



Umbrales y determinantes de la vulnerabilidad térmica dentro del género Coffea

Fernanda Farnese

1er Simposio Colombo - Brasileño

Ecofisiología del Café

Avances científicos e innovaciones para enfrentar los desafíos actuales y futuros en los agrosistemas

Organizan



Apoyan



Vamos ficar sem café?

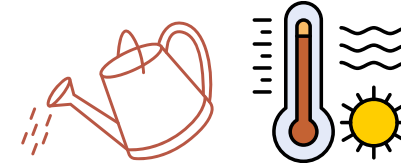


1980
4.9 bilhões
de kg



2025
11.0 bilhões de
kg

Produção dependente das condições climáticas



① Current proportion of regions for *Coffea arabica* cultivation by 2050

⦿ Current levels



▼ 48%
Central
America

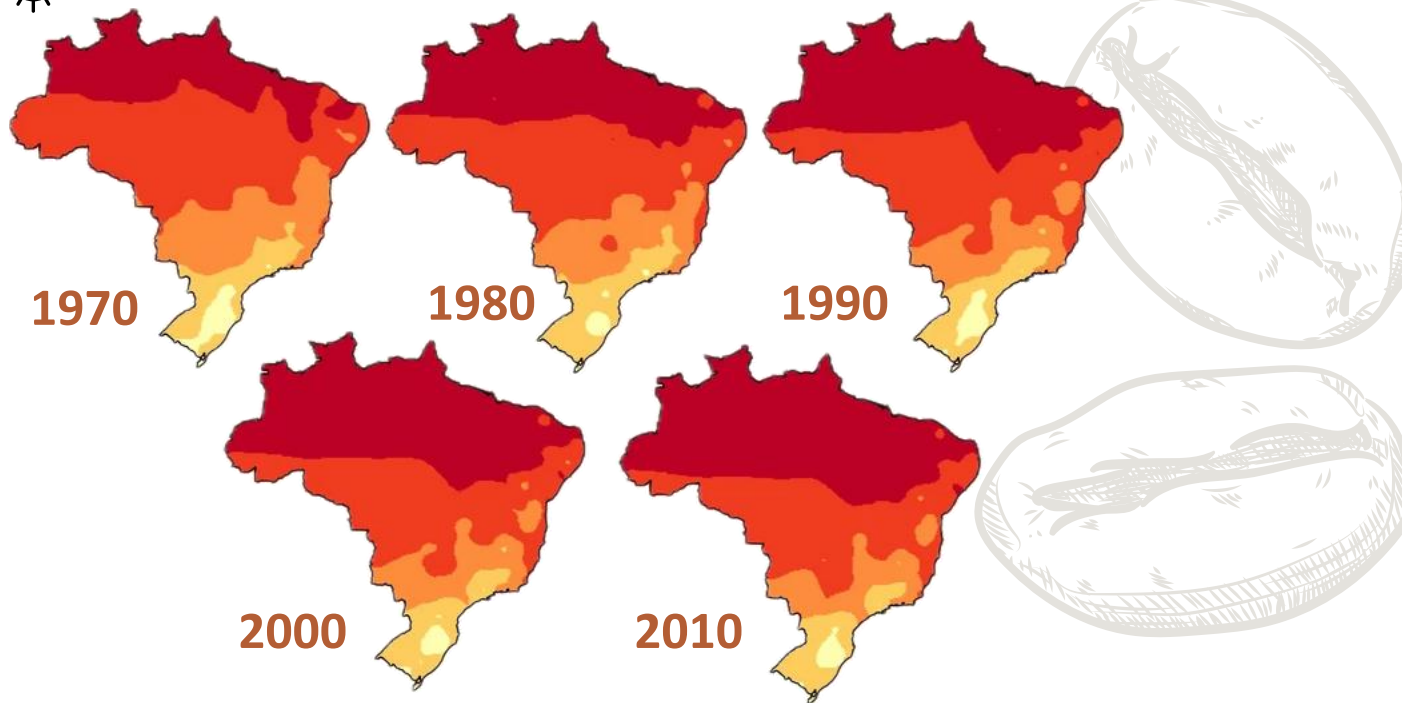
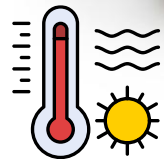


▼ 60%
Brazil



▼ 70%
Southeast
Ásia

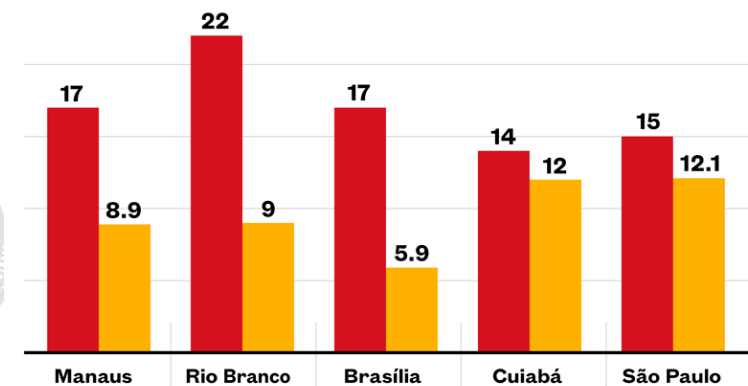
O Brasil nunca foi tão quente



Evolução das ondas de calor no
Brasil

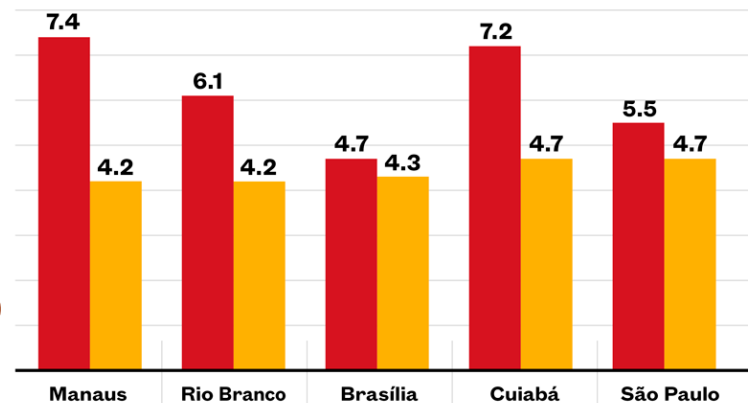
Number of heatwaves

■ In 2023 ■ Yearly average between 1979 and 2023

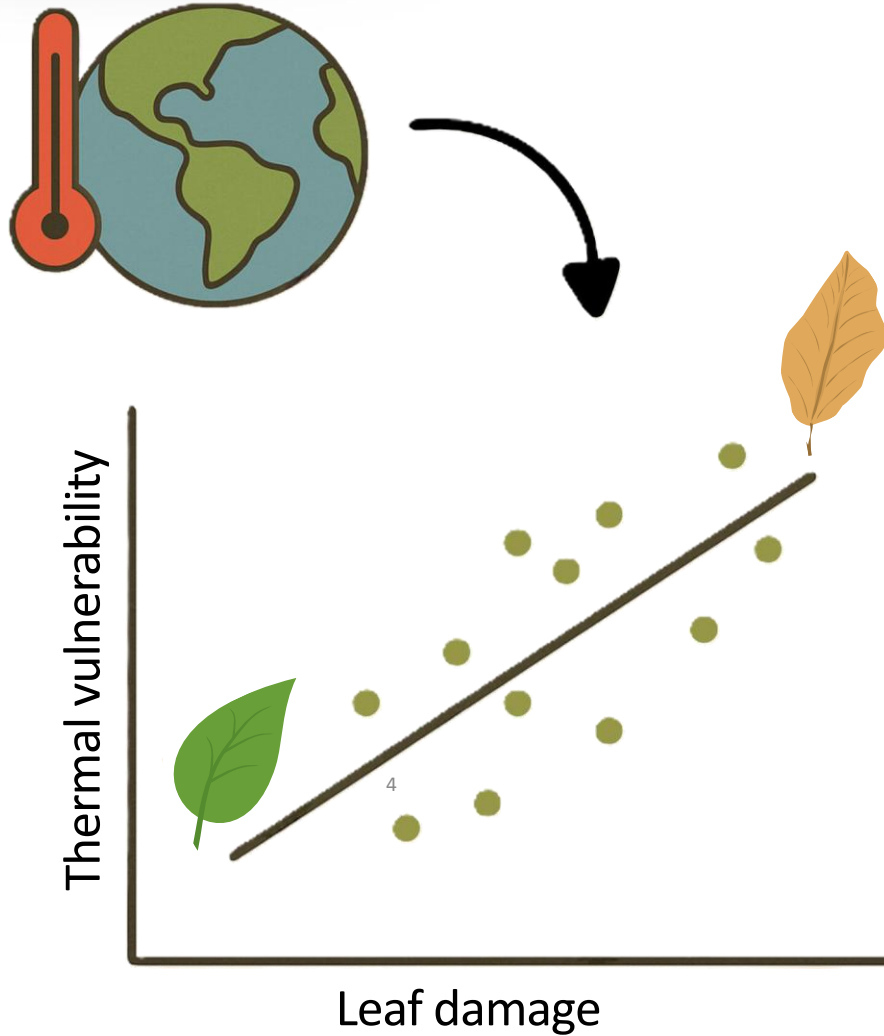


Average duration of heatwaves (in days)

