

**Table 1.** Soil physical and hydraulic properties at sandy loam (site 1) and silt clay loam (site 2) pecan orchards.

Soil depth (cm)	Particle size distribution			Bulk density (Mg cm <sup>-3</sup> )	K <sub>s</sub> <sup>§</sup> (cm min <sup>-1</sup> )	FC <sup>§</sup> (cm <sup>3</sup> cm <sup>-3</sup> )	WP <sup>§</sup> (cm <sup>3</sup> cm <sup>-3</sup> )
	sand	silt	clay				
	(%)						
Site 1 (Sandy loam):							
0–20	63.60 ± 0.86*	27.50 ± 0.96	8.90 ± 0.10	1.44 ± 0.02	0.012 ± 0.001	0.27 ± 0.0002	0.06 ± 0.04
20–40	82.10 ± 3.43	13.50 ± 3.18	4.40 ± 0.31	1.36 ± 0.04	0.0311 ± 0.002	0.17 ± 0.03	0.06 ± 0.0
40–60	92.60 ± 2.14	3.50 ± 1.66	3.90 ± 0.49	1.37 ± 0.04	0.064 ± 0.0031	0.15 ± 0.01	0.03 ± 0.01
60–80	94.60 ± 1.97	1.75 ± 1.80	3.65 ± 0.32	1.33 ± 0.07	0.062 ± 0.0024	0.12 ± 0.01	0.03 ± 0.01
Site 2 (Silty clay loam):							
0–20	22.84 ± 1.92	51.00 ± 1.47	26.16 ± 0.71	1.53 ± 0.04	0.0001 ± 0.0000	0.35 ± 0.04	0.17 ± 0.003
20–40	10.84 ± 1.29	59.00 ± 1.29	30.16 ± 0.82	1.28 ± 0.05	0.0001 ± 0.0001	0.36 ± 0.02	0.19 ± 0.01
40–60	49.34 ± 12.99	37.25 ± 10.88	13.41 ± 3.59	1.24 ± 0.08	0.0174 ± 0.0108	0.25 ± 0.01	0.11 ± 0.0
60–80	37.84 ± 11.52	51.00 ± 10.74	11.16 ± 2.00	1.11 ± 0.05	0.0097 ± 0.0028	0.26 ± 0.03	0.12 ± 0.01

<sup>§</sup> K<sub>s</sub> = saturated hydraulic conductivity; FC = water content at field capacity (at 30 kPa); and WP = water content at wilting point (at 1500 kPa)

\* Value ± standard error

**Table 2.** New coefficients  $C_0$ ,  $C_1$  and  $C_2$  for the calibration equation<sup>§§</sup> derived for each of the 20, 40, 60 and 80 cm CS616 time domain reflectometry (TDR) sensor depths installed at sandy loam (site 1) and silty clay loam (site 2) pecan orchards using a least-squares optimization approach that minimized the sum of squared deviations between the volumetric water content measured by gravimetric water and by CS616 TDR using manufacturer's calibration coefficients.

Sensor depth (cm)	New coefficients for calibration eq.			R <sup>2*</sup>
	$C_0$	$C_1$	$C_2$	
Site 1 (Sandy loam):				
20	-0.066505	-0.009205	0.000634	0.93
40	-2.248828	0.178801	-0.003174	0.95
60	-0.066016	-0.002650	0.000495	0.87
Site 2 (Silty clay loam):				
20	-0.066833	-0.016595	0.000649	0.91
40	-0.797509	0.050046	-0.000538	0.94
60	-0.267377	0.017459	-0.000077	0.89
80	-0.005758	0.007267	0.000051	0.93

<sup>§§</sup> Calibration equation:  $\theta = C_0 + C_1\varepsilon + C_2\varepsilon^2$  where,  $\theta$ : volumetric content (cm<sup>3</sup> cm<sup>-3</sup>);  $\varepsilon$ : dielectric constant; and  $C_0$ ,  $C_1$  and  $C_2$ : calibration coefficients

\* The coefficient of determination of volumetric water contents measured by CS616 TDR sensors using new calibration coefficients versus by gravimetric method

**Table 3.** Example of the daily available soil water content at depths of 20, 40, 60, and 80 cm at sandy loam (site 1) and silty clay loam (site 2) pecan orchards following the irrigation event when peak soil water content was measured at each soil depth.

