

**Supplementary Material**

**Effects of extra potassium supply and rootstocks indicate links between water, solutes and energy in Shiraz grapevines (*Vitis vinifera*) pericarps**

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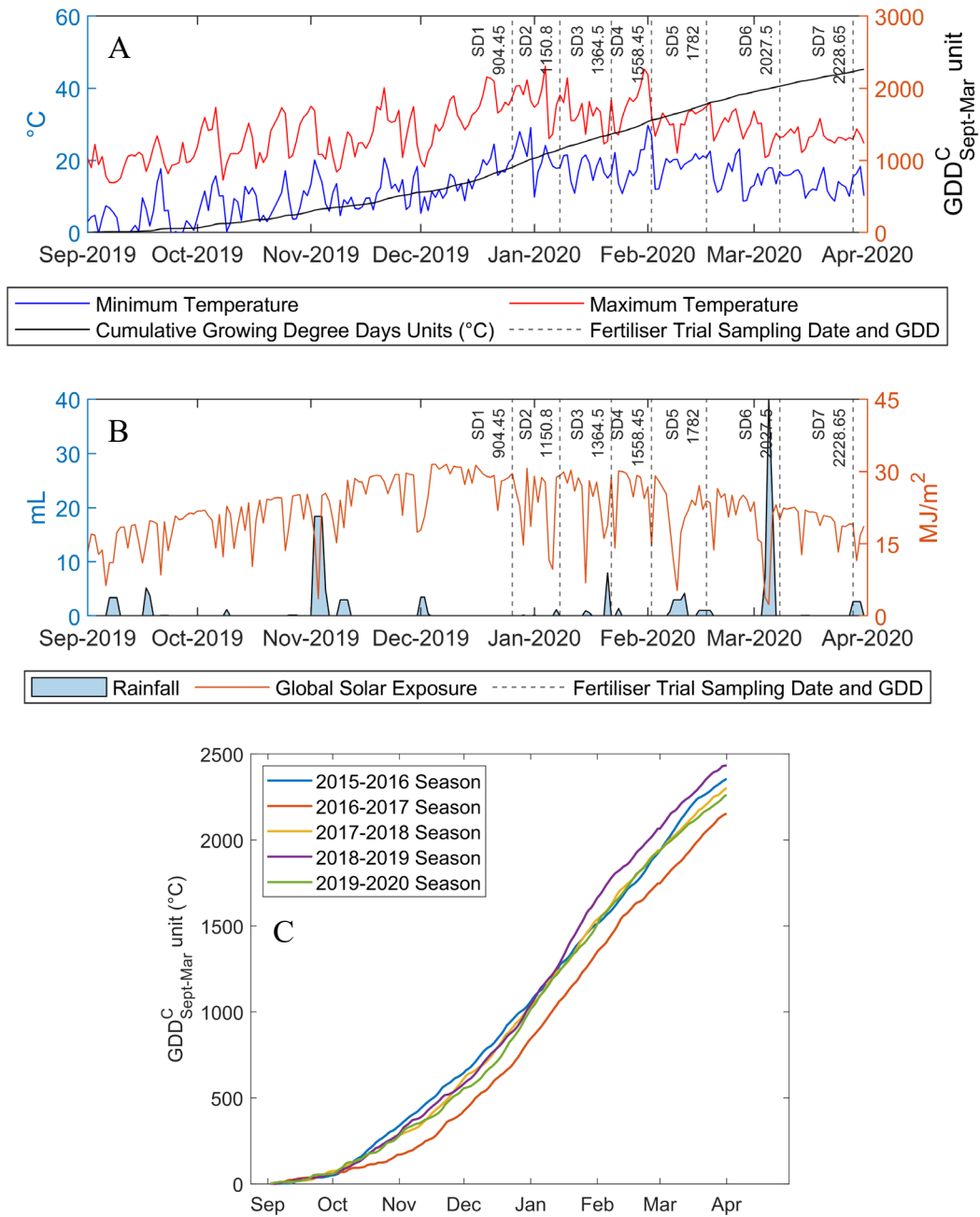
