Arabica Coffee Breeding: Challenges Posed by Climate Change

B.M. Gichimu
Coffee Research Foundation
Kenya

gichimubm@crf.co.ke

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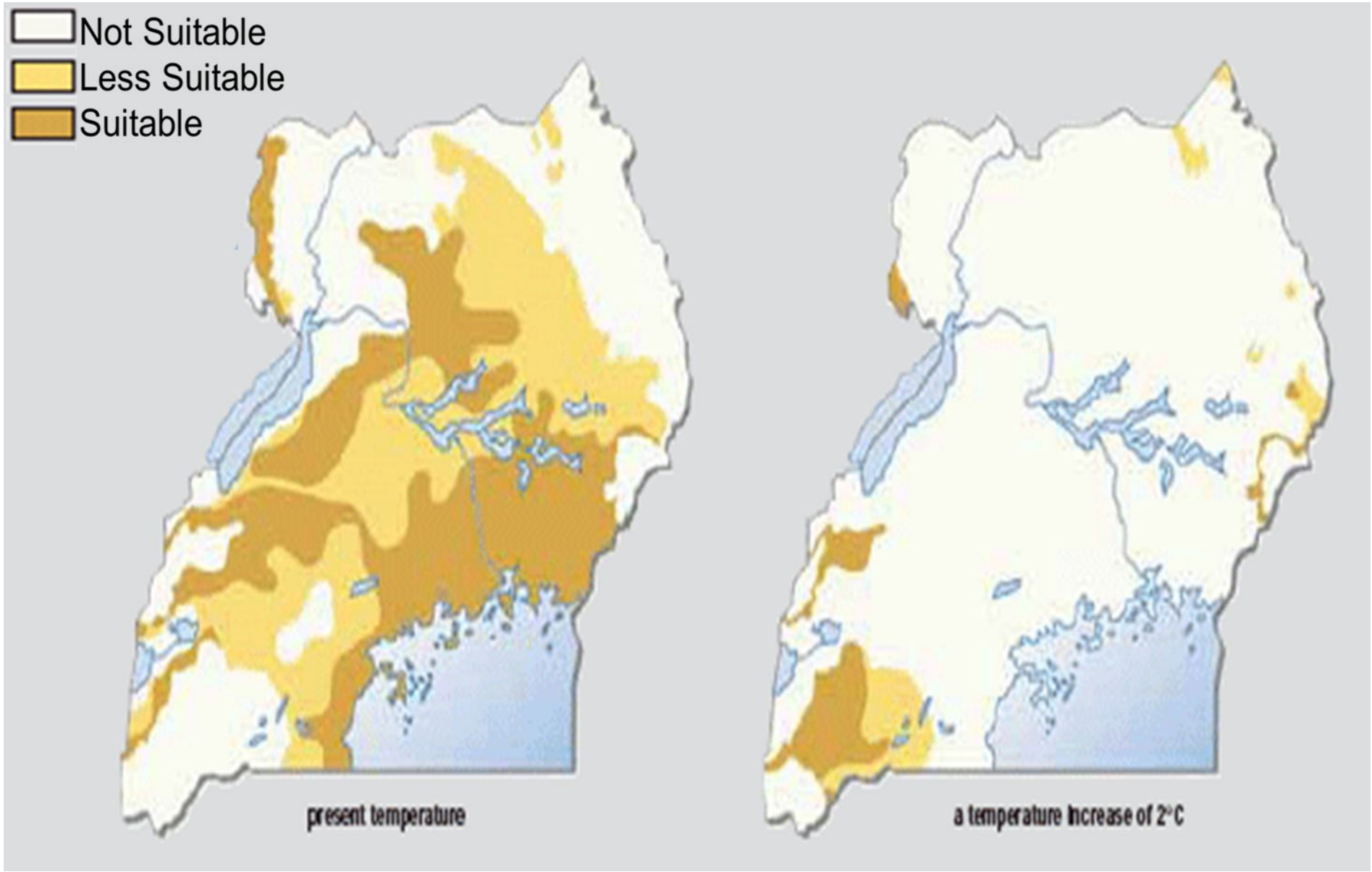
INTRODUCTION

- ✓ Most of Arabica coffee cultivars are renowned for their excellent cup quality, but are more susceptible to pests and diseases
- ✓ The major coffee diseases include the world-wide occurring Coffee Leaf Rust, Coffee Berry Disease which is restricted to Africa, Bacterial Blight of Coffee, found in Brazil and some parts of Africa among others.
- ✓ With climatic conditions shifting dramatically in the current times, management of various coffee diseases is proving to be a challenging affair.
- ✓ More so with global warming, drought has become a serious constraint to *Coffea arabica* production worldwide with dramatic impacts on coffee production.

Impact of Climate Change

- ✓ Shifting of optimal growing zones
- ✓ Changes in rainfall (amount and variability)
- ✓ Change in crop diseases and pests
- ✓ Change in crop yields and quality
- ✓ Loss of agricultural land due to either rising sea levels and/or desertification

Global warming could shrink Uganda's coffee growing areas



TRADITIONAL OBJECTIVES OF ARABICA COFFEE BREEDING

- To develop varieties that are resistant/tolerant to major coffee diseases and pests.
- To continuously improve yield and quality of the resistant selections.

