



# Multiplication of adaptive germplasm for supporting trait characterization

Phenotyping key resilience traits under screen house conditions in Colombia


Marcela Santaella / 6<sup>th</sup> of June, 2023



**Genebanks** Collections of seeds and plant material intended to preserve genetic diversity



Distribution of 500,000 samples to more than 140 countries



**BEANS**

---

**37,934**  
SAMPLES

---

FROM  
**114**  
COUNTRIES




**CASSAVA**

---

**5,965**  
SAMPLES

---

FROM  
**28**  
COUNTRIES



**FORAGES**

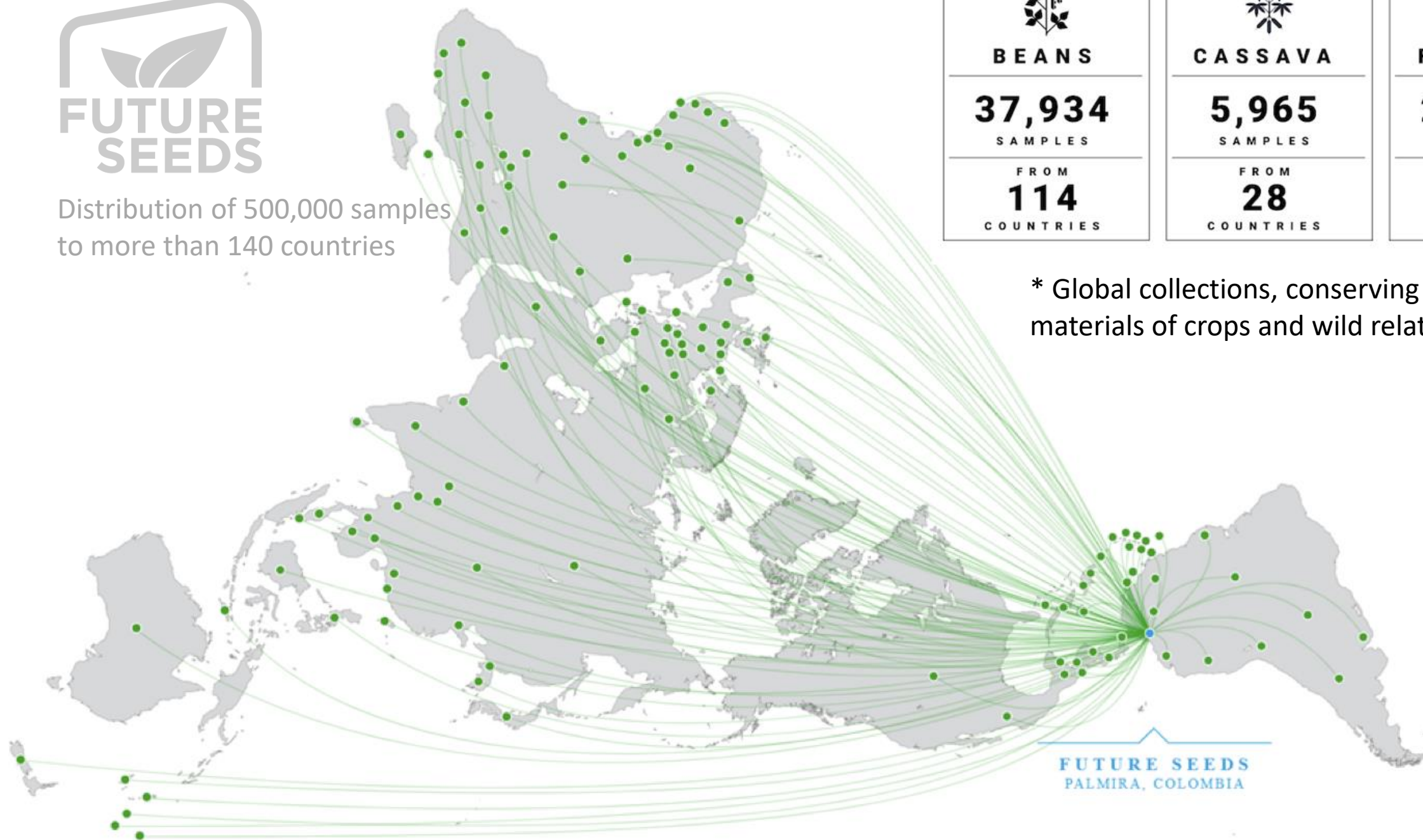
---

**22,661**  
SAMPLES

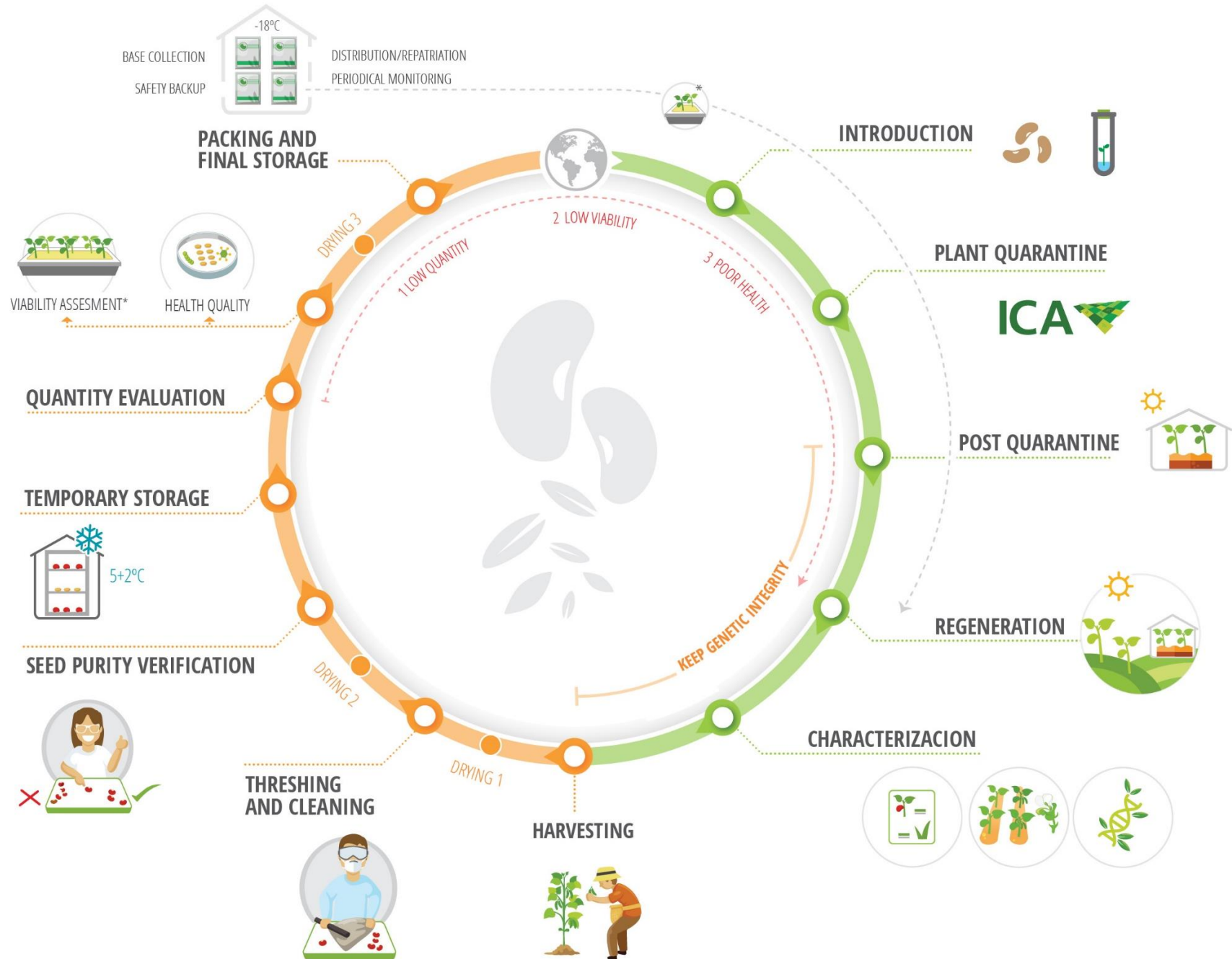
---

FROM  
**75**  
COUNTRIES

\* Global collections, conserving in trust materials of crops and wild relatives, ITPGRFA



# Seed Conservation: operations for Beans and Tropical Forages



# Hybrid Beans in the collection



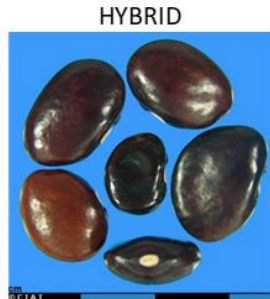
COMPLEX 8



G50879V1, *vulgaris* cultivated



G36211, *coccineus* cultivated



G50879X4, *vulgaris* x *coccineus* hybrid

COMPLEX 11



G51274D, *vulgaris* cultivated



