GROUP LEADER
Vicente Rubio

SENIOR RESEARCHERS
Sandra Fonseca
Pablo Pulido

POSTDOCTORAL RESEARCHERS
Bran López
Cristina Martínez
Jorge Vicente

TECHNICIANS
Yolanda Fernández
Zeltia Ferreiro

PhD RESEARCHERS
Martín Albacete
Esther Cañibano

MASTER STUDENT
Alexandra Oliveira

UNDERGRADUATE STUDENTS
Alicia Arenas
Paloma Cabrerizo
Fernando García
Ying Qian
Irene Tejeda

Role of ubiquitin in the control of plant growth and stress tolerance

Protein ubiquitination is an integral regulatory mechanism of many signaling pathways in plants. Ubiquitin (Ub) conjugation to proteins may trigger degradation of protein targets at the 26S proteasome or changes in their properties (e.g., protein activity, localization, assembly and interaction ability), depending on the extent or specific Ub chain configurations. Protein ubiquitination is mediated by an enzymatic cascade in which different types of E3 Ub ligases provide the substrate specificity. Among them, Cullin4 RING E3 ubiquitin ligases (CRL4) have been involved in biological processes spanning the plant´s whole life by promoting degradation of specific targets controlling those processes. Research at my group has been focused in the characterisation of CRL4 E3s that regulate developmental and stress responses in plants, including light and abscisic acid (ABA)-mediated stress signaling. Thus, we have reported novel mechanisms to modulate ABA responses in plants based on targeted destabilization of the ABA receptors (Irigoyen et al., 2014 Plant Cell; García-León et al., 2019 Plant Cell). Interestingly, CRL4 function is performed in close proximity to chromatin, which should enable rapid translation of environmental and stress signals into changes in gene expression. Indeed, we found that a CRL4-DET1 complex mediates a molecular pathway controlling epigenetic homeostasis (including Histone2B ubiquitination) in response to external stimuli (i.e. light conditions; Nassrallah et al., 2018 eLife). Our current objectives aim to identify and characterise new mechanisms by which CRL4 controls accumulation of specific epigenetic marks over the plant genome in response to environmental changes, to regulate expression of specific gene sets that lead to plant adaptation to changing climate conditions, as it is the case of COP1-DET1-complex-mediated destabilization of HY5 (Figure 1. Cañibano et al., 2021 Molecular Plant). As a highlight of our contributions to this field, we organized an International Conference on Plant Proteostasis in 2022 at the CNB-CSIC.

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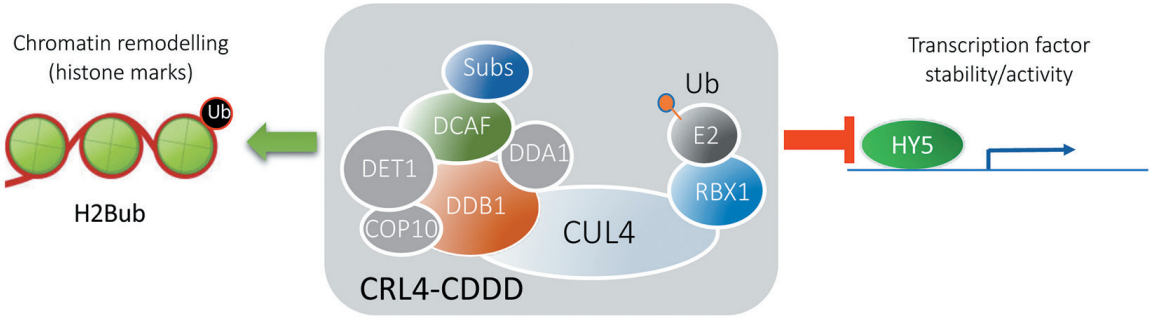

1 *DET1 complexes play multiple roles at the plant chromatin by controlling accumulation of specific epigenetic marks and the stability of transcription factors.*

SELECTED PUBLICATIONS

Grasser KD, Rubio V, Barneche F. Multifaceted activities of the plant SAGA complex. Biochim Biophys Acta Gene Regul Mech 2021, 2, 194613.

