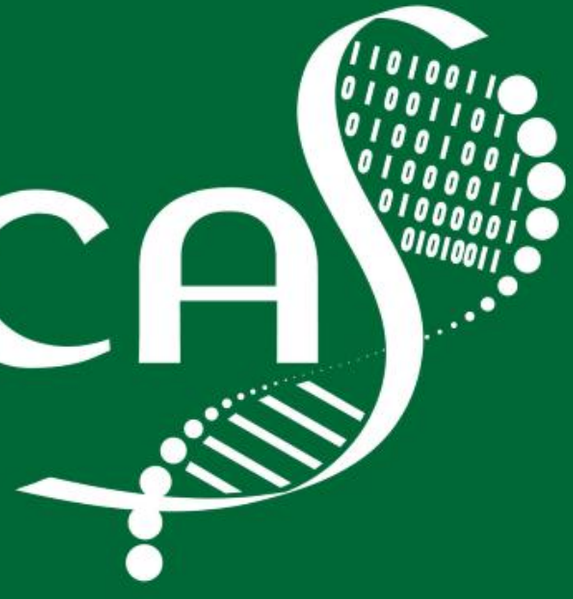
ÓMICAS



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Gobierno de Colombia

COLOMBIA CIENTÍFICA

Técnologías y Métodos para la Fenotipificación de Cultivos Agrícolas

Fenotipificación en cultivos de arroz

Maria Camila Rebolledo
PhD Crop Ecophysiology;
Scientist at CIAT and CIRAD.

Modelado y Control de Drones autónomos para monitoreo agrícola

Julian Colorado
PhD in Robotics – UAV Control
Profesor Javeriana Bogotá

Herramientas HW/SW para fenotipificación

Iván Mondragón
PhD in Robotics – UAV Vision
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Fusión sensorial de imágenes aéreas para fenotipado

Hernan Benitez
PhD Proc. Señales
Profesor Javeriana Cali

David Jiménez
Estudiante PhD
OMICAS Javeriana Cali

Fenomica y mejoramiento de cultivos

Maria Camila Rebolledo
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WHY?

Increase breeding efficiency (Time, cost, accuracy)

Genetic gain is influenced by six factors:

- genetic diversity that can be accessed
- precision with which a trait can be measured
- selection intensity applied
- Relevance of the trait for in the target environment/ the user
- time and costs

