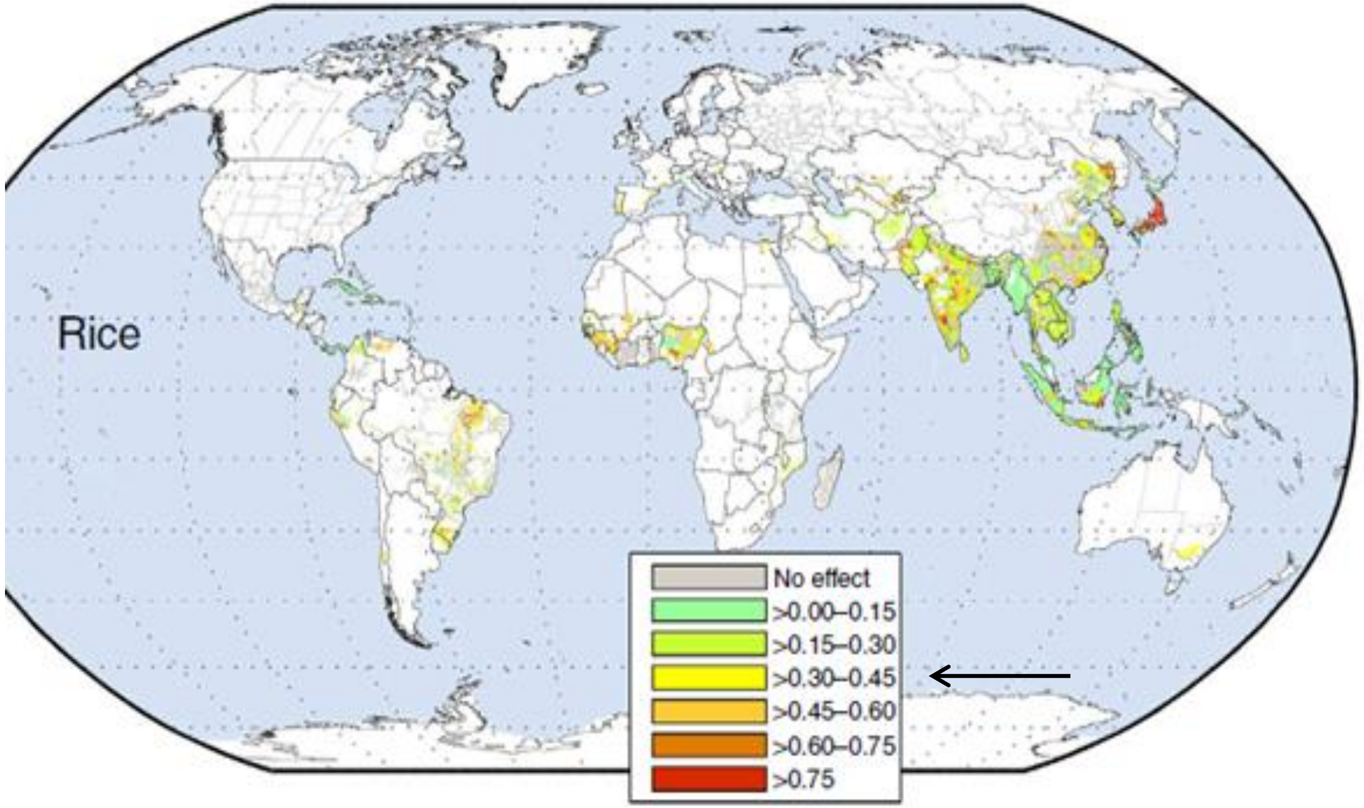
Beating the heat for rice

Integrated pipeline to generate varieties adapted to climate variability at a faster rate

M.C Rebolledo
E. Petro
A.Pena
C.Erazo
D.Jimenez
S.Delerce
E.Torres

Climate variability and rice production

- Climate variability explains ~32% of rice yield variability globally.
- 25% to 38% in Latin America (precipitation and temperature variability).



Ray et al, 2015

Rice production is highly sensitive to climate conditions event under current climate scenarios

We need to provide breeders with the phenomics, genomics and environmental information, as well as target ideotypes, to generate better adapted varieties at a

faster rate.