Cañibano E, Bourbousse C, García-León M, Garnelo Gómez B, Wolff L, et al. DET1-mediated COP1 regulation avoids HY5 activity over second-site gene targets to tune plant photomorphogenesis. Mol Plant 2021, 14, 1–20.

Lee B-D, Yim Y, Cañibano E, Kim S-H, García-León M, et al. CONSTITUTIVELY PHOTOMORPHOGENIC1 promotes seed germination by destabilizing RGA-LIKE2 in Arabidopsis. Plant Physiology 2021, kiac060

Theodoulou FL, Orosa-Puente B, Trujillo M, Rubio V. Plant proteostasis: a proven and promising target for crop improvement. Essays in Biochemistry 2022, 66, 75-85

Llamas E, Pulido P. A proteostasis network safeguards the chloroplast proteome. Essays in Biochemistry 2022, 66, 219-228.

CURRICULUM VITAE ABREVIADO (CVA)

***IMPORTANT** – The Curriculum Vitae cannot exceed 4 pages. Instructions to fill this document are available in the website.*

Part A. PERSONAL INFORMATION

First name	Vicente		
Family name	Rubio Muñoz		
Gender (*Mandatory*)	Male	Birth date	13/07/1973
Social Security, Passport, ID number	281245773057	PAD116298	34809035F
e-mail	vrubio@cnb.csic.es	URL Web https://laboratorio380vr.wixsite.com/rubio	
Open Researcher and Contributor ID (ORCID)		0000-0002-8800-2400	

A.1. Current position

Position	Investigador Científico		
Initial date	01/10/2009		
Institution	Agencia Estatal Consejo Superior de Investigaciones Científicas		
Department/Center	Plant Molecular Genetics Dept.	Centro Nacional de Biotecnología	
Country	Spain	Teleph. number	680635275
Key words	Posttranslational control, proteostasis, ubiquitination, transcriptional control, epigenetics, development, abiotic stress,		

A.2. Previous positions (research activity interruptions, indicate total months)

Period	Position/Institution/Country/Interruption cause
1996-2001	PhD student/CNB-CSIC/Spain
2002-2005	Postdoc/Yale University/USA
2005-2009	Ramón y Cajal Researcher/CNB-CSIC/Spain

A.3. Education

PhD, Licensed, Graduate	University/Country	Year
BSc and MSc Biochemistry	Universidad de Murcia (Spain)	1996
PhD Biological Sciences	Universidad Autónoma de Madrid (Spain)	2001

Part B. CV SUMMARY *(max. 5000 characters, including spaces)*

I am a group leader in the Plant Molecular Genetics Dept. at the CNB-CSIC in Madrid, Spain. I received my BSc degree in Biochemistry from Univ. de Murcia, Spain, and a PhD in Biological Sciences from Univ. Autónoma de Madrid, supervised by Javier Paz-Ares and Antonio Leyva. My thesis project aimed to isolate regulatory components in the phosphate starvation signaling pathway in plants. As a result, I identified for the first time a gene that regulates adaptive responses to a mineral nutrient stress in vascular plants, PHR1, which encodes a transcription factor that controls phosphate starvation responses in Arabidopsis (Rubio et al., 2001. Gene Dev; 953 citations). After completing my PhD, I was awarded a HFSP long-term fellowship to join Xing Wang Deng´s lab at Yale University (USA) where I obtained postdoctoral training in the fields of ubiquitination and light signaling in plants, making two major contributions. 1) I developed a "Tandem Affinity Purification" system for purification of protein complexes in plants (Rubio et al., 2005 Plant J; 200 citations). 2) I unveiled a molecular mechanism by which E3 ubiquitin ligase COP1 and ELF3 control circadian function and photoperiodic flowering (Yu, Rubio et al., 2008. Mol Cell; 294 citations). In 2005, I was awarded a Ramón y Cajal Contract to work at CNB-CSIC, where I combined expertise from two areas; ubiquitination and phosphate signaling, characterizing the roles of the ubiquitin-proteasome system and the lytic vacuole in the control of phosphate starvation signaling (Cardona-López et al., 2015 Plant Cell; 70 citations).

