

Jornada regional de difusión de los proyectos AGROALNEXT-MU

AGROALNEXT

Jornada 1 Manejo Sostenible del Agua y el Suelo en la Agricultura de Zonas Semiáridas

CEBAS, lunes 12 de febrero de 2024

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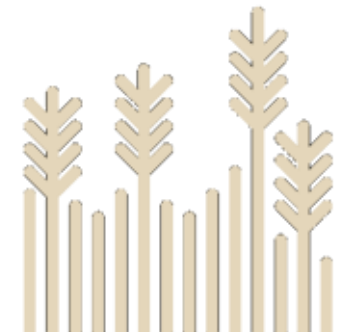


ESTRATEGIAS PARA DESARROLLO DE NUEVOS PROCESOS DE CULTIVO ENFOCADOS A REDUCIR LOS APORTES DE AGUA Y NUTRIENTES

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CEBAS-CSIC
12 de febrero de 2024

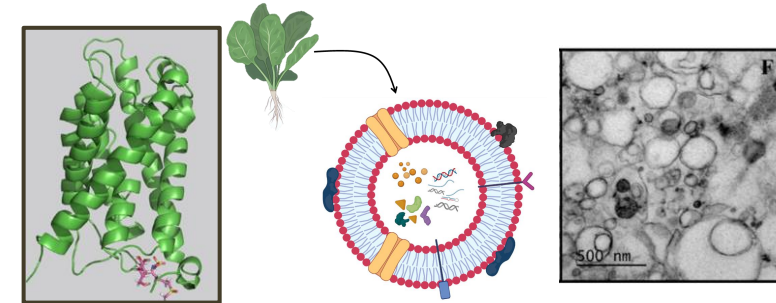


- Estudio de los efectos de estreses abióticos (principalmente salinidad) en brócoli: papel de las acuaporinas.
- Desarrollo de la tecnología de nanoencapsulación empleando vesículas de membrana de origen vegetal.

• Estudio efectos estreses abióticos (salinidad): papel de las acuaporinas.

+ 15 años de investigación

<p>Planta (2013) 237:1297-1310 DOI 10.1007/s00425-013-1849-5</p> <p>ORIGINAL ARTICLE</p> <p>Response of three broccoli cultivars to salt stress, in relation to water status and expression of two leaf aquaporins</p> <p>Beatriz Muries · Micaela Carvajal · María del Carmen Martínez-Ballesta</p>	<p>Journal of proteome research</p> <p>Analysis of Root Plasma Membrane Aquaporins from <i>Brassica oleracea</i>: Post-Translational Modifications, de novo Sequencing and Detection of Isoforms by High Resolution Mass Spectrometry</p> <p>J. Casado-Vela,^{1,2,3} B. Muries,^{2,3} M. Carvajal,¹ I. Boro,¹ F. Elortza,¹ and M.C. Martínez-Ballesta^{1*}</p> <p>Plataforma de Proteómica, CIC BioGUNE, CIBERbhd, ProteoRed, Parque Tecnológico de Bizkaia, Edificio 806, 48160, Bizkaia, Spain, and Departamento de Nutrición Vegetal, Centro de Edafología y Biología Aplicada del Segura - CSIC, Apdo. Correo 164, 30100 Espinardo, Murcia, Spain</p>
<p>Journal of Plant Physiology</p> <p>Intrinsic stability of Brassicaceae plasma membrane in relation to changes in proteins and lipids as a response to salinity</p> <p>Najla Chalbi¹, M^o Carmen Martínez-Ballesta², Nabil Ben Youssef¹, Micaela Carvajal^{1,2*}</p> <p>¹ Laboratory of Extemophyte Plants, Center of Biotechnology of Bot-Citrus (L2P-CIBIC), PO Box 961, 2050, Hammam-Lif, Tunisia ² Departamento de Nutrición Vegetal, Centro de Edafología y Biología Aplicada del Segura (CEBAS-CSIC), Campus Universitario de Espinardo, Edificio 25, 30100, Murcia, Spain</p>	<p>PLOS ONE</p> <p>Plasma membrane aquaporins mediate vesicle stability in broccoli</p> <p>María del Carmen Martínez-Ballesta¹, Pablo García-Gómez¹, Lucía Yepes-Molina¹, Angel L. Guzmán¹, José A. Teruel², Micaela Carvajal^{1*}</p> <p>¹ Aquaporin Group, Plant Nutrition Department, Centro de Edafología y Biología Aplicada del Segura (CEBAS-CSIC), Campus de Espinardo, Espinardo, Murcia, Spain; ² Departamento de Bioquímica y Biología Molecular A, Facultad de Veterinaria, Universidad de Murcia, Espinardo, Murcia, Spain</p>
<p>Environmental and Experimental Botany</p> <p>Relationship between aquaporins expression and B concentration for conferring cold stress tolerance in broccoli cultivars</p> <p>Alvaro Lopez-Zaplana, Juan Nicolas-Espinosa, Micaela Carvajal, Gloria Bárzana</p> <p>Aquaporin Group, Plant Nutrition Department, Centro de Edafología y Biología Aplicada del Segura (CEBAS-CSIC), Campus Universitario de Espinardo, Edificio 25, 30100, Murcia, Spain</p>	<p>Article</p> <p>Detergent Resistant Membrane Domains in Broccoli Plasma Membrane Associated to the Response to Salinity Stress</p> <p>Lucía Yepes-Molina¹, Micaela Carvajal¹ and María Carmen Martínez-Ballesta^{2,*}</p> <p>¹ Group of Aquaporins, Department of Plant Nutrition, Centro de Edafología y Biología Aplicada del Segura (CEBAS-CSIC), Campus de Espinardo, E-30100 Murcia, Spain; lyespes@cebas.csic.es (L.-Y.-M.); mcarvajal@cebas.csic.es (M.C.) ² Department of Agronomy Engineering Universidad Politécnica de Cartagena, Paseo Alfonso XIII, 48, 30203 Cartagena (Murcia), Spain * Correspondence: mcarmen.ballesta@upct.es</p>



