

SUPPLEMENTARY DATA

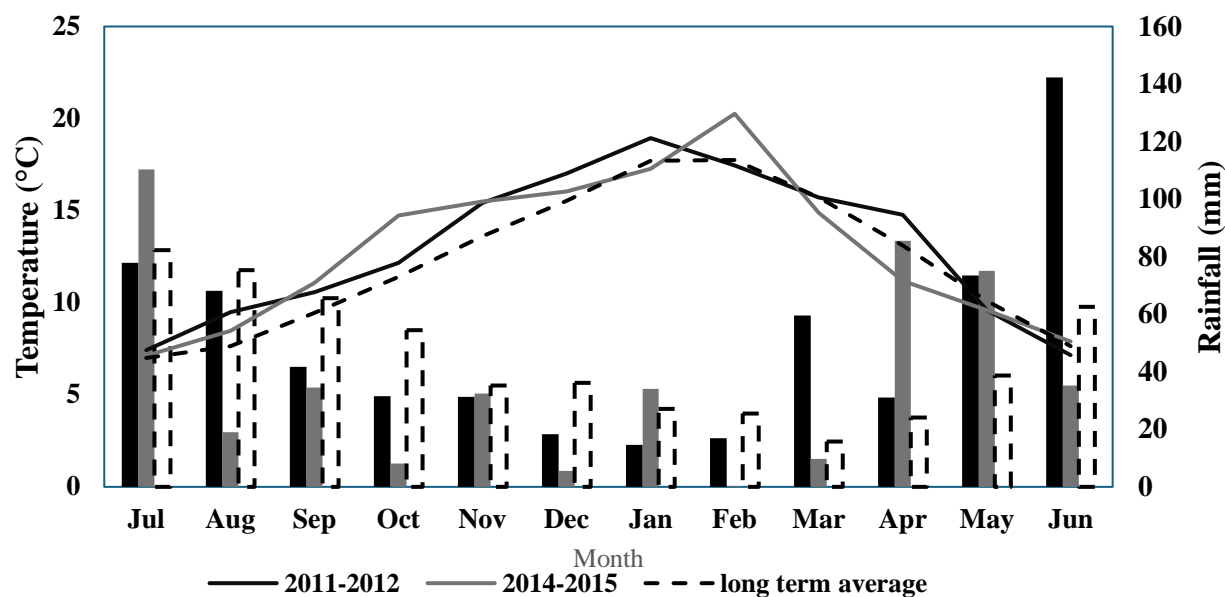


Figure S1. Comparison of average temperature (lines) and rainfall (bars) in growing seasons 2011–2012, 2014–2015, and long-term average at Waite campus, Urrbrae, South Australia.

Sensory attribute	Reference	Scale Ranges		
		Low	Medium	High
Seed colour	Colour charts	Green	Green-Brown	Dark Brown
Sweetness - Semillon	Sucrose solution (Sigma Aldrich)	20 Brix	22 Brix	24 Brix
Sweetness - Cabernet Sauvignon	Sucrose solution (Sigma Aldrich)	29 Brix	31 Brix	33 Brix
Acidity	Tartaric acid solution (Australian Tartaric Products)	0.5 g L-1	1.0 g L-1	2.0 g L-1
Bitterness	Quinine sulfate solution (Sigma Aldrich)	10 mg L-1	20 mg L-1	30 mg L-1
Astringency	GrapEx® solution	1 g L-1	3 g L-1	6 g L-1
Seed crushability	Pepita seeds, hazelnuts, and passionfruit were purchased from the supermarket	Soft (pepita seeds)	Crunchy (hazelnuts)	Brittle (Passionfruit seeds)

Table S1. Description of the attribute ranking exercise used for training panellists. Two sets of sugar concentrations were used to reflect the measured Brix° range of Semillon and Cabernet Sauvignon.

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Semillon Standards	Cabernet Sauvignon Standards
Pineapple	Blueberry
Lemon	Raspberry
Lime	Strawberry
Nectarine	Plum
Tropical (Mix of pineapple, lemon, lime, nectarine and passionfruit)	Mixed Dry Fruit (Mix of cranberries, raisins and blueberries)
Grass	Prunes
	Beans
	Capsicum
	Tomato Stem

Table S2. Standards used for Semillon and Cabernet Sauvignon fruit flavour descriptors used during training and formal berry assessment sessions.

*All standards were fresh fruits or vegetables except for dried fruits.