G35361, *coccineus* cultivated



G51274I, *vulgaris* x *coccineus* hybrid

COMPLEX 14



G35270, *dumosus* cultivated

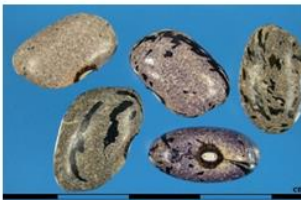


G35271, *coccineus* cultivated



G36124, *dumosus* x *coccineus* cultivated

COMPLEX 19



G23871, *vulgaris* cultivated



G23860M, *vulgaris* wild

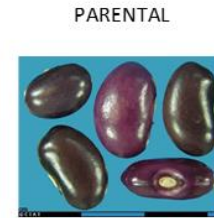


G23860H, *vulgaris* feral

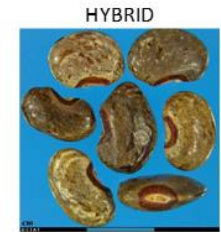
COMPLEX 3



G36179, *dumosus* cultivated

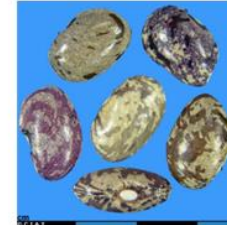


G24764D, *vulgaris* feral



G24764B, *dumosus* x *vulgaris* hybrid

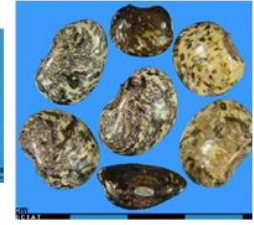
COMPLEX 7



G50785V2, *vulgaris* cultivated



G35998, *coccineus* cultivated

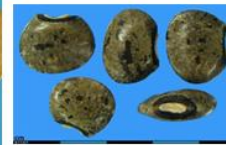


G50785Y1, *vulgaris* x *coccineus* hybrid

COMPLEX 17



G35807, *dumosus* cultivated



G40893B, *costaricensis* wild



G36393, *dumosus* x *costaricensis* feral

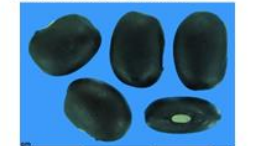
CASE 10



G5773, *vulgaris* cultivated



G40102, *parvifolius* wild



G52443, 3-way hybrid (INB47)



