

# Ovidiu Andrei Toca

atoca@nmsu.edu

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## Research Areas

- Stress ecophysiology of forest species, focusing on reforestation strategies that enhance seedling field performance in harsh environments—such as post-fire and drought-prone landscapes—through nursery cultivation protocols, quality assessment, and outplanting techniques.
- Root architecture and growth dynamics of tree seedlings, focusing on their role in early establishment and survival.
- Physiological stress memory as a driving mechanism for enhancing seedling resistance to recurring environmental stress.
- Plant hydraulic traits related to drought stress resistance and growth potential in trees.

## EDUCATION

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**Ph.D. – Biology** 2019

UNIVERSITY OF ALCALA/PURDUE UNIVERSITY Alcala de Henares, Spain/ West Lafayette, IN

*Dissertation: The role of nitrogen in frost tolerance, root growth dynamics and hydraulic conductance of ecologically distinct pine species.*

**MASTER'S DEGREE – FOREST RESEARCH** 2013

Polytechnic University of Madrid Madrid, Spain

*Dissertation: Effects of fertilizer on the frost resistance of four pine species of the Iberian Peninsula*

**BACHELOR'S DEGREE – BIOLOGY (Five-year career)** 2005

UNIVERSITY OF ALCALA Alcala de Henares, Spain

**LANGUAGE SKILLS** – Fluent in Spanish, Romanian, and English.

**STATISTICS** – R programming and Statistica

## PROFESSIONAL EXPERIENCE

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**RESEARCH SCIENTIST** 2024 – Present

NEW MEXICO STATE UNIVERSITY Mora, NM

- Establish and maintain short- and long-term research projects focused on the stress ecophysiology of forest species, with emphasis on enhancing reforestation success in post-fire and drought-prone environments.
- Pursue and secure federal, state, and private funding to support research projects.
- Advise and mentor graduate students working on research in forest ecophysiology and reforestation.

## POSTDOCTORAL RESEARCH ASSISTANT

2020 – 2024

PURDUE UNIVERSITY

West Lafayette, IN

- Funded by USDA AFRI project: Acclimating commercial tree seedling root system architecture to drought.
- Established several experiments in collaboration with research groups at Idaho University, Oregon State University and the University of Utrecht.
- Current primary research focus is harnessing the morpho-physiological acclimation processes driven by drought memory to harden tree seedlings to harsh outplanting conditions and climate change.

## LABORATORY MANAGER

April – August 2022

PURDUE UNIVERSITY

West Lafayette, IN

- Provided oversight of research and laboratory equipment for the Forest Ecology, Silviculture and Soils Laboratory.
- Responsible for providing Laboratory Safety Training for students and technicians.
- Research Equipment Training: Li-Cor 6400XT, PMS Pressure Chamber, WinRhizo Root Scanner, EMT Environmental Chambers, Costech Elemental Combustion System, HPFM Hydraulic Conductance System.

## VISITING SCHOLAR

Feb – May 2015 and Feb 2016 – April 2017

PURDUE UNIVERSITY

West Lafayette, IN

- Scientific collaboration with Dr. Douglass Jacobs in forestry, ecological restoration, and plant physiology experiments.

## RESEARCH ASSISTANT

June – July 2013 and January – August 2014

UNIVERSITY OF ALCALA

West Lafayette, IN

- Project: Tolerance and ecophysiological strategies of Iberian pines at juvenile stages to drought, low temperature, and nutrient availability. University of Alcalá. P.I. Dr. Pedro Villar-Salvador.

## TEACHING EXPERIENCE

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### PURDUE UNIVERSITY

- Tree physiology (FNR434) – Principal instructor, 3 credits. Fall 2022 and Fall 2023.
- Dendrology (FNR225) – Principal instructor, 3 credits. Fall 2023.
- Costa Rica Natural History Study Abroad – Teaching assistant. Spring 2022.
- Forest Regeneration (FNR535) – Guest lecturer, Fall 2020.

### POLYTECHNIC UNIVERSITY OF MADRID

- Ecophysiological Prospects for Seedling Propagation Practicum – Guest lecturer. Fall 2015

### STUDENT MENTORSHIP

- Laura Quiza-Medina – Visiting scholar in Dr. Jacobs' Regeneration and Restoration Silviculture Laboratory (Purdue University). Undergraduate research project defended in August 2021.

## PEER-REVIEWED JOURNAL ARTICLES

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- **Toca A.**, Moler E. R. V., Gonzalez-Benecke C. A., Nelson A. S., Jacobs D. F. (2025). Drought memory expression varies across ecologically contrasting forest tree species. **Environmental and Experimental Botany**. 231:106094
- **Toca A.**, Moler, E. R. V., Nelson, A., Jacobs, D. F. (2022). Environmental conditions in the nursery regulate

root system development and architecture of forest tree seedlings: a systematic review. **New Forests**, 53(6), 1113–1143.