Método patentado (PCT/ES2012/070366) de obtención de vesículas de membrana enriquecidas en acuaporinas (Carvajal et al., 2011)

Desarrollo de la tecnología de nanoencapsulación empleando vesículas de membrana de origen vegetal.

Colloids and Surfaces B: Biointerfaces

Plant plasma membrane aquaporins in natural vesicles as potential stabilizers and carriers of glucosinolates

María del Carmen Martínez-Ballesta^a, Horacio Pérez-Sánchez^b, Diego A. Moreno^c, Micaela Carvajal^{1,*}

Journal of Advanced Research

Plant plasma membrane vesicles interaction with keratinocytes reveals their potential as carriers

Lucía Yepes-Molina, María Carmen Martínez-Ballesta, Micaela Carvajal

applied sciences

Nanoencapsulated Boron Foliar Supply Increased Expression of NIPs Aquaporins and BOR Transporters of In Vitro *Ipomoea batatas* Plants

Juan Nicolas-Espinosa¹, Pablo García-Gómez¹, Juan J. Ríos², Abel Piqueras³, Gloria Bárzana¹ and Micaela Carvajal^{1,*}

frontiers in Plant Science

Foliar Application of Boron Nanoencapsulated in Almond Trees Allows B Movement Within Tree and Implements Water Uptake and Transport Involving Aquaporins

Juan J. Ríos, Alvaro Lopez-Zaplana, Gloria Bárzana, Alberto Martínez-Alonso and Micaela Carvajal

El objetivo general del proyecto es estudiar diferentes cultivares de brócoli y condiciones de cultivo para reducir el aporte mineral y de agua, y profundizar en la respuesta de estos cultivares a estreses abióticos como salinidad.

Para ello, se establecen los *siguientes objetivos parciales*:

- 1. Búsqueda de las variedades más indicadas para la reducción de nutrientes y de agua.**
- 2. Evaluar el efecto del estrés salino sobre el metabolismo de las plantas.**
- 3. Aplicación de nanotecnologías de precisión para mejorar la respuesta fisiológica de las plantas. Se aplicarán nanotecnologías de encapsulado de nutrientes.**

- **ACTIVIDAD 1.** Selección de cultivar más idóneo para su experimentación en campo atendiendo a respuesta al estrés salino.
- **ACTIVIDAD 2.** Comportamiento del cultivar en condiciones de estrés abiótico atendiendo a la expresión de acuaporinas.
- **ACTIVIDAD 3.** Implantación de nuevas metodologías (nanotecnologías de precisión) para la obtención de brócoli de un modo sostenible.

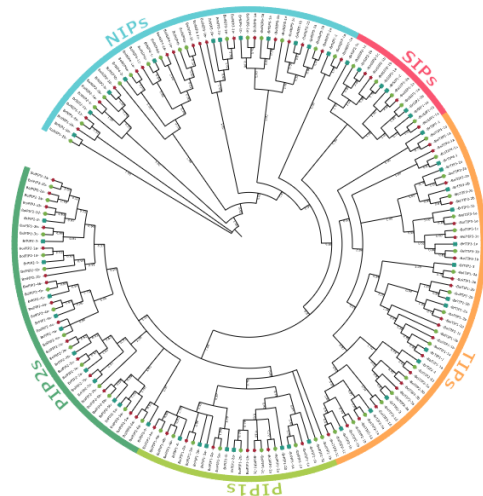
Resultados alcanzados

Identificación acuaporinas brócoli

Se determinaron y clasificaron un total de **65 isoformas** de acuaporina.