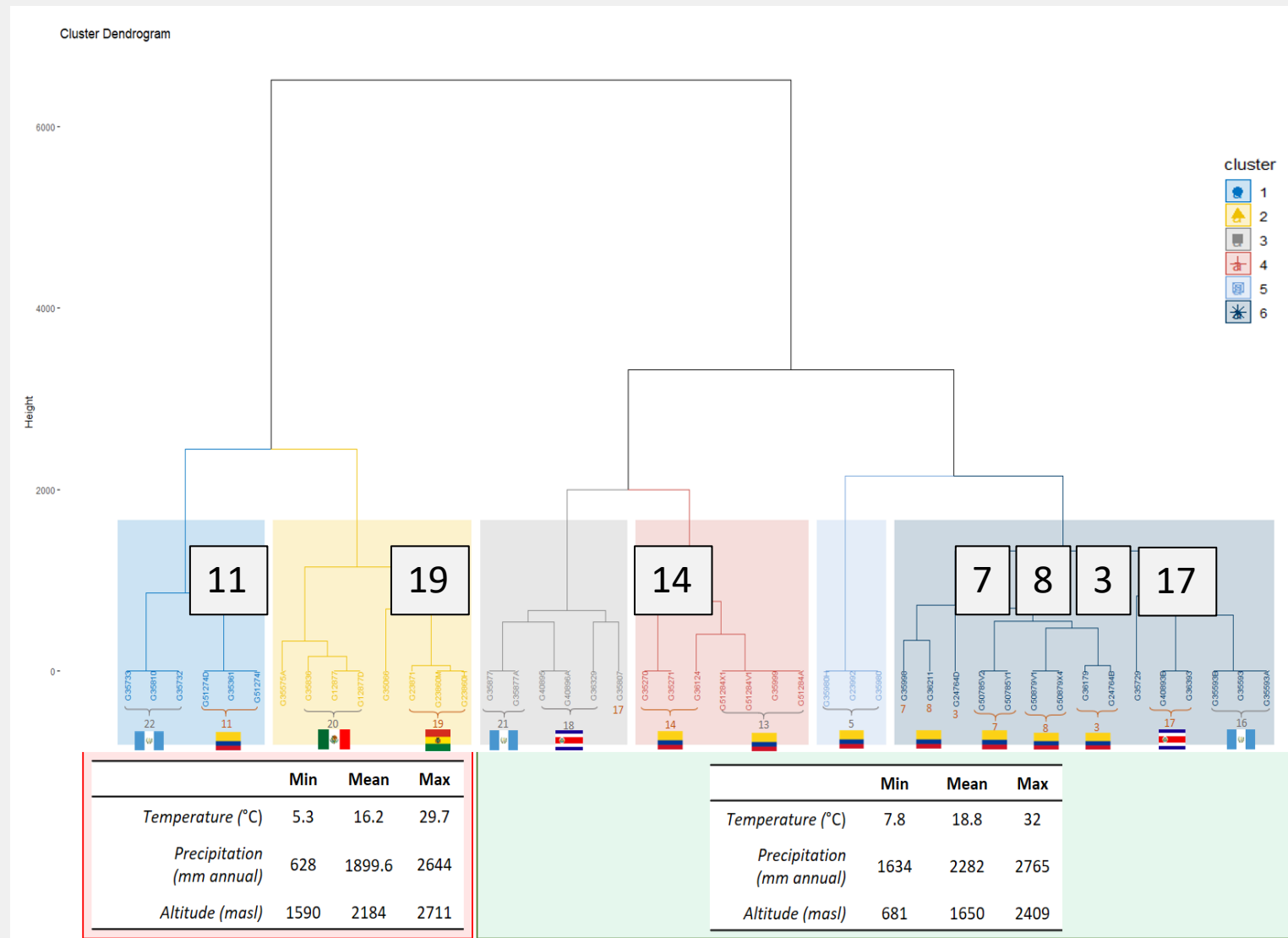
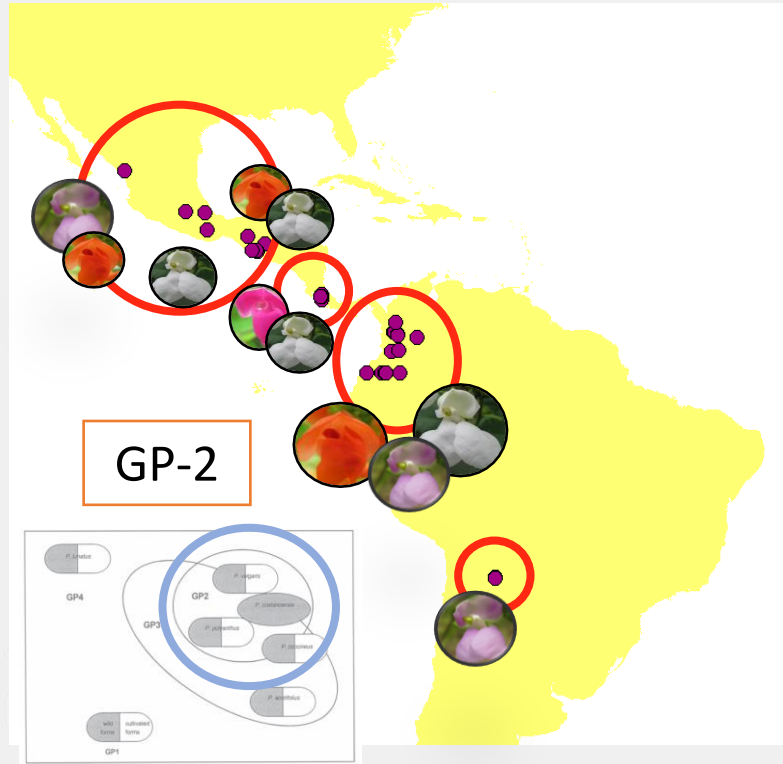
G40001, *acutifolius* cultivated



# Ecogeographic origins of natural bean hybrids



Original accession coordinates → world climate information (temperature, rain, light intensity)  
 → Two main groups, including six clusters (sympatric hybrids + parentals)



## Complex # 11: Colombia, Nariño, Pasto



G51274D, *vulgaris* cultivated  
Seed weight = 29.3 g

X



G35361, *coccineus* cultivated  
Seed weight = 82.8 g

=



G51274I, *vulgaris* x *coccineus* hybrid  
Seed weight = 57.1 g

### Desirable traits

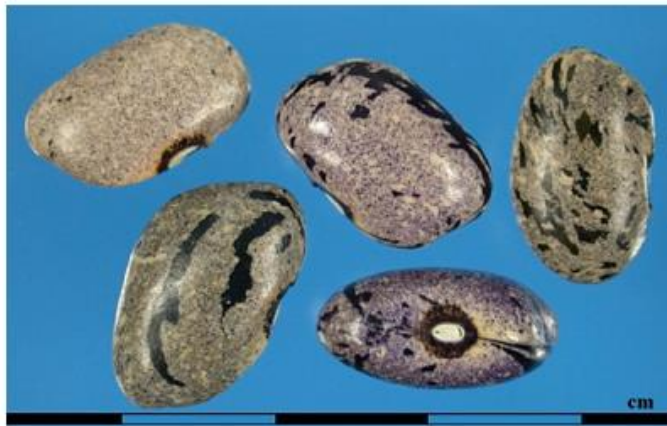
Resistance to white mold?

