NEWILAH (CARBAP)/	03/01/2021 & 09/02/2021 08/01/2021 13/01/2021 08/02/2021 15/02/2021
Final validation by:	
Eglantine FAUVELLE (CIRAD)	19/03/2021

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Scientific Achievements, Key Research Findings & Perspectives

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ABSTRACT

This document presents the scientific progress report of WP5 for period 3. It's a compilation of contribution from partners implicated in WP5 within the framework of RTBfoods. Information from each country related to specific products has been consolidated by work package leaders. During period 3 WP5 activities focused on cassava, yam, sweetpotato, banana and plantain in four countries namely Cote d'Ivoire, Nigeria, Cameroon and Uganda. In IITA Nigeria, selected cassava clones were multiplied and planted in two different sides: Agowu in Osun state and Otobi in Benue state. Local popular variety as well as commonly grown and popular varieties have been added as solid reference. This was done within the framework of preparatory work for participatory processing and consumer testing in Period 4. Also, NRCRI Nigeria replanted 21 TRICOT trials in IMO state for processing and food science evaluation by Cornell University in period 4. Concerning Yam, IITA Nigeria has been evaluating 5 improved clones of each rotundata and alata alongside local and standard clones. 2 Rotundata varieties (TDr0900067 and TDr1000048) performed very well on agronomic and food quality as did 1 Alata variety (TDa1100432). Evaluated were Pounded and Boiled yam made from the varieties. These varieties have been evaluated by the release committee and have been approved, three (03) clones are now released officially. Regarding SweetPotato CIP selected a total of 8 OFSP clones from heterosis trials conducted at the National Crops Resources Research Institute (NaCRRI) in Uganda, National Semi-Arid Resources Research Institute (NaSARRI) and Kachwekano Zonal Agricultural Research and Development Institute (KaZARDI). The advanced yield trials for these eight clones together with check clones are conducted at five sites following the variety release guidelines of MAAIF and the Standard Operating Procedures (SOPs) for Sweetpotato. For matooke at NARL, four field trials (in 4 agro-ecologies of Uganda), each with 91 banana genotypes had been planted in previous periods. Activities in Period 3 focused on participatory selection of preferred genotypes for mass multiplication to plant farmer-managed trials. Regarding plantain at CARBAP, 2 local checks and 8 clones from CARBAP and IITA breeding programs were planted in 2019 in two contrasted localities in Cameroon: Njombe & Bansoa. During period 3, WP5 activities focused on trial follow up, on-farm and laboratory data collection. At farm level, vegetative parameters were measured during growth, at flowering and at harvest. Meanwhile at laboratory level, traits assessed included physical, chemical and physicochemical properties.

1 PRODUCT PROFILES & WP5 TEAMS ACROSS COUNTRIES

Please review table below with information provided by Partner Focal Points:

	Partner Institution(s)	Country	RTB crop(s) of interest for RTBfoods	Processed/Food Product(s) of interest for RTBfoods	Names of people involved in the team for this WP
Team 1	CNRA	Cote d'Ivoire	Sweetpotato	Fried sweetpotato	DIBY Konan Evrard Brice
Team 2	CNRA	Cote d'Ivoire	Cassava	Attieke	N'ZUE Boni KOUAKOU Amani Michel
Team 3	CNRA	Cote d'Ivoire	Yam	Boiled or pounded	KOUAKOU Amani Michel
Team 4	CNRA	Cote d'Ivoire	Plantain	Fried	
Team 5	IITA	Nigeria	Cassava	Gari/Eba	TEEKEN Bela
Team 6	IITA	Nigeria	Yam	Boiled+Pounded	AMELE Asrat
Team 7	NRCRI	Nigeria	Cassava	Fufu + Gari-Eba	MADU Tessy
Team 8	NRCRI	Nigeria	Yam	Boiled+Pounded	MADU Tessy OBIDIEGWU Jude
Team 9	CARBAP	Cameroon	Plantain	Boiled Plantain	NGOH NEWILAH Gérard NOUPADJA Pascal KENDINE VEPOWO Cédric
Team 10	NaCRRI	Uganda	Sweetpotato	Boiled Sweetpotato	YADA Benard
Team 11	NARL	Uganda	Banana	Matooke	AKANKWASA Kenneth

2 WP5 SUMMARY NARRATIVE

Tell us the progress of your WP in Period 3 (Dec. 2019 to Dec 2020) focusing on main Activities & Achievements for each Output contributed to – Do not forget to systematically refer to product profiles concerned. (NB: This section will be copied & pasted as is in the body of the RTBfoods Annual Report for Period 3) [1-page max.].

During period 3, IITA-Nigeria activities on cassava have been mainly focused on preparatory work for participatory processing and consumer testing in Period 4. After the product advancement meeting for Nigeria the selected clones were multiplied and planted in two different sides: Agowu in Osun state and Otobi in Benue state. Local popular variety as well as commonly grown and popular varieties have been added as solid reference. Furthermore, a collaboration was initiated with IITA-Cameroon, ENSAI-University of Ngaoundere and CIRAD for evaluation of the same clones in two sites in Cameroon during period 4. Clones are being multiplied in Ibadan to be taken to Cameroon next year. Methodology for quality evaluation of food products gari and fufu (Nigeria and Cameroon) and bobolo (Cameroon) will be based on a simplified version of the pairwise ranking methodology developed in period 1. A PhD student is currently working on the organisational and institutional factors determining variety use in Cameroon. Also, IITA, NRCRI and NaCRRI evaluated the suitability for cassava processing into food products. The assessed clones were harvested in TRICOT trails planted in period 2. A total of 30 cassava varieties in Nigerian and 12 in Uganda have been evaluated using a total of 320 and 240 trials respectively. The processing followed a lead farmer guide that was developed for training on the evaluation of processing at individual level (households). NRCRI-Nigeria replanted 21 cassava TRICOT trials in IMO state for processing and food science evaluation by Cornell University in period 4 as well as or processing evaluation of 10% of the 320 NextGen TRICOT trials in period 5. Also, NRCRI in line with the outcome of the Product Advancement meeting of 2019 multiplied and planted selected clones at NRCRI station. The

multiplied clones will be utilized for the second TRICOT trials in two regions of SouthEast and SouthSouth of Nigeria in 2021 planting season.

NextGen mother baby trials (IITA/NRCRI) that were used for WP5 in period 1 and 2 (two-year data) have been analysed using Bradley Terry model of comparisons. Furthermore, all local varieties were genetically fingerprinted to know if they were improved or not. The dataset elicited and confirmed important criteria processors use to qualify cassava roots and food products. The method provides a basis for the development of a general WP5 variety evaluation with stakeholders. Results are published with the IJFST journal and are part of the special issue on RTB crops to come out in January. The trial also partly informed the choice to propose the variety TMS13F1160P0004 for release. The variety has now been evaluated by the release committee and released. Other released varieties according to different product profiles are: TMEB693 (Poundable), for the boil eat and or pounded product profile, TMS13F1343P0022 (Obasanjo-2) for the industrial product profile NR130124 (Hope) and IITA-TMS-IBA00070 (Baba-70), both for the food security product profile (fermented food products). The release according to product profile distinction is clearly influenced by evaluation of the varieties for different use. NRCRI in period 3 also evaluated the on-farm trials and food profile of 17 clones planted in two locations using the baby mother trial methodology as well the activity 4 processing methodology to evaluate the clones with the farmers. The clone evaluated are among the recently released varieties [NR130124 (Hope) and IITA-TMS-IBA00070 (Baba-70)].

Concerning Yam IITA Nigeria has been evaluating 5 improved clones of each *rotundata* and *alata* alongside local and standard clones. 2 *Rotundata* varieties (TDr0900067 and TDr1000048) performed very well on agronomic and food quality as did 1 *Alata* variety (TDa1100432). Evaluated were Pounded and Boiled yam made from the varieties. These varieties have been evaluated by the release committee and have been approved and are now released officially. Evaluation of food product quality was done on Appearance, Colour, Aroma, Taste, Texture, Mealiness and overall quality by 10 men and 10 women panellists in each community in each of 8 states in Nigeria. A combination of 5 and 3-point Likert scale was used for the food product evaluation, depending on the trait evaluated.

In 2020, NRCRI yam breeding program in partnership with IITA and Ebonyi State University both in Nigeria successfully released three yam varieties including TDr0900067 and TDr1000048 (*D. rotundata*) and TDa1100432 (*D. alata*). These materials alongside other candidates were tested on -farm in 2019 using our PVS protocol. We look forward commercialising and promoting these varieties in 2021. We anticipate on-farm trials in 2021. This will be formalised after assessment of our multi trial evaluations using vegetative, harvest and post-harvest consideration. This is presently ongoing.

Regarding Sweet Potato CIP selected a total of 8 OFSP clones from heterosis trials conducted at the National Crops Resources Research Institute (NaCRRI) in Uganda, National Semi-Arid Resources Research Institute (NaSARRI) and Kachwekano Zonal Agricultural Research and Development Institute (KaZARDI). The advanced yield trials for these eight clones together with check clones are conducted at five sites following the variety release guidelines of MAAIF and the Standard Operating Procedures (SOPs) for Sweet potato. Trials were planted in the second season (October) of 2020 and harvested is planned for January 2021. Apart from the standard breeding agronomic evaluation, the stored roots will be brought to NaCRRI Biosciences for quality trait analysis.

For Matooke, four field trials (in 4 agro-ecologies of Uganda), each with 91 banana genotypes had been planted in previous periods. Activities in Period 3 had planned to focus on participatory selection of preferred genotypes for mass multiplication to plant farmer-managed trials. It's at farmer-managed trials that genotypes for release are identified and submitted to the National Variety Release Committee. Participatory selection methods involve use many farmers (consumers) in affective tests. The activities were therefore greatly affected by COVID-19 situation. Limited field activities have just started and will continue during period 4. So far, 65 out of the 91 clones from the

trials in Central Uganda (located on-station) have been assessed, with 2 of them showing potential for acceptance.

Regarding boiled plantain, 8 clones from CARBAP and IITA breeding programs and 2 local checks were planted in 2019 in two contrasted localities in Cameroon [Njombe (~80 masl) & Bansoa (~1300 masl)]. During period 3, WP5 activities focused on trial follow up, on-farm and laboratory data collection. At farm level, vegetative parameters were measured during growth, at flowering and at harvest. Meanwhile at laboratory level, traits assessed included physical, chemical and physicochemical properties. The good agronomic and lab performances of some clones is a way-forward towards their adoption by farmers. However, an on-farm evaluation with farmers, alongside consumer's acceptability tests are indispensable for their adoption. These activities will be carried out in Period 4.

Activities performed in Period 3 within RTBfoods WP5 are contributing to 2 project Outputs:

- ***Output 3.1.1:*** *Methodology for participatory assessment of VUEs acceptance developed.*
- ***Output 3.1.2:****Acceptability of VUEs validated by RTB users (farmers, processors, retailers and consumers)*

3 WP5 ACHIEVEMENTS & CONTRIBUTION TO OUTPUT 3.1.1 & OUTPUT 3.1.2

Fill-in the table below to provide an update on progress made toward the achievement of project outputs in Period 3 – ***NB: Information provided in this table will be used to update the RTBfoods Results-Tracker.***

Output	Period 2 Targets/ Milestones	Achieved in Period 3	Variance & Brief Explanation
3.1.1	**11 new hybrids** from partner breeding programs assessed against users' quality preferences	In total **166 new hybrids** from partner breeding programs on cassava, yam, sweetpotato and matooke have been or are being assessed from an RTB user perspective: **15** cassava clones assessed from a mother trial approach (IITA/NRCRI) **30** cassava clones evaluated in Nigeria for agronomic and food product (Eba, Fufu) quality using TRICOT (IITA/NRCRI) **12** cassava clones evaluated in Uganda by (NaCRRI) using TRICOT approach **9** cassava clones evaluated in Côte d'Ivoire for agronomic and food product quality (Attiéké) (CNRA) **10** yam clones evaluated in 8 on farm trials in 8 states for boiled and pounded yam (IITA) **8** sweet potato clones evaluated in 7 sites in Uganda (CIP) **9** sweetpotato clones evaluated in Côte d'Ivoire for agronomic and food product quality (fried & boiled sweet potato) (CNRA) **8** plantain-like hybrids are being evaluated in 2 contrasted localities in Cameroon for their agronomic and postharvest qualities (CARBAP) **65** (out of the 91) Matooke clones that have been planted on-station for evaluation in four sites in Uganda (NARL) have been assessed so far; but participatory activities were highly affected by Covid-19.	Most study cases and PVS data analysis are pending. Trials have been planted but participatory assessments in Perod 3 have sometimes been delayed/ cancelled due to limited capacity to engage with RTB users during Covid-19 crisis.