Our strategy:

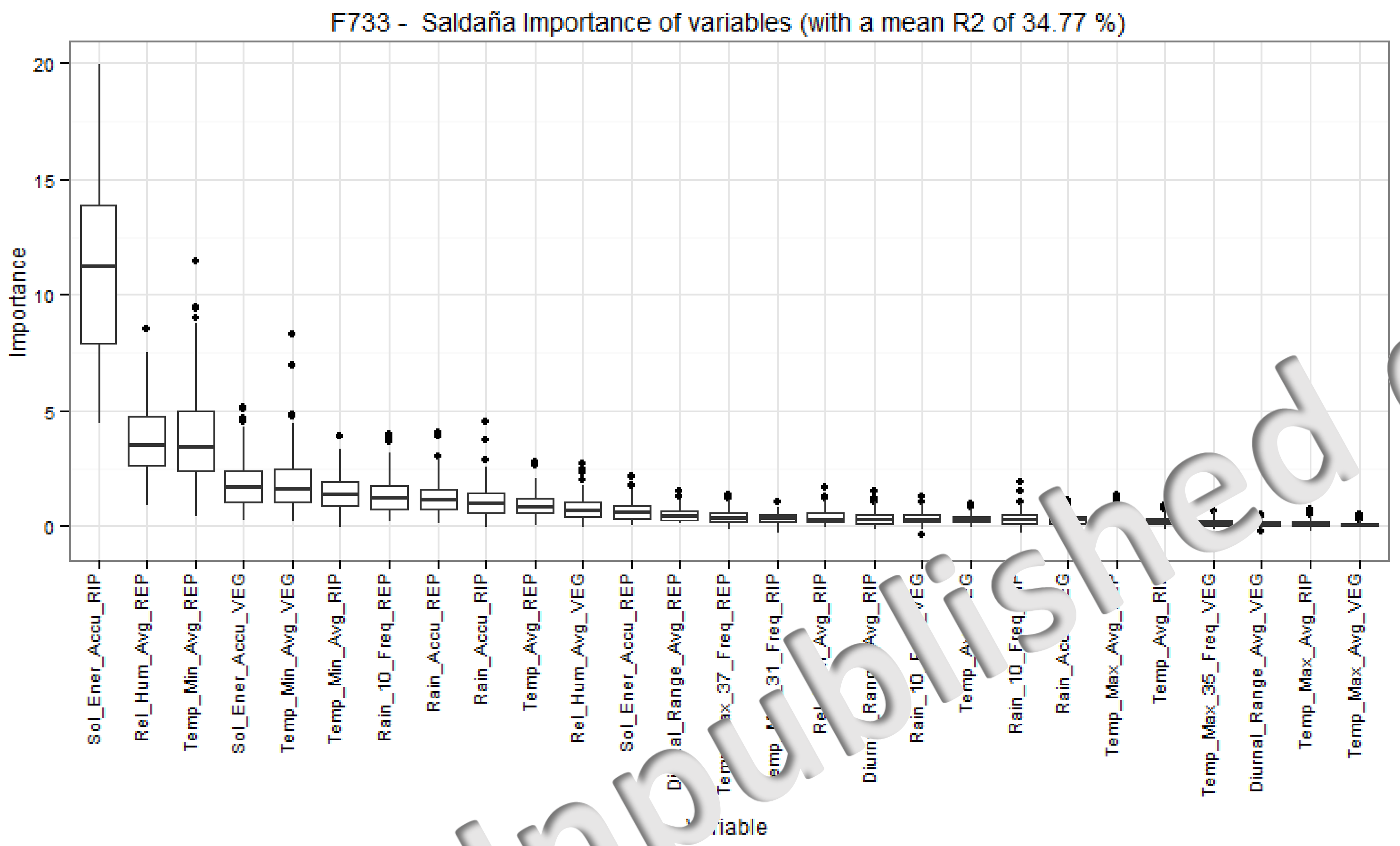
1. Environment characterization “through the eyes of the crop”

2. Trait dissection for specific environments

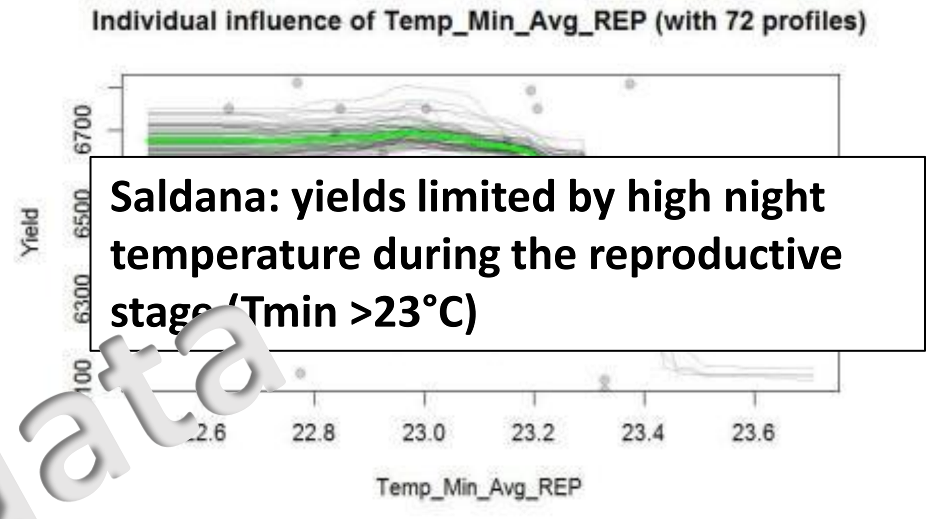
3. Unlocking the gene bank to increase the adaptation for specific environments