In 2009, I obtained a permanent position ("Científico Titular") at CNB-CSIC and became an independent group leader. Since then, research at my group has been focused in the characterization of CRL4 E3s that regulate developmental and stress responses in plants,

including light and abscisic acid (ABA)-mediated stress signaling. In these topics, my group has reported novel mechanisms to modulate ABA responses in plants based on targeted destabilization of the ABA receptors (Irigoyen et al., 2014 Plant Cell; 138 citations; García-León et al., 2019 Plant Cell; 28 citations). Interestingly, CRL4 function is performed in close proximity to chromatin, which should enable rapid translation of environmental and stress signals into changes in gene expression. Indeed, we found that a CRL4-DET1 complex mediates a molecular pathway controlling epigenetic homeostasis (including Histone2B ubiquitination) in response to external stimuli (i.e. light conditions; Nassrallah et al., 2018 eLife; 48 citations). Our current objectives aim to identify and characterize new mechanisms by which CRL4 controls accumulation of specific epigenetic marks over the plant genome in response to environmental changes, to regulate expression of specific gene sets that lead to plant adaptation to changing climate conditions, as it is the case of COP1-DET1-complex-mediated destabilization of HY5 (Cañibano et al., 2021 Molecular Plant; 12 citations). In these topics, I have written several reviews, organized an International Conference on Plant Proteostasis in 2022 and become the Coordinator of an MSCA Doctoral Network action termed “EpiSeedLink” granted also in 2022. Based in these accomplishments, in 2022, I was promoted to “Investigador Científico” at CSIC (pending of official publication).

In sum, I have contributed to 50 publications, 47 of them, with JCR Impact factor, are Q1. They include 35 original Q1 research articles (including 1 in eLife, 2 in Molecular Cell, 3 in Genes and Development, 5 in PNAS, 1 in PLoS Genetics, 3 in Molecular Plant, 1 in Plant Physiology, and 8 in The Plant Cell), 4 technical papers, 8 reviews (1 in Cell and 1 in Science) and 2 book chapters. These accumulate over 5760 citations according to ISI Web of Science (December 2022) and provide an h-index: 28. The average number of citations/year (over the last 5 years) is 518. Five of them were selected by F1000. The average impact factor of the journals in which they were published is over 10. I have supervised 6 PhD theses and currently supervise two additional ones. The CNEAI has granted me 4 “sexenios” (including 1 for “Innovation & Knowledge Transference”). CSIC has granted me 4 “quinquenios” (last in 2017).

Part C. RELEVANT MERITS *(sorted by typology)*

C.1. Publications *(ten most relevant)* (¶*first authorship*; **corresponding authorship*)

10. Theodoulou FL*, Orosa-Puente B*, Trujillo M*, **Rubio V*** (**2022**) Plant proteostasis: a proven and promising target for crop improvement. ***Essays Biochem*** 66: 75-85

9. Cañibano E, Bourbousse C, Garcia-León M, […] **Rubio V*,** Fonseca S* (**2021**) DET1-mediated COP1 regulation avoids HY5 activity over second-site gene targets to tune plant photomorphogenesis. ***Molecular Plant*** 14:963-982. (9/10)

8. García-León M, Cuyas L, El-Moneim DA, […], **Rubio V*** (**2019**) Arabidopsis ALIX regulates stomatal aperture and turnover of ABA receptors. ***The Plant Cell***. pii: tpc.00399.2019. (15/15)

7. Nassrallah A, Rougée M, Bourbousse C, Drevensek S, Fonseca S, Iniesto E, […], Bowler C, **Rubio V***, Barneche F* (**2018**) DET1-mediated degradation of a SAGA- like deubiquitination module controls H2Bub homeostasis. ***eLIFE***. e37892. (22/21)