Irrigation date	IR ‡ (mm)	Soil depth (cm)	Peak water content (cm <sup>3</sup> cm <sup>-3</sup> )	Initial water content	Available water <sup>§§</sup>	
					(cm <sup>3</sup> cm <sup>-3</sup> )	(mm)
Site 1 (south pecan tree):						
June 01 2009	176	20	0.45	0.24	0.21	41.69
		40	0.33	0.14	0.19	38.09
		60	0.27	0.13	0.14	27.55
		80	0.35	0.33	0.02	3.74
June 15 2009	177	20	0.46	0.23	0.23	45.76
		40	0.33	0.13	0.20	40.40
		60	0.28	0.13	0.15	29.66
		80	0.38	0.33	0.05	9.45
Site 2 (south pecan tree):						
May 15 2009	176	20	0.44	0.30	0.14	28.31
		40	0.41	0.26	0.15	29.43
		60	0.35	0.22	0.13	26.24
		80	0.31	0.20	0.12	23.08
June 22 2009	174	20	0.45	0.31	0.14	27.93
		40	0.39	0.27	0.12	23.95
		60	0.38	0.23	0.14	28.69
		80	0.33	0.22	0.12	23.08

‡ Irrigation

§ Volumetric water content after the irrigation event when peak soil water content was measured at each soil depth

¶ Volumetric water content measured at the onset of irrigation event

§§ Thickness of soil layer for equivalent depth of available water (mm) was 200 mm

**Table 4.** Estimated daily deep percolation using the soil water balance equation<sup>§§</sup> below the upper 80 cm soil depth at under-canopy locations at sandy loam (site 1) and silty clay loam (site 2) pecan orchards following each irrigation event when peak soil water content was measured at each soil depth.

Irrigation date	<i>IR</i>	<i>R</i>	$\Delta S$	<i>RO</i>	<i>ET</i>	<i>DP</i>
	(mm)					
Site 1 (Sandy loam):						
June 01 2009	176	-	111.41	-	8.64	55.95
June 15 2009	177	-	125.60	-	11.68	39.72
July 01 2009	174	7.1	125.95	-	9.65	45.49
July 16 2009	179	0.65	140.83	-	8.89	29.93
July 27 2009	178	2.58	124.35	-	8.89	47.34
August 11 2009	176	-	145.47	-	8.46	22.08
September 03 2009	176	-	133.96	-	7.09	34.96
September 25 2009	176	-	126.36	-	6.60	43.04
October 07 2009	165	-	107.14	-	5.49	52.38
October 26 2009	165	-	110.11	-	5.87	49.02
December 01 2009	85	-	54.54	-	2.54	27.92
Total	1827	10.33	1305.71	-	83.79	447.82
Site 2 (Silty clay loam):						
May 15 2009	176	-	108.00	-	8.32	59.68
June 22 2009	174	-	104.80	-	7.75	61.45
August 03 2009	168	-	98.40	-	8.61	60.99
September 03 2009	175	-	105.60	-	7.18	62.22
October 16 2009	176	-	101.60	-	3.44	70.96
November 28 2009	170	1.42	104.00	-	3.73	63.69
Total	1039	1.42	622.40	-	39.03	378.99

<sup>§§</sup>  $DP = IR + R - \Delta S - RO - ET$

where, *DP*: deep percolation; *IR*: irrigation depth; *R*: rainfall;  $\Delta S$ : average change in soil water content in the upper 80 cm soil profile; *ET*: potential evapotranspiration; and *RO*: field runoff (*RO* was considered negligible)

**Table 5.** Root length density (RLD) values in different root diameter classes at 10-cm incremental soil layer for each pecan tree at sandy loam (site 1) and silty clay loam (site 2) pecan orchards.