Los eventos evolutivos de duplicación génica explican la tendencia de las NIPs a extender sus isoformas.

Los motivos conservados y la estructura terciaria determinan el papel biológico de cada isoforma de acuaporina.



Selección cultivar idóneo



Var1 Var2 Var3

Medidas fisiológicas

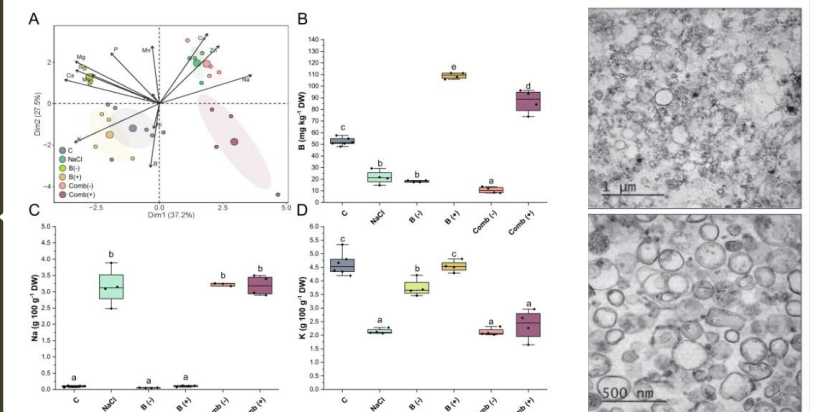
Selección var3

- Estudio respuesta a estrés salino y déficit nutrientes
- Análisis RNA-seq
- Análisis proteómico

Respuesta a nivel de membranas

Los resultados subrayan la importancia del transporte de agua por las **AQPs** y su interacción con la composición de esteroides en las membranas, para facilitar **los mecanismos de adaptación al estrés por salinidad-boro**.

Las plantas modificaron la presencia de AQPs en membrana para evitar la pérdida de agua en salinidad y para aumentar la captación de B en deficiencia de B.



Resultados publicados

Artículos y congresos

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Contents lists available at ScienceDirect

Plant Science

journal homepage: www.elsevier.com/locate/plantsci



Deciphering the effect of salinity and boron stress on broccoli plants reveals that membranes phytosterols and PIP aquaporins facilitate stress adaptation

Juan Nicolas-Espinosa, Lucia Yepes-Molina, Fuensanta Martinez-Bernal, Miriam Fernandez-Pozurama, Micaela Carvajal*

Aquaporins Group, Plant Nutrition Department, Centro de Edafología y Biología Aplicada del Segura (CEBAS-CSIC), Campus Universitario de Espinardo, Edificio 25, 30100 Murcia, Spain

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Insights into the Physiological and Molecular Basis of Blindness in Broccoli Plants: A Comprehensive Study of RNA-Sequencing and Metabolite Profiling

Juan Nicolas-Espinosa¹, Lorena Albaladejo-Marico¹, Micaela Carvajal¹
¹Plant Nutrition Department, Centro de Edafología y Biología Aplicada del Segura (CEBAS-CSIC), Campus Universitario de Espinardo, Edificio 25, 30100 Murcia, Spain

Introduction Blindness or shoot apical meristem (SAM) arrest, hinders plant development by causing the death of the growing point. Factors like low temperatures, day length, and stress can contribute to blindness broccoli, known for its health benefits, is prone to blindness. Glucosinolates play a role in adapting to cold temperatures. Alterations in aquaporins, nutrient transporters, and water regulation pathways may contribute to blindness.

Objectives This study aims to investigate the mechanism behind blindness in broccoli plants by analyzing RNAseq and physiological parameters related to nutrient, water, and gas exchange.

Materials and methods Seed germination was conducted in a semi-arid Mediterranean region, and physiological parameters such as fresh weight, dry weight, and transpiration rate were measured. Mineral content and secondary metabolites were also analyzed. Additionally, RNA sequencing was performed to assess gene expression. Statistical analyses were conducted to determine significant differences.

Results The study shows that blindness in broccoli is associated with altered gene expression and physiological parameters. Key findings include changes in aquaporin and nutrient transporter genes, and the presence of glucosinolates. The results suggest that membranes phytosterols and PIP aquaporins facilitate stress adaptation.

Conclusions Blindness in broccoli plants resembles abiotic stress, with decreased water potential and disrupted hydric signals. Reduced levels of boron, potassium, and magnesium suggest water homeostasis involvement in blindness development. Blind plants require osmolytes like succinic acid and proline for water uptake. Lower GSIs and phenolic compounds in blind plants disrupt water and solute transport. Downregulated genes in aerial parts indicate a complex interplay of molecular and physiological mechanisms in blindness development. Blindness involves disrupted nutrient uptake, metabolism, and gene expression, emphasizing the interconnected factors. Understanding the underlying prevention or treatment. Further research is needed for effective interventions.

