CIAT SUMMARY REPORT (April 2019)

1. Breeders develop improved varieties that integrate user-preferred traits.
Four clones (two with high carotenoids and putative CBSD-immune) were shipped to the USA for their eventual release to be planted in the crossing nursery in Hawaii. There are 16 remaining clones ready for shipment to Maryland as soon as APHIS informs CIAT. In vitro plantlets of > 150 new genotypes produced, indexed and ready for shipment upon receiving the import permits. A total of 5984 botanical seeds from controlled pollinations (full-sib families) produced: 28 crosses of high-carotene (HTCC)/low cyanogenic potential (LHCN) x resistance to CMD (RCMD) (743 seeds); 10 crosses of HTCC/poor culinary quality x RCMD (435 seeds); 82 crosses of HTCC/good culinary quality x RCMD (3002 seeds); and 86 crosses of maximum HTCC x RCMD (1604 seeds). A total of 40044 botanical seed from open pollination nurseries has been produced (42 half-sib families involving HTCC and RCMD. Of particular relevance in the work to combine resistance to whiteflies and CMD. CIAT produced hundreds of F1 genotypes, which were then screened for reaction to white flies. Only 27 F1-genotypes were selected and crosses among them were made to produce a pseudo-F2 generation. A total of 170 full-sib families were obtained from crosses among the 27 genotypes (9,000 seeds), also 13 S1 families (214 seeds) and 11 "F3" full-sib families (417 seeds) from few F2 genotypes that had been obtained years ago were produced. DNA from the 27 F1 genotypes was extracted and shipped so that CIAT can identify which of those carry the CMD2 source of resistance. The material is ready for shipment as soon as the respective import permits are issued.

2. Adoption of technological advances increases breeding efficiency.
In July 2018, the infrastructure for a large red light treatment (RLT) nursery was completed. A total of 24 red LED-light reflectors (50w) were installed to illuminate an area of 1863 m2. A set of 190 clones were planted under this RLT for crossing activities. Of those, 150 clones were also planted nearby, under normal photoperiod conditions. The purpose of this setup was to assess and compare flowering patterns with or without extended photoperiod in a large sample of genotypes. Erect clones (e.g. those that fail to flower or flower very late under normal photoperiod conditions) responded positively to RLT (e.g. flowered earlier and thus height of first branching was lower). On the other hand, bushy types (e.g. genotypes that flower early and profusely) tended to be indifferent to RLT or react negatively (e.g. flower later under RLT).

Data on the impact of RLT on four genotypes was generated for the third consecutive year. An additional experiment compared the effect of RLT alone, or in combination with pruning of young branches in the 1st or 2nd branching events, with or without the addition of BA the day of pruning. RLT during the night resulted (as already demonstrated during the past two years) in earlier branching of otherwise erect genotypes. This earlier flowering allowed pruning young branches much earlier than plants growing under normal photoperiod. Fruit and seed set can be obtained from the 1st branching event, which is generally sterile if branches are not pruned. The highest number of seeds produced was always in a treatment that included extended photoperiod, pruning (either in the 1st or 2nd branching) and with the application of BA on the pruning day. There is an interesting pattern in the response to pruning. In the intermediate flowering genotype clearly the best results were obtained by pruning at the 2nd branching event. In the late flowering clone, pruning in the 2nd branching event yielded higher number of seeds but not considerably higher than pruning at the 1st. In the case of the very late flowering genotype, on the other hand, pruning at the 1st branching event was clearly the best option. With the information generated in 2019CIAT will prepare during 2019 (and before) the following manuscripts:

- Effect of red light treatment and night breaks (based on three consecutive years of data)
- Effect of pruning young branches in combination (or not) with red light treatment. Combining data of two years (at least for one genotype).

3. Effective and efficient project management.
The following videos are ready to be uploaded as soon as NextGen provides guidance on how to handle the video on the pruning of young branches protocol. In total, there are 95 minutes of video images: **1.** Introduction to cassava; **2.** Storage of planting material and planting experimental trials; **3**. Introduction of cassava breeding; **4.** Cassava genetic resources and germplasm collection; **5.** Reproductive biology of cassava and crossing techniques; **6.** Induction of flowering: extended photoperiod and application of plant growth regulators; **7.** Illustration of the pruning of young branches to induce early fruit and seed set; **8.** Germination of botanical seed and transplanting seedling nurseries; **9.** Selection criteria; **10.** Illustration of

the sequence of harvesting an evaluation trial; **11**. Illustration of special traits in cassava; **12.** Starch extraction in cassava and its characterization; **13.** Cartotenoids extraction and quantification; **14.** Illustration of the protocol for post-harvest physiological deterioration; **15.** Ground penetrating radar; **16.** Rapid multiplication scheme using young branches and Jiffy pellets; **17.** Rapid multiplication scheme using "the tunnel". At least 18 presentations were made during the IVth GCP21 International Cassava Conference, Cotonou, Benin and the 18th Triennial Symposium of ISTRC. Cali, Colombia.

4. Increased in project sustainability through capacity building in partner and non-partner breeding programs.

Between September 21 and October 2, Marcela Pineda (CIAT) and Peter Hyde (Cornell University) visited Nigeria (NRCRI and IITA), Uganda (NaCRRI) and Tanzania (TARI). The main purpose of these visits was to interact with colleagues from the host institutions on the different techniques to induce flowering and early fruit set. Training was based on PowerPoint presentations and, more importantly, field demonstrations.

Translation into English of a Quantitative Genetics Manual adapted to RTB crops. Six chapters are already available. During the second semester of 2018, a hands-on training course on statistics and quantitative genetics with special emphasis on RTBs took place in Uganda (71 people) and Nigeria (17 people). The list of participants is available.

The Ph.D. theses of two WACCI students (Lydia Chidimma Ezenwaka and Siraj Ismail Kayondo), supported by the NextGen project, were reviewed. H. Ceballos travelled (April 2018) to Ghana for the defense of these theses.

Students: L.M. Pineda is enrolled as a M.Sc. student at National University of Colombia (Palmira Campus). She is mostly responsible for the induction of flowering work.

Publications: Ikeogu et al. (2018). Rapid analyses of dry matter content and carotenoids in fresh cassava roots using a portable visible and near infrared spectrometer (Vis/NIRS). PLoS ONE 12(12): e0188918.

AWARDS: H. Ceballos was awarded the **Golden Cassava Award** by the GCP21 during the meeting in Bening and the **Lifetime Achievement Award**. For contributions to Root and Tuber Crops. Awarded by the International Society of Tropical Root Crops during the 18th Triennial Symposium of ISTRC (2018).

Project Adjustments: Shipment of botanical seed and *in vitro* plantlets is lagging behind. All the material is ready for shipment and just pending on the required paperwork to be completed. The CBSD immune plants were transplanted (after hardening from the in vitro status) into the field under RLT. Plants from several accessions branched but did not produce flowers. It is possible that because plantlets were transplanted "late" in their phenological development (e.g. red light was not applied at the sprouting), the beneficial effects of RLT were not achieved. Plants will be ratooned in May.

Feedback to the Foundation: The coordination from Ithaca is superb. The slack meetings are useful and the guidance for the annual meeting or this reporting is excellent. We still have some problems regarding the starting date of the project for us and thus the way expenses were approved.