UPOV

Seminar on the role of plant breeding and plant variety protection in enabling agriculture to mitigate and adapt to climate change

Report of thematic session 3:
Plant breeding for climate change adaptation and mitigation in agriculture:
Crop perspectives

Moderator: Mr. Patrick Ngwediagi, Chair of the Administrative and Legal Committee, UPOV

Speakers

- Mr. Greg Rebetzke, Research Genetist, Canberra, Australia
- Mr. Yu Zhang, Research Associate, Shanghai Academy of Agricultural Sciences, China
- Mr. Etienne Bucher, Research group leader “Crop Genome Dynamics”, Agroscope, Switzerland
- Mr. José Ré, Vice President, Global New Products Development – Rice Tech USA, United States of America
- Ms. Hayat Zaher, Researcher, Marrakech Regional Agricultural Research Centre (CRRA), National Institute for Agricultural Research (INRA), Morocco
- Mr. Robert Boehm, Head of Biotechnology, Selecta One, Germany
- Ms. Tina Henriksson, Group Manager Breeding, Cereals & Pulses & Senior winter wheat breeder, Swedish Company Lantmännen, Sweden
- Mr. Pitambar Shrestha, Programme Advisor, Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Nepal
- Ms. Astrid Schenkeveld, Specialist Plant Breeder's Rights & Variety Registration, Rijk Zwaan, Netherlands

Plant breeding is beneficial for all crops

- Plant breeding supports the development of climate smart varieties for all crops, including those of local importance
- Plant breeding is key for adapting crops to each production area
- Crops traditionally grown in each area require adapting to new climatic conditions
- Opportunites to introduce new crops previously unsuitable for cultivation in particular areas

Grassroots breeding of future smart crops

Case example 1: *Bariyo Kaguno* (Bariyo Foxtail Millet), Ghanpokhara, Lamjung District (Contd.)

The Grassroots breeding process

- Seed samples of ***Bariyo Kaguno*** were collected from five custodian farmers, it was mixed and planted in the farmers field.
- True to ***Bariyo Kaguno*** type panicles were selected jointly by farmers and scientists.
- Seeds of the selected panicles were multiplied and distributed to many farmers. Market linkage was developed for grain.
- Data were collected and the variety was registered in the National Seed Board by Ghanpokhara Community Seed Bank.
- The Ghanpokhara Community Seed Bank produces and supplies quality seed in the locality and surrounding districts.