Soil depth cm	Site 1(Sandy loam) <sup>§</sup>				Soil depth cm	Site 2 (Silty clay loam) <sup>§</sup>			
	Mean RLD in root diameter classes, cm root cm <sup>-3</sup> soil					Mean RLD in root diameter classes, cm root cm <sup>-3</sup> soil			
	0.0< $\phi$ ≤ 0.50	0.5< $\phi$ ≤ 1.0	1.0< $\phi$ ≤ 1.5	$\phi$ >1.5		0.0< $\phi$ ≤ 0.50	0.5< $\phi$ ≤ 1.0	1.0< $\phi$ ≤ 1.5	$\phi$ >1.5
East tree:					North tree:				
0-10	1.32±0.123	0.307±0.051	0.069±0.018	0.03±0.011	0-10	1.037±0.198	0.247±0.051	0.071±0.023	0.045±0.016
10-20	3.182±0.817	0.403±0.082	0.092±0.017	0.045±0.006	10-20	1.278±0.186	0.175±0.026	0.038±0.008	0.018±0.002
20-30	2.154±0.137	0.235±0.029	0.049±0.009	0.05±0.014	20-30	0.98±0.121	0.135±0.015	0.025±0.005	0.021±0.01
30-40	1.194±0.218	0.223±0.036	0.06±0.008	0.061±0.012	30-40	0.802±0.118	0.204±0.025	0.064±0.011	0.049±0.011
40-50	0.736±0.091	0.171±0.013	0.048±0.011	0.033±0.009	40-50	0.553±0.101	0.127±0.021	0.036±0.012	0.025±0.009
50-60	0.511±0.066	0.107±0.009	0.034±0.006	0.039±0.008	50-60	0.406±0.077	0.108±0.026	0.034±0.01	0.043±0.023
60-70	0.241±0.085	0.052±0.014	0.011±0.002	0.014±0.005	60-70	0.262±0.027	0.104±0.016	0.049±0.009	0.056±0.013
70-80	0.213±0.065	0.046±0.013	0.016±0.006	0.015±0.008	70-80	0.222±0.037	0.051±0.004	0.016±0.001	0.007±0.003
South tree:					South tree:				
0-10	1.355±0.432	0.245±0.062	0.059±0.015	0.047±0.011	0-10	0.81±0.13	0.138±0.02	0.029±0.006	0.021±0.006
10-20	1.716±0.369	0.311±0.049	0.104±0.014	0.08±0.013	10-20	1.628±0.187	0.25±0.046	0.068±0.015	0.047±0.006
20-30	1.028±0.292	0.222±0.055	0.077±0.022	0.068±0.027	20-30	1.231±0.162	0.158±0.027	0.045±0.007	0.025±0.006
30-40	0.757±0.128	0.18±0.023	0.063±0.013	0.053±0.011	30-40	0.651±0.081	0.15±0.025	0.034±0.005	0.022±0.002
40-50	0.41±0.119	0.11±0.03	0.042±0.012	0.049±0.024	40-50	0.524±0.086	0.114±0.019	0.03±0.007	0.029±0.007
50-60	0.292±0.072	0.087±0.03	0.033±0.011	0.057±0.019	50-60	0.33±0.068	0.071±0.01	0.018±0.004	0.014±0.007