Resistance to Ascochyta blight?

Resistance to bacterial blight?

Resistance to bean golden yellow mosaic virus?

## Complex # 19: Bolivia, Tarija, Cercado



G23871, *P. vulgaris* cultivated  
seed weight = 60.0 g

X



G23860M, *P. vulgaris* wild  
seed weight = 14.9 g

=



G23860H, *P. vulgaris* feral  
seed weight = 26.6 g

### Desirable traits

Low temperature tolerance?

Higher leaf soluble protein content?

Reduced adaxial stomata?

Shade or drought tolerant?



### Complex # 3: Colombia, Boyacá, Garagoa



G36179, *dumosus* cultivated  
Seed weight = 102.3 g

X



G24764D, *vulgaris* feral  
Seed weight = 54.0 g

=



G24764B, *dumosus* x *vulgaris* hybrid  
Seed weight = 45.3 g

#### Desirable traits

Anthracnose resistant?

Low temperature tolerant?



### Complex # 7: Colombia, Antioquia, Andes



G50785V2, *vulgaris* cultivated  
Seed weight = 43.9 g

X



G35998, *coccineus* cultivated  
Seed weight = 71.4 g

=



G50785Y1, *vulgaris* x *coccineus* hybrid  
Seed weight = 35.5 g

#### Desirable traits

Resistance to white mold?

Resistance to ascochyta blight?

Resistance to bacterial blight?

Resistance to bean golden yellow mosaic virus?



Complex # 8: Colombia, Caldas, Salamina



G50879V1, *vulgaris* cultivated  
Seed weight = 46.1 g

X



G36211, *coccineus* cultivated  
Seed weight = 90.5 g

=



G50879X4, *vulgaris* x *coccineus* hybrid  
Seed weight = 44.0 g

**Desirable traits**

Resistance to white mold?

Resistance to ascochyta blight?

Resistance to bacterial blight?

Resistance to bean golden yellow mosaic virus?

Shade tolerance?



Complex # 14: Colombia, Putumayo, San Francisco (valley of Sibundoy)



G35270, *dumosus* cultivated  
Seed weight = 60.0 g

X



G35271, *coccineus* cultivated  
Seed weight = 74.9 g

=



G36124, *dumosus* x *coccineus* cultivated  
Seed weight = 76.7 g

**Desirable traits**

Anthraxnose resistant?

Ascochyta blight resistant?

White mold resistant?

Resistant to bacterial blight?

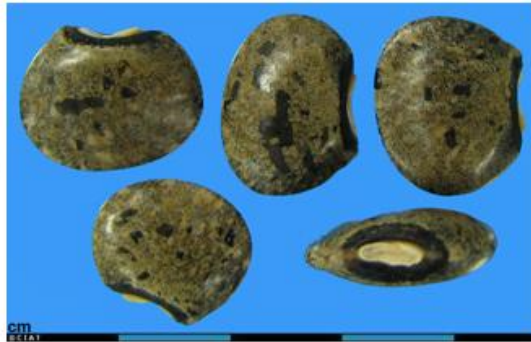
Shade tolerance?

Complex # 17: Costa Rica, Cartago, Cartago



G35807, *dumosus* cultivated  
Seed weight = 69.6 g

X



G40893B, *costaricensis* wild  
Seed weight = 10.1 g

=



G36393, *dumosus* x *costaricensis* feral  
Seed weight = 42.1 g

**Desirable traits**

White-mold resistant?

Anthraxnose resistant?

# Hybrid from the Bean Breeding Program



G5773, *vulgaris* cultivated; 24.0 g

X



G40102, *parvifolius* wild; 1.8 g



G40001, *acutifolius* cultivated; 16.1 g

=



G52443, 3-way hybrid (INB47); 22.5 g

**Desirable traits**

High temperature tolerance?

Drought tolerance?

Active pulvini?

Improved translocation to seed?





