30th Conference 27-31 October Asic 2025 Lisbon, PORTUGAL Rectory of the University of Lisbon

34151

# Photosynthetic Performance of Arabica F1 Hybrids vs Parents Under Shade and Full Sun Conditions

Mauricio VILLEGAS[1] (amvillegas1101@gmail.com), Benoit BERTRAND[2], Carmenza GONGORA[3], HUVER POSADA[4], S LARGO[3]

[1] *Cafexport, Bogota, Colombia* ; [2] *ASIC, MONTPELLIER, FRANCE* ; [3] *CENICAFE, MANIZALES, COLOMBIA* ; [4] *FEDERACION DE CAFETEROS DE COLOMBIA, BOGOTA, COLUMBIA*

## Introduction

Arabica coffee trees can be grown in full sun or shade. The Arabica plant's ability to adapt its photosynthetic mechanisms in response to varying light intensity is crucial for determining its growth and productivity. Excessive or insufficient light intensity can significantly impact yield. Some literature suggests that this ability depends on the genotype.

Arabica F1 hybrids are recognized for their high yield potential. Our study aims to establish whether these hybrids have superior photosynthetic capacities to their parents, which could account for their enhanced performance. In other words, does the heterosis that manifests in yield also manifest in photosynthetic capacity?

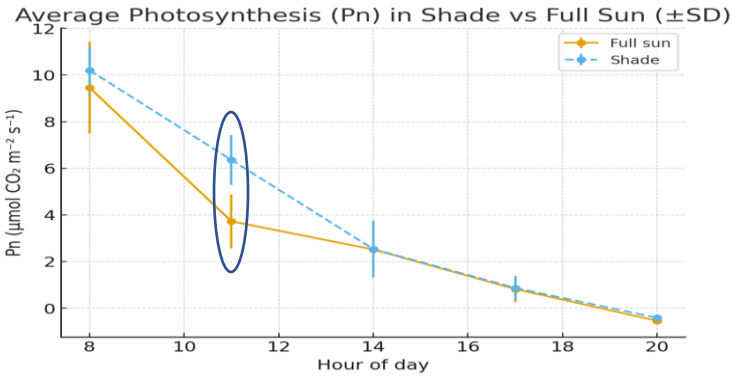


**Fig 1:** Net Photosynthesis depending on the time of day in shade and sun

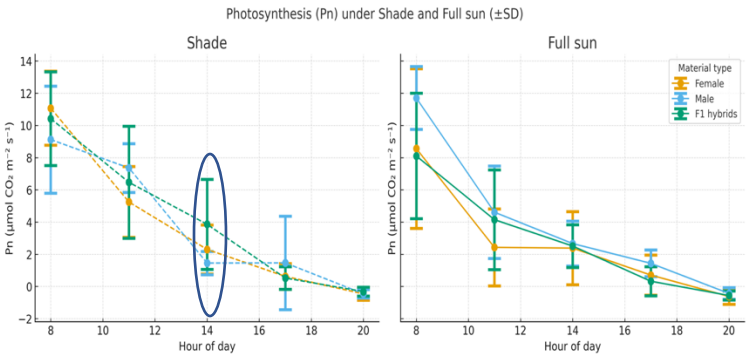


**Fig 2:** Net Photosynthesis depending on the time of day in shade and sun. Comparison between F1 and parents

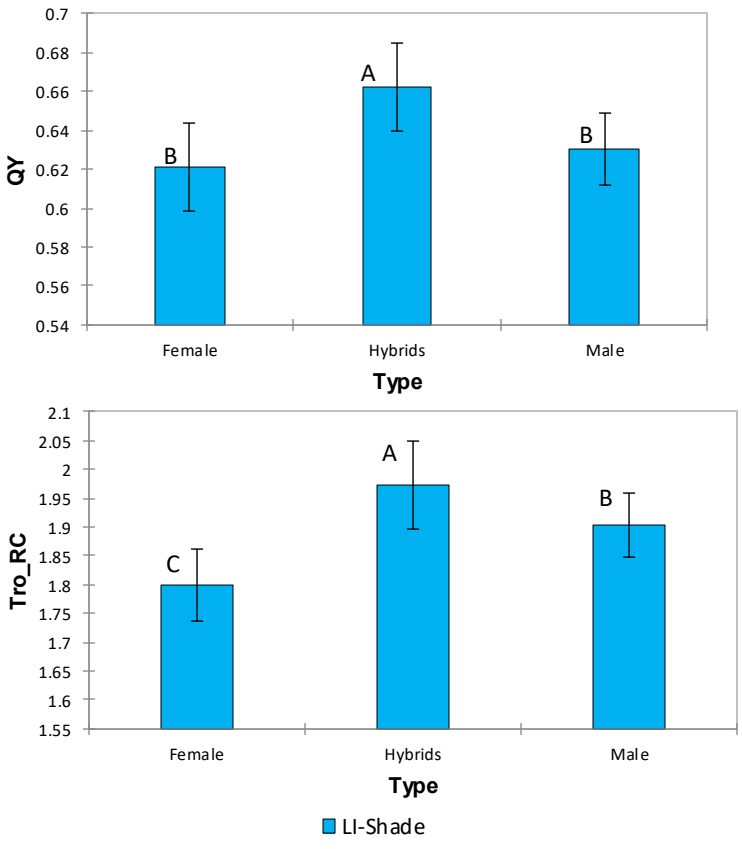


**Fig. 3:** Quantum efficiency and Tro_RC measured between 11h and 14h by a fluorometer under Shade net.

## Materials & Methods

Four F1 hybrids from 2 progenies of the Castillo Variety (CU1842, CX 2385) x 2 Ethiopian E057 and E286 were evaluated.

The hybrids and parental were planted in Naranjal, Caldas - Colombia, at an altitude of 1381 m. The photosynthetic variables of 48 selected plants, distributed in two environmental conditions Full sun and Shade (Shade net). The photosynthetically active radiation (PAR) was reduced by about 50% under shade net compared to full sun. Photosynthesis was measured using infrared gas equipment (TPS-2) at five points throughout the day (8:00, 11:00, 14:00, 17:00 and 20:00), as well as by a fluorometer (Handy PEA) between 11:00 and 14:00.

