GCRF BBR: Developing a hybrid bean collection to advance climate-ready bean breeding

Final Virtual Project Workshop

6th June 2023

Alliance Bioversity & CIAT

EMBL-EBI

GCRF Global Challenges Research Fund

NIAB

UKRI Biotechnology and Biological Sciences Research Council

Introductions: Project Team

Tom Wood

Jane Thomas

Sarah Dyer

Marcela Santaella

Peter Wenzl

Krystyna Gostkiewicz

Simon McAdam

Diego Conejo

Juan Reyes

Daniel Debouck

Javier Gereda

Scientific Advisory Board

Claire Domoney, JIC

Scott Jackson, U. Georgia/Bayer

David Marshall, SRUC

Steve Beebe, CIAT

Clare Mukankusi, CIAT

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

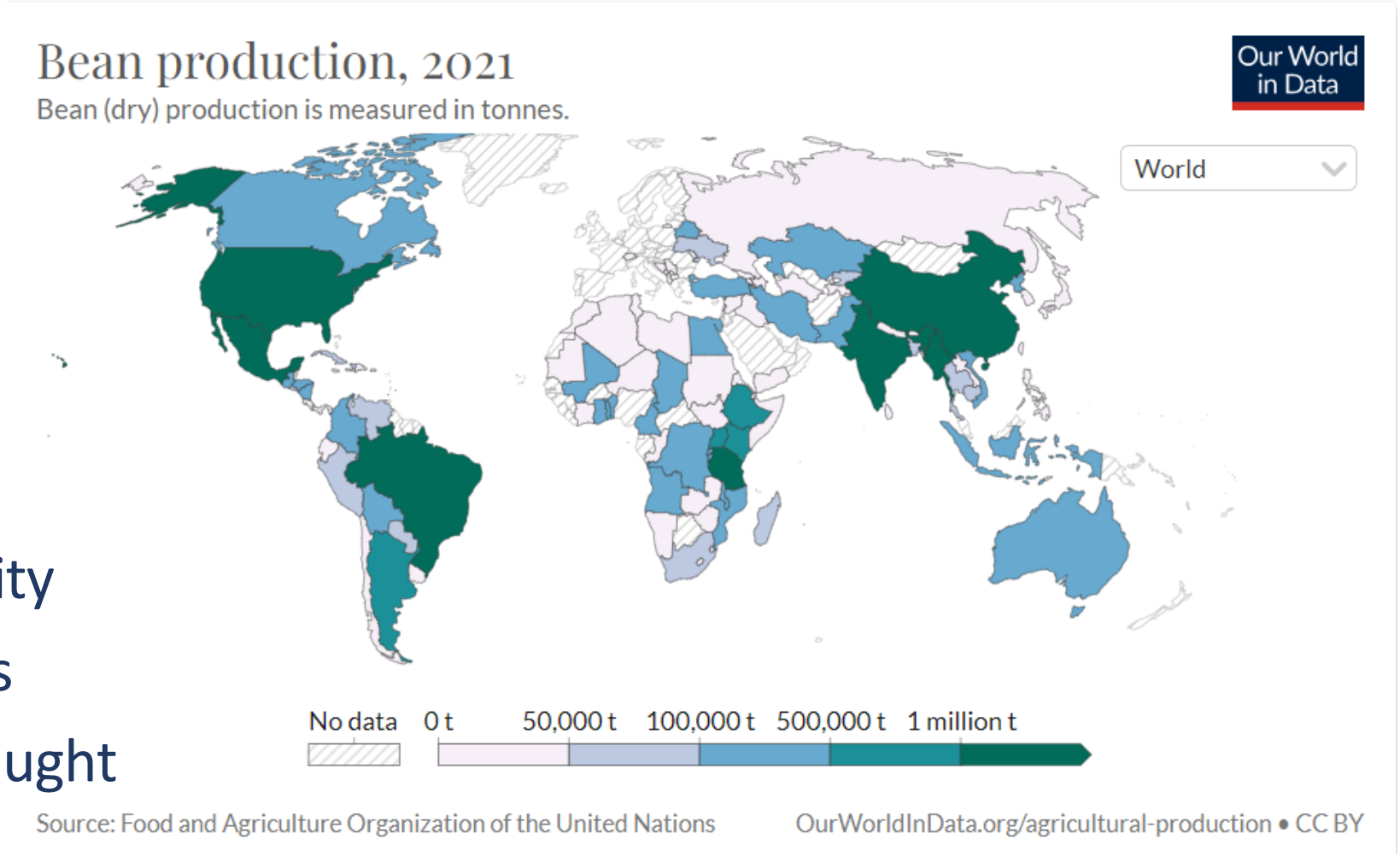
Agriculture and climate change

Warming oceans

Greater climatic variability

Heavier, protracted rains

Extended periods of drought



Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Genetic diversity in *Phaseolus* spp.

Primary

- *Phaseolus vulgaris* L. var. *aborigineus* (Burkart) Baudet

Secondary

- *Phaseolus albescens* McVaugh ex Ramirez-Delgadillo & A. Delgado; *Phaseolus coccineus* L.; *Phaseolus costaricensis* Freytag & Debouck; *Phaseolus dumosus* Macfad.; *Phaseolus persistentus* Freytag & Debouck

Tertiary

- *Phaseolus acutifolius* A. Gray; *Phaseolus acutifolius* A. Gray var. *acutifoilus*; *Phaseolus acutifolius* A. Gray var. *tenuifolius* A. Gray; *Phaseolus angustissimus* A. Gray; *Phaseolus carteri* Freytag & Debouck; *Phaseolus filiformis* Benth.; *Phaseolus maculatus* Scheele; *Phaseolus parvifolius* Freytag

