Plant and Soil

Supplementary Tables and Figures

Soil with deficient inorganic elements promotes the accumulation of *hesperidin*, *nobiletin* and *tangeretin* in pericarps of *Citrus reticulata* 'Chachi'

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Table S1 Summary of sampling orchards in the study

Location	Orchard abbreviation	Geographic location	Sample collection date	Cultivar	Cultivation method	Cultivar age	Cultivar height range	Soil type	Soil color	Orchard type
Dongjia Town, Xinhui District, Jiangmen City, Guangdong Province, China	DJ	22°31′26″N, 113°3′55″E	2021-11	*Citrus reticulata* 'Chachi'	Circle branch	5 years	1.5-2.5m	Paddy soil	Crimson and reddish brown	Paddy Field Citrus
Gujing Town, Xinhui District, Jiangmen City, Guangdong Province, China	GJ	22°19′13″N, 113°5′27″E	2021-11	*Citrus reticulata* 'Chachi'	Circle branch	8 years	1.5-3.0m	Red soil	Yellow and red	Montane Citrus
Deqing County, Zhaoqing City, Guangdong Province, China	DQ	23°16′15″N, 111°47′50″E	2021-11	*Citrus reticulata* 'Chachi'	Circle branch	5 years	1.8-3.0m	Alluvial soil	Grayish brown	Paddy Field Citrus

Table S2 Vertical distribution of soil physicochemical properties (mean±standard deviation) in three regions.

Soil type	Region	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Salinity (%)	CEC (cmol/kg)	SOM (g/kg)
paddy soil	DJ	0-10	20.31±7.69	68.87±6.79	10.81±1.61	0.1635±0.1124	14.13±2.58	30.65±9.19
		10-20	11.49±1.28	76.71±3.05	12.01±2.56	0.1613±0.1074	12.61±1.85	18.25±2.46
		20-30	11.61±2.15	76.65±1.59	11.74±2.02	0.1515±0.0755	11.71±2.05	18.91±0.99
		30-40	10.46±1.91	77.83±2.90	11.71±1.97	0.2965±0.1349	13.61±2.44	18.99±7.58
		40-50	10.39±1.14	77.08±2.87	12.53±2.19	0.2978±0.1849	11.12±0.91	14.84±3.37
		50-60	11.07±1.45	76.65±3.23	12.28±2.05	0.3106±0.1423	11.84±0.69	16.45±3.28
		60-70	11.46±1.49	76.24±3.26	12.30±3.52	0.2419±0.0579	12.46±1.96	18.14±6.10
		70-80	11.77±3.05	76.33±4.97	11.90±2.41	0.2376±0.0702	12.84±1.79	15.88±3.13
		80-90	11.61±3.91	75.25±6.75	13.14±2.90	0.2061±0.0759	13.31±2.01	19.15±4.55
		90-100	8.12±3.90	79.87±3.57	12.01±2.61	0.2460±0.1215	15.68±1.44	17.21±4.87
red soil	GJ	0-10	16.20±3.36	67.75±5.66	16.05±4.05	0.0349±0.0162	4.49±0.47	26.90±2.75
		10-20	21.75±23.41	60.53±22.16	17.72±8.83	0.0292±0.0132	4.64±0.45	14.68±2.38
		20-30	10.73±5.07	67.14±9.68	22.13±10.49	0.0230±0.0164	4.55±0.58	14.80±3.10
		30-40	11.30±5.10	75.68±4.60	13.02±4.63	0.0239±0.0118	4.49±0.81	13.88±4.74