■ In 2023 ■ Yearly average between 1979 and 2023



A vulnerabilidade depende da termotolerância



SCIENTIFIC REPORTS

OPEN

Subcontinental heat wave triggers terrestrial and marine, multi-taxa responses

Received: 16 March 2018

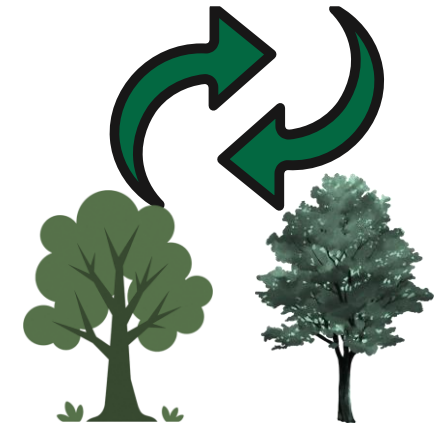
Accepted: 10 August 2018

Published online: 30 August 2018

Katinka X. Ruthrof^{1,2}, David D. Breshears^{3,4}, Joseph B. Fontaine⁵, Ray H. Froend⁶, George Matusick¹, Jatin Kala⁵, Ben P. Miller^{2,7}, Patrick J. Mitchell⁸, Shaun K. Wilson^{9,10}, Mike van Keulen⁵, Neal J. Enright⁵, Darin J. Law³, Thomas Wernberg¹⁰ & Giles E. St. J. Hardy¹

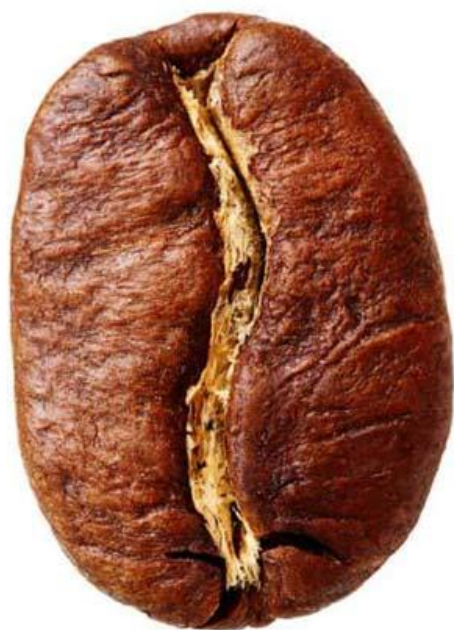


Mortalidade
de árvores

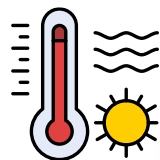


Alterações
fitossociológicas

Mais de 100 espécies dentro do gênero *Coffea*!



Arabica



Canephora

PRIMARY RESEARCH ARTICLE

Global Change Biology WILEY

Not so robust: Robusta coffee production is highly sensitive to temperature

Jarrod Kath¹  | Vivekananda M. Byrareddy¹ | Alessandro Craparo^{2,3} |
Thong Nguyen-Huy^{1,4}  | Shahbaz Mushtaq¹ | Loc Cao⁵ | Laurent Bossolasco⁵

¹Centre for Applied Climate Sciences,
University of Southern Queensland,
Toowoomba, Qld, Australia

²International Center for Tropical
Agriculture (CIAT), Hanoi, Vietnam

³CGIAR Research Program on Climate
Change, Agriculture and Food Security
(CCAFS), Cali, Colombia

⁴Vietnam National Space Center, Vietnam
Academy of Science and Technology, Hanoi,
Vietnam

⁵Sustainable Management Services, ECOM
Agroindustrial, Ho Chi Minh City, Vietnam

Correspondence

Jarrod Kath, Centre for Applied Climate
Sciences, University of Southern
Queensland, Toowoomba, Qld, Australia.
Email: jarrod.kath@usq.edu.au

Abstract

Coffea canephora (robusta coffee) is the most heat-tolerant and 'robust' coffee species and therefore considered more resistant to climate change than other types of coffee production. However, the optimum production range of robusta has never been quantified, with current estimates of its optimal mean annual temperature range (22–30°C) based solely on the climatic conditions of its native range in the Congo basin, Central Africa. Using 10 years of yield observations from 798 farms across South East Asia coupled with high-resolution precipitation and temperature data, we used hierarchical Bayesian modeling to quantify robusta's optimal temperature range for production. Our climate-based models explained yield variation well across the study area with a cross-validated mean $R^2 = .51$. We demonstrate that robusta has an optimal temperature below 20.5°C (or a mean minimum/maximum of $\leq 16.2/24.1^\circ\text{C}$), which is markedly lower, by 1.5–9°C than current estimates. In the middle of robusta's currently assumed optimal range (mean annual temperatures over 25.1°C), coffee yields are 50% lower

Design Experimental



15 Materiais Vegetais
(IAC e IAPAR)



8 Comerciais



Espécies	Classificação
<i>Coffea arabica</i> cv. IAC Catuaí SH3	Comercial
<i>Coffea arabica</i> cv. IAC Catuaí H20	Comercial
<i>Coffea arabica</i> cv. Obatã IAC 1669-20	Comercial
<i>Coffea arabica</i> var. semperflorens	Comercial
<i>Coffea canephora</i> cv. CcR1	Comercial
<i>Coffea canephora</i> cv. CcR2	Comercial
<i>C. arabica</i> cv. Obatã IAC / <i>C. canephora</i> cv. CcR1	Comercial
<i>C. arabica</i> cv. Obatã IAC / <i>C. canephora</i> cv. CcR2	Comercial



Design Experimental



15 Materiais Vegetais



7 Selvagens



Espécie	Classificação
<i>Coffea stenophylla</i>	Selvagem
<i>Coffea kapakata</i>	Selvagem
<i>Coffea bengalensis</i>	Selvagem
<i>Coffea racemosa</i>	Selvagem
<i>Coffea congensis</i>	Selvagem
<i>Coffea eugenioides</i>	Selvagem
<i>Coffea liberica</i>	Selvagem



Parâmetros Avaliados



Vulnerabilidade das membranas celulares



Temperatura de transição de fase



Termotolerância dos fotossistemas



Tletal_5

26.38°C

Tletal_15

28.27°C

Tletal_30

30.48°C

Tp

40.90°C

T5

41.01°C

T50

50.19°C

20

25

30

35

40

45

50

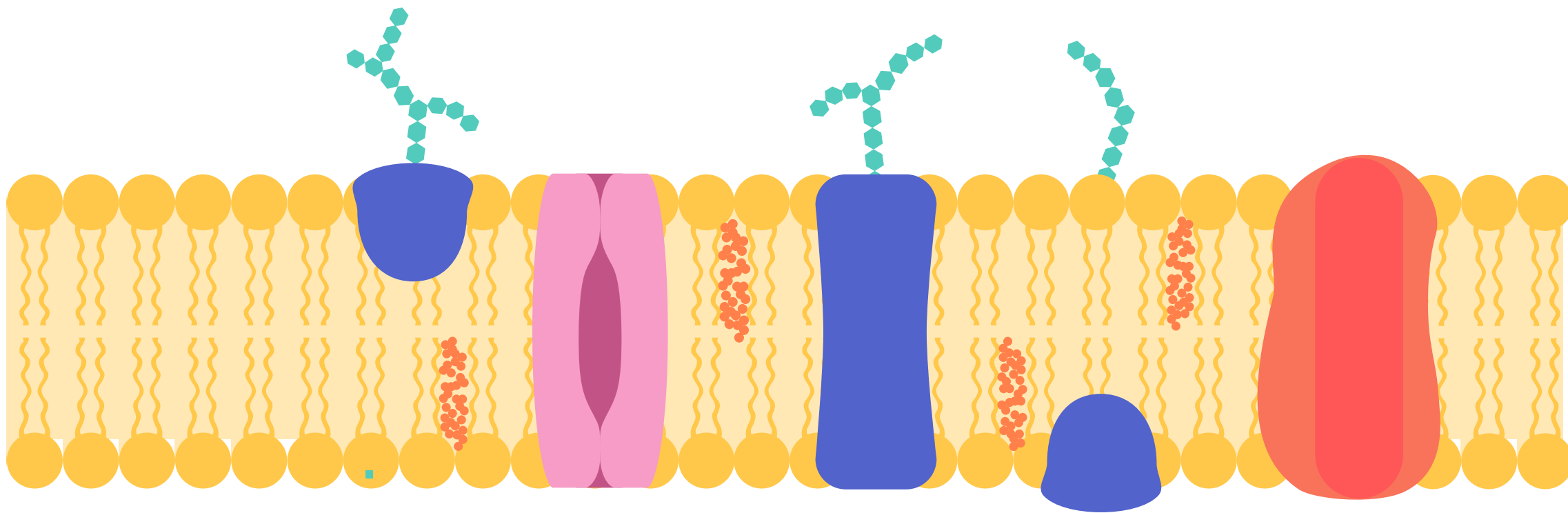
55

60

Temperatura (°C)