Output	Period 2 Targets/ Milestones	Achieved in Period 3	Variance & Brief Explanation
3.1.2	**10** clones meeting users' preferences **(VUEs) identified**	In total, **17 advanced clones** meeting end user preferences have been identified: - **4 +1** user preferred cassava clone developed, selected and officially released in Nigeria partly based on mother baby trial evaluation of 15 clones (IITA/NRCRI) - **3 yam** user preferred clones developed, selected and officially released in Nigeria (2 Rotundata, 1 Alata) based on evaluation of 10 clones.(IITA) - **7 cassava** clones for Attiéké in Côte d'Ivoire at CNRA - So far **2 Matooke** clones have shown good potential for acceptance	NA

Please complete/update the List of Deliverables submitted in Period 3 & Responsible Persons below. The draft list hereunder has been consolidated by Eglantine based work plans for Period 3: Deliverable Titles as well as Responsible Persons may be changed.

Activities performed under 3.1.1 & 3.1.2	Deliverables Expected for Submission in Period 3 (Responsible Person or Data Managers)
Participatory evaluation of new hybrids (from partner RTB breeding programs)	O.1- Evaluation reports of advanced trials from RTB partner breeding programs are included in the WP5 Scientific Progress Report for Period 3 (no deliverable in Period 3): • Candidate yam genotypes from AfricaYam Breeding Program for the production of Boiled & Pounded Yam at NRCRI-Nigeria (T. Madu) • Candidate cassava genotypes from NextGen for the production of Gari/Eba & Fufu at NRCRI-Nigeria (T. Madu) • Candidate yam genotypes for production of Boiled & Pounded Yam at IITA-Nigeria (A. Amele) • Candidate cassava genotypes from NexGen for the production of Gari/Eba at IITA-Nigeria (B. Teeken) • Candidate cassava genotypes from NextGen for the production of Boiled Cassava at NaCRRI-Uganda (R. Kawuki) • Candidate sweetpotato genotypes from SweetGAINS breeding program for the production of boiled sweetpotato at NaCRRI-Uganda (J. Swanckaert, B. Yada) • Advanced Matooke genotypes from NARL Breeding Program for Matooke production at NARL-Uganda (K. Akankwasa) • Plantain-like hybrids from CARBAP & IITA Breeding programs for Boiled Plantain production at CARBAP-Cameroon (G. Ngoh) • New cassava genotypes for Attiéké production at CNRA-Côte d'Ivoire (B. Nzue) • New sweetpotato genotypes for the production of fried and boiled sweetpotato at CNRA-Côte d'Ivoire (K. Dibi) • New plantain clones for the production of fried plantain at CNRA-Côte d'Ivoire (S. Traoré)
Development of methodological documentation for the evaluation of advanced material/new hybrids (with WP1 Guidance)	O.2- Preliminary findings and inputs for the development of a general guidance for RTB foods crops evaluation including specific key characteristics per product profile are currently included in the WP5 Scientific Progress Report (WP1/2--> processing and acceptance attributes; WP4--> agronomic and breeding recommendations) (no deliverable in Period 3)

For each advanced trial listed hereunder, summarize Activities performed in Period 3 & Key Scientific Findings from participatory evaluations of advanced clones (cf list hereunder). For each evaluation case, please precise the breeding program providing the material, the number of advanced clones assessed & local checks, the traits assessed, the methods used & the type of stakeholders involved in the evaluation [20-30 lines each].

3.1 NRCRI – Yam (Boiled & Pounded)

Breeding Program: AfricaYam

Trial design:

The trial design of RCBD can be retained as it has continued to be effective in getting the expected results. The number of clones reduced in number with a national and a local check with at least, three replicates in a minimum of three yam friendly environments. The number of traits to be evaluated for should be reduced.

Methodology applied for Hybrid Evaluation:

The methodology applied for hybrid evaluation should involve Agricultural Faculties or Colleges with emphasis on Crop departments as stakeholders. The traits to be assessed should include all standard of operation protocol (SOPs) generated (Vegetative trait, harvest trait and Disease trait). The processes and stages of work in the boiled and pounded yam should be as stated below: Day 1 should include harvesting, field data collection, generation of traits for tuber quality, boiled yam and pounded yam, voting for selection of best traits for each of the qualities above (tuber quality, boiled and pounded yam quality) and tuber ranking (by voting). Day 2 should focus on sensory evaluation beginning from peeling, washing, labelling, cooking, pounding, packaging, displaying to assessment of panellists.

Results & Findings:

In the results and findings, breeders should look out for hybrid yams that have high potentials over the already existing yams in the areas the yam were evaluated. This will make it easy for farmers' acceptability when any of the developed yams make it to the release and registration stage.

Challenges Faced & Lessons learnt:

Numerous challenges have been facing the work ranging from identification of stakeholders and sites selection for establishment of trials. Stakeholders benefits is also a big challenge as many of them expect either yam materials or regular payments as deal in the work. Cattle menace and loss of yams to thieves causes problems at some time in some locations. Non-availability or late release of funds at required times in the year affects the planting times and or harvest times exposing the yam plants to difficult conditions resulting in poor performance of the crops. Late arrival of planting materials from partners at sometimes delays the planting dates, causing late planting.

3.2 NRCRI – Cassava (Gari-Eba & Fufu)

Breeding Program: NextGen/Cassava

Trial design:

IITA/NRCRI have been evaluating the processing into gari of the TRICOT trails that were planted in period 2. A total of 30 cassava varieties have been evaluated using a total of 320 trials. These trials have been evaluated at different time points in the processing on user defined traits that were established based on Nextgen Survey work and RTB foods WP1 work. The processing followed a lead farmer guide that was developed to train lead farmers on the evaluation of the processing of the individual farmers 'households

For cassava NRCRI, Nigeria has replanted 21 TRICOT trials in IMO state for processing evaluation and food science evaluation by Cornell University PhD food science student Chinedozi Amaefula in

period 4 as a preparation for the processing evaluation of 10% of the 320 Nextgen tricot trials in period 5. Tricot trials measure 90 square meters with three varieties: each variety having 30 stands planted with 1 by 1 meter spacing.

Methodology applied for Hybrid Evaluation:

The processing of the TRICOT trials followed a lead farmer guide that was developed based on Nextgen Survey work and RTB foods WP1 work to train lead farmers on the evaluation of the processing of the individual farmers 'households

Results & Findings:

Results are being analysed

Challenges Faced & Lessons learnt:

3.3 IITA – Yam (Boiled & Pounded)

Breeding Program: IITA yam breeding

Trial design:

Five candidate and two standard varieties of *D.rotundata* and *D. alata* were grown on-farm at Oyo, Edo, Nassarawa, Abuja, Kogi, Anambra, Benue, and Abiya states in Nigeria forest, transition and southern Guinea Savannah ecologies in 2019/20 cropping season. The on-farm trials were planted in single plot of 10 stands and using farmers as a replicate (three farmers at each site). Food quality assessment (boiled and pounded yam products) were done by 20 panellists (10 male and 10 female) at each on-farm site.

Methodology applied for Hybrid Evaluation:

Tuber samples of 500g per clone were weighed, peeled, and washed thoroughly with water. The peeled samples were prepared into about 4g cubes and cooked for boiled and pounded yam quality assessment. For pounded yam quality assessment, the cubes were cooked and pounded using pounding machine. About 125ml of water was used to cook the tuber samples for 30mins. There after the pounding machine was turned to pound the boiled yam samples for 10mins. All samples were subjected to the same procedure.

Each of the boiled and pounded yam samples were given unique identification code. A panel consisting of 20 natural boiled and pounded yam eaters (10 male and 10 female participants) with adequate knowledge of acceptable qualities of good boiled and pounded yam constituted at each site. In Abuja and Ibadan IITA stations a panel constituted nine and six members, respectively. The panellist assessed and rated the pounded yam samples on 8 attributes/characteristics: appearance, texture, aroma, colour, taste, mealiness, elasticity, moulding and general acceptability. Table 1 below shows the attributes with their scales of rating.

Each boiled and pounded yam samples with unique identification was placed in plastic plates. A panel consisting of 20 natural boiled and pounded yam eaters (10 male and 10 female participants) with adequate knowledge of acceptable qualities of good boiled and pounded yam constituted at each site. In Abuja and Ibadan IITA stations a panel constituted nine and six members, respectively. The panellist assessed the samples for boiled and pounded yam attributes using scales presented in Table 1. The attributes used for assessing boiled yam quality were appearance, colour, aroma, taste, texture, mealiness and overall acceptability for boiled yam consumption. The attributes used for assessing pounded quality were appearance, texture, aroma, colour, taste, mealiness, elasticity/stretchability, moulding and overall acceptability for pounded yam consumption.

Table 1. Boiled and pounded yam attributes and scales of rating

Boiled and pounded yam Attributes	Rating Scale
Appearance	1= Dislike extremely; 2=Dislike; 3=Neither like nor dislike; 4=Like; 5=Like extremely
Colour	1= Dislike extremely; 2=Dislike; 3=Neither like nor dislike; 4=Like; 5=Like extremely
Aroma	1= Dislike extremely; 2=Dislike; 3=Neither like nor dislike; 4=Like; 5=Like extremely
Taste	1= Dislike extremely; 2=Dislike; 3=Neither like nor dislike; 4=Like; 5=Like extremely
Texture	1= Strong; 2= Intermediate 3= Soft
Mealiness	1= Soggy, 2= Slightly mealy, 3= Mealy
Overall quality	1= Dislike extremely; 2=Dislike; 3=Neither like nor dislike; 4=Like; 5=Like extremely
Mouldability*	1= Not mould well/sticky at hand; 2= Intermediate; 3= Easy to mould
Elasticity/stretchability*	1= Not elastic/stretch at all; 2= intermediate; 3= Stretch very well or very elastic

**Attributes only for pounded yam*

The data from consumer acceptability score for the boiled and pounded yam quality were subjected to ordinal logistic regression analyses with the standard varieties used as a reference point. From the ordinal logistic regression analysis, the log odds ratio for each clone was estimated. The log odd ratio estimate for each clone indicates the chance of being in a high (liked much for that particular trait) or low (disliked for the trait) response category. A higher log odds ratio indicates that the candidate clone was rated better or assessed good for the boiled or pounded yam attributes by most of the panellist compared to the reference standard variety (local popular variety at respective site).

Results & Findings:

The results of consumer acceptability for boiled and pounded yam quality of the assessed clones were presented in figures 1, 2, 3 and 4 below. From the white yam clones (*D. rotundata*), TDr0900067 and TDr1000048 were identified as good for agronomic and food quality attributes and presented for release as new variety in Nigeria. The two *rotundata* clones were approved for release as a new variety in Nigeria in December 2020 by national crop variety and livestock breed release committee. From the water yam clones (*D. alata*), TDa1100432 was identified as good for agronomic and food quality attributes and present for release as a new variety in Nigeria. This clone was also approved for release as a new variety in Nigeria in December 2020 by national crop variety and livestock breed release committee.