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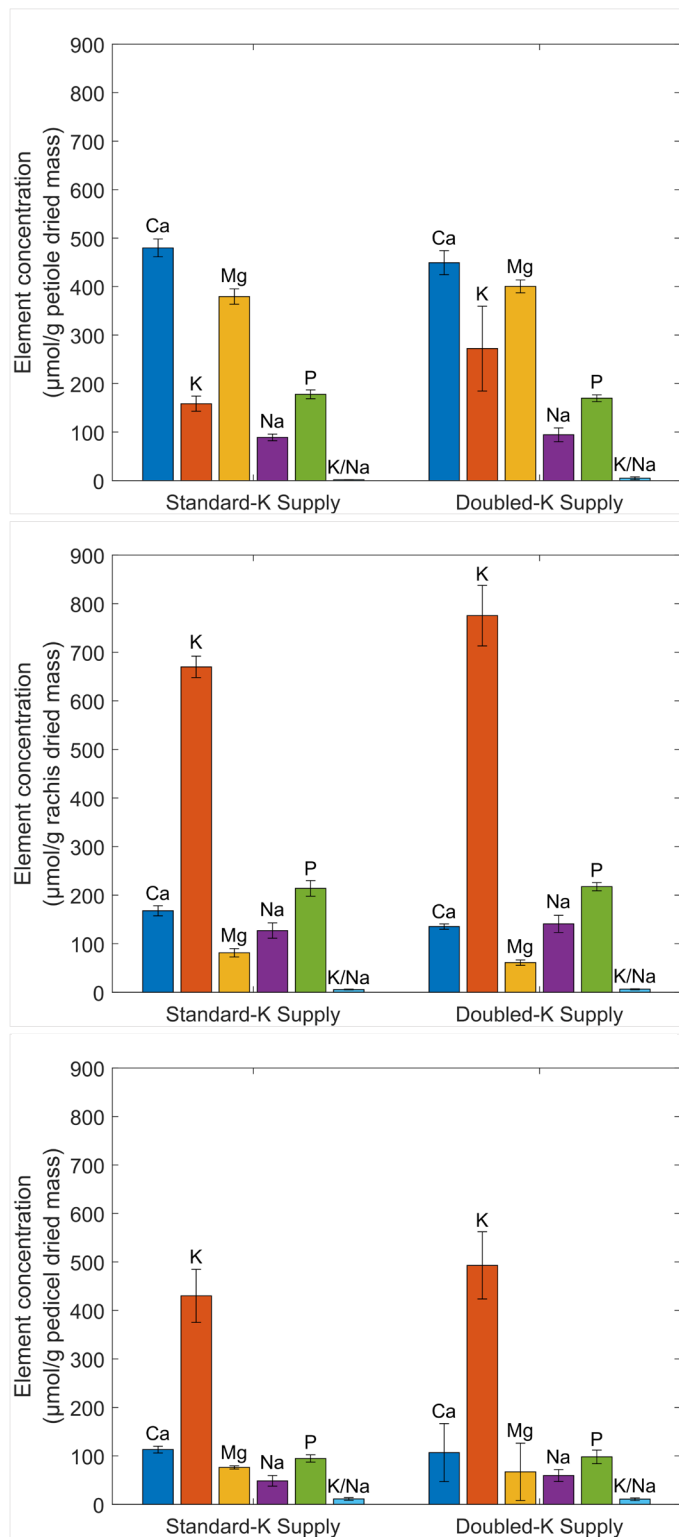
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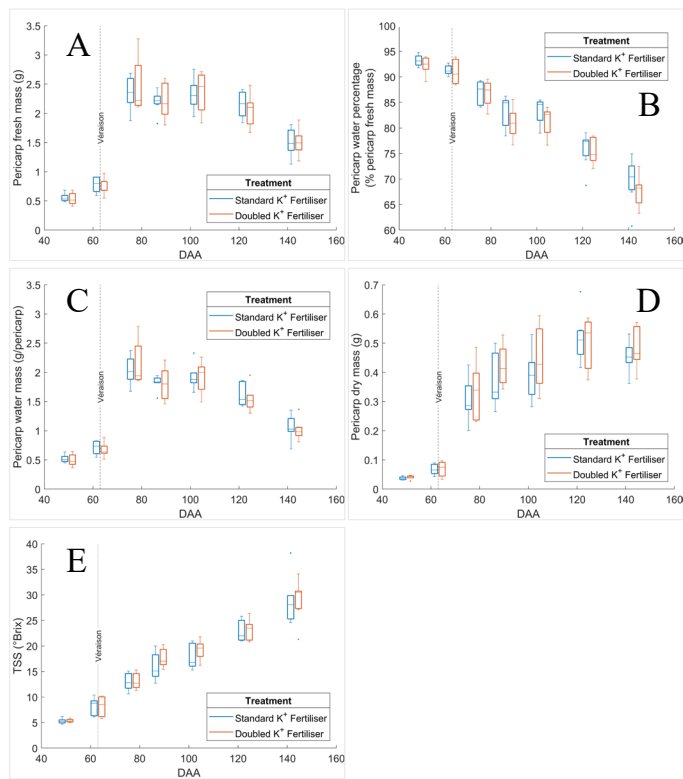
# Supplementary Data