# Seed multiplication – external stations

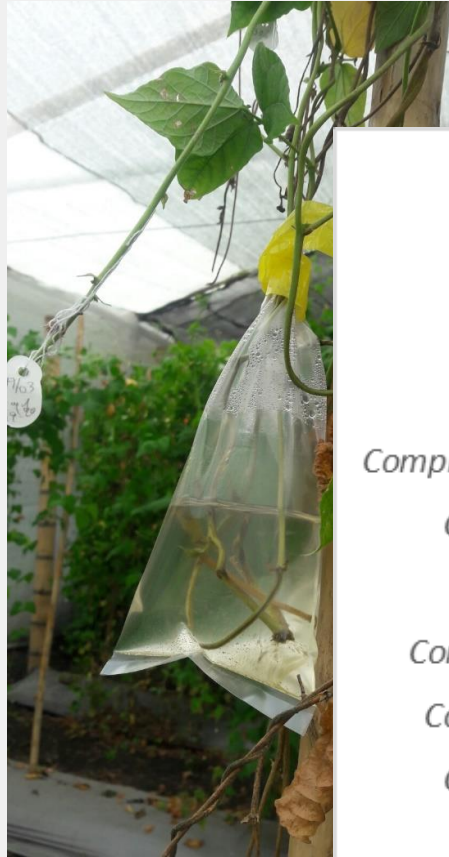


# Seed sowing and plant vegetative multiplication

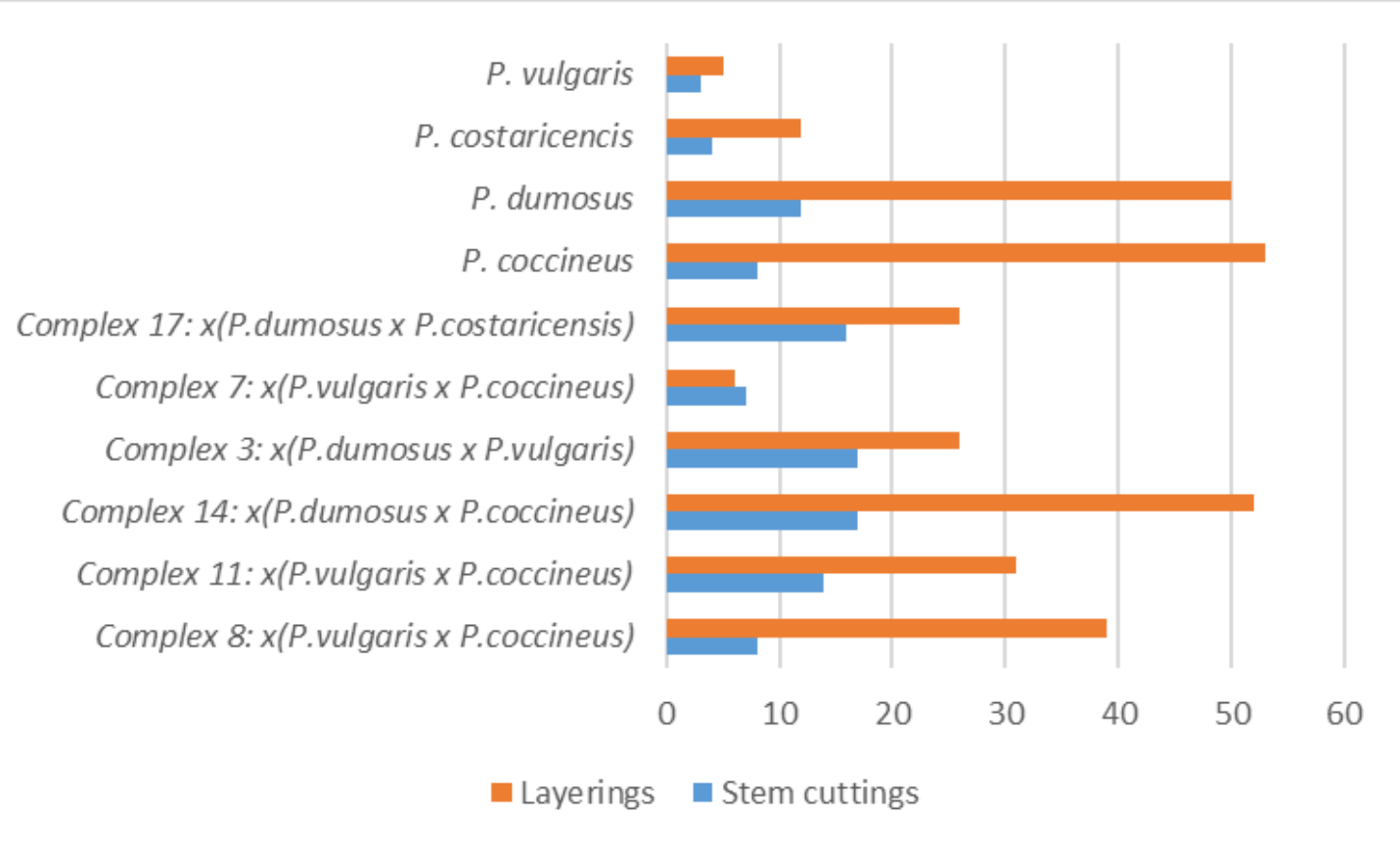
Stolons/aerial layerings



Water layerings



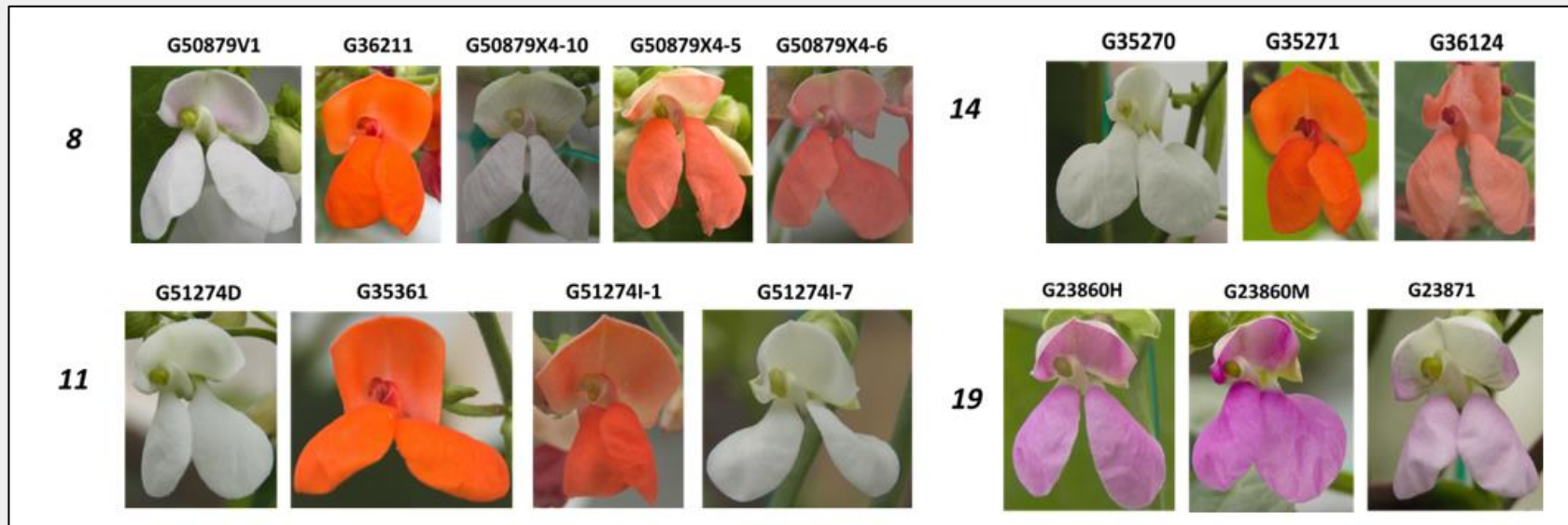
Stem cuttings