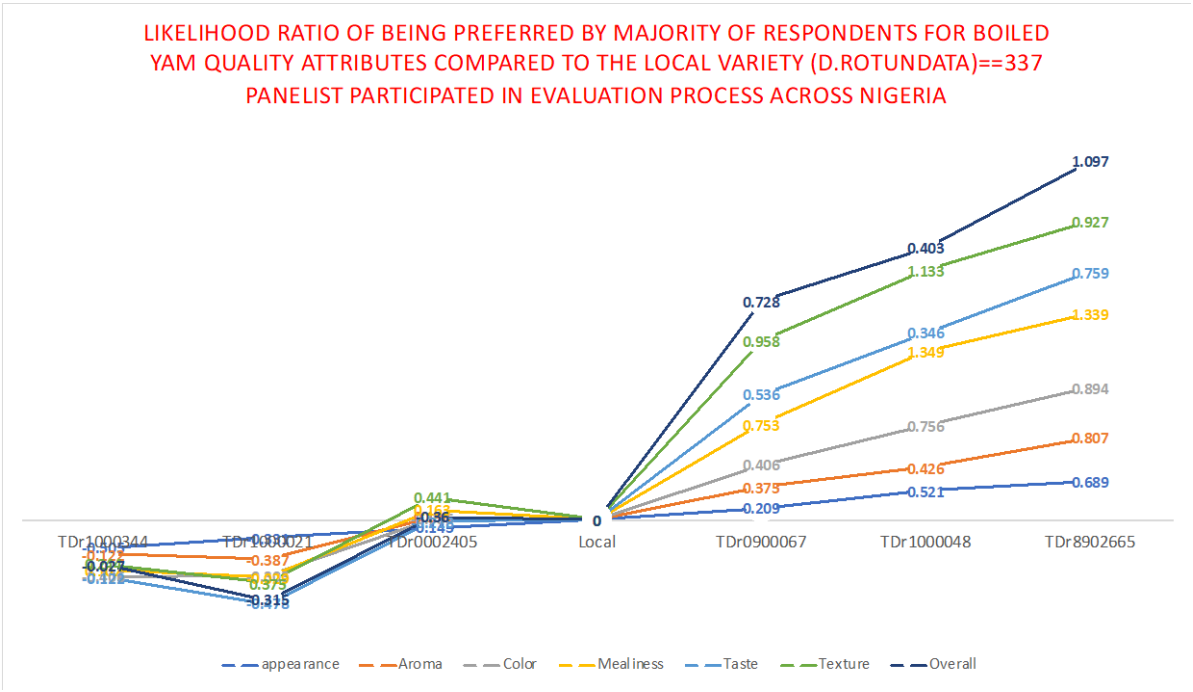

Figure 1. Comparison of elite white yam clones for boiled yam quality with local variety

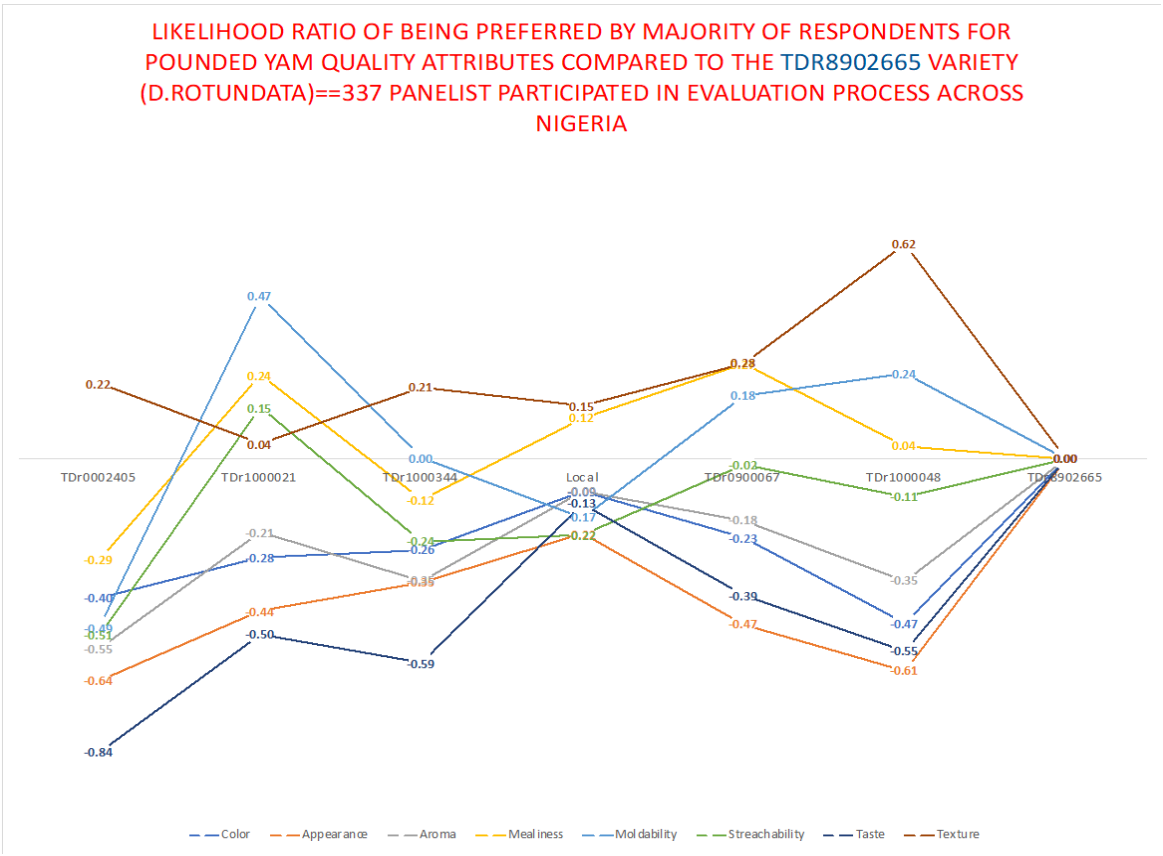

Figure 2. Comparison of elite white yam clones for pounded yam quality with standard improved variety TDr8902665

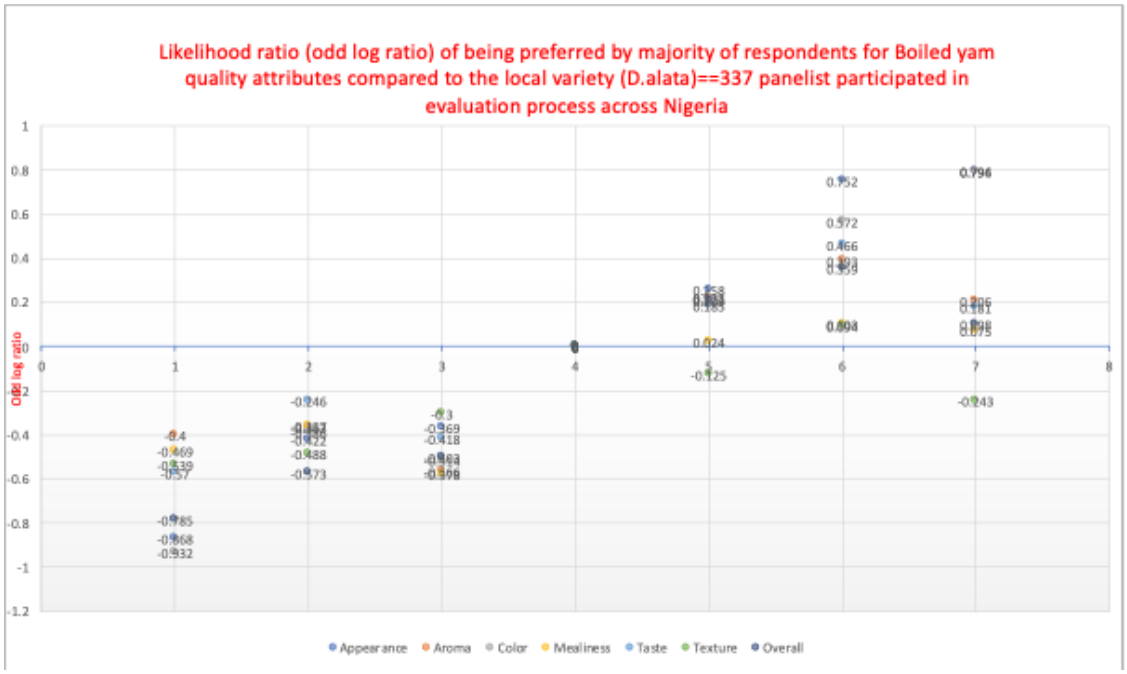

Figure 3. Comparison of elite D. alata clones for boiled yam quality with local variety. Clones: 1= TDa0200061, 2=TDa1000365, 3=TDa0000194, 4=local, 5= TDa1100317,6=TDa1100432 and 7= TDa1100245

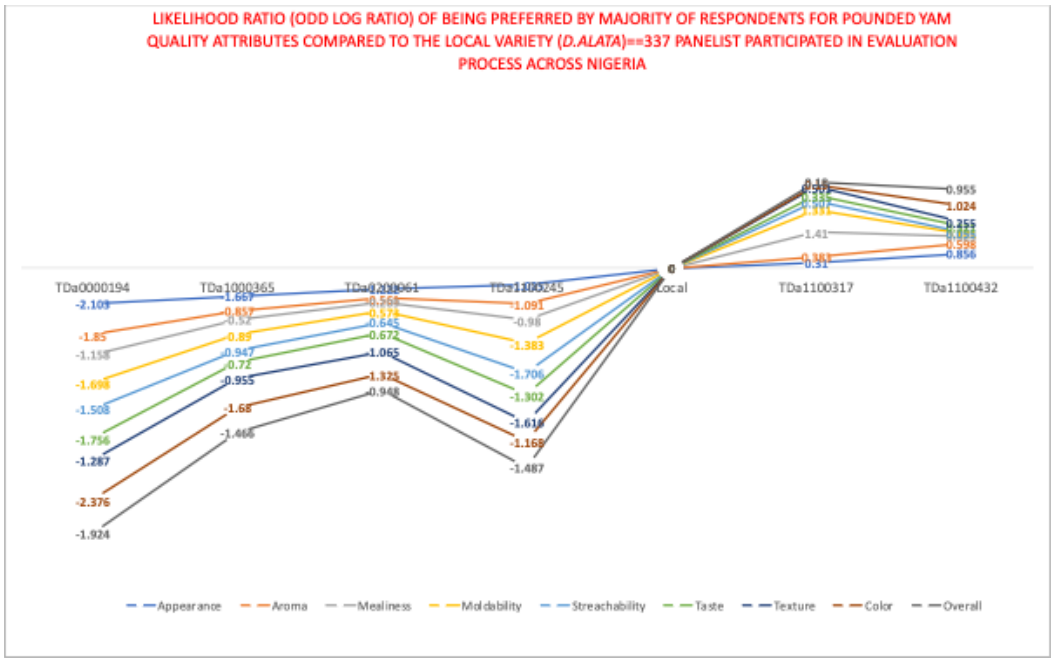

Figure 4. Comparison of elite D. alata clones for pounded yam quality with local variety. Clones: 1= TDa0200061, 2=TDa1000365, 3=TDa0000194, 4=local, 5= TDa1100317,6=TDa1100432 and 7= TDa1100245

Challenges Faced & Lessons learnt:

Small fund allocated for the activity and covid-19 pandemic.

3.4 IITA – Cassava (Gari-Eba)

Breeding Program: NextGen/Cassava

Trial design: In Benue and Osun state (derived savannah agro-ecology) varieties will be evaluated by "champion farmer processors" in the communities identified during WP1. Varieties were planted in period 3 in July 2020 and are planned to be harvested a year later. Trial design Benue and Osun: Experimental design: RCBD with 3 replications, Plot size: 28.0m^2 (plot length: 5.6m, plot width: 5m. spacing 1m x 0.8m, 42 stands: 6 x7).