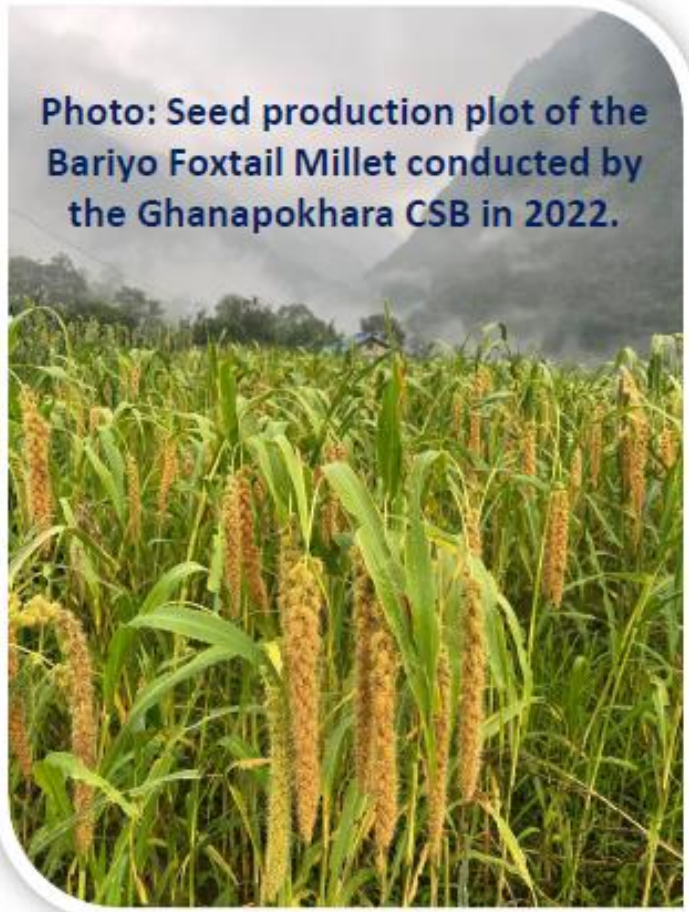


Photo: Seed production plot of the Bariyo Foxtail Millet conducted by the Ghanapokhara CSB in 2022.

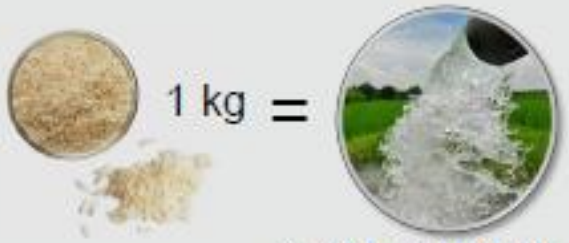
In the long run

- New crops
- New characters
- New resistances

Rice: Reducing water requirement and use

- New rice varieties incorporate upland rice characteristics (non-flooded areas).
- This is useful to reduce irrigation water
- Improves transplanting operation in paddy fields.
- Reducing water requirement reduces CO_2 emissions to the atmosphere

We bred hybrids with lower environmental footprint



2,500-5,000 liters
Source: IRRI

Traditional way to grow rice

Improved hybrids

+

Improved irrigation management

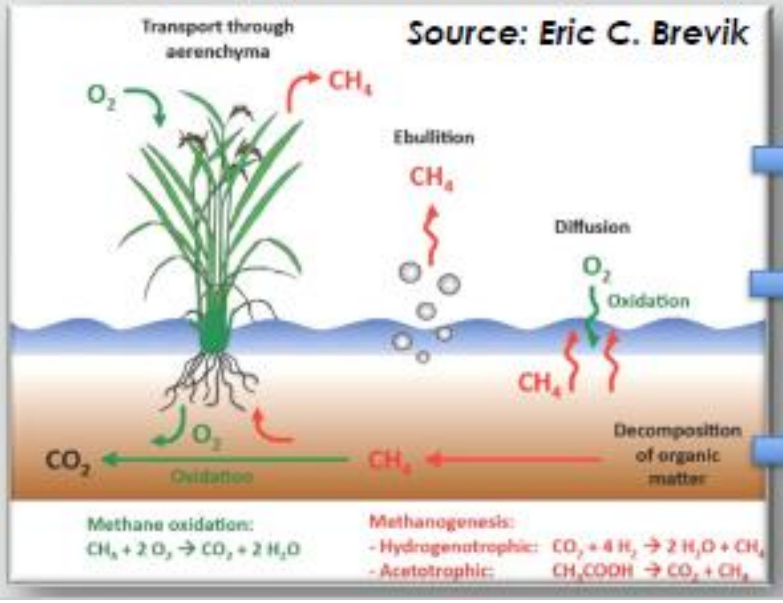
=

AWD (Alternate Wetting and Drying), Furrow irrigation, Direct seeding

SmartRice®

** Based on average of farm collection data and state-collected data*

Methane emission from a rice field



AWD can reduce methane emissions in rice cultivation by an average of 48% over continuous flooding ***Source: IRRI***

AWD reduces global warming potential by 43%
Sanchis et al. 2012

Improved rice hybrids emit 29% fewer greenhouse gases per unit of output
Nalley et al. 2014

