CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS (CRAG), Barcelona- Spain

EXCELENCIA SEVERO OCHOA

www.cragenomica.es

CRAG CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

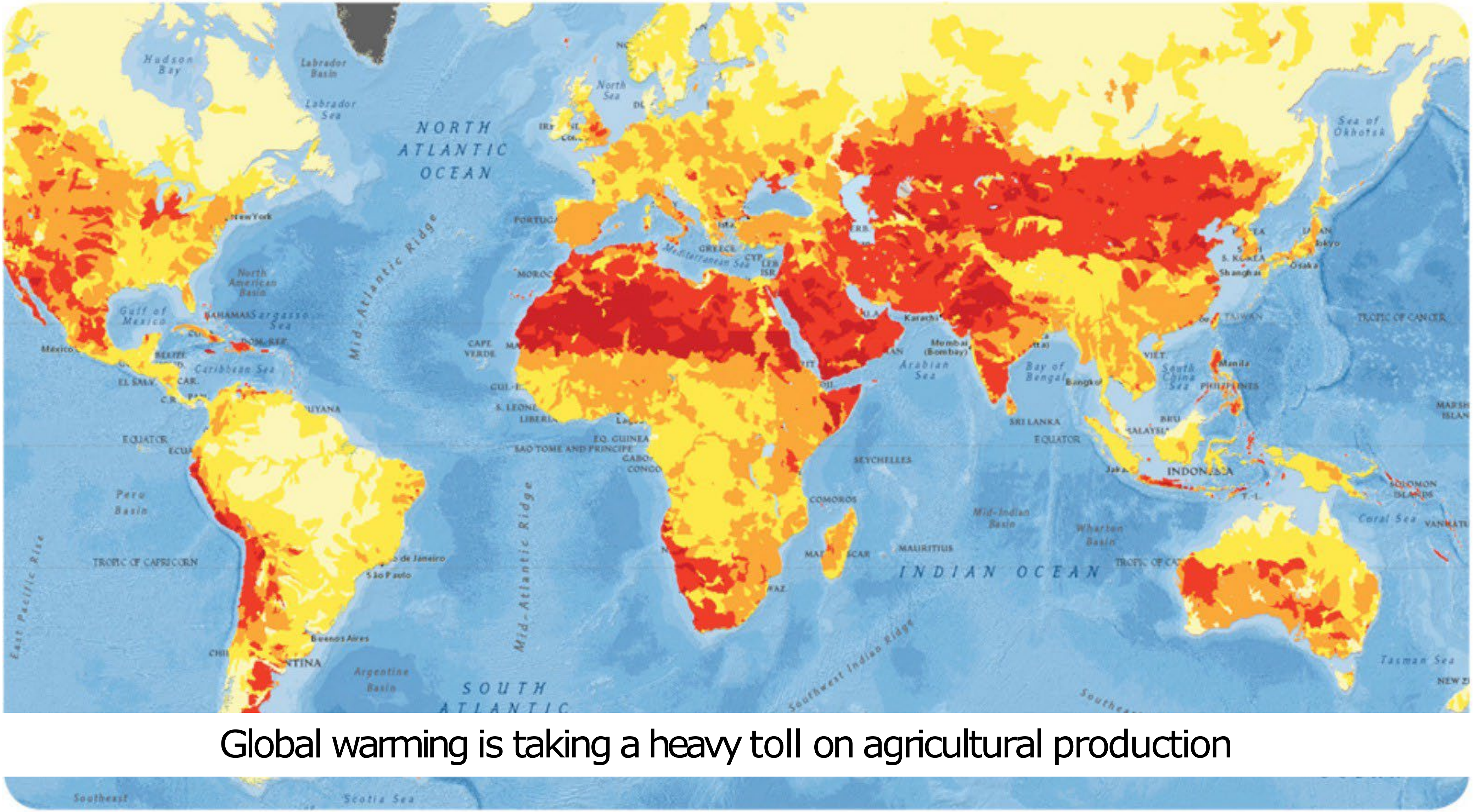
Plant Health Summit. IQS, 3 de Julio 2024

EL ROL DE LA I+D EN LA AGRICULTURA SOSTENIBLE

Ana I. Caño-Delgado
Centre for Research in Agricultural Genomics (CRAG)
Barcelona -Spain-

CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

RISK OF EXTREME DROUGHT

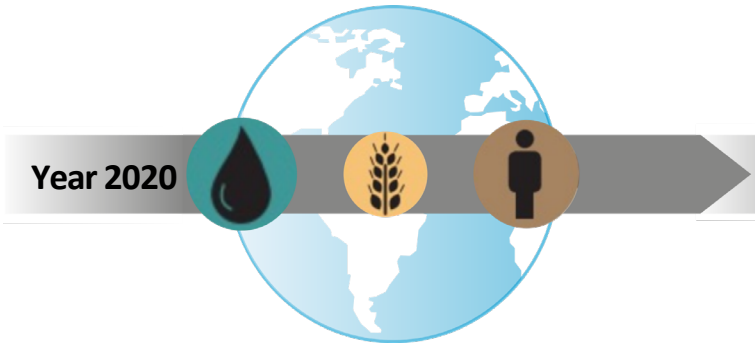


Global warming is taking a heavy toll on agricultural production

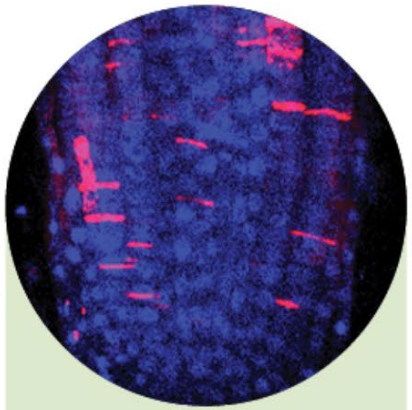
Average Annual Global Cost = **35.000.000.000 €**

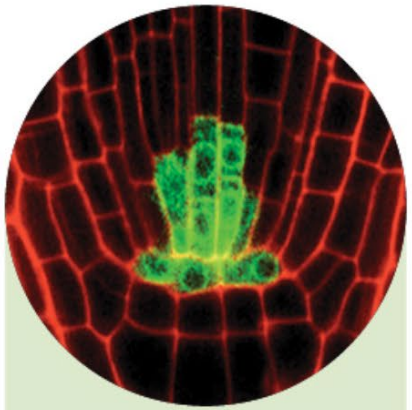
FAO. The impact of disasters and crises on agriculture and food security: 2021.

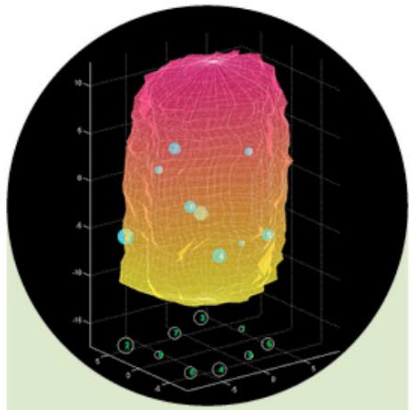
NO efficient technologies available to cope with the growing episodes of droughts in the fields



Gupta,Rico and Caño-Delgado. *Science* (2020)





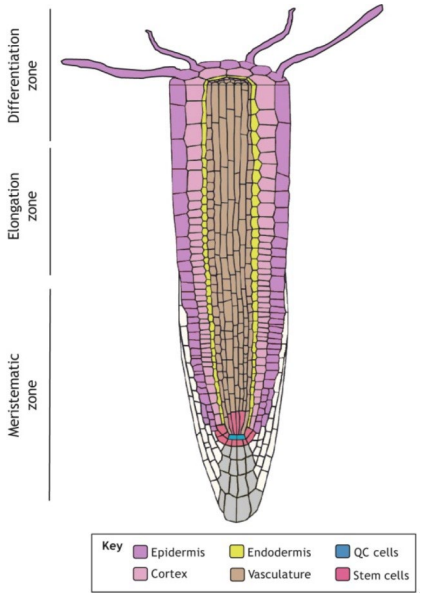


20 YEARS OF RESEARCH IN PLANT BIOLOGY

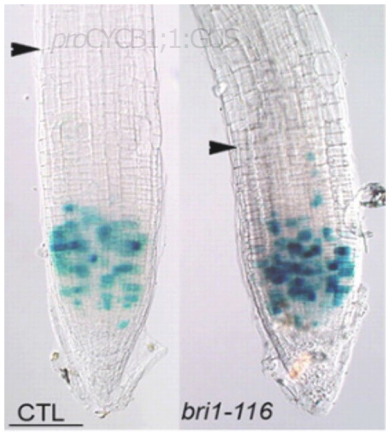
crag
CENTRE FOR RESEARCH
IN AGRICULTURAL GENOMICS

Brassinosteroid are natural biostimulants for inducing root growth and adaptation to climate