1.Environment characterization "through the eyes of the crop":

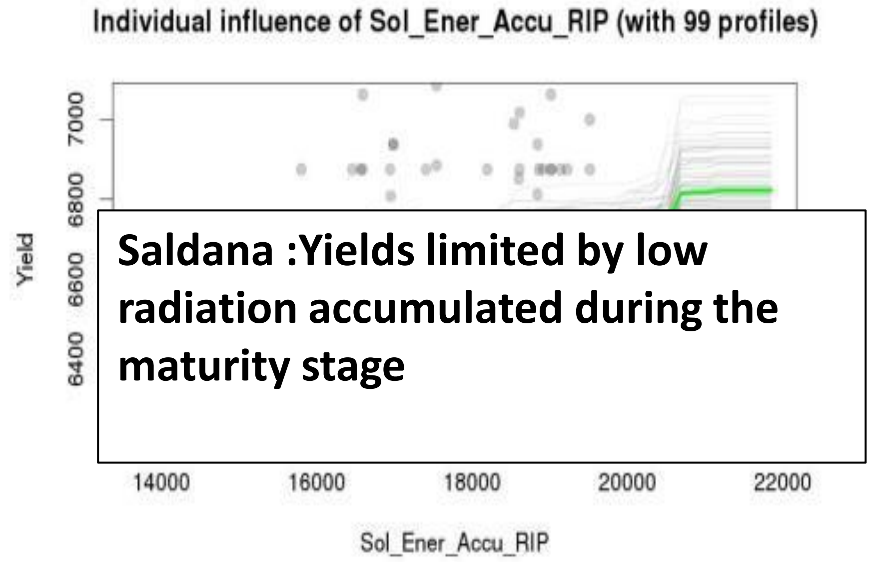
Big data analysis of commercial data



Boxplots of conditional permutation based VI scores using CIF on cultivar F733 subset (Jimenez and Delerce)