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

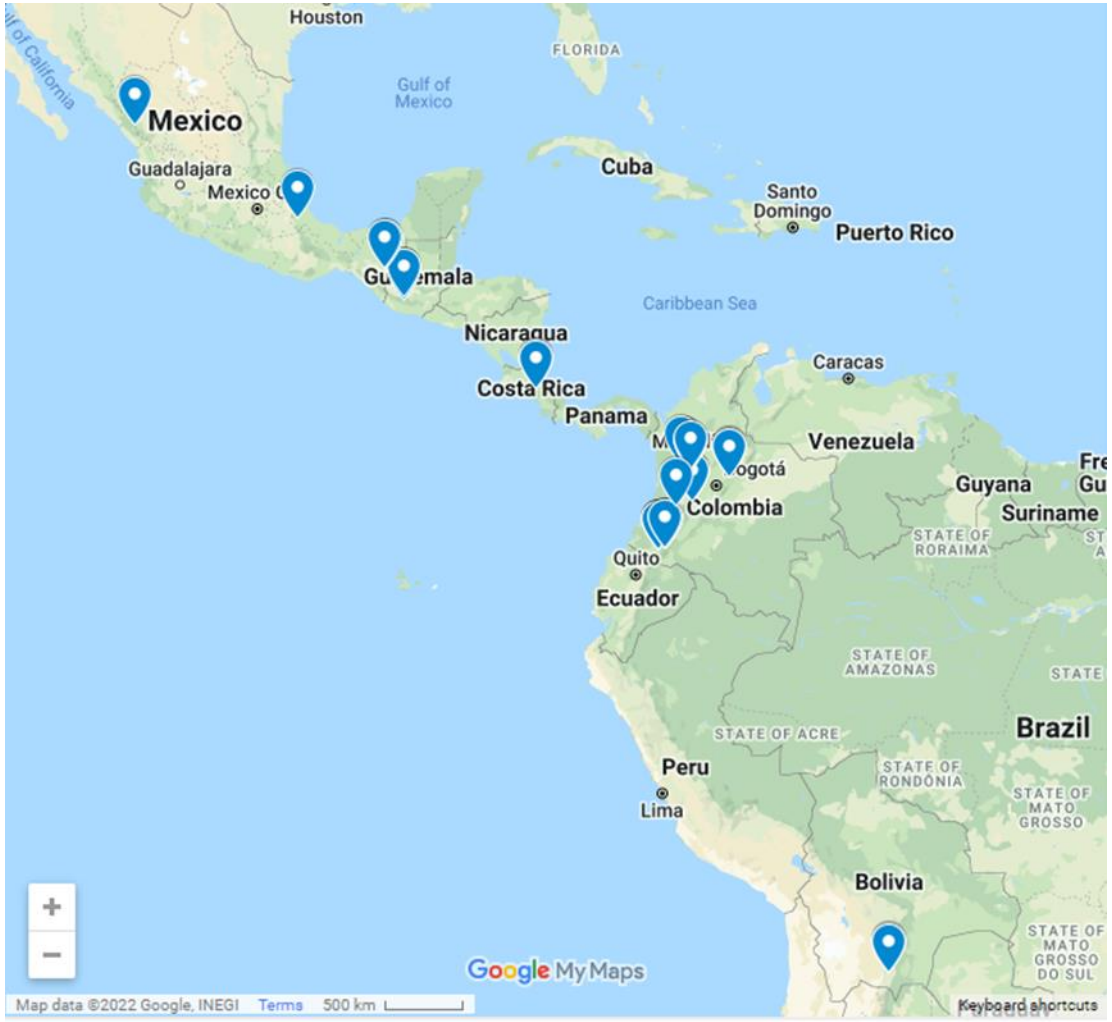
Motivation

Natural hybrid accessions from across centres of diversity collected and stored at Future Seeds

Spontaneous interspecific hybrids between wild/landraces/cultivated *Phaseolus* spp.

Sources of novel genetic diveristy

Could these materials be an interesting starting point for breeders?



Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Aim: To develop CIAT's collection of *Phaseolus vulgaris* hybrids by adding layers of targeted phenotypic information and genomic data to promote usability of these natural hybrids for climate-ready bean breeding.

Hybrid accession	Species	Collection information	Representative parent 1	Representative parent 2
G24764B	*P. dumosus* x *P. vulgaris* hybrid	Colombia, Boyacá, Garagoa	G36179, *P. dumosus* cultivated	G24764D, *P. vulgaris* feral
G35980H	*P. vulgaris* x *P. dumosus* cultivated	Colombia, Tolima, Chaparral	G23992, *P. vulgaris* cultivated	G35980, *P. dumosus* cultivated
G50785Y1	*P. vulgaris* x *P. coccineus* hybrid	Colombia, Antioquia, Andes	G50785V2, *P. vulgaris* cultivated	G35998, *P. coccineus* cultivated