Arabidopsis as a model

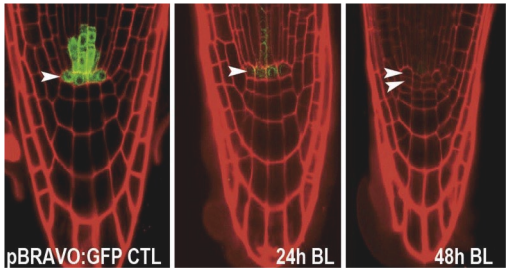


Cell cycle progression



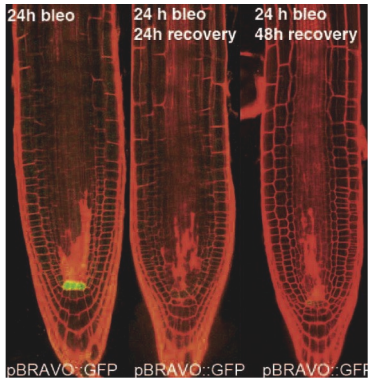
González-García et al., 2011
Pavelescu et al., 2017
Mecchia et al-., 2021

QC division and stem cell differentiation



Vilarrasa-Blasi et al., 2014
Betegón, et al., 2019
Planas-Riverola et al., 2019
Mercadal et al., 2022

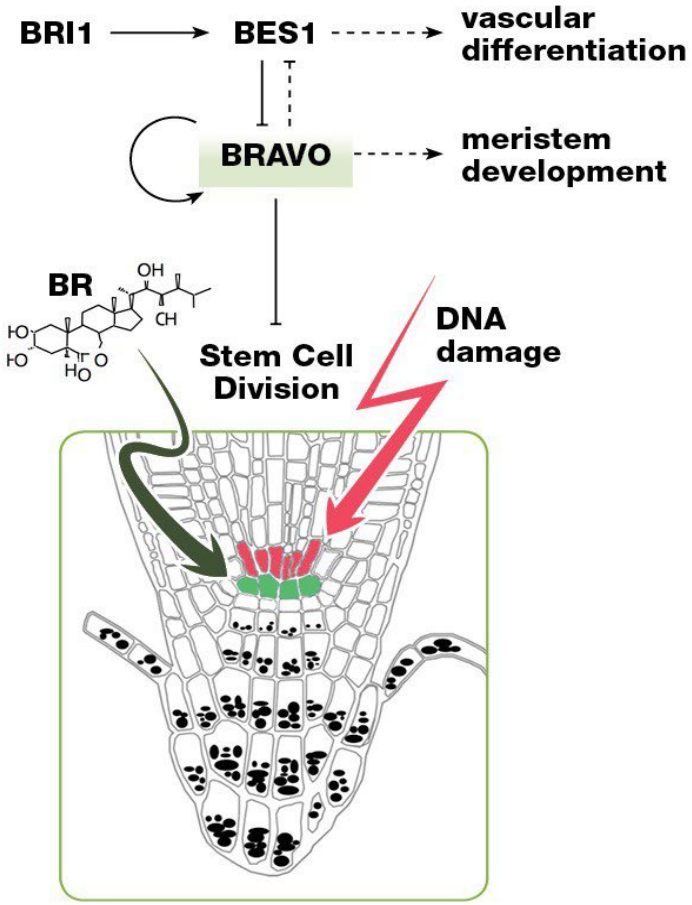
Response to DNA-damage



Vilarrasa-Blasi et al., 2014
Lozano-Elena et al., 2019
Betegón, Mercadal et al., 2021
Mercadal et al., 2022

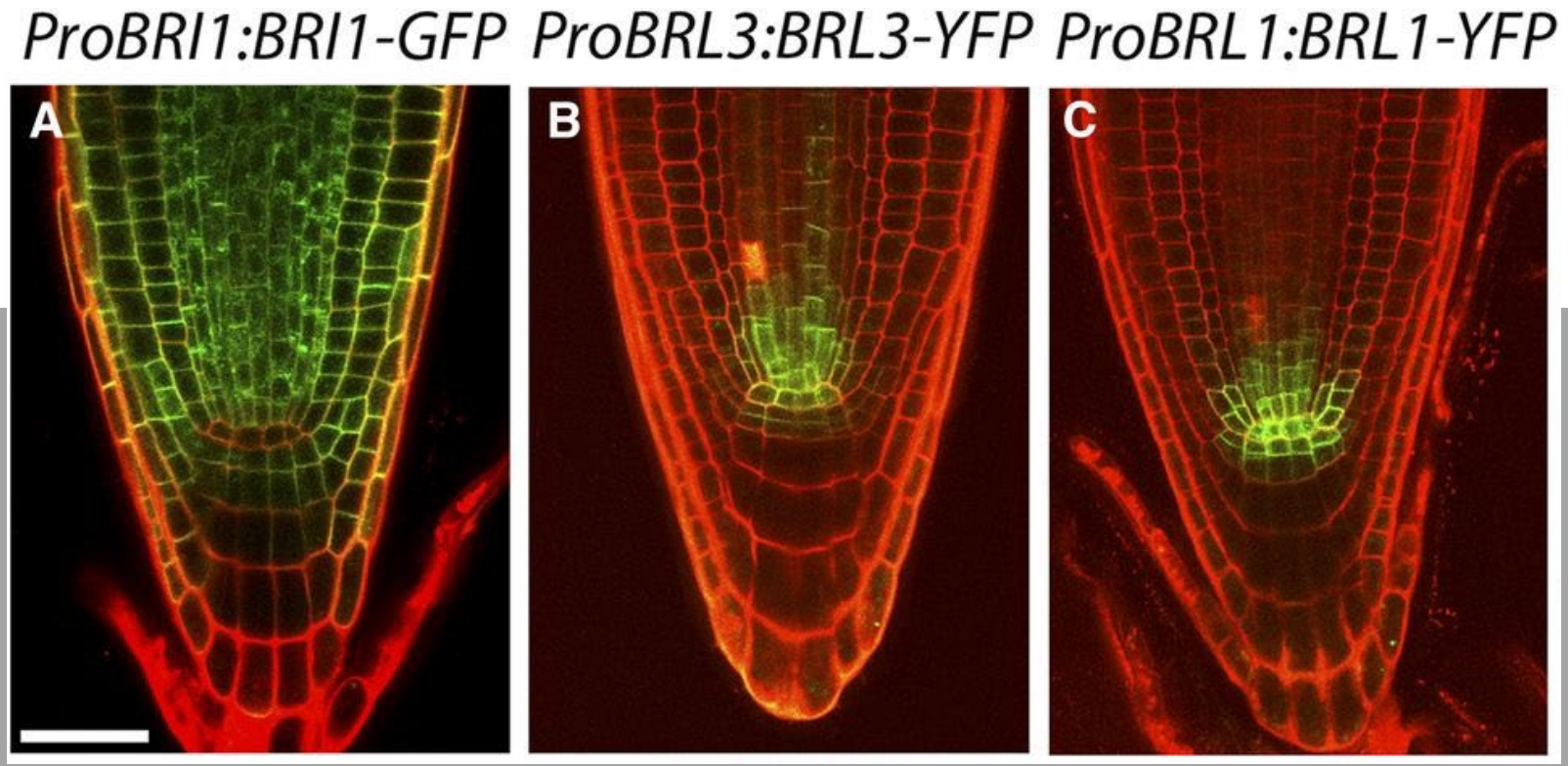
Decoding the roles of Brassinosteroids in root growth and development

- Ibañes et al., ***PNAS***, 2009.
- Caño-Delgado et al., ***Ann.Rev.Cell Dev. Biol.***, 2010.
- González-García et al., ***Development***, 2011.
- Fabregas et al., ***Plant Cell***, 2013.
- Vilarrasa-Blasi et al., ***Developmental Cell***, 2014.
- Fábregas et al., ***Plos Genetics***, 2015.
- González-García et al., ***Cell Reports***, 2015.
- Espinoza et al., ***Development,*** 2016
- Lozano-Elena, Planas-Riberola *et al.,* ***J. Cell Science.***2017
- Pavelescu *et al.,* ***Mol. Sys. Biol.*** 2018
- Fàbregas, Lozano *et al.,* ***Nat Comms.*** *2018*
- *Betegón et al.,* ***Plant Journal*** *2019*
- *Riberola et a.l.,* ***Development*** *2020*
- *Betegon et añ,* ***Mol SYs Bio,*** 2021
- Mercadal et al., ***Development*** 2022

