

Table S1. Basic and physical properties of soil under mineral and organic amendments and fertility-promoting microorganisms in soils cultivated with pecan trees

Factors	t ha ⁻¹				Kg ha ⁻¹				
Eigenvalues ^S	Zeolite (A)	CaCO ₃ (B)	Bovine Manure (D)	Goat Manure (E)	Mycorrhizal fungi (F)	<i>Bacillus subtilis</i> (G)	Eigenvectors Subtotal	+/-	
		12.0 ^R	3.0	30.0	3.0	30.0	15.0		
<u>Electrical conductivity cv 1.13 R² 0.9991 μ 3.24 dS m² (2.50 – 4.00)^T [1.20 - 2.5]^U L^V, C, I → 2.2</u>									
23.9(15.7)	+3 ^W			(+2)			5		5/0
-16.7(-11.3)		(-2)	+2			(+1)	5		3/2
Freq. / response	3 L,C,B,D ,E	2 F,G	2 E	2 L,F	0	1	10		
Dose		6.3**	1.7*	44.3*	4.3*	34.0*	9.4*		≥ 2 ^x
<u>Carbonates cv 10.26 R² 0.9419 μ 22.4% (15.0 – 22.4) [7.1 – 10.0] → 6.3</u>									
43.8		+3					3		3/0
-53.3(-33.3)	(+3)	+2					5		5/0
	3	5	0	0	0	0	8		
		12.0	2.1	45.5	4.5	43.3	15.0		≥ 2
<u>Saturation percentage cv 2.83 R² 0.9802 μ 36.7% (33.0 – 42.0) [35.0 – 45.0] → 36.4</u>									
16.7(9.9)	+3				(+2)		5		5/0
-4.7(-2.3)			+2			(+2)	4		4/0
	3	0	2	0	2	2	9		
		22.1	2.0	33.9	2.0	22.4	14.4		≥ 2
<u>Organic matter cv 25.49 R² 0.8036 μ 0.88% (0.63 – 1.16) [0.81 – 1.20] → 1.22</u>									
97.4(37.7)	-2	+2		(-3)			7		2/5
-76.6				+2	+1		3		3/0
	2	2	0	5	1	0	10		
		4.0	4.6	31.0	2.5	34.1	13.0		≥ 2
<u>Cation exchange capacity cv 11.68 R² 0.9490 μ 22.50 meq 100 g⁻¹ (18.52 – 29.78) [27.60 – 37.50] → 30.7</u>									
54.7	+4						4		4/0
-30.6			+2	+2			4		4/0
	4	0	2	2	0	0	8		
		21.7	4.3	22.8	4.0	38.8	15.8		≥ 2
<u>pH CaCl₂ cv 0.6150 R² 0.9731 μ 8.12 (7.92 – 8.22) [7.1 – 7.7] → 7.4</u>									
9.5(3.7)	(+3)				+2		5		5/0
-8.2		+3					3		3/0
	3	3 L,C,E ,G	0 L,C,F	0 C	2 L, C	0 L	8		
		11.7	4.0	29.5	2.9	25.6	17.3*		≥ 2
<u>pH EPS cv 0.1515 R² 0.9972 μ 8.26 (8.12 – 8.36) [7.4 – 8.2] L, C, I → 7.4</u>									
6.4(2.1)	(+2)				+2	(-1)	5		4/1
-5.6		+3					3		3/0

	2 L,C,F	3 L,C, D,E,F ,G	0 L,C,F	0 L,C,F	2 L,C	1 L	8	
		11.6*	5.1*	30.9*	3.0*	24.6*	20.3*	≥ 2
	Summary							
Subtotal	20	15	6	9	7	4	61	53/8
Proportion +/-	18/2	13/2					Factors ^y / Variables ^z	11/8
Selection	7/7	5/7						7
Fact. t ha ⁻¹	Zeolite [11.6 t ha ⁻¹] Calcium carbonate [5.1 t ha ⁻¹]							
Variables	Electrical conductivity (2.2 dS m ²) = organic matter (1.22%) > pH EPS (7.4) > pH CaCl ₂ (7.4) = Carbonates (6.3%) = Cation exchange capacity (30.7 meq 100 g ⁻¹) = Saturation percentage (36.4%)							