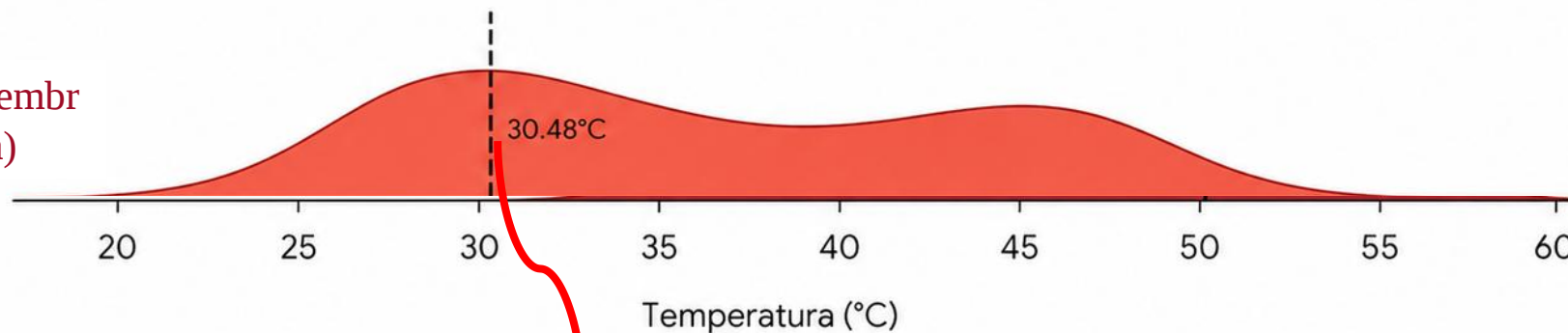


Estrutura mais termossensível da célula



Quais espécies?

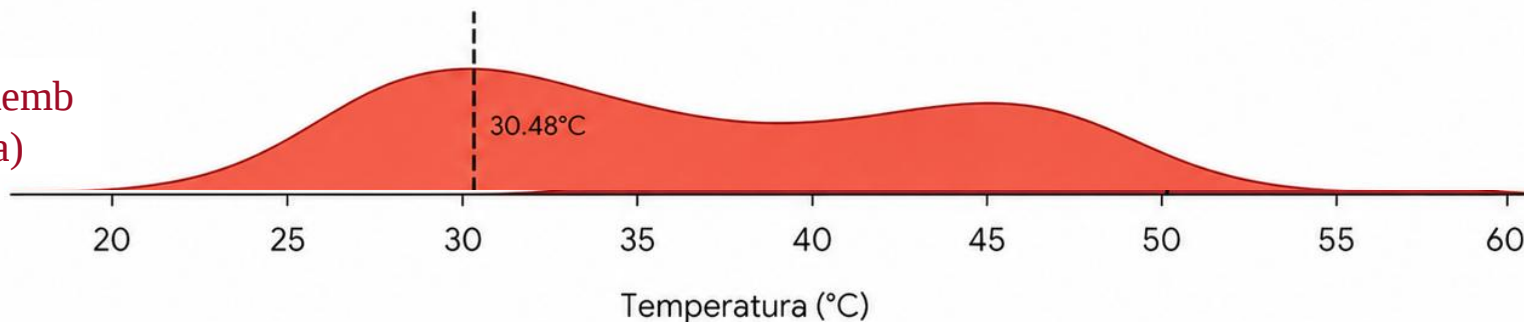
T30(membrana)



Não há um grupo mais vulnerável

Espécie	Classificação
<i>Coffea congensis</i>	Selvagem
<i>Coffea eugenoides</i>	Selvagem
<i>Coffea racemosa</i>	Selvagem
<i>Coffea arabica</i> var. <i>semperflorens</i>	Comercial
<i>Coffea canephora</i> cv. CcR1	Comercial

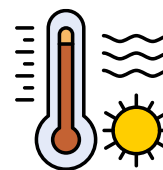
T30(membrana)



Comumente associado com morte das células em plantas expostas à seca



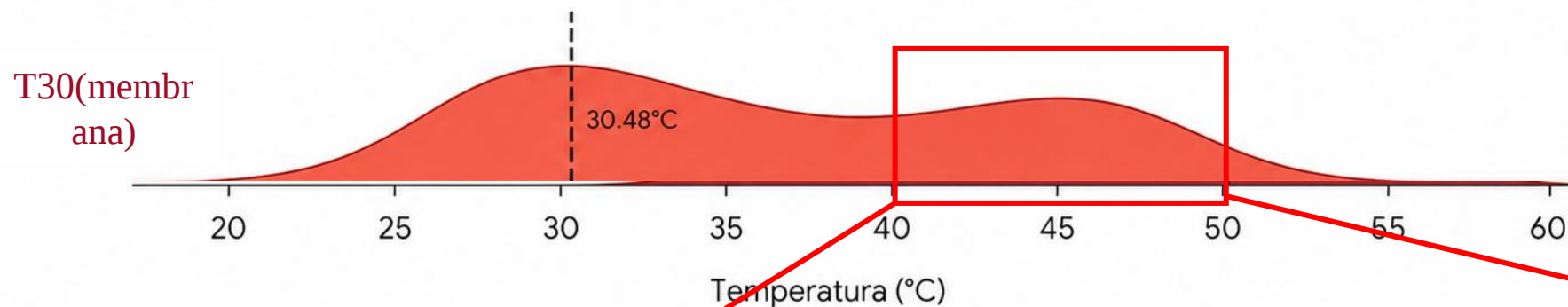
Correlação com observações no campo



30 a 35 °C



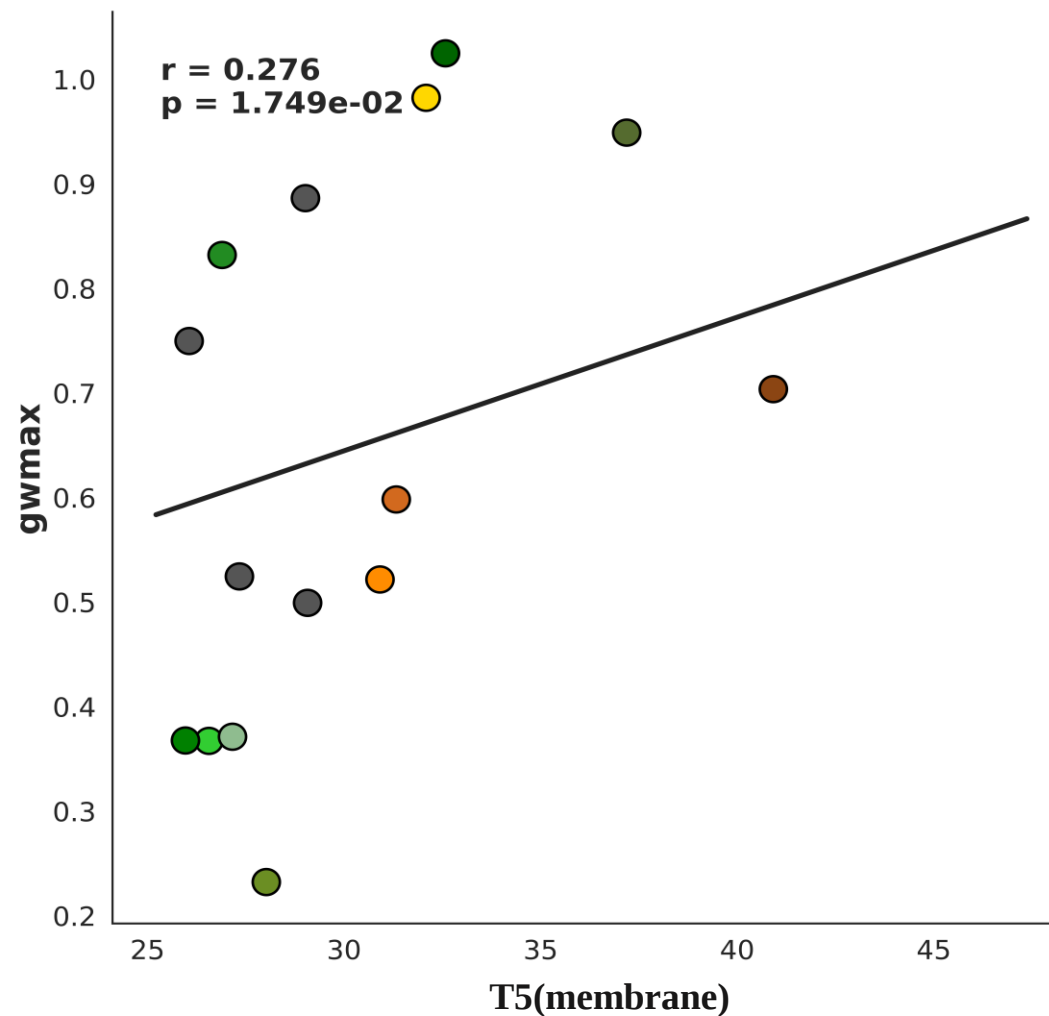
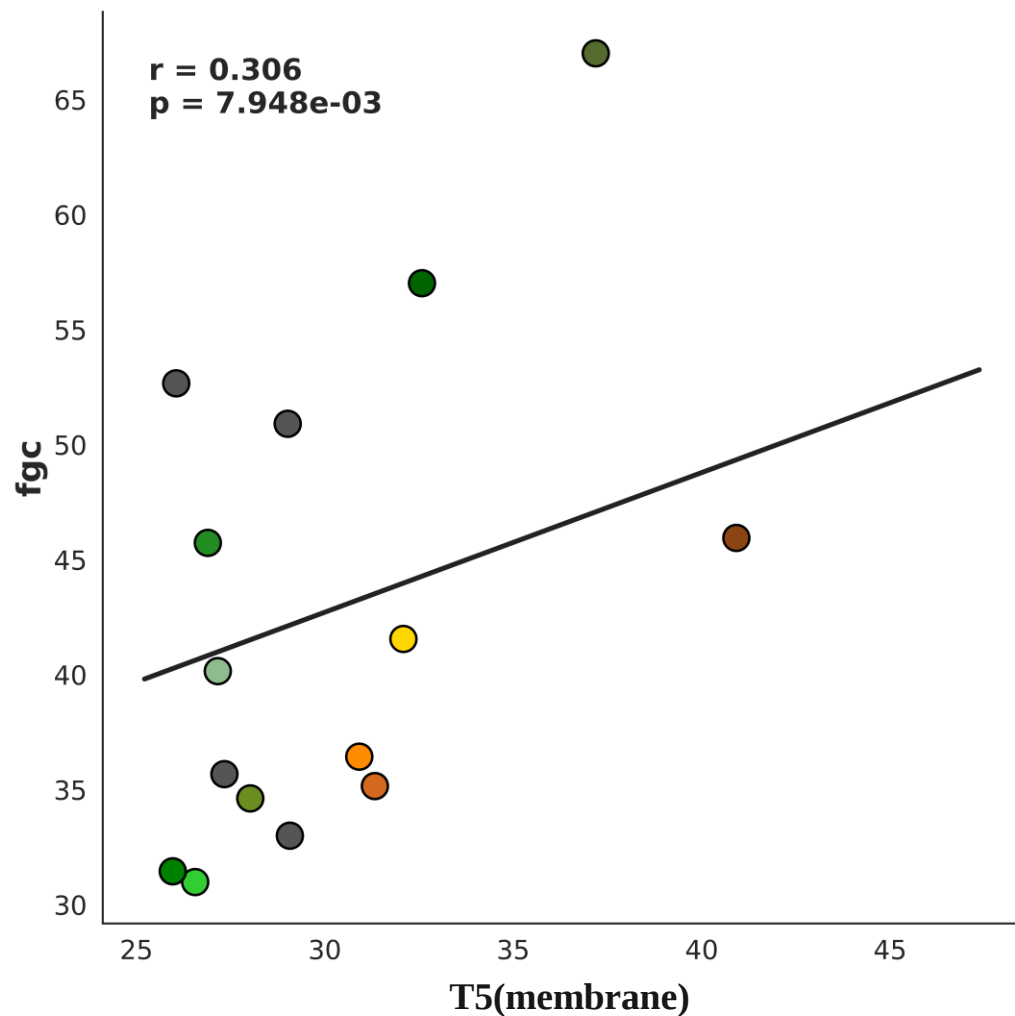
Há espaço para melhoramento genético?



