Instituto Nacional de Investigação Agrária e Veterinária, I.P.

Ecophysiological tools for Agroecology

Ecophysiology Group - Oeiras
Biotechnology and Genetic Resources Unit

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Summer School 2026
Elvas 27-29 April

GOVERNO DE PORTUGAL
MINISTÉRIO DA AGRICULTURA E DO MAR

Stress Physiology/Crop Productivity

- **Adaptation to Climate Change**
- Varietal Selection for Crop Improvement
- Stress Resistance
  - Drought
  - Extreme temperatures
  - High CO_2
  - Radiation
  - Salinity
  - Nutritional deficiencies
  - Biotic factors
- Irrigation support
- Biofortification

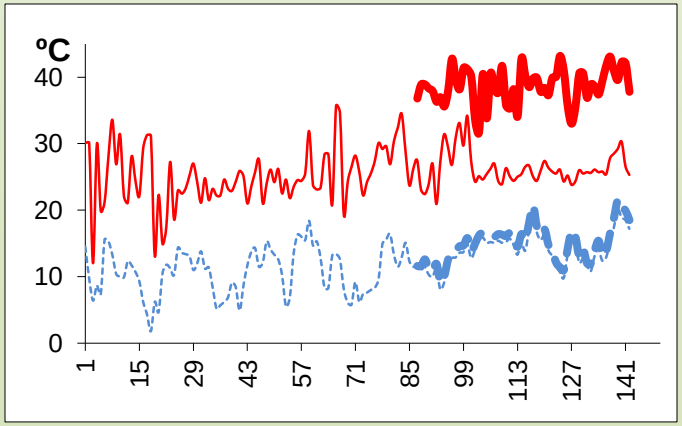
- ❖ **Productivity and quality improvement**
- ❖ **Increased crops sustainability**
- ❖ **Greater efficiency in the use of resources**
- ❖ **Characterization and valorization of plant genetic resources**

Experimental Fields

Controlled growth conditions

Greenhouse 1000 m²

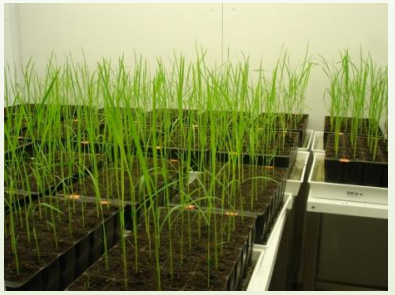
- **Temperature**
- **Shading**
- **Irrigation system**
- **Temperature and humidity sensors**
- **Data logger**



