

Components of a world class breeding program

Please use this outline to keep specific notes on the aspects of the breeding vision as it is shared and discussed. The following outline highlights the key pillars and components of the CGIAR breeding program. The vision is that we use the most appropriate management practices and the effective research methods to develop products that meet targeted needs of our customers. To meet this challenge and to keep up with a changing world, we must develop and actively drive a culture of purposeful and measured improvement.

A. Defining breeding targets and objectives

i. Vision: All breeding is oriented to development of products for maximum impact

1. CGIAR and NARS breeding programs achieve a **rate of genetic gain** of at least twice that of pre-2019 levels and at least 1% per annum
2. Parent development, product development and exploration of genetic diversity are separate **activities all oriented to the development of products that will be adopted by growers**
3. There is a **clear understanding of for whom and what you're breeding**
4. Breeding is directed by **high quality product profiles** and that it is clear who those product profiles are serving
5. **Distinct germplasm pools and breeding schemes** need to be developed and improved for each targeted market segment

B. Strategy for breeding scheme

i. Vision: Breeding scheme is optimized for rate of genetic gain and likelihood of developing products for impact

1. Variety development, parent development, identification and validation of novel genetic diversity **are three distinct and separate activities**
2. Seek a **short breeding cycle** to the biological limit from cross to multi-environment yield, disease and quality assessment
3. **Stage gate system** is implemented

C. Strategy for breeding operations

i. Vision: Breeding strategy is executed in such a way as to optimize data accuracy, cost and throughput

1. **Technology** (e.g. genotyping) is adopted and implemented appropriately to increase rate of genetic gain per dollar invested
2. Breeding operations and **data collection** are conducted in a way so as to limit losses of data; be accurate; be cheap; be fast to collect; be readily analyzed and interpreted
3. Breeding programs have **good data management** practices
4. **Quality control** is regularly applied
5. **Parent and product selections** are made on the basis of high-quality trials
6. **Breeding program costs** are known and readily retrieved

D. Crossing

- i. Vision: Best parental selection decisions are made and genetic diversity managed according to the breeding strategy
 1. Variety development programs strictly use **elite by elite** in crossing
 2. **Genetic diversity is measured** and actively managed

E. Evaluation

- i. Vision: Germplasm is tested in a way to maximize accuracy
 1. **Genetic gains** are assessed annually in a scientifically robust way
 2. Current best practice **trial designs** are implemented
 3. **Reliable data** is developed every year and is representative of the targeted population of environments to select parents earlier
 4. Latest **phenotyping technologies** and field/environment characterization technologies are exploited for generating data on relevant traits and trials

F. Selection

- i. Vision: Parents and products are selected on the basis of accurate data and aligned with the product profile
 1. There is an **annual advancement meeting**
 2. An **accurate selection index** is aligned with the product profile
 3. Current best practice **trial analyses** are implemented to develop estimates of breeding values and genetic merit
 4. Best practice **visualization tools** for decision making are used
 5. Both **selection intensity and genetic diversity** are critically considered when selecting parents

G. Product verification, release and delivery

- i. Vision: There is a pipeline and process for maximum impact of breeding program outputs
 1. **Effective pipeline** in place that delivers high quality germplasm from the first cross to adopted varieties
 2. **Sufficient data is generated and available** to enable growers to make informed variety choices

H. Collaboration and culture

- i. Vision: There is a culture that allows for improvement, sustainability and synergy
 1. Breeding programs fully exploit **external trialing and germplasm**
 2. **Breeding teams are the experts**
 3. There is a **culture of continuous improvement**
 4. Clear pathway and metrics to **deploy new and successful breeding methods**
 5. An **annual review** of the breeding program against key performance metrics is held
 6. Work is done with consideration of **respect and safety** for all employees