

Reduction of cracking in the Fuji apple variety

Summary

Thanks to its organoleptic quality, the Fuji apple is one of the varieties most sought after and accepted by consumers. Despite the agronomic difficulties associated with cultivating this variety, apple producers consider it to be a high-profit product, if minimum production levels are achieved. Many years, these minimum levels are not reached due to a high percentage of non-marketable fruit, caused by various defects that make its production virtually unviable. One of these defects is cracking. Cracking occurs slightly before the harvest and can individually or jointly affect the stalk area, the calyx or the flesh of the apple. In just a few hours, a little cracking in any of these areas of the fruit can quickly result in the cleaving of the pulp, which often leads to the complete or partial rotting of the fruit, making its sale impossible. Cracking frequently affects 10 to 20% of total production and in some years as much as 50%, with the resulting economic losses. There are numerous causes that trigger this condition, although there is one that is always present: rain or high relative humidity a few days before the fruit harvest. In order to address this problem, various solutions are proposed in this operational group that could reduce cracking. Of particular note is the installation of rain nets, which have reduced the incidence of cracking by up to 63% in the best case.

Objectives

The general objective is to reduce losses caused by cracking in the production of the Fuji apple. The specific objectives are:

1. Develop a harvest management protocol that minimises the likelihood of the appearance of cracking without affecting the potential quality of this variety.
2. Assess the technical viability of the installation of rain nets in order to prevent the appearance of this physiological disorder.
3. Assess the effect of different nitrogen fertilisation strategies on the risk of the development of cracking.
4. Design a strategy on the use of authorised bioregulators to reduce losses caused by cracking.
5. Assess the effect of different irrigation strategies on total losses due to cracking.

Description of the actions carried out in the project

Based on the objectives, five courses of action were addressed to minimise the effects of the cracking of Fuji apples:

- 1) Comparing different **harvesting times** to determine the most appropriate state of maturity. The effectiveness of the pre-harvest Harvista™ treatment on maturity management was assessed in three commercial Fuji orchards. Unfortunately, the treatment was applied at a late stage of maturity

(due to rains), which meant differences between treated and untreated apples could not be observed.

- 2) Installation of **rain nets** for tree protection compared to uncovered trees. Different types of nets were tested: reinforced raffia, plastic film and Protecta net, installed in a marked out section of three commercial Fuji orchards. The existing hail net structure was used to install the rain net below.
- 3) Conducting tests to compare **nitrogen fertilisation** applied close to harvest time with that applied in the spring. We compared four strategies where the total 60.9N-30.5P-74K units were applied at different times (a single application in spring, three applications spread from April to June, four applications spread from April to June and pre-harvest and four applications spread from April to June and post-harvest) which were compared with a suspended fertiliser control.
- 4) Conducting a further trial to assess the effectiveness of applying auxins (ANA), gibberellins (GA) and calcium solutions alone or in combination and other foliar treatments with Parka and biostimulants. A total of seven strategies and an untreated control were compared during two campaigns.
- 5) Comparison of **two types of irrigation system** on a commercial plot: drip irrigation and micro-sprinkler irrigation above the trees. Naandanjain's Flipper-type micro-sprinkler distributed the water to a width of 2 m, covering a row of apple trees only. Watering began in late June and lasted until harvest.

The effects of different **irrigation water quantities** were also evaluated. One month before harvest, plot irrigation quantities was changed so that three different treatments were left: (1) no irrigation, (2) normal irrigation with drippers of 4L/h per tree and, (3) double flow with 2 drippers per tree of 4L/h.

Final results and practical recommendations

In the field, different types of cracking can be observed. In the years assessed, cracking located on the back of the apple and to a lesser extent on the calyx and peduncle were most frequently found.

Below are the hypotheses tested and their results in reducing cracking in the Fuji apple:

EFFECTS	PROPOSAL	RESULT WITH RESPECT TO THE
Date of harvest	Pre-harvest treatment with 6-7 starch Harvista™	No difference. Delay to harvest by 7-10 days.
Nitrogen fertilisation	Different moments of application pre- and post-harvest	No difference. Reduction in
Foliar treatments	ANA and GA bioregulators ₄₊₇ , calcium chloride, Parka,	No difference
Micro-sprinkler irrigation	Applied one month before harvest	No difference
Different irrigation quantities	No watering and double watering, applied one month before harvest	No difference
Rain nets	Net types: plastic film, reinforced raffia and Protecta	Significant reduction in cracking and also colouration



Fuji apple with cracking on the flank



Installation of hail and rain net

Conclusions

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

1. Treatment with Harvista™ to manage harvesting did not provide good results in cracking control, probably because it was applied with excessively high starch levels as a result of inclement weather; the hypothesis remains but applying the treatment before fruit ripening starts, at starch levels 2-4.
2. No differences were found between the different nitrogen fertilisation application times (spring, pre-harvest and post-harvest). The trend in the results showed apples with suspended fertilisation had less cracking and more colour. Clearly attention needs to be paid to the amount and method in which fertiliser units are applied in a Fuji orchard.
3. The different foliar treatments tested showed no efficacy in controlling cracking. A strategy was tested with ANA, with GA₄₊₇+BA, with calcium chloride, the combination of the three, with GA₄₊₇, with PARKA® and the Stilo® Hydro Record® biostimulant.
4. No clear differences were found between conventional micro-sprinkler irrigation and drip irrigation nor between the different quantities applied one month before harvest.
5. Rain nets are a good alternative to consider to maintain the quality of the apple epidermis, as they significantly reduce cracking although they also reduce the percentage of coloured surface. More experience is needed to test materials and installation systems that allow a good economic balance in fruit farms both in terms of fruit quality and return on investment.

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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 problems of cracking in the apple)	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. These include follow-up meetings of the Fruit Producers Technical Committee and the technical conference, attended by more than a hundred fruit growers, technicians and other specialists involved in the apple sector at the four sessions. They had the opportunity to see and learn about a number of

elite fruit growing using state-of-the-art technologies. The documentation submitted is available on the RuralCat website.



Project website

<http://www.fructicolaemporda.com>

More information on the project

PROJECT DATES	TOTAL BUDGET
Start date (month-year): June 2018	Total budget: €137,376.00
Completion date (month-year):	DARP funding: €56,142.72
Current status: Executed	EU funding: €42,353.28
	Own funding: €38,880.00

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