**Caráter
herdável?**

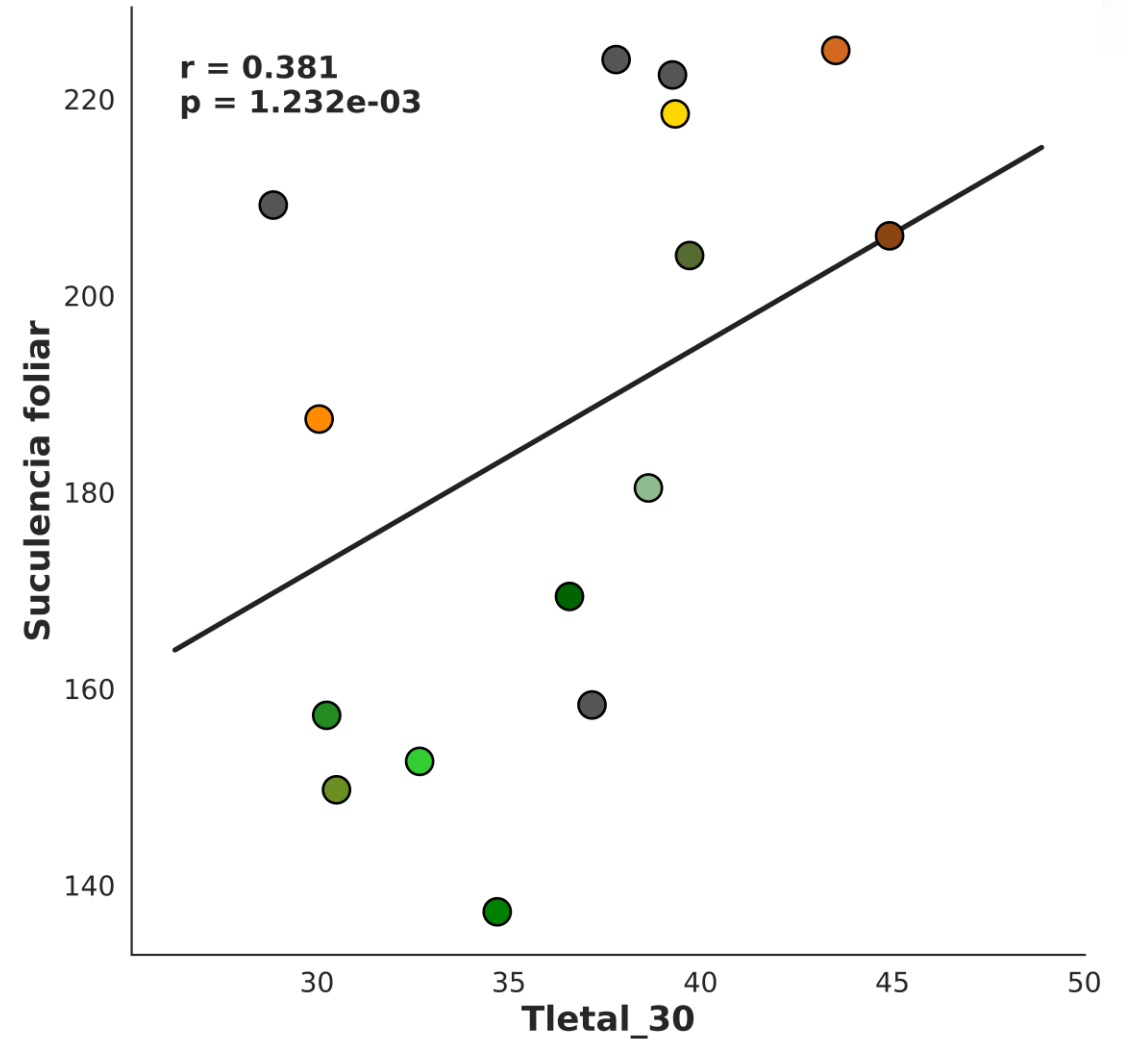
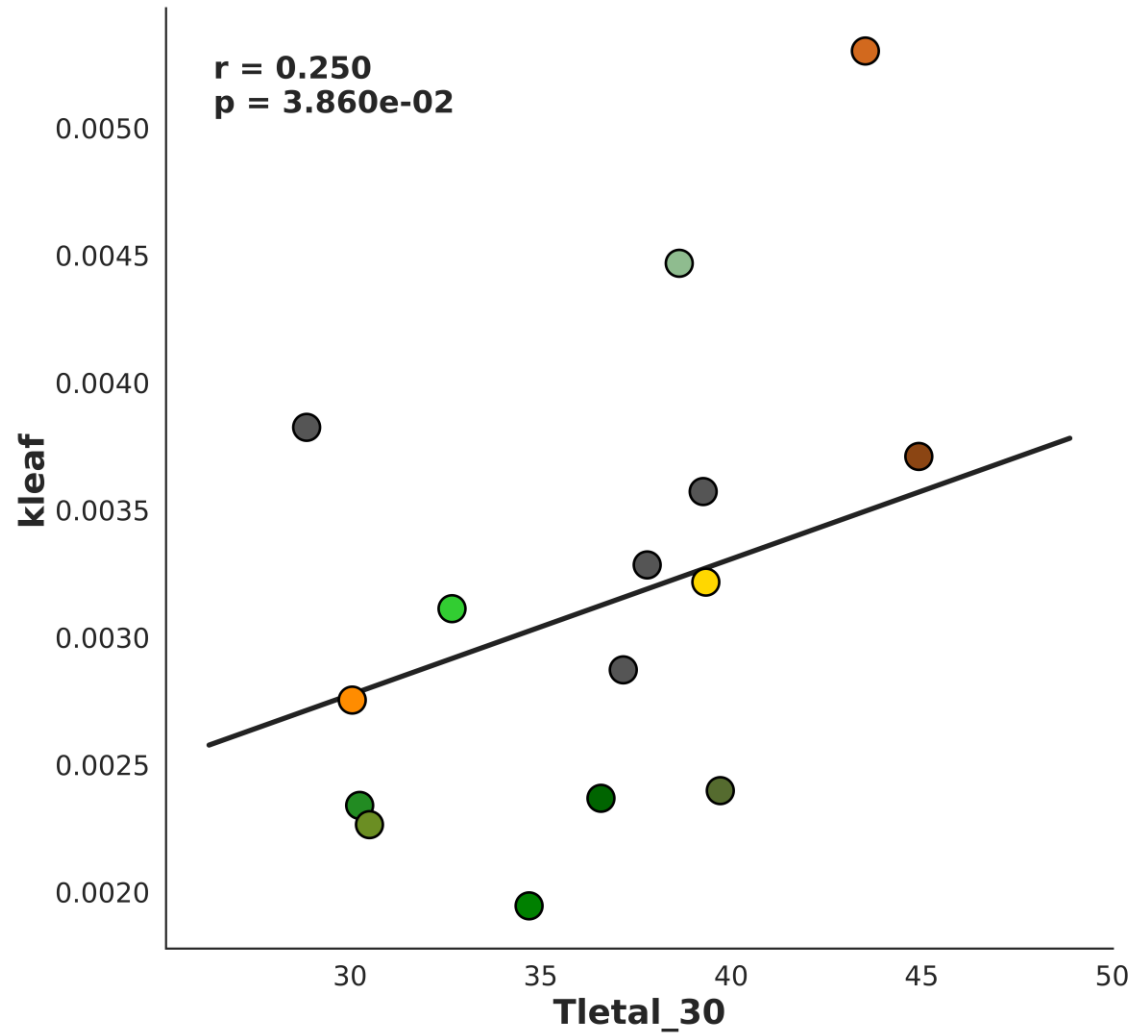
Espécies	Classificação
<i>Coffea bengalensis</i>	Selvagem
<i>Coffea liberica</i>	Selvagem
<i>Coffea stenophylla</i>	Selvagem
<i>Coffea arabica</i> cv. H20	Comercial
<i>Coffea arabica</i> cv. Obatã IAC	Comercial
<i>Coffea canephora</i> cv. CcR2	Comercial
<i>C. arabica</i> cv. Obatã IAC / <i>C. canephora</i> cv. CcR2	Comercial