HTP phenotyping during the breeding process

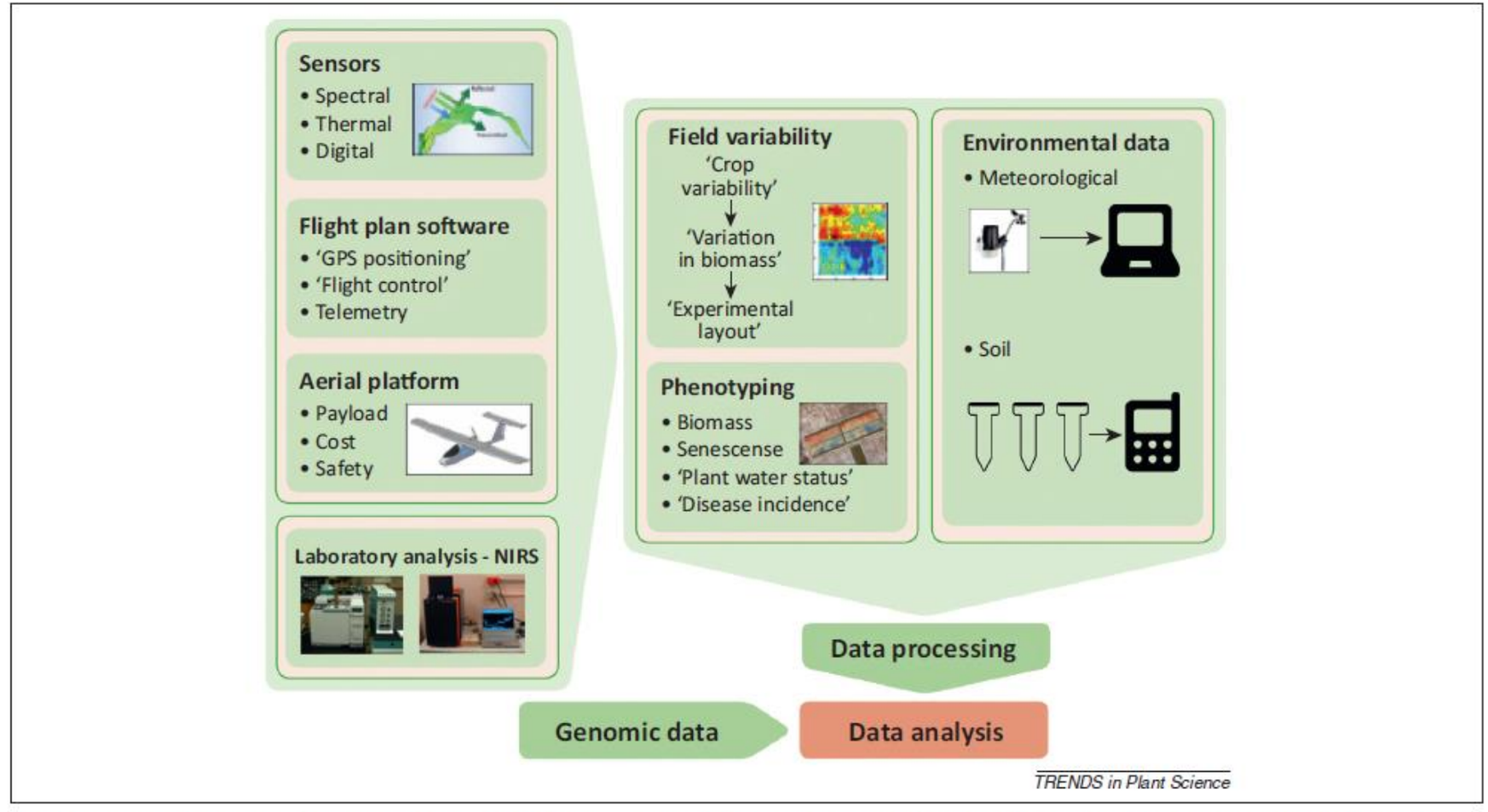


Figure 3. Summary of the different components of the breeding process where high-throughput phenotyping is involved. These include evaluation of key traits at the right moment, assessment of spatial variability, environmental characterization, and further integration of all the information.

Araus, Cairns (2014)

What breeders do with HTP data?

Association phenotype– genotype.

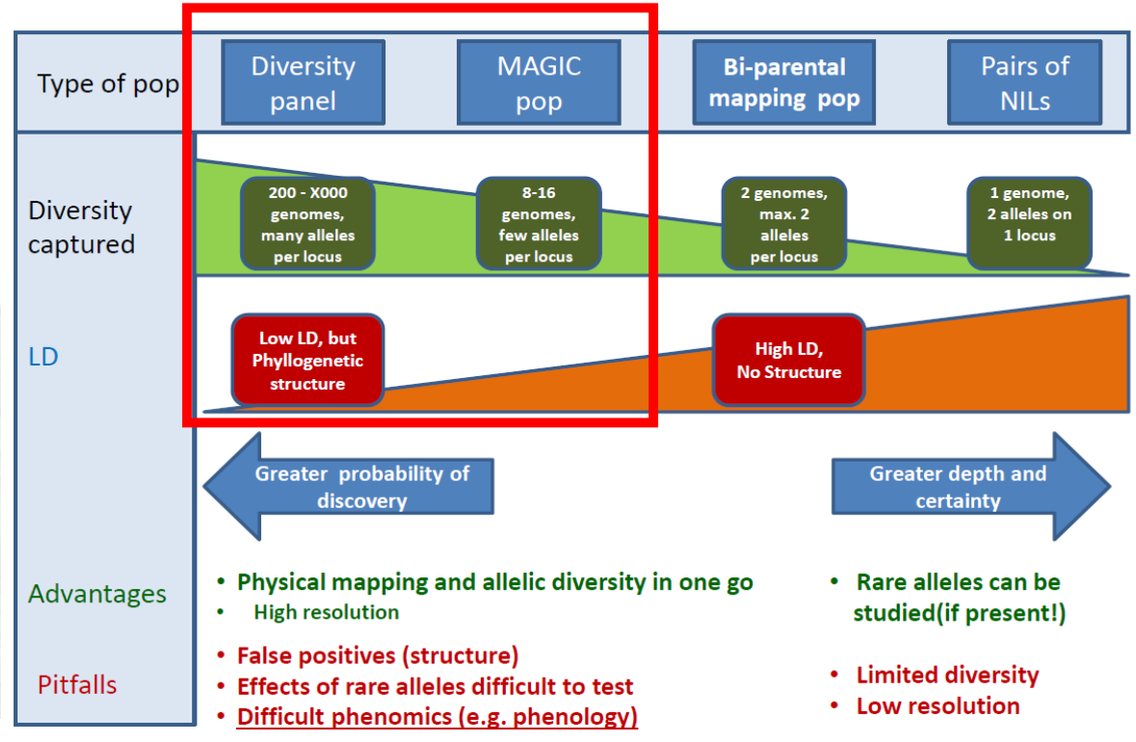
Objective: Identify markers (SNPs) and genomic regions that can be associated with a quantitative trait.