MAJOR COFFEE DISEASES

CLR in Low altitudes

CBD in high altitudes

BBC in windy and
cooler high altitude areas

Climatic Requirements of Arabica Coffee

- Altitude - 1400 – 2200 m asl
- Temperatures - 18 – 21ºC
  - >25ºC - Photosynthesis is reduced
  - >30ºC - Leaves are damaged
- Rainfall - >1000 mm with a 2 month dry spell

CHALLENGES POSED BY CLIMATE CHANGE

- Changing dynamics of crop diseases
  - CLR moving to high altitudes
  - New races of CLR emerging
  - CBD moving to lower altitudes
  - BBC becoming more prevalent
  - CWD more severe under draught conditions

- Changing economic importance of some pests
  - High temperatures favors infestation of thrips and leaf miner
  - 1ºC increase in temperature would increase the population of coffee berry borer by 8.8%
  - Increased wetness would increase the infestation of nematodes

CHALLENGES POSED BY CLIMATE CHANGE

- Breeding for durable resistance to major diseases and pests without adversely affecting yield and quality.
  - Has been successful but an emerging challenge is the diverse variation within the pathogen to counter the narrow genetic base of Arabica coffee – new pathogen races keep emerging
  - Necessitates broadening genetic base of *C. arabica* (e.g. thro' interspecific hybridization) and search for new sources of resistance
  - Difficult to achieve without adversely affecting yield and quality
  - New important coffee pests are also emerging as population of natural enemies is interrupted

CHALLENGES POSED BY CLIMATE CHANGE

- Sporadic rains
  - Causes reduced and sporadic flowering
  - Different berry growth stages at the same time – affects disease and pest management, harvesting and processing
  - Does this have a breeding solution?

CHALLENGES POSED BY CLIMATE CHANGE

- Reducing suitable coffee growing areas - necessitating breeding for tolerance to abiotic stresses (draught, salinity, extreme temperatures).
  - Challenged by low genetic variation in Arabica coffee
  - Also challenged by lack of clear understanding of causes of the differences in drought tolerance in coffee (Pinheiro *et al*, 2005; Blum, 2005; Da Matta and Ramalho, 2006).
- Changing production temperatures
  - High temp fasten coffee ripening thus reduces quality
  - Extreme temperatures (both high & low) impair cell metabolic processes (e.g. photosynthesis)
  - Can any cultivar be tolerant to both conditions??

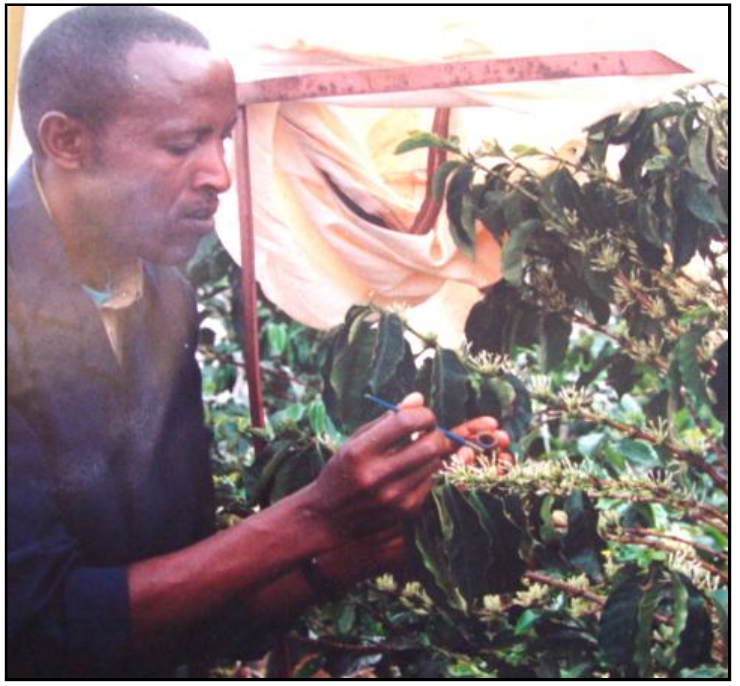
What kind of an Arabica coffee variety holds the key to the ambiguous climate change?

- High Yielding
- Good Quality
- Resistant to Major Diseases
- Resistant to Major Pests
- Drought & Heat Tolerant
- Dwarf but Deep Rooted
- Widely Adapted
- Less or no mucilage
- Early Maturing
- etc

No cultivar with such combining ability!!

Mitigation Strategies

- Breeding against climate change
  - Is this possible?
  - How durable in an ever changing climate?
  - Not in one cultivar
- Biotechnology?
  - Food safety considerations?
  - Costs?
  - Consumer perception?



These can only be long term solutions!!!!

Short term mitigation strategies

- Use of shade in coffee
  - Reduces the air temperatures
  - Evens out flowering
  - Conserves surface moisture
  - Litter fall contributes to soil organic matter and nutrients
- Mulching
- Grass Strips
- Coffee friendly cover crops
- Others – Forking, Sub-soiling, Furrows, Half moon basins

Parting Shot!!

Climate change can not be mitigated by a single strategy, it requires a multi-disciplinary approach.


THANKS
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