Understanding and using diversity

The genotypic data provide unifying information across landraces, acting as a common backbone to which other valuable information can be added. This knowledge framework serves as a catalogue enabling germplasm bank users to select products to meet their needs.

“These landraces likely offer my needed disease resistance!”

The molecular atlas – navigating diversity

The maize molecular atlas brings landraces into active use by germplasm bank users – current examples include the use of landraces in heat tolerance research, development of new drought tolerant breeding lines, and participatory maize breeding with smallholder farmers to improve landrace disease tolerance.

The molecular atlas is a knowledge and information platform that brings these data resources and associated tools together. Similar to satellite navigation systems in a car, the molecular atlas enables navigation through a framework of complex data to help move effectively from a genetic diversity need to a potential solution. The atlas facilitates unparalleled access to the vast range of unused diversity available on germplasm bank shelves – crucial diversity for the development of nutritious, climate change responsive varieties of the future.

ATLAS USE
Identify new variation for heat tolerance

Process

1. Find all landraces in target environment of interest
2. Find landraces which come from places with long term high temperatures during flowering or perform well under high temperature stress
3. Use genotypic data to conduct diversity analysis and define small representative set of landraces for field evaluation
4. Conduct field evaluations to identify the best heat tolerant landraces
5. Upload data to germinate to share with the broader community

Molecular Atlas Tool/Resource

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For more information, email us at seed@masagro.org
Websites:
www.seedsofdiscovery.org
www.cimmyt.org
The molecular atlas

The molecular atlas provides the data, tools and resources to allow germplasm bank users – maize breeders, researchers, extension agents etc., to identify the diversity of likely value for their specific needs from the tens of thousands of landraces available to them.

The molecular atlas – a public knowledge resource

The molecular atlas framework is available providing:

- **Data** – genotypic, phenotypic, GIS, passport.
- **Knowledge** – marker-trait associations, germplasm panels.
- **Tools** – data collection software, online query tools, data visualization tools and software, statistical analysis methods, training links.

The information and tools of the atlas are international public goods. Contents are publically accessible within a proactive intellectual property framework ensuring that the genetic resources and benefits arising from their use remain in the public domain, within reach of smallholder farmers.

The atlas currently consists of several components.

**MAIZE DIVERSITY**

**Maize and Mexico**

Maize was domesticated in Mesoamerica, around 10 thousand years ago. Today it is one of the three most important food staples globally and is central to the diet of many regions particularly so in Mexico where the crop has large cultural significance.

**Landraces – past and present**

Landraces are the varieties of maize that farmers across the globe have adapted to their local environments over tens, hundreds or thousands of years. They represent the broadest range of maize genetic diversity and are the ancestors of all modern maize varieties. Landraces are still grown in some farming communities today, though the extent of their use has declined for many reasons. To ensure the availability of this diversity for future generations, many of these landraces have been conserved in germplasm banks – safeguarding the vast range of diversity cultivated over millennia.

**Diversity to meet challenges**

**Use of landraces**

Until recently it was very difficult for the users of germplasm banks to identify which landraces were of the most potential value for their needs. The information needed to make a selection was scarce, rather like a library without a catalogue.

“Which landraces can help me develop a variety with – heat tolerance? higher nutrient content? disease resistance ...?”

**Making diversity more accessible**

Recent advances in DNA sequencing techniques provided an opportunity to rapidly and cost effectively genetically fingerprint or genotype germplasm bank collections. Using these methods, MasAgro genotyped the entire international maize collection – 28,000 maize accessions, publically available and held in trust for humanity by CIMMYT. This genotypic data, helps understand and use the germplasm bank diversity.

**Molecular atlas components**

- **KDSmart** – Android based tablet and phone phenotypic data collection.
- **KDXplore** – Computer based trial data management and data curation tool.
- **Germinate 3** – Online data warehouse and knowledge center with data query, visualization and download capability. germinate.seedsofdiscovery.org
- **Flapjack** – Graphical genotype viewer helps identify germplasm and diversity of highest value.
- **CurlyWhirly** – multidimensional data visualization to help understand genetic diversity and identify the most useful landraces.

**Online data warehouse and knowledge center with data query, visualization and download capability seedsofdiscovery.org**

- **Statistical analysis tools and scripts to conduct analysis of genotypic, phenotypic and GIS data.**
- **Flapjack** – Graphical genotype viewer helps identify germplasm and diversity of highest value.