Evaluation of stomatal density and leaf venation of mango cultivars with agronomic interest in the Canary Islands

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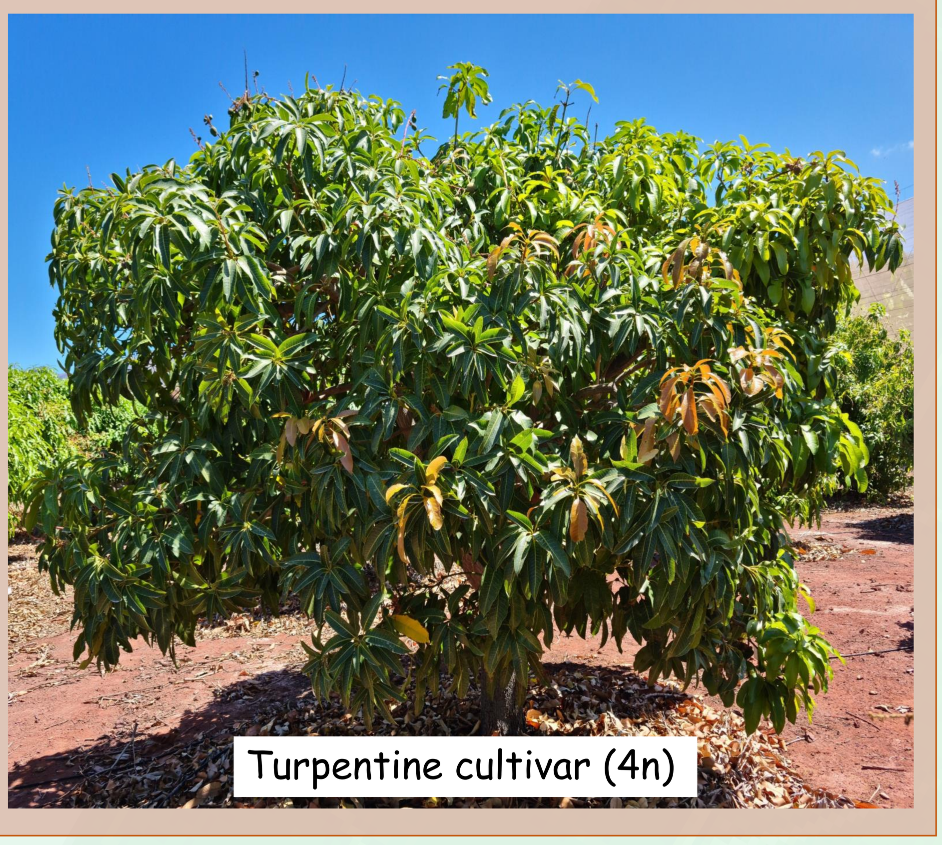
Background

The leaf vein is the main structure for physical support and transport of water/nutrients in the leaf, which contributes to its growth and development[1]. It also transports biomolecules from the mesophyll to the rest of the plant. Therefore, leaf venation is strongly related to hydraulic conductance and gas exchange[2].

In recent years, the development of polyploid cultivars of tropical and subtropical fruit trees has gained momentum due to improved productivity, diversification of supply, adaptability to different environmental conditions and their potential for genetic improvement[1-3]; However, there are few studies about polyploidization in mango (*Mangifera indica* L.), a species that during germination can induce the formation of autoploids in polyembryonic cultivars.