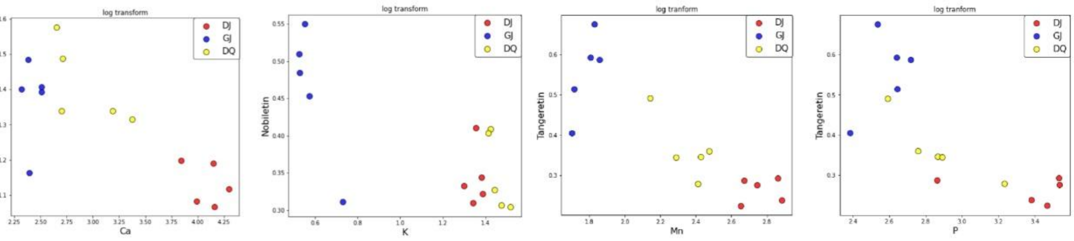
		40-50	21.91±19.33	62.92±19.24	15.16±7.90	0.0226±0.0117	4.28±0.47	12.98±4.38
		50-60	11.83±3.27	67.49±11.18	20.68±7.95	0.0209±0.0111	4.33±0.77	12.12±4.33
		60-70	15.06±8.46	68.02±10.99	16.92±9.57	0.0268±0.0053	4.28±0.42	12.93±5.56
		70-80	12.63±5.24	69.93±7.93	17.44±10.31	0.0248±0.0059	4.29±0.51	10.25±3.68
		80-90	19.45±10.24	65.37±9.63	15.18±8.40	0.0209±0.0098	4.12±1.06	10.18±5.07
		90-100	13.83±6.82	68.41±6.16	17.76±11.43	0.0198±0.0076	3.97±0.67	7.40±2.13
		0-10	27.19±7.11	65.59±6.86	7.22±0.81	0.1703±0.0669	9.75±1.73	32.01±9.33
		10-20	30.96±15.58	62.29±14.41	6.74±1.28	0.1264±0.0534	6.97±1.25	14.58±1.65
		20-30	23.29±3.98	67.96±3.08	8.75±1.53	0.1207±0.0256	8.67±0.95	13.06±1.92
		30-40	19.96±1.77	71.59±2.38	8.44±1.03	0.1163±0.0245	7.75±0.78	12.33±1.99
alluvial soil	DQ	40-50	21.23±2.40	70.64±2.93	8.13±0.84	0.1091±0.0312	7.37±0.81	9.77±1.83
		50-60	22.63±5.11	68.84±4.37	8.54±1.19	0.0860±0.0322	7.42±0.76	8.71±2.13
		60-70	22.11±6.66	68.82±5.70	9.07±1.03	0.0753±0.0324	7.79±3.01	6.76±2.21
		70-80	24.88±3.61	66.10±3.77	9.02±0.87	0.0632±0.0315	6.08±1.90	5.71±1.01
		80-90	29.50±2.39	62.22±2.59	8.28±0.66	0.0509±0.0315	6.62±1.75	5.42±1.36
		90-100	32.38±6.02	59.94±5.52	7.67±0.63	0.0457±0.0310	6.47±1.44	6.15±1.57

Table S3 Linear stepwise regression equations between *hesperidin, nobiletin, tangeretin* and soil physicochemical indexes across different soil depths. r^2 is determination coefficient which reflects the fitting effect of the model. Meaning of abbreviations: "*Hes*" is *Hesperidin*, "*Nob*" is *Nobiletin* and "*Tan*" is *Tangeretin*. Y_1: $log_{10} Hes$; Y_2: $log_{10} Nob$; Y_3: $log_{10} Tan$; X_{13}:$\log_{10} pH$; X_{14}:$\log_{10} Sand$; X_{15}:$\log_{10} Silt$; X_{16}:$\log_{10} Clay$; X_{17}:$\log_{10} SOM$; X_{18}:$\log_{10} CEC$; X_{19}:$\log_{10} Salinity$.