Table 2. Cassava clones and local check planted in Benue and Osun

Varieties (product profile: food security gari and fufu)	
TMS13F1343P0022	TMS30572 (Check)
TMS13F1307P0016	TMEB3 (Osun trial)
TMS13F1343P0044	TMEB1_MS6 (Osun trial)
TMS13F1160P0004	TMEB2 (Benue trial)
TMS14F1278P0003	TMEB1142(Akpu) (Benue trial

The same clones except for the local checks are being multiplied for trial establishment in Cameroon and evaluated for gari and fufu (these varieties are all aimed at the product profile for food security: gari and fufu). It also includes two of the 5 released varieties: TMS13F1160P0004 (Game Changer), TMS13F1343P0022 (Obasanjo-2), NR130124 (Hope) and TMEB693 (Poundable).

Local farmer communities identified during WP1 work: survey, participatory processing and consumer evaluation will be engaged in processing. Samples of roots and products of best and worst varieties will be taken and analysed in the food science lab of IITA. Consumer testing is planned in the cities of Makurdi and Osogbo.

In cooperation with ENSAI / University of Ngaoundere and insights obtained during the RTB foods PhD student work of Noel Takam local clones will be added and trials installed at two locations in Cameroon: Littoral/centre region and Est region. These trials will be evaluated by "champion" farmer processors. ENSAI / University of Ngaoundere and CIRAD Cameroun will carry out laboratory analysis on roots and food products. This will be followed up with consumer testing in rural and urban areas.

IITA/NRCRI have been evaluating the processing into gari of the TRICOT trails that were planted in period 2. A total of 30 cassava varieties have been evaluated using a total of 320 trials. These trials have been evaluated at different time points in the processing on user defined traits that were established based on Nextgen Survey work and RTB foods WP1 work. The processing followed a lead farmer guide that was developed to train lead farmers on the evaluation of the processing of the individual farmers 'households

Methodology applied for Hybrid Evaluation:

Growth of the plants in the trials in Osun and Benue have and are being evaluated using standard breeding evaluation protocol used by IITA.A simplified method used for the mother baby trials will be used (see WP5 Scientific Progress Report in Period 1) to do the food product quality evaluation with farmer-processors. Methodology will be further developed with the WP5 team in the first months of period 4. A collaboration with ENSAI Cameroun will result in additional laboratory analysis of roots and food products.

The processing of the TRICOT trials followed a lead farmer guide that was developed based on Nextgen Survey work and RTB foods WP1 work to train lead farmers on the evaluation of the processing of the individual farmers 'households

Results & Findings:

The analysis of the mother baby trials has shown that Mother trial two-year data evaluated with champion farmer processors can provide a good articulation of the relation between varieties and food product qualities (for trial layout, varieties used and method see WP5 report of period 1). Moreover, the pairwise comparison elicited important user quality criteria for gari-eba and fufu. The study elicited a range of important root and food quality characteristics such as attractive light colour of the food products, their density as well as characteristics related to the food product texture which mostly confirmed the findings of a state/region representative WP1 survey study in Nigerian and Cameroon that was done alongside this study. The pairwise ranking method used will provide input to the development of a generic WP5 method to be developed and used for the RTB crops in the RTB foods project. Table 3 (Osun state trial) and 4 (Imo state trial) show the fresh roots to make the food products and the food products evaluation based on 2-year data from the mother trials. The recently improved variety TMS13F1160P0004 did as expected well on agronomic parameters and also performed well across the food product evaluation by champion processors working within a tradition of strongly fermented gari-eba (Osun state) and within a tradition of little fermentation gari-eba (Imo state). This variety has been advanced during the product advancement meeting and has been proposed for release to the national release committee and has been officially released under the name 'game changer', because of its excellent qualities but rather small plants with rather thin stems. Another variety that was supported by this mother baby trial analysis is TMEB 693 ('poundable') that provided good food quality and although not evaluated people stated that the growth was very good and that it was good for pounding and thus good for quick food preparation. This variety that is a popular landrace from Ghana has also been released. Other varieties released were TMS13F1343P0022 (Obasanjo-2) for the industrial product profile, NR130124 (Hope) and IITA-TMS-IBA00070 (Baba-70), both for the food security product profile (fermented food products). The release of these varieties was mainly based on feedback from medium and larger scale processors through the processing of roots form so call IITA cassava 'demand creation trials'.

Table 3. Bradley-Terry analysis of the evaluation of fresh roots and food product by 'champion processors', based on two-year data from mother trial in Osun State[+].

Category/Variety	Group	Fresh roots for gari	*Gari*	*Eba*	Fresh roots for *fufu*	*Fufu* pounded	*Fufu* turned
Local							
AKPU	1	-0.26	1.87****	0.97**	-1.87****	-1.19**	0.14
HONOURABLE1	2	0.06	0.21	0.32	-0.84*	-1.58***	-2.29****
HONOURABLE2	2	-0.8	2.05****	0.17	0.37	-1.09**	1.37**
OMOH_LOCAL1	1	0.62	0.8*	0.54	-1.58***	-0.67	0.14
OMOH_LOCAL2	2	-1.34**	1.13**	0.19	-1.25**	-1.20**	-1.092
Common landraces							
TMEB1	1	-1.56***	0.78*	-0.06	-0.99**	-0.53	-0.49
TMEB2	1	-1.53***	0.25	-0.83	-1.66***	-0.32	-0.65
TMEB419	1	-3.03****	0.89**	-0.46	-1.29**	-1.44**	-1.27*
TMEB693	1	-2.07****	2.24****	0.25	-1.13**	0.63	-1.27*
TMEB7	1	-2.03****	0.95**	0.77*	-2.36****	0.69	-16.55
IITA/NRCRI Improved							
IITA-TMS-IBA010040	2	-1.57***	-0.57	-1.39***	-0.50	-1.16**	-2.46****
IITA-TMS-IBA30572	2	-1.61***	-0.03	-1.13**	-2.19****	-0.01	-0.066
IITA-TMS-IBA961632	2	-1.57***	2.04****	0.42	0.27	-0.44	-0.8
IITA-TMS-IBA980505	2	-1.99****	-1.65***	-1.78***	-1.25**	-1.20**	-3.98****
IITA-TMS-IBA980581	2	-3.21***	0.59	-0.46	-2.88****	1.51**	-1.2688*
NR8082	2	-1.40***	0.48	0.3	-1.10**	-1.99****	-2.38****
TMS13F1160P0004	2	-1.58***	0.79	0.65	0.41	-0.45	13.49
TMS13F1176P0002	2	-2.41***	-1.47**	-4.52****	-3.34****	-15.94	-1.59**
TMS13F1365P0002	2	-0.38	0.65	-0.53	0.00	0.00	0.00
WK195	2	0.00	0.00	0.00	-1.44***	1.00	-1.08*

[+] Varieties with higher estimates are preferred more often in paired comparisons than those with lower estimates. Results from the best five and worst five varieties are highlighted in in bold green and bold red, respectively, for *gari, eba*, 'pounded' fufu and 'turned' *fufu*. The groups represent the landraces (1) and improved varieties (2)

Significance levels indicate the probability that the estimate is significantly different from 0: * = p <0.10; ** = p < 0.05, ***= p <0.010, ****=p <0.001.

Table 4. Bradley-Terry analysis of the evaluation of fresh roots and *gari* by 'champion processors', based on two-year data from mother trial in Imo State[+].

Group/Variety	Group	Fresh roots for gari	Gari
Local			
Agric	2	-12.09	0.09
Chigazu	1	-14.94	1.36
Durungwo	1	-11.92	0.81
KatiKati	1	-12.71	-1.28**
Mgboto_Umuahia	1	-11.97	2.03***
Nwageri	2	-12.43	1.86***
Nwocha	1	-10.90	0.03
Salome(6months)	1	-12.53	2.02***
Common landraces			
TMEB1	1	-10.40	-0.08
TMEB2	1	-10.10	0.39
TMEB419	1	-10.84	-0.90*
TMEB693	1	-11.90	0.82
TMEB7	1	-12.11	-0.45
WK195	1	-12.38	0.00
IITA/NRCRI Improved			
IITA-TMS-IBA010040	2	-12.30	-14.97
IITA-TMS-IBA30572	2	-11.81	0.42
IITA-TMS-IBA961632	2	-9.37	0.05
IITA-TMS-IBA980505	2	-13.59	-1.25*
IITA-TMS-IBA980581	2	-12.20	1.26*
NR8082	2	-12.80	1.67**
TMS13F1160P0004	2	-25.63	1.62**
TMS13F1176P0002	2	-11.75	1.03
TMS13F1365P0002	2	-11.11	1.58***

[+] Varieties with higher estimates are preferred more often in paired comparisons than those with lower estimates. Results from the best five and worst five varieties are highlighted in in bold green and bold red, respectively, for *gari*. The groups represent the landraces (1) and Improved varieties (2).

Significance levels indicate the probability that the estimate is significantly different from 0: * = p <0.10; ** = p < 0.05, ***= p <0.010, ****=p <0.001

Data from the TRICOT trial food product and agronomic analysis are being analysed. Initial results show that farmers chose their final favourite variety based firmly on food yield as well as food product quality, stressing the need to consider processing and food product quality traits. Important traits that determined the final variety choice by farmers were: root overall impression, density of the root (DM), overall impression processing into gari, ease of peeling, pulp colour/ discoloration, releasing water during pressing, swelling of pressed cake when toasting, gari color, gari taste, mouldabitly of eba, stickiness (to the hand), swelling of gari when making eba, eba taste, overall impression of stored eba, mouldability after storing eba, softness of stored eba, colour of the stored eba.

Challenges Faced & Lessons learnt:

A lesson learned from the mother baby trial analysis of based on period 1 and 2 work is that it is not self-evident that experienced food processors can judge from the root alone if the variety will be optimal or not for gari or fufu. With regards to the different varieties there is little articulation in the pairwise ranking data for fresh roots with the intention to make gari or fufu. This could also be an indication that breeders have a good idea on the type of roots users want to see.

3.5 NaCRRI – Cassava (Boiled)

Breeding Program: NaCRRI

Through partnership with NextGen cassava project, we adopted the triadic comparison of technologies (TRICOT) approach for assessment of elite cassava clones. A manual for undertaking this assessment was developed "Farmer-based Assessment of End-User Root Quality Traits for "Boiled" Cassava Food Products in Uganda'' Briefly, this manual provided guidance on trial establishment, harvesting, processing and assessing end-user root quality attributes with farmers. Accordingly, six districts were selected for TRICOT trials: Mityana (central region), Luweero (central region), Arua (West Nile region), Dokolo (Northern region), Serere (Eastern region) and Kaberamaido (Eastern region). These regions represented major cassava production and consumption areas, and where "*boiled cassava roots*" is a predominant food product.

A total of 40 farmers were selected per district and thus making a total of 240 farmers. Table 5 provides a summary of traits assessed in TRICOT evaluations, while Table 6 provides ranking of clones for softness. A major challenge observed is the harmonization of rankings, as at each evaluation stage clone rankings vary considerably.

Table 5. Traits considered for boiled root product assessment in TRICOT trials in Uganda

At harvest	Final product	Processing
Root shape	Cooking time	Ease of peeling
Root size	Final product	
Root size	Taste	
Root yield	Mealiness	
Root yield	Colour	
Disease resistance	Taste	
Disease resistance	Texture	
Quality of stems	Softness	
Quality of stems	Fibrousness	
Cortex colour	Overall liking	
Overall liking	Comparisons of A,B,C clones relative to what farmer usually uses	

Table 6. Softness ranking of cassava clones under TRICOT evaluation in Uganda

Variety	Overall performance (raw roots)	Performance of boiled roots
NAROCASS 1	65.6	54.16
UG130007	54.34	29.17
UG120193	43.03	58.72
UG120124	33.84	21.55
UG120198	29.33	34.63
MM16/0707	28.94	9.31
UG120156	24.21	22.96
MM06/123	14.48	35.34
UG130017	13.76	17.7
UG120180	13.7	33.33
UG120024	2.78	15.05
MM16/1627	0	3.52

3.6 CIP – Sweetpotato (Boiled)

Breeding Program: SweetGAINS

Trial design:

A total of eight OFSP clones (Table 7) are selected from heterosis trials conducted at the National Crops Resources Research Institute (NaCRRI), National Semi-Arid Resources Research Institute (NaSARRI) and Kachwekano Zonal Agricultural Research and Development Institute (KaZARDI).

