SCREENING OF MARKERS FOR DROUGHT TOLERANCE IN COCOA HYBRIDS

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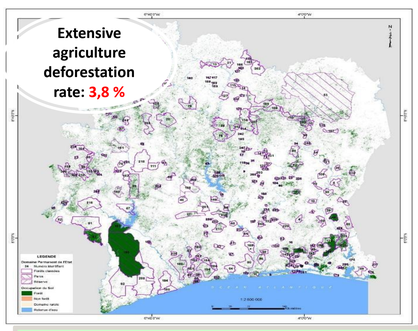
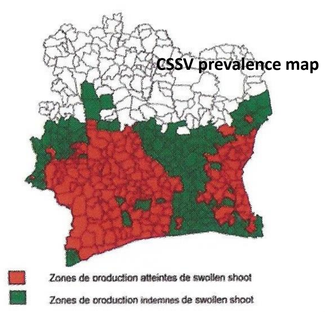
Cocoa farming constraint





Objectives

- ❑ To improve sustainability of cocoa production
- ❑ To characterize productive cocoa genotypes for their adaptation to low rainfall environments
- ❑ To identify morpho-physiological and biochemical traits of water stress tolerance in cocoa

Materials and methods

Treatment

Randomised Complete Block Design with two factors, Ⅰ water regimes with three levels; 100%CC, 50%CC and 20%CC (Ⅱ) cocoa progeny with ten levels

Plants materials

10 *Théobroma cacao L*, hybrid plants
VTLCP-22 (I-14xNC29/66); VTLCP-11 (I-14xNC42/94); VTLCP-24 (I-21xNC23/43); VTLCP-25 (I-21xNC29/66); VTLCP-26 (I-21xNC42/94); VTLCP-29 (I-56xNC23/43); VTLCP-27 (I-29xNC23/43); VTLCP-28 (I-29xNC42/94); VTLCH-4 (II-67xNC42/94); VTLCH-3 (II-67xNC29/66).

Methods

➢ **Agro-morphological parameters**

- Height (cm) and diameter (cm) at the crown
- Total number of leaves

➢ **Physiological parameters of cocoa**

Leaf water potential, Leaf gas exchange (net photosynthesis, stomatal conductance, transpiration, intracellular CO2 content), water use efficiency (WUE), ratio Pnet/Ci. Stomatal resistance chlorophyll fluorescence (initial fluorescence (F0), maximum fluorescence and PS-II quantum yield).

➢ **Cytosolic metabolites in cocoa leaves**

Epicuticular wax, Cytosolic soluble sugars, Cytosolic free amino acids, Cytosolic proline, Soluble cytosolic proteins.

➢ **Oxidative metabolism in cocoa leaves**

Super Oxide Dismutase activity, Peroxidase activity Polyphenoloxidase activity , Catalase activity, Leaf lipid peroxidation.

