

Use of rain nets to reduce the application of fungicides to control apple scab disease

Summary

In many places, scab is the most common disease in apple production. It is caused by the fungus *Venturia inaequalis* and its anamorph *Spillocaea pomi*. The disease begins at the beginning of winter, caused by spores projected from the inoculum reservoir present in the fallen leaves affected the previous year, the so-called primary infections. Rain triggers the release of the spores and provides the conditions needed to germinate and infect the unripe tissues. From the first spots, new spores appear that spread the disease, affecting new leaves and fruits. Most currently produced apple varieties are susceptible to the fungus.

Disease control is achieved by applying fungicides to prevent primary infections from thriving. Ten to twenty treatments are often required during the most sensitive period, depending on weather conditions of the year. The current legislative framework for agricultural production in the European Union with regard to the use of plant protection products (Directive 91/414/EEC, Regulation 396/2005 and Directive 128/2009), the foreseeable new guidelines of the CAP (Green Deal in its strategic Farm to Fork proposal) and pressure from society are aimed at reducing pesticides, including fungicides, in apple production.

This innovative project has shown that two techniques, installing rain nets and removing inoculum from the orchard soil, are applicable to our production conditions. They improve the effectiveness of disease control and reduce or eliminate the need for fungicides. The innovation involving the use of rain nets in apple growing also affects the quality of the product obtained: negatively, causing loss of colour, and positively, reducing russetting and cracking of the fruit. Finally, different types of facilities that allow nets to be moved throughout the campaign and reduce investment need to be explored.

Objectives

The general objective of the innovative project was the control of scab, reducing fungicides as far as possible during the apple production process. The following specific objectives were established:

1. Assess the feasibility of installing rain nets to control apple scab
2. Assess the effectiveness of *V. inaequalis* inoculum removal techniques to improve disease control

Description of the actions carried out in the project

Based on the objectives, the following actions were taken to control apple tree scab:

1. **Installing rain nets in apple orchards for comparison to uncovered trees.** The nets were mounted in marked out zones of two Fuji apple farms under the hail net. Two types of net were tested (reinforced raffia and plastic film) in two types of cover (V5 chapel and flat with elastics). The trees under the nets were not treated with fungicides on one of the farms and occasionally on the other. On one farm, control trees were not covered with rain nets or treated with fungicides throughout the season to assess the level of disease.



Raffia rain net and flat structure with elastics



Plastic film rain net and chapel structure

2. **Carrying out an inoculum *V. inaequalis* reduction test in winter, in addition to fungicide treatments during spring, compared to areas without actions to decrease inoculum pressure.** The trial was conducted on a Gala Brookfield apple farm with a history of the disease. Two mechanical inoculum reduction methods were tested: removal of leaves from the ground and burying leaves with soil work and a biological method with two applications of *Trichoderma* ssp. The inoculum control was carried out in winter, and the trees were treated with fungicides in spring. The incidence of scab was compared with that obtained in trees receiving conventional treatment and an untreated control, both without action on the inoculum in winter.



Mechanical collection of soil leaves from apple orchards, the source of primary scab inoculum

Final results and practical recommendations

The main result with the **installation of rain nets** was:

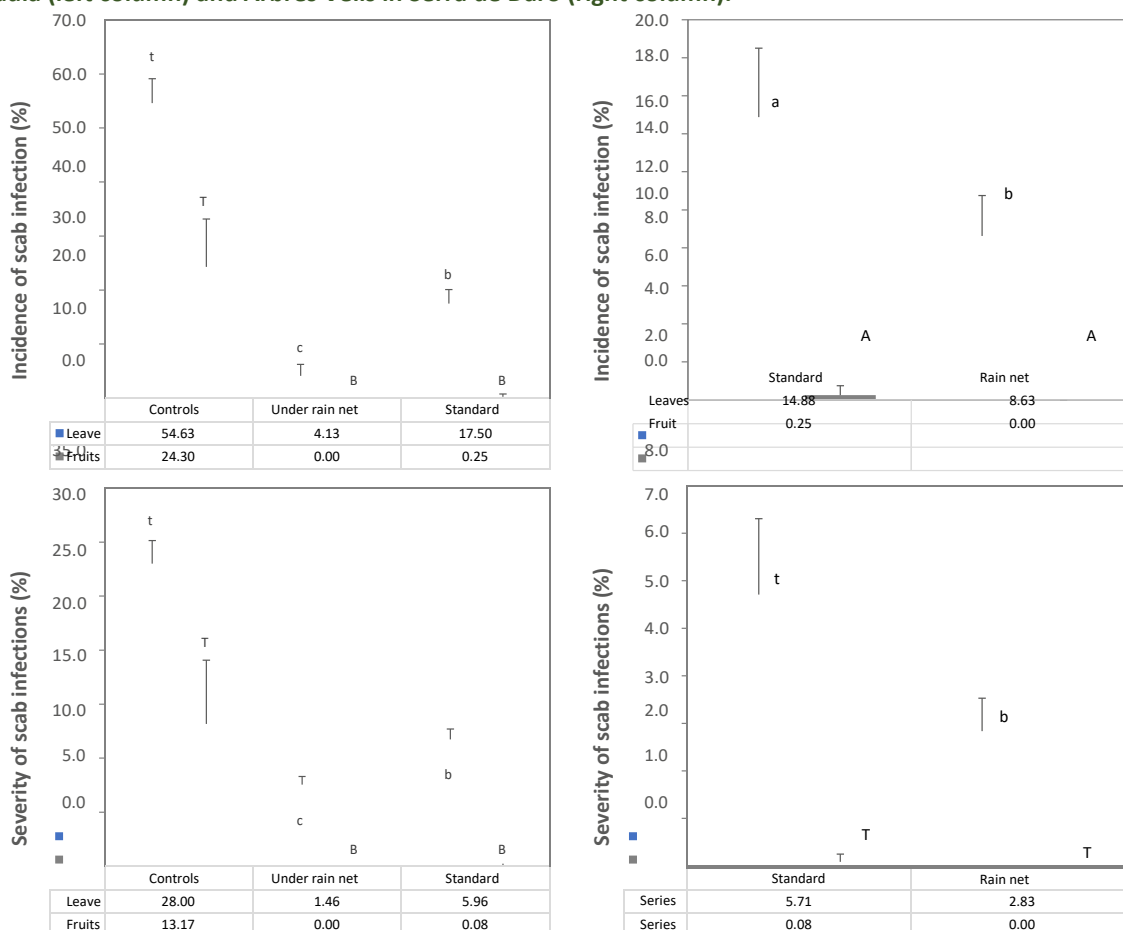
- They can **eliminate or reduce fungicide treatments against scab in varieties with a similar sensitivity to Fuji**, even in years with high rates of the disease. In 2020, a year with a high scab rate, 20 fungicides were used in the standard areas and between 0 and 6 in the areas covered by rain nets.

It may also be possible to reduce the number of fungicides required for varieties more sensitive than Fuji if kept under cover.

Additionally,

- The nets **modify environmental conditions** on the plantation. Under the nets, trees are not directly moistened by the rain, leaf wetting and the luminosity is less, and maximum daily temperature in spring are higher.
- **Treatments to control other diseases (e.g. powdery mildew, sooty blotch) or pests (e.g. red spider mite)** are not avoided, indeed some diseases may find conditions under the nets more favourable.
- The rain net **does not substantially affect production from the trees, nor fruit calibre, but it reduces the red colouring of the apple**. Other studies show a positive effect of nets in reducing cracking and russetting in fruits sensitive to disease.

Scab levels in the rain net tests on two test farms in Girona, Institute of Agrifood Research and Technology (IRTA) Mas Badia (left column) and Arbres Vells in Serra de Daró (right column).



