Mediterranean Stone pine and pine nuts: more knowledge for a better management

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(Portugal)
Pinus pinea distribution in Portugal

Forested area ~3.2 million ha

Preço da pinha (€/kg)

Cone price (€/kg)

Pine nut price (€/kg)

Reus é a Capital Europeia de Frutos Secos e as cotações da bolsa de Reus são a principal referencia em todo o mercado da UE.
Stone pine stands in Portugal

Natural regeneration stands

Natural regeneration stands mixed with cork oak

Afforestations in the understory of other species

New plantations for grafting

Grafting success rates ~80-90%
Managers main problems and research interests

Survey (75 participants)

Who was present?

- Landowners: 19.2%
- Industry: 38.4%
- Forestry associations: 9.6%
- Companies: 9.6%
- End-user: 9.6%
- Researcher: 9.6%

Main threats to cone production:

- Climate change: 43.8%
- Pests and diseases: 23.3%
- Lack of management: 24.7%

Main problems on the chain of custody:

- Absence of nuts certification value: 35.6%
- Absence of labor force: 20.5%
- Competition with Asian pine nuts: 13.7%
- Transparency of cone commercialization: 9.6%
- Lack of knowledge about management: 9.6%

Research priorities:

- Climate change: 26.3%
- Watering and fertilization: 14.5%
- Management: 10.5%
- Pests and diseases: 14.5%
- Tree breeding and genetics: 19.7%
- Network of permanent monitoring plots: 14.5%
Reported reduction in cone production

Especially in south regions without production for a couple of years

What to do with these stands?

Management alternatives to increase cone production? (irrigation, fertilization)

Commercial: Resin exploitation?

Ecological: Soil protection; biodiversity
Climate change

Water deficit leads to productivity reduction

Increases carbohydrates needs to keep structures growing

Higher susceptibility to pests and diseases

Trees with no capacity to overcome the rapid climate change

Precipitation in Spring

Temperature in Spring

SPRING: pollination, flowering, diameter growth, new branches, fertilization

Abnormalities of precipitation and maximum and minimum temperatures in relation to the average 1971-2000 (source: IPMA)
Pine cone theft

Pine cone declaration Law nº 77/2015, de 12 de Maio mandatory for all the operators involved in the collection, transport, storage, processing, import and export of pine cones of stone pine in continental territory

Monitoring the commercialization of pine cones from harvest to the final destination, allowing for increased phytosanitary control, including import inspection

Improve the transparency of marketing channels for pine cones and the knowledge of authorities and economic operators in the sector.

Allow traceability throughout the economic circuit of the pine cones, enabling certification and quality control processes.

To compile statistical information on the sector that supports decision-making on forestry policy and the development of the sector.

Reinforcement of the monitoring and surveillance component
Pests and diseases

**Leptoglossus occidentalis**  
Sugador das pinhas

**Dioryctria mendacella**  
Traça das pinhas

**Pissodes validirostris**  
Gorgulho das pinhas

Detetado em Portugal pela 1ª vez em 2000
What is the focus of our investigation at the moment?
Biomass allometric models for stone pine (aboveground and roots) suitable to use in Mediterranean countries
Fertirrigation trials

- Plantation in 2010
- Grafting in 2013
- FR since 2015
- 7 x 7 m

- Plantation in 2007
- Grafting in 2011
- FR since 2014
- 6 x 8 m
Using drones for forest management

Models for canopy height using photogrammetry

Visible light flights above the canopies

Tree counting and vigour quantification using multispectral sensors

Using high resolution UAV imagery to estimate tree variables in Pinus pinea plantation in Portugal

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Reproductive phenology

Flower receptivity

Pollen dehiscence

Events synchronization and relationship with perturbation factors (meteorological, pests)
Integrated management of the biotic agents associated with loss of stone pine nut production (+ PINHÃO)

Main objectives:

- Develop **diagnostic and monitoring processes** to determine the impact of biotic agents on stone pine nut production.
- Determine periods of pine cone development at risk by correlating the pine tree phenology with the biological cycle of biotic agents.
- **Develop processes and control tools** for biotic agents affecting pine nut production
Nutrition and fertilization of rainfed and irrigated Pinus pinea (FERTIPINEA)

Main objectives:

✓ Establishment of fertilizer recommendations for installation of new stone pine stands based on soil analysis

✓ Establishment of fertilizer recommendations for young and adult stone pine stands based on soil and leaf (needles) analysis and, where applicable, irrigation water quality

✓ Establishment of reference values for needle analysis interpretation to stone pine stands

✓ Validation of irrigation opportunity criteria at the most critical stages of the vegetative cycle

✓ Establishment of biometric and ecophysiological indicators for monitoring environmental stresses to pine stone
CONCLUSIONS

✔ Portugal is...

Active in the stone pine research, using new tools in forest management to increase cone production
Making an effort to improve its strategy for the transparency of marketing channels
Communicating and sharing research knowledge with stakeholders

✔ The investigation is focused on...

Climate change topic, namely the impacts of heat waves, precipitation reductions on the reproductive biology
Pests and diseases, especially in developing monitoring methodologies
Silviculture: sustainable watering and fertilization

→ Always open to collaborations with other countries