

Sustainable wheat production under less water and high CO₂

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VISION

Uniqueness:

Problem: Nearly 40 % area of the globe under moderate to severe drought

Roughly 30% people will be affected (ICARDA)

Opportunities: Diverse global wheat germplasm developed at **CIMMYT**
(International maize and wheat improvement center), Mexico

Upstream research (eco and molecular physiology)

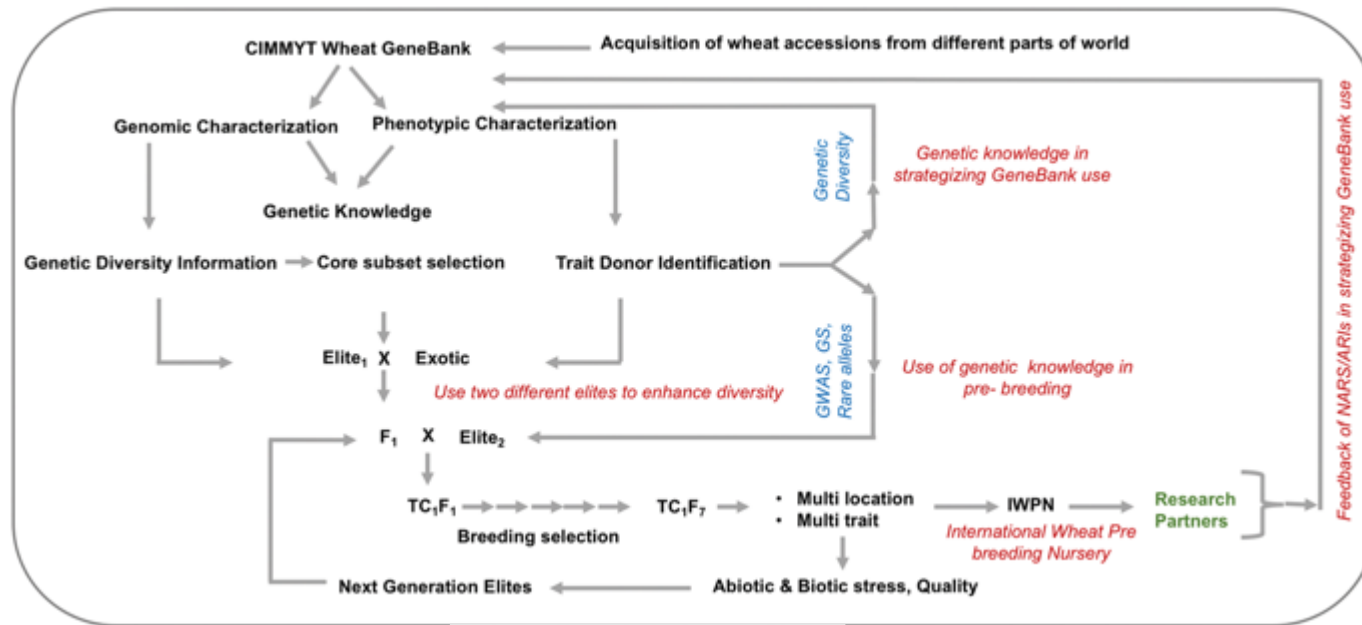
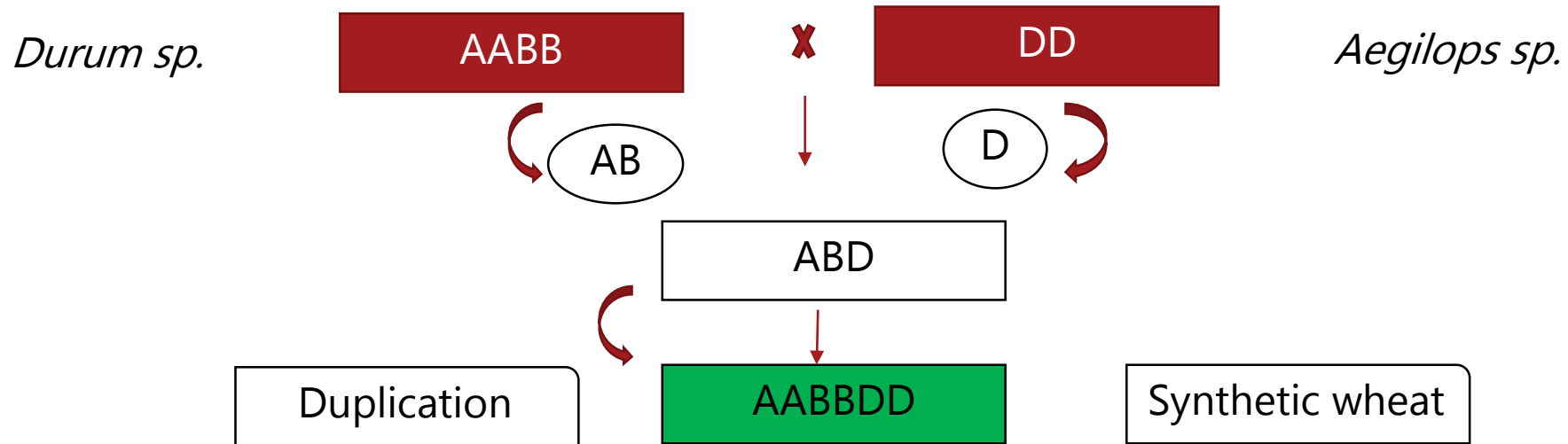
Greenhouses (climate can be auto-controlled) at **KU**