- Moler E. R. V., **Toca A.**, Jacobs D. F., Nelson A. S. (2022). Root system adaptations represent untapped opportunities for forest tree seedling improvement. **New Forests**, 53(6), 1069–1091.
- **Toca A.**, Villar-Salvador P., Oliet J. A., Jacobs D. F. (2020). Normalization criteria determine the interpretation of nitrogen effects on the root hydraulics of pine seedlings. **Tree Physiology** 40:1381–1391.
- **Toca A.**, Oliet J.A., Villar-Salvador P., Jacobs D. F. (2019). Ecologically distinct pine species show differential root development after outplanting in response to nursery nutrient cultivation. **Forest Ecology and Management** 451:117562.
- **Toca A.**, Oliet J.A., Villar-Salvador P., Maroto J., Jacobs D. F. (2018). Species ecology determines the role of nitrogen nutrition in the frost tolerance of pine seedlings, **Tree Physiology**, 38: 96–108.
- Fernández-Pérez L., Villar-Salvador P., Martínez-Vilalta J., **Toca A.**, Zavala M.A. (2018). Distribution of pines in the Iberian Peninsula agrees with species differences in foliage frost tolerance, not with vulnerability to freezing-induced xylem embolism, **Tree Physiology** 38: 507–516.

**REVIEWER OF MANUSCRIPTS FOR:** Tree Physiology, Frontiers in Plant Science, Annals of Botany, New Forests, Forests, Sustainability.

## RESEARCH FUNDING

- Center for Digital Forestry at Purdue University. Digital phenotyping to develop linkages between forest tree root system architecture and plantation establishment (co-PI). 2022-2023. **\$31,561.**

## RESEARCH PRESENTATIONS

- **Toca A.** Harnessing plant stress resistance to improve reforestation success. 2025. Guest Lecture
- Nelson A.S., Moler E.R.V., **Toca A.**, Jacobs D. F., Gonzales-Benecke C., Pinto J., and McDonough T. Drought conditioning to improve outplanting performance: Perspectives from tree seedlings and applications to rangeland plants. Society for Range Management Meeting, Rangeland Technology and Equipment Council Symposium: Beyond direct seeding: the next frontier of landscape scale vegetation restoration. Boise, ID. 2023. Oral presentation.
- **Toca A.**, Meline V., Moler E.R.V., Herrero-Huerta M., Nelson A.S., Jacobs D. F. X-ray computed tomography opens new horizons for root system architecture analysis in forest tree seedlings. 8th International Symposium of Roots of Woody Plants. 2022. Oral presentation.
- **Toca A.**, Moler E.R.V., Nelson A.S., Jacobs D. F. Manipulation of environmental conditions to regulate forest tree seedling root system development and architecture. Symposium – Forest Seedling Root Development and Function for Reforestation and Restoration. 2021. Oral presentation.
- Moler E.R.V., **Toca A.**, Jacobs D. F., Nelson A.S. Root system adaptations represent untapped opportunities for forest tree seedling improvement. Symposium – Forest Seedling Root Development and Function for Reforestation and Restoration. 2021. Oral presentation.
- **Toca A.**, Martínez-Catalán R. A., Oliet J. A., Villar-Salvador P., Jacobs D. F. Root growth dynamics of ecologically different pine species varies in relation with nitrogen nutrition. Society of American Foresters. 2016, Poster.
- Martínez-Catalán R. A., **Toca A.**, Oliet J. A., Villar-Salvador P. Importancia del estado nutricional en el crecimiento radical de pinos ibéricos durante su establecimiento. III Reunión conjunta del Grupo de Trabajo de Repoblaciones Forestales de la SECF y el Grupo de Trabajo de Restauración Ecológica de la AEET. 2015, Poster.
- **Toca A.**, Oliet J. A., Villar-Salvador P. Efecto de la fertilización sobre la morfología y el estado nutricional de cuatro especies de pino de la península ibérica durante el endurecimiento. III Reunión conjunta del Grupo de Trabajo de Repoblaciones Forestales de la SECF y el Grupo de Trabajo de Restauración Ecológica de la AEET. 2015, Poster.

- **Toca A.**, Oliet J. A., Fernández L., Villar-Salvador P., Martínez-Vilalta J., Savé R., Grau B., Herralde F., Castro J., Jacobs D. F. Comparison of the root, needle and xylem cold tolerance in four Iberian pines. 5th international conference on Mediterranean Pines (Medpine5). 2014, Oral presentation.
- **Toca A.**, Maroto J., Oliet J. A., Villar-Salvador P., Martinez-Catalán R. A. Relation between nitrogen fertilization and the frost resistance of four pine species. 5th international conference on Mediterranean Pines (Medpine5). 2014, Poster.
- Villar-Salvador P., Savé R., Castro J., **Toca A.**, Maroto J., Grau J., Zuccarini P., Herralde F., Oliet J. A., Differences in seedling field performance, water use efficiency, and root structure and function explains the distribution of four Iberian pines. 5th international conference on Mediterranean Pines (Medpine5). 2014, Oral presentation.