Capacidade evaporativa e características estruturais são importantes nos estágios iniciais da tolerância térmica





Alterações nas correlações a medida que os danos avançam





Tletal_5

26.38°C

Tletal_15

28.27°C

Tletal_30

30.48°C

Tp

40.90°C

T5

41.01°C

T50

50.19°C

20

25

30

35

40

45

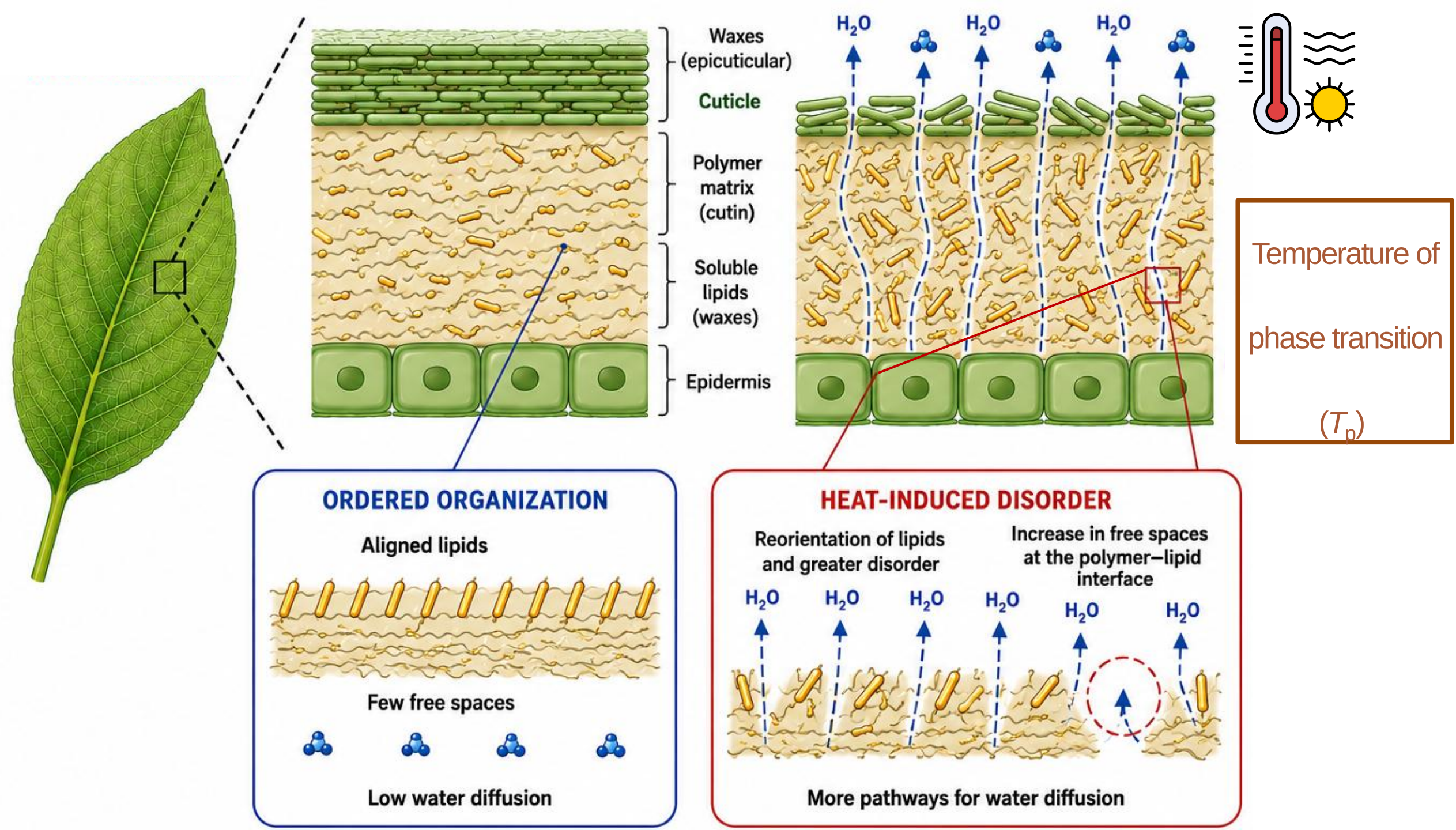
50

55

60

Temperatura (°C)





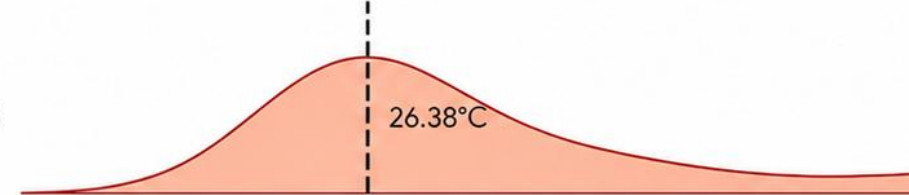


Quais espécies foram mais vulneráveis?

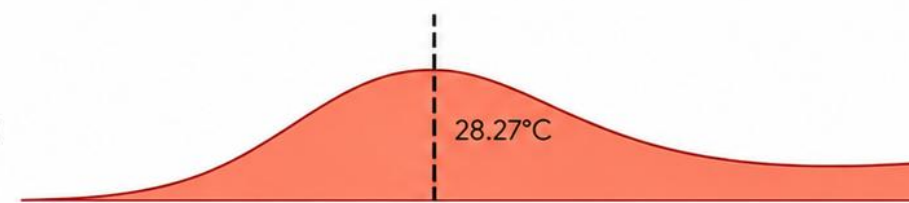
Espécies	Classificação
<i>Coffea bengalensis</i>	Selvagem
<i>Coffea liberica</i>	Selvagem
<i>Coffea canephora</i> cv. CcR1	Comercial
<i>C. arabica</i> cv. Obatã IAC / <i>C. canephora</i> cv. CcR1	Comercial