Turpentine cultivar (4n)

Objective

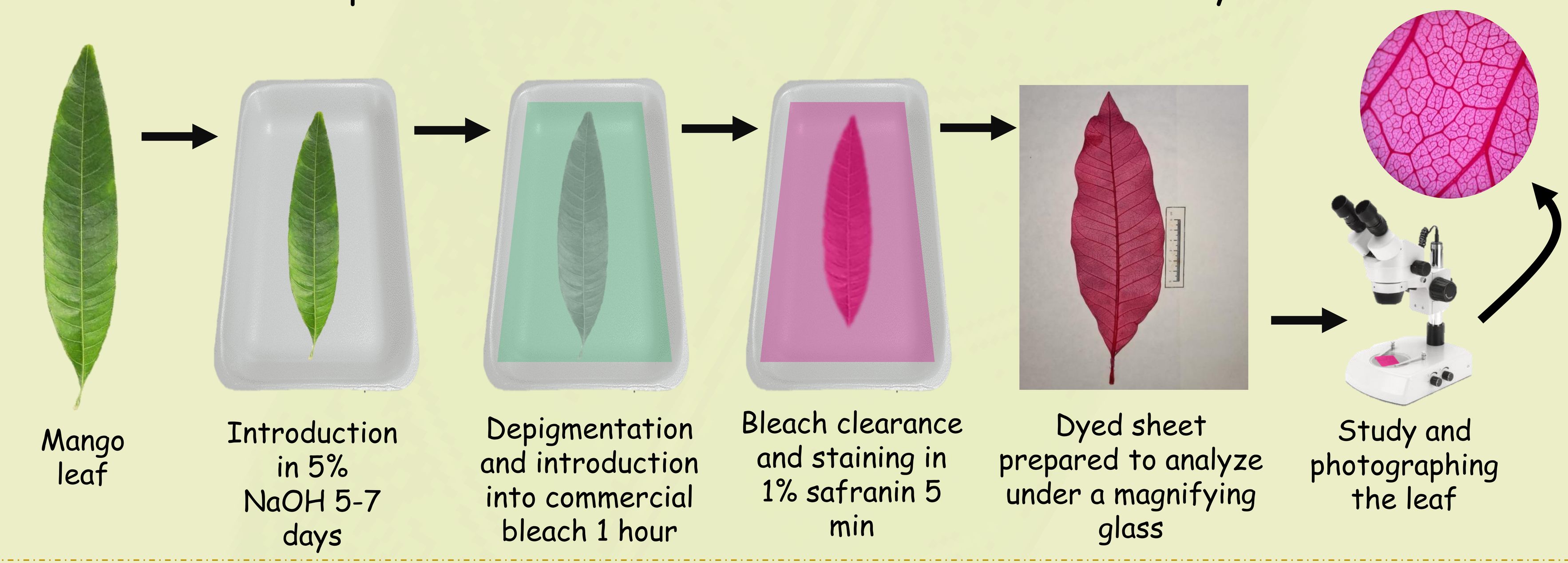
Mango cultivation is well adapted to the subtropical conditions of the Canary Islands. The development of autoploid rootstocks could help implement materials that are more resistant to diseases and abiotic stresses.

The main objective of this study was to evaluate the stomatal density and leaf venation of different mango cultivars with different ploidy with interest for the Canary Islands.