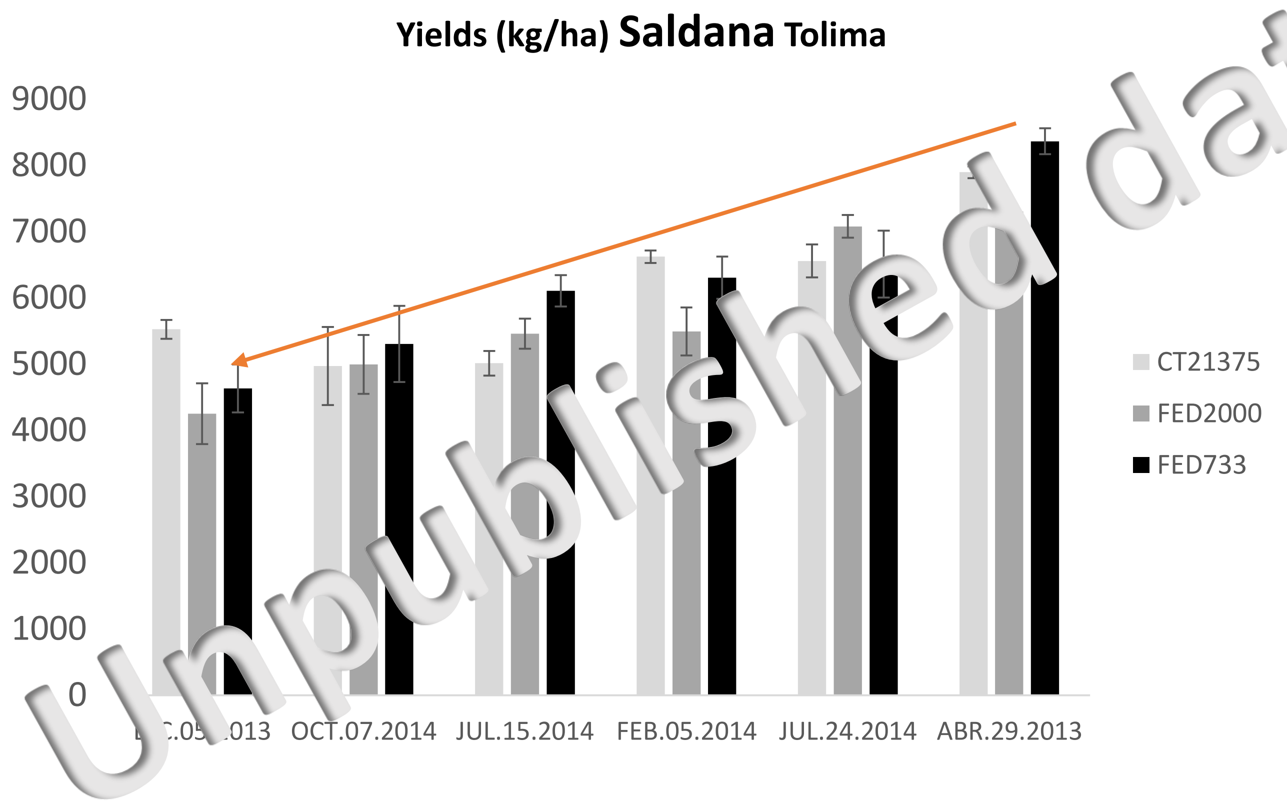


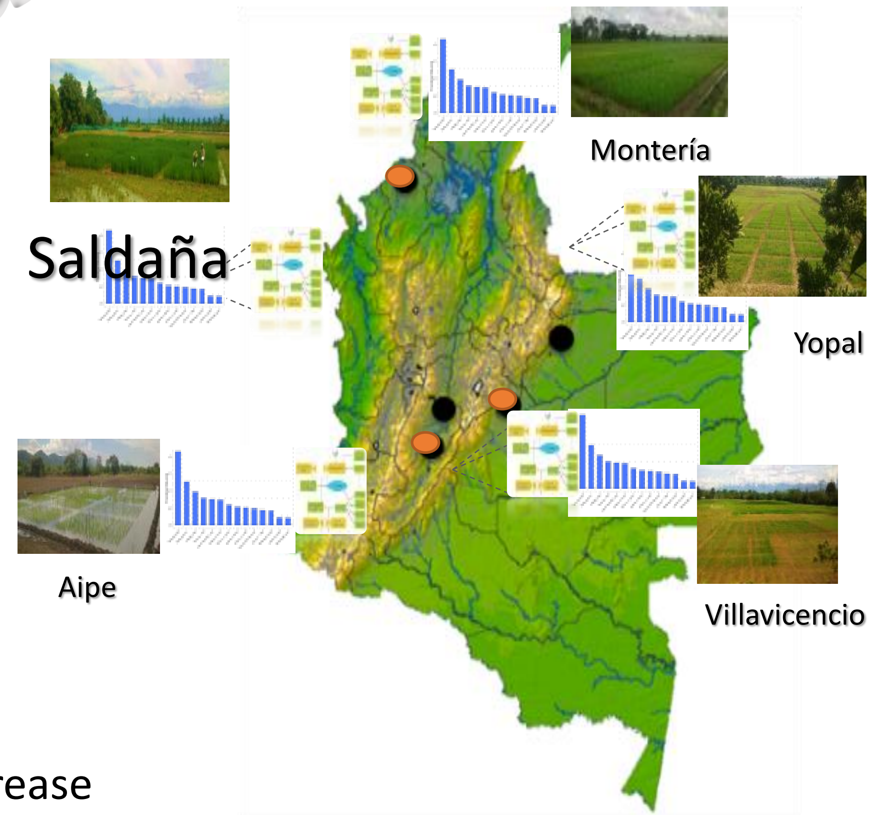
Saldana: yields limited by high night temperature during the reproductive stage (Tmin >23°C)



Saldana :Yields limited by low radiation accumulated during the maturity stage

1.Environment characterization "through the eyes of the crop":
Multi-environmental trials