Table 7. Pedigrees of orange-fleshed sweetpotato advanced clones

Clone	Flesh color	Clone Code Name	Female parent	Male parent
D11	Orange	UGP20140113-2	Huarmeyano	Ejumula
D15	Orange	UGP20140022-1	NASPOT5/58	NK259L
D20	Deep orange	UGP20140117-14	Huarmeyano	NASPOT 7
D26	Deep orange	UGP20140119-11	Huarmeyano	NASPOT 10 O
S36	Deep orange	UGP20140089-8	Mugande	Ejumula
S47	Orange	UGP20140029-13	Resisto	Magabali
S97	Orange	UGP20140102-19	NASPOT 11	SPK004
1.44	Orange	UGP20130001-44	Ejumula	New Kawogo

The advanced yield trials for these eight clones together with check clones are conducted at five sites following the variety release guidelines of MAAIF and the Standard Operating Procedures (SOPs) for Sweetpotato Breeding trials. The sites will include NaCRRI, NaSARRI, Abi Zonal Agricultural Research and Development Institute (AbiZARDI), Bulindi Zonal Agricultural Research and Development Institute (Builndi ZARDI) and Rwebitaba Zonal Agricultural Research and Development Institute (Rwebitaba ZARDI).

The trials are planted using a row-column design with three replications. Each plot has five ridges each with 15 plants making a total of 75 plants per plot. The check clones are NASPOT 8, NASPOT 10 O, Ejumula, New Kawogo and NASPOT 11.

The trials were planted in the second season (October) of 2020 and harvested is planned for January 2021. The second seasons advanced yield trials will be planted in the first season 2021 (April) and

harvested in July 2021. All routine activities from land preparation, planting, weeding, disease and pest damage assessment, harvesting will be done in accordance with the standard protocols already established.

Methodology applied for Hybrid Evaluation:

We will collect data on plant establishment at one month after planting. First sweetpotato virus disease (SPVD) scores will be taken at one month after planting and the second and last one will be taken at one month to harvesting or 90 days after planting days using 1-9 scale as defined in the SOPs. Alternaria blight disease scores will be taken following the similar times as SPVD. At harvest, we will collect data on plant stand, storage root yield, vine yield, storage root skin and flesh color, sweetpotato weevil severity (1-9 scale) and incidence. The storage roots will be brought to NaCRRI Biosciences for quality trait analysis. All data will be collected and managed through the field book app and SweetPotatoBase.

Results & Findings:

Trials are still underway. Results will come in Period 4.

Challenges Faced & Lessons learnt:

Final selection of candidate varieties will be done on the cooking behaviour. A thorough evaluation of the boiled samples is necessary in a timely fashion.

3.7 NARL/Bioversity – Matooke

Breeding Program: NARL Breeding Program for Banana (Matooke)

Trial design:

The trial has 91 genotypes with two local checks, replicated in four agro-ecological regions of Uganda.

Methodology applied for Hybrid Evaluation:

The hybrids are evaluated through working with users in the various agro-ecologies. Once planted, the data on response to pests and diseases, yield and maturity age is collected. This is combined with farmers own observations, which are obtained at stakeholder engagement meeting at the trail sites. When the clone mature, they are harvested, cooked and served to consumers (a minimum of 30 men and women for testing. The respondents give feedback on a 6-point hedonic scale, translated in local languages. The field data and sensory data are often combined to select clones to advance. A summary selection criterion is shown in the table below:

Table 8. Banana product profile: Matooke

Region/Market segment	Trait (economic, sustainability, livelihood) and value	Target trait level	Market Priority	Selection Objective
Highlands of East and Central Africa				
Fresh market and processing	Yield	30% greater than Mbwazirume variety across a range of soil and management conditions	1	Maximize
	Table quality (needs regional assessment)	A general acceptability score of at least 4 (on a hedonic scale of 1 to 6), using landrace variet *Mbwazirume* as a check (acceptability is judged on cooked samples using taste, aroma, colour, texture/mouth-feel	1	Reach threshold
	Earliness: planting to harvest	300 to 390 days	2	Minimize
	Plant stature (girth at 1m/height ratio)	A ratio of at least 0.15	2	Maximize
	Plant height	Less than 350 cm	2	Minimize
	Suckering behavior	75% follower sucker growth at flowering, 3-4 suckers at flowering	2	Optimize
	Resistance to black Sigatoka	INSL at flowering of 70% and above	3	Reach threshold
	Resistance to weevils	40% resistance higher than that of the moderate resistant check (Kainja)	2	Maximize
	Resistance to *Radopholus similis and P. goodeyi*	40% resistance higher than that of the moderate resistant check (Kainja)	2	Maximize
	Resistance to BXW	Sources of resistance to be identified	2	Opportunistic
	Bunch orientation	Pendulous score of 1 or 2	1	Opportunistic
	Drought tolerance (water productivity)- Needs regional assessment.	Tools to be developed	3	Reach threshold
	High ProVitA content	Average –Carotene(≥20 µg/ g dry weight)	2	Opportunistic
	Fusarium	Comparable to resistant check (Calcutta 4)	1	Maximize
	Resistance to BBTV	Sources of resistance to be identified	3	Opportunistic

Results & Findings:

Sixty-five (65) out of the 91 clones from the central region trial (located on-station) have been assessed. Results show that only 2 of them were scored close to 4 (see criteria table) and could qualify for advancement. However, the majority of tested clones were rated unacceptable. The testing of materials delayed due to COVID-19 and has just began. Results will be shared in the next report

Challenges Faced & Lessons learnt:

Field activities were hampered by COVID-19.

3.8 CARBAP – Plantain (Boiled)

Breeding Program: CARBAP & IITA Breeding Programs

Trial design:

Two (2) multi-location evaluation trials of selected genotypes were set-up in the localities of Njombe (Littoral region, ~80masl) and Bansoa (West region, ~1300masl). A randomized complete block design with five (5) plants per genotype and five (5) replications was applied in each locality, with a 3 x 2 m spacing. Ten (10) genotypes were selected for this study, with eight (8) clones from two (2) breeding programs namely: CARBAP and IITA, and two (2) local checks (Table 9). These genotypes were planted on the 20th of August 2019 in Njombe and on the 11th of September 2019 in Bansoa. A view of these plots is shown below (Photos 1 & 2).

Table 9. Clones and local checks used in the trials in Njombe and Bansoa

Selected genotypes	Breeding program	Code number in the layouts
CARBAP 838	CARBAP	1
CARBAP 969	CARBAP	2
CARBAP F568	CARBAP	3
CARBAP K74	CARBAP	4
Batard	Landrace (local check)	5
PITA 14	IITA	6
PITA 21	IITA	7
PITA 23	IITA	8
PITA 27	IITA	9
Kelong Mekintu	Landrace (local check)	10

Photo 1. A view of the plot in Bansoa (15th Dec 2020)

Photo 2. A view of the plot in Njombe (20th Dec 2020)

Methodology applied for Hybrid Evaluation:

At farm level, parameters measured included: Number of standing leaves at flowering, Harvest date, Flowering date, Height and Circumference of mother plant, Number of suckers at flowering, Number of leaves at harvest, Bunch weight, Number of fingers, Length of fingers and Circumference of fingers. Meanwhile at laboratory level, traits assessed were: Fruit weight, Pulp and peel weight, Pulp and peel colour, Peel thickness, Fruit girth, Pulp firmness, Pulp pH, Pulp total titratable acidity, Pulp total soluble solids, Pulp and peel dry matter contents and Pulp starch content.

Results & Findings:

Despite the fact that there is just two (2) weeks difference in the planting dates between the two locations and the early rain stop at Bansoa (high altitude), genotypes in Njombe were almost completely harvested and assessed and are already into their second cycle, while those in the locality of Bansoa are just entering first cycle flowering.

Vegetative data (HT, C10 and DTF) collected on some genotypes both in Bansoa and Njombe are presented in table 10 below.

Table 10. Vegetative data measured on genotypes in Njombe and Bansoa six months after planting

GENOTYPES	NJOMBE*			BANSOA**		
	DTF (days)	HT (cm)	C10 (cm)	DTF (days)	HT (cm)	C10 (cm)
CARBAP 969	297.5 ± 29.2	296.5 ± 32.2	67.1 ± 4.7	NA	25.33 ± 8.78	5.57 ± 0.81
CARBAP F568	304.0 ± 39.3	289.0 ± 59.4	62.4 ± 10.4	NA	22.70 ± 8.89	5.90 ± 2.37
CARBAP 838	307.2 ± 40.9	193.1 ± 33.7	53.0 ± 5.5	NA	22.50 ± 7.46	9.10 ± 3.05
CARBAP K74	326.4 ± 30.8	283.2 ± 45.4	66.7 ± 8.3	NA	NA	NA
BATARD	370.7 ± 11.9	376.5 ± 32.9	80.1 ± 8.1	NA	18.69 ± 8.08	5.44 ± 2.12
PITA 14	307.0 ± 52.4	246.3 ± 54.9	52.4 ± 11.1	NA	NA	NA
PITA 21	322.4 ± 42.7	285.7 ± 49.7	59.7 ± 9.4	NA	NA	NA
PITA 23	314.5 ± 33.3	322.9 ± 23.1	70.0 ± 4.8	NA	22.70 ± 10.61	6.25 ± 3.18
PITA 27	341.2 ± 32.1	277.2 ± 30.1	60.1 ± 8.1	NA	20.28 ± 11.14	6.32 ± 2.08
KELONG MEKINTU	350.0 ± 36.1	262.0 ± 59.1	65.0 ± 6.1	NA	20.67 ± 8.54	8.96 ± 2.76

DTF: days to flowering; HT: height of mother plant; C10: circumference of mother plant; NA: not available

*Data concerns genotypes as of December 20, 2020

**Data concerns genotypes as of December 15, 2020

At laboratory level, routine analyses (physicochemical) were only performed on fruits from the genotypes in Njombe as presented in table 11.

Table 11. Physicochemical analyses of *Musa* genotypes in Njombe

GENOTYPES	FWt (g)	PuWt (g)	PeWt (g)	Pu/pe	PeT (mm)	FG (cm)	PeC	PuC
CARBAP 969	181.5	112.3	67.9	1.7	3.3	4.0	Green	Cream
CARBAP F568	187.9	113.1	73.3	1.5	3.5	3.9	Dark green	Ivory
CARBAP 838	118.3	56.6	60.7	0.9	3.5	3.3	Medium green	Ivory
CARBAP K74	257.5	163.1	92.3	1.8	3.3	3.8	Light green	Cream
BATARD	236.0	138.1	96.1	1.4	3.3	4.0	Medium green	Orange
PITA 14	129.8	81.9	46.8	1.8	2.8	3.4	Medium green	Yellow
PITA 21	230.5	148.6	80.5	1.8	3.2	3.9	Medium green	Ivory
PITA 23	182.9	114.6	67.1	1.7	3.2	3.8	Medium green	Yellow
PITA 27	174.3	116.3	56.9	2.1	2.9	3.7	Medium green	Ivory
KELONG MEKINTU	177.5	100.9	74.2	1.4	3.6	3.8	Light green	Orange

FWt: Fruit weight; PeWt: Peel weight; PuWt: Pulp weight; Pu/pe: Pulp to peel ratio; PeT: Peel thickness; FG: Fruit girth; LF: Finger length; PeC: Peel colour; PuC: Pulp colour.

Challenges Faced & Lessons learnt:

When dwarfism was observed on some genotypes 3 months after planting as it was the case in Bansoa, data were not collected. All the genotypes were subjected to dwarfism in Bansoa except *PITA 14* as this genotype was planted late. Data collection was also limited by (i) diseases such as the Banana Streak Virus (BSV) which attacked *PITA 21* thereby retarding its growth, and (ii) the attack of some genotypes by nematodes.