6. Cardona-López X, Cuyas L, Marín E, […], Paz-Ares J*, **Rubio V*** (**2015**) ESCRT-III-Associated Protein ALIX Mediates High-Affinity Phosphate Transporter Trafficking to Maintain Phosphate Homeostasis in Arabidopsis. ***The Plant Cell*** 27: 2560-2581. (11/11)

5. Irigoyen ML, Iniesto E, Rodriguez L, […], Deng XW*, **Rubio V*** (**2014**) Targeted degradation of abscisic acid receptors mediated by ubiquitin ligase substrate adaptor DDA1**.** ***The Plant Cell*** 26:712-728 (12/12)

4. Yu J-W¶, **Rubio V¶**, Lee N-Y¶, Bai S¶, […], Paek N-C, Deng XW (**2008**) COP1 and ELF3 control circadian function and photoperiodic flowering by regulating GI stability. ***Molecular Cell*** 32: 617-630. (2/15)

3. Rubio V¶, Shen Y, Saijo Y, Liu Y, Gusmaroli G, Dinesh-Kumar SP, Deng XW (**2005**) An alternative tandem affinity purification strategy applied to Arabidopsis protein complex isolation. ***The Plant Journal*** 41: 767-778.

2. González E, Solano R, **Rubio V**, Leyva A, Paz-Ares J (**2005**) PHOSPHATE TRANSPORTER TRAFFIC FACILITATOR1 is a plant-specific SEC12-related protein that enables the endoplasmic reticulum exit of a high-affinity phosphate transporter in Arabidopsis. ***The Plant Cell*** 17: 3500-3512.

1. Rubio V[¶], Linhares F, Solano R, Martín AC, Iglesias J, Leyva A, Paz-Ares J (**2001**) A conserved MYB transcription factor involved in phosphate starvation signaling both in vascular plants and in unicellular algae. ***Genes and Development*** 15: 2122-2133.

C.2. Congresses

-Invited oral presentations to international research institutes and universities: 23

2011. Lausanne Univ., Switzerland; **2012.** Peking Univ., Beijing, China; **2013.** TUM, Munich, Germany; **2014.** Sam Noble Foundation, OK, USA; Trinational Institute for Plant Research, Strasburg, France; CEA-Cadarache, France; **2015.** Suez Canal Univ., El-Ismailia, Egypt; Chinese Agricultural Univ. Beijing, China; Plant Stress Center-Shanghai, China. **2016.** CEA-Cadarache, France; Institut de Biologie de l'Ecole Normale Supérieure, Paris, France; Kyoto Univ., Japan; **2017;** Dong-A Univ., Busan; Gyeonsang Univ., Yinyu; Yonsei Univ., Seoul, South Korea; VIB-Ghent. Belgium; **2018.** KASBC- Jeju Island, South Korea; Kyoto Univ., Kyoto, Japan; NAIST Institute, Nara, Japan; Univ. of Talca, Chile; **2020** Regensburg Univ. Germany; **2021** Univ. Internacional Andalucía, Baeza, Spain; **2022** Univ. of Tübingen, ZMBP, Germany.

-Selected talks at international conferences. 6

2014. 5th International Symposium Phosphorus in Soils and Plants, Montpellier, France; **2017.** Zomes IX Conference. Rome, Italy.; **2018.** New Phytologist Conference on Plant Proteostasis, Durham, UK; **2019.** Zomes X Conference. Akko. Israel; **2019.** International Conference in Arabidopsis Research-ICAR 2019. Wuhan. China. **2022.** European Workshop on Plant Chromatin. Pruhonice. Czech Republic.

-Invited oral presentations to national research institutes and universities: 5

2019. Invited seminar at Instituto de Bioingeniería. Univ. Miguel Hernández. Elche; **2013.** Invited seminar at CBGP-UPM-INIA. Madrid; **2009 and 2017.** Invited seminars at IMBCP-UPV-CSIC. Valencia; **2010.** Invited seminars at CID-CSIC, Barcelona.