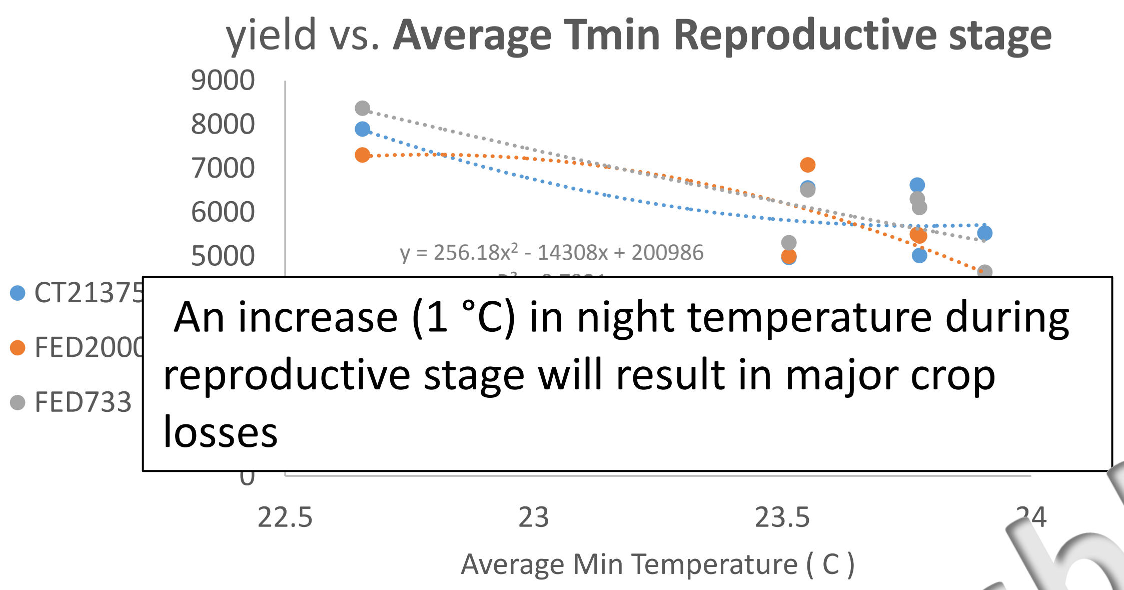




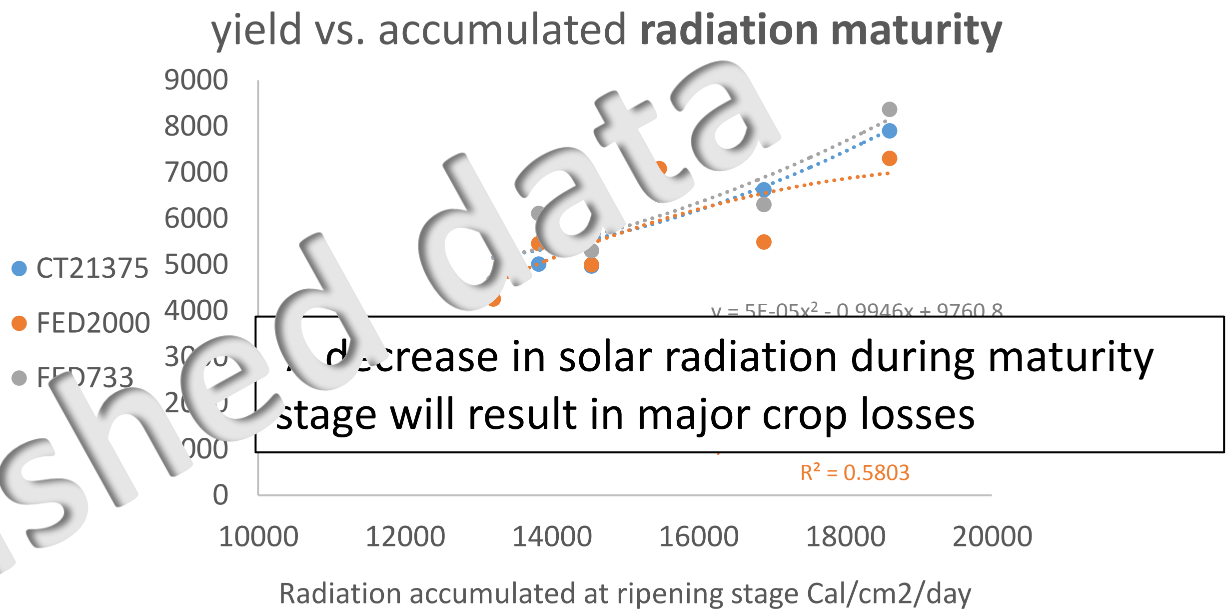
-Same management, same soil, just different sowing dates and a decrease of almost 50% on grain yields