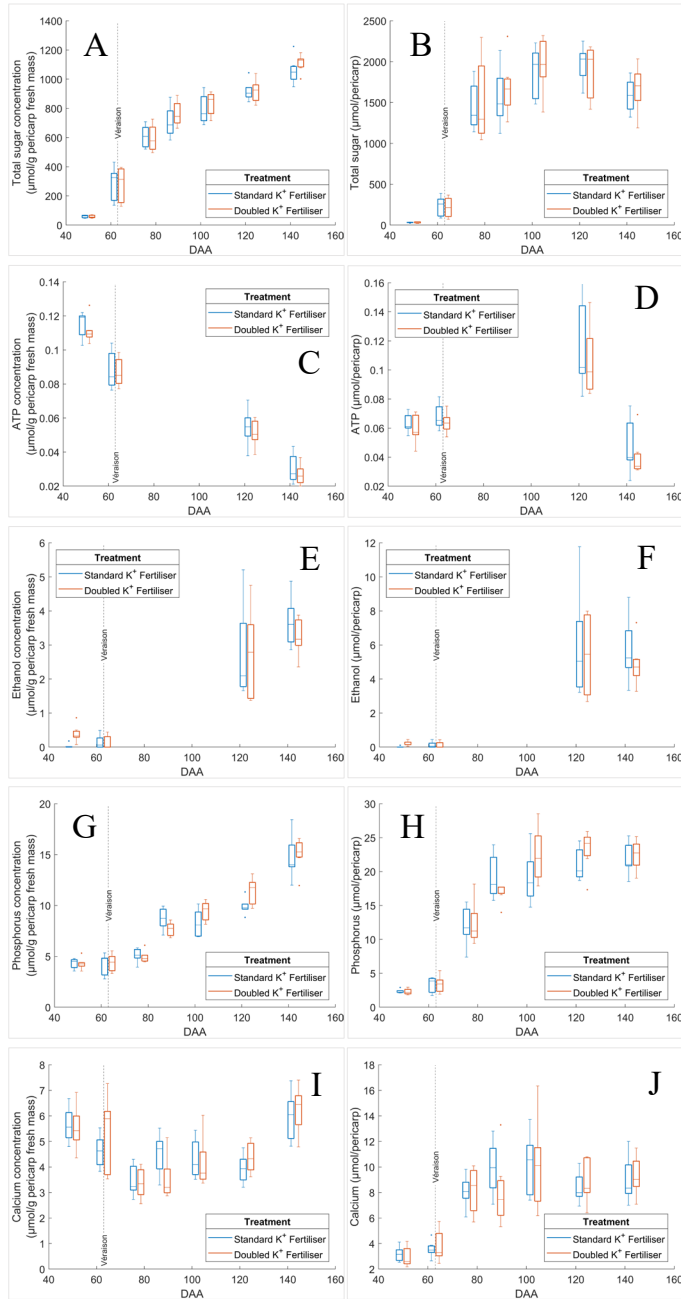
**Supplementary Fig. S1.** Cumulative growing degree days (GDD) and daily weather of the 2019/2020 grape growing season for the K-fertiliser trial (A, B), and the GDD units in five growing seasons, from the 2015/2016 season to the 2019/2020 season. Data were recorded by the climate station Wagga Wagga AMO (Station Number: 072150) and accessed through the Bureau of Meteorology website (<http://www.bom.gov.au/climate/data>). (A, B) Vertical dash lines indicate the sampling days, from sampling date 1 (SD1) to sampling date 7 (SD7), with corresponding GDD units beginning from 1<sup>st</sup> September 2019. The DAA of each sampling date was 50 (SD1), 63 (SD2), 77 (SD3), 88 (SD4), 103 (SD5), 123 (SD6), and 143 (SD7).



