Supplemental Data for:

Yuan F, Schreiner RP, Osborne J and Qian MC. 2018. Effects of soil NPK supply on Pinot noir wine phenolics and aroma composition. Am J Enol Vitic 69:371-385. doi: 10.5344/ajev.2018.17077.

Supplemental Table 1 Concentrations of volatile compounds in Pinot noir wines according to vine nutrient supply in 2012[a].

		Control	75% N	50% N	30% N	15% N	50% P	20% P	0% P	50% K	20% K	0% K
	Esters											
C1	ethyl butanoate	167 ± 21 abc	165 ± 12 abc	144 ± 12 abcd	111 ± 28d e	77.0 ± 9.1 e	192 ± 34 a	182.5 ± 29 ab	161 ± 11 abc	124 ± 24 cde	137 ± 1 bcd	160 ± 12 abcd
C2	ethyl hexanoate	152 ± 13 a	141 ± 6 ab	129 ± 5 abcd	123 ± 6 abcd	100 ± 4 d	136 ± 22 ab	120 ± 18 bcd	131 ± 10 abc	116 ± 11 bcd	103 ± 3 cd	120 ± 15 bcd
C3	ethyl pentanoate	1.02 ± 0.13 ab	1.42 ± 0.28 abc	1.66 ± 0.17 ab	1.40 ± 0.58 abc	2.04 ± 0.37 a	1.12 ± 0.20 bc	1.07 ± 0.29 bc	1.05 ± 0.14 bc	0.88 ± 0.22 c	0.95 ± 0.11 c	1.02 ± 0.19 bc
C4	hexyl acetate	1.09 ± 0.22 ab	0.64 ± 0.03 abc	0.75 ± 0.17 abc	0.85 ± 0.20 abc	1.17 ± 0.12 a	0.49 ± 0.09 bc	0.48 ± 0.09 bc	0.47 ± 0.07 bc	0.64 ± 0.34 abc	0.41 ± 0.06 c	0.46 ± 0.02 bc
C5	octyl butyrate	0.16 ± 0.02	0.14 ± 0.02	0.15 ± 0.002	0.14 ± 0.01	0.12 ± 0.01	0.13 ± 0.01	0.13 ± 0.02	0.15 ± 0.02	0.13 ± 0.02	0.14 ± 0.01	0.12 ± 0.03
C6	ethyl octanoate	340 ± 39 a	313 ± 18 abc	292 ± 16 abc	269 ± 23 bcd	204 ± 10 d	307 ± 28 abc	290 ± 57 abc	329 ± 31 ab	269 ± 21 bcd	259 ± 0.95 cd	261 ± 16 cd
C7	octyl acetate	0.48 ± 0.01 a	0.42 ± 0.01 ab	0.39 ± 0.01 abc	0.36 ± 0.05 bc	0.39 ± 0.05 abc	0.36 ± 0.03 bc	0.37 ± 0.05 abc	0.41 ± 0.03 abc	0.34 ± 0.02 bc	0.35 ± 0.02 bc	0.30 ± 0.10 c
C8	diethyl succinate	77.0 ± 9.8 abc	74.2 ± 4.8 bc	66.3 ± 4.0 c	66.9 ± 11.3 c	41.6 ± 5.5 d	80.5 ± 10.6 abc	75.0 ± 8.7 bc	79.5 ± 8.0 abc	88.7 ± 5.5 ab	86.3 ± 9.0 abc	97.2 ± 11.4 a
C9	ethyl acetate[b]	44.7 ± 2.3 ab	40.4 ± 1.2 abc	33.3 ± 1.2 cd	29.2 ± 4.1 de	24.1 ± 0.5 e	46.8 ± 3.9 a	44.9 ± 2.2 ab	44.0 ± 1.0 ab	38.9 ± 6.3 bc	39.1 ± 1.7 bc	43.9 ± 1.7 ab