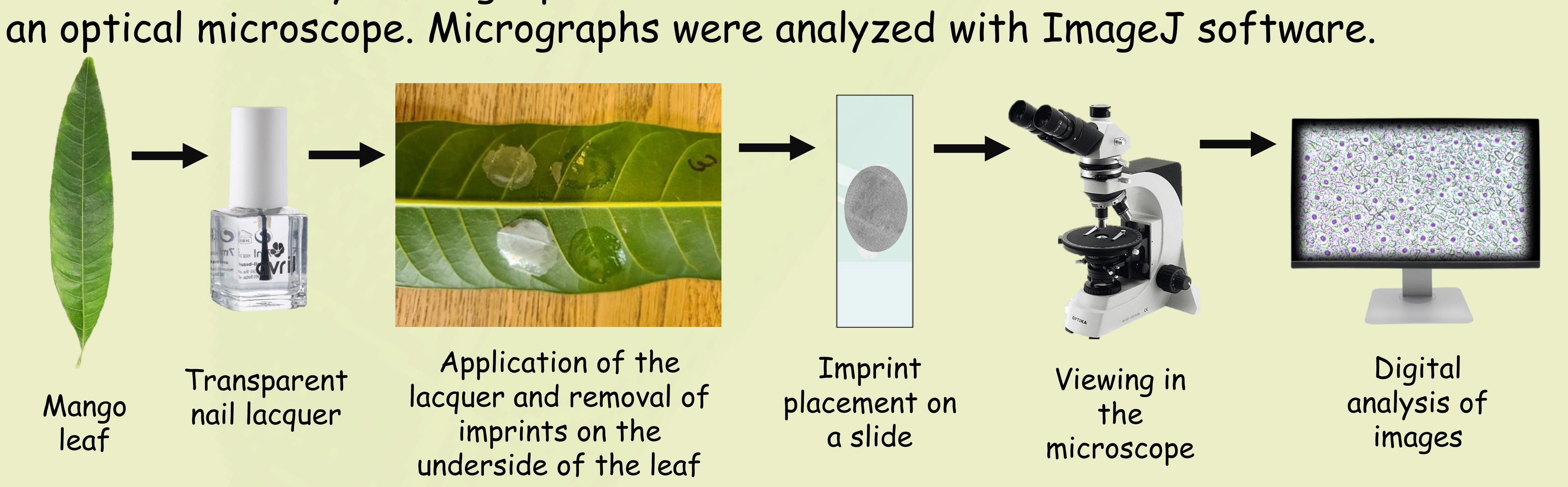
Material and methods

Well-watered adult trees of each of the cultivars (Kensington, Torbert, Manga Blanca and Turpentine) and ploidy were chosen and sampled. From each tree, six mature leaves were randomly taken in the third position from the apex to the base of a branch without vegetative growth or floral development.

A foliar clearance protocol was carried out for the venation study.



For stomatal analysis, fingerprints were taken with nail varnish and visualized with an optical microscope. Micrographs were analyzed with ImageJ software.

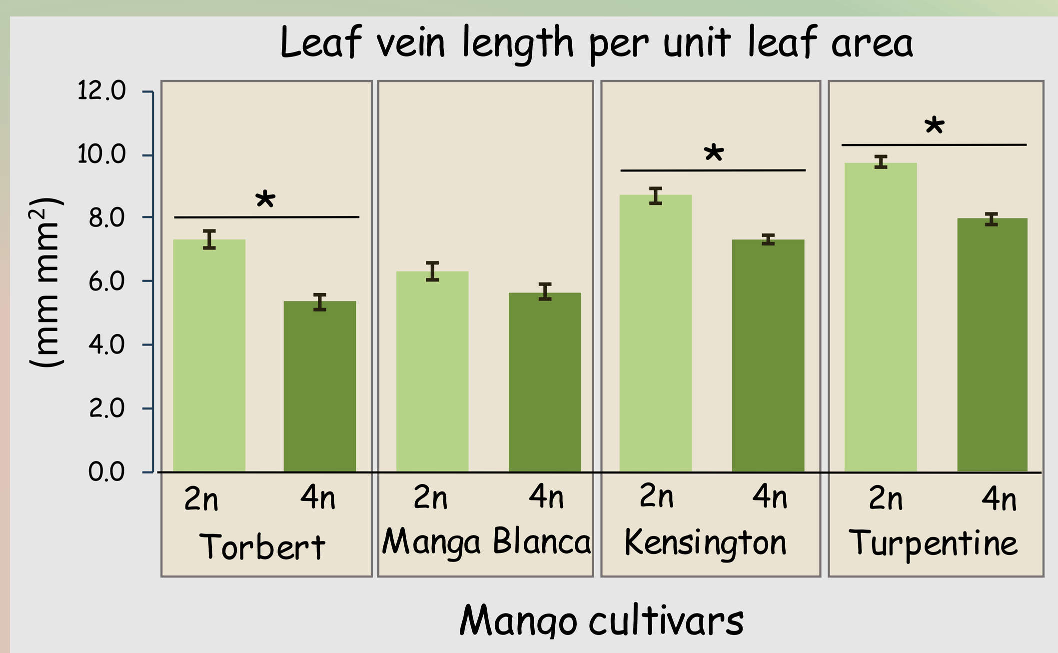


A Student t-analysis was performed to compare the differences between ploidies in each cultivar, using the IMB SPSS 25 software.