During the collection of data in Njombe, a number of issues on some genotypes were observed. These issues included: broken trunk, fallen plant and bunch with inconsumable fruits that could be due to drought experienced by the mother plant of these genotypes. Hence, the number of plants implicated in data collection for the concerned genotypes during the first production cycle was limited.

3.9 CNRA – Yam (Pounded)

Postponed to period 4.

3.10 CNRA – Cassava (Attiéké)

Breeding Program: not precise.

Trial design:

- Two demonstration trials were set up in a peasant environment, in Sakiaré (Yamoussoukro) and in Okpoyou (Dabou). They consisted of 10 and 11 varieties respectively. They were set up by village producer groups under the supervision of the CNRA team. The fields in a peasant environment were made up of 2 blocks. Each block received all varieties. The 11 varieties in Okpoyou were made up of 9 from CNRA (Bocou2, Bocou5, Bocou6, Bocou7, Yacé, I090006, I084157, I083774, I083724b) and 2 local (Ess-akpl and Agbêgrê). In Sakiaré, of the 10 varieties, there were 8 from the CNRA (Bocou2, Bocou5, Bocou6, Yacé, I090006, I084157, I083774, I083724b) and 2 local (Yavo and Kolou). The local varieties were chosen on the basis of their aptitude for making good attiéké (Ess-akpl and Yavo) or bad attiéké (Agbêgrê and Kolou) in the locality. The witness chosen by the CNRA is the Yacé (ability to make good attiéké at the

national level). Among the varieties used in the two localities, there were 5 varieties with yellow flesh from CNRA.

- A test was set up at a station in Bouaké to determine the effect of the different harvest dates on the quality of the attiéké. For this test, the split-plot device with 3 repetitions was used. The main factor is the harvest date with 5 dates (from 9 months to 21 months) and the secondary factor, the variety with 13 varieties.

Methodology applied for Hybrid Evaluation:

The various harvests of the demonstration tests took place from August 10 to 15 and 24 to 28, 2020 in Okpoyou and Sakiaré respectively. At harvest, morphological, sanitary and agronomic data were taken. Two agricultural days were organized, one for harvesting and the other for tasting. These days brought together producers, processors, consumers and researchers. ANADER (supervisory structure) and PAMCI (cassava processing company) were represented. The tasting of products made into attiéké, placali and porridge was done by the villagers and other participants. The data collected during these stages are: the attiéké yield of the varieties and the organoleptic data. The tasting focused on several quality criteria for the attiéké, namely: color, grain size, presence of fiber, aroma, consistency and flavor. These criteria were evaluated on a rating scale ranging from 1 to 5 (1 = very bad, 2 = bad, 3 = acceptable, 4 = good and 5 = very good). The varieties harvested were subjected to physico-chemical analyzes (humidity, pH, reducing sugars, etc.) on the fresh cassava and on the attiéké.

Results & Findings:

The statistical analyses carried out on the data collected during the harvest showed that the yield of the varieties varied from 12.81 t / ha (I090006) to 25.26 t / ha (Bocou6) at Okpoyou. In Sakiaré, the yields were between 11.20 t / ha (I084157) and 20.95 t / ha (Bocou2). The Bocou5 variety had the highest attiéké yield, 73%, and the I083774 and I084157 varieties had the lowest yields, 55% in Okpoyou. In Sakiaré, the yields varied from 60 (Kolou) to 46% (I084157). At the end of the attiéké tasting, all the varieties were appreciated by the participants with the exception of some varieties such as I084157, I083724b and Kolou. The physicochemical analysis carried out on the attiéké revealed, among other things, a humidity level which varies from 44.4 (Bocou5) to 51.8% (Bocou6); an energy value varying from 192,262 cal (I083774) to 224,224 cal (Bocou5).

Challenges Faced & Lessons learnt:

The major difficulties encountered during this work are:

- Restriction of activities due to the Covid-19 pandemic
- Insufficient funds that prevented regular monitoring of the work
- Lack of equipment and chemicals for performing physico-chemical analyzes in the laboratory.
- The lessons learned are:
- Mobilization of villagers during the implementation of activities
- Producers' satisfaction during agricultural days
- The delay in carrying out activities due to the disruption of funds

3.11 CNRA – Sweetpotato (Fried & Boiled)

Breeding Program: not precise.

Trial design:

Sweet potato production trials were carried out in two regions, Gbêkê (in the center of Côte d'Ivoire) and Poro (in the north of Côte d'Ivoire). Two (2) villages were selected per region for a total of 4 villages. In the Gbêkê region, the villages are *Broukro and Kongondékro* and in the Poro region, the villages are *Dyelokaha and Sanbalakaha*.

These tests were set up by the producers under the supervision of the CNRA and the ANADER teams. The experiments were composed of 11 varieties in each village (2 local varieties proposed per region according to their appreciation and 9 varieties from CNRA). Among the varieties used in the two regions, there were 3 varieties with white flesh, 4 varieties with orange flesh and 4 varieties with yellow flesh.

Methodology applied for Hybrid Evaluation:

To evaluate the acceptance of the varieties used, 2 consumers tests were conducted per village with varieties with good yields. Two (2) dishes were evaluated during the tests: *fries* and boiled *sweet potato*. Attributes assessed were the sweet taste, the texture and the appearance.

Agronomic traits (morphological, yield, resistance, etc.) were collected before harvest. Field days were organized at harvest time and sensory test conducted the same day. Stakeholders involved were producers, processors, consumers, researchers, and other extension services such as ANADER. Tastings of sweet potato French fries and porridge were conducted by villagers and other participants.

Results & Findings:

Yield

Statistical analyses of data collected during harvest showed that the yield of the varieties varied from one region to another. For example, in the Gbêkê region, the yield ranged from 5.3 t/ha (Aleda ouffouet) to 6.4 t/ha (Chinese wosso) for the local varieties and from 3.6 t/ha (Irene) to 12.2 t/ha (BF59*CIP4) for the CNRA varieties. In the Poro region, the yield ranged from 3.8 t/ha (Affou) to 7.5 t/ha (Dyelo) for the local varieties and from 8.0 t/ha (Covington) to 30.4 t/ha (Fatôni 2) for the CNRA varieties.

Consumers tests

At the end of the sensory tests, in the Gbêkê region, the most appreciated yellow and white flesh varieties were Aleda Manda and Fatoni 2. Concerning the Poro region, the most appreciated varieties were the varieties with orange flesh (Irene, TIB-440060 and CIP-199062-1).

Challenges Faced & Lessons learnt:

The main difficulties encountered during this work were: the restriction of activities due to the Covid-19 pandemic, the lack of funds which prevented the regular monitoring of the work.

Perspectives:

Biophysical analyses to be conducted on the same samples.

3.12 CNRA – Plantain (Fried)

Plantain bunches from eleven varieties were harvested and transported to Azaguié and Anguédédou. The fruits from the following eleven varieties and clones namely: Horne 1 (**18**), Orishele (**32**), PITA 3 (**28**); FHIA 21 (**15**) French dark (**22**), 3 Vert (**12**), Big Ebanga (**22**), Saci (**15**), Banadyshie (**10**), BITA 3 (**25**), Zakoi (**10**) SH 3640 (**15**) were analyzed in Dr EBAH laboratory.

A new farm have been settled at Anguédédou with the above mentioned varieties together **8 new** varieties and clones including: FHIA 25, Banane Kaki, Red Ebanga, Corne 18 Rouge, Aboisso, French Clair, Corne bout Rond and Vrai Corne.

Due to COVID-19, plots settled at Azaguié (40 Km from Abidjan) could not be followed properly. Therefore, bunches were abnormally small and consequently not analyzed. Most activities were postponed to period 4.

3.13 Methodology development

Lessons Learnt from participatory assessments of new hybrids in Period 3:

Which are the major methodological learnings from activities monitored in Period 3 by WP5 partners on the different RTB crops (reported in section 3)? Which conclusions are already shareable with partner breeders to improve variety assessment before release ('low hanging fruits')? [1 page].

IITA and NRCRI learned from the TRICOT cassava agronomic and food product evaluation that the final variety choice made by farmers is very much more influenced by the postharvest traits, food product quality, yield of the variety and pre-harvest traits. Farmers made informed (data show little randomness) decisions when choosing the final overall best variety. Complete analysis of the data will be shared in period 4. The TRICOT method is found a very good scalable method to get feedback on the overall suitability of varieties in relation to farmers and their households' livelihoods. This method must be complemented with focussed evaluation of a more limited number of field trials to be evaluated with champion processors (like the mother and baby trial setup of which the results are discussed in this rapport), including lab analysis of the best and worst evaluated varieties.

IITA in cooperation with NRCRI has produced a pairwise ranking mother trial approach in period one that has already partly been reused. Furthermore, 2 lead farmer guides have been developed describing the TRICOT agronomic and post-harvest evaluation procedures for this citizen science approach. A formal guide to select TRICOT participants in a social/gender inclusive and expertise focused way is under development.

NRCRI boiled and pounded yam lessons learned:

- There should be clear and proper agreement with stakeholders before establishing the trials.
- Stakeholders should be properly guided and should accept to carry out the work according to instructions
- Staking in MLTs should be averagely 2 m high.
- During sensory evaluation, farmers should not be over stretched to enable them give out their best.

The following conclusions are already shareable with plant breeders A) high yield, b) Disease resistance C) High starch content d) High dry matter content e) Low oxidation rate f) Multiple tubers and plant vigour and early maturing.

However, one of the commitment of WP5 was the development of a guidance for RTB-Foods crops evaluation with the contribution of WP1, WP2, WP3 and WP4 leaders in order to integrate keys constraints, information and results. WP5 co-leaders discussed: - Sequence methodology development - Main components to be integrated into the proposed methodology including raw and processed material characterisation in laboratory and field assessment. In order to implement the consolidation of the methodology and his guidance after the feedback of the WP leaders and PMU, a workshop was planned. But due to COVID 19 pandemic, this Workshop was postponed to period 4.

Considering breeders' constraints, what are the essentials that should be taken into consideration in the development of the RTBfoods methodology to engage RTB users with breeders? [±20 lines].

- A clear (er) picture is needed showing the products made by the target population and their relative importance for men and women's income and food security (household use).
- FAO (and other similar) statistics provide aggregated information that may not be relevant for our purposes and must be complemented with more focused quantitative and qualitative studies.
- An interdisciplinary discussion is needed to combine and weight the different data streams.
- An interdisciplinary team (including breeders, food scientist, agronomists, economist, anthropologists and gender specialists) should commit to robust product profile development
- Need to assure that results and insights from different initiatives and projects will be merged (accumulation of insights) in through a central CGIAR initiative
- Resources for this are needed: could be standardly budgeted for in all breeding related projects, and/ or should be Windows 1&2 core funding.
- It requires a strong effort and ample time, interaction with a diverse group of people, detailed discussions, constantly highlighting the overall objective and framework (Which is rather straightforward)

4 COVID-19 IMPACT ON WP WORKPLAN IN PERIOD 3

*Narrative on the impact of Covid-19 sanitary crisis on the completion of WP workplan in Period 3, in each country of WP implementation. For each set of activity impacted, mention the **level of impact** (i.e. postponed field or lab work, missing harvests, support gaps, delays in data analysis, etc.), the **consequences** on sub-sequent activities (including activities performed in other WPs) & the impact on the **capacity to deliver** in Period 3 – NB: This section aims to provide elements to the PMU to justify eventual deficiencies in reaching Period 3 milestones/targets & to request a budget reallocation for Period 4 (if applicable) [1-2 page].*

All field work related activities of WP5 were slowed down by COVID 19 in almost all the institutions implicated in RTBfoods project.