Expected outcome: Which genetic bases are important to confer drought tolerance?

Eco and molecular physiology may confirm the findings

To identify the climate resilient genotypes

Similar strategy can be applied for different crops under different stress conditions

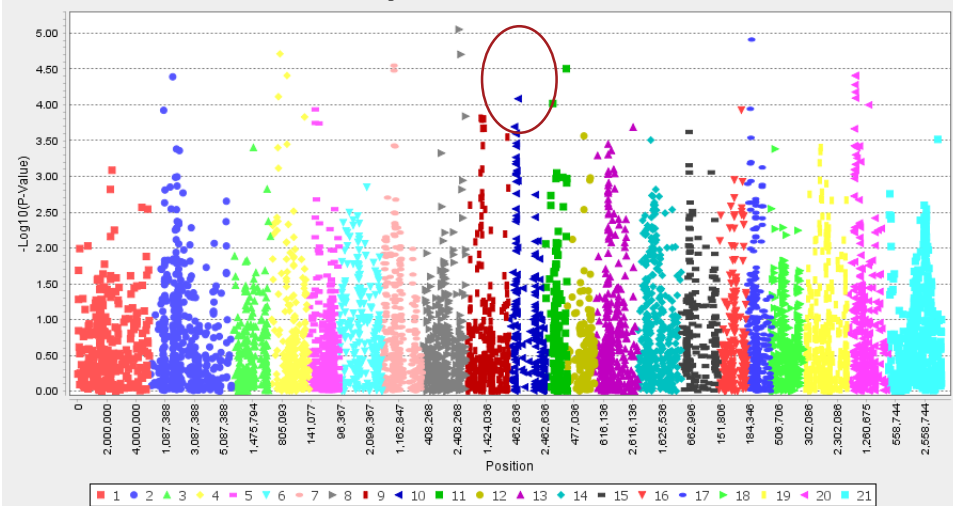


Singh et al 2018

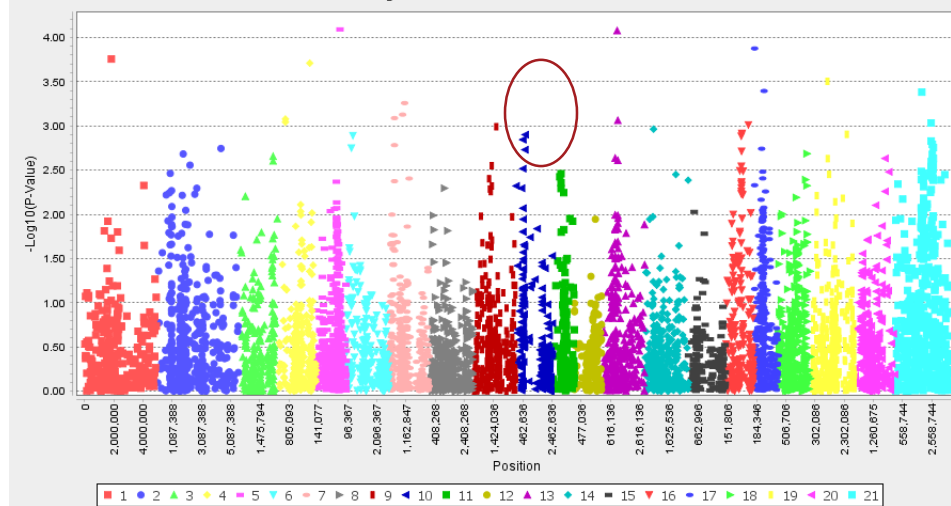
Materials and Methods

- Genotypes : 339 (Derivatives of synthetics and landraces)
- Background: Three-way crosses with top-elites
- Treatments: Well-watered and Drought (irrigation was stopped after anthesis)
- Years: 2016 and 2018
- DNA samples were quantified with a Nano-Drop 8000 spectrophotometer V 2.1.0. DArTseq™ technology (<http://www.diversityarrays.com/dart-application-dartseq>) at CIMMYT headquarters (Texcoco, Mexico) was used for genotypic characterization (Genotyping)
- Days to heading, CTD, NDVI, days to flowering days to maturity, plant height, spike length, number of grains per spike, thousand kernel weight (TKW), kernel abortion and plant yield was recorded (Phenotyping)
- Tassel 5 was used for association studies and R was used to generate haplotypes.

