

ALMOND: Key factors in improving the management of brown rot in almonds

Summary

In Catalonia, the growing of almonds (*Prunus dulcis*) is characteristic of the coastal regions of Tarragona and the Lleida plain, mainly in dry farming systems. It was traditionally adopted in marginal areas because it presents one of the few opportunities for production in semi-arid lands with poor quality soils. However, IRTA studies have made new varieties and new techniques available for irrigated almond cultivation (new production models, new irrigation strategies, etc.). In this context of new agronomic practices and almond growing systems, it is necessary to address the diseases that may restrict the potential development and consolidation of new irrigated plantations, such as the one caused by *Monilinia* spp. The GO-ALMON project studied the epidemiology of brown rot in almonds in the Vall de l'Ebre production area, and identified the causal agent. Its presence in infected plant material was monitored, and its sensitivity to the main fungicide products used in the intensive management of this crop assessed. This project determined the extent of the damage caused by *Monilinia* spp. in almonds and the factors that contribute to it.

Objectives

The general objective of this project was to improve knowledge of the causal agents of brown rot in almonds in order to improve control of the disease. The following specific objectives were established in order to achieve this overall objective:

- 1-Study the epidemiological factors affecting the incidence and severity of the disease in almonds caused by *Monilinia* spp. and its adaptive capacity in the Vall de l'Ebre region.
- 2-Characterise and monitor the symptoms and quantify the damage and losses associated with the disease.
- 3-Identify and quantify the *Monilinia* spp. populations causing brown rot.
- 4-Determine the resistance/susceptibility to fungicidal products of *Monilinia* spp. populations isolated under intensive growing conditions of this crop.

Description of the actions carried out in the project

The actions carried out in the GO-ALMON were classified into 4 groups, according to the specific objectives defined in the project:

1. Actions to **study the epidemiology** of *Monilinia* spp. in almond trees in the Vall de l'Ebre region:

Action 1.1. The location, distribution, and incidence of primary propagules caused by *Monilinia* spp. was ascertained.

Action 1.2. The location, distribution and incidence of secondary propagules throughout the phenological cycle of the crop were studied, and specifically in flowers and fruits.

Action 1.3. The final incidence of the disease in fruit and its distribution on the almond farms studied was determined.

Action 1.4. The strains causing brown rot were isolated in order to identify the species causing the disease.

Action 1.5. The incubation and latency period of different strains in recently established infections of flowers and fruit in a variety of almond was determined.

Action 1.6. The agro-meteorological factors of each farm were determined to establish their correlation with the epidemiological information.

2. Actions to **classify and quantify the damage** associated with the disease.

Action 2.1. The evolution of symptoms and damage associated with varying degrees of severity the disease in the different phenological stages of the crop and in the various organs that may be affected was classified and monitored.

Action 2.2. Crop losses in the field and the decline in fruit quality after the harvest associated with disease damage were assessed.

3. Actions to **monitor populations of *Monilinia* spp.** in production areas.

Action 3.1. The plant organs affected by brown rot were sampled, and the causal strains were isolated.

Action 3.2. The species of *Monilinia* causing the disease was identified.

4. Actions to determine **the resistance/susceptibility to fungicidal products** of the populations of *Monilinia* spp. obtained from plantations with intensive management.

Action 4.1. Strains of *Monilinia* spp. causing brown rot in almonds were isolated from intensively managed plantations.

Action 4.2. The species of *Monilinia* causing the disease was identified.

Action 4.3. The resistance/susceptibility to fungicidal products usually used to control *Monilinia* spp. was determined.

Final results and practical recommendations

The studies to identify the **primary sources of propagules** showed that in the farms studied, the soil under the trees contains no spores of *Monilinia* spp., and that the main source of spores are **mummies present on the ground and in the tree**, and especially the latter. Wood cankers with symptoms of brown rot also presented spores of this fungus. It is therefore advisable to remove all plant material of this type during the autumn-winter so that the primary propagules in the next campaign are as limited as possible.

A **secondary source of propagules** was found to be *Monilinia* spp. as the cause of points of infection with symptoms of the disease. Its incidence was also highly correlated with weather conditions, and with rain in particular. Spores of *Monilinia* spp. were identified throughout the crop's phenological cycle, in **flowers and during development of the fruit**, as well as in **cankers**. However, in environmental terms the presence of *Monilinia* spp. in the fields evaluated can be considered insignificant, and it was not determined to be a source of secondary propagules. Treatments to control it should be applied when the risk of infection arises.