Controlled growth conditions

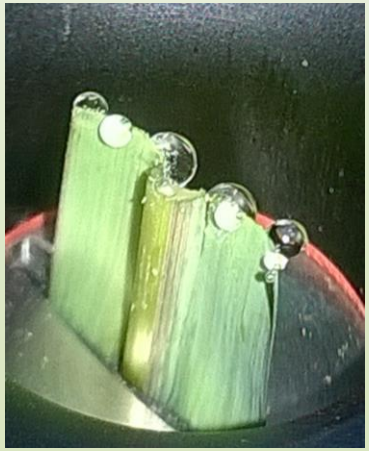
Climatized Growth Chambers

- Temperature
- Humidity
- CO_2
- Radiation



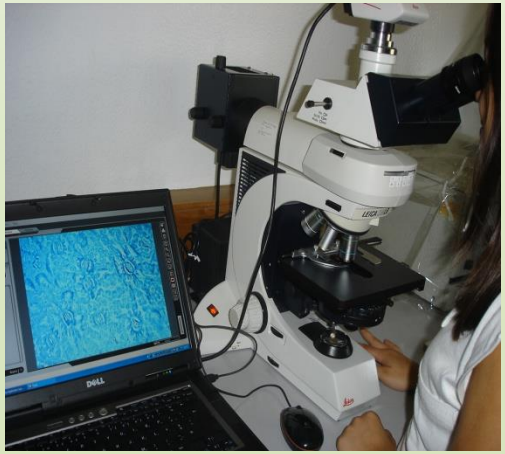
Ecophysiological tools

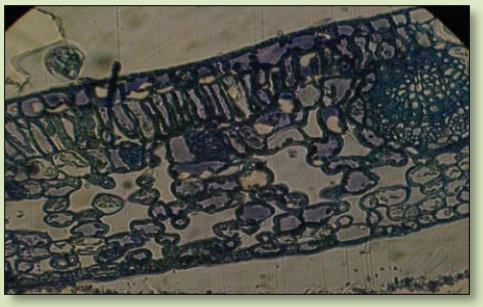
- Water relations (water potential, RWC)
- Gas exchanges and photosynthesis (IRGA)
- Water use efficency
- Growth analysis/ Yield Components
- Quality

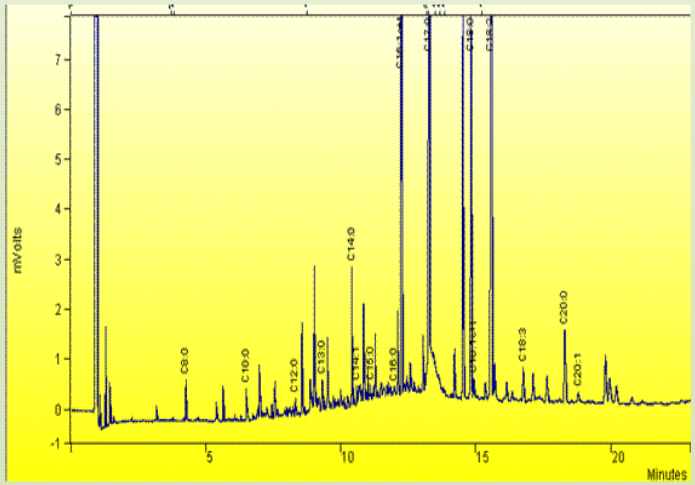


Physiological indicators

- Soluble sugars (HPLC)
- Lipids (GC-FID e TLC)
- Pigments (SPAD, espetrophotometry)
- Membrane stability (conductimeter)
- Microscopy observations







Research activities and R&D projects

Cereals

❖**Rice –** National Rice Breeding Program - INIAV Innovation Hub in Salvaterra de Magos;

- Supports the sustainability, productivity, and profitability of national rice production.
- Portugal is the major European rice consumer (17 Kg/person)
- Potential to improve self-provisioning
- Multidisciplinary team: breeding, agronomy, ecophysiology, and genetics;
- to obtain high-yielding varieties adapted to national soil and climate conditions;
- Tolerance to salinity, heat, and emerging pests and diseases, without compromising quality.
- To test new agricultural practices that promote more efficient use of resources (soil and water)

- Speed Breeding

Research activities and R&D projects

Cereals

❖**Rice –** National Rice Breeding Program - INIAV Innovation Hub in Salvaterra de Magos;

The National Rice Breeding Program has led to the registration of **new rice varieties in the National Catalogue of Varieties**, notably the **Caravela** variety (Carolino rice), which is already available on the market.

- Collaboration with the Rice Operational and Technological Center (COTARROZ) and companies
- Traits of interest for the entire rice value chain)
- Knowledge transfer to farmers and companies (Open days, agricultural fairs)
- General public and students

Research activities and R&D projects

Cereals

❖ **Rice** - INIAV Innovation Hub in Salvaterra de Magos

Project “Strengthening the Genetic Heritage of Portuguese Rice: The Key to Sustainable Innovation” (funding programme: PEPAC-C115-009583)

Commitment with the conservation of rice genetic resources (seed collections from Portuguese Plant Germplasm Bank/INIAV)

- Ensures the multiplication of seed and characterization of accessions

- Phenological traits, agronomical behavior, biochemical characterization (amylose), morphological traits
- Genetic diversity required to support the National Rice Breeding Program.

