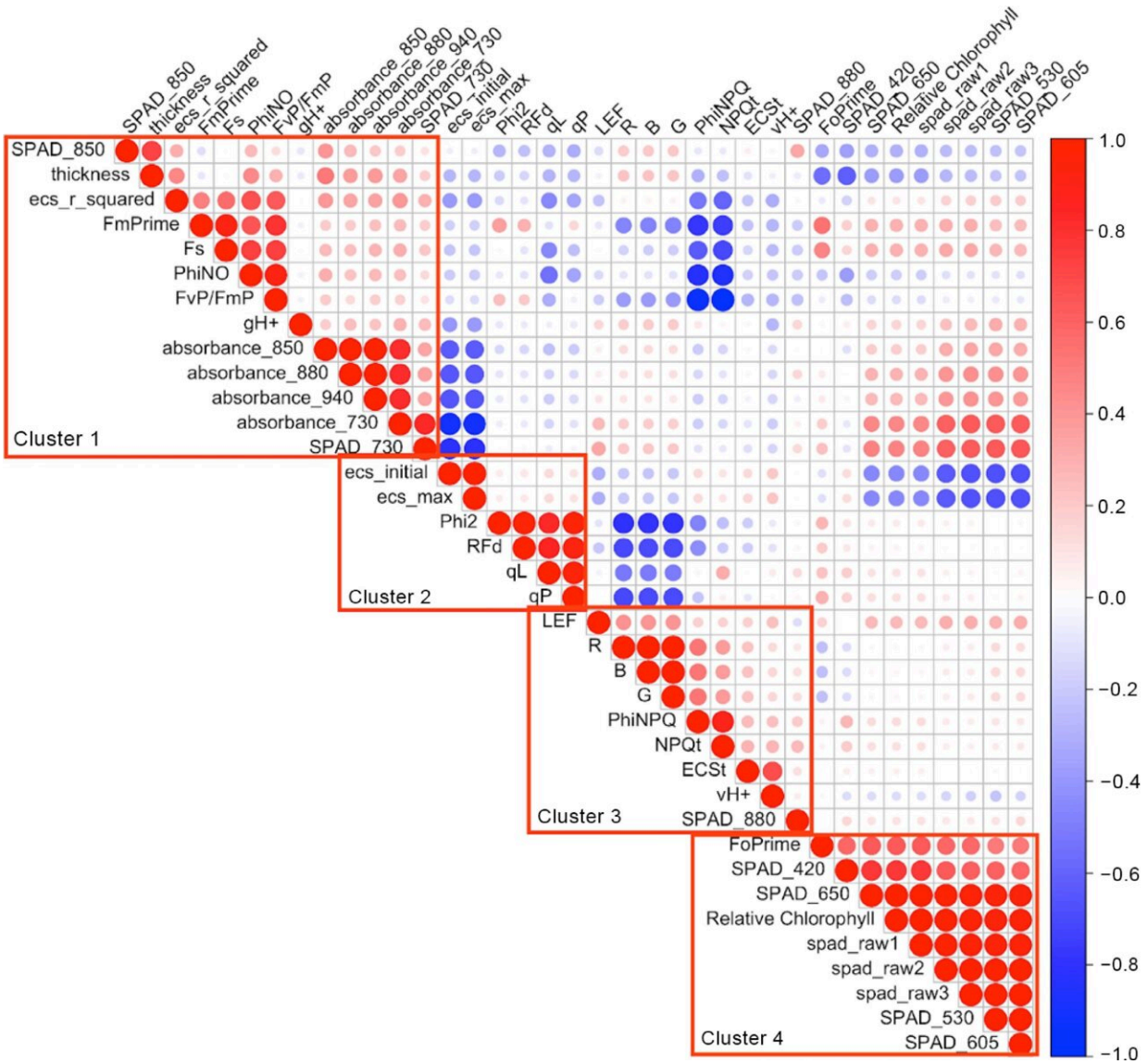
The genetic blueprint of photosynthesis in citrus: Study identifies key traits and genes to boost fruit production

July 30 2024



Heatmap illustrating the pairwise correlations among 37 photosynthesis-related traits, with clustered traits showing interrelatedness. Credit: *Fruit Research* (2024). DOI: 10.48130/frures-0024-0013

A research team investigated 71 citrus accessions and varieties using over 56,000 single nucleotide polymorphisms (SNPs) and 37 leaf reflectance parameters to study photosynthesis-related traits. They identified four distinct clusters of interrelated traits and found 125 genomic loci and 189 genes associated with these traits. This research provides valuable insights into the genetic and physiological mechanisms of photosynthesis, potentially leading to improved breeding and orchard management for enhanced fruit production and tree health.

Photosynthetic carbon gain is crucial for plant performance in both natural and agricultural systems. Identifying genes mediating photosynthesis is vital for understanding carbon regulation in leaves and its allocation to flowers and fruits, impacting overall plant physiology and fruit production.

Current research highlights the importance of chlorophyll content and fluorescence in measuring photosynthetic performance. However, understanding the interrelated genetic influences and plant physiology in photosynthesis remains challenging.

A study published in ***Fruit Research*** on 23 May 2024, aims to link photosynthetic traits with genetic data in citrus to identify related loci and genes, thereby enhancing crop yield and efficiency.

In this study, a pairwise correlation analysis was conducted on 37 photosynthesis-related traits, revealing four distinct clusters of interrelated traits. Cluster 1 includes traits such as photochemical

efficiency (FvP/FmP), leaf thickness, absorbance at various wavelengths, and SPAD readings. Cluster 2 includes electrochromic shift values and the quantum yield of Photosystem II (Phi2). Cluster 3 encompasses traits related to red, blue, and green light captured by the PAR sensor and non-photosynthetic quenching (NPQt). Cluster 4 contains SPAD readings at shorter wavelengths and minimal fluorescence.

The analysis showed correlations such as a negative correlation between SPAD 850 and Phi2, qL, and qP, and a significant positive correlation between NPQt and PhiNPQ. Principal Component Analysis (PCA) on genomic and photosynthesis-related trait data from 71 citrus accessions distinguished four groups with some overlap.

A genome-wide association study identified 125 genomic loci associated with 11 photosynthesis-related traits, revealing positive or negative correlations between trait clusters. Biological annotation of significant SNPs identified 189 genes, with some linked to processes like glycolysis and mitochondrial functions.

According to the study's lead researcher, Zhenyu Jia, "This intricate weave of genomic information and trait correlations beckons further research to decipher the complex puzzle of photosynthesis regulation and functionality, revealing the intricate interplay of genetics in shaping these essential traits."

In summary, this study analyzed photosynthesis-related traits in 71 citrus accessions and varieties using over 56,000 SNPs and 37 leaf reflectance parameters. The findings enhance our understanding of the genetic and physiological factors in photosynthesis, facilitating the advancement of more resilient and productive fruit tree varieties through targeted breeding strategies and improved orchard management.

More information: Xuesong Wang et al, Revealing genetic determinants of photosynthesis-related traits in citrus *via* genome-wide association studies, *Fruit Research* (2024). DOI: 10.48130/frures-0024-0013

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