Acknowledgments This work was supported by the Spanish Ministerio de Ciencia e Innovación (MCIN) through the project PID2020-113543GB-I00 (MCIN/AEI/10.13039/501100011033) and the project PID2020-113543GB-I00 (MCIN/AEI/10.13039/501100011033).

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Broccoli (*Brassica oleracea* L. var. *italica*) extract for enhancing seed germination and growth under abiotic stresses

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Introduction The plant extracts contain a wide range of bioactive compounds that can positively influence plant growth and development. Among the bioactive compounds, there are hormones, antioxidants, mineral nutrients, and enzymes that could also improve the ability to withstand stress by enhancing physiological and biochemical mechanisms that protect against stress-induced damage.

Materials and methods An extract from broccoli was obtained and characterized by HPLC from freeze-dried leaves. The mineral composition as well as the primary metabolites of the extract were measured. Seeds from three different crops, broccoli, tomato and lettuce were grown in agar enriched with different concentrations of our broccoli extract. The effect of the extract was tested on control seeds and those grown under abiotic stresses. The green expanded cotyledon was counted over the next 24 days and the plant growth was determined in agar.

Objectives The objective of this research project is to investigate the potential of broccoli extracts derived from agricultural and food industry waste, which are known to contain abundant active biomolecules, for improving crop germination and growth under drought and salinity stress.

Results The study shows that the broccoli extract significantly improves seed germination and growth under abiotic stresses. Key findings include increased germination percentage, fresh weight, and root length. The results suggest that the extract contains bioactive compounds that enhance plant growth and stress tolerance.

Conclusions Broccoli extract obtained from agricultural industry waste rich in secondary metabolites such as glucosinolates and phenolic compounds. Broccoli extract increased the percentage of expanded green cotyledons in broccoli seeds and fresh weight in broccoli, tomato, and lettuce seeds. Broccoli extract increased the percentage of expanded green cotyledons, fresh weight, and root development of broccoli seeds under abiotic stress conditions.

Acknowledgments This work was supported by the Spanish Ministerio de Ciencia e Innovación (MCIN) through the project PID2020-113543GB-I00 (MCIN/AEI/10.13039/501100011033).

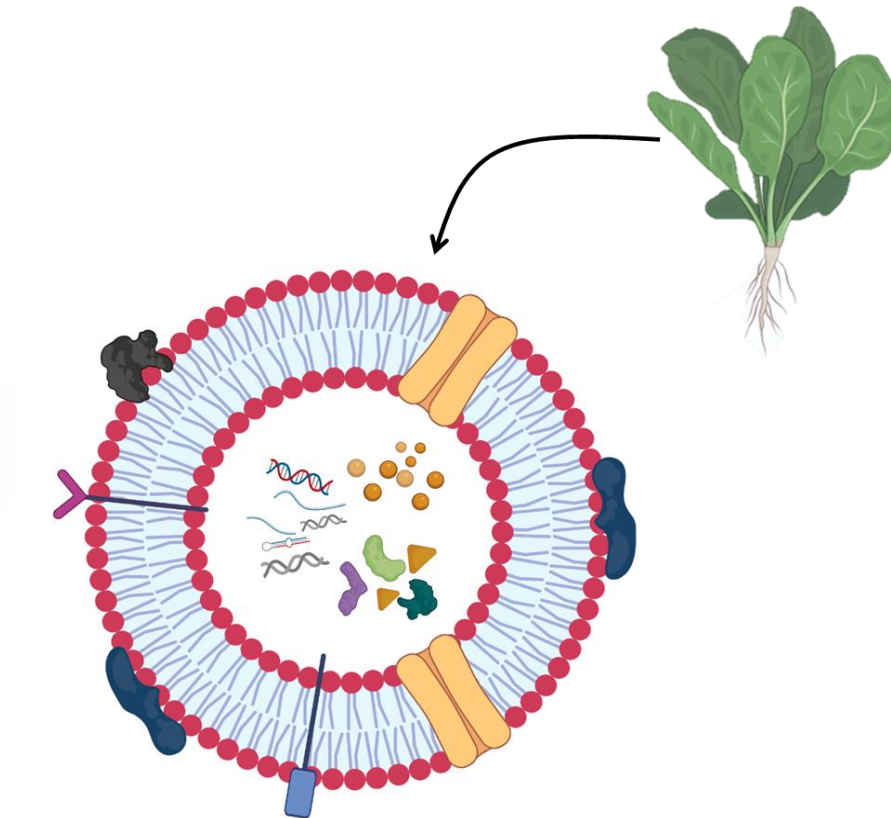


Experimentos en curso

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- ACTIVIDAD 3.** Implantación de nuevas metodologías (nanotecnologías de precisión) para la obtención de brócoli de un modo sostenible.

Aplicación foliar de nutrientes encapsulados



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