RiceTec

Areas for developing WDR variety

II. Upland cropping (prone to waterlogging)

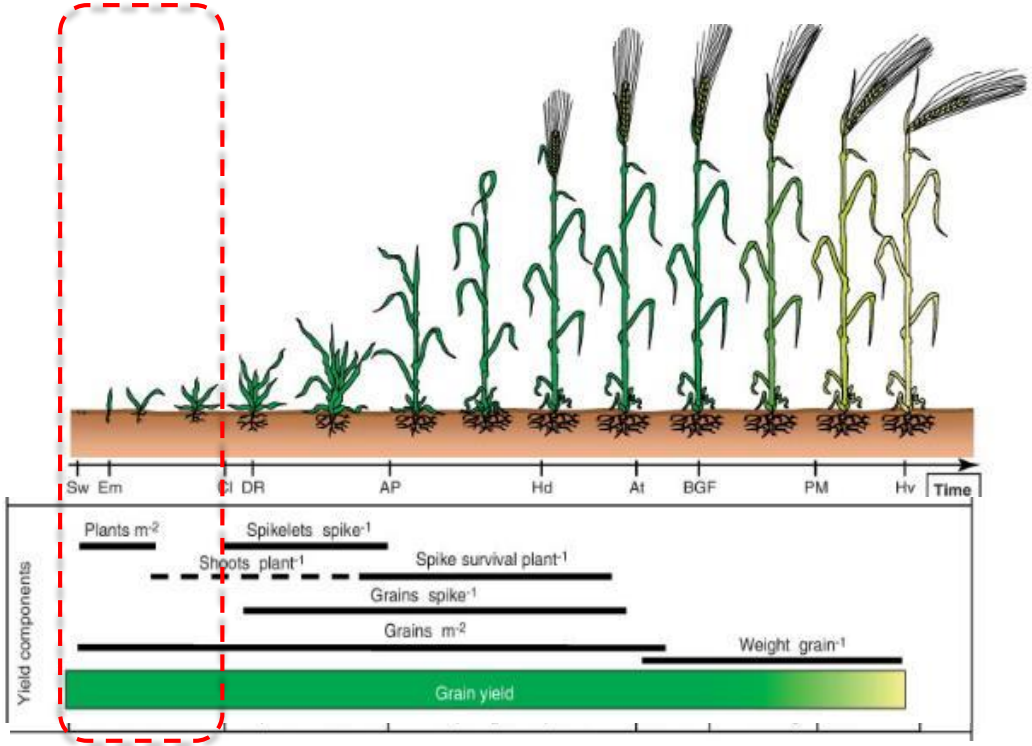
Adjust crop planting structure

Realizing value-added farmland to increase farmers' incomes

Wheat: Changing plant morphology to access subsoil moisture

- Plant breeding is developing new varieties with improved characteristics to access subsoil moisture during the establishment period of crops
- This improves the early establishment crops enabling young plants to support longer periods of drought.

Opportunity breeding - Optimising crop establishment



Establishment

Vegetable crops: avoiding losses and waste through new characteristics

- New characteristics maximize plant production in protected environments (e.g. Hydroponics)
- New characteristics enable avoiding losses due to:
  - new disease resistances
  - longer shelf life

Examples

Delayed pinking of fresh cut lettuce

(Leaf wound-induced discoloration)

