

Supplementary Data

Supplementary Table 1. Physical and chemical characteristics of soils sampled from 0 to 20 cm depth of the plots before the establishment of the trial. Values are means of three replicates with standard error.

Sand (%)	Clay (%)	Silt (%)	Textural class
78.74±0.58	13.26±0.03	8.00±0.00	Sandy loam

Factors	pH	Carbon (%)	Total N (%)	Avail. P (mg/kg)	Exch. K (cmol/kg)	Exch. Mg (cmol/kg)	Exch. Ca (cmol/kg)
Detected levels	6.03±0.14	1.38±0.03	0.14±0.01	7.95±1.81	0.13±0.02	1.37±0.10	7.58±0.57
Critical levels	5.60	50	0.09	20.00	0.25	1.33	7.50

Supplementary Table 2. Leaf area, leaf dry mass and relative water content of some seed-derived cocoa varieties in response to field conditions during vegetative phase recorded in 2022/2023 wet and dry growing season. Values are the means of 4 replicates with ± standard error. Values with asterisks indicate significance ($p \leq 0.005$; student t-test) between wet and dry seasons for a specific parameter.

Seed-derived cocoa varieties	Leaf area (cm ²)		Leaf dry mass (g)		Relative water content (%)	
	WS	DS	WS	DS	WS	DS
AMAZ 15-15 x EQX 78	85.87±1.45	93.83±5.12	1.35±0.16	1.29±0.08	80.97±1.28	75.59±1.12*
CRG 2029 x AMAZ 3-2	96.97±8.94	100.63±9.43	1.38±0.13	1.42±0.11	82.86±0.51	78.19±0.87*
CRG 2029 x CRG 0314/102	84.45±17.30	98.30±9.29	1.15±0.29	1.22±0.13	78.54±2.55	79.62±2.03
CRG 9006 x AMAZ 3-2	85.06±7.51	88.37±1.60	1.27±0.12	1.10±0.09	81.27±0.44	77.77±1.91
CRG 9006 x T17/524	92.60±7.76	87.57±7.41	1.38±0.11	1.11±0.06	82.61±1.05	80.26±2.46
GU 144C x EQX 78	88.81±7.37	90.27±7.85	1.39±0.15	1.18±0.15	81.67±0.88	80.02±2.13
GU 144C x MAN 15-2	94.79±6.17	88.10±4.52	1.39±0.14	1.23±0.13	80.93±0.74	74.61±3.67
PA 150 x CRG 0314/102	97.79±10.75	93.04±8.11	1.51±0.19	1.22±0.10	79.89±1.53	83.61±1.94
PA 7 x AMAZ 3-2	99.61±11.55	88.39±8.86	1.60±0.20	1.07±0.11	81.96±0.92	72.01±7.10
PA 7 x CRG 8914	91.42±7.13	82.73±2.12	1.37±0.11	1.06±0.08	82.47±1.12	79.27±0.10
SPD	93.94±4.21	92.65±5.40	1.34±0.06	1.21±0.04	82.41±0.81	77.45±1.34*
T60/887 x CRG 0314/102	93.98±3.48	88.29±7.14	1.50±0.07	1.18±0.02*	82.92±1.24	80.34±2.43
T63/967 x CRG 9006	92.11±7.96	96.83±7.21	1.30±0.07	1.24±0.20	84.30±1.52	77.33±1.34*
T65/238 x CRG 9006	94.2±4.93	87.46±9.17	1.40±0.05	1.12±0.07*	82.20±0.78	78.80±0.59*
T79/501 x AMAZ 3-2	96.97±4.79	83.02±1.79*	1.38±0.07	0.95±0.08*	80.49±1.16	79.48±0.94

WS-Wet season; DR-Dry season; SE-Standard error

Supplementary Table 3. The analysis of variation from treatment, season and their interactions on physiology and leaf traits of some seed derived cocoa varieties in response to field conditions during vegetative phase recorded in 2022/2023 wet and dry growing season.