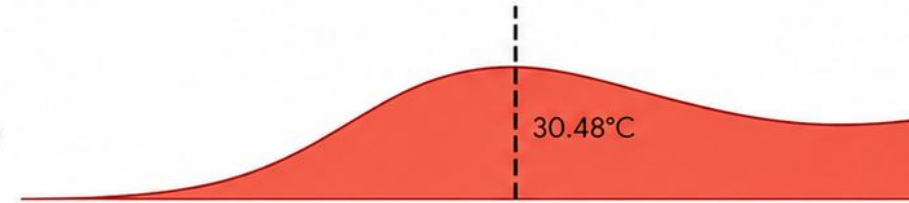
Tletal_5



Tletal_15



Tletal_30



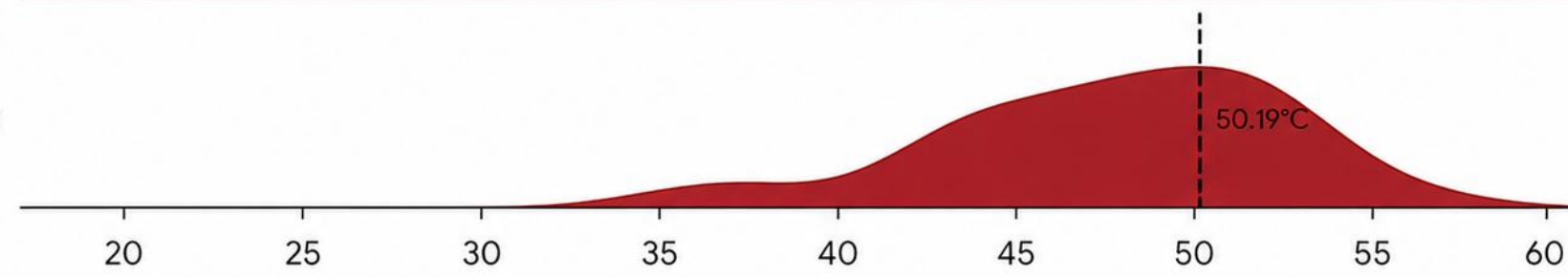
Tp



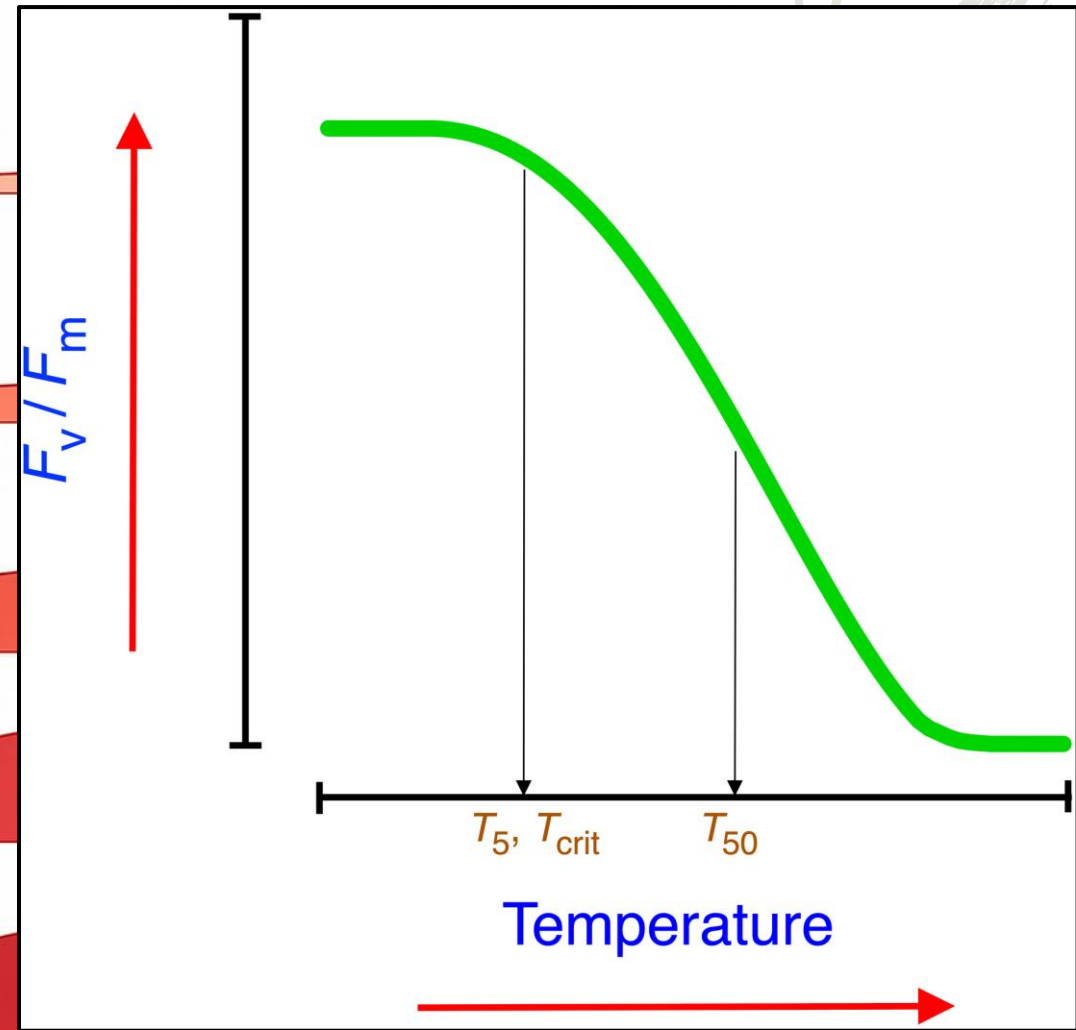
T5



T50

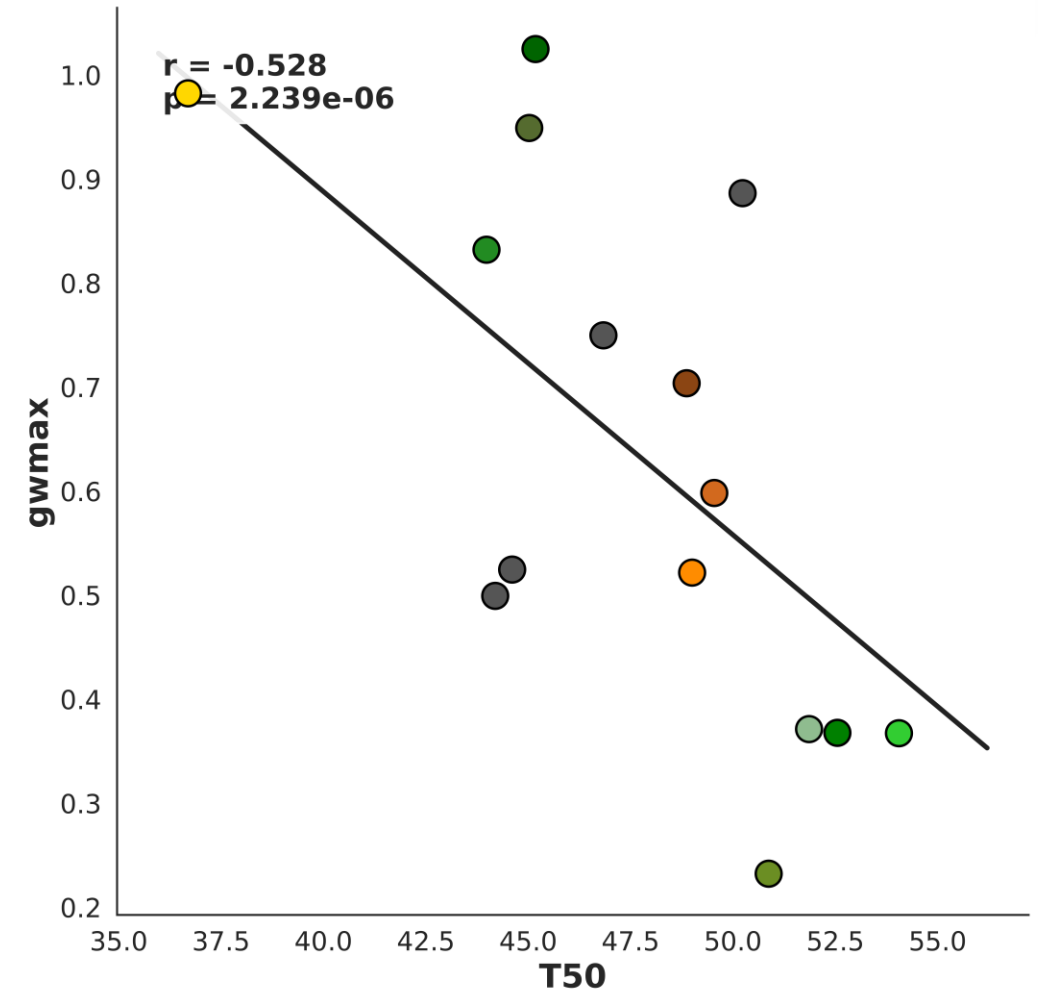
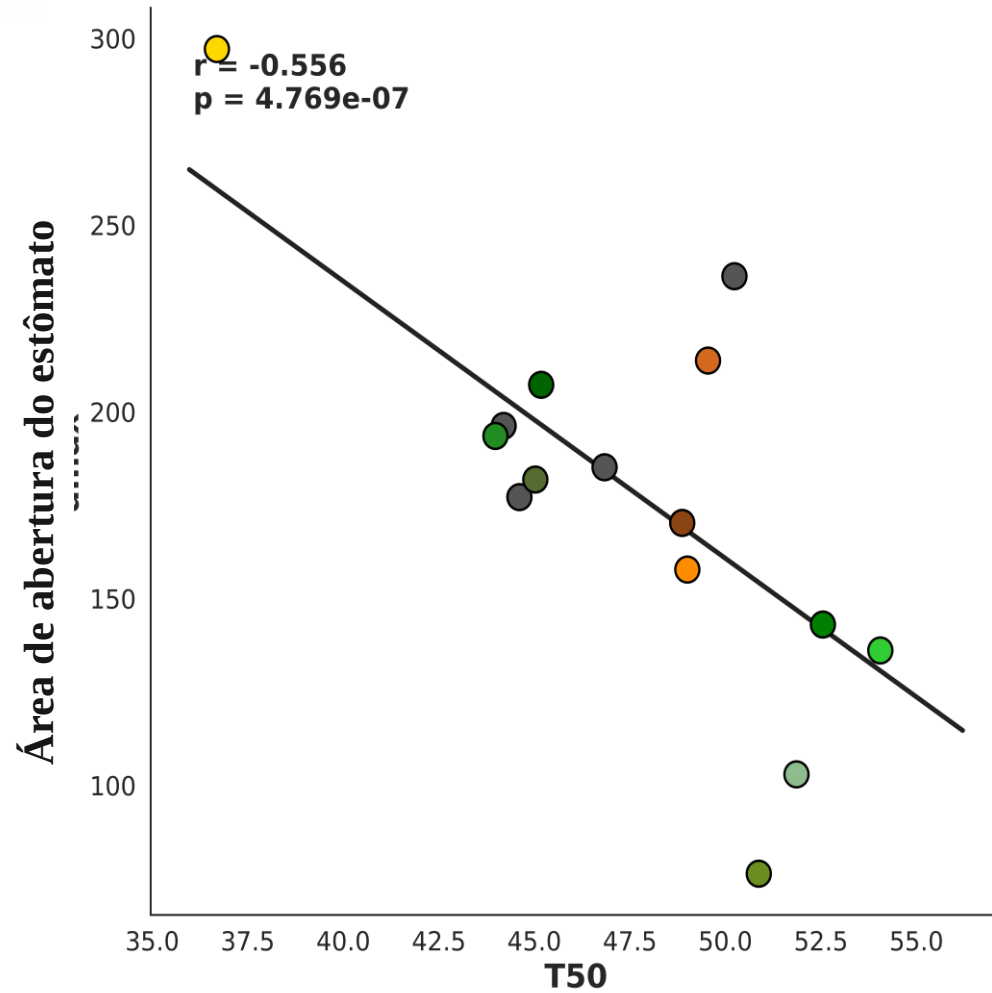