❖ **Rice** - Biofortification with selenium. Crop physiology and grain quality **(PRODER; PDR2020)**

Research activities and R&D projects

Cereals

❖Wheat

- Varietal selection for breeding

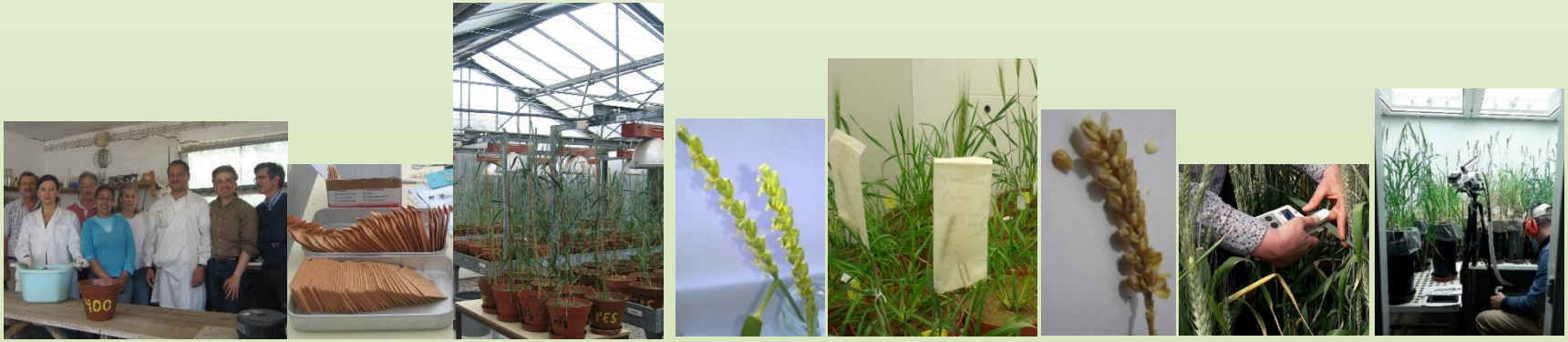
- Project “Wheat genotypes evaluation for high temperature and drought using photosynthetic performance and protoplasmic tolerance traits” (Enhancing the Value of Crop Diversity in a World of Climate Change, Global Crop Diversity Trust /FAO/Biodiversity Int./CGIAR).
- Project “FASTBREED - Implementation of a Bread and Durum Wheat Breeding Program Based on Genomic Selection” (Alentejo 2020).

- Genetic diversity for adaptation to Mediterranean conditions (funding Program PEPAC Genetic Resources; PRODER)

- Biofortification (Zn and Fe) (COST; PDR2020)

❖Barley

- Project **“**Enhancement of national production with differentiated varieties” (PRODER)



Research activities and R&D projects

Cereals

❖**Maize –** INIAV Innovation Hub in Coruche-António Teixeira Experimental Station

Partnership with the National Association of Maize and Sorghum Producers (ANPROMIS)

- Close connection with maize and other cereal producers, and seed companies.
- Collaboration with higher education institutions and vocational schools.
- Experimental plots enable applied research for new solutions to improve productivity and preserve biodiversity, as well as soil and water resources (cover crops)

Flagship actions: Field days for demonstration and knowledge transfer

Research activities and R&D projects

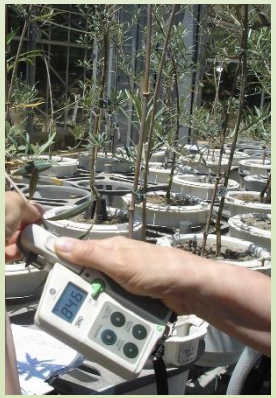
Vineyards and olive orchards

Project “Biochar4@ll - Long-term sustainable carbon capture and valorization in agricultural production” (funding program COMPETE2030-FEDER-01471600).

- benefits of biochar application in vineyards and olive orchards (Oeste and Alentejo)
- ecophysiology, plant water status, and vineyard productivity, soil composition and its microbiome.

Project “Soil4Ever – Increasing Irrigated Crop Productivity through Sustainable Soil Management” (funding program PTDC/ASP-SOL/28796/2017).