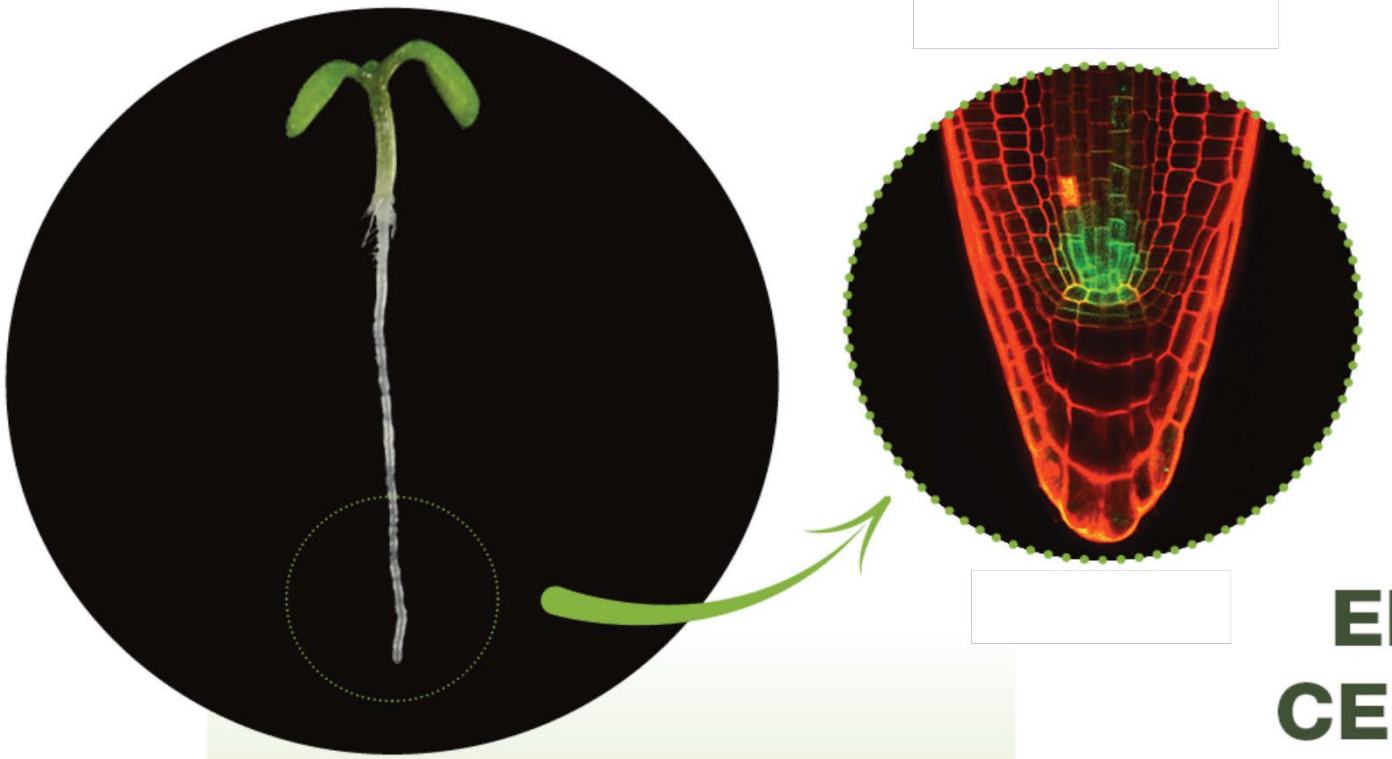


CRAG
CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

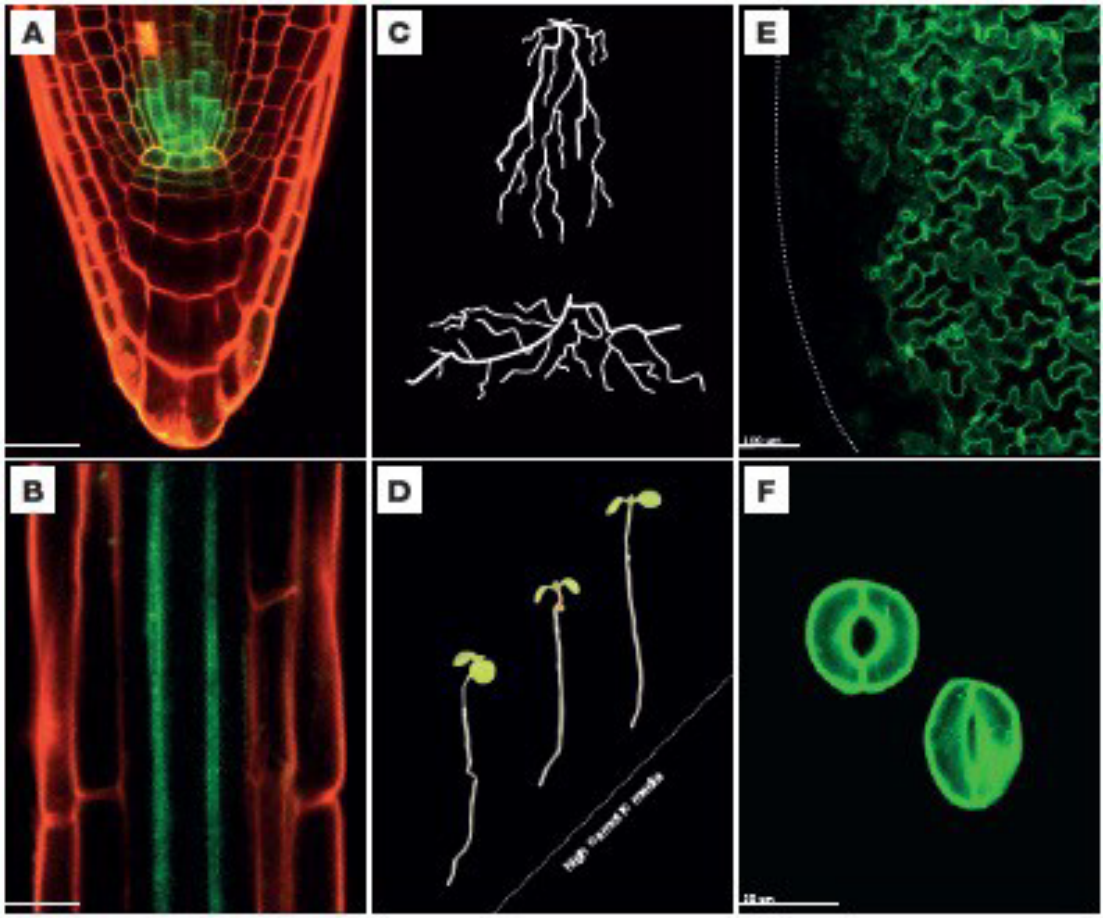
Cell specificity for the BRI1-like family of receptors



Caño-Delgado et al., 2004; Fàbregas et al., 2013; Salazar-Henao et al., 2016; Fàbregas et al., 2018; Planas-Riverola et al., 2019; Gupta et al., 2020



ENGINEERING CELL-SPECIFIC SIGNALING TO UNDERSTAND DROUGHT RESISTANCE

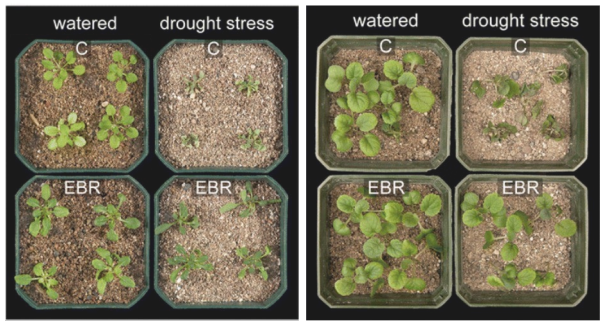


Gupta, Rico-Medina et al., *Science* (2020)