Standard	Reference
Dark fruits	Fresh plum, fresh blueberry, rehydrated freeze-dried mulberry
Spice/port character	Chinese five spice, mixed dried cranberries, raisins and blueberries
Floral	Fresh lavender and violet flowers
Chocolate	Milk and dark chocolate
Savoury	Beef jerky, tobacco
Green	Fresh green capsicum, green beans, Eucalyptus leaves

Table S3. Standards generated and reference materials used during wine sensory assessment of Cabernet Sauvignon.

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Attribute	Scale word anchors
Pulp	
Detachment from skin	Easy to separate to firmly attached
Juiciness	All is gelatinous to all is juicy
Sweetness	Not very sweet to very sweet
Acidity	Low to very acidic
Green/Grassy flavour	Absent to intense
Tropical flavour	Absent to intense
Flavour intensity	Absent to intense
Skin	
Disintegration	Easy, homogenous mixture to very difficult, big pieces
Acidity	Low to very acidic
Green/Grassy flavour	Absent to intense
Tropical flavour	Absent to intense
Flavour intensity	Low to intense
Bitterness	Absent to intense
Tannic intensity	Tongue slides effortlessly over the roof of mouth to tongue slides with great difficulty
Tannin grain size	Soft, fine, and silky grains to high-grade sandpaper
Astringency	Not difficult to re-salivate to difficult to re-salivate after more than 5 seconds
Seed	
Colour	Green, yellow-green to dark brown
Crushability	All seeds are soft to brittle, crunchy like passionfruit seeds
Flavour	Herbaceous to no flavour
Astringency	Absent to extremely astringent
Bitterness	Absent to extremely bitter
Tannic intensity	Tongue slide effortlessly to tongue slides with great difficulty

Table S4. Pulp, skin, and seed attributes were assessed in Semillon berry sensory evaluation, and scale word anchors were used for each attribute.

Attribute	Scale word anchors
Palate	
Body	Thin to full
Phenolic length	Short to long
Acidity	Low to high
Astringency (tannic quantity)	Low to high
Grain size of tannin	Fine to coarse
Alcohol	Low to high
Bitterness	Low to high

Table S5. Attributes and scale word anchors generated and used for wine descriptive analysis of Semillon.

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Attribute	Scale word anchors
Pulp	
Detachment from skin	Easy to separate to firmly attached
Juiciness	All is gelatinous to all is juicy
Sweetness	Not very sweet to very sweet
Acidity	Low to very acidic
Green flavour	Absent to intense
Fresh dark fruit flavour	Absent to intense
Ripe dark fruit flavour	Absent to intense
Flavour intensity	Low to high
Skin	
Disintegration	Easy, homogenous mixture to very difficult, big pieces
Acidity	Low to very acidic
Dark grape flavour	Absent to intense
Bitterness	Absent to intense
Astringency	Absent to intense
Tannic intensity	Tongue slides effortlessly over roof of mouth to tongue slides with great difficulty
Tannin grain size	Soft, fine, and silky grains to high-grade sandpaper
Astringency	Easy to re-salivate to difficult to re-salivate after more than 5 seconds
Seed	
Colour	Green, yellow-green to dark brown
Crushability	All seeds are soft to brittle, crunchy like passionfruit seeds
Flavour	Herbaceous to no flavour
Astringency	Absent to extremely astringent
Bitterness	Absent to extremely bitter
Tannic intensity	Tongue slides effortlessly to tongue slides with great difficulty

Table S6. Pulp, skin, and seed attributes assessed in Cabernet Sauvignon berry sensory evaluation and scale word anchors used for each attribute.

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Attribute	Scale word anchors
Colour	
Colour	Brick red to Dark red
Colour Transparency	Clear to Opaque
Aroma	
Dark Fruits	Low to high
Spice/port character	Low to high
Floral aroma	Low to high
Chocolate	Low to high
Savoury	Low to high
Green	Low to high
Aroma intensity	Absent to intense
Palate	
Dark Fruits	Low to high
Spice/port character	Low to high
Floral aroma	Low to high
Chocolate	Low to high
Savoury	Low to high
Green	Low to high
Flavour intensity	Absent to intense
Acidity	Low to high
Astringency (tannin quality)	Low to high
Grain size of tannin	Fine to coarse
Alcohol	Low to high
Body	Thin to full
Phenolic length	Short to long
Fruit length	Short to long
Bitterness	Low to high

Table S7. Attributes and scale word anchors generated and used for wine descriptive analysis of Cabernet Sauvignon.

