

EXOGENOUS APPLICATION OF ABSCISIC ACID BY FOLIAR SPRAYING ON FICUS CARICA L.: ON-TREE RIPENING MONITORING UNTIL COMMERCIAL HARVEST



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C. Moraga-Lozano¹, M. Palomino-Vasco¹, A.M. Fernández-León¹, B. Velardo-Micharet¹, M. López-Corrales², A. Rodríguez³, M.J. Serradilla^{1*}

¹ Centro de Investigaciones Científicas y Tecnológicas de Extremadura (CICYTEX), Instituto Tecnológico Agroalimentario de Extremadura (INTAEX), Dept. of Postharvest, Plant Value Enhancement, and Emerging Technologies, Avda. Adolfo Suárez s/n, 06007 Badajoz (Spain); manuel.serradilla@juntaex.es

² Centro de Investigaciones Científicas y Tecnológicas de Extremadura (CICYTEX), Instituto de Investigaciones Agraria Finca La Orden-Valdesequera, Dept. of Mediterranean Fruticulture, Autovía V, km 372, 06480 Guadajira (Spain)

³ Escuela de Ingenierías Agrarias. Instituto Universitario de Recursos Agrarios (INURA), Universidad de Extremadura, Dept. of Nutrition and Bromatology, Crta. Cáceres s/n, 06007 Badajoz (Spain)

Introduction

Figs are an infructescence called syconium, known for their organoleptic and nutritional value. Their development and growth are divided into three phases, and ripening is a dual mechanism depending on abscisic acid (ABA; non-climacteric part) and ethylene (climacteric part). In addition, figs present the disadvantage of not ripening simultaneously on the same shoot, which makes harvesting difficult.

ABA has been extensively documented to affect ethylene production, ripening, and senescence processes. Moreover, it can stimulate adaptive responses to abiotic stress. On-tree ABA application in figs via the ostiole has been shown to stimulate growth and homogenise fruit ripening, thus facilitating harvesting.

OBJETIVE: Study the effect of exogenous applications of ABA on fig ripening

Results and discussion

Ripening onto the tree

Fruit colour underwent a progressive transformation throughout the ripening process, showing an increase in L (lightness) and C (chromaticity) values. Conversely, hue angle (h) decreased over time. Hue shifted from a greener shade to a more yellowish one.

With regard to the chlorophyll index, different behaviours were observed throughout the process of ripening on the tree (Figure 1A). Consequently, an increase was observed between stages T1 and T2, although from T2 to T3 the value remained approximately constant. At T3, a decrease in the index was observed, only to increase again on the last test date.

The most significant changes were observed in fruit size (Figure 1B). As anticipated, size increased throughout the ripening process. However, it is noteworthy that ABA-treated figs consistently exhibited an increased size, particularly those subjected to 2.27 mM ABA. The differences in size observed versus control figs were statistically significant in all dates, with the exception of the final one.