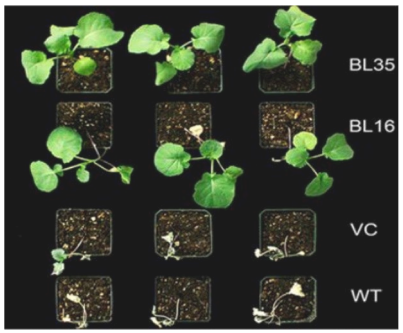
DROUGHT RESPONSES ARE CELL SPECIFIC

Previous roles of BRs in abiotic are controversial

+ BL hormone

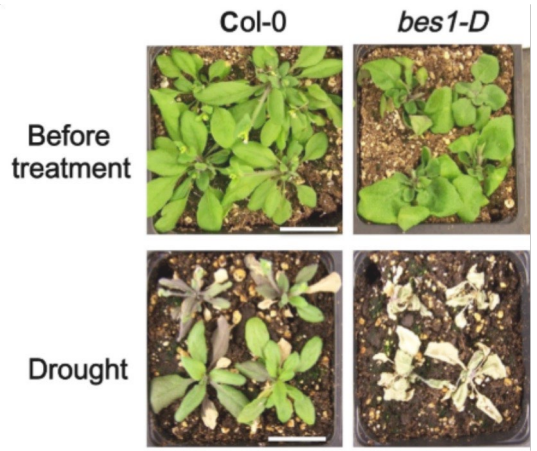


Kagale et al., 2007



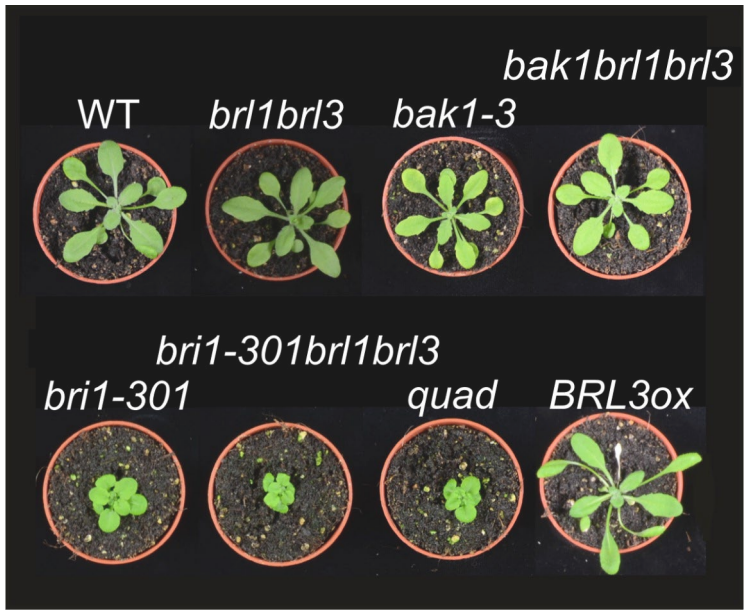
Sahni et al., 2016

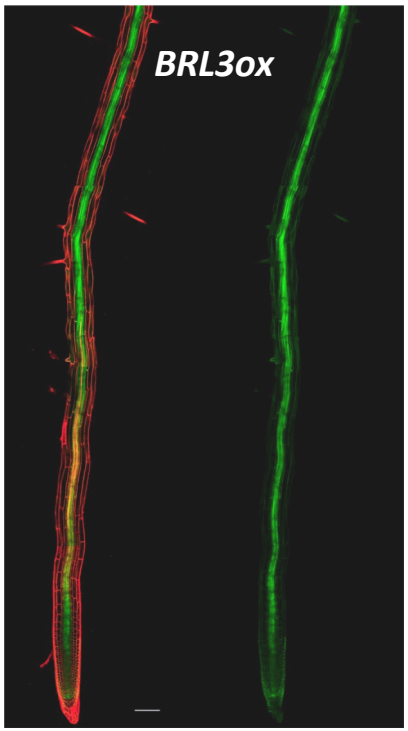
+ BR Signaling



Ye et al., 2017

Investigating the roles of BRI1-like receptor family in plant abiotic stress



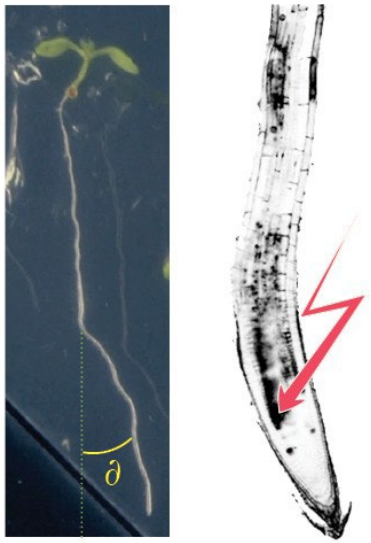


CRAG
CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

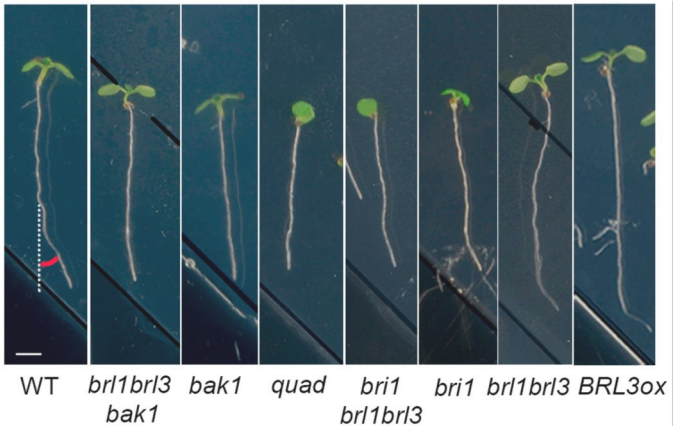
Fàbregas, Lozano et al., *Nature Comms*., (2018); Gupta el al., under revision, BioRxiv (2023)

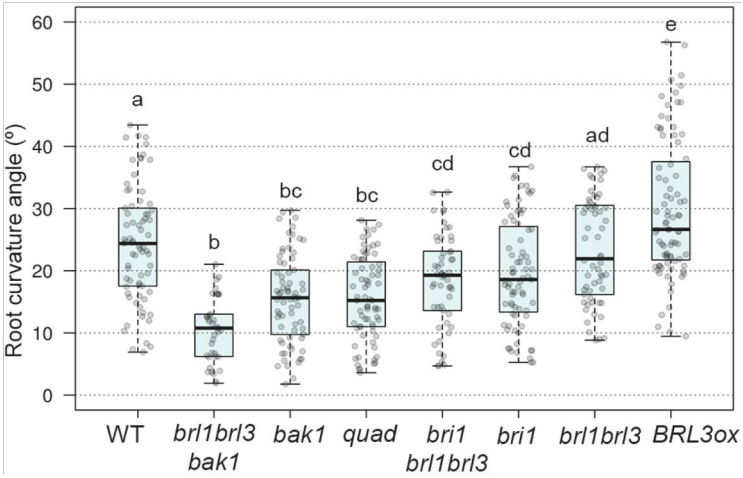
The BRL3 signalosome accounts for root hydrotropism

Root hydrotropism



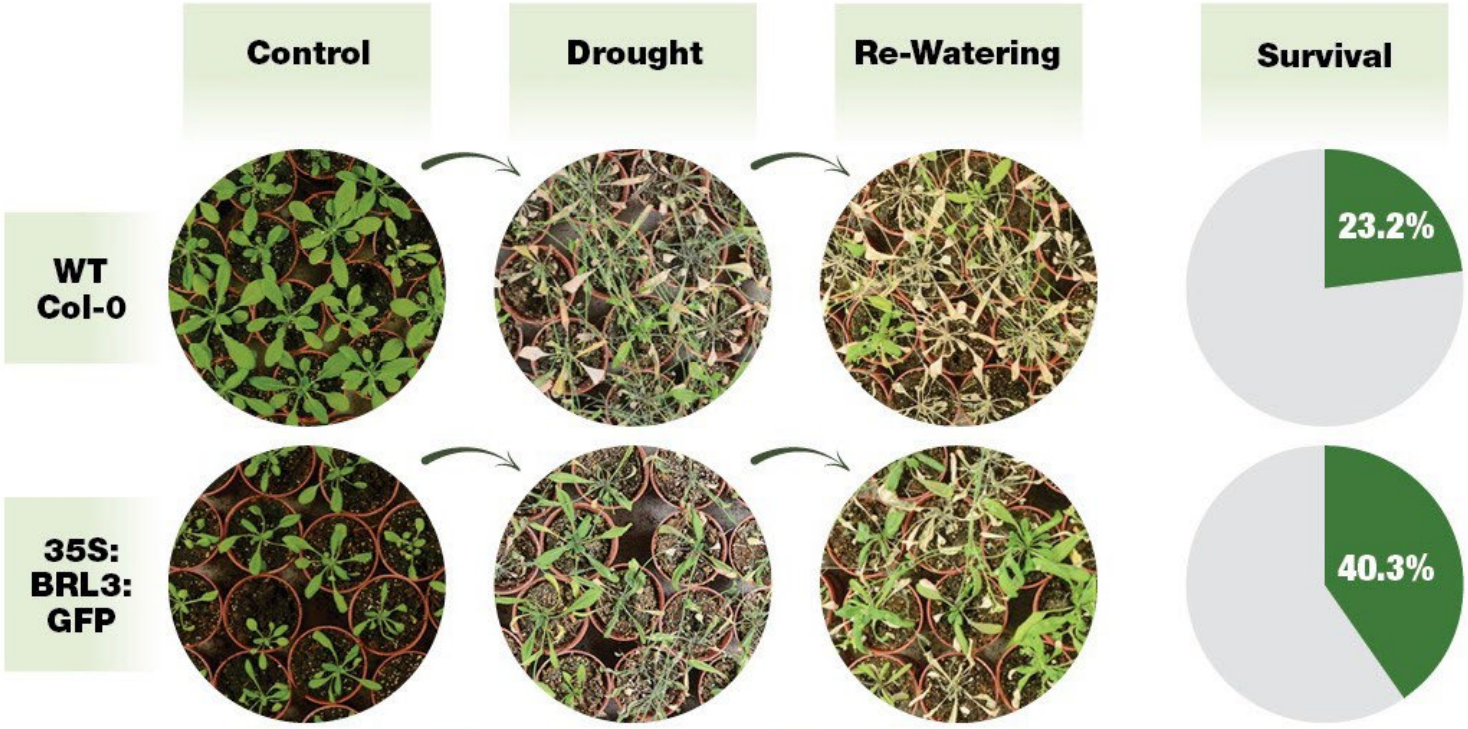
6 day old
400mM Sorbitol





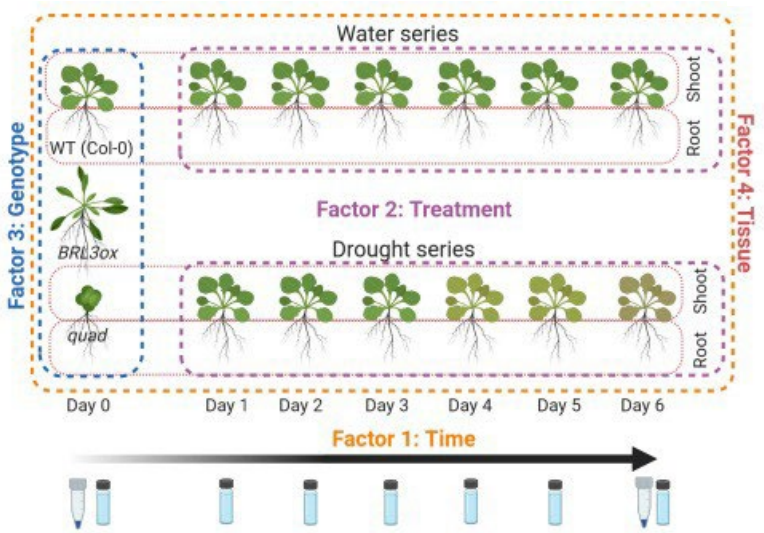
Fàbregas, Lozano-Elena et al., Nature Comms., (2018)