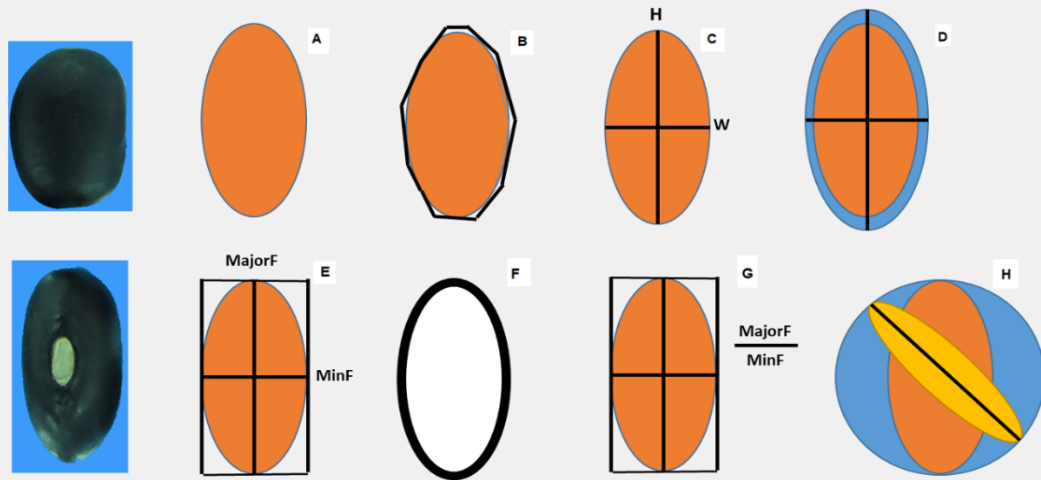
# Morphological characterisation



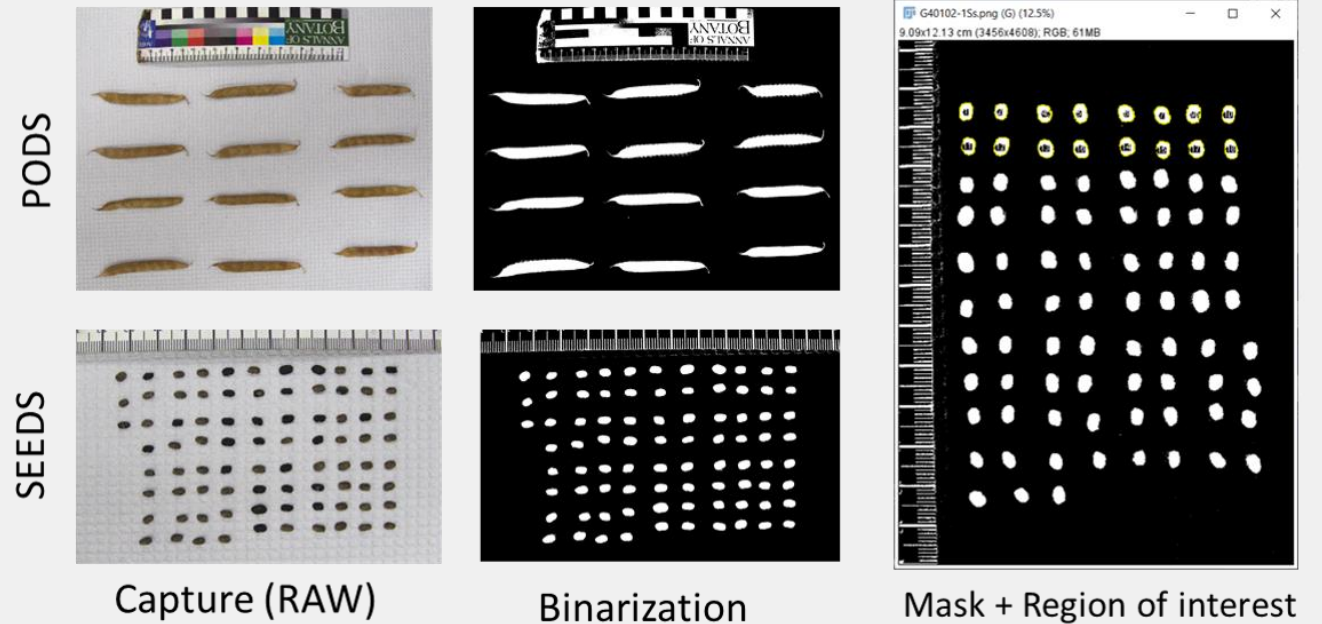
- Basic morpho-agronomic and phenological characterisation
- Physiological parameters measured (MultiSpeQ)
- Flower color, pod and seed measurements, based on images