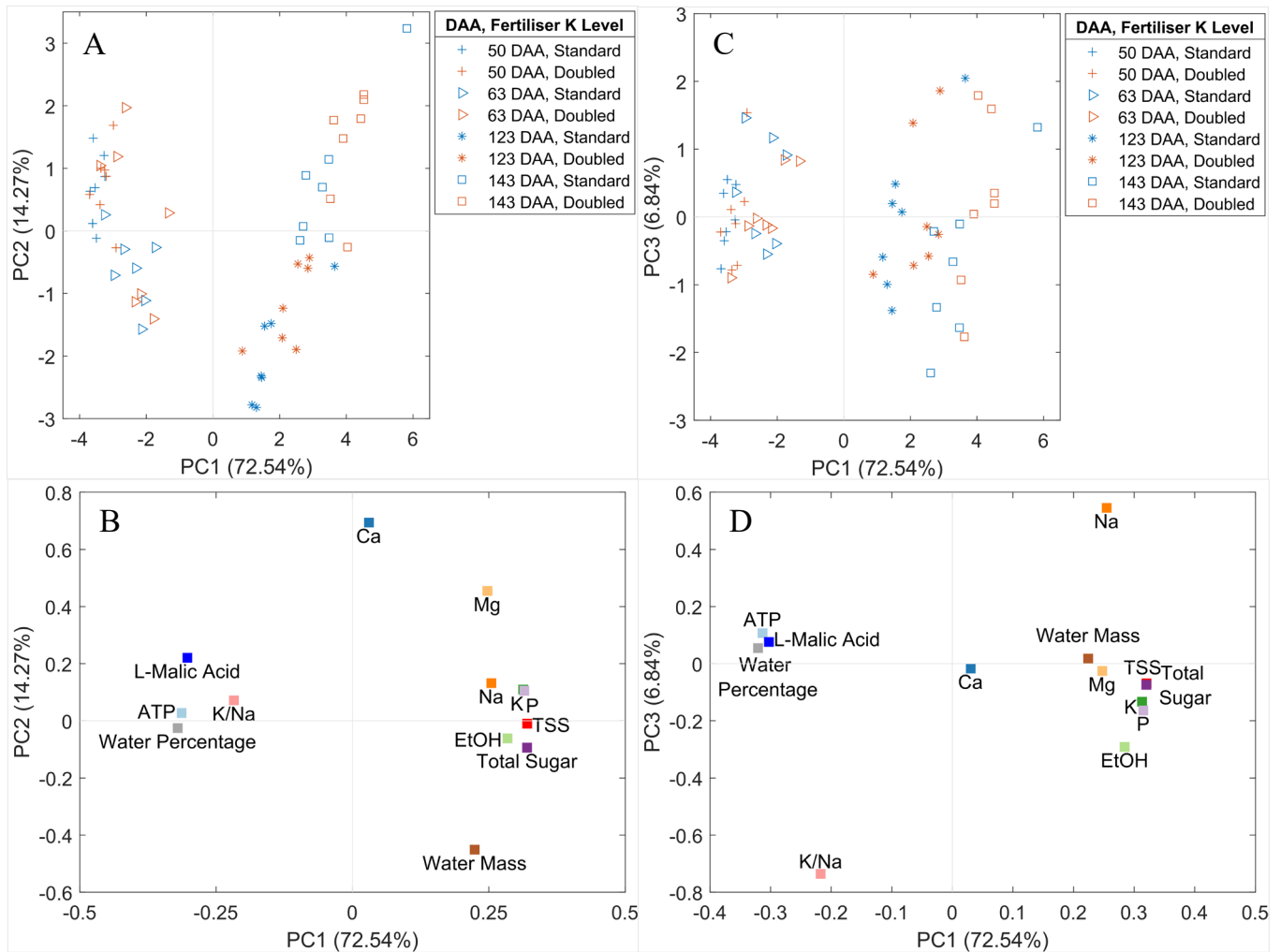
**Supplementary Fig. S2.** Inorganic element concentrations in petiole (A), Rachis (B), and Pedicel (C) in a Shiraz K-fertiliser trial. Data are presented as the mean values of 7 biological replicates, with error bars indicating the standard error of the mean.