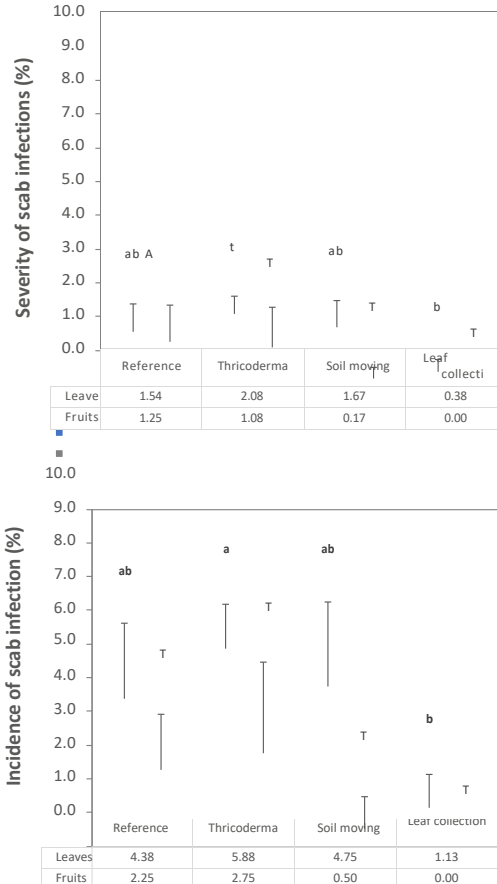
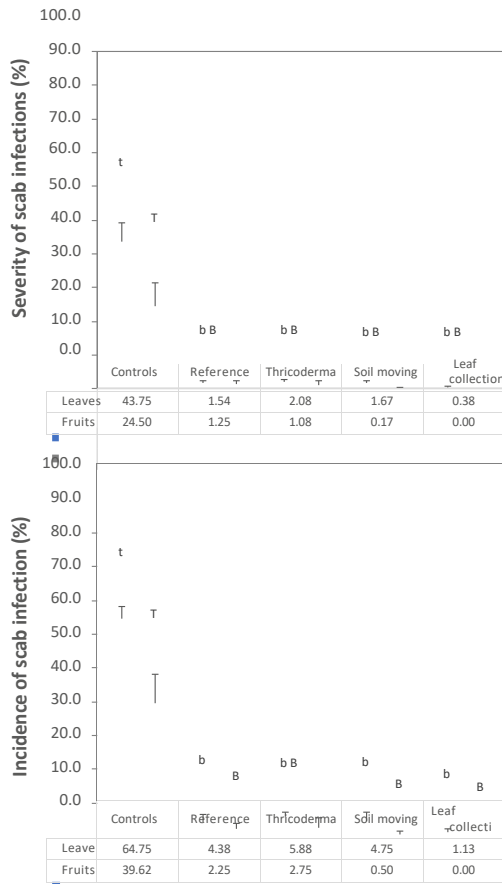
Incidence and severity of scab in the rain net test carried out in Girona in 2020. The letters in the columns indicate significant values different from the means, according to the Tukey test (p -value <0.05). Capital letters refer to fruit and lower-case letters to leaves.

The results obtained from applying measures to reduce the *V. inaequalis* inoculum show that:

- They complement standard fungicide treatments to improve **control of primary scab infections**, especially in years of high rates of the disease, more evidently in the fruit than the leaves.
- The most effective methods were the **mechanical collection of leaves and burial by soil moving**.

The application of *Trichoderma* did not improve the result compared to conventional fungicide treatment.

Scab in the inoculum removal test carried out in Girona.



Rate and severity of scab in the control carried out on 7/07/2020 in the inoculum reduction test in Ullà (2019-2020). The left of the figure shows the values for all test variants in relation to the untreated control, the right shows the data for inoculum reduction treatments in relation to the usual reference air-borne treatments in the zone. The error bars show the coefficient of variation in the mean for each treatment. The different letters in the columns indicate significant differences according to the Tukey test with a probability greater than 95%.

Conclusions

From the test conditions in this operational group, it may be concluded that:

- Rain nets help significantly reduce fungicide use for the control of scab in apples.
- Removing inoculum present in leaves in the soil of orchards in winter helps improve the effectiveness of primary *V. inaequalis* infection control, the cause of apple scab.

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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)	REGION(S)
Girona, Barcelona, Lleida (Any fruit area with apple scab problems)	Alt Empordà, Baix Empordà, Baix Llobregat, Segrià, Pla d'Urgell, Urgell, Noguera, Garrigues.

Dissemination of the project (publications, seminars, multimedia, etc.)

Various results transfer activities have been carried out throughout the project included in the PATT. Mention should be made of the follow-up meetings of the Fruit Producers Technical Committee and the technical seminar where more than a hundred fruit growers, technicians and other specialists involved in the apple sector attended the four different sessions, where they were able to see and learn about a number of technical solutions to maintain elite fruit growing using the most innovative technologies. The documentation submitted is available on the RuralCat website.



Project website

<https://www.gironafruits.com/>

More information on the project

PROJECT DATES	TOTAL BUDGET
Start date (month-year): June 2018	Total budget: €81,938.00
Completion date (month-year): September 2020	DARP funding: €33,486.36
Current status: Executed	EU funding: €25,261.64
	Own funding: €23,190.00

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