^ksimple mean (12.0) of the factors; cv coefficient of variation, R² coefficient of determination, μ overall mean of the response variable ^T(range of original data) ^V[sufficiency range]); ^Uregression linear L, quadratic C, interaction I; ^Seigenvalues expressed as a percentage of the mean; ^Weigenvectors are coded in octadeciles starting from the fourth octadecile 0.500 as follows: ± 1 , from 0.501 to 0.625; ± 2 , from 0.626 to 0.750; ± 3 , from 0.751 to 0.875; ± 4 , from 0.876 to 0.1000; X selection of those variables that are significant in both the regression and the factor, ^Y selection of factors is $\geq 20\%$ of the sum of the positive eigenvectors ^Zselection of variables based on the response significant in the general regression as well as in each factor in particular; $\rightarrow$ optimal value for selecting the dose for each factor. Probability * significant ($0.05 \leq Pr \leq 0.01$) ** highly significant ($Pr < 0.01$), otherwise not significant.

Variables	Cu (1.75 mg kg ⁻¹) > NO ₃ (152.9 kg ha ⁻¹) = zinc (3.5) > Fe (4.31 mg kg ⁻¹) > P (15.9 mg kg ⁻¹)
-----------	---

^Rsimple mean (12.0) of the factors; cv coefficient of variation, R² coefficient of determination, μ overall mean of the response variable ^T(range of original data) ^V[sufficiency range]); ^Uregression linear L, quadratic C, interaction I; ^Seigenvalues expressed as a percentage of the mean; ^Weigenvectors are coded in octadeciles starting from the fourth octadecile 0.500 as follows: ± 1, from 0.501 to 0.625; ± 2, from 0.626 to 0.750; ± 3, from 0.751 to 0.875; ± 4, from 0.876 to 0.1000; X selection of those variables that are significant in both the regression and the factor, ^Y selection of factors is ≥ 20% of the sum of the positive eigenvectors ^Zselection of variables based on the response significant in the general regression as well as in each factor in particular; → optimal value for selecting the dose for each factor. Probability * significant (0.05 ≤ Pr ≤ 0.01) ** highly significant (Pr < 0.01), otherwise not significant.

Table S3. Cations and their relationships meq 100 g⁻¹ of soil under mineral and organic amendments and fertility promoting microorganisms in soils cultivated with pecan trees.