1. Environment characterization "through the eyes of the crop":

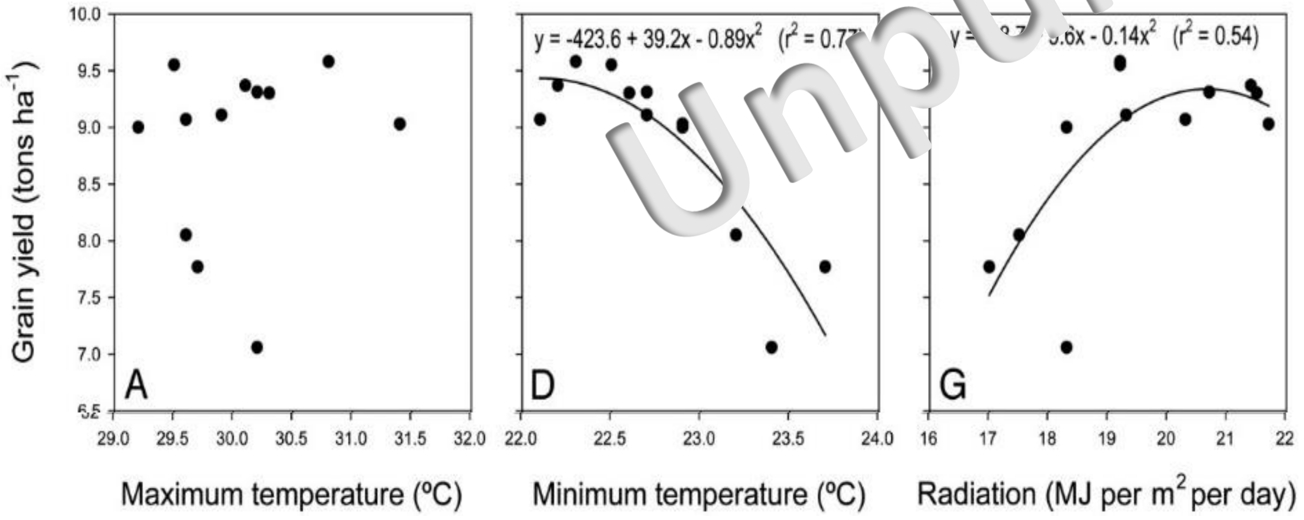
Validation of the main crop limiting factors



An increase (1 °C) in night temperature during reproductive stage will result in major crop losses



A decrease in solar radiation during maturity stage will result in major crop losses

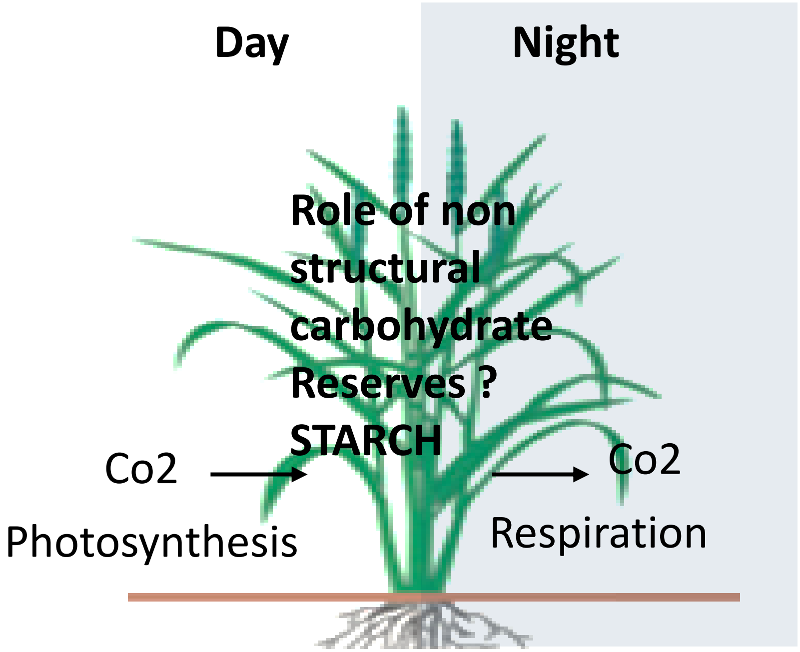


IRRI Data 1979-2003

Peng S et al. PNAS 2004;101:9971-9975

High night temperatures AND low radiation occur together in the field causing grain yield losses even under current climates