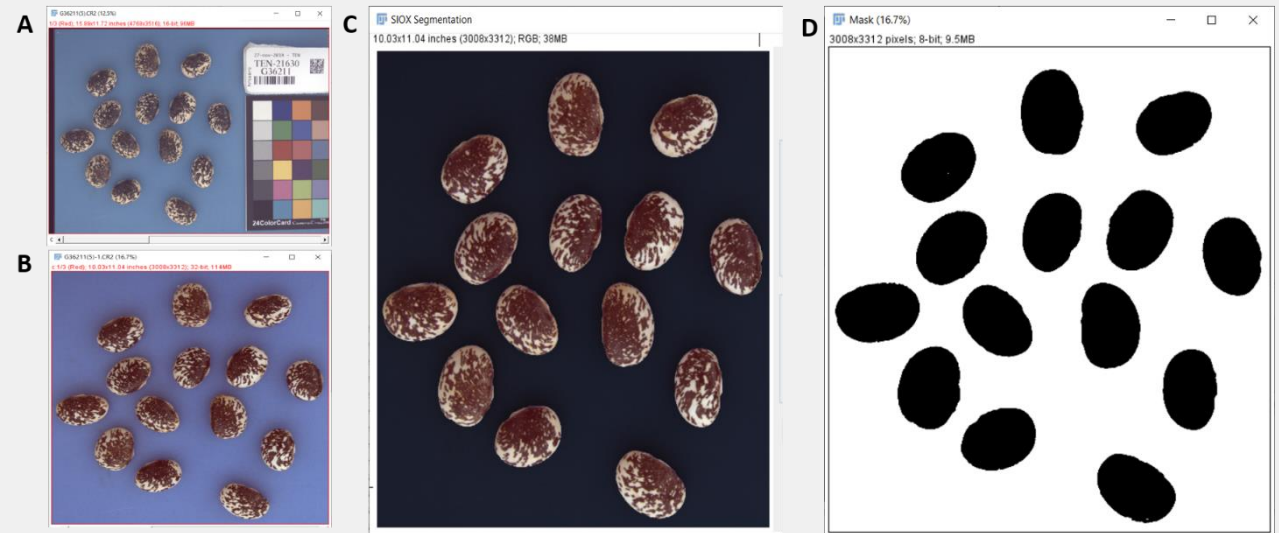
# Pod and Seed morphology



**Figure 1.** Morphometric descriptors used in the characterization. (A) Area, (B) Solidity, (C) Height and Width, (D) Minor and Major, (E) MajorFeret and Minorferet, (F) Perimeter, (G) Aspect ratio (AR) and (H) Roundness.



Canon SX60 HS camera, 16.1 megapixels



frontiers | Frontiers in Plant Science | TYPE Original Research | PUBLISHED 08 December 2022 | doi: 10.3389/fpls.2022.1008666

## Using phenomics to identify and integrate traits of interest for better-performing common beans: A validation study on an interspecific hybrid and its *Acutifolii* parents

Diego Felipe Conejo Rodriguez <sup>1\*</sup>, Milan Oldřich Urban <sup>2\*</sup>, Marcela Santaella <sup>1</sup>, Javier Mauricio Gereda <sup>1</sup>, Aquiles Darghan Contreras <sup>3</sup> and Peter Wenzl <sup>1</sup>



