

Learning how to rescue a landrace: a study of the giant maize, Jala, and the community who grows it



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Introduction

Germplasm banks, such as CIMMYT's, have been the *ex situ* sources of crop genetic diversity for plant breeders and researchers for decades. **Increasingly, these institutions are providing seed from *ex situ* collections and technological support directly to smallholder farmers, who have always been the *in situ* guardians of landraces.**

In the case of maize in its center of origin, mounting evidence suggests that accelerating loss of genetic diversity may indeed impact the ability of this critically important crop species to adapt to the changing environments of the future.

We seek the following: 1) a clear understanding of the current status of genetic diversity, both in farmers' fields and in genebanks, 2) documentation of the impact that collaborations between gene banks and farmers could have on the maintenance of diversity and the resiliency of farmers' seed systems, and 3) a plan for monitoring and preventing the erosion of crop genetic diversity. In 2017, we initiated the first case study of a maize landrace that addresses these issues. **We take a multidisciplinary approach, combining population genetics, agronomy, and socioeconomics.**



2016 "Largest Maize in the World" Contest winner: 45cm long, grown by Don Carmen Gomez Rodriguez

Materials and Methods

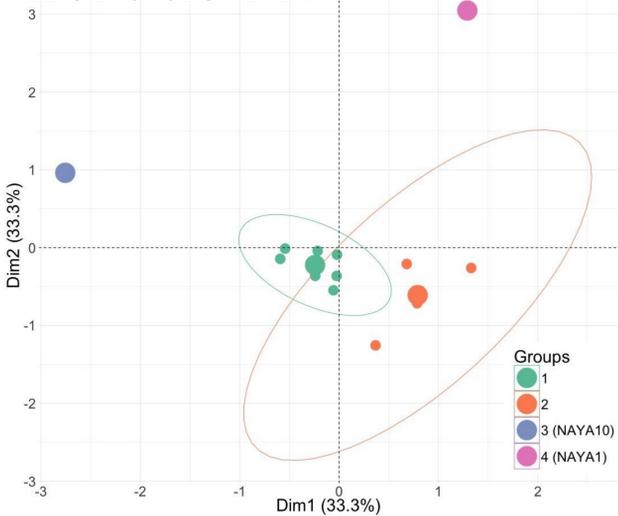
Two students, Luis Armando Flores (MEX) and Aaron Waybright (USA), lived in Jala for 5 months (Jul-Dec 2017) and carried out the field work for two studies:

- **Field trial** of 14 historical Jala landrace accessions from the CIMMYT Bank and locally grown Jala maize from 4 farmers' 2016 harvest;
- **Farmer interviews**, repeating a 2001 survey carried out by E. Rice [Genet Resour Crop Evol 54:701-713 (2007)], focused specifically on Jala landrace farming practices.

Results and Discussion

Landrace Diversity: Conservation *Ex Situ* and *In Situ*

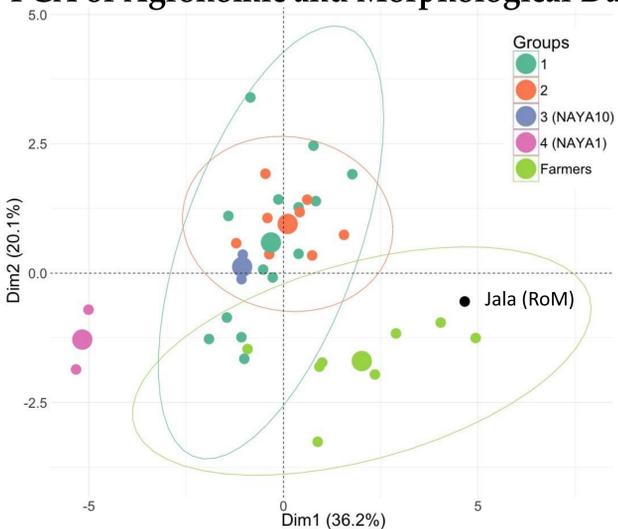
MDS Plot of SNP Data



13 of the historical Jala landrace accessions were genotyped as part of the Seeds of Discovery project at CIMMYT. A biodiversity analysis of 33,505 SNPs using BIO-R identified **two main groups and two potential outliers (NAYA10 and NAYA1)**. Both groups include accessions collected in multiple decades (1944-1988).

(Download BIO-R hdl:11529/10820)

PCA of Agronomic and Morphological Data



A principal components analysis of 11 morphological and agronomic traits collected in 2017 from 13 genebank accessions and four farmer accessions grown in the field in Jala. These traits were included in the original **Races of Maize (RoM)** evaluations, which allow us to overlay the ideotype identified by Wellhausen et al. (1952) into the plot.

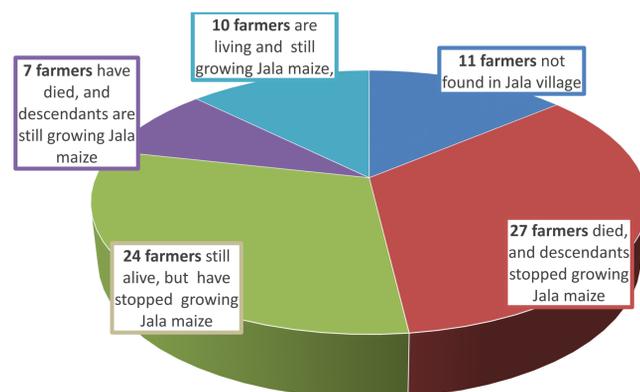
The PCA of agronomic and morphological data provides further evidence that **NAYA1 may not be pure Jala.**

Interestingly, the **ideotype of Jala described by Wellhausen falls within the 95% CI ellipse of the *in situ* Jala accessions**, but remains separate from the *ex situ* conserved accessions.

Data included: Plant Height, Days to Anthesis, Leaf Length, Leaf Width, Ear Length, Grain Width, Grain Thickness, Grain Length, Ear Diameter, Cob Diameter, Kernel Rows per Ear

The Challenge of Intergenerational Change And Agriculture

Only 22% of the farmers' families who were growing Jala landrace in 2001 are still growing it in 2017.



Jala farmers are becoming older, and there is no sign of a generational turnover.

Jala and Jomulco communities	Rice (2007)	Our study (2017)	ProAgro (2016)*	INEGI (2015) Municipality
Average age (years)	64	63	65	Average: 30 años
Farmers owning more than 11 ha	59	72	63	Children (-15 years): 33%
Farmers owning between 2-11 ha	66	61	65	Youth (15-29): 24%
Farmers owning less than 2 ha	64	66	64	Adults (30-59): 31%
				Elders (+60): 12%

The average age of Jala farmers is ≈60 years (Rice, 2007 and this study).

These results resonate with data from ProAgro, a nationwide subsidy program in Mexico (based on 2007 census). However, the 2015 National Census, indicates that **> ½ the population of Jala county is <30 yrs old.**

Interviewees' recommendations to conserve Jala maize:

Integrate Young Farmers (8)	Explore market opportunities (7)	Find strategies to stop growing hybrids (4)	Strengthen seed conservation (4)	Promote the development of food products with the landrace (2)
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