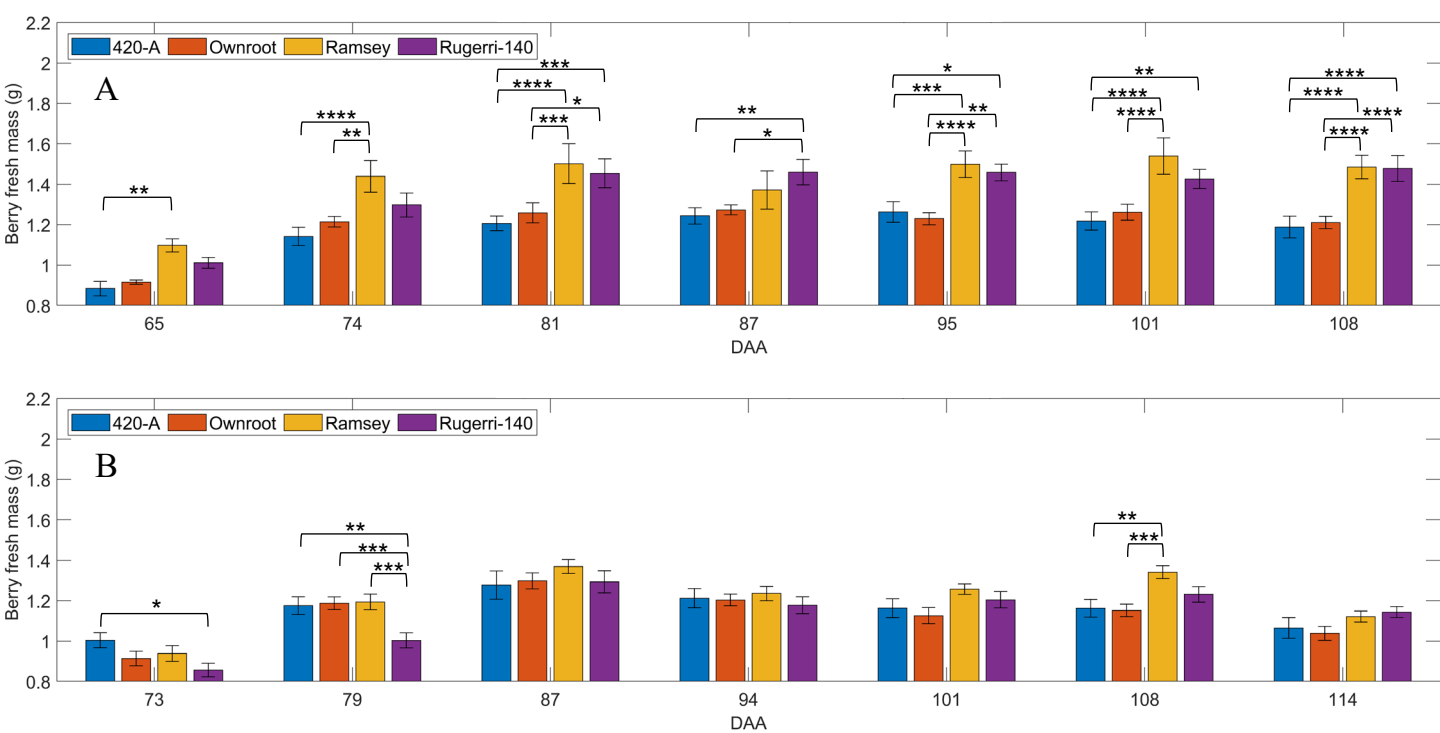
**Supplementary Fig. S3.** Seasonal evolution of pericarp fresh mass (A), water percentage (B), water mass (C), dry mass (D) and TSS (E) in the Shiraz K-fertiliser trial. Vertical dash lines represent the onset of ripening (veraison). Box plots from two groups are separated by sampling dates 50, 63, 77, 88, 103, 123, or 143 DAA.