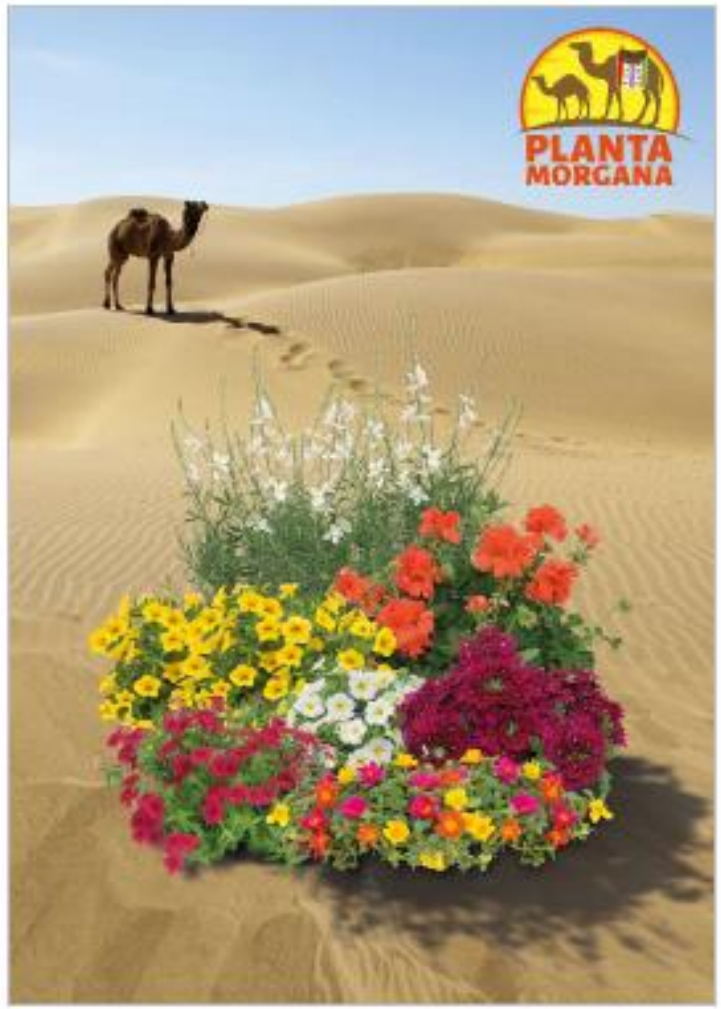
- Extended shelf life
- Less waste
- Suitable for Food Service
- Stronger against cracking
- Less sensitive for leaking seals

Ornamental crops: breeding for drought resistance and introduction of new adapted crops

- The sector is instensively using plant breeding to develop varieties adapted to increased drought periods
- New varieties are being developed from species more adapted to extreme environments, such as succulents and others

Marketing tolerant Varieties/Cultures

- Recommendation of more drought stress tolerant plant series
- Marketing with POS-material (pots, banner, label)



