

**Table S1.** Experiments and factors that were analyzed in this study.

Experiment	Description	Material	Root diameter (mm)	Root depth (cm)	Scan direction angle (°)	Experimental area (cm × cm)	Soil moisture (%)	GPR frequency (MHz)	Survey line layout
I	Root diameter experiment	Citrus root proxies	6,9,11,13,15,18,22,29	25	90°	100 × 100	-	1600	Straight
III	Root water content experiment	Citrus root proxies	29,30	25	90°	100 × 100	-	1600	Straight
III	Scan direction experiment	Citrus root proxies	29	25	0°,15°,30°,45°,60°,75°,90°	100 × 100	-	1600	Straight
IV	Horizontal distance detection accuracy (between root) experiment	Citrus root proxies	18,17	25	90°	140 × 100	3.8	1600	Straight
V	Vertical distance detection accuracy (between root) experiment	Citrus root proxies	18,17	25,26,28,30,35,40	90°	140 × 100	4.7	1600	Straight
VI	Root depth experiment	Citrus root proxies	24	10,20,30,40,50,60,70	90°	100 × 100	3.1	1600	Straight
VII	Soil moisture experiment	Citrus root proxies	23	25	90°	100 × 100	16,11,6	1600	Straight
VIII	Simulated tree root experiment	Citrus tree roots	Table 2	Table 2	Random	200 × 200	-	900/1600	Circular

	Tree root	Citrus							
IX	field	tree	Random	Random	Random	Random	-	1600	Circular
	experiment	roots							

**Table S2.** Diameter, length, and depth of ten tree roots arranged for experiment VIII. Values were measured at six different distances (radiuses) from the center of a simulated tree root system. Radius 1 = 15 cm, radius 2 = 30 cm, radius 3 = 45 cm, radius 4 = 60, radius 5 = 75 cm, radius 6 = 90 cm.

Root number	Root diameter (mm)	Root length (cm)	Root depth (cm)					
			Radius 1	Radius 2	Radius 3	Radius 4	Radius 5	Radius 6
1	20	110	25	25	25	25	25	25
2	8	52	-	-	25	25	25	-
3	20	93	25	25	25	25	25	25
4	16	79	25	25	25	25	25	-
5	10	103	25	25	25	25	25	25
6	18	51	29	33	-	-	-	-
7	12	53	29	33	-	-	-	-
8	14	81	29	33	37	41	45	-
9	17	87	29	33	37	41	45	-
10	9	92	29	33	37	41	45	-

**Table S3.** Distance between roots arranged for experiment VIII at six different distances (radii) from the center of a simulated tree root system. Radius 1 = 15 cm, radius 2 = 30 cm, radius 3 = 45 cm, radius 4 = 60, radius 5 = 75 cm, radius 6 = 90 cm.

Root number	Distance in radius 2 (cm)	Root number	Distance in radius 3 (cm)	Root number	Distance in radius 4 (cm)	Root number	Distance in radius 5 (cm)	Root number	Distance in radius 6 (cm)
1-3	46	1-2	23	1-2	31	1-2	50	1-3	143
		2-3	63	2-3	64	2-3	70		
3-4	19	3-4	28	3-4	40	3-4	45		
4-5	28	4-5	38	4-5	50	4-5	50	3-5	130
5-6	17	5-6	23	5-8	90	5-8	105		
6-7	18	6-7	30						
7-8	19	7-8	25						
8-9	20	8-9	32	8-9	42	8-9	45		
9-10	18	9-10	22	9-10	28	9-10	45		
10-1	12	10-1	21	10-1	34	10-1	61		