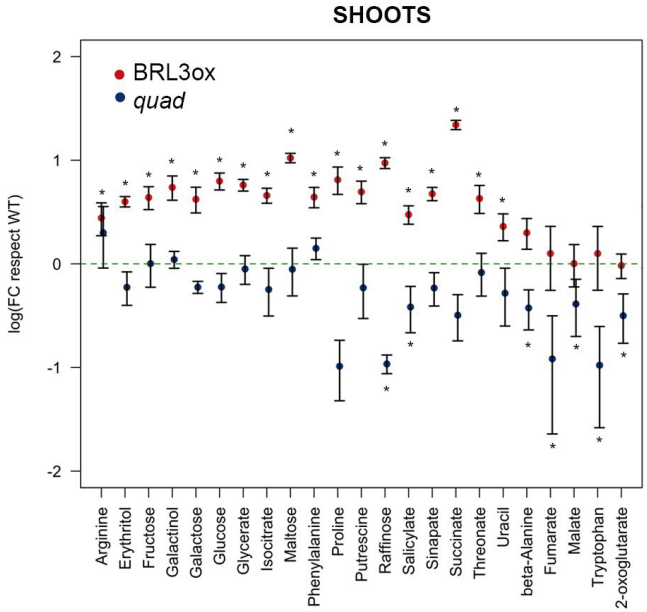
BRL3 receptors confer drought resistance without penalizing yield

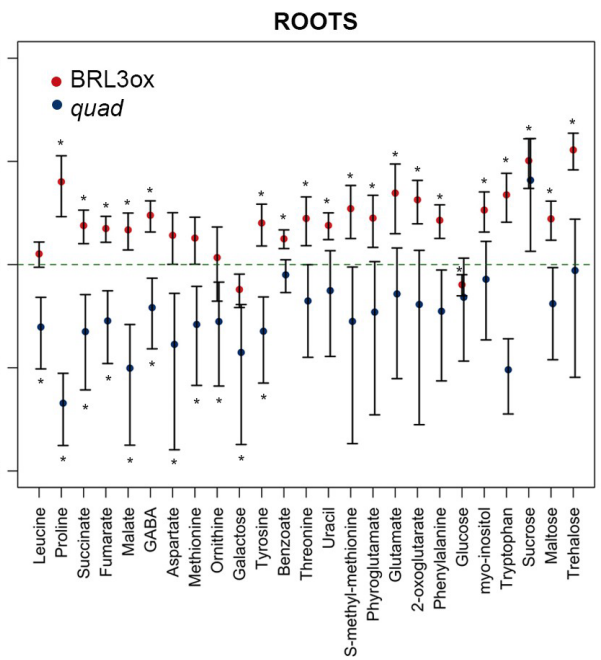


(WO2015177215A1)

Why? BRL3OX plants are metabolically primed





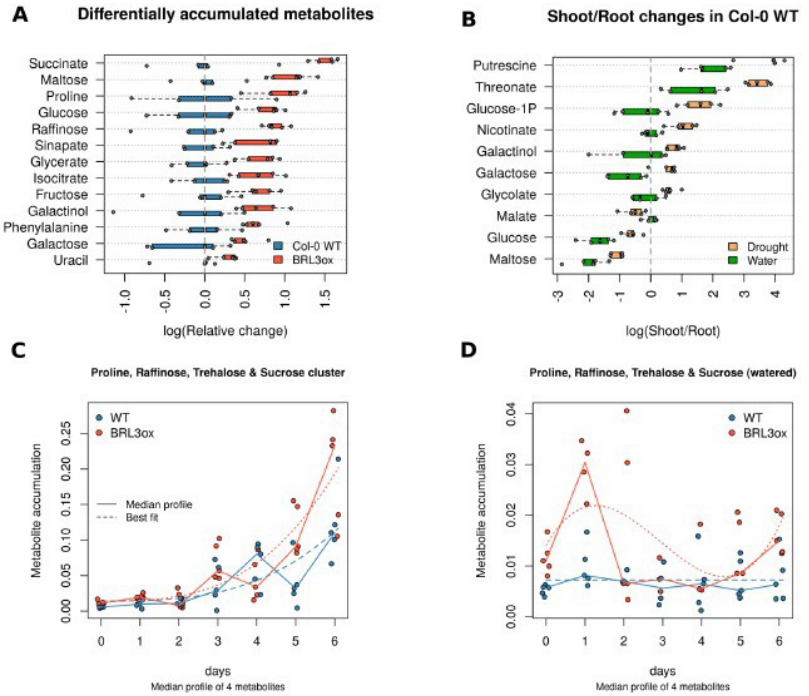


Fàbregas, Lozano-Elena, et al., *Nat Comms.* (2018);
Lozano-Elena, et al., *Scientific Data* (2022)

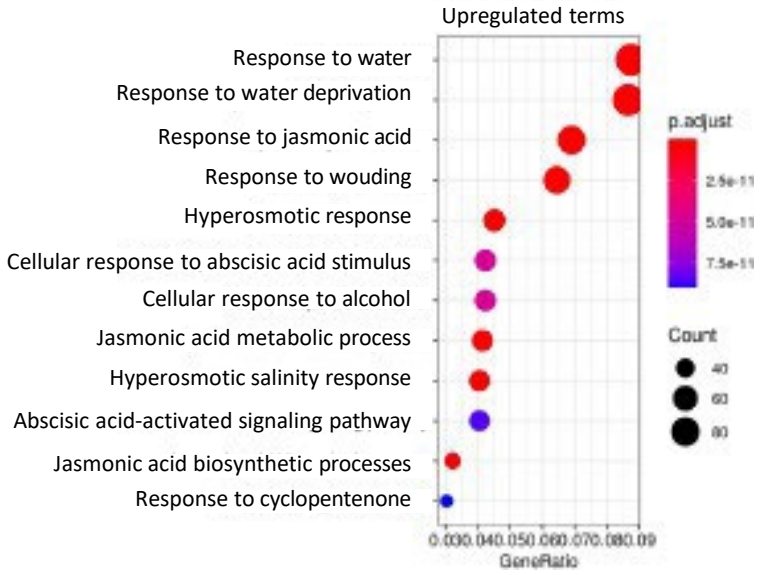
CRAG
CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