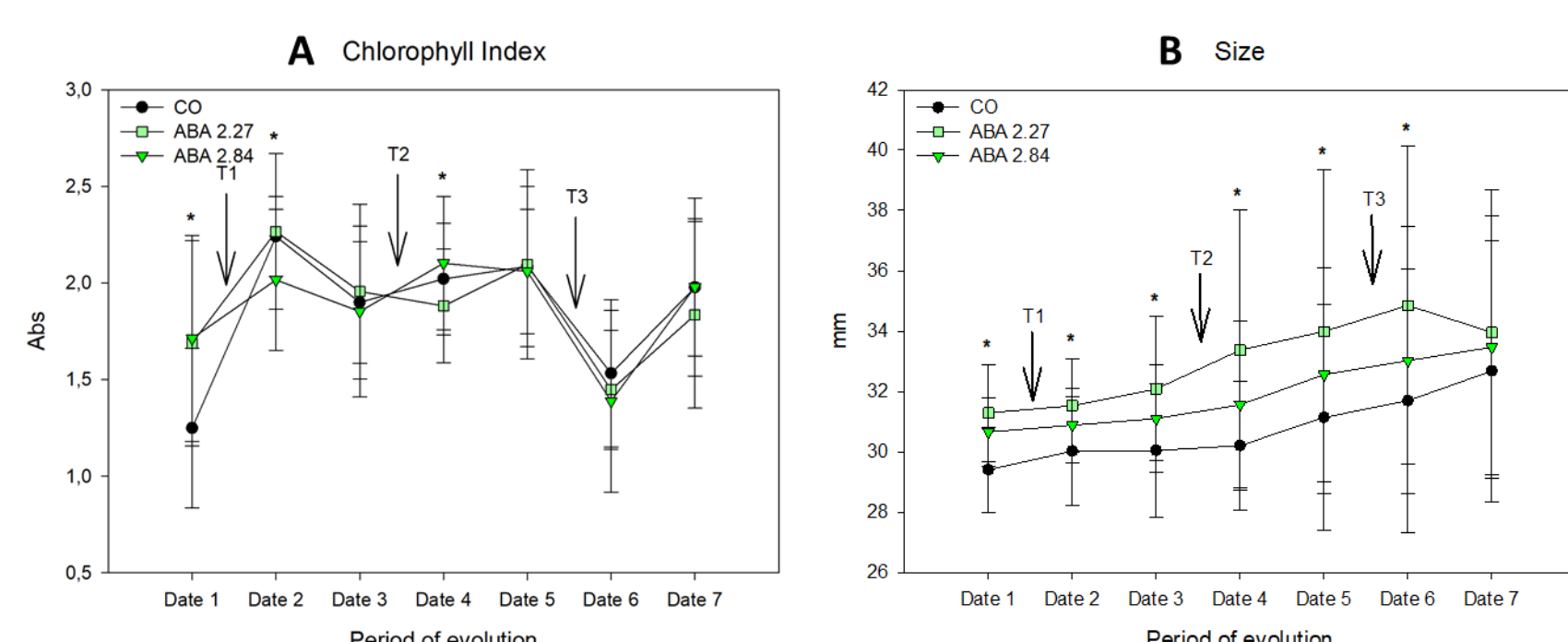
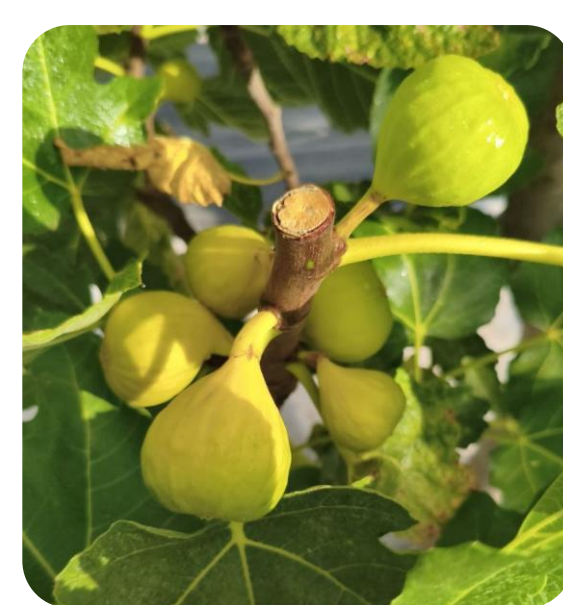


Figure 1. Chlorophyll index (A) and size (B) evolution over ripening. Results are presented as mean values $\pm$ standard deviation. T1, T2 and T3 indicates the three phases of the fig development. Asterisk indicates significant differences ($p < 0.05$).

Conclusions

- Foliar ABA applications improved fig colour during its development in the tree, obtaining shades more associated to ripe fruit.
- Foliar ABA treatments increased fruit size, specially ABA 2.27 mM.
- 2-APP treated fruit were less ripe, greener in colour, firmer and presented a higher moisture and titratable acidity.
- 3-APP treated fruit showed a higher ripening index.
- ABA-treated fruit presented a higher weight. Also, they exhibited a reduced ethylene production rate.