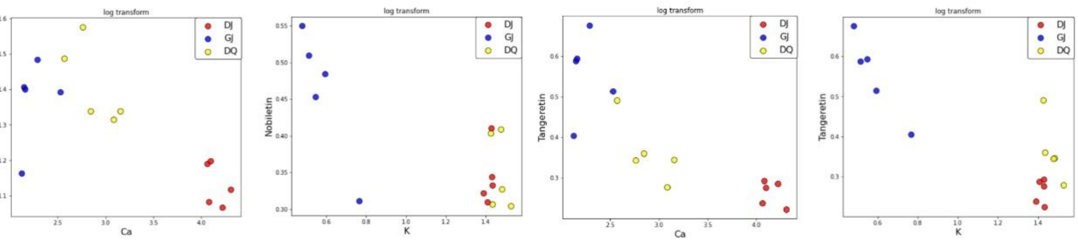
Depths	Stepwise regression models	r^2	ANOVA		Pearson correlation coefficients	Key affecting physicochemical indexes
			F	*p*		
	Y_1=14.949-0.728X_{13}	0.493	14.621	0.002	Y_1-X_{13}: -0.728 (p<0.01)	pH
0-10cm	Y_2=3.094-0.695X_{19}	0.444	12.164	0.004	Y_2-X_{19}: -0.695 (p<0.01)	Salinity
	Y_3=6.491-0.856X_{18}	0.713	35.712	0.000	Y_3-X_{18}: -0.856 (p<0.01)	CEC
					Y_1-X_{13}: -0.711 (p<0.01)	
	Y_1=3.323-0.805X_{13}+0.940X_{14}+0.661X_{15}	0.715	12.713	0.001	Y_1-X_{14}: 0.418 (p>0.05)	pH
					Y_1-X_{15}: -0.286 (p>0.05)	
10-20cm	Y_2=2.879-0.682X_{19}	0.424	11.319	0.005	Y_2-X_{19}: -0.682 (p<0.01)	Salinity
					Y_3-X_{18}: -0.840 (p<0.01)	
	Y_3=8.968-0.526X_{18}+0.479X_{16}-0.404X_{17}	0.877	34.150	0.000	Y_3-X_{16}: 0.459 (p>0.05)	CEC、SOM
					Y_3-X_{17}: -0.598 (p<0.05)	
	Y_1=14.252-0.729X_{13}	0.496	14.755	0.002	Y_1-X_{13}: -0.729 (p<0.01)	pH
20-30cm	Y_2=3.195-0.731X_{19}	0.498	14.903	0.002	Y_2-X_{19}: -0.731 (p<0.01)	Salinity
	Y_3=7.342-0.920X_{18}	0.834	71.330	0.000	Y_3-X_{18}: -0.920 (p<0.01)	CEC
					Y_1-X_{13}: -0.715 (p<0.01)	
	Y_1=11.143-0.688X_{13}+0.461X_{14}	0.677	15.669	0.000		pH
30-40cm					Y_1-X_{14}: 0.501 (p>0.05)	
	Y_2=3.423-0.665X_{19}	0.399	10.311	0.007	Y_2-X_{19}: -0.665 (p<0.01)	Salinity
	Y_3=6.695-0.904X_{18}	0.803	58.002	0.000	Y_3-X_{18}: -0.904 (p<0.01)	CEC
					Y_1-X_{13}: -0.712 (p<0.01)	
	Y_1=14.097-1.004X_{13}+0.575X_{14}+0.659X_{19}	0.782	17.769	0.000	Y_1-X_{14}: 0.672 (p<0.01)	pH、Sand
40-50cm					Y_1-X_{19}: -0.414 (p>0.05)	
	Y_2=4.491-0.759X_{18}+0.568X_{17}	0.699	17.273	0.000	Y_2-X_{18}: -0.656 (p<0.01)	CEC

