28th Conference Asic 2021
From 28 June to 1 July 2021

A possible underground exit: the histometry analysis of primary lateral roots aiming possible water deficit tolerance in coffee plants

S1-P-27

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Introduction

Water deficit is a challenge that affect all crops, whereas plants have limited strategies to cope with it, ranging from structural, morphological to anatomical and other features. The descriptive analysis and histometry of primary lateral roots from thirteen adult coffee varieties was performed as a base line for the seek for water deficit tolerance traits.

Materials/Methods

Three plants from thirteen *Coffea arabica* accessions were selected based on the available information on their water deficit tolerance. Primary lateral roots were sampled and processed according to Pérez-Molina *et al* (2021) for anatomical and histometry analysis.

Conclusion/Perspectives

There is variation of the histological traits of primary lateral roots of adult coffee plants. This variation may be attributed to several cultivar characteristics and environmental interactions. Further evaluation of the behavior and phenotypic plasticity of coffee plant cultivars are expected to provide amenable traits to evaluate and identify genotypes more tolerant to water stress.

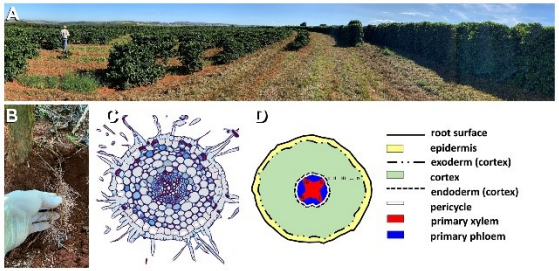

Figure 1: A - Coffee plant plantation (EPAMIG, Brazil), **B -** root sampling, **C -** schematic picture of a primary lateral root; and **D –** schematic view of the measured tissues/regions.

Results/Discussion

There are significant differences of histological traits of primary lateral roots, despite one environment was evaluated. This is attributed to the phenotypic plasticity inherent to the cultivars and possible interactions with microorganisms, developmental stage, soil properties and other features that may influence tissue differentiation in roots. It is expected that, under water deficit conditions, these differences will be more evident. This variability is hypothesized to subsidize, at least in part, the differences in water deficit tolerance.

Table 1. Histometry (area of tissues/regions identified in cross sections) of lateral primary root of 13 *C. arabica* seedlings cultivars categorized into two degrees of tolerance to water stress (sensitive or tolerant). Cultivars: X5B9P1, X7B13P14, Acauã, Bourbon, Catiguar MG2, Catuaí SH3, Geixa, IAC125RN, IPR100, Obatã, Sagarana 19, Sarchimor and Tupi.