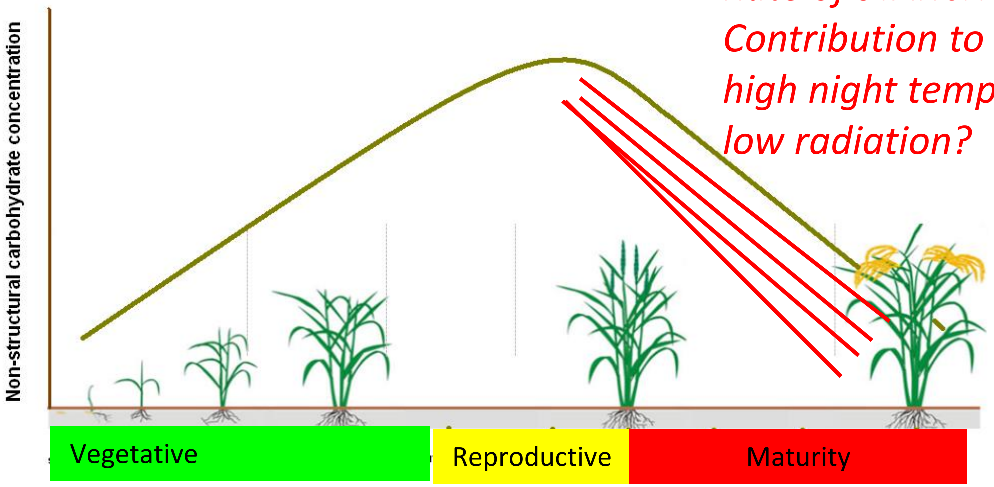
2.Trait dissection to increase the adaptation of rice varieties to specific climatic conditions



-Low radiation will decrease the photosynthetic rate

-High night temperatures will increase respiration rates

Rate of STARCH decrease? Contribution to yield under high night temperature and low radiation?



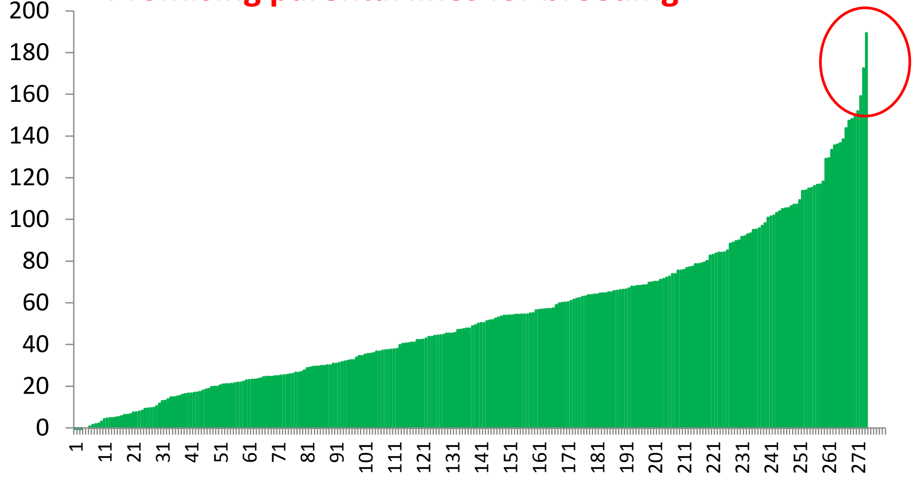
Co2 Assimilation ↓

Co2 Loss ↑

Negative balance for CO2 in the plant

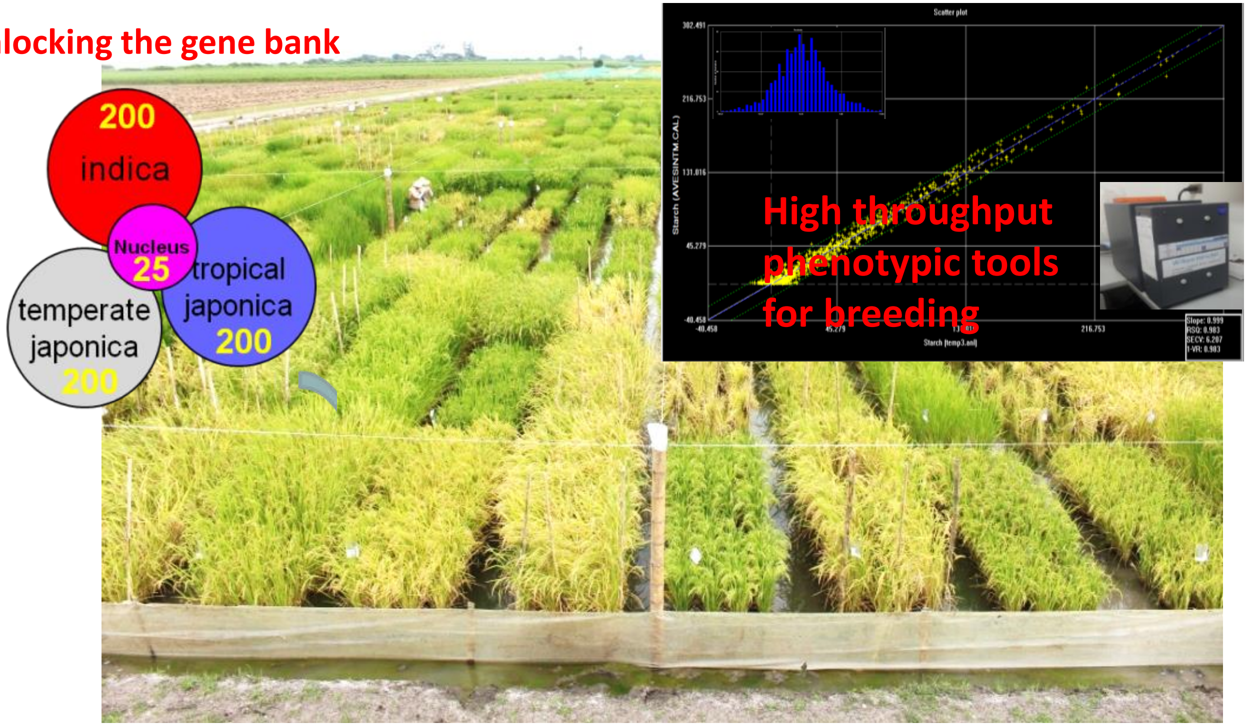
3.Unlocking the gene bank to increase the adaptation of rice varieties to specific climatic conditions