P-Values by Chromosome for BLUP_Yld

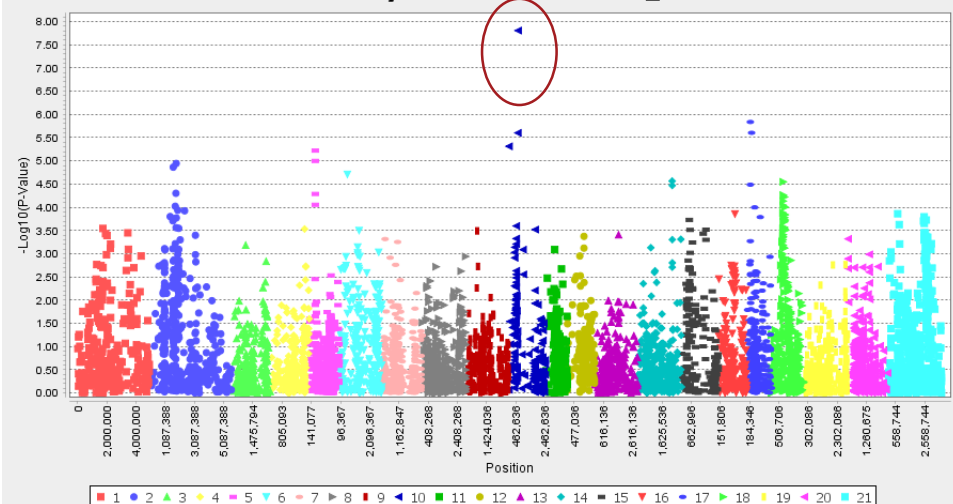


P-Values by Chromosome for Yield_2018



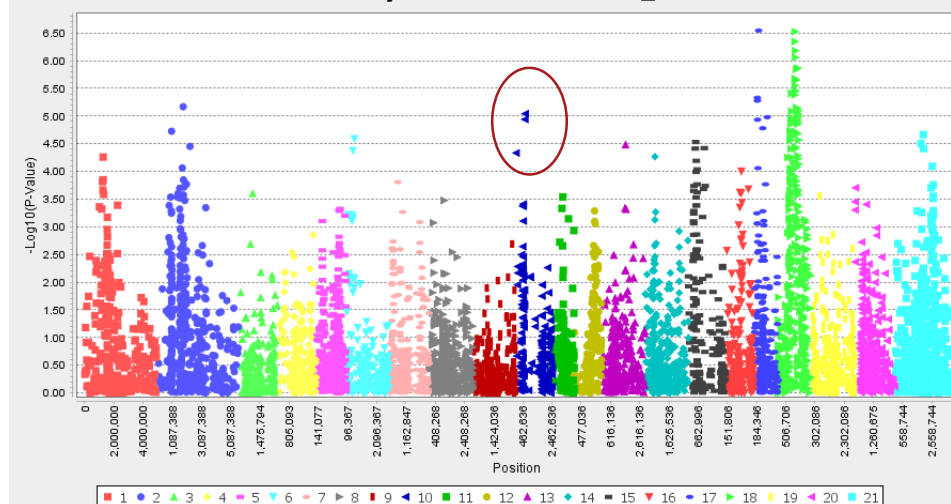
Well-Watered 2016