					Y_2-X_{17}: 0.430 (p>0.05)	
	Y_3=9.153-0.808X_{18}+0.266X_{17}-0.250X_{15}	0.875	33.524	0.000	Y_3-X_{18}: -0.874 (p<0.01) Y_3-X_{17}: 0.135 (p>0.05) Y_3-X_{15}: -0.637 (p<0.05)	CEC、Silt
50-60cm	Y_1=9.320-0.603X_{13}+0.525X_{14}	0.658	14.473	0.001	Y_1-X_{13}: -0.659 (p<0.01) Y_1-X_{14}: 0.590 (p<0.05)	pH、Sand
	Y_2=-0.096-0.857X_{19}+0.520X_{17}	0.615	12.189	0.001	Y_2-X_{19}: -0.662 (p<0.01) Y_2-X_{17}: 0.199 (p>0.05)	Salinity
	Y_3=6.644-0.841X_{18}	0.685	31.486	0.000	Y_3-X_{18}: -0.841 (p<0.01)	CEC
60-70cm	Y_1=4.731-0.616X_{19}+0.402X_{14}	0.596	11.337	0.002	Y_1-X_{19}: -0.708 (p<0.01) Y_1-X_{14}: 0.543 (p<0.05)	Salinity, Sand
	Y_2=0.115-0.848X_{19}+0.576X_{17}	0.573	10.398	0.002	Y_2-X_{19}: -0.602 (p<0.05) Y_2-X_{17}: 0.214 (p>0.05)	Salinity
	Y_3=8.997-0.843X_{13}	0.689	32.034	0.000	Y_3-X_{13}: -0.843 (p<0.01)	pH
	Y_1=6.675-0.684X_{19}	0.427	11.421	0.005	Y_1-X_{19}: -0.864 (p<0.01)	Salinity
70-80cm	Y_2=8.978-0.590X_{13}	0.298	6.938	0.021	Y_2-X_{13}: -0.590 (p<0.05)	pH
	Y_3=8.896-0.866X_{13}	0.731	39.013	0.000	Y_3-X_{13}: -0.866 (p<0.01)	pH
	Y_1=10.824-0.643X_{17}	0.369	9.183	0.010	Y_1-X_{17}: -0.643 (p<0.01)	SOM
80-90cm	Y_2=9.111-0.608X_{13}	0.321	7.608	0.016	Y_2-X_{13}: -0.608 (p<0.05)	pH
	Y_3=5.933-0.866X_{18}	0.731	39.084	0.000	Y_3-X_{18}: -0.866 (p<0.01)	CEC
	Y_1=10.819-0.704X_{18}	0.457	12.792	0.003	Y_1-X_{18}: -0.704 (p<0.01)	CEC
90-100cm	Y_2=9.810-0.624X_{13}	0.342	8.290	0.013	Y_2-X_{13}: -0.624 (p<0.05)	pH
	Y_3=9.635-0.855X_{13}	0.711	35.447	0.000	Y_3-X_{13}: -0.855 (p<0.01)	pH

(A)


log transform
DJ
GJ
DQ
Hesperidin
Ca
log transform
Nobiletin
K
log tranform
Tangeretin
Mn
log tranform
Tangeretin
P

(B)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GJ
DQ
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Ca
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Nobiletin
K
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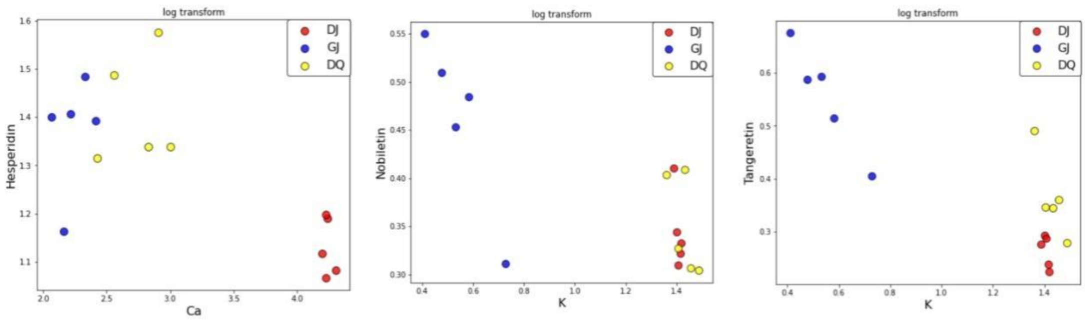
Tangeretin
Ca
log transform
Tangeretin
K

(C)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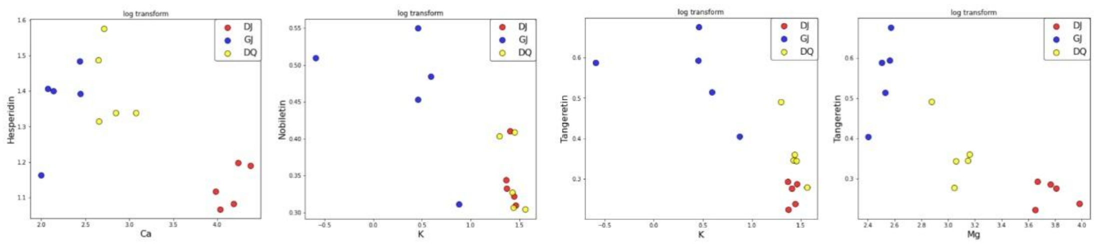
Tangeretin
K