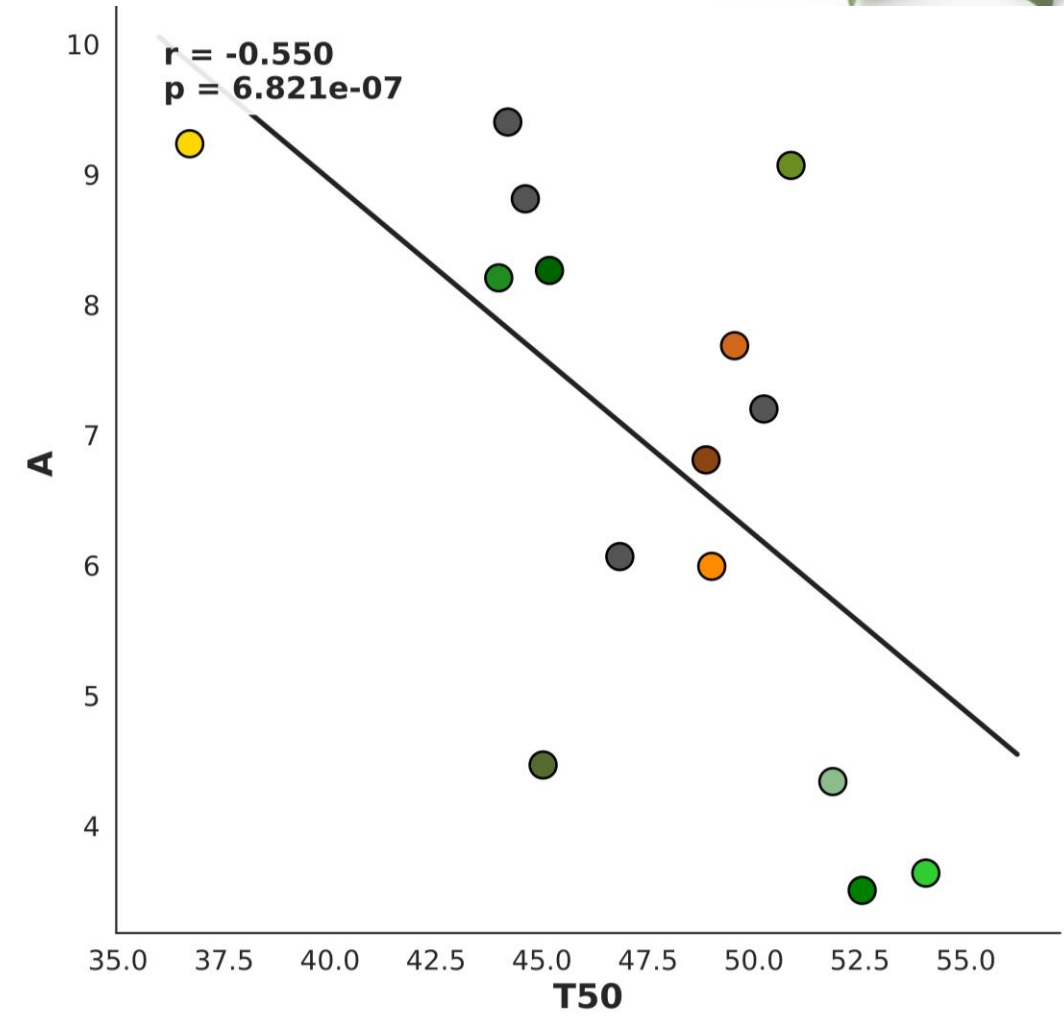
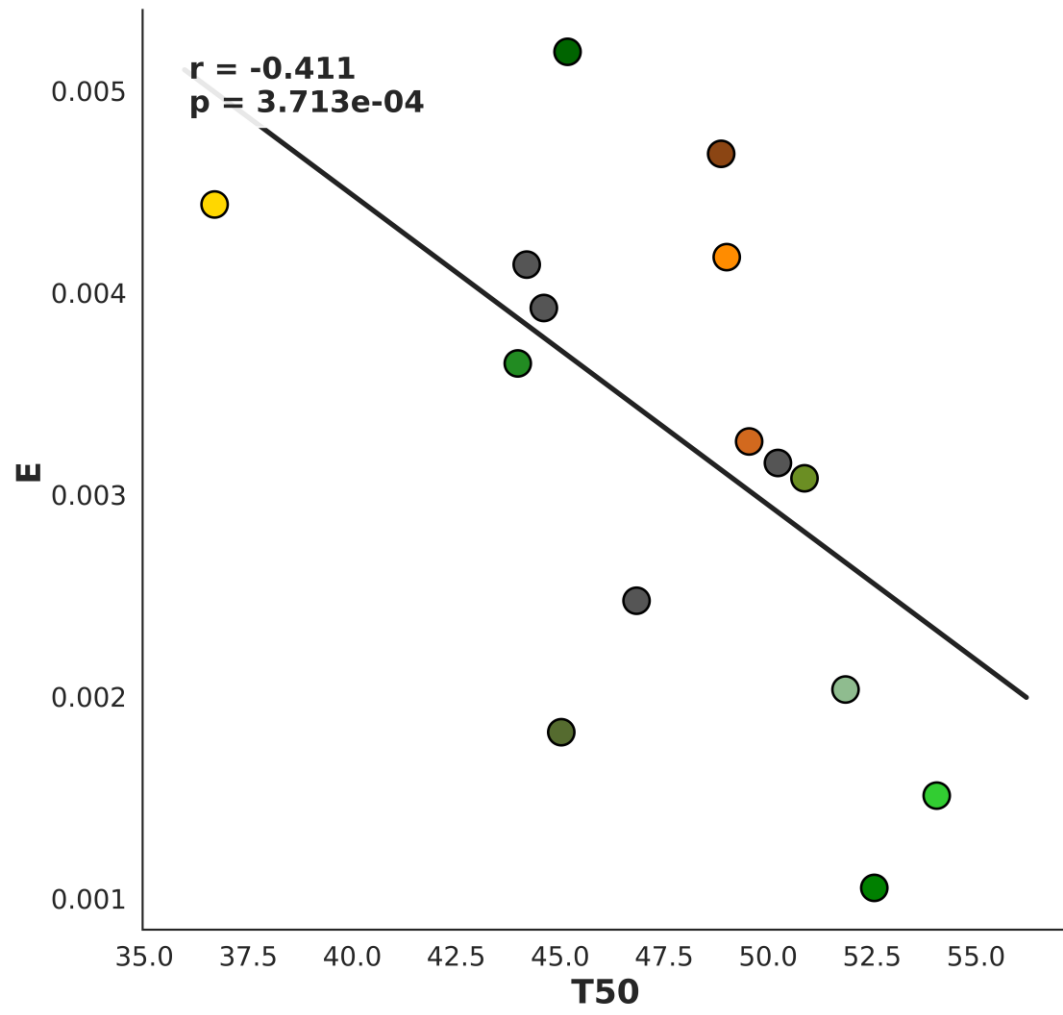
Temperatura (°C)