G50879X4	*P. vulgaris* x *P. coccineus* hybrid	Colombia, Caldas, Salamina	G50879V1, *P. vulgaris* cultivated	G36211, *P. coccineus* cultivated
G51274I	*P. vulgaris* x *P. coccineus* hybrid	Colombia, Nariño, Pasto	G51274D, *P. vulgaris* cultivated	G35361, *P. coccineus* cultivated
G36124	*P. dumosus* x *P. coccineus* cultivated	Colombia, Putumayo, San Francisco (valley of Sibundoy)	G35270, *P. dumosus* cultivated	G35271, *P. coccineus* cultivated
G36393	*P. dumosus* x *P. costaricensis* feral	Costa Rica, Cartago, Cartago	G35807, *P. dumosus* cultivated	G40893B, *P. costaricensis* wild
G23860H	*P. vulgaris* feral	Bolivia, Tarija, Cercado	G23871, *P. vulgaris* cultivated	G23860M, *P. vulgaris* wild
G35877A	*P. dumosus* feral	Guatemala, Sololá, Panajachel	G35729, *P. dumosus* cultivated	G35877, *P. dumosus* wild
G52443	3-way *Phaseolus* hybrid (INB47)	CIAT Bean Program	G5773, *P. vulgaris* cultivated	G40102, *P. parvifolius* wild; G40001, *P. acutifolius* cultivated
ASC144	*P. vulgaris* x *P. dumosus*	CIAT Bean Program	CAL96 *P. vulgaris*	G35575A, *P. dumosus*, cultivated
MIB780	*P. vulgaris* x *P. dumosus*	CIAT Bean Program	FEB226 *P. vulgaris*	G35575B, *P. dumosus*, cultivated