(D)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GJ
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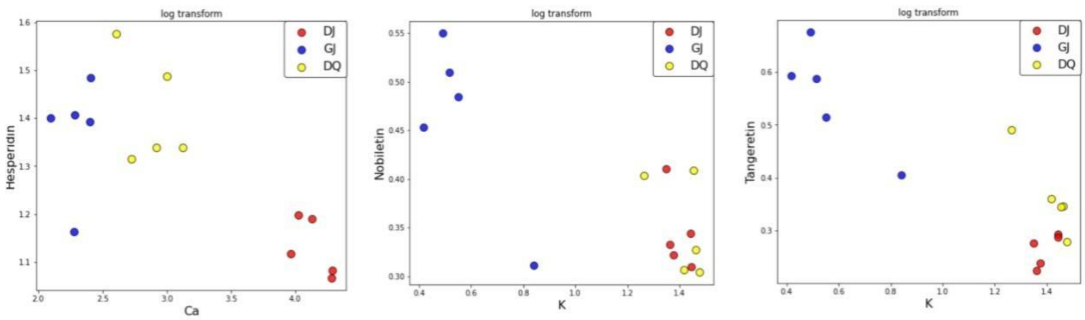
Nobiletin
K
log transform
Tangeretin
K
log transform
Tangeretin
Mg

(E)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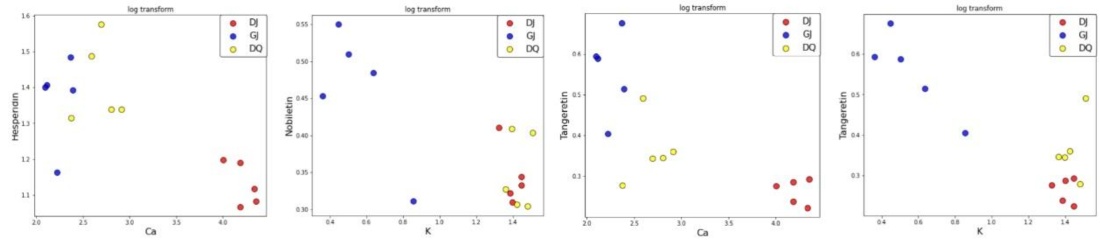
Tangeretin
K

(F)



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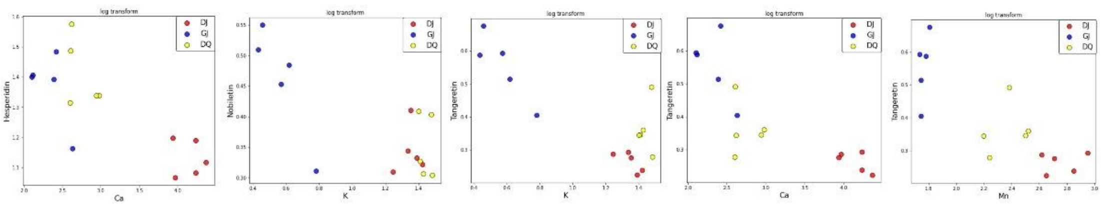
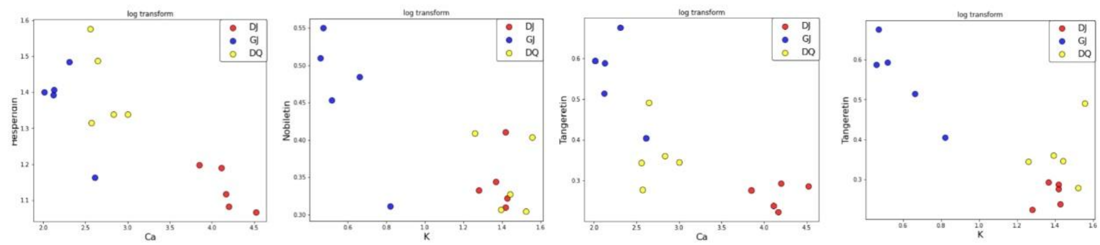
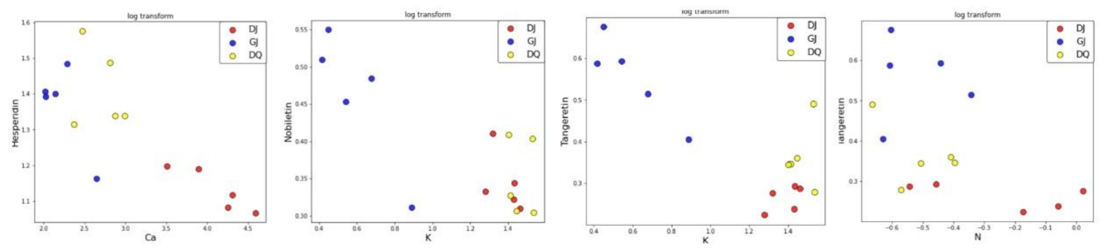