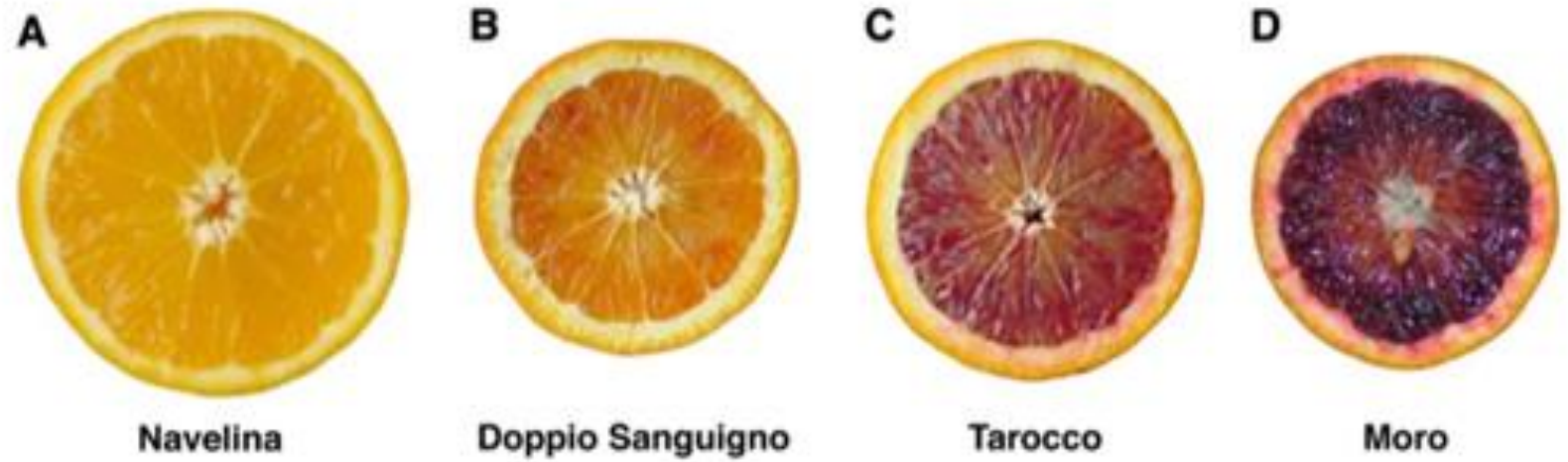
Substitution by new cultures

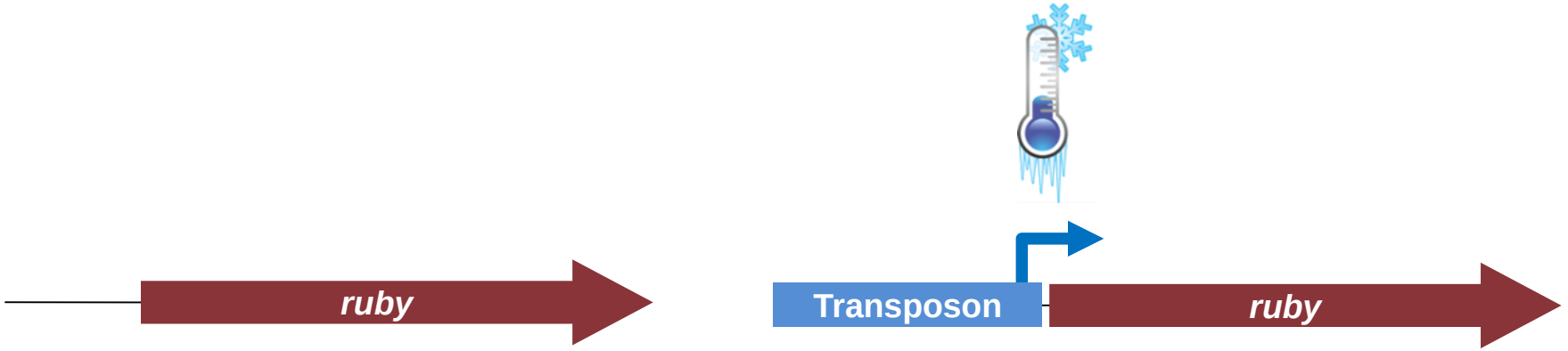
- Species with naturally evolved plant stress tolance mechanisms
- C4/CAM-metabolism, drought-adapted morphology
  - Grasses
  - Crassulaceae (Sedum, Echeveria)
  - Xerophytes (Helichrysum, Calocephalus)
  - Others (Portulak, Brachyscome, Felicia)

New breeding techniques: Transposable elements

- New breeding techniques are widely available with great level of precision
- Transposable elements are an example: they occur naturally and create adapted traits; e.g. response to heat stress
- Mobilizing transposable elements that respond to stress can generate useful characteristics

Crop traits influenced by transposons





Transposable elements create a link between the environment and the genome

Butelli, E. et al. Plant Cell 24
Walker, A.R. et al. Plant J 49

Plant variety protection is key to promote plant breeding

- PVP under the UPOV Convention is an “open innovation” system
- Breeder’s exemption is key for further research and breeding

The role of plant breeder's rights

RIJK ZWAAN

- Return on investment is necessary to continue developing new varieties
- PBR is THE IP protection system: providing adequate protection, while others can continue to find solutions to today's challenges – Open Innovation

Conclusions

- Plant breeding is fundamental for all types of crops to address the challenges posed by climate change
- Also important to support reduction of emissions of greenhouse gas emissions.
- New techniques are available (e.g. Transposable elements)
- Certain plant breeding techniques are still heavily regulated
- PVP is encouraging plant breeding by all types of breeders