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Variable	Season	Treatments			P-value
		Control	Potassium Silicate	Biodynamic Silica	
Al (mg/kg)	2011/2012	0.90 a	1.20 a	1.30 a	0.098
	2014/2015	0.90 a	0.58 a	0.85 a	0.106
B (mg/kg)	2011/2012	50 a	48 a	48 a	0.619
	2014/2015	59 a	53 b	50 b	0.018
Ca (mg/kg)	2011/2012	12267 a	11567 a	12400 a	0.487
	2014/2015	27000 a	29167 a	28500 a	0.520
Cu (mg/kg)	2011/2012	22 a	21 a	21 a	0.585
	2014/2015	6 a	6 a	6 a	0.322
Fe (mg/kg)	2011/2012	12 a	12 a	13 a	0.701
	2014/2015	14 a	12 a	136 a	0.303
K (mg/kg)	2011/2012	30000 a	27333 a	29333 a	0.269
	2014/2015	29100 a	29317 a	29183 a	0.912
Mg (mg/kg)	2011/2012	2967 a	3033 a	3033 a	0.819
	2014/2015	3717 a	3550 a	3483 a	0.611
Mn (mg/kg)	2011/2012	144 a	181 a	133 a	0.145
	2014/2015	293 a	273 a	205 a	0.072
N (%)	2011/2012	0.80 a	0.82 a	0.80 a	0.818
	2014/2015	1.96 b	2.12 a	1.95 b	0.016
Na (mg/kg)	2011/2012	122 b	153 a	148 a	0.010
	2014/2015	209 a	164 a	209 a	0.097
P (mg/kg)	2011/2012	4800 a	4467 a	4467 a	0.164
	2014/2015	1533 a	1692 a	1572 a	0.455
S (mg/kg)	2011/2012	1250 a	1163 a	1200 a	0.091
	2014/2015	2113 a	2300 a	2130 a	0.098
Zn (mg/kg)	2011/2012	24 a	23 a	22 a	0.139
	2014/2015	28 a	26 a	32 a	0.199

Table S8. The effect of biodynamic silica and potassium silicate on leaf blade element levels of Semillon in the 2011/2012 and 2014/2015 growing seasons.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

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Variable	Season	Treatments			P-value
		Control	Potassium Silicate	Biodynamic Silica	
Al (mg/kg)	2011/2012	1.0 a	1.4 a	1.1 a	0.305
	2014/2015	0.6 a	0.7 a	0.6 a	0.721
B (mg/kg)	2011/2012	43 a	45 a	43 a	0.756
	2014/2015	55 a	62 a	69 a	0.421
Ca (mg/kg)	2011/2012	14267 a	13500 a	13033 a	0.513
	2014/2015	21300 a	23000 a	21667 a	0.250
Cu (mg/kg)	2011/2012	28 a	31 a	28 a	0.622
	2014/2015	5 a	4 a	5 a	0.553
Fe (mg/kg)	2011/2012	14 a	15 a	14 a	0.151
	2014/2015	12 a	12 a	12 a	0.940
K (mg/kg)	2011/2012	33667 a	28333 a	32333 a	0.120
	2014/2015	10550 a	10850 a	10916 a	0.805
Mg (mg/kg)	2011/2012	2307 a	3000 a	2667 a	0.122
	2014/2015	2650 a	2700 a	2783 a	0.852
Mn (mg/kg)	2011/2012	113 a	72 a	151 a	0.202
	2014/2015	89 a	177 a	160 a	0.220
N (%)	2011/2012	0.9 a	1.1 a	1.1 a	0.328
	2014/2015	2.2 a	2.0 b	2.1 ab	0.014
Na (mg/kg)	2011/2012	283 a	214 a	199 a	0.226
	2014/2015	340 a	396 a	353	0.244
P (mg/kg)	2011/2012	1850 b	2267 ab	3033 a	0.046
	2014/2015	1218 a	1155 a	1195 a	0.179
S (mg/kg)	2011/2012	1427 a	1540 a	1467 a	0.485
	2014/2015	2133 a	2066 a	2106 a	0.528
Zn (mg/kg)	2011/2012	35 a	34 a	32 a	0.613
	2014/2015	34 a	31 a	35 a	0.458

Table S9. The effect of biodynamic silica and potassium silicate on leaf blade element levels of Cabernet Sauvignon in the 2011/2012 and 2014/2015 growing seasons.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