60-70	0.132±0.039	0.053±0.017	0.026±0.005	0.029±0.009	60-70	0.25±0.057	0.088±0.019	0.029±0.005	0.032±0.007
70-80	0.11±0.047	0.016±0.009	0.012±0.007	0.04±0.022	70-80	0.141±0.048	0.041±0.013	0.016±0.006	0.01±0.004
North tree:					Southwest tree:				
0-10	0.797±0.176	0.235±0.092	0.078±0.042	0.049±0.026	0-10	1.225±0.098	0.595±0.265	0.07±0.01	0.054±0.005
10-20	1.165±0.243	0.168±0.026	0.052±0.012	0.049±0.011	10-20	3.282±0.202	1.225±0.708	0.12±0.023	0.102±0.01
20-30	0.763±0.24	0.117±0.012	0.033±0	0.026±0.005	20-30	1.858±0.294	0.476±0.177	0.062±0.007	0.049±0.003
30-40	0.254±0.033	0.076±0.01	0.028±0.007	0.038±0.008	30-40	1.371±0.342	0.219±0.062	0.043±0.012	0.026±0.011
40-50	0.177±0.059	0.04±0.01	0.012±0.003	0.004±0.002	40-50	1.186±0.074	0.372±0.196	0.038±0.012	0.019±0.009
50-60	0.127±0.043	0.029±0.007	0.011±0.003	0.013±0.005	50-60	0.789±0.153	0.248±0.097	0.04±0.022	0.021±0.013
60-70	0.037±0.008	0.006±0.001	0.001±0	0.003±0.001	60-70	0.52±0.172	0.091±0.037	0.024±0.007	0.016±0.008
70-80	0.016±0.004	0.007±0.003	0.002±0.001	0.001±0	70-80	0.563±0.202	0.407±0.182	0.055±0.022	0.046±0.021
Outside the tree dripline:					Outside the tree dripline:				
0-10	0.907±0.262	0.226±0.07	0.056±0.019	0.032±0.01	0-10	0.987±0.101	0.155±0.036	0.036±0.006	0.014±0.002
10-20	1.343±0.417	0.229±0.085	0.064±0.025	0.062±0.025	10-20	1.2±0.141	0.19±0.036	0.046±0.009	0.035±0.003
20-30	0.533±0.128	0.108±0.015	0.045±0.006	0.033±0.004	20-30	1.098±0.106	0.206±0.017	0.044±0.008	0.05±0.006
30-40	0.189±0.03	0.051±0.01	0.019±0.005	0.038±0.009	30-40	1.261±0.22	0.168±0.029	0.044±0.013	0.101±0.05
40-50	0.077±0.007	0.021±0.001	0.006±0	0.007±0.004	40-50	0.743±0.061	0.117±0.021	0.027±0.006	0.028±0.005
50-60	0.064±0.008	0.021±0.005	0.006±0.001	0.02±0.007	50-60	0.567±0.035	0.124±0.025	0.033±0.014	0.024±0.003
60-70	0.037±0.006	0.01±0.002	0.003±0.001	0.002±0	60-70	0.393±0.11	0.058±0.006	0.017±0.001	0.008±0.002
70-80	0.02±0.004	0.004±0.001	0.003±0.001	0.004±0.001	70-80	0.339±0.118	0.06±0.017	0.024±0.01	0.031±0.016