As IITA could carry out less fieldwork activities because of Covid 19, we focused on the proper planning of WP5 work in period 4. As the TRICOT work was already designed to function with little staff involvement (Lead farmers were trained to do evaluation of the TRICOT trials) the TRICOT experienced little consequences and post-harvest evaluation could take as planned. Lead farmer trainings could be held with protective measures which did not at all impinge on the quality of the trainings. The team IITA and NRCRI teams even managed to a follow up feedback exercise with the TRICOT participants to share the initial results with the farmers and have discussions on why certain varieties were chosen as best and worst in their area.

Also, the food science anchoring work by Cornell PhD student Chinedozi Amaefula planned for this year could not take place and is rescheduled to period 4 and 5. However NRCRI prepared the development of a good food science protocol for this anchoring work by replanting

21 TRICOT trials in Imo state. These trials will be evaluated by Chinedozi next year as a preparation for the full anchoring of the TRICOT trials in period 5 covering 10% of all the trials in the 4 states.

COVID 19 also negatively impacted interactions between institutions and / or countries. For example, participatory test on plantain programmed in Cote d'Ivoire could not be organised by CNRA and CARBAP due to COVID 19 pandemic.

Furthermore, a workshop programmed within the framework of evaluation protocol development has been postponed to period 4 due to COVID 19.

In the table below, summarize the consequences of Covid-19 crisis on each activity planned initially, team by team. Report the impact on completion level & the adaptation strategy chosen in agreement with WP coordination team (delays, postponing, cancellation, etc).

Country	Institute	Product Profile	Impacts & Coping Strategy
Nigeria	NRCRI	Fufu & Gari-Eba	
Nigeria	NRCRI	Boiled & Pounded Yam	
Nigeria	IITA	Gari-Eba	Focus on good preparation of WP5 trials for evaluation in period 4.
Nigeria	IITA	Boiled & Pounded Yam	
Uganda	NaCRRI	Boiled Cassava	
Uganda	NARL/Bioversity	Matooke	
Uganda	CIP	Boiled Sweepotato	
Cameroon	CARBAP	Boiled Plantain	Some lab evaluation to be carried out in external laboratory has been postponed to period 4.
Côte d'Ivoire	CNRA	Attiéké	
Côte d'Ivoire	CNRA	Pounded Yam	
Côte d'Ivoire	CNRA	Fried Sweetpotato	
Côte d'Ivoire	CNRA	Fried Plantain	

5 WP5 COORDINATION

5.1 Scientific collaborations between partners

Any successful collaborations on some activities and/or for some food products between WP5 partners?

In cooperation with ENSAI / University of Ngaoundere and insights obtained during the RTB foods PhD student work of Noel Takam, Nextgen clones that came out of the Nigerian product advancement meeting for the gari/fufu product profile will be taken to Cameroun, local cassava clones will be added and trials will be installed at two locations in Cameroon (multiplication for installing the trials has started in period 3): Littoral/centre region and Est region. These trials will be evaluated by “champion” farmer processors in period 5. ENSAI / University of Ngaoundere and CIRAD Cameroun will carry out laboratory analysis on roots and food products. This will be followed up with consumer testing in rural and urban areas.

IITA & NRCRI on Gari-Eba & Gari-Fufu: They have been thoroughly cooperating on analyzing the mother baby trial approach and NRCRI has been using the mother trial protocol again in the WP5 evaluation of breeding trialsiThe pairwise ranking and normal ranking procedures with maximum 5 varieties per batch provide a good way to determine the best from the worst and is much more reliable than ranking larger amount of varieties. Furthermore, IITA and NRCRI are working together on the gender responsive Tricot trial approach and its anchoring through the measurements and processing of 10% of all the trials. For this a food science cornell PhD student will measure and process 21 TRICOT trials in Imo state as a preparational exercise for the full anchoring of 32 to 40 trials which will take place in 2022 (period 5).

CIP & NaCRRI on boiled sweetpotato: NaCRRI is responsible for the last stages of breeding for sweetpotato in Uganda. That means that CIP hands over the material to NaCRRI and NaCRRI organizes the on-farm trials and release of new varieties.

CARBAP & CNRA: Participatory test and laboratory analysis on boiled plantain has been discussed and programmed in Cote d’Ivoire in July 2020 by the two institutions. Due to COVID-19 these activities could not be organised, they have been postponed to period 4.

CIRAD contribution and interaction within the frame work of WP5

The participatory evaluation activity of clones from breeding programs was very strongly impacted in period 3 due to COVID, which greatly limited travel, access to fields and accessibility to laboratories. Alexandre Bouniol based in Benin, coordinates varietal evaluation activities. An exhaustive inventory was drawn up of the trials in progress and the implicated logistics. Different types of participatory trials are being carried out: TRICOT (NEXTGEN/cassava; CRP-RTB/sweet potato), Mother Trial (cassava, yam, banana), baby trial (cassava, sweet potato, yam, potato). For the TRICOT trials it was decided that 10% of the clones evaluated by the farmers will be transported to the laboratory for physicochemical analyzes and processing into final food products for textural and sensory evaluation. In the case of the Baby and Mother trials, champion processors from the various villages will transform the crops and evaluate the quality of the final products. As part of the RTBfoods projects, in period 3, studies were carried out on the preferences of new hybrids from breeding programs: plantain in Cameroon: “CARBAP K74”, sweet potato in Uganda “NASPOT 8” , and cassava in Benin (IITA / harvestplus clones), Nigeria (NEXTGEN) and Uganda (NaCCRI) with local processors and consumers. This work was valorized through 5 publications in the special IJFST issue, with co-authors and contributions from CIRAD.

- Raw & boiled plantain quality characteristics. https://doi.org/10.1111/ijfs.14812
- Quality characteristics of boiled sweetpotato. https://doi.org/10.1111/ijfs.14792
- Rheological and textural properties of lafun. https://doi.org/10.1111/ijfs.14902
- Cassava and food product quality in Nigeria (Eba & fufu). https://doi.org/10.1111/ijfs.14862
- Cassava traits and kwon physicochemical properties. https://doi.org/10.1111/ijfs.14940

Very promising NEXTGEN clones have been identified, responding to the preferences of producers and consumers. Further trials were conducted to test the suitability of new hybrids for the production of Attiéké, boiled plantain, Matooke, boiled sweet potatoes, boiled and mashed yam and boiled potato. Unfortunately, because of the Covid -19, CIRAD was prevented from participating in these evaluations. In period 4, based on the first experiences, an assessment methodology specific to WP5 / RTBfoods will be developed and adapted for each product profile

5.2 Support strategy of WP5 coordinators

Describe briefly how has been (re)organised the Coordination of the WP in Period 3 and how Responsibilities have been shared between activity focal points – Highlight Strengths & Complementarities [± 15 lines].

Following Ted Carey retirement, Jolien Swanckaert was designated by PMU as WP leader assisted by Gérard Ngoh Newilah, Béla Teeken and Alexandre Bouniol. Within WP5 coordination team focal points have been determined by crop:

- Banana and plantain: Gérard Ngoh Newilah
- Yam: Alexandre Bouniol
- Cassava: Béla Teeken
- Sweet and Irish potato: Jolien Swanckaert

Their role was to contact crop focal points in order to collect information and be aware of the activities planned and implemented by the different teams in various institutions.

Which are the Challenges & Roadblocks faced in the coordination of WP5 team work? [1 page].

It has been a quite difficult for WP5 team to obtain feedbacks from partners to consolidate scientific report in Period 3. This can be explained by the following main reasons:

i) Partners had to focus and prioritize their work on the reporting of others WPs for which a lot of field activities were conducted in period 1 and 2 and for which deliverable are waited. The WP5 suffering, in this case, to be the last step of the RTBfoods project methodology.
ii) The crop programs have they own evaluation methodology that are prioritized. The WP5 methodology development has to integrate these ones in order to be as smart as possible in order to be efficient. For this development, exchanges with breeders and also other WP leaders are needed.
iii) The Covid crisis has prevented the conduct of field activities and also the organization of a specific and inclusive workshop on methodology development.

Strategies to be reinforced/developed by WP5 coordination team for Risk mitigation & Partner mobilization in WP5 activities? If possible, refer to the teams you would like to see more involved in WP5 activities in the future (Institute + Country + RTB crop or food product concerned) [±20 lines].

In order to increase the degree of involvement of the different partners it seems necessary to involve them in the elaboration of the WP5 methodology. This will be possible during a specific workshop conduct during parallel session of the next annual meeting. This work can also be done through holding virtual meetings during the first 2021 semester.

Following the elaboration of the WP5 methodology, supports will be proposed and provided to teams in order to design and implement field activities as well as on-farm and laboratory evaluation. If needed and if the sanitary situation allowed it, WP5 leaders will also propose to participate to field activities.

6 INTERACTION MECHANISMS BETWEEN WPS

Fill-in the table below with a brief description or bullet-point lists of interactions with other WPs (successful ones & gaps) & propositions for risk mitigation

	Successful Interactions/ Coordination with other WPs (specific actions concerned, frequency, tool sharing)	**Gaps in Interactions/Coordination with other WPs: What is needed from other WPs ?** **(NR = not relevant)**	**Risk Mitigation: How to Improve (specific actions to be taken, frequency, tool sharing?)**
WP1	Good identification of focus communities to work with during WP5 and good identification of important quality characteristics on which the improved clones can be evaluated	WP1 complete product profiles and activities reports will be useful in order to design WP5 field activities, especially on processing and gender aspects.	WP1 leader will be involved in WP5 methodology development
WP2	Ongoing discussion on which traits to focus on based on the results of WP1 work, official decision meeting is to be held.	Finalization of the traits to focus on is necessary Alignment of NIRS readings from roots to foods needs to be put in place. Information regarding the way of stabilization of samples for the analysis that will need to be carried out within laboratories	Identification of analysis that won't be transferable until the field and definition of stabilization protocols for samples.
WP3		Identification of methods/analysis developed through WP3 and that can be easily carried out on the field for WP5 concerns	Virtual meeting with WP3 leader in order to check the possibility of characterizing with high throughput methods samples from WP5 (raw material, intermediate products, and final product)
WP4	For cassava in Nigeria in cooperation with WP4 multiplication for the 2nd year TRICOT trials has been realized in 3 locations to better supply the next round of TRICOT trials. Furthermore, trials with advanced material in Osun and Benue have been prepared for evaluation with champion processors and advanced material within the food security gari-eba product profile have been multiplied for Cameroon in period 4	Identification of on farm trials available for field activities during period 4 and 5. Share agronomic scores of evaluations, for the varieties ready to release.	Specific virtual meeting with WP4 leader. TRICOT trials will be repeated for a second year including a pilot food science evaluation of 21 TRICOT trials with the aim of developing a well thought through protocol for the anchoring of the TRICOT trials in cooperation with WP4 through food science evaluation (including lab analysis of roots and intermediate foods and preparation of food in the lab in period 5.
WP6/ PMU		Make partners aware of the mobilization of budgets to be able to conduct these field activities of WP5	

7 COMPLEMENTARITY WITH OTHER PROJECTS OR BREEDING PROGRAMS ON RTB CROPS

Narrative on complementarity with other projects or breeding programs from national partners (e.g. NextGen, AfricaYam, SASHA/SweetGAINS, CRP RTB, BBB, HarvestPlus). Describe the types of complementarity (students, equipment share, facilities, participation of WP coordinators in partner projects, events or initiatives on RTB crops).

Activities are complementary to the Nextgen cassava project as it has been in period 1 and 2 based on the mother baby trial evaluation with farmer processors. The TRICOT trials function as an additional complementary scalable tool to get feedback from users (farmers and processors) on the food product quality of the different varieties and how this food product quality influences their overall ranking of the varieties that they have been evaluating in their field from planting to processing into food products. The Nextgen TRICOT evaluation (that measures the suitability of varieties and food products obtained in relation to the real livelihood conditions of farmers and processors) and the focused detailed food science evaluation with experienced farmer processors are therefore complementary.

