

Supplementary Table S1. Treatment combinations, planting schedule, deficit irrigation levels, and total water use in the field experiment.

Plot No.	Soil type	Pre-planting soil moisture level	Planting month	Deficit irrigation level*	Treatment name	ET ₀ (mm day ⁻¹)	Kc	ETc (mm day ⁻¹)	Water use (mm)
1	Clay	FC 80%	Oct-23	0% Deficit	CFC80 DI0	13.4	0.4	5.35	261.1
2	Clay	FC 80%	Oct-23	30% Deficit	CFC80 DI30	15.4	0.5	6.92	276.3
3	Clay	FC 80%	Oct-23	60% Deficit	CFC80 DI60	17.3	0.5	8.66	270.6
4	Clay	FC 50%	Dec-23	0% Deficit	CFC50 DI0	17.6	0.6	9.67	186.9
5	Clay	FC 50%	Dec-23	30% Deficit	CFC50 DI30	16.9	0.6	10.13	178.8
6	Clay	FC 50%	Dec-23	60% Deficit	CFC50 DI60	16.0	0.7	10.41	178.8
7	Clay	FC 30%	Feb-24	0% Deficit	CFC30 DI0	15.3	0.7	10.74	101.1
8	Clay	FC 30%	Feb-24	30% Deficit	CFC30 DI30	15.1	0.7	10.57	109.7
9	Clay	FC 30%	Feb-24	60% Deficit	CFC30 DI60	15.1	0.7	10.57	106.8
10	Sandy	FC 80%	Oct-23	0% Deficit	SFC80 DI0	14.6	0.4	5.83	270.0
11	Sandy	FC 80%	Oct-23	30% Deficit	SFC80 DI30	13.7	0.5	6.16	251.8
12	Sandy	FC 80%	Oct-23	60% Deficit	SFC80 DI60	12.8	0.5	6.40	276.8
13	Sandy	FC 50%	Dec-23	0% Deficit	SFC50 DI0	13.1	0.6	7.20	191.3
14	Sandy	FC 50%	Dec-23	30% Deficit	SFC50 DI30	15.4	0.6	9.22	179.8
15	Sandy	FC 50%	Dec-23	60% Deficit	SFC50 DI60	17.1	0.7	11.10	179.2
16	Sandy	FC 30%	Feb-24	0% Deficit	SFC30 DI0	17.6	0.7	12.32	102.4
17	Sandy	FC 30%	Feb-24	30% Deficit	SFC30 DI30	17.0	0.7	11.92	103.7
18	Sandy	FC 30%	Feb-24	60% Deficit	SFC30 DI60	16.1	0.7	11.25	106.0

*Irrigation was scheduled weekly using a surface drip irrigation system and implemented under three deficit levels based on crop evapotranspiration (ETc): full irrigation (100% ETc, referred to as DI0), moderate deficit irrigation (70% ETc, DI30), and severe deficit irrigation (40% ETc, DI60). ET₀: Reference Evapotranspiration (mm day⁻¹), Kc: Crop Coefficient, and ETc: Crop Evapotranspiration (mm day⁻¹)

Supplementary Table S2. Monthly soil moisture constants (0–60 cm) in clay and sandy soils, October 2023–February 2024.

Soil type	Month/Year	FC (%)	PWP (%)	AW (%)	AD (%)
Clay	Oct-23	30.1 ± 1.6	22.2 ± 0.21	7.9 ± 1.6	4.75 ± 0.7
	Nov-23	23.8 ± 1.4	22.2 ± 0.14	1.6 ± 0.2	0.95 ± 0.1
	Dec-23	18.5 ± 0.9	22.2 ± 0.03	-3.7 ± 0.1	–
	Jan-24	14.0 ± 0.6	22.2 ± 0.04	-8.2 ± 0.1	–
	Feb-24	11.3 ± 0.5	22.2 ± 0.03	-10.9 ± 0.2	–
Sandy	Oct-23	14.0 ± 0.7	7.1 ± 0.10	6.9 ± 0.7	4.10 ± 0.4
	Nov-23	10.2 ± 0.5	7.1 ± 0.12	3.1 ± 0.2	1.83 ± 0.1
	Dec-23	8.6 ± 0.4	7.1 ± 0.01	1.5 ± 0.1	0.90 ± 0.0
	Jan-24	6.2 ± 0.3	7.1 ± 0.04	-0.9 ± 0.1	–
	Feb-24	5.2 ± 0.3	7.1 ± 0.02	-1.9 ± 0.1	–

FC: Field Capacity (%), PWP: Permanent Wilting Point (%), AW: Available Water (%), and AD: Allowable Deficit (%). Data are presented as mean ± standard deviation (SD) with four replicates (n = 4)

Supplementary Table S3. Pearson correlation coefficients among cumulative water use, water use efficiency, emergence, growth, yield, and yield components of sugarcane under varying initial soil moisture and deficit irrigation regimes.