- increased salinity in irrigation water - Impacts in olive and pomegranate trees performance and productivity (Water Users Association of Roxo, Alentejo).



Research activities and R&D projects

Chestnuts groves and cover crops

Project EGIS – Strategies for Integrated Soil and Water Management in Nut-Producing Crops (Funding program PDR2020-101-030980). National Competence Center for Nuts (Promoter), Polytechnic Institutes of Bragança, Coimbra and Viseu, UTAD, and Producers' Associations (2022).

- Chestnut trees under rainfed conditions in the highlands of central Portugal (Serra de São Mamede)
- Cover vegetation improves soil fertility and water retention capacity;
- It may benefit plants performance and production under drought stress
- Ecophysiological traits monitored during crop cycle in native and hybrid varieties, to evaluate which are the most adapted to local conditions.

Project PastForBreed – Conservation and Breeding of Grassland and Forage Species (Funding program PDR2020-784-FEADER-042725 2022).

- *Trifolium* acessions subjected to drought

Research activities and R&D projects

Cork oak and holm oak woodland 'Montado'

- Detection and control of infection by *Phytophthora cinnamomic* (AGRO).
- Conservation/rehabilitation. Cork and environmental valorization (AGRO).
- *Lolium* - Nitrogen-fixing biofertilizers for grass crops (PTDC/AGR-AAM/100577/2008)

Contribute to preserve and maintain this man made agroecosystem, through the use of :

- more resilient grass and legumes species to be used as cover crops/pasture/ soil protection
- oak trees resistant to diseases and extreme environments

Research activities and R&D projects

Other legume species

❖**Vigna** –CoHeSus – Study of the Genetic Diversity of Cowpea for a Healthier and More Sustainable Diet. Project ALT20-03-0145-FEDER-029867. INIAV (Promoter) and University of Lisbon; 2018–2022.

❖**Vigna** - Adaptation to drought and development of new varieties for dry regions (UE-STD).

❖**Chickpea –** Tolerance to drought: morphological, physiological and chemical characterization (PIDDAC).

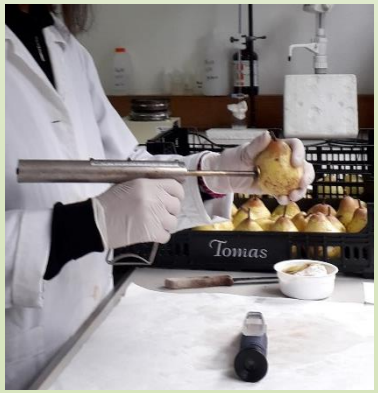
❖**Peanut** - Amélioration génétique de l'adaptation à la sécheresse de l'arachide (UE-STD).

❖**Pachyrhizus** - Exploring the potential of a sustainable crop as an alternative non-food source (Fair).

Research activities and R&D projects

Other crops

- **Pinus -** rePlant – Implementation of collaborative strategies for integrated forest and fire management - "Plant responses to abiotic stress (drought)" (POCI-FEDER)
- **Coffea -** Implications of environmental changes in CO_2 levels, drought and temperature at the plant level and on grain quality (PTDC; Horizon 2020)
- **Casuarina -** Salt stress tolerance and its relationship with nitrogen fixation (PTDC)
- **Cotton -** Feasibility of introduction in the Alqueva irrigation scheme influence area (PEDIZA).
- **Tomato –** Crop monitoring in view of irrigation using physiological indicators (PARIPIPI).
- **Vitis, Pyrus, Potato, Tomato** – Biofortification (PDR2020)
- **Almond tree -** Characterization of varietal performance under rainfed conditions (PDRITM).



Key messages

- Multidisciplinary teams in close collaboration
  - to assess crops performance under changing climate
  - to characterize and evaluate plant genetic resources
- Research for improved resilience of crops and agroecosystems
- Involving farmers and other stakeholders in AE concerns
- Creativity and persistence in communication

Thank you
for your attention!

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