All the strains isolated in these fields were identified as ***Monilinia laxa***, and differences between those isolated in terms of their ability to infect flowers and fruits were observed.

When characterising and monitoring the disease in the field to assess the damage and loss it causes, a high degree of variability was observed in the field, but an **assessment of trees up to a height of 2 metres is sufficient**. Once again, the number of inflorescences and/or shoots affected was found to be heavily affected by climate conditions, with the highest incidence of disease in the 2020 campaign.

Monitoring of the disease in Catalonia and in other producing areas showed that **the primary species causing this disease is *M. laxa***. No resistance to the most widely used fungicides in the intensive management of this crop was detected in the isolates obtained and evaluated; no baseline differences in fungicides including fludioxinil, fenbuconazole, piraclostrobin, tebuconazole or diphenconazole were observed.

Conclusions

➤ The primary species causing brown rot in almonds is *Monilinia laxa*.

- The primary sources of propagules are mummies, which are mainly those located in trees, as well as cankers.
- A secondary source of propagules was found to be *M. laxa* spores, which are mainly found in flowers and fruits at different stages of their development, as well as in cankers. In environmental terms, the presence of this pathogen in the field is virtually nil.
- The incidence of the disease in the field can be assessed by counting plant material with symptoms that is located up to a height of 2 metres; there is no need to evaluate entire trees.
- The presence of *Monilinia* spp., primarily *M. laxa*, was monitored in all production areas in both Catalonia and elsewhere in Spain.
- The isolates from samples obtained from intensively managed fields and evaluated in this project showed no resistance to any of the 6 fungicides studied: fludioxonil, fenbuconazole, pyraclostrobin, boscalid, tebuconazole or difenoconazole.

Leader of the Operational Group

ORGANISATION: CRISOLAR NUTS, SL

Coordinator of the Operational Group

ORGANISATION: IRTA

CONTACT E-MAIL: silvia.fernandez@irta.cat

Other members of the Operational Group (grant recipients)

ORGANISATION: BORGES AGRICULTURAL & INDUSTRIAL NUTS

ORGANISATION: UNIÓ NUTS, SCCL

ORGANISATION: OCEAN ALMOND, SL

CONTACT E-MAIL: info@boletsdesoca.com

ORGANISATION: FRUITS SECS LES GARRIGUES, SCCL

Subject area(s) of application

- ☐ Agricultural production system
- ☒ Agricultural practice
- ☐ Agricultural equipment and machinery
- ☐ Livestock farming and animal welfare
- ☐ Vegetable production and horticulture
- ☐ Landscape / Territorial management
- ☒ Pest and disease control
- ☐ Fertilisation and nutrient management
- ☐ Soil management
- ☐ Genetic resources
- ☐ Forestry
- ☐ Water management
- ☐ Climate and Climate Change
- ☐ Energy management
- ☐ Waste and by-product management
- ☐ Biodiversity and environmental management

- ☐ Food quality/processing and nutrition
- ☐ Supply chain, marketing and consumption
- ☐ Competitiveness and agricultural and forestry diversification
- ☐ General

Geographical area(s) of application

PROVINCE(S): Lleida

REGION(S): El Segrià, La Noguera, La Segarra

Dissemination of the project: publications, seminars, multimedia, etc. (State

1. Dissemination of the project at the **IRTA Fruit Growing Seminar in October 2019**, on a poster entitled "Key factors in improving the management of brown rot in almonds" which presented the project's main objectives to the fruit growing sector.
2. Dissemination of the results in the **lecture** "New ideas in the epidemiology of *Monilinia* spp. in almond trees," at the **2021 IRTA Fruit Growing Seminar** (20 October 2021, in both Catalan and Spanish). The main results of the project regarding the epidemiological studies were presented.
3. Writing of a dissemination article, which is in the preparation stage, with the main results obtained for the sensitivity to fungicides of populations of *Monilinia* spp. in almonds.
4. Participation in the seminar organised by Crisolar, with the talk "Main diseases of the almond tree: the current state of knowledge," in Lleida on 14 July 2021. Fruitcentre (online).

More information on the project

PROJECT DATES	TOTAL BUDGET
Starting date: July 2019	Total budget: €211,364.00
End date: September 2021	DARP funding: €86,380.08
Current status: Executed	EU funding: €65,163.92
	Own funding: €59,820.00

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