Alliance Bioversity & CIAT

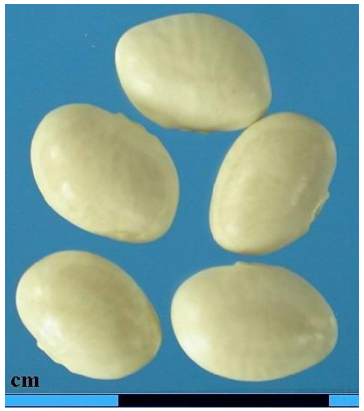
EMBL-EBI

NIAB

Case 10 : CIAT Bean Program, 3-way cross

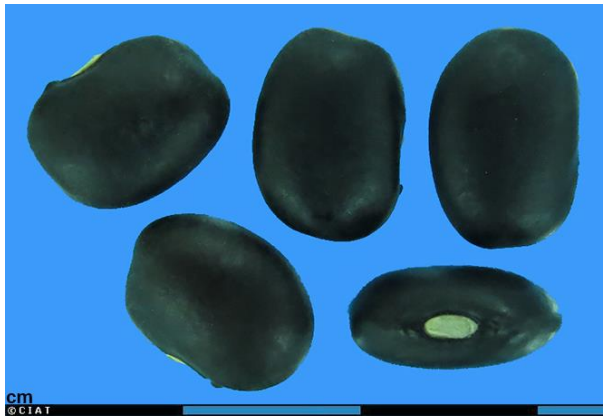
G5773, *vulgaris* cultivated

X



G40001, *acutifolius* cultivated

=



G52443, 3-way hybrid (INB47) (10 accessions)

G40102, *parvifolius* wild

Desirable traits
Tolerance to high temperature?
Tolerance to drought?
Active pulvini?
Improved translocation to seed?

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Complex 11, Colombia, Nariño Pasto

X

=

G51274D, *P. vulgaris* cultivated

G35361, *P. coccineus* cultivated

G51274i, *P. vulgaris x P. coccineus* hybrid

Desirable traits
Resistance to root rots?
Resistance to anthracnose, ascochyta?
Low phosphorus tolerance?
Low temperature tolerance?

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Complex 14, Colombia, Putomayo, Sibundoy Valley

G35270, *P. dumosus* cultivated

x

G35271, *P. coccineus* culitvated

=

G36124, *P. dumosus x P. coccineus*

Desirable traits
Resistance to root rots?
Resistance to anthracnose, ascochyta?
Resistance to rust and web blight?
Low temperature tolerance?

Objectives

-**Develop a detailed resource for domesticated/wild hybrids of common bean** (*Phaseolus vulgaris* L.) **and sister taxa**

- *P. coccineus, P. costaricensis* and *P. dumosus*

- **Provide characterisation data for these materials**
    - Characterisation including stomatal concentration, root angle and whorl no.
    - Phenotyping data for anthracnose, *rhizoctonia* root rot, web blight and white mould
    - Data on crossability with a widely adapted line
    - Genotype information from hybrids and putative parents

- **Engage with the breeder and research communities** to ensure awareness of the resource

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Aims for the workshop

Exploiting hybrid diversity to tackle abiotic/biotic stress...

Current approaches, future perspectives

Characterizing morphological traits, disease resistance

Utilizing genomics to investigate hybrid genetic diversity

Open discussion, utilizing the new resources, climate change in a local/regional context, knowledge and expertise gained during the project

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Agenda

7:00–7:20 Tom Wood, moderator, NIAB: Introduction, project overview

7:20-8:20: Abiotic Resilience in *Phaseolus* spp.