Perspectives:

Marker assisted selection (MAS) and development of NILs to accelerate breeding.

What kind of panel?

DIVERSITY PANEL



BREEDING PANEL

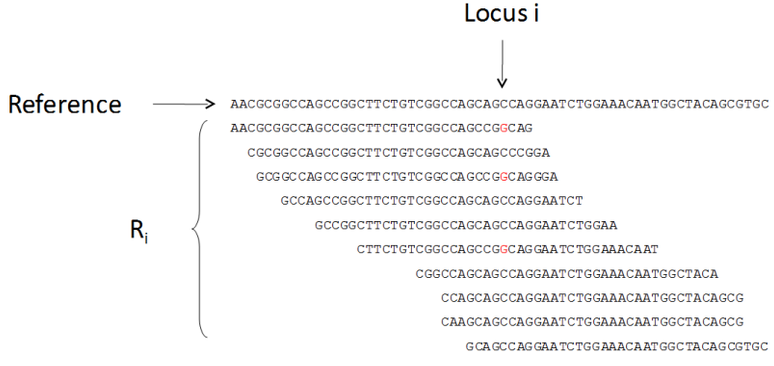
GWAS

Population panel

Genotyping

Phenotyping

- Extraction and sequencing of DNA.
- Thousand of SNPs to provide high genome coverage.



- <u>Complex traits:</u>
  More than 40 only at CIAT.

- <u>Experimental Design:</u>
  2 years
  3 repetition (RCBD)
  900 plots
  300 varieties

Association using TASSEL

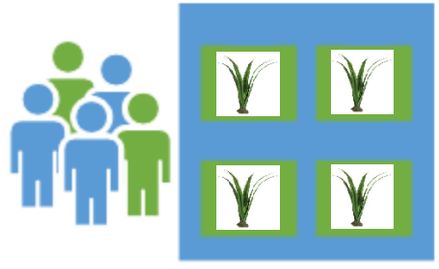
Genotypic input

GWAS Model:
GLM,MLM1(2)