Variable	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
pH	3.47 a	3.52 a	3.45 a	0.453
Titrateable acidity	6.1 a	5.7 a	5.2 a	0.088
Residual sugar (g/L)	0.4 a	0.3 a	0.4 a	0.579
Alcohol (%v/v)	13.61 a	12.91 a	13.47 a	0.591
Chemical Age	0.9 a	0.86 a	0.91 a	0.419
Degree of ionisation of anthocyanins	3.78 a	4.11 a	3.49 a	0.902
Total anthocyanin	36.1 a	29.5 a	36.2 a	0.422
Colour density (au)	1.46 a	1.36 a	1.43 a	0.445
Colour density SO ₂ corrected (au)	1.45 a	1.44 a	1.42 a	0.643
Hue (au)	1.44 a	1.44 a	1.46 a	0.792
Total phenolics (au)	12.8 a	11.3 a	12.7 a	0.436
SO ₂ resistant pigments (au)	0.523 a	0.580 a	0.523 a	0.732
Epicatechin concentration (g/L)	0.672 a	0.624 a	0.715 a	0.696

Table S10. The effect of biodynamic silica and potassium silicate vineyard applications on wine composition of Semillon in the 2014/2015 season.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

Variable	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
pH	4.13 a	3.88 a	3.94 a	0.053
Titrateable acidity	9.0 b	7.2 b	7.6 a	0.008
Residual sugar (g/L)	0.3 a	0.5 a	0.3 a	0.380
Malic acid (g/L)	0.06 a	0.06 a	0.06	0.697
Alcohol (%v/v)	15.65 a	16.26 a	15.45 a	0.696
Chemical Age	0.614 a	0.63 a	0.771 a	0.385
Degree of ionisation of anthocyanins	26.3 a	31.1 a	25.2 a	0.361
Total anthocyanin	224 a	271 a	262 a	0.734
Colour density (au)	14.9 a	18.2 a	20.0 a	0.262
Colour density SO ₂ corrected (au)	13.5 a	16.7 a	17.5 a	0.289
Hue (au)	0.954 a	0.905 a	0.975 a	0.419
Total phenolics (au)	68.6 a	79.7 a	83.2 a	0.217
SO ₂ resistant pigments (au)	4.2 a	5.4 a	7.0 a	0.395
Epicatechin concentration (g/L)	3.2 a	4.2 a	4.1 a	0.112

Table S11. The effect of biodynamic silica and potassium silicate vineyard applications on wine composition of Cabernet Sauvignon in the 2014/2015 season.

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Berry sensory attributes	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
Pulp detachment	3.7 a	3.4 a	3.2 a	0.271
Pulp juiciness	10.7 b	11.8 a	11.3 a	0.058
Pulp sweetness	9.1 a	9.3 a	8.8 a	0.148
Pulp acidity	5.6 a	5.4 a	5.8 a	0.540
Pulp grassy aroma	3.8 a	3.9 a	3.8 a	0.867
Pulp tropical aroma	8.9 a	8.5 a	8.4 a	0.354
Pulp flavour intensity	9.1 a	8.9 a	8.7 a	0.561
Skin disintegration	10.8 a	10.3 a	10.8 a	0.415
Skin acidity	5.2 a	4.9 a	5.1 a	0.737
Skin grassy aroma	3.6 a	4.2 a	3.9 a	0.294
Skin tropical aroma	5.6 a	5.7 a	5.6 a	0.937
Skin flavour intensity	5.7 a	6.1 a	6.1 a	0.471
Skin tannic intensity	4.4 b	4.5 b	5.0 a	0.066
Skin tannin grain size	3.6 b	3.6 b	3.8 a	0.068
Skin astringency	3.7 a	3.7 a	4.0 a	0.384
Seed colour	9.0 a	8.9 a	9.1 a	0.919
Seed crushability	11.7 a	11.8 a	11.4 a	0.565
Seed flavour	8.0 b	7.7 b	8.5 a	0.063
Seed astringency	7.2 b	8.1 a	8.6 a	0.065
Seed bitterness	5.4 a	6.7 a	6.3 a	0.172
Ease of tongue movement	7.1 b	7.9 a	7.7 a	0.081

Table S12. Effects of biodynamic silica and potassium silicate applications on grape berry pulp, skin and seed attributes in Semillon during the 2011/2012 growing season.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