7:20-7:35: Milan Urban, CIAT: "The climate change-driven challenges and opportunities between physiology and breeding – focus on Phaseolus"

7:40-7:55: Marcela Santaella/Javier Gereda, CIAT: "Multiplication of adaptive germplasm for supporting trait characterization, phenotyping of key resilience traits under screen house conditions in Colombia"

8:00-8:05: Video: Multiplication and characterization of a panel of hybrid beans

8:05-8:20: Krystyna Gostkiewicz, NIAB: "Characterizing variation in root angle and stomatal density in *Phaseolus* interspecifics"

Questions – 10 mins

8:30-9:25: Disease Resistance in *Phaseolus* spp.

8:30-8:45: Gloria Mosquera, CIAT "Improvement of Plant Disease Resistance, response in the greenhouse vs crop production areas"

8:50-9:15: Simon McAdam "Confirming novel sources of resistance against *Phaseolus* pathogens *C. lindemuthianum* in the hybrid complexes *R. solani* and *S. Sclerotium"*

Questions – 10 mins

Break – *10 mins*

Agenda

9:35-10:15: Genetic Characterisation

9:35-9:50: Juan D Lobaton, CIAT: “Common bean interspecific introgressions”

9:50-10:05: Tom Wood, NIAB: “Genotypic analysis of select hybrid complexes, F1 crossing program and accessing the new resources”

Questions – 10 mins

10:15–11:00: Discussion

Opportunities for supporting future collaborations, characterisation of material and exploiting novel diversity from the project in breeding programs

Agenda

7:20-8:20: Abiotic Resilience in *Phaseolus* spp.

7:20-7:35: Milan Urban, CIAT: “The climate change-driven challenges and opportunities between physiology and breeding – focus on Phaseolus”

7:40-7:55: Marcela Santaella/Javier Gereda, CIAT: “Multiplication of adaptive germplasm for supporting trait characterization, phenotyping of key resilience traits under screen house conditions in Colombia”

8:00-8:05: Video: Multiplication and characterization of a panel of hybrid beans

8:05-8:20: Krystyna Gostkiewicz, NIAB: “Characterizing variation in root angle and stomatal density in *Phaseolus* interspecifics”

Questions – 10 mins

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Agenda

8:30-9:25: Disease Resistance in *Phaseolus* spp.

8:30-8:45: Gloria Mosquera, CIAT "Improvement of Plant Disease Resistance, response in the greenhouse vs crop production areas"

8:50-9:15: Simon McAdam "Confirming novel sources of resistance against *Phaseolus* pathogens *C. lindemuthianum* in the hybrid complexes *R. solani* and *S. Sclerotium*"

Questions – 10 mins

Break – *10 mins*

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Agenda

9:35-10:15: Genetic Characterisation

9:35-9:50: Juan D Lobaton, CIAT: “Common bean interspecific introgressions”

9:50-10:05: Tom Wood, NIAB: “Genotypic analysis of select hybrid complexes, F1 crossing program, accessing the new resources”

Questions – 10 mins

Alliance Bioversity & CIAT

EMBL-EBI

NIAB

Agenda

10:15– 11:00: Discussion

Opportunities for supporting future collaborations, characterisation of material and exploiting novel diversity from the project in breeding programs

Discussion

- How is climate change impacting on the cultivation or productivity of *Phaseolus* spp. in you region? What effort are you making to manage this?
- Which traits do you perceive to be the most important for common bean for your growing environment, both now and in the future?
- What additional support and/or technology would you require to start utilising non-adapted germplasm for research or breeding purposes?
- What common bean ideotypes will be most important in a changing climate?
- What will be the biggest barriers to the uptake of new (climate-tolerant) varieties?
- Are there additional actors or stakeholders to engage with that could help leverage greater impact from the hybrid genetic resources, i.e. environmental modellers, agro-foresters?

Discussion

- Key knowledge gained from project
- Considerations for future projects
- Ongoing research