BRL3 receptors trigger the metabolic adaptation to drought stress

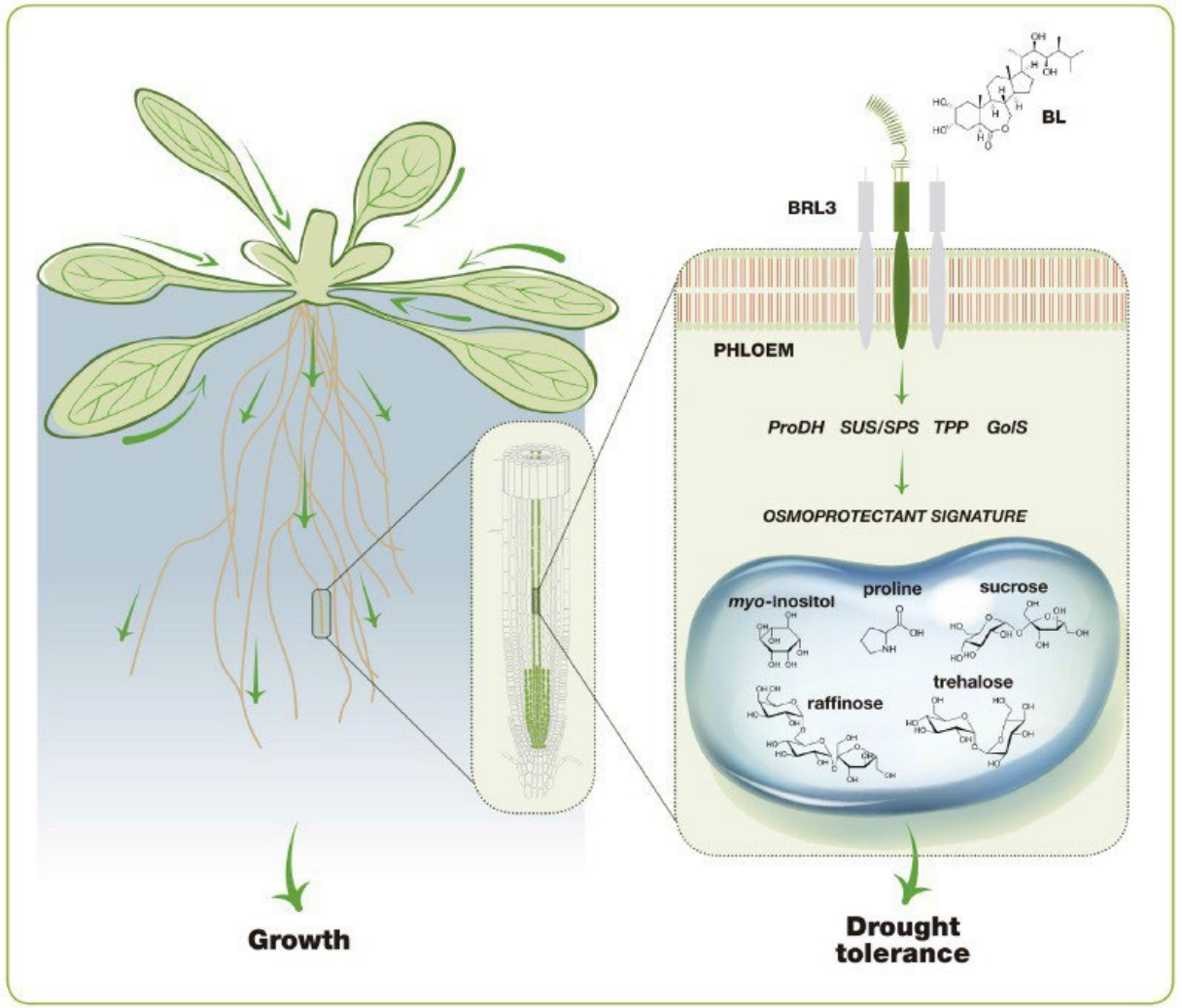
A metabolic signature for plant adaption to drought



Transcript to metabolite correlation



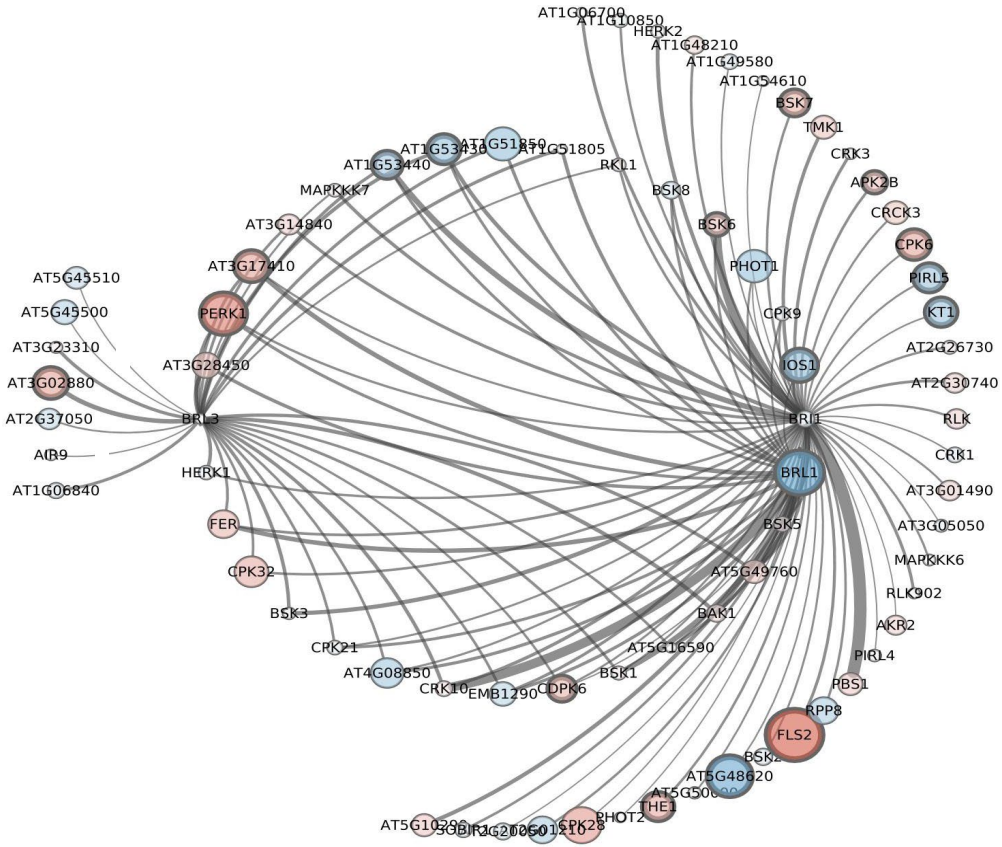
Fàbregas, Lozano-Elena, et al., *Nat Comms.* (2018);
Lozano-Elena, et al., *Scientific Data* (2022)



CRAG
CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

Deciphering the components for the BRL3 signaling pathway in drought stress

A proteomic network of interactions for BRI1-like family



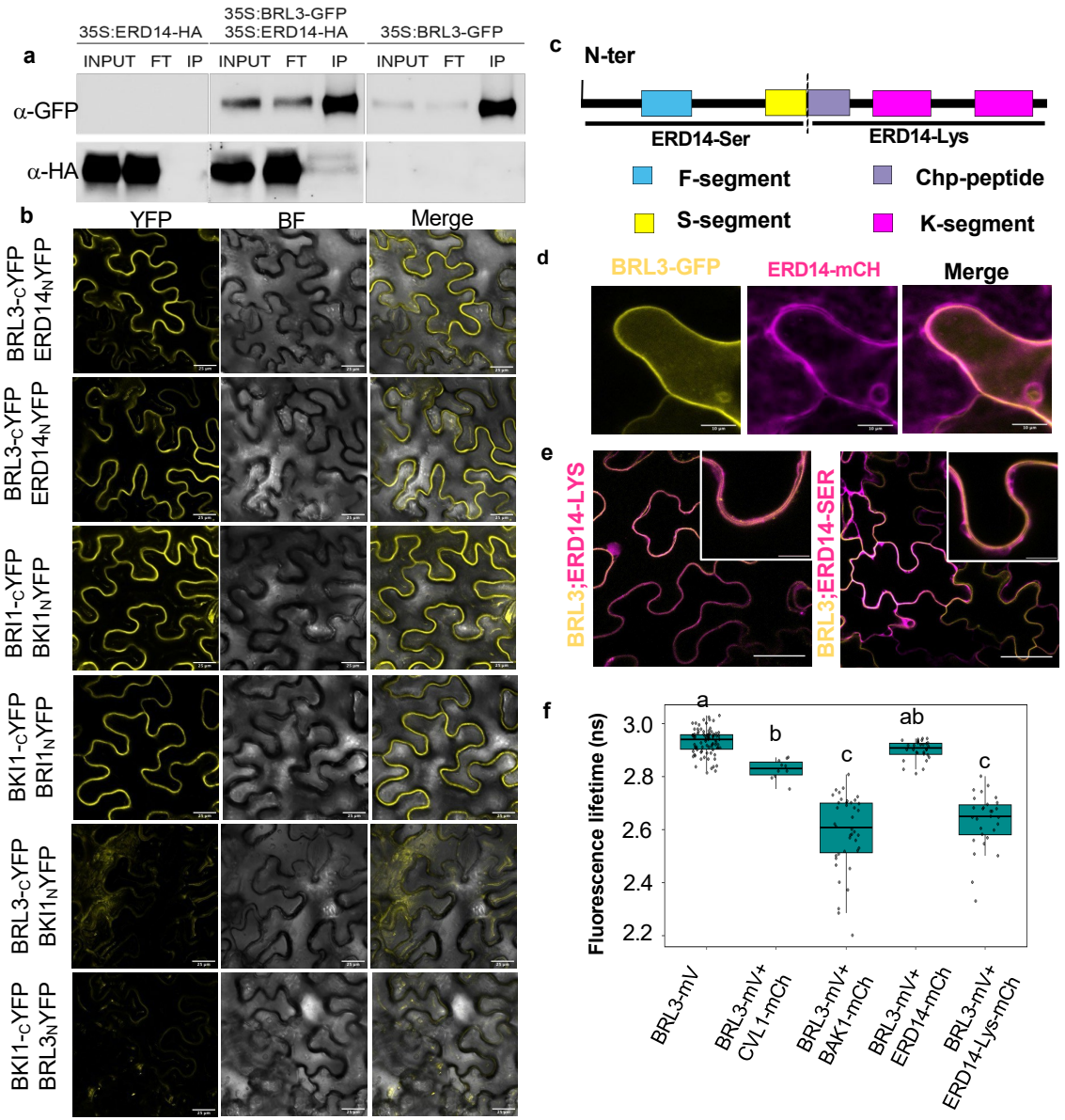
-Edges: Interaction identified by IP

-Edges width: Overall energy (-ddG) of the ppi

-Node size: Fold change of transcript expression under drought (roots)