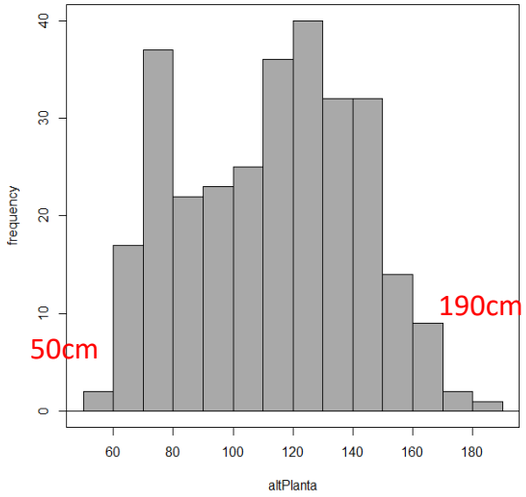
Stats

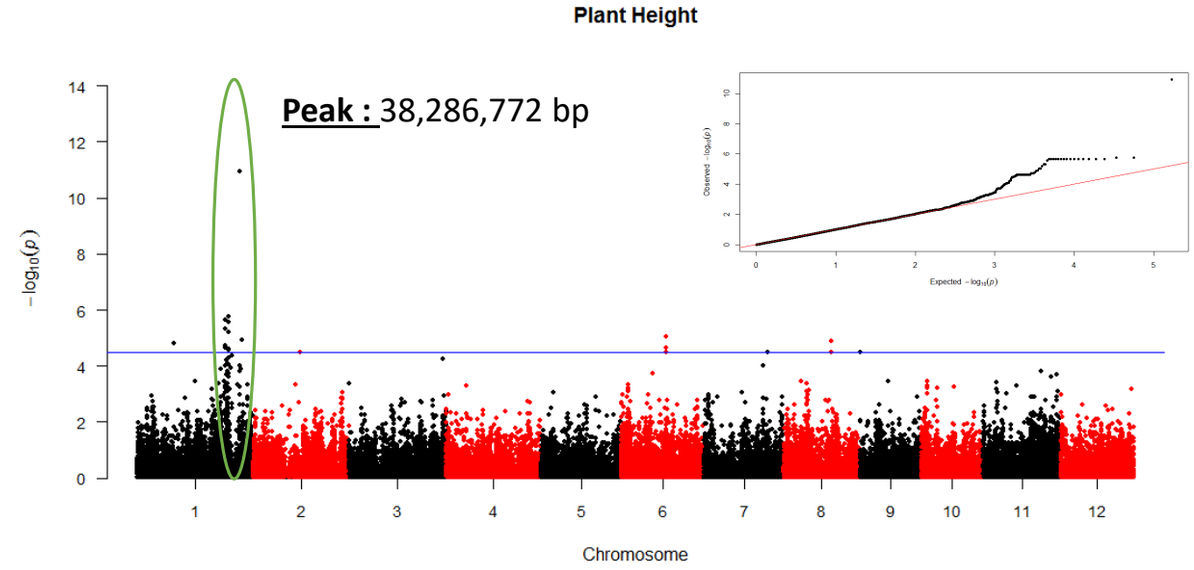
Effects

Phenotypic input

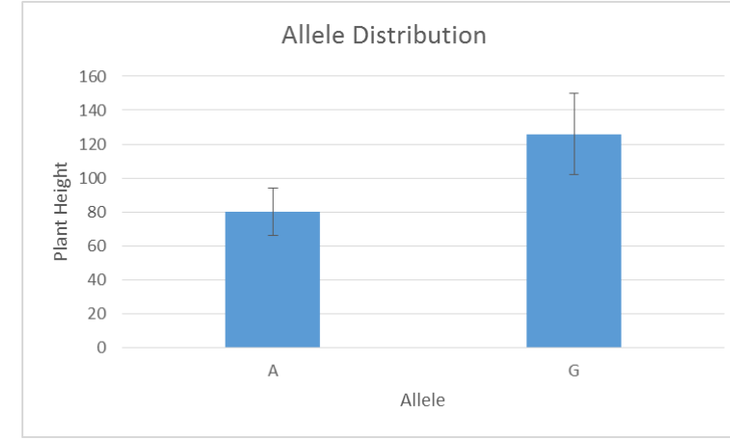


GWAS validation for Plant Height
Semi-dwarf1 (SD1)



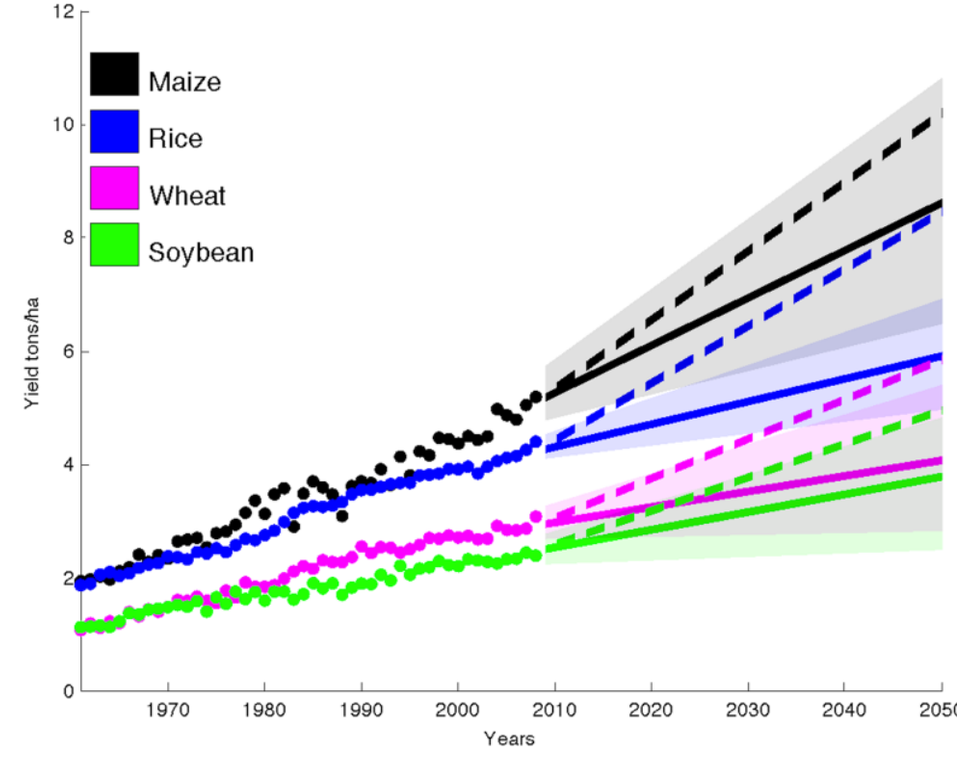


Gene SD1 : 38,382,382bp - 38,385,504bp



Rice in LAC : Ecophysiology and linkage with breeding

Diversity of environments
-Irrigated areas:
Temperate and tropical
-Rainfed areas:
Favorable, s avannas and traditional upland