-Selected talks at national conferences: 11

2010. II Biannual Conference of Young Researchers in Proteomics. Cordoba; **2010, 2012, 2014, 2016, 2018, 2020, 2022.** Spanish Plant Molecular Biology Meetings (RBMP)**; 2016, 2018.** XIV and XV Symposiums on Phytohormone Metabolism and Action, Spanish Phytohormone Society. **2022.** Plant Redox network symposium, Salobreña.

-**Organizer** of CNB Workshops "Advances in Molecular Biology by young researchers abroad." (CNB-CSIC Madrid, España). From 2009-2011

-**Scientific Committee member** IX National Biotechnology Congress" Salamanca 8-10/7/2015

-**Chairman** of the "Signalling" Session at 30th International Conference in Arabidopsis Research (ICAR 2019; Wuhan, China) Dates: 16-21/6/2019

-**Co-Organizer** of the International Conference on Plant Proteostasis held at the CNB-CSIC in Madrid, September 21-23, 2022

C.3. Research projects. *All granted (Amounts include overheads)*

10. EpiSeedLink: From seed to seedling: Epigenetic mechanisms of priming to design strategies for crop improvement. Coordinator: Vicente Rubio (CNB-CSIC). Ref 101073476. HORIZON-TMA-MSCA-DN. 1/10/2022-30/09/2026. 2.689.725 Euros (total consortium)

9. New chromatin remodeling pathways in the plant response to environmental signals. PI: Vicente Rubio and Sandra Fonseca (CNB-CSIC). PID2019-105495GB-I00. MICINN (Spanish National R+D Program). 1/06/2020-31/05/2023. 205.700 Euros

8. Impact of nuclear domains on gene expression and plant traits. (INDEPTH; CA16212) (COST Action). 01/01/2018-Present. Total consortium: 520.000 Euros

7. Integration of abiotic stress signals and environmental stimuli mediated by the plant ubiquitin system. PI: Vicente Rubio and Sandra Fonseca (CNB-CSIC). BIO2016-80551-R. MINECO (Spanish National R+D Program). 30/12/2016 - 29/12/2019. 205.700 Euros

6. European network to integrate research on intracellular proteolysis pathways in health and disease. (PROTEOSTASIS; BM1307**)** (COST Actions). 23/04/2014 - 24/04/2018. Total consortium: 500.000 Euros

5. DDA1 target ubiquitination towards improving plant adaptation to abiotic stresses. PI: Vicente Rubio (CNB-CSIC). BIO2013-46539-R. MINECO (Spanish National R+D Program). 01/01/2014 - 31/04/2017. 193.600 Euros

4. Regulation of the ubiquitination machinery in the control of development and stress responses in plants. PI: Vicente Rubio (CNB-CSIC). BIO2010-18820. MICINN (Spanish National R+D Program). 01/01/2011 - 31/12/2013. 133.100 Euros
3. Ubiquitinación de proteínas nucleares en la señalización del ayuno de fosfato en plantas. PI: Vicente Rubio. CSIC (Intramural Project) 1/1/2010-31/12/2010. 30.000 Euros
2. FOSSI, Phosphate signaling. Coordinator: Laurent Nussaume (CEA, Cadarache, Francia) PI: Vicente Rubio (CNB-CSIC). EUI2008-03742**.** MICINN (Programa Plant-KBBE)**.** 01/04/2009 - 31/12/2012**.** Total, 750.000 Euros; 213.000 Euros for V.Rubio´s group**.**
1.TRANSPLANTA, Function and biotechnological potential of plant transcription factors. Coordinator**:** Javier Paz-Ares (CNB-CSIC). Reference 28317. MEC (Program Consolider-Ingenio 2010). 01/11/2007 – 30/06/2013. Total, 2.500.000 Euros.

