

SUPPLEMENTARY MATERIAL

Growing-medium effects and limited responses to short-fermented banana stem liquid organic fertilizer in grafted ‘Alligator’ avocado seedlings

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Supplementary Note S1. Experimental design and statistical analysis

The experiment used a 5×3 factorial randomized complete block design with three blocks, giving 45 experimental units. Factor K comprised five banana stem liquid organic fertilizer concentrations (0, 225, 450, 675, and 900 mL L⁻¹), and factor M comprised three growing-media compositions: cocopeat + soil (1:2, v/v), rice husk + soil (1:2, v/v), and cocopeat + rice husk + soil (1:1:2, v/v/v). At each observation time, data were analyzed using the model $Y_{ijk} = \mu + B_k + K_i + M_j + (KM)_{ij} + \varepsilon_{ijk}$. The numerator and denominator degrees of freedom were 4 and 28 for K, 2 and 28 for M, and 8 and 28 for K $\times$ M. Number-of-leaves observations were transformed using $\sqrt{(x + 0.5)}$ and retained at full numerical precision for ANOVA, CV calculation, and DMRT. All other variables were analyzed on the original scale. Treatment means and standard errors were reported in their original measurement units. Separate analyses were conducted at each observation time; no repeated-measures inference regarding temporal change was performed.

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Supplementary Table S1. Complete factorial RCBD ANOVA results for all measured variables at each observation time.

Parameter	WAT	Analysis basis	F(K)	P(K)	F(M)	P(M)	F(K×M)	P(K×M)	CV (%)
Seedling height (cm)	4	Original	0.582	0.678	3.799	0.035*	1.251	0.308	4.94
Seedling height (cm)	8	Original	1.183	0.340	3.967	0.030*	1.770	0.126	5.32
Seedling height (cm)	12	Original	1.470	0.238	5.104	0.013*	1.409	0.236	6.59
Seedling height (cm)	16	Original	1.770	0.163	3.524	0.043*	1.573	0.178	7.59
Cumulative stem diameter increment (mm)	4	Original	1.221	0.324	0.822	0.450	0.470	0.867	24.90
Cumulative stem diameter increment (mm)	8	Original	0.500	0.736	0.651	0.529	0.797	0.610	15.33
Cumulative stem diameter increment (mm)	12	Original	0.335	0.852	1.046	0.365	0.878	0.546	13.65
Cumulative stem diameter increment (mm)	16	Original	1.409	0.257	0.848	0.439	1.822	0.115	13.11
Number of leaves	4	$\sqrt{(x+0.5)}$	4.446	0.007**	1.093	0.349	1.588	0.173	12.36
Number of leaves	8	$\sqrt{(x+0.5)}$	2.378	0.076	0.801	0.459	0.956	0.489	14.18
Number of leaves	12	$\sqrt{(x+0.5)}$	3.073	0.032*	0.823	0.450	0.985	0.468	12.09
Number of leaves	16	$\sqrt{(x+0.5)}$	3.371	0.023*	0.412	0.666	0.926	0.511	11.11
Leaf length (cm)	4	Original	0.839	0.512	0.125	0.883	0.603	0.767	20.16
Leaf length (cm)	8	Original	0.328	0.857	0.748	0.483	0.855	0.565	20.37
Leaf length (cm)	12	Original	0.572	0.685	0.408	0.669	0.676	0.708	19.93
Leaf length (cm)	16	Original	0.644	0.636	1.106	0.345	0.732	0.663	19.13
Leaf width (cm)	4	Original	0.687	0.607	1.503	0.240	1.487	0.206	15.47
Leaf width (cm)	8	Original	0.440	0.778	0.736	0.488	0.839	0.577	22.34
Leaf width (cm)	12	Original	0.658	0.626	0.675	0.517	0.514	0.835	22.23
Leaf width (cm)	16	Original	0.609	0.659	2.594	0.093	0.954	0.490	19.54
Leaf length-to-width ratio	0	Original	0.484	0.748	0.896	0.420	2.282	0.051	14.07
Leaf length-to-width ratio	16	Original	0.879	0.489	0.512	0.605	1.077	0.407	18.86
SPAD index	0	Original	1.332	0.283	0.743	0.485	0.703	0.686	28.15
SPAD index	16	Original	0.093	0.984	0.561	0.577	1.355	0.259	8.45

Note. K = liquid organic fertilizer concentration; M = growing-medium composition; WAT = weeks after transplanting; CV = coefficient of variation; ns = not significant; *P < 0.05; **P < 0.01. P-values with asterisks indicate significant effects. Number-of-leaves data were analyzed after $\sqrt{(x + 0.5)}$ transformation; all other variables were analyzed on the original scale.

Supplementary Table S2. Residual normality and homogeneity-of-variance diagnostics for the selected analytical scale.