P-Values by Chromosome for BLUP_Yld



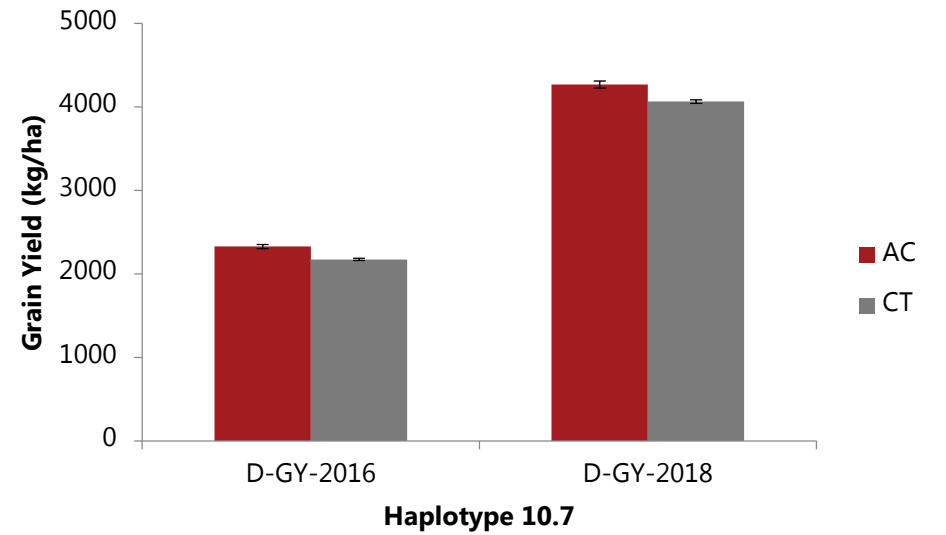
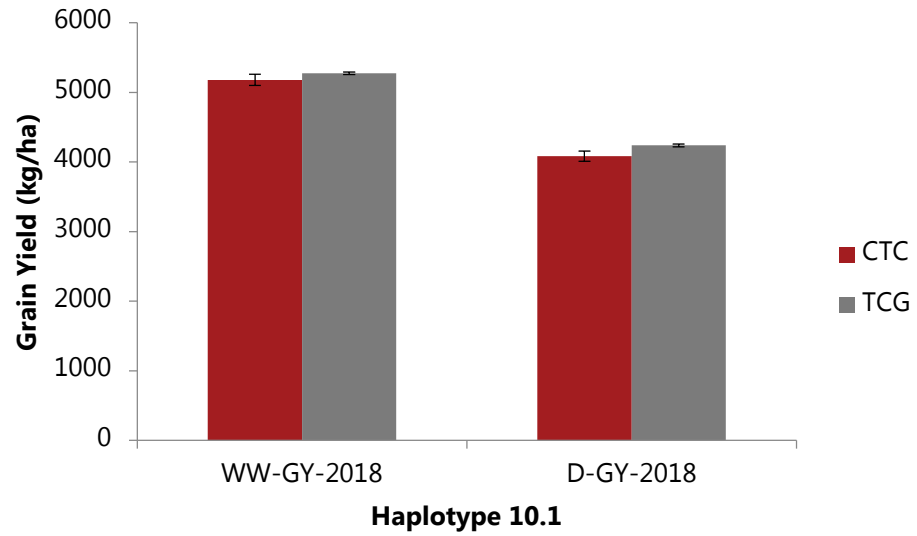
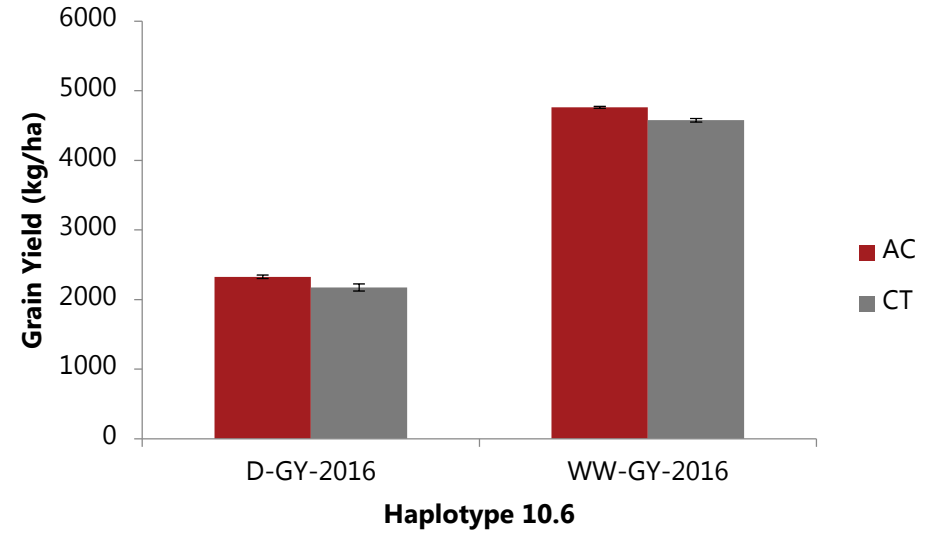
Well-Watered 2018