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Berry sensory attributes	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
Pulp detachability	9.8 a	8.1 b	9.5 a	0.040
Pulp juiciness	11.2 a	11.1 a	10.7 a	0.345
Pulp sweetness	9.1 ab	9.0 b	10.1 a	0.079
Pulp acidity	6.4 a	7.1 a	6.5 a	0.551
Pulp citrus flavour	7.0 a	7.8 a	6.7 a	0.241
Pulp tropical flavour	8.6 a	8.5 a	8.6 a	0.986
Pulp grassy flavour	4.5 a	5.1 a	4.1 a	0.150
Pulp flavour intensity	8.6 a	9.5 a	9.3 a	0.318
Skin disintegration	5.5 b	7.3 a	5.7 b	0.002
Skin acidity	5.0 b	7.0 a	4.4 b	0.004
Skin citrus flavour	5.7 ab	6.7 a	5.0 b	0.086
Skin tropical flavour	5.9 a	6.5 a	6.2 a	0.747
Skin grassy flavour	4.4 a	5.2 a	4.4 a	0.229
Skin flavour intensity	5.6 b	7.5 a	6.4 ab	0.013
Skin bitterness	2.3 a	2.4 a	2.4 a	0.974
Skin astringency	5.2 a	5.8 a	5.4 a	0.691
Skin tannic intensity	5.9 a	7.3 a	6.8 a	0.119
Skin grain size of tannins	6.4 a	6.5 a	7.1 a	0.721
Skin re-salivation	6.6 a	6.9 a	6.4 a	0.754
Seed colour	9.6 a	9.3 a	10.2 a	0.390
Seed crushability	8.8 a	8.4 a	8.2 a	0.770
Seed astringency	9.0 a	9.5 a	8.6 a	0.427
Seed tannin size	7.9 a	7.9 a	6.4 b	0.009
Seed bitterness	6.0 a	6.3 a	5.2 a	0.291
Seed flavour	5.5 a	5.7 a	6.3 a	0.460
Seed re-salivation	7.7 a	8.6 a	8.1 a	0.459

Table S13. Effects of biodynamic silica and potassium silicate applications on grape berry pulp, skin, and seed attributes in Semillon during the 2014/2015 growing season.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

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Berry sensory attributes	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
Pulp detachment	5.7 a	5.2 a	5.9 a	0.173
Pulp juiciness	10.3 a	10.4 a	9.7 a	0.349
Pulp sweetness	9.5 b	10.1 a	10.0 a	0.095
Pulp acidity	5.3 b	6.1 a	5.9 a	0.003
Pulp green aroma	2.6 a	2.8 a	2.6 a	0.663
Pulp fresh dark fruit aroma	8.7 a	9.4 a	9.0 a	0.170
Pulp ripe dark fruit aroma	8.7 a	8.2 a	8.6 a	0.536
Pulp flavour intensity	8.8 a	9.4 a	9.0 a	0.427
Skin disintegration	11.1 a	10.3 a	10.5 a	0.117
Skin acidity	4.2 a	4.9 a	4.4 a	0.229
Skin dark grape flavour	7.1 a	7.5 a	7.8 a	0.330
Skin bitterness	2.2 a	2.3 a	1.9 a	0.506
Skin astringency	4.2 b	4.4 b	4.7 a	0.043
Skin tannic intensity	5.3 b	5.3 b	5.7 a	0.064
Skin tannin grain size	4.0 a	3.8 a	3.7 a	0.561
Skin astringency	4.0 a	4.1 a	3.9 a	0.836
Seed colour	8.9 a	7.9 b	8.0 b	0.030
Seed crushability	11.4 a	11.6 a	11.5 a	0.804
Seed flavour	8.1 b	7.8 b	8.9 a	0.052
Seed astringency	7.2 b	7.8 a	7.8 a	0.065
Seed bitterness	6.1 a	7.6 a	6.9 a	0.292
Ease of tongue movement	7.0 b	7.4 a	7.4 a	0.063

Table S14. Effects of biodynamic silica and potassium silicate applications on grape berry pulp, skin and seed attributes in Cabernet Sauvignon during the 2011/2012 growing season.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

