Supplementary materials

Supplementary Methods 1. Detailed description of inputs used in experimental treatments corresponding to Table 1.

SM1.2. Soil fertilization regimes (note [1]). Conventional soil fertilization applied in treatments T1 and T3–T6 consisted of urea (46% N, 214 kg ha^{-1}), potassium chloride (60% K_2O, 206 kg ha^{-1}), langbeinite [($K_2SO_4 \cdot 2MgSO_4$), 22% K_2O, 18–22% MgO, 22% S, 127 kg ha^{-1}], Microessential® SZ (12-40-0 enriched with 10% S and 1% Zn, 124 kg ha^{-1}), Nutrimenores® (micronutrient blend containing Zn, B and Mg, 52 kg ha^{-1}), ammonium sulfate (21% N, 24% S, 99 kg ha^{-1}) and Ferticacao® (20-6-17 N-P_2O_5-K_2O, 200 kg ha^{-1}).

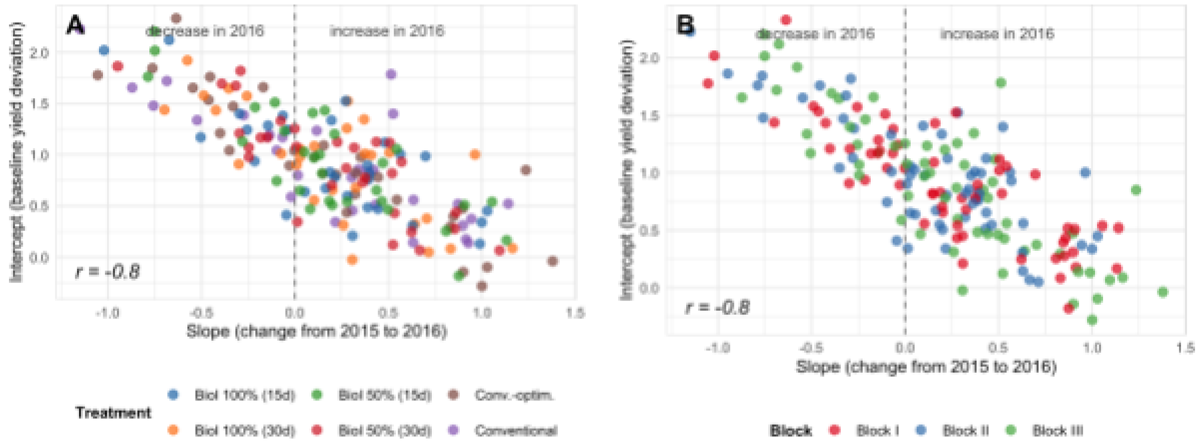
The optimized soil fertilization regime used in treatment T2 consisted of urea (760 kg ha^{-1}), ammonium nitrate (33.5% N, 688 kg ha^{-1}), diammonium phosphate (18-46-0, 326 kg ha^{-1}), potassium chloride (1,231 kg ha^{-1}), langbeinite (471 kg ha^{-1}), and biol at 100% concentration (184 L ha^{-1}).

SM1.1. Foliar fertilization (note [2]). T1, Foliar fertilization (total ha^{-1}): Aminocrop®: A biostimulant containing 24% free amino acids and 8% N, derived from vegetable protein hydrolysis (2 L). Foska®: A systemic potassium phosphite formulated as 0-30-20 used as an inductor of plant resistance, providing 30% P and 20% K(3 L). Ful/Bionic 622®: An organic-complexed micronutrient blend containing Zi, Mn, and Br (60-50-50 g L^{-1}, respectively, chelated with fulvic acids (38 g L^{-1}) and carboxylic groups (3 L). Ful/Bionic Boro®: A boron deficiency corrector (50 g L^{-1}) complexed with fulvic acids (41 g L^{-1}) to improve translocation (2 L). Humitec Cu®: A copper corrector (12% Cu) chelated with EDTA and enriched with humic extracts from Leonardite to enhance absorption (1 L). Humitec Mn®: A manganese corrector (10%) chelated with EDTA (2 L). Cohesion Zn®: A specialized adjuvant and zinc source (10%) and organic acids to improve droplet adhesion and foliar uptake (2 L). Potassium Nitrate: Soluble grade (13-0-46), supplying 13% N and 46% K for fruit filling (8 L).

SM1.3. Fungicide applications (note [3]). Foliar fungicide applications in treatments T1 and T2 included azoxystrobin (0.6 L ha^{-1}), chlorothalonil 720 (0.75 L ha^{-1}), fosetyl-aluminium (0.3 L ha^{-1}), metalaxyl + mancozeb (0.5 L ha^{-1}), propiconazole (0.6 L ha^{-1}), mandipropamid (0.3 L ha^{-1}), and copper sulfate pentahydrate (0.5 L ha^{-1}).

SM1.4. Biol application volumes (note [4]). High-volume applications at 100% Biol concentration reached 4,429 L ha^{-1} (T3), while the equivalent concentration at a reduced volume was 2,226 L ha^{-1} (T4). Treatments T5 and T6 utilized a 50% Biol dilution, with application volumes of 2,214 L ha^{-1} and 1,107 L ha^{-1}, respectively.

Supplementary Figures.



Supplementary Figure 1. Plant-level trade-off between baseline yield and temporal resilience in cacao. Each point represents an individual plant, showing its random intercept (deviation from average baseline yield in 2015) and its random slope (deviation from the average change in yield from 2015 to 2016). The strong negative correlation ($r \approx -0.78$) indicates that plants with higher initial yield tended to exhibit a greater decline over time. (A) Coloration by treatment shows management strategies shifted populations along this pre-existing trade-off axis rather than creating distinct clusters. (B) Coloration by block confirms that underlying spatial variability did not alter the fundamental trade-off structure. The dashed line at slope = 0 represents no change from the first to the second year; points to the left represent plants with a yield decrease in 2016, while points to the right represent plants with a yield increase.