C.4. Contracts, technological or transfer merits.
Contract: UBIQULTURA, Estudio Proteómico de la ruta de la ubiquitina para la mejora de plantas de interés. Coordinator: Crisanto Gutiérrez (CBM-CSIC). PI: Vicente Rubio (CNB-CSIC). S-GEN/0191/2006. Comunidad de Madrid. 01/01/2007 – 31/12/2009; Total: 873.000 Euros; 113.000 Euros for Vicente Rubio´s group**.**
Patent "Stress Tolerant Plants". EP13382197.5. Vicente Rubio, Maria Luisa Irigoyen, Elisa Iniesto. Priority: Europe. Licensed to Plant Biotech Limited (UK) 29/05/2013.

C.5. Scientific Awards
-"Salvador de Madariaga" Fellow at CEA-Cadarache, France June-Sept. 2016.
- Positive evaluations by the CNB´s SAB in March 2010 (Promotion to C1 researcher) and in April 2016 (Promotion to C2 researcher, being C3 the top rank).
-Positive evaluation of his research career by spanish ANEP (Program I3) 2009.
-"Ramón y Cajal" Fellow. 2005-2009. Plant Molecular Genetics Dept. CNB-CSIC, Madrid.
-Human Frontiers Science Program Long-term Postdoctoral Fellow. 2002-2005. Adviser: Prof. Xing Wang Deng. MCDB Dept. Yale University, New Haven, CT, USA.
- Best average grades in the BSc. & MSc. Degree in Biochemistry. Univ. de Murcia, 1996.

C.6. Supervised PhD Students
6. Marta García (Severo Ochoa Program) "Unraveling the role of Arabidopsis ALIX in the trafficking and turnover of ABA receptors" UAM. Defense: 22/11/2019 (Summa cum laude)
5. Amr Nassrallah (La Caixa Foundation Fellow) "Target destabilization and chromatin remodelling are coordinated by CRL4-CDDD E3 ubiquitin ligases to repress photomorphogenesis in *A. thaliana* (L.)" UAM) Defense: 31/3/2017 (Summa cum laude)
4. Mónica Rojas (CSIC PhD Fellow) "The KISS ME DEATHLY family of E3 ubiquitin ligases are involved in nutritional crosstalks, regulating phenylpropanoids biosynthesis in *Arabidopsis thaliana* (L.)" UAM. Defense: 3/2/2016 (Summa cum laude)
3. Elisa Iniesto (MINECO FPI) "Regulation of the abscisic acid signaling mediated by DDA1, a novel substrate adaptor of E3 ubiquitin ligases". UAM. Defense: 20/11/2015 (Summa cum laude). Extraordinary Doctorate Award.
2. Laura Cuyàs (MINECO FPI) "AtALIX, a component of the endomembrane system involved in phosphate starvation signaling" UAM. Defense: 22/02/2014 (Summa cum laude)
1. Ximena Cardona (MINECO FPI) "Identification of a component of the endomembrane system, AtALIX, involved in phosphate starvation signaling in plants" UAM. Defense: 29/11/2011 (Summa cum laude)
PhD theses under supervision (MINECO FPI Fellows) **1. Esther Cañibano**. UAM. Estimated-October 2023. **2. Martín Albacete** UIMP. Estimated- October 2025 **3. Paolo Lucas UAM. Estimated-March 2027**

C.7. Reviewer Activity: Guest Editor at eLife (since 2020). Reviewer for Nature Comm, eLIFE, PNAS, Plant Cell, PLoS Genetics, Molecular Plant, Plant Phys, Plant Journal, New Phytologist, Journal Experimental Botany, Plant Cell Environment, and Frontiers in Plant Science. Reviewer of grants for spanish ANEP, french ANR, belgian FNRS, and german BMBF.

C.8. Teaching: Conferences at the Masters in Biotechnology/Molecular Biosciences Program. UAM. 2013-2014, 2015-2016. and for Biotechnology degree. Univ. Salamanca. Since 2009-Present. **C.9. Outreach.** Lab **Twitter** account **@VicenteRubioSci**