<sup>§</sup> RLD: mean value ± standard error (for tree, n=4; for outside the tree dripline, n=3);  $\phi$  is the root diameter (mm)

**Table 6.** Results of a multiple regression analysis with stem water potential (SWP, MPa) at mid-canopy (at 4.6 m) as the dependent variable and average values of volumetric water content at depths of 20 and 40 cm ( $\theta_{avg}$ ,  $\text{cm}^3 \text{cm}^{-3}$ ), midday average air temperature ( $T_{md}$ , °C) and midday relative humidity ( $RH_{md}$ , %) as the independent variables.

Site 1 (Sandy loam)			Site 2 (Silty clay loam)		
Regression equation <sup>¶</sup>	R <sup>2</sup> <sup>‡</sup>	Adjusted R <sup>2</sup> (P-value <sup>§</sup> ; SEE <sup>§</sup> )	Regression equation <sup>¶</sup>	R <sup>2</sup> <sup>‡</sup>	Adjusted R <sup>2</sup> (P-value <sup>§</sup> ; SEE <sup>§</sup> )
East tree:			North tree:		
SWP = -3.36 + 8.58× $\theta_{avg}$	0.65	0.62 (0.00017; 0.11)	SWP = -7.72 + 17.48× $\theta_{avg}$	0.73	0.71(0.00000; 0.18)
SWP = 0.53 - 0.046× $T_{md}$	0.69	0.66 (0.00007; 0.11)	SWP = 1.57 - 0.097× $T_{md}$	0.69	0.67 (0.00002; 0.19)
SWP = -1.27 + 4.35× $\theta_{avg}$ - 0.029× $T_{md}$	0.75	0.71 (0.00012; 0.09)	SWP = -3.76 + 10.92× $\theta_{avg}$ - 0.052× $T_{md}$	0.83	0.80 (0.00000; 0.15)
SWP = -1.26 + 4.35× $\theta_{avg}$ - 0.029× $T_{md}$ - 0.0015× $RH_{md}$	0.75	0.70 (0.00061; 0.102)	SWP = -4.16 + 10.69× $\theta_{avg}$ - 0.042× $T_{md}$ - 0.005× $RH_{md}$	0.83	0.80 (0.00000; 0.15)
South tree:			South tree:		
SWP = -2.15 + 6.78× $\theta_{avg}$	0.76	0.75 (0.00001; 0.105)	SWP = -5.65 + 12.65× $\theta_{avg}$	0.84	0.83(0.00000; 0.16)
SWP = 0.88 - 0.057× $T_{md}$	0.82	0.81 (0.00000; 0.09)	SWP = 1.93 - 0.11× $T_{md}$	0.60	0.57(0.00016; 0.26)
SWP = -0.39 + 3.28× $\theta_{avg}$ - 0.036× $T_{md}$	0.89	0.87 (0.00000; 0.07)	SWP = -4.22 + 10.73× $\theta_{avg}$ - 0.025× $T_{md}$	0.86	0.84 (0.00000; 0.16)
SWP = -0.314 + 3.31× $\theta_{avg}$ - 0.037× $T_{md}$ - 0.0015× $RH_{md}$	0.89	0.86 (0.00000; 0.08)	SWP = -4.63 + 10.26× $\theta_{avg}$ - 0.014× $T_{md}$ + 0.007× $RH_{md}$	0.86	0.84 (0.00000; 0.16)
North tree:			Southwest tree:		
SWP = -1.59 + 2.8× $\theta_{avg}$	0.62	0.59(0.0003; 0.104)	SWP = -3.2 + 6.01× $\theta_{avg}$	0.69	0.67(0.00002; 0.2)
SWP = 0.27 - 0.041× $T_{md}$	0.68	0.65 (0.00009; 0.09)	SWP = 1.92 - 0.11× $T_{md}$	0.72	0.70 (0.00001; 0.19)
SWP = -0.44 + 1.25× $\theta_{avg}$ - 0.03× $T_{md}$	0.72	0.68 (0.00026; 0.09)	SWP = -0.402 + 3.23× $\theta_{avg}$ - 0.063× $T_{md}$	0.80	0.78 (0.00000; 0.17)
SWP = 0.056 + 1.75× $\theta_{avg}$ - 0.036× $T_{md}$ - 0.013× $RH_{md}$	0.79	0.73 (0.00026; 0.085)	SWP = -1.92 + 3.17× $\theta_{avg}$ - 0.029× $T_{md}$ + 0.016× $RH_{md}$	0.85	0.82(0.00000; 0.15)

<sup>¶</sup>For each tree, one-parameter regression model (regression between SWP and  $\theta_{avg}$ , and between SWP and  $T_{md}$ ), two-parameter regression model (multiple regression between SWP, and  $\theta_{avg}$  and  $T_{md}$ ), and three-parameter regression model (multiple regression between SWP, and  $\theta_{avg}$ ,  $T_{md}$ , and  $RH_{md}$ )

<sup>‡</sup>R<sup>2</sup>: the coefficient of determination

<sup>§</sup>P-value from ANOVA section of the regression (significant at  $P < 0.05$ ); SEE: standard error of estimate