Results and discussion

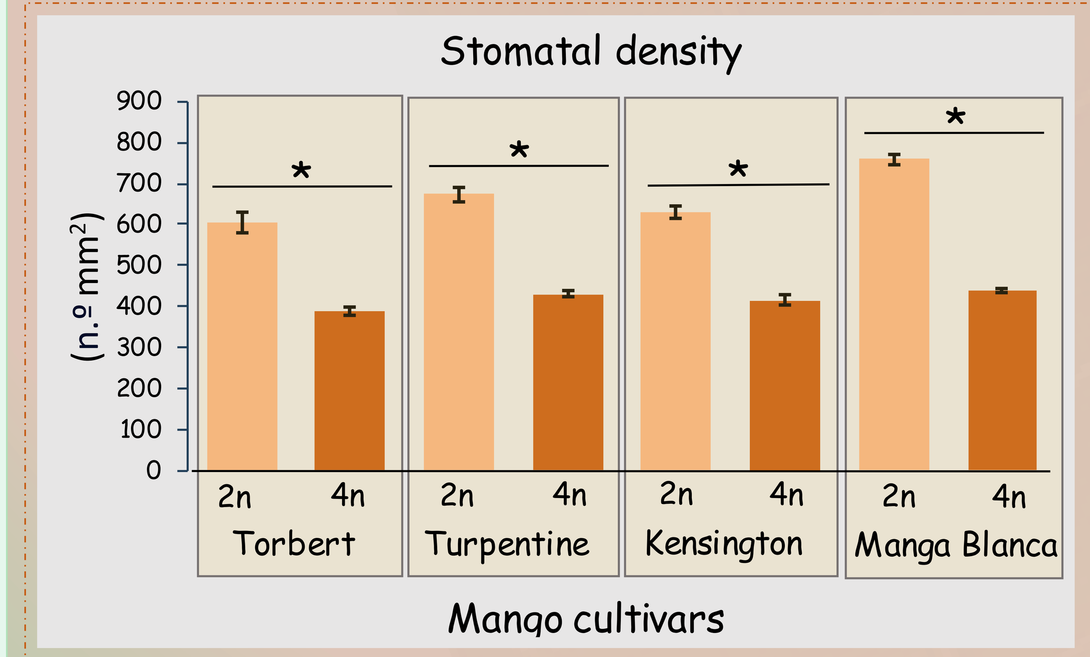
From the study of leaf venation, the parameter vein length per unit leaf area (VLA) was obtained. This parameter is an indicator of the density and efficiency of the vascular system of a leaf. Leaf veins are vascular structures that transport water, nutrients and other compounds through the leaf. These veins form a complex and branched network that provides structural support to the leaf and facilitates the distribution of the resources necessary for photosynthesis and plant metabolism[1,3].

The results of this study indicate that there are significant differences between the diploid and tetraploid cultivars of three varieties analyzed (Torbert, Kensington and Turpentine), with the VLA parameter being higher in the diploids.