Leaf gas exchange with Licor- 6200

Chlorophyll fluorescence measurment with OS-30p fluorometer

Stomatal resistance measurment with AP4 porometer

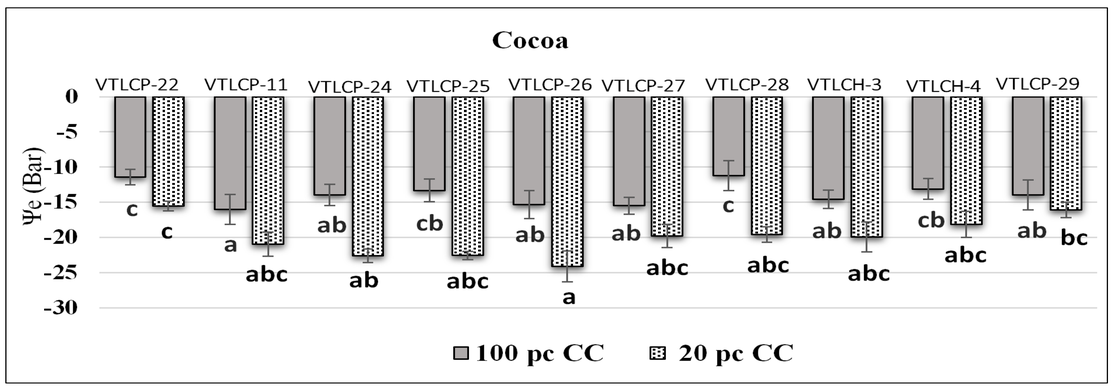
Results

Agro-morphological characteristics of cocoa under irrigation regime

Cocoa	Number of leaves (NF)			Leaf area (Sft, cm²)			Reduction in leaf area compared to control %	
	100%CC	50%CC	20%CC	100 %CC	50%CC	20%CC	50%CC	20%CC
VTLCP-22	24a	19a	17a	8875a	7419a	4014a	16.40	54.77
VTLCP-11	22ab	16ab	15ab	9551a	4147ab	4064a	56.58	57.44
VTLCP-24	22ab	17ab	15ab	9810a	5562ab	3990a	43.30	59.32
VTLCP-25	23a	18a	13ab	8382a	6694a	3980a	20.13	52.51
VTLCP-26	23a	14ab	16a	8672a	4906ab	4316a	43.42	50.22
VTLCP-27	23a	15ab	17a	9001a	4613ab	4364a	48.75	51.51
VTLCP-28	21b	18a	17a	6620ab	6807a	5221a	-2.82	21.12
VTLCH-3	24a	16ab	15a	8958a	5436ab	4621a	39.31	48.40
VTLCH-4	16b	11b	10b	3917b	3167b	2100b	19.14	46.37
VTLCP-29	23a	17ab	14ab	8115a	5959ab	4505a	26.56	44.48
Mean	22	16	15	8190,1	5471	4117,5		

Physiological characteristics of cocoa

- ○ **Leaf water potential (Ψe)**

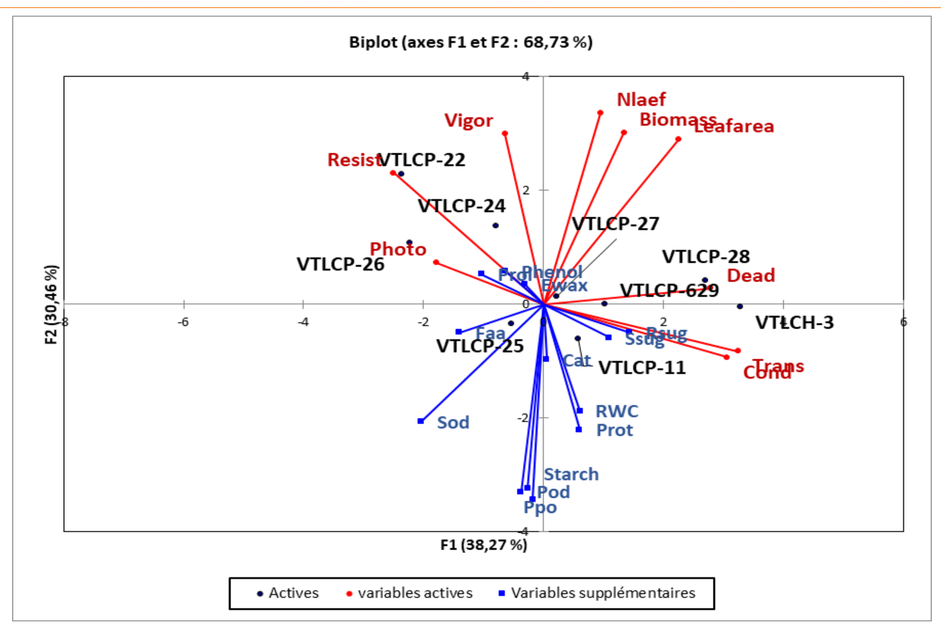


- ○ **Net photosynthetic activity, stomatal conductance, transpiration and intracellular CO2 content of cocoa under irrigation**

