Impact of long term water deficit on production and flowering occurrence in the 'Granny Smith' apple tree cultivar

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Apple trees are usually irrigated to avoid yield losses due to water deficit but the shortage of water has become a critical problem in apple orchards. Nevertheless, most of the studies that have been conducted on tree responses to water stress have focused on shoot, leaf and fruit growth during a single growing season.

This study presents the results of an experiment performed over 8 years on Granny Smith trees subjected to well water and water stress conditions. The yearly production of growth units along branches and the yield components (number of fruits, yield and individual fruit weight) were recorded over the experimental period. Statistical indexes adapted from the biennial bearing index were computed to analyze the impact of water stress on biennial bearing.

Trees subjected to water stress did not display any significant decrease in total yield. Nevertheless, water stress increased the crop load (i.e. the number of fruits per trunk cross sectional area) and the total number of harvested fruits over the experimental period. Conversely, water stress decreased the individual fruit weight whatever the year. The increase in the cumulative number of harvested fruits and crop load were mainly associated with a higher proportion of floral GUs under water stress, especially in OFF years, this leading to reduce biennial bearing in this condition. The observed increase in the transition probability towards flowering along branches was hypothesized to be related to a decrease in vegetative growth under water stress that can favor floral induction in the meristems. The decrease in individual fruit weight under water stress was interpreted as the result of the increase in crop load.

This study showed that water stress affects yield components by modifying the equilibrium between vegetative and reproductive growth. Forthcoming works will further analyze the effect of water stress taking into account the genotypic variability.

Key words: water stress, yield components, flowering, biennial bearing, architecture