-Node color: Upregulation (red) or downregulation (blue)

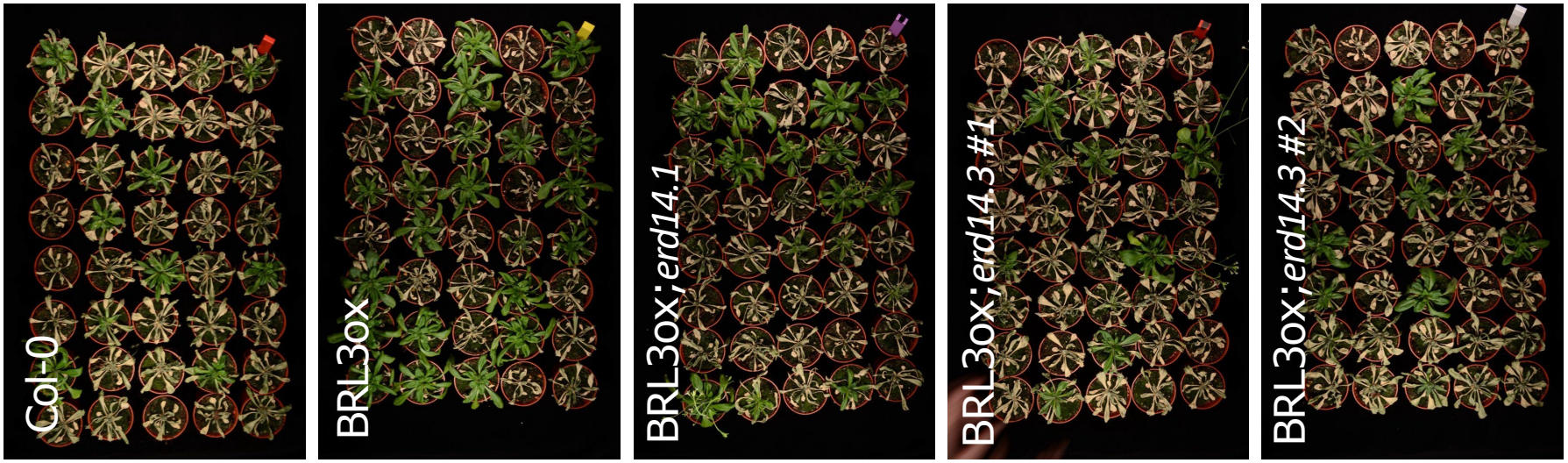
Lozano-Elena, unpublished results with B. Oliva, Computational Structural Biology Dept., UPF, Barcelona, Spain



BRL3 receptor protein interacts with the dehydrin ERD14 at the plasma membrane

Marquès-Bueno, Herrero et al., submitted (2023)

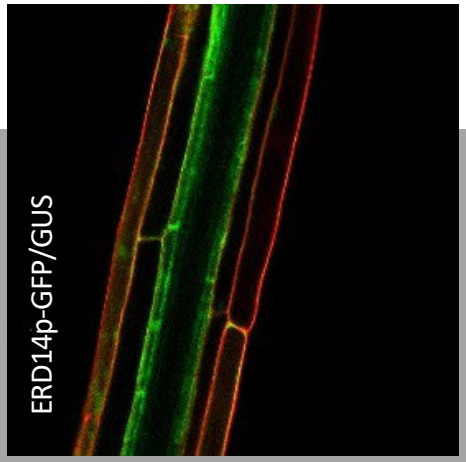
erd14 reverts BRL3-OX drought resistance phenotype

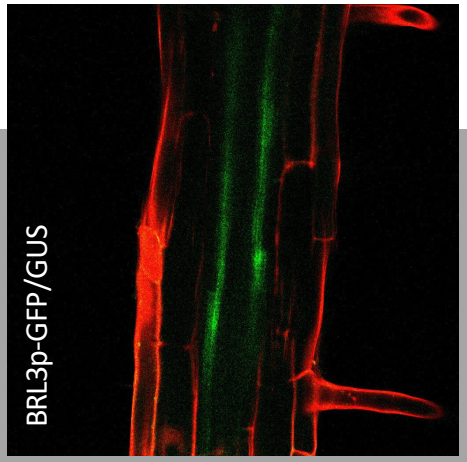


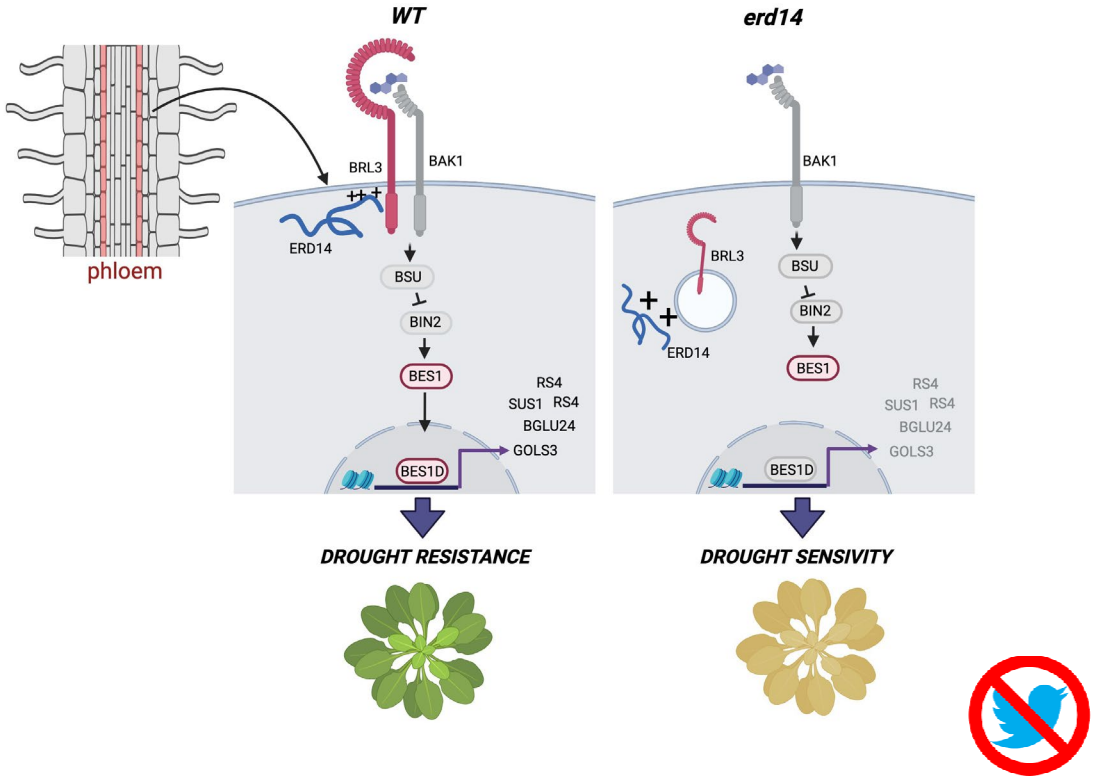
Survival rate (%)	**15 %**	**50%**	**20%**	**10%**	**17.5%**

Marquès-Bueno, Herrero et al., unpublished (2023)

ERD14 chaperones vascular BRL3 receptors at the plasma membrane to confer drought stress adaptation







Marquès-Bueno, Herrero et al., unpublished (2023)