Cocoa	Net photosynthesis, Pn (µmol de CO_2 m^{-2} s^{-1})		Stomatal conductance (gs) (mol m^{-2} s^{-1})		Transpiration (E) (mmol m^{-2} s^{-1})		CO_2content (Ci) (ppm)	
	100%CC	20%CC	100%CC	20%CC	100%CC	20%CC	100%CC	20%CC
VTLCP-22	26.72a	17.30a	0.26h	0.27g	0.71i	0.73f	353a	332a
VTLCP-11	9.22b	7.38ed	0.49d	0.39d	1.31d	1.04cd	294f	290c
VTLCP-24	7.99b	13.65ab	0.36g	0.33e	0.95h	0.87e	340b	332a
VTLCP-25	7.48b	4.86e	0.41ef	0.34e	1.09f	0.90e	298e	297c
VTLCP-26	20.72ab	7.35ed	0.39gf	0.20h	1.03g	0.67f	355a	310b
VTLCP-27	10.87b	8.16cde	0.45e	0.30f	1.20e	0.96ed	329c	312b
VTLCP-28	11.22b	6.17e	0.55c	0.41c	1.48c	1.09c	291f	290c
VTLCH-3	11.50b	8.03cde	0.70a	0.53a	1.88a	1.43a	271h	270d
VTLCH-4	16.49ab	12.25bc	0.40f	0.34e	1.08f	0.91e	304d	295c
VTLCP-29	9.36b	11.13bcd	0.64b	0.48b	1.65b	1.26b	286g	277d
Mean	13.15	9.62	0.46	0.36	1.24	0.99	314.5	301

- ○ **Initial fluorescence (Fo), photochemical quantum of PS-II (Fm) and quantum efficiency or quantum yield of PS-II (Fm/Fv) of cocoa under water regimes**

Cocoa	Fo (Unit)		Fm (Unit)		Fv/Fm	
	100%CC	20%CC	100%CC	20%CC	100%CC	20%CC
VTLCP-22	114.2abc	155.7bcd	448.7d	248.0ab	0.742bc	0.361abc
VTLCP-11	115.0ab	174.0ab	465.6bcd	221.6ab	0.752abc	0.550a
VTLCP-24	90.92c	160.3bc	471.4abcd	288.3a	0.758ab	0.361abc
VTLCP-25	110.8abc	121.3cd	484.0ab	193.0ab	0.770ab	0.333abc
VTLCP-26	131.4a	146.5bcd	491.0a	193.0ab	0.724c	0.381ab
VTLCP-27	109.4abc	143.5bcd	458.8cd	182.0ab	0.758ab	0.209bc
VTLCP-28	120.6ab	219.5a	485.6ab	266.8ab	0.751abc	0.114c
VTLCH-3	114.6ab	138.3bcd	475.4abc	243.0ab	0.758ab	0.422ab
VTLCH-4	102.4bc	122.8cd	467.2abcd	179.2ab	0.781a	0.288abc
VTLCP-29	116.6ab	109.0d	468.4abcd	141.3b	0.751abc	0.201bc
Mean	112.88	148.9	471.0	220.0	0.754	0.31



- ○ **Biplot showing the relationship between the morpho-physiological biochemical parameters observed and cocoa hybrids and watering regime**

Conclusion and perspectives

- ✓Hybrids VTLCH-4, VTLCP-24 and VTLCP-22 are characterized by high photosynthetic activity, good water use efficiency and high CO2 accumulation.
- ✓Hybrids VTLCP-26, VTLCP-25 and VTLCP-27 are characterized by photochemical activity, stomatal resistance and vegetative vigor.
- ✓Hybrids VTLCP-28, VTLCP-29, VTLCP-11 and VTLCH-3 are characterized by high transpiration rate and high stomatal conduce.

VTLCH-4, VTLCP-24 and VTLCP-22 showed morpho-physiological characteristics of adaptation to water deficit stress and seems to be promising candidates for a sustainable production in climate change context.

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