Promising parental lines for breeding

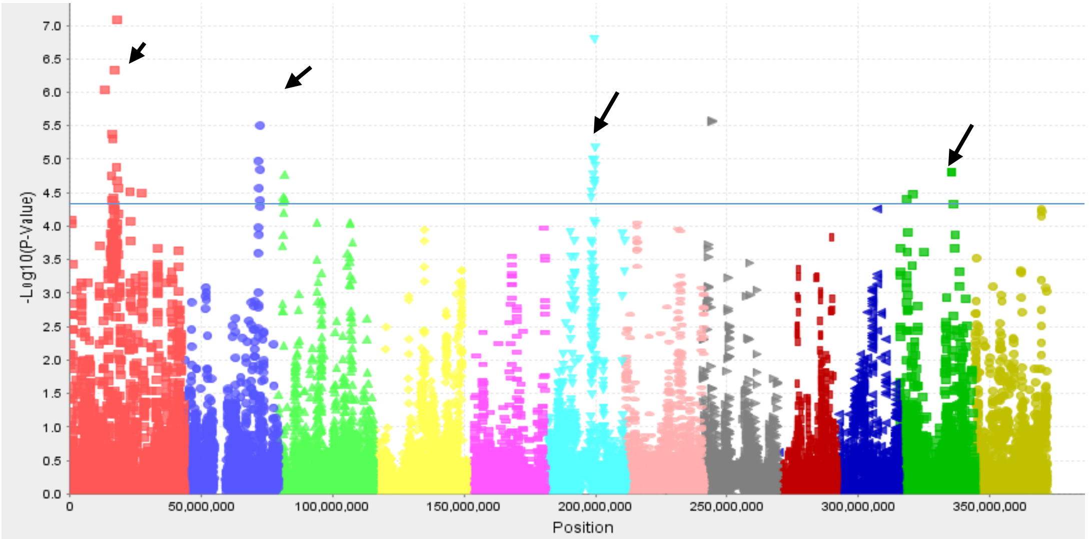


starch contribution to grains (mg/gDM)

Unlocking the gene bank



New genes conferring tolerance to low light and high night temperatures for breeding



Traits, genes and promising parental lines that will confer higher yield under high night temperatures and low light in Saldana Tolima

1.Environment characterization

DATA

2.Trait Dissection

DATA

3.Unlocking the gene bank

DATA

Site characterization "through the eyes of the crop"
- Climate
- Soils
- cropping system
- management
- End use of the crop

Change breeding focus

Traits of interest/ promising parental lines
- Trait dissection
- Genetic resources

Provide breeding tools

Genes
- Genotyping and phenotyping tools
- Local genetic background

Research Program on Rice

CGIAR Global Rice Science Partnership

Clima y Sector Agropecuario Colombiano

Adaptación para la Sostenibilidad Productiva

PROSPERIDAD PARA TODOS CIAT

COLCIENCIAS PROSPERIDAD PARA TODOS

New plant types for climate variability

Breeding

Empirical and Mechanistic modelling + Future spatial and temporal climate (CCAFS)

Breeding

Varieties adapted to climate change

GRISP II ?