Material and methods



Physiological maturity

2024 season

Super-intensive conditions

2 or 3 applications (APP)

One APP per week

Foliar application



Ripening onto the tree

- Colour parameters (CIELab)
- Size (mm)
- Chlorophyll index

Commercial harvest

- Colour parameters (CIELab)
- Firmness (N mm⁻¹)
- Weight (g) and size (mm)
- Chlorophyll index
- Total soluble solids (TSS; °Brix)
- Titratable acidity (TA; % citric acid)
- Ripening index (RI; TSS/TA)
- Moisture content (%)
- Respiration (mL CO₂ kg⁻¹ h⁻¹) and ethylene production (μL C₂H₄ kg⁻¹ h⁻¹) rates

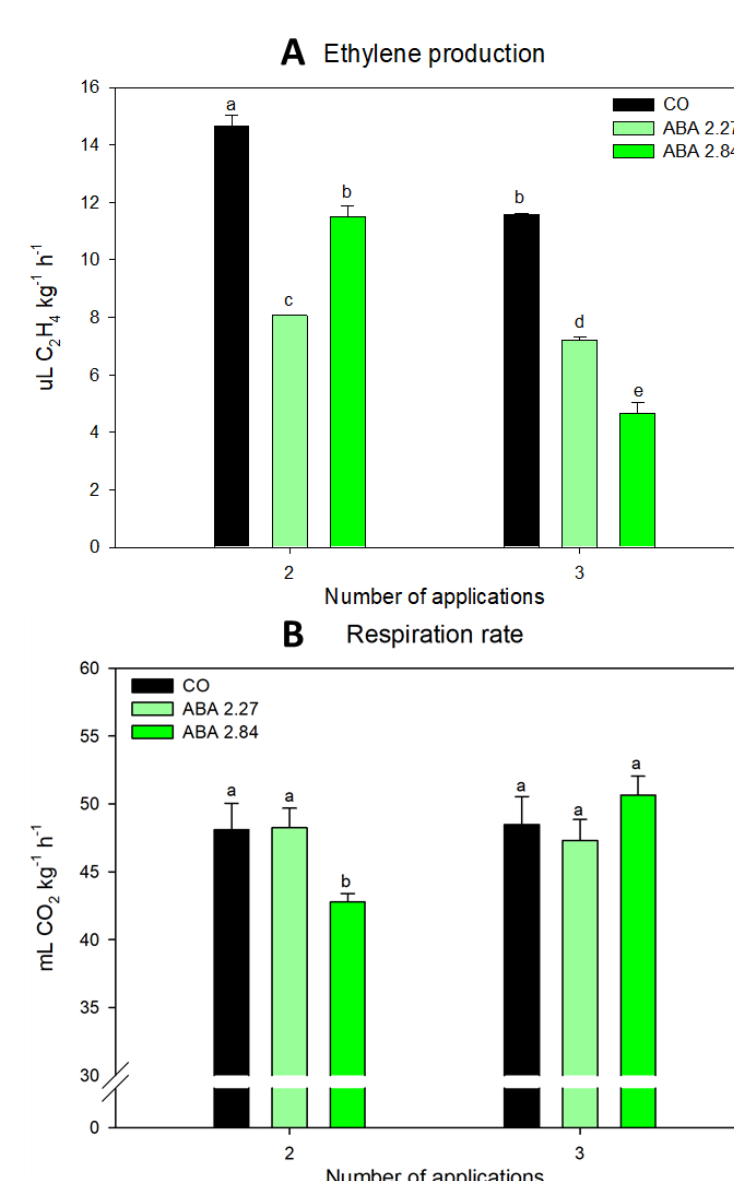
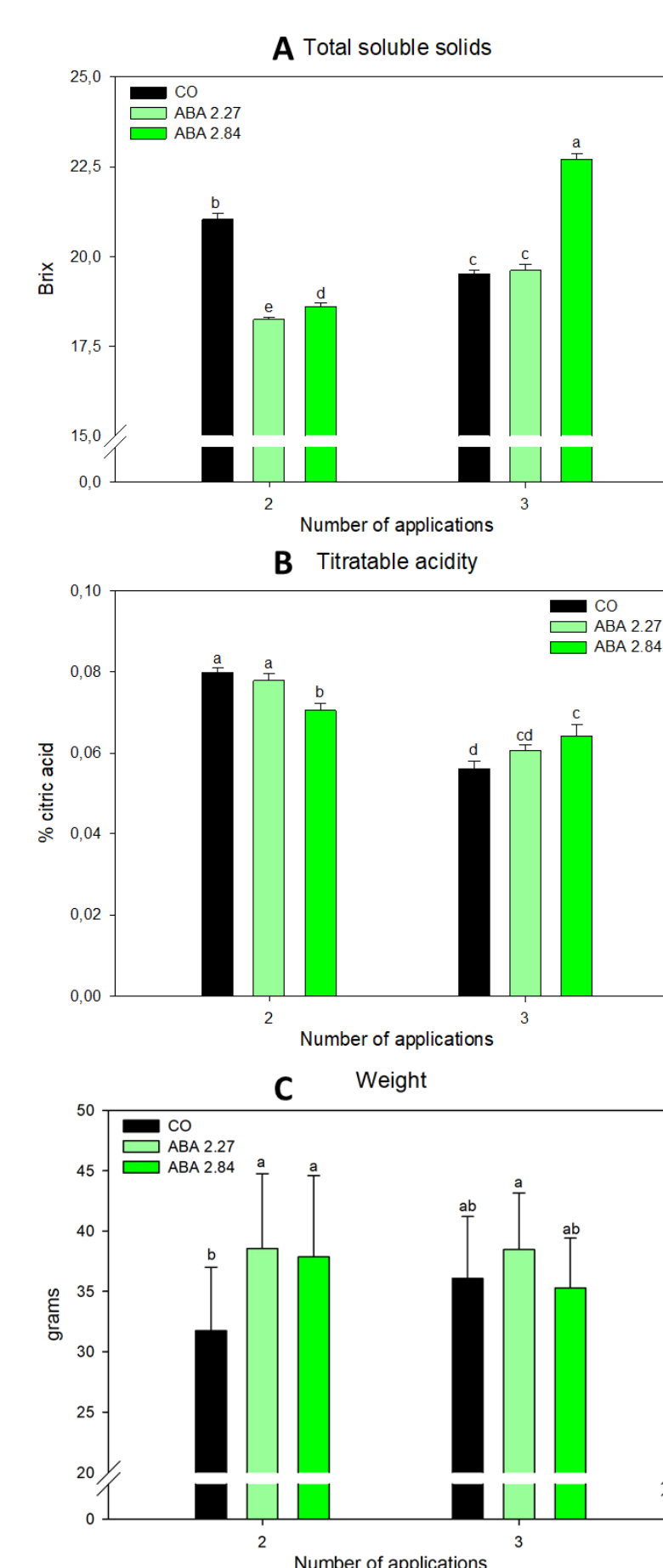
Commercial harvest