**Supplementary Fig. S4.** Seasonal evolution of pericarp concentration and content of sugar (A, B), ATP (C, D), ethanol (E, F), P (G, H) and Ca (I, J) in the Shiraz K-fertiliser trial. Vertical dash lines represented the onset of ripening (veraison). Box plots from two groups are separated by sampling dates 50, 63, 77, 88, 103, 123, or 143 DAA.



**Supplementary Fig. S5.** Principal component analysis for pericarp measured attributes in the Shiraz K-fertiliser trial using samples collected at 50 DAA (pre-veraison), 63 DAA (veraison), 123 DAA (harvest maturity) and 143 DAA (over mature), including the scores (A, C) and loadings (B, D) on PC1 versus PC2 (A, B) and PC1 versus PC3 (C, D). **The pericarp measured attributes included the water mass, water percentage, TSS, as well as the concentrations of ATP, ethanol, L-malic acid, total sugar, Ca, K, Mg, Na and P.**



**Supplementary Fig. S6.** Impact of rootstock on Shiraz berry fresh mass in 2018/2019 (A) and 2019/2020 (B) seasons. Data are presented as mean values with error bars indicating the standard error of the mean (n=10). Comparisons with significant differences were indicated by asterisks between rootstocks on the same sampling dates.

**Supplementary Table S1.** The p values of two-way ANOVA and the following multiple comparison tests for inorganic elements concentration in vegetative tissues in K-fertiliser trial. The effect of tissue (T), fertiliser K<sup>+</sup> level (KL) and their interaction were examined for each element concentration by ANOVA. \*The factors with statistically significant effects in ANOVA and the comparisons with significant differences in multiple comparison test (p<0.05) were marked in bold.

Inorganic Elements	Source of Variance	The p-value	Multiple Comparison Tests' p-value			
[K]	T	<b>&lt;0.0001****</b>	Comparison	Standard K <sup>+</sup>	Doubled K <sup>+</sup>	
			<i>Petiole vs. Rachis</i>	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	
			<i>Pedice l vs. Rachis</i>	<b>0.0326*</b>	<b>0.0076**</b>	
			<i>Pedice l vs. Petiole</i>	<b>0.0111*</b>	0.0596	
	KL	<b>0.0374*</b>	Comparison	Petiole	Rachis	Pedice l
			<i>Standard K<sup>+</sup> vs. Doubled K<sup>+</sup></i>	0.6611	0.7273	0.9587
	T:KL	0.8783				
[P]	T	<b>&lt;0.0001****</b>	Comparison	Standard K <sup>+</sup>	Doubled K <sup>+</sup>	
			<i>Petiole vs. Rachis</i>	0.0999	<b>0.0118*</b>	
			<i>Pedice l vs. Rachis</i>	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	
			<i>Pedice l vs. Petiole</i>	<b>&lt;0.0001****</b>	<b>0.0001***</b>	
	KL	0.9567	Comparison	Petiole	Rachis	Pedice l
			<i>Standard K<sup>+</sup> vs. Doubled K<sup>+</sup></i>	0.9893	0.9998	0.9999
	T:KL	0.7768				
[Mg]	T	<b>&lt;0.0001****</b>	Comparison	Standard K <sup>+</sup>	Doubled K <sup>+</sup>	
			<i>Petiole vs. Rachis</i>	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	
			<i>Pedice l vs. Rachis</i>	0.9990	0.9975	
			<i>Pedice l vs. Petiole</i>	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	
	KL	0.7248	Comparison	Petiole	Rachis	Pedice l
			<i>Standard K<sup>+</sup> vs. Doubled K<sup>+</sup></i>	0.6409	0.6729	0.9845
	T:KL	0.1001				
[Na]	T	<b>&lt;0.0001****</b>	Comparison	Standard K <sup>+</sup>	Doubled K <sup>+</sup>	
			<i>Petiole vs. Rachis</i>	0.3635	0.1724	
			<i>Pedice l vs. Rachis</i>	<b>0.0027**</b>	<b>0.0018**</b>	