Together with CIRAD Cameroon and ENSAI Cameroon a detailed comparison (through champion local Cameroonian processors) of Nextgen clones that were advanced for gari and fufu in Nigera, with local Cameroonian varieties will be made in Cameroon. Furthermore, Cornell Nextgen PhD student Chinedozi Amaefula will assist in the food science anchoring of the 320 Nextgen TRICOT trials that have been evaluated for food product quality using the Citizen Science triadic comparison of varieties. Trials for establishing a good methodology for this have been established in IMO state this year. Full food science anchoring work of the 320 TRICOT trials in four states in Nigeria will take part in period 5.

With SweetGAINS or other on Sweetpotato in Uganda? On-farm trials and user preferences are organized by NaCRRI. These activities are funded by the DDBIO project (Development and Delivery of Biofortified Crops at Scale) which supports the last stages of breeding that is at the national performance trials and on-farm trials that are required for release and registration of new varieties. Eight orange-fleshed advanced clones were evaluated by NaCRRI at five on-station sites. The storage roots will be brought to NaCRRI Biosciences for quality trait analysis. Additional quality analysis will be supported by the SweetGAINS project.

WP5 activities at NARL on Matooke were super-imposed on activities of ABBB project and the National Banana Programme in Uganda. The Food science team is responsible for participatory variety selection.

8 CONCLUSION & PERSPECTIVES

8.1 WP5 Progress & key achievements in period 3

Synthesis on Key Achievements at WP level in Period 3 & Level of Progress toward the completion of WP overall objectives in RTBfoods framework [±20 lines].

Cassava: A total of 30 cassava varieties have been evaluated using a total of 320 trials at NRCRI-Nigeria. 21 TRICOT trials were planted in IMO state for further evaluation (processing, food science, etc.). Furthermore, IITA-Nigeria planted ten cassava clones and local checks in 2 localities in Nigeria. After evaluation 4 cassava clones were approved for release as new varieties in Nigeria in December 2020 by national crop variety and livestock breed release committee. In Côte d'Ivoire 21 cassava genotypes were planted in two localities namely Sakiaré (Yamoussoukro) and Okpoyou (Dabou).

The harvested tubers were processed into attiéké and tested for color, grain size, presence of fibres, aroma, consistency and flavour by consumers. 18 clones were suitable for attiéké.

Yam: Five candidates and two standard yam varieties were planted in 8 locations in Nigeria by IITA. Food quality assessment (boiled and pounded yam products) were done by 20 panellists (10 male and 10 female) at each on-farm site. The attributes used for assessing boiled yam quality were appearance, colour, aroma, taste, texture, mealiness and overall acceptability for boiled yam consumption. The attributes used for assessing pounded quality were appearance, texture, aroma, colour, taste, mealiness, elasticity/stretchability, moulding and overall acceptability for pounded yam consumption. Finally, two D. *rotundata* clones (TDr0900067 & TDr1000048) and one D. *alata* clone (TDa1100432) were approved for release as a new variety in Nigeria in December 2020 by national crop variety and livestock breed release committee.

Sweet potato: Eight OFSP clones and local checks selected from heterosis trials conducted in various research institutes were planted in five locations by CIP in Uganda. Harvesting and evaluation will be done in period 4. In Côte d'Ivoire 11 clones were tested in four villages in two regions.

Matooke: 91 genotypes and 02 local checks were planted in four agro-ecological regions of Uganda by NARL. 65 out of 91 clones from the central region trial (located on-station) have been assessed and results show that only 02 of them are qualified for advancement.

Plantain: Eight (08) clones from CARBAP and IITA breeding programs and 2 local checks were planted in two contrasted localities in Cameroon [Njombe (~80 masl) & Bansoa (~1300 masl)]. Activities focused on trial follow up, on-farm and laboratory data collection. At farm level, vegetative parameters were measured during growth, at flowering and at harvest. Meanwhile at laboratory level, traits assessed included physical, chemical and physicochemical properties. The good agronomic and lab performances of some clones is a way-forward towards their adoption by farmers. However, an on-farm evaluation with farmers, alongside consumer's acceptability tests are indispensable for their adoption. These activities will be carried out in Period 4.

Success Story Box : Focus on Main Conclusions & Implications for Cassava Breeders from the IJST Special Issue '***Understanding cassava varietal preferences through pairwise ranking of gari-eba and fufu prepared by local farmer-processors***' https://doi.org/10.1111/ijfs.14862 [15-20 lines] Analysis using pairwise ranking provides good articulation of varietal differences (Scoring does not). Instead of only looking at overall quality evaluation (mother baby trials), the most important identified user food product quality criteria can be added. It is not advised to pairwise compare more then 5 (maybe 6) clones at a time. A selection of the best and worst varieties will be made from the evaluated batches of 5 to 6 varieties in order to have contrasting varieties: bad rated and very good rated varieties. Laboratory results on the roots and food products from the best and the worst varieties can be analysed in the lab and compared. The spectrometer value a* measured on gari is a measure for the strongly undesired browning. This trait must be systematically screened for all late stage breeding populations and proof of concept must operationalised to be able to detect this feature within physio-chemistry of the fresh roots. IITA WP2 team is working with Didier Mbeguie Mbeguie who is evaluating polyphenols in cassava in Cameroon.

8.2 Perspectives for period 4

Draft Period 4 WP Roadmap:

Identify major Next Steps at WP level in Period 4 & Priority Activities to be performed to reach these targets (new hybrids from partner breeding programs to be assessed, product profile, institutes & scientists involved, next steps in methodology development, etc.) [± 1 page].

CIP – Uganda on boiled sweet potato:

1. On-farm trials in 2021

As required by variety release committee guidelines, we will conduct on-farm trials of these selected clones (ca~5) at ten districts spread across the major agro-ecological zones of Uganda. These include North Eastern Dry lands (Kotido), North Eastern Savannah Grasslands (Kumi), North Western Savannah Grasslands (Arua), Kioga Plains (Iganga, Lira), Lake Victoria Crescent (Mukono, Busia), Western Savannah Grasslands (Hoima), South Western Farmlands (Kabarole) and Highland Ranges (Mbale).

These trials will be planted in the September 2021 and harvested in December 2021 and April 2022 and harvested in July 2022. In each district, we will select five farmers (farms) in which trials will be conducted. The participating farmers will be selected with gender and youth involvement mainstreamed. These farms will be half an acre in size and will be jointly identified by the breeding team at NaCRRI and the District Production Officers at the various local governments. Half an acre is needed to provide enough land to serve as guard rows as destruction of on-farm trials by stray animals is very rampant from our earlier experience. The farmers will be facilitated to prepare the land in time for trial establishment.

We will then plant trials on farm using a row-column design/ and or randomized complete block design (RCBD) with three replications. In addition to the clones under test, we will include the most popular local varieties in the districts as local checks. We will also include NASPOT 8 (most preferred OFSP variety as identified in WP1) as a check in the trials.

Data collection will be done three times, as stipulated in the sweetpotato-breeding manual. First data collection is at 1 month after planting where plant establishment is recorded. The second data collection is at 2 months (60 days) after and where sweetpotato virus disease (SPVD) rating is done. At harvest, data will be collected on storage root yield, SPVD, Alternaria blight and sweetpotato weevil rating. The assessment of acceptability of the varieties is done with farmers for both raw and cooked samples. All acceptability ratings will be disaggregated with gender and cross cutting issues taken care of. As needed, the trained sensory panel at Kawanda will be involved in sensory evaluation of the harvested root samples to complement the on-farm evaluation. Storage root samples will be carried to NaCRRI for dry matter content determination and quality profiling using NIRs.

2. DUS trials in 2021-2022

The candidate varieties will be evaluated side by side with the known released varieties that are similar to the candidates to assess for DUS. This trial will be planted in the September 2021 and harvested in December 2021 and April 2022 and harvested in July 2022 at four sites of NaCRRI, NaSARRI, Rwebitaba ZARDI and AbiZARDI. These trials will be planted using a randomized complete block design at the sites with three replications. Each plot will contain 100 plants. The trials will be managed in partnership with the Seed Certification Department of MAAIF. Data will be collected three times, that is at one month, two months and at four months (harvest). The clones will be assessed for distinctiveness, uniformity and stability for recommendation of variety release.

All data collected from preliminary yield trials, advanced yield trials; on farm trials and DUS will be analysed and compiled in to a variety release dossier August 2022. The dossier will be formally submitted to the variety release committee as a basis for application for and inclusion of the one to two candidate varieties in to the national cultivar list. Upon approval by the variety release committee, the varieties will be submitted for commercialization by the different government and non-governmental organizations promoting commercialization of OFSP in Uganda by November 2022.

IITA - Nigeria on cassava

Local farmer communities identified during WP1 work: survey, participatory processing and consumer evaluation will be engaged in processing of cassava trials established in period 3. Samples of roots and products of best and worst varieties will be taken and analysed in the food science lab of IITA. Consumer testing is planned in the rural areas and the cities of Makurdi and Osogbo.

In cooperation with ENSAI / University of Ngaoundere and insights obtained during the RTB foods PhD student work of Noel Takam local cassava clones will be added and trials will be installed at two locations in Cameroon (multiplication for installing the trials has started in period 3): Littoral/centre region and Est region. These trials will be evaluated by “champion” farmer processors in period 5. ENSAI / University of Ngaoundere and CIRAD Cameroun will carry out laboratory analysis on roots and food products. This will be followed up with consumer testing in rural and urban areas.

For period 4 IITA/NRCRI and NaCRRI will select new participants were needed and plant the second round of TRICOT trials. The same varieties will be used to have second year data. Lead farmer trainings will be partly redone as some new participants will be selected.

NRCRI-Nigeria on cassava

Preparation pilot work on the 21 TRICOT trials in Imo state by cornell student Chinedozi Amaefula will be carried out in period 4. This is to get in place a very workable method for the larger scale food science anchoring of 10% of the the whole TRICOT (320 trials) in the 4 states, which she will carry out in period 5.

IITA - Nigeria on Boiled & Pounded Yam

The newly released and pipeline clones will be evaluated in Nigeria using on-farm trial network. In collaboration in NRCRI participating farmers will be selected and on-farm testing will be established at least 20 farmers field to assess the varieties for boiled and pounded yam quality. The on-farm testing will be conducted in participatory set-up.

NRCRI - Nigeria on Boiled & Pounded Yam

NRCRI will conduct consumer testing on Yam varieties harvested from on- farm trials.

CNRA – Côte d’Ivoire on Fried Plantain

1. Establishment of an experimental plot at AZAGUIE, made up of eleven (11) plantain genotypes including six (6) traditional varieties (3 vert, Big Ebanga, Corne 1, Orishele, Saci, Zakoi) and five (5) hybrids (Bita 3, FHIA 21, Pita 3, SH3640, CARBAP-K74).

2. Establishment of a trained jury for sensory analyzes of fried plantain products: chip, aloco and claco obtained respectively from green plantain, half-ripe plantain and over ripe plantain pulps.

3. Development of physicochemical and biochemical methods for fresh and processed plantains evaluation. These methods will primarily target the organoleptic (sugar, organic acids, fat) and nutritional properties (phenolic compounds, carotenoids and acrylamide and its precursors).

CARBAP - Cameroon on boiled plantain

All the findings obtained in Period 3 clearly show how heterogeneous the genotypes are to each other. Hence, the adoption of a genotype will be done when taking particular characteristics into consideration. However, it is important to know if these genotypes will be accepted by consumers, processors and farmers through sensory evaluation, processing demonstration and on-farm participative evaluation. Next year, WP5 activities will focus on:

1. The continuation of agronomic data collection
2. The continuation of assessments of plantain traits at laboratory level
3. The participative evaluation with stakeholders of the plantain value-chain (farmers, traders, processors, consumers)
4. The processing ability of plantain fruits from the two experimental plots
5. The implementation of sensory testing of derived processed food products.

NARL/ Bioversity - Uganda on Matooke

1. Continue participatory assessments of the 91 genotypes
2. Select clones for more on-farm trials.
3. Farmer/User-led selection of genotypes for release

We expect that the selection tools being developed by the project will be tested during activity 3. However, some of the traits such as bunch and finger characteristics and colour pulp are already being used in the evaluations.

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