In fruit harvested at commercial maturity, it was found that 2-APP treated figs were less ripe than those 3-APP treated. Consequently, 2-APP figs exhibited a greener colouration, a higher chlorophyll index, greater firmness and a higher moisture content in comparison to 3-APP figs (data not shown).

With respect to TSS (Figure 2A) and TA (Figure 2B), 2-APP figs demonstrated lower values in ABA-treated fruit, with the exception of 3-APP figs treated with ABA 2.84 mM. Therefore, RI proved to be significantly lower in 2-APP figs than in 3-APP figs.

At the physicochemical level, the most significant changes were observed in weight (Figure 2C), which increased considerably in ABA-treated figs, both in 2-APP and 3-APP. Size showed the same trend, but with less pronounced differences.

Figure 2. TSS (A), TA (B) and weight (C) in harvested figs treated with 2 and 3-APP. Results are presented as mean values $\pm$ standard deviation. Different letters indicate significant differences ($p < 0.05$).



Finally, differences were observed in the rate of ethylene production (Figure 3A), where ABA-treated figs showed lower values in all cases. Furthermore, 3-APP figs exhibited lower values when compared to 2-APP figs. By contrast, there were only significant differences in the respiration rate (Figure 3B) of figs treated with 2-APP of ABA 2.84 mM.

Figure 3. Ethylene production (A) and respiration (B) rates in harvested figs treated with 2 and 3-APP. Results are presented as mean values $\pm$ standard deviation. Different letters indicate significant differences ($p < 0.05$).

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