30th Conference 27-31 October Asic 2025 | Lisbon, PORTUGAL Rectory of the University of Lisbon

GHENT UNIVERSITY

Joint FAO/IAEA Programme Nuclear Techniques in Food and Agriculture

#33889

Enhancing Drought Tolerance in *Coffea arabica* Through Induced Mutagenesis

Radisras Nkurunziza, Joanna Jankowicz-Cieslak, Sajid Shokat, Stefaan P.O. Werbrouck, Pooja Bhatnagar-Mathur

Introduction

Climate change poses a severe threat to *Coffea arabica* production. Genetic improvement of *C. arabica* has been constrained by its narrow genetic base, long reproductive cycle and limited access to genes valuable for adaptation and stress tolerance. Induced mutagenesis offers a strategy to enhance genetic variation and introduce novel traits for improved drought and climate resilience. This study assessed the effectiveness of ethyl methanesulfonate (EMS) and gamma radiation to induce drought tolerance in *C. arabica*, aiming to develop climate-resilient coffee varieties.

Materials and Methods

- *C. arabica* seeds were treated with gamma (50 Gy) or EMS (1-4%) (Fig. 1).
- The M_1 plants were maintained until reproductive maturity.
- M_2 seeds were used to establish M_2 population.
- The M_2 families were screened for tolerance to drought stress.
- Data was recorded at 40 days after stress.

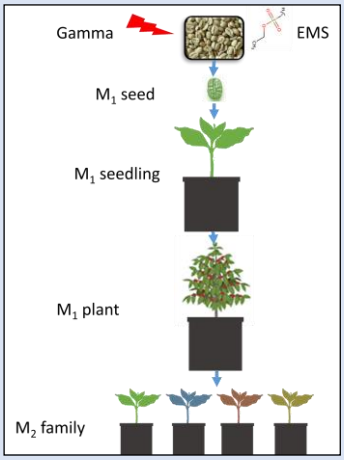

Figure 1: Step-wise methodology.

Results and Discussion

- EMS and gamma induced tolerance to drought stress (Fig. 2A).
- Wild-type plants showed severe stress symptoms (Fig. 2A-1) than mutant plants (Fig 2A-2-5).
- Wild-type plants failed to recover, while some mutants displayed differential recovery levels (Fig 2B).
- Overall, mutagenesis induced high genetic variability (73%) (Fig. 3).
- Superior drought-tolerant families identified: M377, M415, and M441 (Fig. 4).
- Our results support mutant family-based selection for drought tolerance.

Figure 2: Variation in drought tolerance (A) and recovery levels levels after drought stress (B) among mutants.

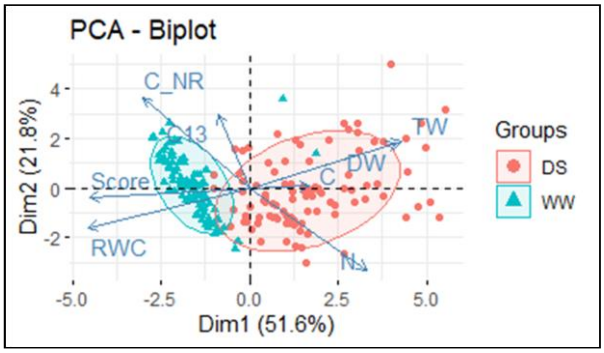

Figure 3: PCA revealed 73% variability between drought stressed (DS) and well-watered (WW) for physiological traits.

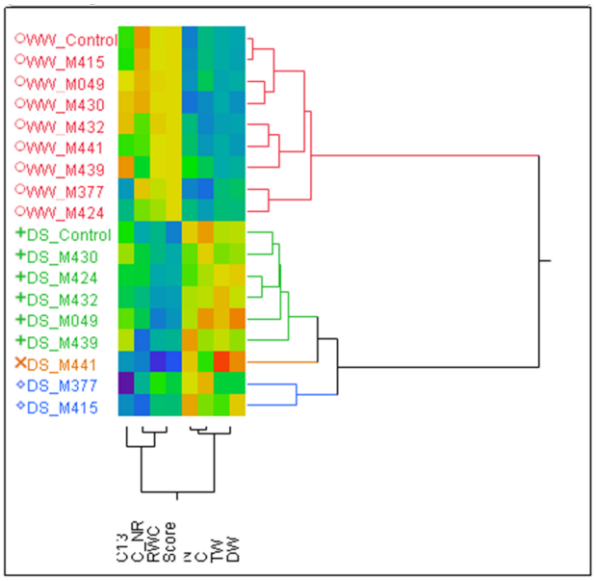

Figure 4: Clustering of mutant families for both drought stressed (DS) and well-watered treatments (WW).

Conclusion/Perspectives

- Induced mutagenesis using EMS and gamma effectively enhanced drought tolerance in *C. arabica*.
- Mutant family-based selection offers a promising strategy for rapid discovery of drought-tolerance in coffee mutant populations.

Acknowledgement:

This work was supported by Belgium through the Peaceful Use Initiative to the FAO/IAEA: "Enhancing Climate Change Adaptation and Disease Resilience in Banana-Coffee Cropping Systems in East Africa"