P-Values by Chromosome for Yield_2018



Drought 2016

Drought 2018



Materials and Methods

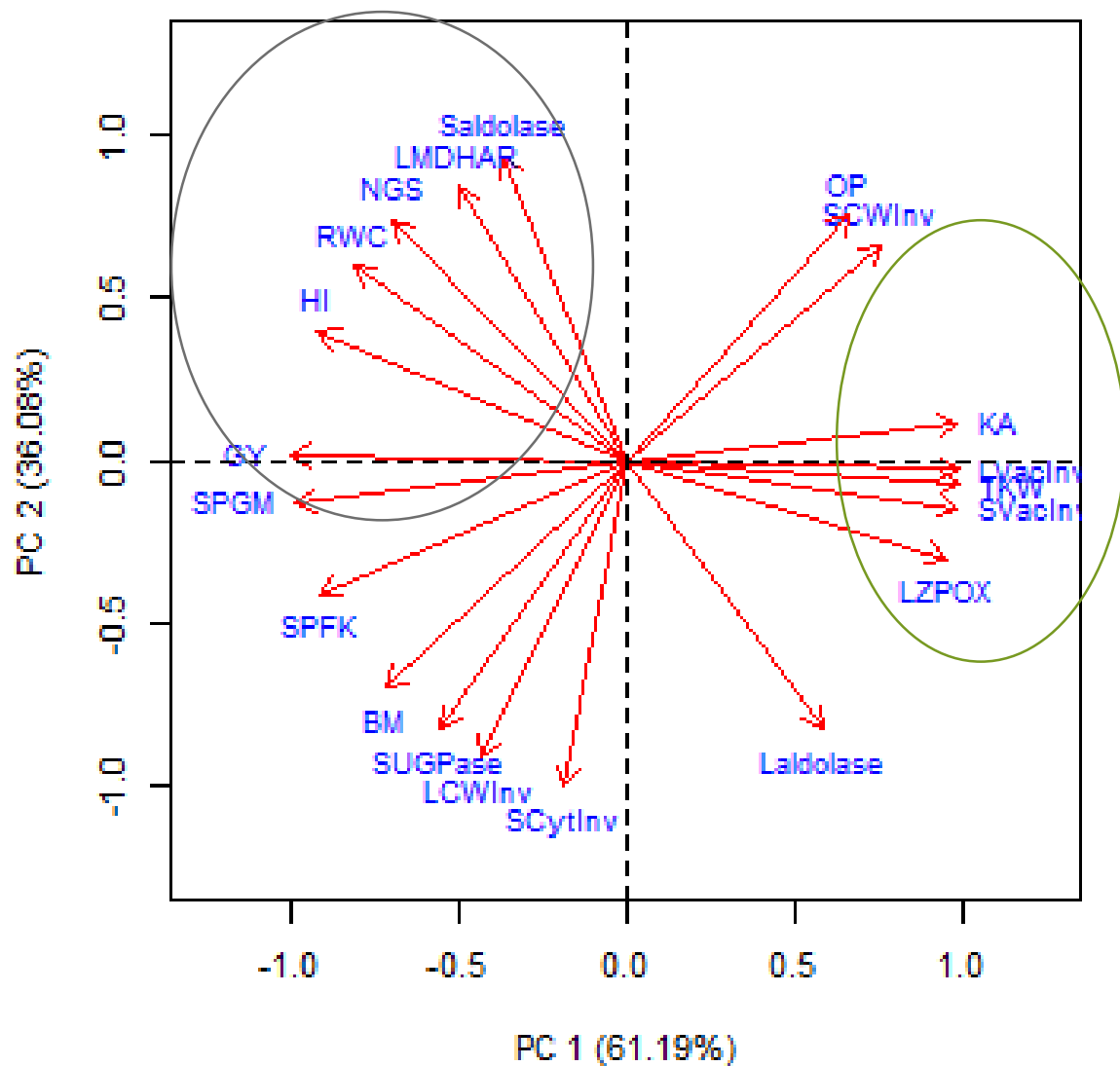
- Genotypes: 06
- CO₂:
 - i) 400ppm
 - ii) 800 ppm
- Irrigation:
 - i) Well-watered (95% water holding capacity)
 - ii) drought (Irrigation was withdrawn during anthesis)