(H)



(I)



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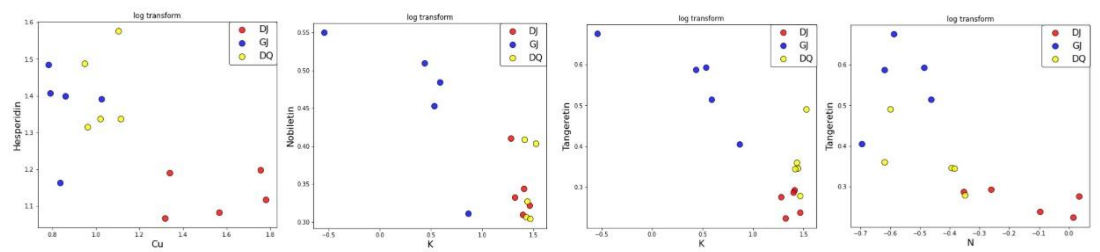
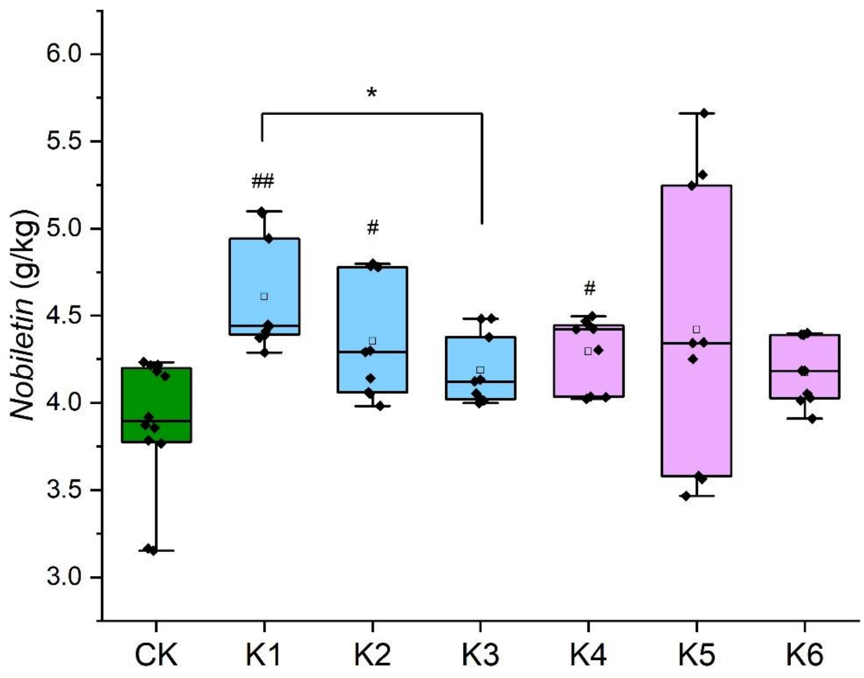