	Phenotype		Cultivar												Cultivar	F	R^2	P_{model}
	Sensitive	Tolerant	X5B9P1	X7B13P14	Acauã	Bourbon	Catiguar MG2	Catuaí SH3	Geixa	IAC125RN	IPR100	Obatã	Sagarana 19	Sarchimor	Tupi				
Total cross section area[#]	0.257 ± 0.022a	0.263 ± 0.019a	0.17 ± 0.005a	0.166 ± 0.021a	0.423 ± 0.044a	0.44 ± 0.065a	0.265 ± 0.039a	0.282 ± 0.042a	0.198 ± 0.032a	0.309 ± 0.076a	0.352 ± 0.112a	0.129 ± 0.005a	0.116 ± 0.011a	0.226 ± 0.033a	0.122 ± 0.032a	n.s.	5.90	0.20	***
Epidermis[#]	0.034 ± 0.002a	0.036 ± 0.002a	0.031 ± 0.001a	0.027 ± 0.001a	0.052 ± 0.004a	0.047 ± 0.005a	0.036 ± 0.005a	0.035 ± 0.004a	0.031 ± 0.002a	0.036 ± 0.006a	0.041 ± 0.008a	0.025 ± 0.001a	0.024 ± 0.002a	0.032 ± 0.002a	0.019 ± 0.004a	n.s.	6.25	0.21	***
Cortex[#]	0.206 ± 0.019a	0.208 ± 0.016a	0.126 ± 0.005a	0.129 ± 0.018a	0.343 ± 0.036a	0.365 ± 0.057a	0.209 ± 0.031a	0.223 ± 0.034a	0.156 ± 0.028a	0.255 ± 0.066a	0.284 ± 0.097a	0.097 ± 0.004a	0.085 ± 0.009a	0.175 ± 0.028a	0.094 ± 0.026a	n.s.	5.81	0.2	***
Stele[#]	**0.017 ± 0.002b**	**0.019 ± 0.001a**	**0.013 ± 0e**	**0.01 ± 0.001d**	**0.029 ± 0.004d**	**0.028 ± 0.004c**	**0.019 ± 0.003d**	**0.025 ± 0.004be**	**0.011 ± 0.002d**	**0.017 ± 0.004be**	**0.026 ± 0.008be**	**0.007 ± 0.001d**	**0.007 ± 0bd**	**0.019 ± 0.004a**	**0.009 ± 0.003be**	n.s.	5.38	0.19	***
Xylem[#]	0.006 ± 0.001a	0.007 ± 0.001a	0.004 ± 0a	0.003 ± 0a	0.011 ± 0.002a	0.01 ± 0.001a	0.007 ± 0.001a	0.011 ± 0.002a	0.004 ± 0.001a	0.005 ± 0.001a	0.009 ± 0.003a	0.002 ± 0a	0.003 ± 0a	0.008 ± 0.002a	0.003 ± 0.001a	n.s.	5.56	0.19	***
Phloem + Procambium[#]	0.006 ± 0.001a	0.007 ± 0.001a	**0.005 ± 0cde**	**0.004 ± 0cde**	**0.011 ± 0.001b**	**0.011 ± 0.002b**	**0.008 ± 0.001ade**	**0.008 ± 0.001ade**	**0.004 ± 0.001cde**	**0.007 ± 0.002abe**	**0.01 ± 0.003ab**	**0.002 ± 0c**	**0.002 ± 0c**	**0.007 ± 0.001acde**	**0.004 ± 0.001cd**	n.s.	5.72	0.20	***
Number poles protoxylem	4.822 ± 0.137a	4.722 ± 0.115a	**4.769 ± 0.122cdef**	**4.08 ± 0.294def**	**5.067 ± 0.179b**	**5.889 ± 0.281ab**	**4.778 ± 0.258cf**	**5.875 ± 0.507cef**	**4.5 ± 0.298cdef**	**4.923 ± 0.487acef**	**4.429 ± 0.388abc**	**4.158 ± 0.191de**	**4.941 ± 0.277cef**	**4.462 ± 0.312d**	n.s.	5.58	0.19	***
Number cortex cells	8.158 ± 0.29a	**8.19 ± 0.246a**	**7.192 ± 0.216cdef**	**6.854 ± 0.425cdef**	**10.1 ± 0.344b**	**10.188 ± 0.806b**	**8.646 ± 0.728adf**	**8.423 ± 0.702adef**	**7.518 ± 0.508cdef**	**9.077 ± 1.387abf**	**8.714 ± 1.24ab**	**6.227 ± 0.097ce**	**6.421 ± 0.314c**	**8.059 ± 0.465acdef**	**7.154 ± 0.541cde**	n.s.	4.62	0.17	***
Pericycle[#]	0.004 ± 0a	**0.005 ± 0a**	**0.004 ± 0def**	**0.003 ± 0.001ef**	**0.006 ± 0.001c**	**0.007 ± 0.001bc**	**0.004 ± 0.001adf**	**0.005 ± 0.001abcd**	**0.003 ± 0ef**	**0.005 ± 0.001abdef**	**0.007 ± 0.003abc**	**0.002 ± 0e**	**0.002 ± 0e**	**0.004 ± 0.001adf**	**0.002 ± 0.001ef**	n.s.	4.25	0.16	***

mean ± standard error; *n.s.*: $P>0.05$; *: $P<0.05$; ***: $P<0.001$; *F*: Fisher value: R^2: coefficient of determination; P_{model}: model probability; Statistical significance among main effects was determined by two-way ANOVA; Means followed by different letters within rows (among tolerance or cultivars) indicate significant difference according to a Fisher's least significant difference (*LSD*, $P<0.05$). [#]measures (mm^2) in primary root cross sections

References:

Pérez-Molina, J. P; Picoli, E. A.T.; Oliveira, L. A.; Silva, B. T.; Souza, G. A.; Rufino, J. L. S.; Pereira, A. A.; Ribeiro, M. F.; Malvicini, G. L.;Turello, L.; D'Alessandro, S. C.; Sakiyama, N. S.; Ferreira, W. P. M. Treasured exceptions: Association of morphoanatomical leaf traits with cup quality of Coffea arabica L. cv. "Catuaí", Food Research International, 141: 110118, 2021. https://doi.org/10.1016/j.foodres.2021.110118.