Data:

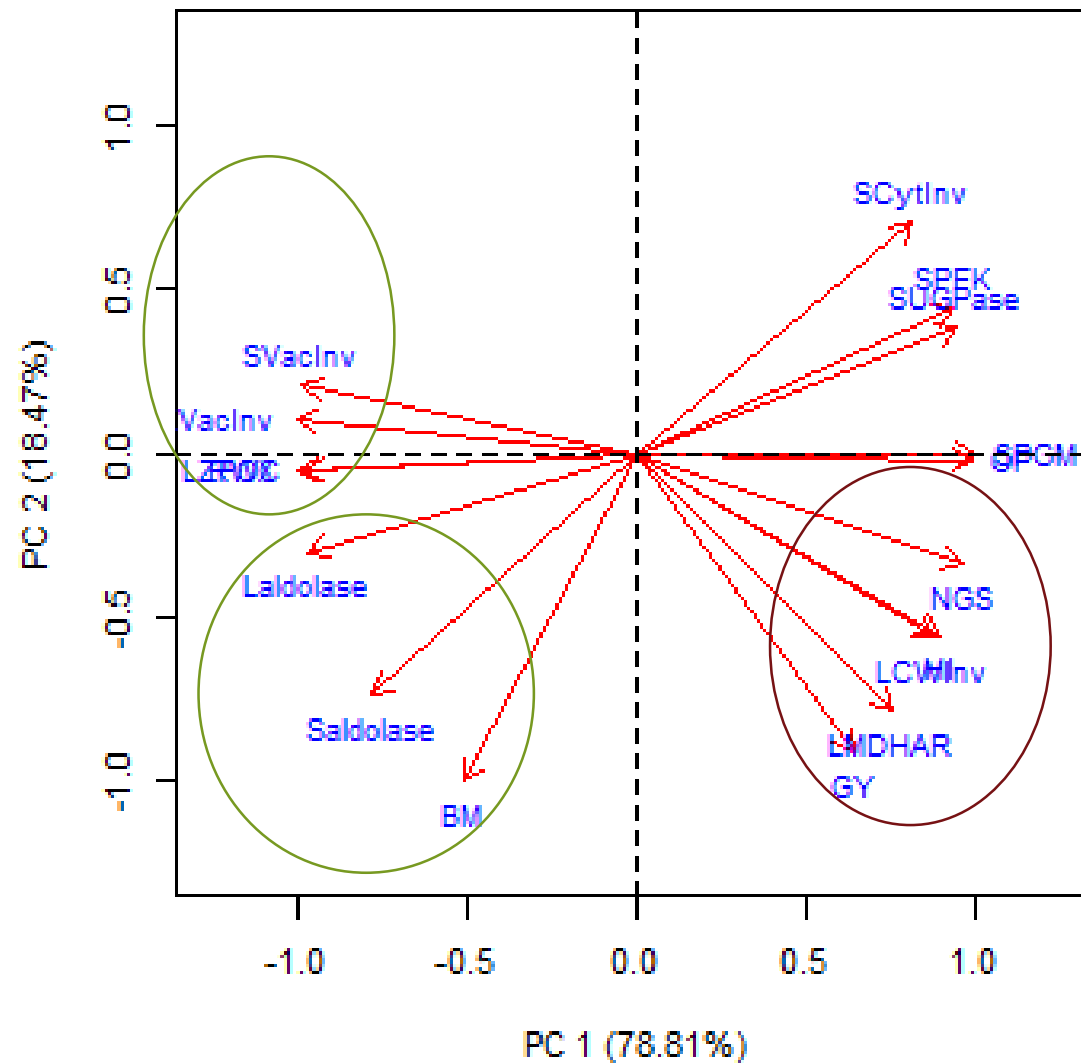
- Irrigation
 - i) Evapotranspiration
 - ii) Fraction of Transpirable Soil Water
- Plant Traits
 - i) Ecophysiology
 - ii) Molecular Physiology
 - iii) Agronomy



Biplot. Location: Drought



Biplot. Location: Well-Watered



Results

- The association of yield and yield related traits with molecular markers was established
- Study of eco and molecular physiological parameters has confirmed the tolerance of these genotypes
- Diverse tolerant germplasm can be grown under different field conditions
- These genotypes will be helpful improve the economy of drought prone areas in the developing world

