GO COLOR 4.0

Summary

A number of new tools are available to improve the colouring of apples. One of the primary requirements is to determine the areas in the field that have the worst conditions for colouring in commercial fruit. Remote sensing is one of the most powerful tools for categorising the vigour of plantations in a fast, robust and economical way, which offers scalability of the system. When the variables extracted by remote sensing are correctly validated in the field, they provide information about the vegetation's physical characteristics – in this case the vigour and density of the tree. It is therefore possible to determine areas of homogeneous growth, where the trees present similar growth, and in this case a similar ratio of shading of the fruit by the leaf. It is possible to determine different management areas where it is possible to intervene to correct the parameters of the vegetation and thereby improve the colouring of the apples thanks to remote sensing. This technology is highly developed and is currently applied in grapes for wine production, but its use with sweet fruit is at a very early stage.

The project aims to improve the colouring of apples by differentiating areas in plots based on the vigour reported by remote sensinǵ. Different cultural techniques will be implemented using this new methodology, depending on the vigour of each area. In other words, each plot will be treated based on its characteristic variability or heterogeneity, and not as a homogeneous unit.

Other options to improve the colouring of two-tone apples will also be considered. Some are used in other countries, but their effectiveness in Catalonia's unfavourable growing conditions is unknown. For example, some techniques that may be of interest for late two-tone apples (Fuji and Pink Lady), such as tree defoliation, have begun to be studied. Another possibility would be to use some groups of phytoregulators that cause physiological changes that enhance the colour of the fruit. However, these products need to be tested under our conditions, and their economic profitability needs to be studied.

Objectives

The main objective of this project was to improve the colouring of two-tone apples, and specifically the Gala and Pink Lady varieties.

This overall objective involved the following specific objectives:

1) Correlate and validate the information from remote sensing with the field variables for each variety, in order to establish a zoning criterion for the vigour of plantations based on the parameters of the canopy.
2) Evaluation of complementary colour improvement strategies.
    a) N - Reduction of N and irrigation adjustment to improve colour by reducing vigour.
    b) D - Use of phytoregulators to enhance the colouring of the fruits by removal of leaves and increased interception of light.
    c) B - Use of biostimulants to enhance fruit colouring through physiological changes.
3) Definition of individual strategies for each plot and zone according to their vigour.

Description of the actions carried out in the project

Objective 1, for the zoning and classification of plots, was carried out in 2019. Fifteen plots from each of the three cooperatives participating in the project were used. For each plot 120 shoots were measured (5 shoots per tree and 24 trees/plot) and the data correlated with the images acquired by satellite. This enabled the plots to be categorised and zoned according to vigour. A list of plots classified according to their vigour was subsequently drawn up. This classification was based on satellite imagery correlated with field measurements. All this information was uploaded to the E-STRATOS platform, where all participants in the project can access it, and each cooperative therefore has access to all this information.

The complementary strategies for colour improvement were assessed in 2020. This included three different types of test. The first was based on evaluating different nutrition strategies (N) and consisted of 3 treatments. The second type of test evaluated different defoliation strategies (D) and also consisted of 3 treatments. The third type of test evaluated the use of biostimulants and other hormonal/phytoregulatory products to enhance colour (B), and consisted of 4 treatments. Each test was repeated four times, with each repetition consisting of 3 rows of about 15-20 m each. All this added more complexity to the tests and the project, but at the same time yielded more solid results, and also enabled the various strategies to be monitored through remote sensing.

The actions envisaged under Objective 3 were based on selecting the best-performing strategies for 2020 and re-evaluating them individually and in combination in 2021. All the tests for the Gala variety at the Tornafruit and Les Planes cooperatives had been carried out by 22 September 2021. This means that all the trees were harvested, and the fruit calibrated to evaluate the results.

Some treatments were applied to Pink Lady (Fruilar), although most of them took place in late September and October. Harvesting is expected to begin in late October, and the samples will then be processed following the same methodology as for the Gala variety. The results will therefore not be available until next autumn/winter.

Final results and practical recommendations

Some of the strategies evaluated significantly improved the colouring, including Chromafruit, Ethephon in some cases, and defoliation. Others such as the management of nitrogen nutrition had no clear effect.

It should also be noted that the weather conditions were very good for colouring the fruit during the two-year evaluation period of the strategies (2020-2021), which means that even the control treatments had very good colouring. However, this meant that the possible effects of the treatments were less clear.

Conclusions

The conclusions are the following:

- 2020 was a good year for colouring, which has made it difficult to see significant colour gains in the various treatments.
- Ethephon performed best when increasing overall colouring.
- Stoller (Chromafruit) appears to particularly increase the percentage of fruit > 90% colour.
- Ethephon worked better with high vigour. With low vigour, Stoller without defoliation provided results comparable to manual defoliation.
- Goactiv provided no improvement compared to the Control.

- In nutrition, the complexity of the design plus the application of each treatment and the response time makes it very difficult to have conclusive results in little more than three years.
- In general, the vertical position of the Redpulse (mechanical defoliator) works better than the horizontal position, although the formation of the trees plays a significant role. The differences are smaller with low vigour and in flat systems.
- The ideal time for defoliation is 2 to 3 weeks before harvest. Four weeks is too early, and one week is too late. Two applications appear to enhance the colouring, but it can be counterproductive if not applied carefully, as more fruit may fall.
- 2021 was also a good year for the colouring of the Gala variety.
- Chemical defoliation significantly enhanced colouring in the Gala variety, but the fact that it causes cosmetic damage in 5-10% of the fruit means that it is not a recommended strategy.
- Chromafruit treatments are currently some of the best to enhance colour. We are awaiting the results for Pink Lady to confirm this, as well as the mechanical defoliation data.

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Subject area(s) of application

☒ Agricultural production system
☒ Agricultural practice
☒ Vegetable production and horticulture

Geographical area(s) of application

PROVINCE(S): Lleida and Girona
REGION(S): El Pla d'Urgell, El Segrià, L'Urgell, La Noguera, Les Garrigues, El Baix Empordà

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

In October 2019, an explanatory poster of the project was installed at the entrance to the marquee at the 24th IRTA annual Fruit Growing Seminar.

In addition, a remote seminar was held on 3 June 2021 to present the 2020 results to all the members of the three cooperatives participating in the project.

A field demonstration of the mechanical defoliator was held on 16 July 2021, which was also published on IRTA's information channels.

More information on the project

PROJECT DATES	TOTAL BUDGET
Starting date: July 2019	Total budget: €158,950.00
End date: September 2021	DARP funding: €64,951.50
Current status: Executed	EU funding: €48,998.50
	Own funding: €45,000.00

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