Parameter	WAT	Selected basis	Shapiro–Wilk W	Shapiro P	Levene F	Levene P	Analytical decision
Seedling height (cm)	4	Original	0.988	0.911	0.454	0.940	Retain original scale; assumptions acceptable for the balanced RCBD.
Seedling height (cm)	8	Original	0.994	0.997	0.614	0.832	Retain original scale; assumptions acceptable for the balanced RCBD.
Seedling height (cm)	12	Original	0.986	0.869	0.599	0.845	Retain original scale; assumptions acceptable for the balanced RCBD.
Seedling height (cm)	16	Original	0.982	0.703	0.563	0.872	Retain original scale; assumptions acceptable for the balanced RCBD.
Cumulative stem diameter increment (mm)	4	Original	0.974	0.387	0.580	0.859	Retain original scale; assumptions acceptable for the balanced RCBD.
Cumulative stem diameter increment (mm)	8	Original	0.975	0.424	0.624	0.824	Retain original scale; assumptions acceptable for the balanced RCBD.
Cumulative stem diameter increment (mm)	12	Original	0.964	0.173	0.331	0.984	Retain original scale; assumptions acceptable for the balanced RCBD.
Cumulative stem diameter increment (mm)	16	Original	0.949	0.048	0.571	0.866	Retain original scale; marginal residual non-normality, but variance homogeneity was satisfactory; interpret cautiously.
Number of leaves	4	$\sqrt{x+0.5}$	0.972	0.332	0.644	0.807	Retain $\sqrt{x+0.5}$ for count-data analysis.
Number of leaves	8	$\sqrt{x+0.5}$	0.960	0.124	0.447	0.944	Retain $\sqrt{x+0.5}$ for count-data analysis.
Number of leaves	12	$\sqrt{x+0.5}$	0.944	0.030	0.375	0.972	Retain $\sqrt{x+0.5}$ transformation; residual normality remained imperfect, but variance homogeneity was satisfactory; interpret cautiously.
Number of leaves	16	$\sqrt{x+0.5}$	0.952	0.061	0.364	0.976	Retain $\sqrt{x+0.5}$ for count-data analysis.
Leaf length (cm)	4	Original	0.981	0.677	0.602	0.842	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf length (cm)	8	Original	0.989	0.945	0.305	0.989	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf length (cm)	12	Original	0.967	0.227	0.344	0.981	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf length (cm)	16	Original	0.974	0.401	0.573	0.865	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf width (cm)	4	Original	0.966	0.203	0.364	0.976	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf width (cm)	8	Original	0.986	0.842	0.726	0.733	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf width (cm)	12	Original	0.961	0.132	0.839	0.625	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf width (cm)	16	Original	0.989	0.942	0.343	0.981	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf length-to-width ratio	0	Original	0.975	0.443	0.860	0.605	Retain original scale; assumptions acceptable for the balanced RCBD.
Leaf length-to-width ratio	16	Original	0.973	0.362	0.418	0.957	Retain original scale; assumptions acceptable for the balanced RCBD.
SPAD index	0	Original	0.976	0.470	0.356	0.978	Retain original scale; assumptions acceptable for the balanced RCBD.
SPAD index	16	Original	0.979	0.591	0.531	0.895	Retain original scale; assumptions acceptable for the balanced RCBD.

Note. Residual diagnostics were assessed separately for each variable and observation time. Shapiro–Wilk tests indicated departures from residual normality for cumulative stem diameter increment at 16 WAT ($P = 0.048$) and number of leaves at 12 WAT after square-root transformation ($P = 0.030$), whereas homogeneity of variance was satisfactory for both variables. Given the balanced RCBD and the absence of evident heteroscedasticity, the selected analytical scales and factorial ANOVA were retained; the corresponding results should therefore be interpreted cautiously.

Supplementary Table S3. Duncan's Multiple Range Test results for number of leaves at each observation time.

WAT	Treatment	LOF concentration (mL L ⁻¹)	Mean ± SE (original units)	Mean on $\sqrt{(x+0.5)}$ scale	DMRT group
4	K0	0	30.22 ± 2.21	5.4908	a
4	K1	225	30.78 ± 2.21	5.5639	a
4	K2	450	22.78 ± 2.21	4.7784	b
4	K3	675	26.22 ± 2.21	5.1367	ab
4	K4	900	20.44 ± 2.21	4.5402	b
8	K0	0	31.78 ± 2.74	5.6285	-
8	K1	225	32.00 ± 2.74	5.6416	-
8	K2	450	25.11 ± 2.74	5.0162	-
8	K3	675	29.00 ± 2.74	5.3968	-
8	K4	900	22.56 ± 2.74	4.7703	-
12	K0	0	34.89 ± 2.57	5.9159	ab
12	K1	225	35.00 ± 2.57	5.9075	a
12	K2	450	27.33 ± 2.57	5.2265	bc
12	K3	675	30.11 ± 2.57	5.5065	abc
12	K4	900	25.22 ± 2.57	5.0559	c
16	K0	0	36.89 ± 2.52	6.0855	a
16	K1	225	37.11 ± 2.52	6.0832	a
16	K2	450	29.78 ± 2.52	5.4749	ab
16	K3	675	32.33 ± 2.52	5.7057	ab
16	K4	900	26.67 ± 2.52	5.1930	b

Note. Means followed by the same lowercase letter within an observation time are not significantly different at $\alpha = 0.05$. DMRT was performed on full-precision $\sqrt{(x + 0.5)}$ -transformed observations, while means and standard errors are shown in the original units. DMRT was not interpreted at 8 WAT because the overall LOF-concentration effect was not significant ($P = 0.076$).

Data availability

The verified master dataset and formula-traceable statistical workbook are available from the corresponding author upon reasonable request and may also be supplied to the journal as a separate spreadsheet file.