Ray DK, Mueller ND, West PC, Foley JA (2013) Yield Trends Are Insufficient to Double Global Crop Production by 2050. PLoS ONE 8(6): e66428. doi:10.1371/journal.pone.0066428

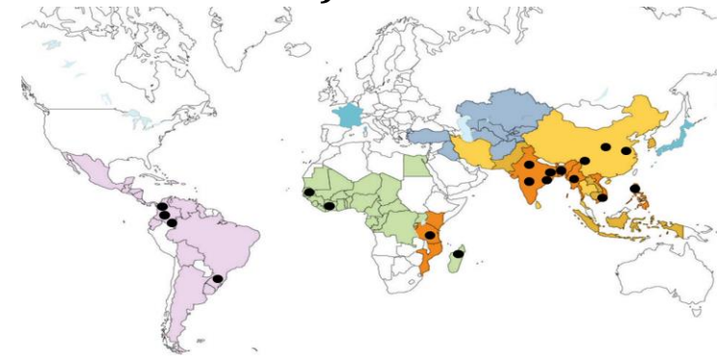
Rice Ecophysiology and linkage with breeding

RESEARCH PROGRAM ON Rice

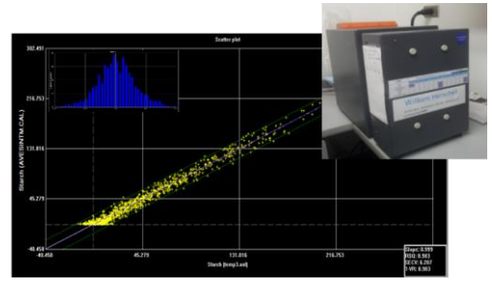
CGIAR

Development / Adaptation of HTP phenotypic tools and QTL-Gene discovery

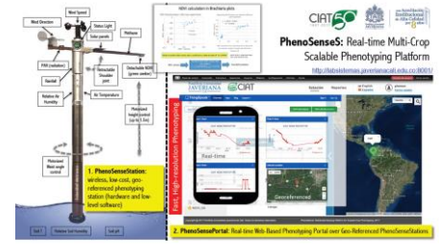
Rice Global Array (IRRI-AfricaRice-CIRAD-CIAT-IRD)



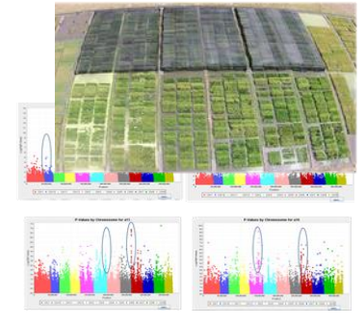
Aerial Biomass (Colciencias-Colombia – Universidad Javeriana Bogotá)



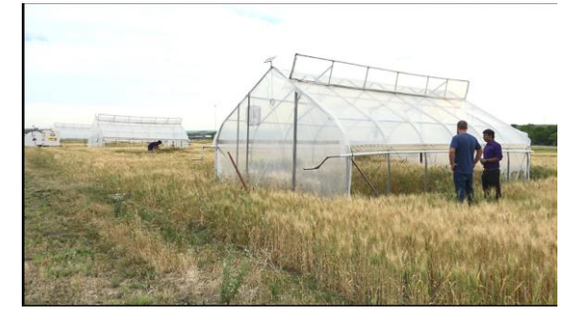
Non structural Carbohydrates : Increase Carbon translocation to grains (CIAT)



Environmental sensing (CIAT-Universidad Javeriana Cali)



Low radiation tolerance (Colombia Cientifica-OMICAS)



High Night temperature tolerance (Colombia Cientifica OMICAS)

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Current approach at AgBio for breeding