# Seed production for additional characterisation at NIAB, UK

**Complex 11** (*x P. vulgaris x P. coccineus*)  
G 51274I



Complex 11 - hybrid

**Complex 19** (*x P. vulgaris x P. vulgaris wild*)  
G 23860H



Complex 19 - hybrid



capturada en moto g



**Complex 3 (x *P. dumosus* x *P. vulgaris*)**  
G 24764B



Complex 3 - hybrid

**Complex 7 (x *P. vulgaris* x *P. coccineus*)**  
G 50785Y1



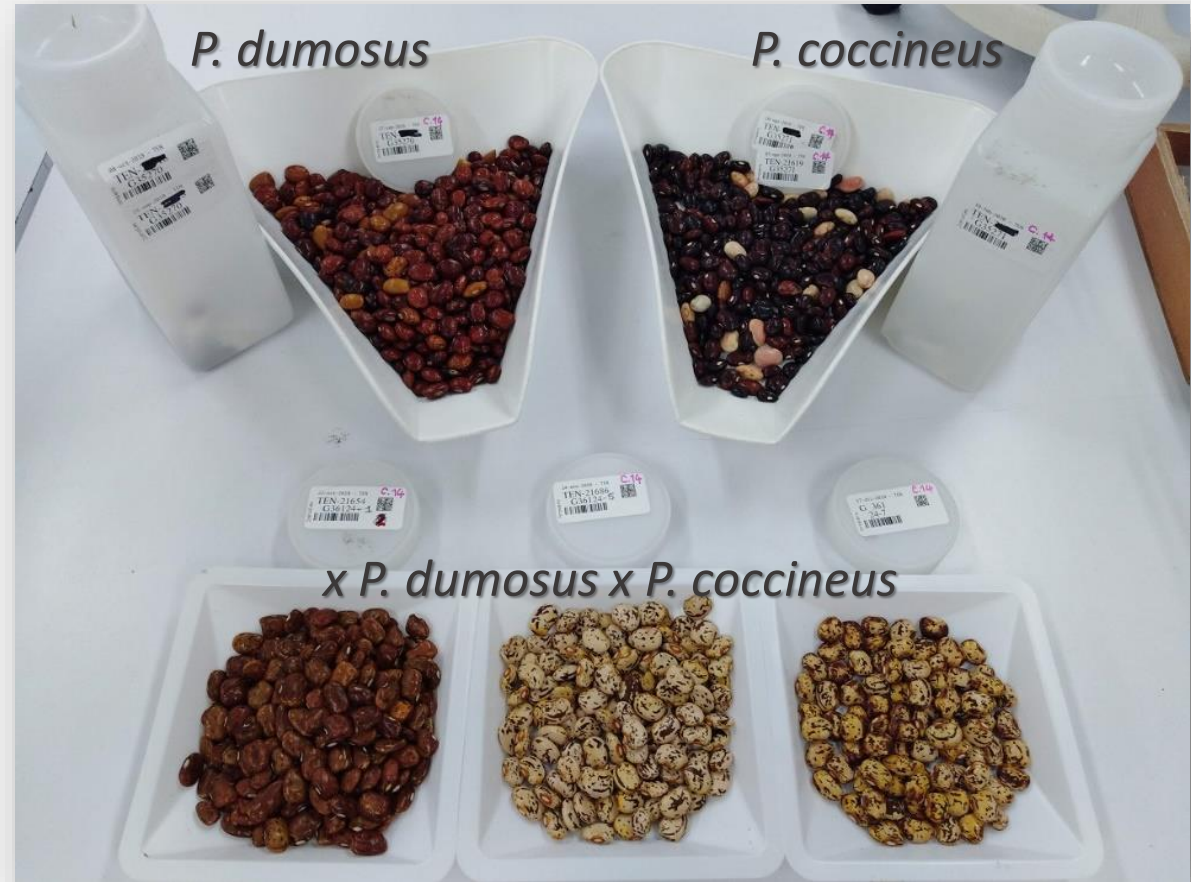
Complex 7 - hybrid



# Complex 8 (*x P. vulgaris x P. coccineus*) – G 50874X4



# Complex 14 (*x P. dumosus x P. coccineus*) – G 36124

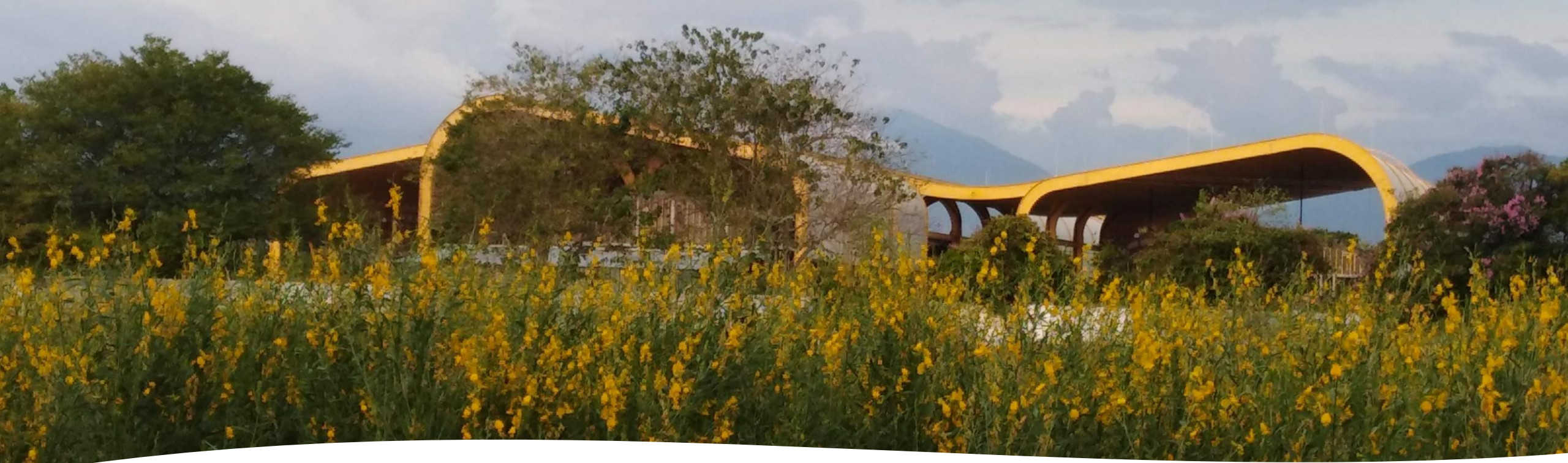


# Complex 17 (*x P. dumosus x P. costaricensis*) – G 36393



# Case 10 (*x P. vulgaris x P. parvifolius x P. acutifolius*) – G 52443



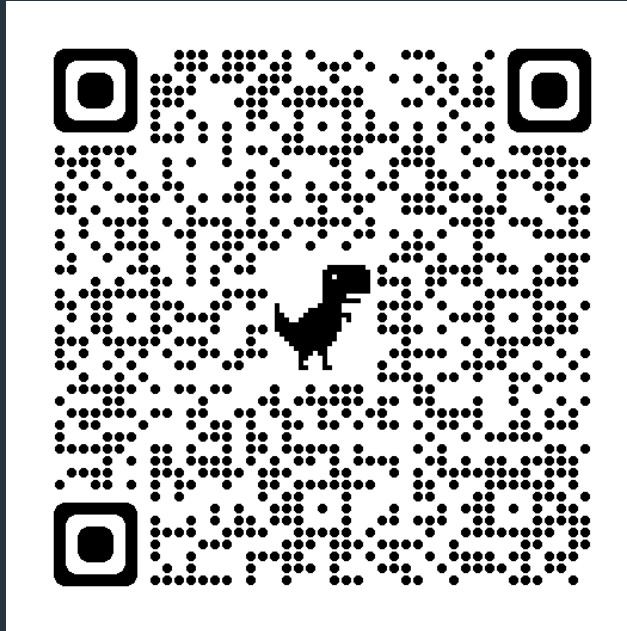


# Fertile collaboration

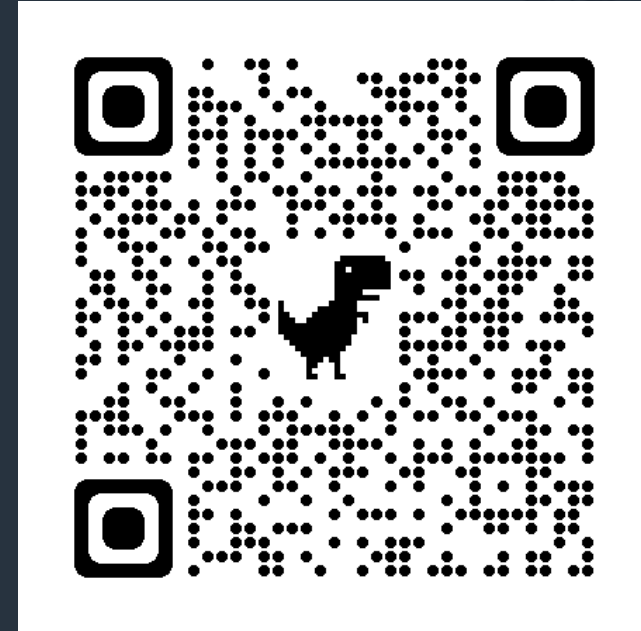
- NIAB Partners leading the project: Tom Wood, Jane Thomas, Simon McAdam, Krystyna Gostkiewicz, and Sarah Dyer (currently at EBI)
- Field Team at Tenerife station: Alvaro Mestizo, Jeison Ypiales, Guillermo Rosero, Salomon Genoy
- Palmira campus Team: Hernán Escobar, Jersaín Naranjo, Wilson Guzmán, Cesar Franco, Maria Mercedes Parra, Cenaida Perenguez, Fanny Gil, Juan Gilberto Dominguez, Angélica Martínez, Diana Niño, Dimary Libreros, and many more
- Research Team: Diego F. Conejo, Juan David Reyes, Javier M. Gereda, Ramiro Sabogal, Luis Guillermo Santos, Maritza Cuervo, Julio César Ramírez, Peter Wenzl, Steve Beebe and Daniel Debouck

# Thanks

NIAB Project website



Seed's request website



Marcela Santaella, Ph.D.  
Genebank Operations Manager  
6<sup>th</sup> of June 2023