## Results/Discussion

In comparing shade and full sun environments (Fig.1), net photosynthesis (Pn) was similar at 8 a.m. (Pn = 9–10). By 11 a.m., Pn was nearly twice as high in shade (6.7) as in full sun (3.7). At 2 p.m., Pn values were comparable under both conditions, and subsequently declined to between 0.3 and 1.5 by 5 p.m.

At 14:00, the warmest time of day, the F1 hybrids showed higher net photosynthesis (Pn) than both the female and male parental groups under shade (see Fig. 2). This gain co-occurs with higher quantum efficiency (QY=Pn/PAR ), higher TRo/RC (Fig 3) and ETo/RC, than parents, indicating more efficient excitation trapping and electron transport per reaction centre. FT and Fo are also higher without a concomitant drop in ETo/RC, which points to better antenna–RC coupling rather than photoinhibitory quenching.

## Conclusion

F1 hybrids appear to perform better in terms of photosynthesis than their parents under shade when the temperatures are higher at midday. This makes them less affected by midday depression under shaded systems. These better photosynthetic performances of F1 hybrids are likely to contribute to the observed heterosis for yield under shade (+47%). These results reinforce those previously obtained by Toniutti et al., 2019.

**Perspectives:** It would be interesting to verify whether hybrids convert more efficiently, handle sunflecks (fleeting peaks of light in shaded areas) better, and dissipate excess light quickly, thereby stabilizing PN on hot middays.

**Bibliography:** Bertrand, B., Villegas Hincapié, A. M., Marie, L., & Breitler, J. C. (2021). Breeding for the main agricultural farming of arabica coffee. *Frontiers in Sustainable Food Systems*, *5*, 709901.

Toniutti, L., Breitler, J. C., Guittin, C., Doulbeau, S., Etienne, H., Campa, C., Bertrand, B. (2019). An altered circadian clock coupled with a higher photosynthesis efficiency could explain the better agronomic performance of a new coffee clone when compared with a standard variety. *International journal of molecular sciences*, *20*(3), 736.