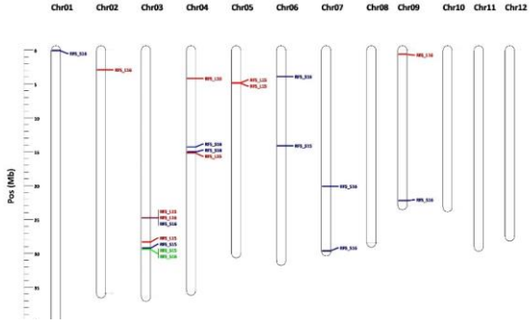
Issues	Environment sensing	Aerial crop sensing	Belowground crop sensing	Controlled conditions crop sensing
Tools	• Small and portable meteorological stations • GASMET for GHG	• UAVs • Plant sensing (multispeq) • Small cameras with automatic capture	• GPR • Soil sampling	• Growth chambers with controlled env.conditions, hydroponics • Image analysis "medium-throughput“ • Chemical analysis using NIRS
What are we sensing?	• Actual climatic-soil conditions	• Biomass, grain yield , NUE and WUE • Photosynthetic efficiency	• Root biomass	• Root morphology, grain filling, carbohydrates (starch sucrose) remobilisation, grain /forage quality, plant architecture • Aluminium and Phosphorus tolerance, Tolerance to high temperature, Drought Tolerance, Tolerance to low light. • Biotic stress tolerance (bacteria/virus)
	• Greenhouse gas emisions (soil+plants+animals)		• Soil carbon stocks	

Trait identification in diversity panels (300 lines, 4 environements)

$$Source:Sink = \frac{Last\ ligulated\ leaf\ area\ (source)}{Panicle\ weight\ (sink)}$$

Plants with lower source:sink ratio showed higher tolerance to low radiation during grain filling

Genotype : phenotype association study (GWAS) for Source:sink

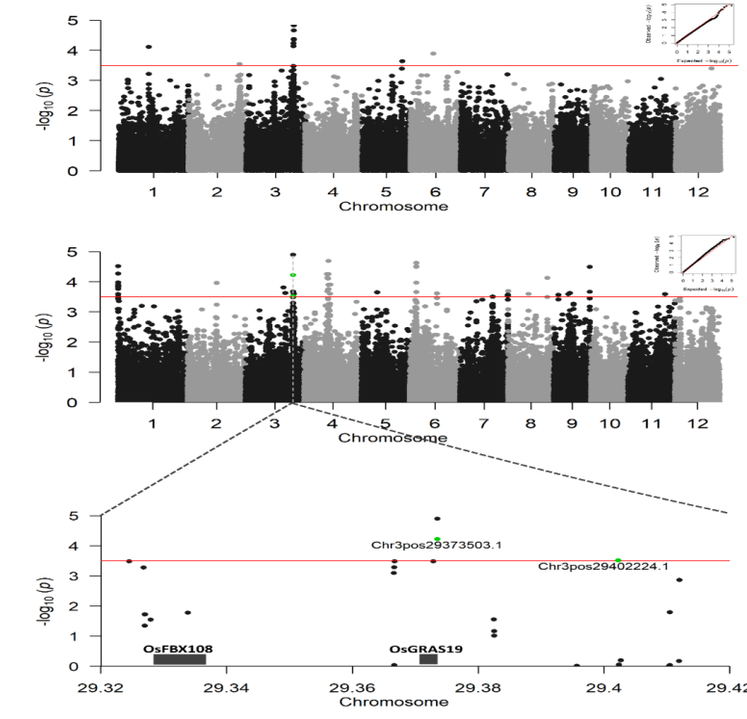


21 QTLS identified

MC.Rebolledo et al, P6-Omicas

OsGRAS19: candidate gene for light use efficiency

- Within a Source:Sink QTL we found OsGRAS19
- GRAS genes are transcription factors unique in plants, playing an important role in plant growth; development; and phytocrome A regulation.
- Its role for low radiation tolerance will be validated in rice or in A.Thaliana (AtGRAS-19)



Agradecimientos

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

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Pontificia Universidad JAVERIANA Cali
IES ANCLA

CGIAR RESEARCH PROGRAM ON Rice

Pontificia Universidad JAVERIANA Bogotá

FEDEARROZ

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GHENT UNIVERSITY

東京大学
THE UNIVERSITY OF TOKYO

ILLINOIS

Pontificia Universidad JAVERIANA Cali
IES Ancla

UNIVERSIDAD DEL QUINDÍO

Universidad de Ibagué

UNILLANOS
UNIVERSIDAD DE LOS LLANOS

Universidad de los Andes
Colombia

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Apoyan

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