			<i>Pedicel vs. Petiole</i>	0.2995	0.4616	
	<i>KL</i>	0.3712	Comparison	Petiole	Rachis	Pedicel
			<i>Standard K<sup>+</sup> vs. Doubled K<sup>+</sup></i>	0.9997	0.9789	0.9921
	<i>T:KL</i>	0.9521				
<b>[Ca]</b>	<i>T</i>	<b>&lt;0.0001****</b>	Comparison	Standard K <sup>+</sup>	Doubled K <sup>+</sup>	
			<i>Petiole vs. Rachis</i>	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	
			<i>Pedicel vs. Rachis</i>	0.0947	0.7187	
			<i>Pedicel vs. Petiole</i>	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	
	<i>KL</i>	0.0548	Comparison	Petiole	Rachis	Pedicel
			<i>Standard K<sup>+</sup> vs. Doubled K<sup>+</sup></i>	0.6588	0.5919	0.9996
	<i>T:KL</i>	0.5926				
<b>K/Na</b>	<i>T</i>	<b>0.0011**</b>	Comparison	Standard K <sup>+</sup>	Doubled K <sup>+</sup>	
			<i>Petiole vs. Rachis</i>	0.6728	0.9945	
			<i>Pedicel vs. Rachis</i>	0.3525	0.5875	
			<i>Pedicel vs. Petiole</i>	<b>0.0144*</b>	0.2821	
	<i>KL</i>	0.5350	Comparison	Petiole	Rachis	Pedicel
			<i>Standard K<sup>+</sup> vs. Doubled K<sup>+</sup></i>	0.8653	<i>1</i>	0.9999
	<i>T:KL</i>	0.6214				

**Supplementary Table S2.** The p values of two-way repeated measures ANOVA for the impacts of two explanatory factors, DAA and fertiliser K<sup>+</sup> level (KL), and within-subject factor, plant (PL), on pericarp parameters in the K-fertiliser trial. The effects of interaction between factors were shown as DAA:KL, DAA:PL and KL:PL. \*The sources of variance with significant contribution (p<0.05) to the pericarp components were marked in bold.