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Berry sensory attributes	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
Pulp detachability	7.9 a	6.7 b	8.5 a	0.002
Pulp juiciness	8.2 a	6.1 b	8.3 a	0.011
Pulp sweetness	10.2 a	10.5 a	10.3 a	0.814
Pulp acidity	4.9 a	4.0 a	5.0 a	0.291
Pulp ripe dark fruit flavour	9.7 b	10.8 a	9.5 b	0.013
Pulp fresh dark fruit flavour	7.1 a	6.4 a	7.7 a	0.201
Pulp green flavour	2.7 a	2.6 a	3.0 a	0.315
Pulp flavour intensity	9.6 a	9.9 a	10.4 a	0.166
Skin disintegration	6.8 a	7.7 a	6.8 a	0.150
Skin acidity	4.8 a	4.4 a	5.4 a	0.189
Skin ripe dark fruit flavour	9.4 b	10.5 a	9.7 ab	0.074
Skin fresh dark fruit flavour	6.1 a	5.3 a	6.1 a	0.327
Skin green flavour	2.6 a	2.2 a	2.5 a	0.351
Skin flavour intensity	7.8 a	8.3 a	8.0 a	0.400
Skin bitterness	2.2 a	2.3 a	2.8 a	0.334
Skin astringency	6.1 a	6.3 a	6.0 a	0.921
Skin tannic intensity	7.4 a	7.4 a	6.9 a	0.592
Skin grain size of tannins	6.3 a	6.3 a	6.3 a	0.997
Skin re-salivation	7.4 a	7.8 a	6.4 b	0.006
Seed colour	10.5 a	11.0 a	10.4 a	0.240
Seed crushability	8.3 a	9.1 a	9.4 a	0.141
Seed astringency	9.4 a	7.5 b	8.3 b	0.010
Grain size of tannin	8.2 a	6.4 b	8.2 a	0.053
Bitterness	6.5 a	5.1 a	6.3 a	0.169
Seed flavour	7.1 a	5.1 b	5.9 ab	0.016
Re-salivation	8.0 a	7.2 a	8.2 a	0.294

Table S15. Effects of biodynamic silica and potassium silicate applications on grape berry pulp, skin and seed attributes in Cabernet Sauvignon during the 2014/2015 growing season.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

Wine sensory attributes	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
Astringency (Tannic quantity)	6.7 a	6.6 a	6.8 a	0.928
Tannin size	5.7 a	4.9 a	5.5 a	0.229
Alcohol	6.4 a	6.8 a	7.4 a	0.121
Body	7.0 a	7.2 a	7.8 a	0.208
Phenolic length	7.7 a	6.0 b	7.2 ab	0.078
Bitterness	4.0 a	4.7 a	4.6 a	0.551

Table S16. Effects of biodynamic silica and potassium silicate applications on wine attributes in Semillon during the 2014/2015 growing season.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.

Wine sensory attributes	Treatments			P-value
	Control	Potassium Silicate	Biodynamic Silica	
Wine colour	11.6 a	12.0 a	9.7 b	0.008
Wine transparency	13.4 a	13.5 a	12.6 b	0.001
Dark fruits aroma	11.3 a	9.9 ab	9.7 b	0.081
Spice/Port character aroma	11.2 a	11.2 a	10.0 a	0.174
Floral aroma	3.5 a	4.4 a	3.8 a	0.310
Chocolate aroma	5.2 a	4.7 a	4.0 a	0.312
Savoury aroma	5.6 a	6.3 a	6.1 a	0.670
Green aroma	5.1 a	5.6 a	5.9 a	0.639
Aroma intensity	9.9 a	9.2 a	9.4 a	0.367
Dark fruits flavour	11.5 a	11.5 a	11.0 a	0.577
Spice/Port character flavour	10.4 a	11.0 a	10.1 a	0.523
Floral flavour	4.0 a	3.5 a	3.9 a	0.438
Chocolate flavour	4.5 a	5.6 a	4.7 a	0.232
Savoury flavour	5.0 a	5.9 a	5.1 a	0.176
Green flavour	67.1 a	55.6 a	59.3 a	0.491
Flavour intensity	10.7 b	11.5 a	10.3 b	0.016
Acidity	7.4 a	6.5 a	67.7 a	0.282
Astringency (Tannic quantity)	11.9 a	11.4 a	10.9 a	0.283
Tannin size	10.0 a	7.9 b	7.5 b	0.005
Alcohol	9.2 a	9.5 a	9.1 a	0.676
Body	11.2 a	11.1 a	10.7 a	0.271
Phenolic length	11.3 a	11.2 a	10.6 a	0.516
Fruit length	7.2 a	7.0 a	7.4 a	0.830
Bitterness	4.3 a	3.8 a	3.5 a	0.667

Table S17. Effects of biodynamic silica and potassium silicate applications on wine attributes in Cabernet Sauvignon during the 2014/2015 growing season.

Different superscript letters within rows indicate statistical differences using LSD at a 5 % level and within one growing season.