Kenya - KALRO Innovea Global Coffee Breeding Network

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Arabica Breeding: Current Progress, Challenges, and Goals

I. Report Overview & Objectives

- **Project Title:** Innovea Global Coffee Breeding Network—Arabica
- **Reporting Period:** 2024-2025
- **Partner Institution & Location:**
  - Kenya Agricultural and Livestock Research Organization
  - Kitale, Trans Nzoia County, North Rift region
- **Date of Report:** November 2025

Alignment with Core Objectives:

The Innovea breeding program is in line with the broader KALRO crop improvement plan "To enhance agricultural productivity through technology, innovation and partnerships" and the coffee breeding objectives "selection for high-value coffee varieties which are high yielding, with high cup quality, disease-resistant and adaptable to different coffee growing zones, and collecting new coffee germplasms and conserving them in the different conservation sites, to address challenges of limited genetic diversity"

- This partnership has led to accession of high value selection for evaluation and eventual release as superior varieties in Kenya. This type of genetic combination wouldn't have been achieved by using genotypes found within the country only. Therefore, using other improved varieties contributed to increased genetic gain.
- The trial site region is under rapid coffee expansion in Kenya, hence the highest rate of new variety adoption. The Kitale site region is highly predisposed to Coffee berry disease (CBD), the main limiting disease of arabica coffee in Kenya, with up to 80% crop loss. Kitale and its environment has reported increased aggression of CBD attack to resistant coffee genotypes hence will provide ideal selection conditions for CBD tolerance to Innovea materials. Although it's too early to make informed observations, majority of the selections are yet to be predisposed to CBD attack.
- Despite the increased demand for Kenyan coffee, the production has been on a declining trend, attributable to climate change leading to increased diseases pressure and low yield and quality. The selection of resilient and high value varieties is expected to enable the country to reclaim its lost glory as a major producer of arabica coffee globally

II. Overall Progress

A. Seed Propagation

- A total of **24 seed lots** received: 22 from RAB (Rwanda) and 2 from Costa Rica.
- All RAB seed lots were successfully propagated and established in the field with local checks (Ruiru 11, Batian, SL28).
- Costa Rica lots failed to germinate.

B. Seedling Genotyping

- **470 seedlings** were sampled and shipped to **Intertek** for genotyping and hybridity testing.
- Results guided selection of true hybrids for field establishment.

C. Experimental Design

- **Design:** Augmented Random Complete Block Design (ARCBD).
- **Trial Composition:** 324 genotypes (12 F1 hybrids, 10 pure lines, 5 global checks, 3 local checks).
- **Replication:** 3 reps, organized into 4 plots.

D. Field Establishment

- **Spacing:** 8′ × 8′ (2.4 × 2.4 m).
- **Planting Mixture:** Topsoil + 0.02 m^3 manure + 100 g TSP (45% P_2O_5).

E. Data Collection

- **Morphological traits:**
  - Plant height - measured from ground level using meter rule.
  - Girth - measured 5 cm above ground using a digital vernier caliper.
  - Plant type (dwarf, tall).
  - Date of flowering
- **Disease monitoring:**
  - Coffee leaf rust scored on 1–5 scale.
  - No CBD incidence reported so far.

F. Field Plant Genotyping

- **300 samples** collected following Row × Column pattern, covering all genotypes.
- Samples shipped to **Diversity Array Technology (DArT)** for genotyping.

G. Yield Data

- Ongoing: ripe cherries harvested and weighed per tree, then processed individually.

Executive Summary of Achievements

During the reporting period, the KALRO Innovea Arabica breeding made significant progress in implementation of the project objectives, including successfully obtaining and propagating 24 seed lots (22 from Rwanda and 2 from Costa Rica), genotyping of 470 seedlings for hybridity verification, and establishing 324 genotypes in the field under an Augmented Random Complete Block Design. Field observations show good plant vigor, uniform establishment, and early adaptation to the Kitale environment. The data revealed early maturity within the selection with flowering starting at 9 months of age. Morphological and yield data collection are ongoing, supported by digital tools that improve accuracy and traceability, where a clear

distinction between tall and dwarf genotypes have been obeserved. Genotyping of 300 field samples has been completed to strengthen genetic analysis. Overall, the project will lay a strong foundation for identifying high-yielding, disease-tolerant, and climate-resilient Arabica varieties, reinforcing Kenya's contribution to the global Innovea coffee breeding network. The second-year data is expected to identify CBD infection in the varieties, as data for the first year did not reveal any infection in the field while Coffee rust susceptible genotypes have been consistent over several observation period. The data based on flowering time will support selection for early maturing varieties. The combination of yield performance and disease resistance will support making informed decisions during selection. Quality analysis, a critical selection trait, is expected upon adequate samples collection.

A. **Research & Data Collection**

Data was collected using the fieldbook and this made the work more efficient and accurate.

III. Challenges and Limitations

A. **Establishment & Agronomic Challenges**

- Coffee Leaf Rust infection was severe in some genotypes
- Destruction of plants by wild animals, hares, deer
- Climate change related challenges e.g crinkling of leaves
- Unexplained of death of some individual trees
- Stunted growth of some trees

B. **Research & Analysis Limitations**

- Synchronized data analysis by WCR team and KALRO is yet to be realized.

IV. Next Steps and Future Goals

A. Addressing Research Limitations

- Come up with a common agreement with WCR on the age or stage of plants infection, to control CLR (and or CBD) in order to exploit full yield potential of the affected genotypes.

B. Future Data Collection & Analysis

- Continuous collaboration with WCR and improvements in field data systems are expected to enhance the efficiency and accuracy of future analyses.
- Continue yield and morphological data collection through 2026 harvest.
- Initiate quality evaluation of early maturing selections after 2026 harvest

C. Contribution to Long-Term Objectives

a. How will the upcoming activities contribute to identifying and selecting **new high-performing, climate-resilient coffee varieties** for the nation's coffee sector?

- The upcoming activities, including yield and quality data collection, are critical in selection of the best-performing genotypes in terms of disease resistance and improved production. Quality in Kenya is a critical factor during selection for a new variety as it's an important in factor in determining the market price.

b. Once the best performing varieties are identified the following are the plans

i) Multiply the most promising genotypes through tissue culture and carry out a National Performance trial across different environments for variety release as hybrids
ii) Selfing of the best performing genotypes for further selection
iii) The lines selected from pedigree selection could be used in generating more crosses to create more new varieties.

Photos


Field layout and holes preparation



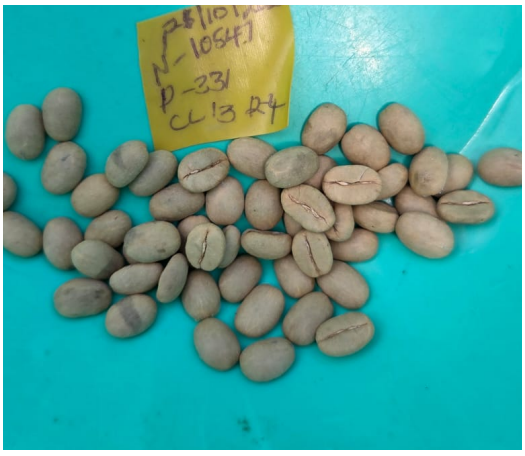
Field established coffee


Data collection

Genotyping sample collection

Innovea Kitale – status





Ripe cherry and processed coffee