Pericarp component	The p value of the source of variance					
	<i>DAA</i>	<i>KL</i>	<i>PL</i>	<i>DAA:KL</i>	<i>DAA:PL</i>	<i>KL:PL</i>
Fresh mass	< <b>0.0001</b> ****	0.9558	0.4075	0.8288	0.2233	<b>0.0013</b> **
Water mass	< <b>0.0001</b> ****	0.8029	0.3116	0.8888	0.3898	<b>0.0154</b> *
Water percentage	< <b>0.0001</b> ****	0.2474	0.2946	0.7726	0.9654	<b>0.0083</b> **
Dry mass	< <b>0.0001</b> ****	0.4642	0.5486	0.5963	0.5853	<b>0.0004</b> ****
Seeds fresh mass	< <b>0.0001</b> ****	0.3328	0.2076	0.7897	0.6921	0.7133
TSS	< <b>0.0001</b> ****	0.6216	0.5258	0.9029	0.7801	<b>0.0002</b> ****
[Total sugar]	< <b>0.0001</b> ****	0.6493	0.4652	0.6505	0.6868	<b>0.0001</b> ****
Total sugar content	< <b>0.0001</b> ****	0.7006	0.3773	0.8441	0.4902	<b>0.0006</b> ****
[L-malic acid]	< <b>0.0001</b> ****	0.0988	0.2103	0.8694	<b>0.0050</b> **	0.2456
L-malic acid content	< <b>0.0001</b> ****	0.0650	0.5343	<b>0.0027</b> **	0.0589	<b>0.0164</b> *
[ATP]	< <b>0.0001</b> ****	0.1681	<b>0.0357</b> *	0.8441	0.3647	0.1530
ATP content	< <b>0.0001</b> ****	0.1235	0.1897	0.6333	<b>0.0176</b> *	0.1292
[Ethanol]	< <b>0.0001</b> ****	0.8622	0.8146	0.6758	0.8874	0.3788
Ethanol content	< <b>0.0001</b> ****	0.6088	0.8016	0.8656	0.8988	0.2672
[Ca]	< <b>0.0001</b> ****	0.9999	0.8615	<b>0.0366</b> *	0.1148	< <b>0.0001</b> ****
Ca content	< <b>0.0001</b> ****	0.9080	0.7948	0.0839	<b>0.0163</b> *	< <b>0.0001</b> ****
[K]	< <b>0.0001</b> ****	0.0588	0.3344	<b>0.0092</b> **	0.6667	<b>0.0128</b> *
K content	< <b>0.0001</b> ****	0.2242	0.8452	<b>0.0161</b> *	0.9183	<b>0.0004</b> ****
[Mg]	< <b>0.0001</b> ****	0.1349	0.9054	<b>0.0103</b> *	<b>0.0206</b> *	< <b>0.0001</b> ****
Mg content	< <b>0.0001</b> ****	0.4070	0.8093	0.1223	0.3256	< <b>0.0001</b> ****
[Na]	< <b>0.0001</b> ****	0.4740	0.9029	0.5944	0.9982	< <b>0.0001</b> ****
Na content	< <b>0.0001</b> ****	0.4589	0.9252	0.6019	0.9973	< <b>0.0001</b> ****
K/Na	< <b>0.0001</b> ****	0.4898	0.8859	0.3711	0.9898	< <b>0.0001</b> ****

[P]	<b>&lt;0.0001****</b>	0.5040	0.7610	<b>0.0092**</b>	0.4102	<b>0.0002***</b>
P content	<b>&lt;0.0001****</b>	0.6447	0.7898	<b>0.0124*</b>	0.3621	<b>&lt;0.0001****</b>

**Supplementary Table S3.** The p values of two-way repeated measures ANOVA for berry K and fresh mass in Shiraz grown on own-rooted vines or 3 rootstocks in 2018/2019 and 2019/2020 seasons. Two experimental factors, DAA and rootstock (RT), and one within-subject factor, plant (PL), and their interactions were examined. \*The sources of variance with significant impact ( $p < 0.05$ ) on berry components were marked in bold.

Season	Berry component	The p value of the source of variance					
		<i>DAA</i>	<i>RT</i>	<i>PL</i>	<i>DAA:RT</i>	<i>DAA:PL</i>	<i>RT:PL</i>
2018/2019	[K]	<b>&lt;0.0001****</b>	<b>0.0003***</b>	0.7642	<b>&lt;0.0001****</b>	0.8665	<b>&lt;0.0001****</b>
	K content	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	0.3948	<b>&lt;0.0001****</b>	0.1075	<b>&lt;0.0001****</b>
	Fresh mass	<b>&lt;0.0001****</b>	<b>0.0007***</b>	0.7261	<b>0.00785**</b>	0.3481	<b>&lt;0.0001****</b>
2019/2020	[K]	<b>&lt;0.0001****</b>	<b>&lt;0.0001****</b>	0.9359	0.0772	0.0206	<b>&lt;0.0001****</b>
	K content	<b>&lt;0.0001****</b>	<b>0.0158*</b>	0.5148	<b>&lt;0.0001****</b>	0.37	<b>&lt;0.0001****</b>
	Fresh mass	<b>&lt;0.0001****</b>	0.2878	0.6340	<b>&lt;0.0001****</b>	0.3077	<b>&lt;0.0001****</b>