Factors	t ha ⁻¹			Kg ha ⁻¹				
Eigenvalues ^s	Zeolite (A)	CaCO ₃ (B)	Bovine manure (D)	Goat manure (E)	Mycorrhizal fungi (F)	<i>Bacillus subtilis</i> (G)	Eigenvectors Subtotal	+/-
	12.0 ^R	3.0	30.0	3.0	30.0	15.0		
<u>Calcium (Ca) cv 9.42 R² 0.9842 μ 15.15 8 (11.48 – 23.06)^T [15.00 -25.00] → 20.68</u>								
67.0(38.7)	+3	(+2)			(+1)		6	
-30.9(-14.7)			(+3)	+3			6	
	<u>3</u>	<u>2</u>	<u>3</u>	<u>3</u>	1	0	12	
	19.0*	4.3	21.4	3.2	29.8	17.0	≥ 2 ^x	
<u>Magnesium (Mg) cv 17.06 R² 0.9461 μ 3.42 (2.29 – 4.90) → 3.93</u>								
81.3(39.6)	-1	+3	(+1)	(-1)			6	
-91.9			+2	+1			3	
	1	<u>3</u>	<u>3</u>	<u>2</u>	0	0	9	
	9.4	4.0	28.2	2.7	28.9	15.3	≥ 2	
<u>Potassium (K) cv 15.56 R² 0.9782 μ 0.85 (0.46 – 1.31) [0.56 – 0.80] → 0.61</u>								
98.8		+3					3	
-117.8			+1	+2			3	
	0	3 F	1 L,C	2 C	0	0	6	
	12.0	2.5	34.4	3.5	32.6	14.8	≥ 2	
<u>Sodium (Na) cv 23.04 R² 0.8852 μ 3.08 (1.96 – 4.57) → 2.38</u>								
179.2(88.0)	(+4)				+3		7	
-137.9		+3					3	
	<u>4</u>	<u>3</u>	0	0	3	0	10	
	12.6	2.7	32.6	3.2	37.7	14.7	≥ 2	
<u>Calcium percentage cv 3.15 R² 0.9855 μ 66.89 (58.46 – 77.45) [68.00 – 72.00] L → 69.6</u>								
	+2		(+3)				5	
19.9(13.4)				(+2)	+3		5	
-20.0(-17.3)	<u>2</u>	0	<u>3</u>	<u>2</u>	3	0	10	
	12.3	3.1	29.2	3.0	27.8	15.4	≥ 2	
<u>Magnesium percentage cv 11.40 R² 0.9758 μ 15.38 [9.0 – 12.9] → 11.1</u>								
54.0(32.2)		+3	(+1)	(-2)			6	
-77.9(-55.9)	+1(+1)		-1	(+2)			5	
	<u>2</u>	<u>3</u>	<u>2</u>	<u>4</u>	0	0	11	
	13.9	2.4	39.1	4.0	39.1	15.6	≥ 2	
<u>Potassium percentage cv 3.15 R² 0.9992 μ 3.85 (1.67 – 5.85) [4.00 -6.60] L^V, 6C, I → 4.98</u>								
78.6		+4					4	
-100.7(-51.1)	(+4)		+1	+1	+1		7	
	4 L,C	4	1 L,C,E,F	1 L,C,F	1 C	0 L	11	
		L,C,E,F,G						
	12.3*	2.5*	33.7*	3.5*	33.9*	15.0*	≥ 2	
<u>Sodium percentage cv 13.46 R² 0.9662 μ 13.86 (8.87 – 20.03) [3.5 – 4.5] → 5.6</u>								
170.9(61.6)	(+2)			(-1)	+3		6	

-141.0		+3	(-1)			(+1)	4
	<u>2</u>	<u>3</u> L,G	1	1 C	3 C	1 L	11
	12.0	3.0	30.0	3.0	30.0	15.0	≥ 2
Summary							
Subtotal	18	21	14	15	11	1	80
Proportion +/-	17/1	21/0	12/2	12/3	11/0	1/0	Factors ^y / Variables ^z 12/9
Selection	6/8	7/8	4/8	5/8			8/8
Factors ton ha ⁻¹	Calcium carbonate [4.3 t ha ⁻¹] > zeolite [19.0 t ha ⁻¹] > goat manure [3.5 t ha ⁻¹] > bovine manure [39.1 t ha ⁻¹] > arbuscular mycorrhizal fungi [33.9 kg ha ⁻¹]						
Variables	Ca (20.68 meq 100 g ⁻¹) = % K (5.6) = % Na (5.6) = % Mg (11.1) > Na (2.38 meq 100 g ⁻¹) = % Ca (69.6) > Mg (3.93 meq 100 g ⁻¹) > potassium (0.61 meq 100 g ⁻¹)						

^Rsimple mean (12.0) of the factors; cv coefficient of variation, R² coefficient of determination, μ overall mean of the response variable ^T(range of original data) ^V[sufficiency range]); ^Uregression linear L, quadratic C, interaction I; ^Seigenvalues expressed as a percentage of the mean; ^Weigenvectors are coded in octadeciles starting from the fourth octadecile 0.500 as follows: ± 1, from 0.501 to 0.625; ± 2, from 0.626 to 0.750; ± 3, from 0.751 to 0.875; ± 4, from 0.876 to 0.1000; X selection of those variables that are significant in both the regression and the factor, ^Y selection of factors is ≥ 20% of the sum of the positive eigenvectors ^Zselection of variables based on the response significant in the general regression as well as in each factor in particular; → optimal value for selecting the dose for each factor. Probability * significant (0.05 ≤ Pr ≤ 0.01) ** highly significant (Pr < 0.01), otherwise not significant.