Plantas que dependem da transpiração exibiram menor tolerância fotossintética





Tletal_5

26.38°C

Tletal_15

28.27°C

Tletal_30

30.48°C

Tp

40.90°C

T5

41.01°C

T50

50.19°C

20

25

30

35

40

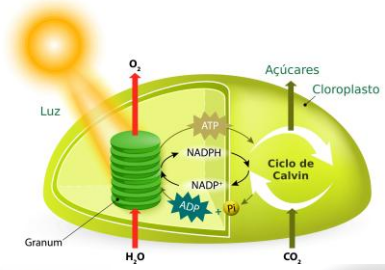
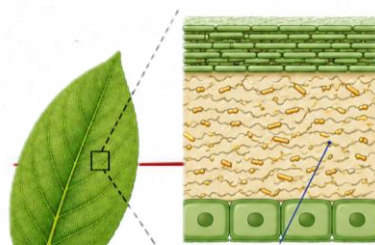
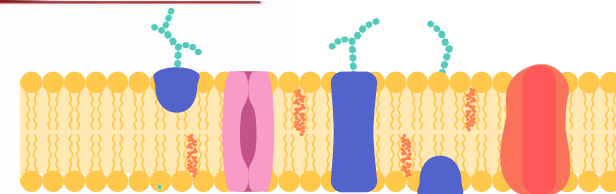
45

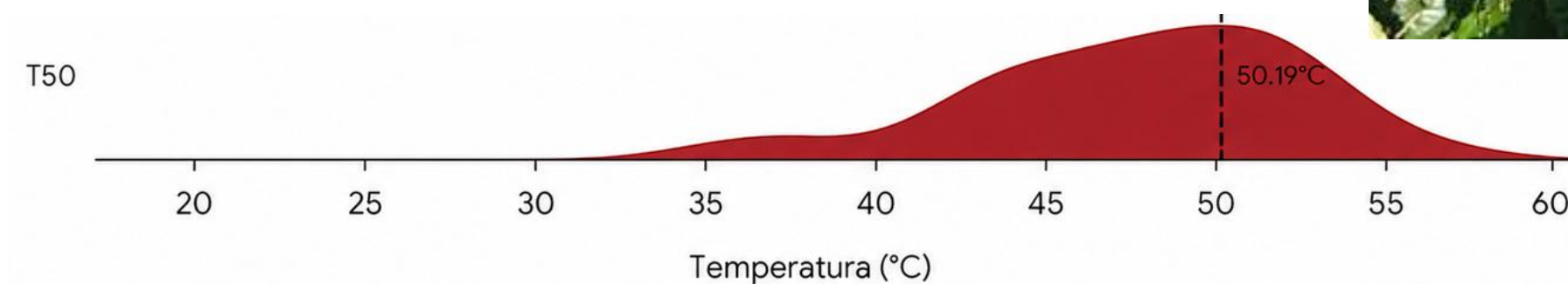
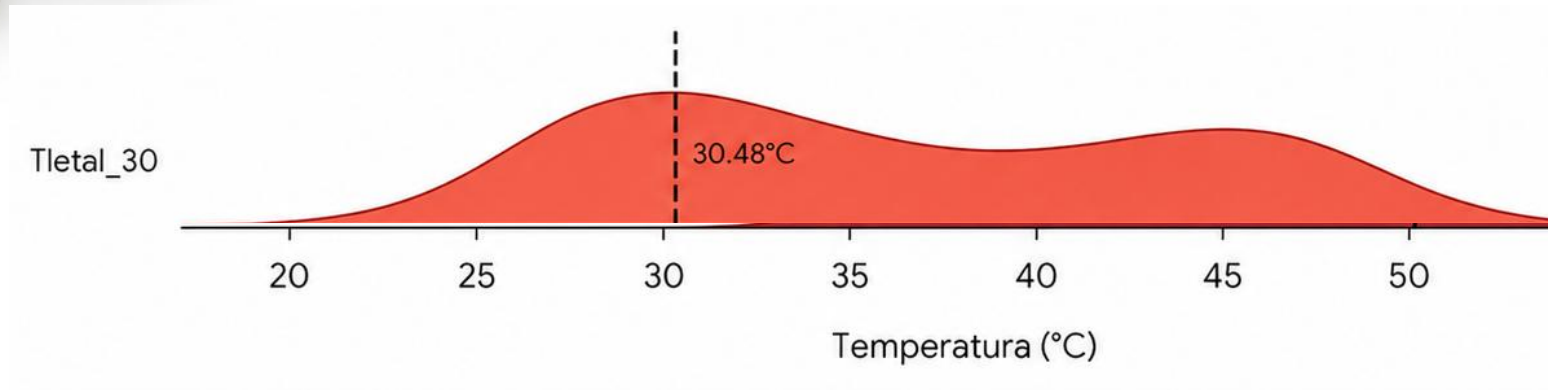
50

55

60

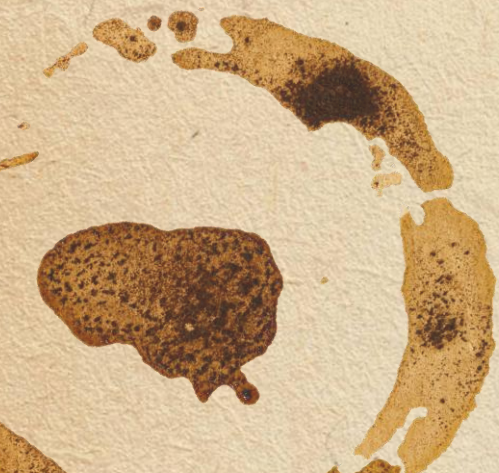
Temperatura (°C)

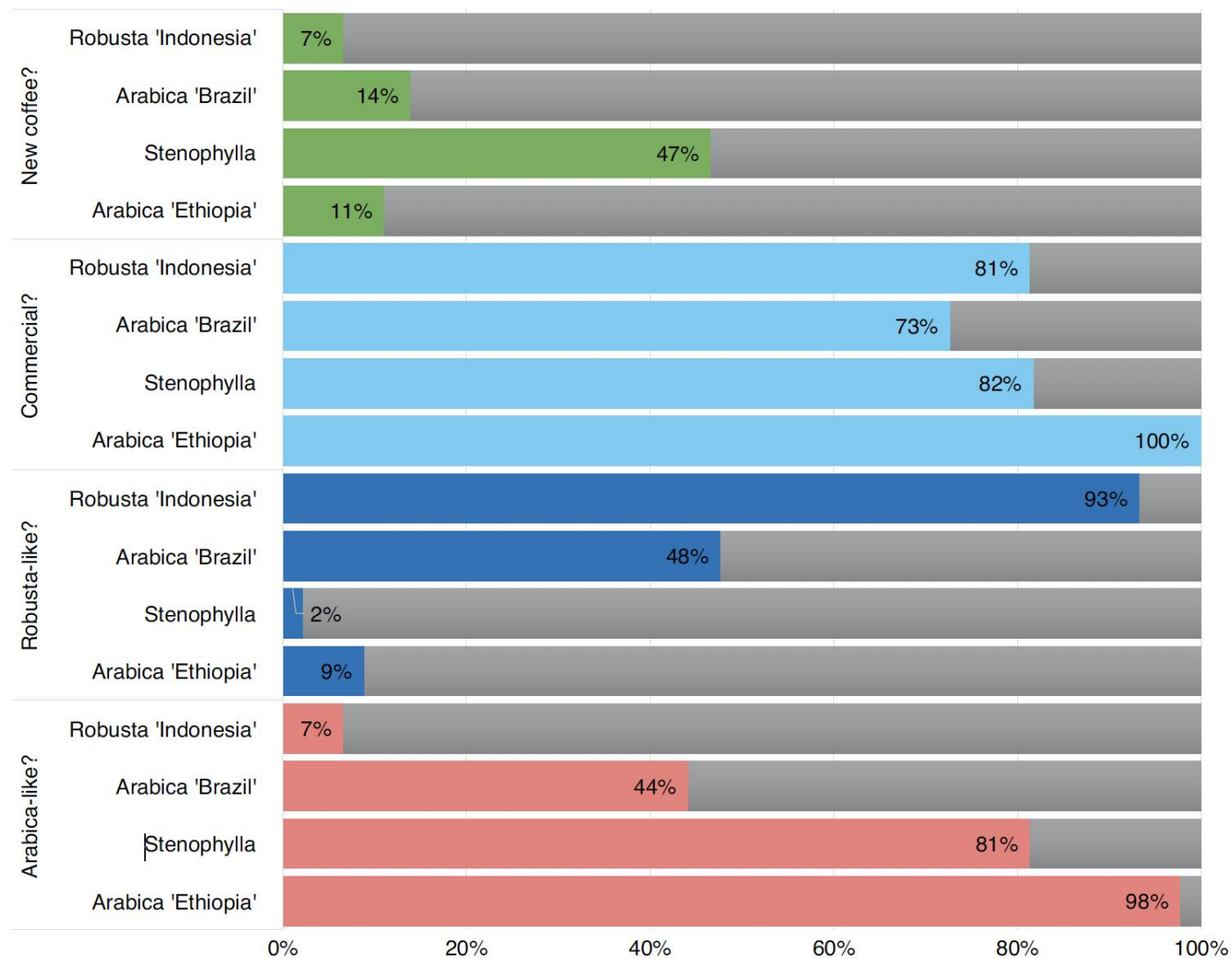




Species	Classification
<i>Coffea stenophylla</i>	Selvagem
<i>C. arabica</i> cv. Obatã IAC	Comercial

**E o
gosto do
café?**









Cenicafé®
Centro Nacional de Investigaciones de Café



cenicafe.org



Cenicafé FNC



@cenicafe



cenicafé



CenicaféFNC



@cenicafefnc