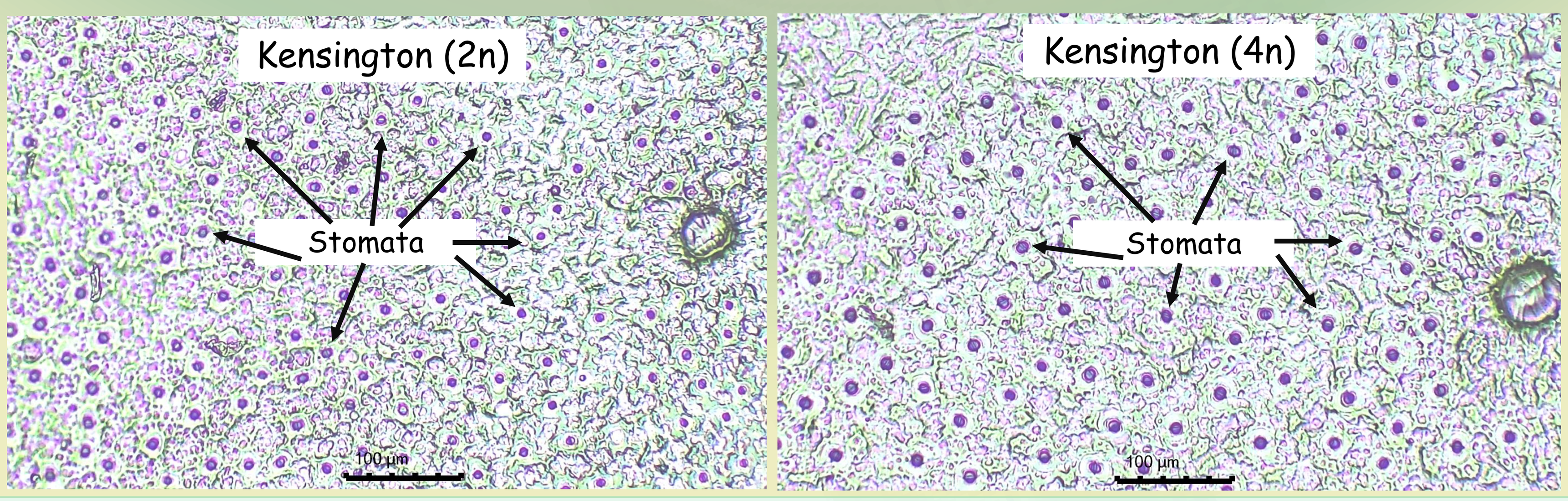
A high VLA indicates a greater number of veins in the leaf, which implies a greater demand for water and nutrients to maintain these structures. If available resources are limited in the environment, a high VLA can hinder the plant's ability to meet its needs and can lead to water stress or nutritional deficiencies. Furthermore, a greater vein length implies a greater evaporation surface. This can result in a higher transpiration rate, which increases water loss from the plant. However, the values obtained are similar to those of other tree species from tropical and subtropical zones, higher than in wetland species and lower than in species from semi-desert zones[3].

Stomatal density refers to the number of stomata present on the surface of a leaf or plant structure. Stomatal density is generally expressed as the number of stomata per unit area (no. mm^2). It is an important parameter to study the physiology of plants, since it is related to the gas exchange capacity and the regulation of the water balance of plants[2,4].



The results of this study indicate that there are significant differences between all diploid and tetraploid cultivars, with the stomatal density being greater in the diploids, exceeding 600 stomata per mm^2.

A high stomatal density may indicate a greater gas exchange capacity and greater photosynthetic efficiency under optimal conditions of light and water availability. However, under environmental stress conditions, such as drought or high temperatures, high stomatal density can increase water loss through transpiration, which can be disadvantageous for the plant[2,4]. In other crops such as bananas, a trend towards larger and lower density stomata has also been observed as the ploidy level increases[5].



Conclusiones

In drought conditions or in environments with limited water availability, as can occur in low latitudes on the southern slopes of the Canary Islands, a high VLA and a high stomatal density can make diploid cultivars more susceptible to water stress, contrary to what happens in tetraploids, which could present greater efficiency in water use.

This makes tetraploid varieties an interesting resource for study, especially knowing the future scenarios under climate change that agriculture faces, so the search and conservation of tetraploid cultivars could be key.

References

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