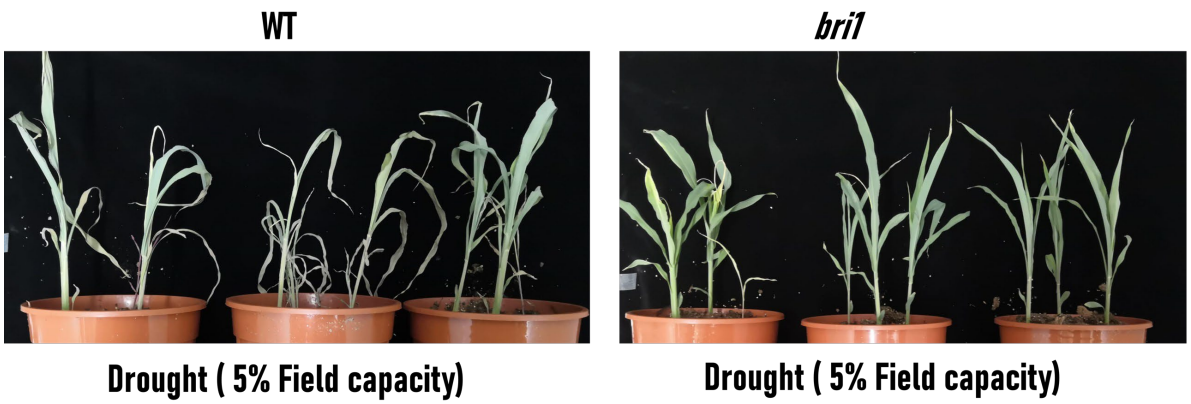
BRL3 ENGINEERED PLANTS CAN SURVIVE DROUGHT WITHOUT PENALIZING GROWTH

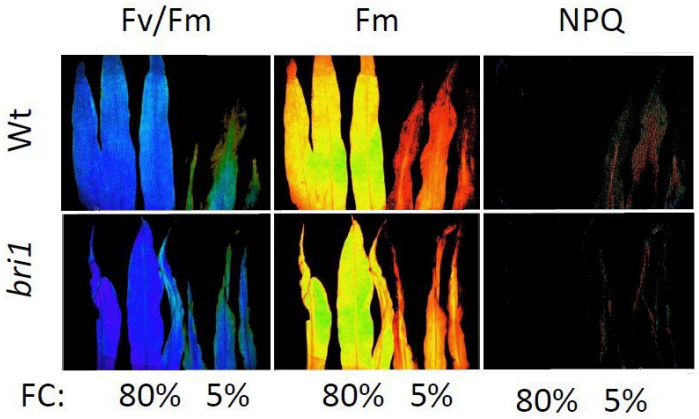
OPENING A DOOR FOR AGRICULTURAL PRODUCTION ON A CLIMATE EMERGENCY

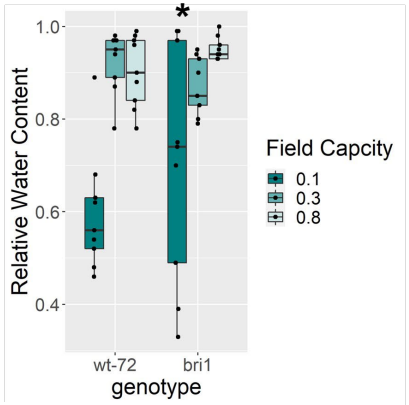
TRANSLATION TO CEREALS

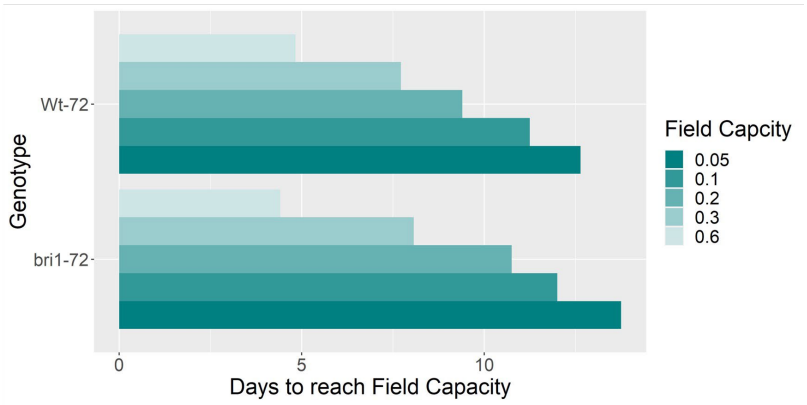
Sorghum bicolor

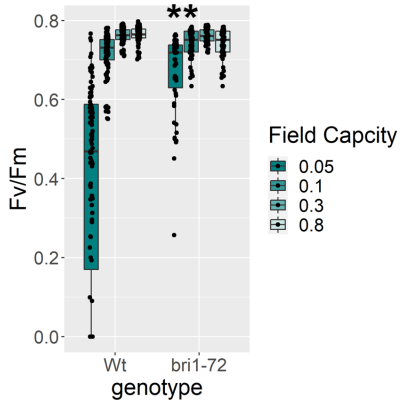
Sorghum *Sbbri1* mutants display increased tolerance to drought stress







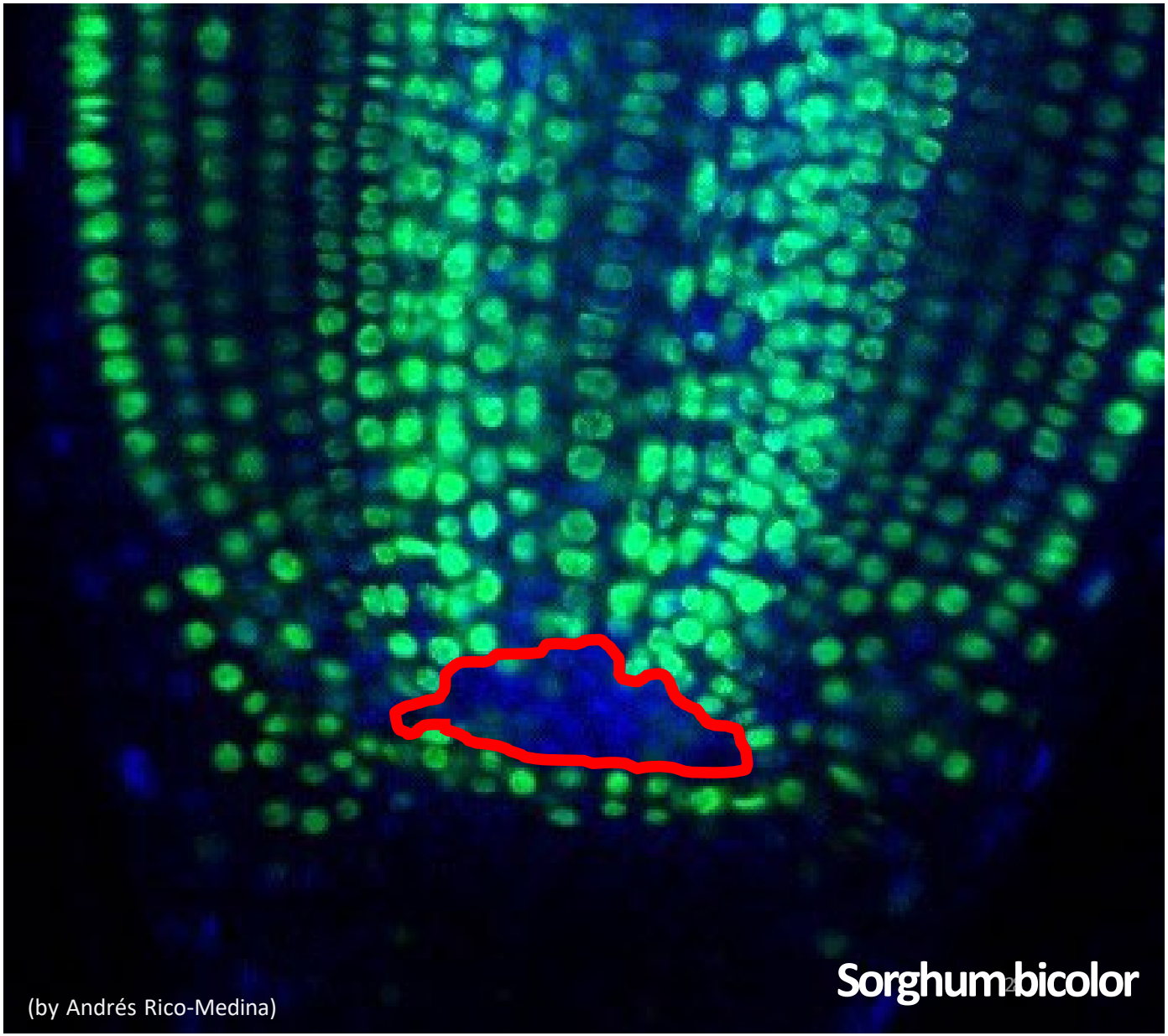




CRAG
CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

Fontanet-Manzaneque, Rico-Medina, Blasco-Escámez, Laibach et al. Submitted (2022)

NEW METHODS FOR SORGHUM



GENETIC EDITION THE WAY OUT

Lab members:

David Blasco
Veredas Coleto
Azahara Rodríguez
Mar Ferreira Guerra
Juan Fontanet
Aditi Gupta
Ivan Herrero
Natalie Laibach
Fidel Lozano-Elena
Mar Marqués Bueno
Ainoa Planas-Riverola
Andrés Rico-Medina
Xabier Simón

Former members:

Nadja Bosh
Isabel Betegón Putze
Mary-Paz González-García
Norma Fabregas
Mike Karampelias
Josep Vilarrasa-Blasi
Irina Pavelescu
Martin Mecchia
Damiano Martignago

Collaborators:

I. Efroni, Hebrew Univ. of Jerusalem, Israel
A. Ferney, Max Planck, Germany
J. Russinova, PSB, VIB, Ghent, Belgium
R. Sozzani, NCSU, US
M. Ibañes, Physics, UB, Barcelona
B. Oliva, Structural bioinformatics, UPF, Barcelona
S. Wendeborn, Chemistry, Basel, Switzerland

CRAG
CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS

EMBO
excellence in life sciences

European Research Council
Established by the European Commission

EXCELENCIA SEVERO OCHOA

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD


Planet
BIOTECH
Transfering research knowhow
into agricultural value
acano@planet-biotech.com
Tel +34 646 688 212
erc
European Research Council
"la Caixa" Foundation
Ship2B Foundation
CAJAMAR INNOVA
AGAUR
Agència de Gestió d'Ajuts Universitaris i de Recerca
crag
CENTRE DE RECERCA EN AGRIGENÒMICA

Thank you!

Ana I. Caño-Delgado

www.cragenomica.es

Twitter: Ana_CanoDelgado

erc

crag

CENTRE FOR RESEARCH IN AGRICULTURAL GENOMICS