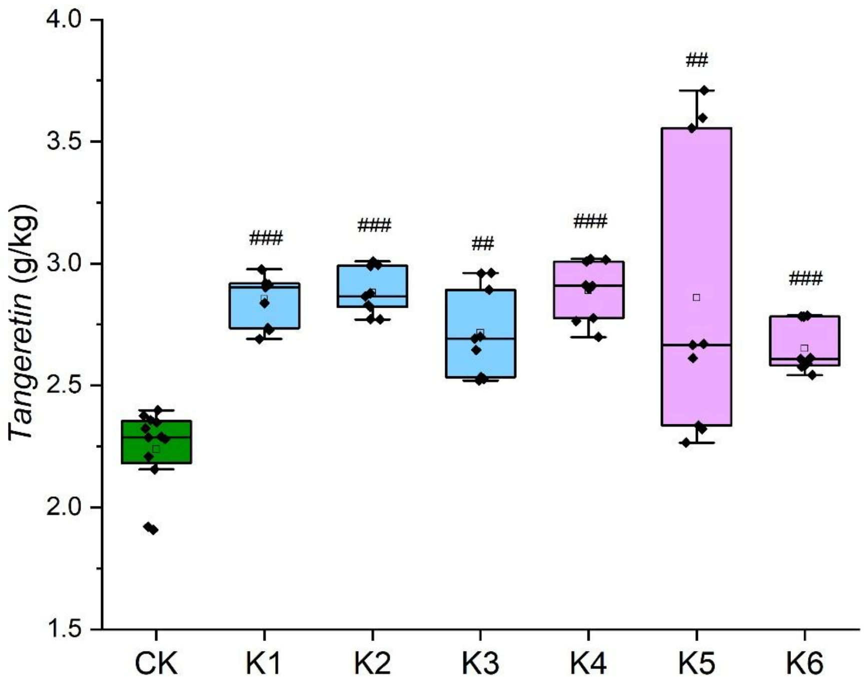
Fig. S1 The scatter diagrams between *hesperidin, nobiletin, tangeretin* and key soil elements across different depths. Significant relationships between three components and key soil elements were shown on above scatter diagrams. Both the independent and dependent variables have been standardized based on log functions (log lase 10). Soil depths: (A) 0-10cm; (B)10-20cm; (C)

20-30cm; (D) 30-40cm; (E) 40-50cm; (F) 50-60cm; (G) 60-70cm; (H) 70-80cm; (I) 80-90cm; (J) 90-100cm.



6.0
5.5
5.0
4.5
4.0
3.5
3.0
Nobiletin (g/kg)
*
##
#
#
CK
K1
K2
K3
K4
K5
K6

(a)



4.0
3.5
3.0
2.5
2.0
1.5
Tangeretin (g/kg)
##
###
###
##
###
###
CK
K1
K2
K3
K4
K5
K6

(b)

Fig. S2 The effect of potassium based inorganic fertilizers on the contents of *nobiletin* and *tangeretin* in the pericarp of *Citrus reticulata* 'Chachi'. K1, K2 and K3 was the one experimental group, which applied 0.3%, 0.6%, and 0.9% of KH_2PO_4 foliar fertilizers, respectively; K4, K5 and K6 was another experimental group, which applied 0.3%, 0.6%, and 0.9% of K_2SO_4 foliar fertilizers, respectively; CK was control group, which was set to spray equal amounts of clean water on the leaves. * is the significant differences in experimental treatments with different concentrations of the same fertilizer, * means $p<0.05$; # is the significant differences between each experimental treatment and the control group, # means $p<0.05$, ## means $p<0.01$, ### means $p<0.001$. (a) The effect of KH_2PO_4 and K_2SO_4 foliar fertilizers on the content of *nobiletin* in the pericarp of *Citrus reticulata* 'Chachi'; (b) The effect of KH_2PO_4 and K_2SO_4 foliar fertilizers on the content of *tangeretin* in the pericarp of *Citrus reticulata* 'Chachi'.