Parameters	Source of variation	DF	SS	MS	F	P
Relative chlorophyll content	Season	1	0.813209	0.813209	256.71	0.001
	Varieties	14	0.062701	0.004479	1.41	0.163
	Treatment x Season	14	0.030196	0.002157	0.68	0.787
	Error	90	0.285105	0.003168		
Photochemical efficiency	Season	1	0.83	0.83	260.80	0.001
	Varieties	14	0.05	0.004	1.21	0.280
	Varieties x Season	14	0.03	0.002	0.72	0.750
	Error	90	0.29	0.003		
Stomatal conductance (mmol m ⁻² s ⁻¹)	Season	1	253647	253647	134.85	0.001
	Varieties	14	22025	1573	0.84	0.628
	Varieties x Season	14	28443	2032	1.08	0.386
	Error	90	169290	1881		
Relative water content (%)	Season	1	360.84	360.84	20.03	0.001
	Varieties	14	236.12	16.87	0.94	0.524
	Varieties x Season	14	309.87	22.13	1.23	0.269
	Error	90	1639.62	18.02		
Leaf area (cm ²)	Season	1	112.90	112.90	0.47	0.490
	Varieties	14	1120.30	80.00	0.33	0.990

	Varieties x Season	14	1641.10	117.20	0.49	0.930
	Error	90	21748.30	239.00		
Leaf dry mass (g)	Season	1	1.27	1.27	21.08	0.001
	Varieties	14	0.55	0.04	0.65	0.817
	Varieties x Season	14	0.78	0.06	0.92	0.540
	Error	90	5.48	0.06		
Specific leaf mass (g cm²)	Season	1	0.00011	0.00011	53.73	0.001
	Varieties	14	0.00004	0.00000	1.26	0.250
	Varieties x Season	14	0.00003	0.00000	0.91	0.550
	Error	90	0.00019	0.00000		
Electrolyte leakage (%)	Season	1	305.97	305.97	34.31	0.001
	Varieties	14	227.91	16.28	1.82	0.047
	Varieties x Season	14	92.90	6.64	0.74	0.725
	Error	90	802.53	8.92		

Supplementary Table 4. The analysis of variation from treatment, season and their interactions on non-structural carbohydrate, carbon and nitrogen metabolism of some seed derived cocoa varieties in response to field conditions during vegetative phase recorded in 2022/2023 wet and dry growing season.

Parameters	Source of variation	DF	SS	MS	F	P
Soluble sugars	Varieties	14	1561.19	111.51	2.28	0.010
	Seasons	1	961.70	961.70	19.66	0.001
	Varieties x Season	14	621.72	44.41	0.91	0.553
	Error	90	4402.99	48.92		
Starch	Varieties	14	2609.38	186.38	6.36	0.001
	Seasons	1	41.11	41.11	1.40	0.239
	Varieties x Season	14	1359.39	97.10	3.31	0.001
	Error	90	2636.79	29.30		
NSC	Varieties	14	3514.54	251.04	3.71	0.001
	Seasons	1	1400.48	1400.48	20.68	0.001
	Varieties x Season	14	1881.60	134.40	1.98	0.028
	Error	90	6095.80	67.73		
Soluble starch ratio	Varieties	14	10.33	0.74	4.01	0.001
	Seasons	1	0.26	0.26	1.39	0.242
	Varieties x Season	14	4.86	0.35	1.89	0.038
	Error	90	16.57	0.18		
Carbon	Varieties	14	45.50	3.25	1.06	0.407
	Seasons	1	55.37	55.37	18.01	0.001
	Varieties x Season	14	61.55	4.40	1.43	0.156
	Error	90	276.71	3.08		
Nitrogen	Varieties	14	1.97	0.14	1.19	0.296
	Seasons	1	3.79	3.79	32.08	0.001
	Varieties x Season	14	0.85	0.06	0.52	0.918
	Error	90	10.62	0.12		
Carbon nitrogen ratio	varieties	14	120.84	8.631	0.91	0.554
	Seasons	1	85.66	85.66	9.01	0.003
	Varieties x Season	14	80.32	5.74	0.60	0.856
	Error	90	855.99	9.51		