Correlation coefficient	Cumulative water use	Water use efficiency	Days to emergence	Germination percentage	Plant height	Tillers clump ⁻¹	Leaves plant ⁻¹	Dry shoot weights	Biomass accumulation	LAI	SPAD	Stalks plot ⁻¹	Stalk length	Stalk diameter	Fresh stalk weight	Total cane yield
Water use efficiency	0.6226** *															
Days to emergence	-0.7708** *	-0.5203 ***														
Germination percentage	0.8826** *	0.5823 ***	-0.9503* **													
Plant height	0.9262** *	0.6035 ***	-0.9193* **	0.9912***												
Tillers clump ⁻¹	0.9785** *	0.6098 ***	-0.7267* **	0.8698***	0.9189 ***											
Leaves plant ⁻¹	0.8261** *	0.4927 ***	-0.6542* **	0.7624***	0.7897 ***	0.8285 ***										
Dry shoot weights	0.9558** *	0.6136 ***	-0.9028* **	0.9706***	0.9867 ***	0.9397 ***	0.7987 ***									
Biomass accumulation	0.9539** *	0.6411 ***	-0.9053* **	0.9710***	0.9864 ***	0.9377 ***	0.7978 ***	0.9991 ***								
LAI	0.9606** *	0.5980 ***	-0.8328* **	0.9443***	0.9722 ***	0.9764 ***	0.8212 ***	0.9739 ***	0.9719***							
SPAD	0.9412** *	0.5768 ***	-0.8385* **	0.946***	0.9691 ***	0.9628 ***	0.7986 ***	0.9682 ***	0.9660***	0.9914 ***						
Stalks plot ⁻¹	-0.1894	-0.1196	0.4933* **	-0.4600***	-0.4173 **	-0.1821	-0.2480	-0.3199 *	-0.3208*	-0.3341 *	-0.3495 **					
Stalk length	-0.244	-0.1527	0.4755* **	-0.4694***	-0.4404 ***	-0.245	-0.3084 *	-0.3462 *	-0.3457*	-0.3810 **	-0.3888 **	0.9779 ***				
Stalk diameter	-0.1812	-0.0973	0.4623* **	-0.4391***	-0.4010 **	-0.1796	-0.2496	-0.3016 *	-0.3004*	-0.3299 *	-0.3405 *	0.9859 ***	0.9923 ***			

Correlation coefficient	Cumulative water use	Water use efficiency	Days to emergence	Germination percentage	Plant height	Tillers clump ⁻¹	Leaves plant ⁻¹	Dry shoot weights	Biomass accumulation	LAI	SPAD	Stalks plot ⁻¹	Stalk length	Stalk diameter	Fresh stalk weight	Total cane yield
Fresh stalk weight	-0.122	-0.0738	0.4277*	-0.3945**	-0.3484**	-0.1209	-0.2180	-0.2467	-0.2469	-0.2702*	-0.2834*	0.9778***	0.9787***	0.9842***		
Total cane yield	-0.1218	-0.0731	0.4275*	-0.3944**	-0.3482**	-0.1207	-0.2175	-0.2466	-0.2467	-0.2701*	-0.2833*	0.9779***	0.9787***	0.9843***	0.9875***	
Sugar yield	-0.1201	-0.0699	0.4267*	-0.3907**	-0.3443*	-0.1183	-0.2146	-0.2429	-0.2429	-0.2684*	-0.2801*	0.9752***	0.9767***	0.9829***	0.9993***	0.9993***

Values represent Pearson correlation coefficients between cumulative water use, water use efficiency, crop emergence, growth parameters, yield, and yield components of sugarcane. *: P < 0.05, **: P < 0.01, and ***: P < 0.001