C10	isoamyl acetate	187 ± 25 de	220 ± 33 cd	312 ± 56 bc	342 ± 92 ab	413 ± 33 a	153 ± 28 de	155 ± 12d e	131 ± 18 de	119 ± 29 e	138 ± 15d e	124 ± 9 e
C11	ethyl isobutyrate	21.5 ± 0.9 cd	24.4 ± 3.3 abcd	31.0 ± 5.6 a	27.2 ± 3.8 abc	30.4 ± 5.1 ab	24.8 ± 1.8 abcd	26.1 ± 2.2 abcd	22.4 ± 3.2 bcd	18.8 ± 4.6 d	19.7 ± 0.9 cd	21.0 ± 2.6 cd
C12	isobutyl acetate	50.9 ± 12.3 ab	50.1 ± 8.2 ab	56.4 ± 11.5 a	47.3 ± 5.5 ab	45.3 ± 7.3 ab	49.4 ± 5.4 ab	53.8 ± 7.1 ab	41.4 ± 2.4 ab	36.6 ± 7.1 b	38.6 ± 5.9 ab	40.2 ± 3.4 ab
C13	ethyl isovalerate	2.72 ± 0.39 ab	3.29 ± 0.65 ab	2.76 ± 1.85 ab	3.35 ± 0.61 ab	3.64 ± 0.67 a	2.91 ± 0.37 ab	2.11 ± 1.46 bc	1.30 ± 1.51 c	2.11 ± 0.45b c	2.11 ± 0.06 bc	2.25 ± 0.17 bc
C14	ethyl phenylacetate	0.15 ± 0.03 cd	0.20 ± 0.04 bc	0.26 ± 0.03 ab	0.31 ± 0.05 a	0.28 ± 0.03 a	0.13 ± 0.01 cd	0.13 ± 0.02 d	0.13 ± 0.02 d	0.15 ± 0.003 cd	0.15 ± 0.01 cd	0.14 ± 0.03 cd
C15	phenylethyl acetate	2.88 ± 0.43 d	3.67 ± 0.73 cd	5.20 ± 1.09 bc	6.67 ± 2.01 ab	8.73 ± 1.30 a	2.60 ± 0.31 d	2.45 ± 0.32 d	2.57 ± 0.20 d	2.78 ± 0.21 d	2.64 ± 0.13 d	2.54 ± 0.34 d
	Alcohols											
C16	1-propanol[b]	23.3 ± 4.2 a	16.1 ± 1.4 bc	12.3 ± 1.7 cd	10.6 ± 2.4 cd	6.69 ± 0.83d	22.5 ± 1.5 ab	23.3 ± 2.2a	22.9 ± 3.2 ab	21.8 ± 3.4 ab	19.6 ± 1.0 ab	26.4 ± 5.7 a
C17	1-hexanol	442 ± 19 ab	409 ± 35 ab	428 ± 25 ab	435 ± 31 ab	395.3 ± 18 b	435 ± 28 ab	427 ± 25 ab	438 ± 8 ab	459 ± 9 a	421 ± 16 ab	452 ± 25 ab
C18	1-octanol	343 ± 5 ab	320 ± 21 abc	282 ± 11 cd	290 ± 43 bc	234 ± 13 d	356 ± 31 a	337 ± 31abc	349 ± 11 a	346 ± 8 a	319 ± 15 abc	338 ± 20 ab
C19	1-nonanol	5.81 ± 0.32 a	5.02 ± 0.19 ab	4.68 ± 0.67 abc	4.70 ± 0.63 abc	3.76 ± 13.0c	4.77 ± 0.35 abc	5.16 ± 0.53 ab	5.59 ± 0.26 a	4.63 ± 1.01 abc	4.23 ± 0.33 bc	4.76 ± 0.40 abc
C20	1-decanol	0.20 ± 0.10 a	0.18 ± 0.01 a	0.15 ± 0.01 bc	0.14 ± 0.02 bc	0.12 ± 0.01 c	0.17 ± 0.01ab	0.18 ± 0.02 ab	0.19 ± 0.02	0.16 ± 0.01 ab	0.16 ± 0.003 ab	0.17 ± 0.01 ab
C21	E-2-hexenol	23.4 ± 2.6 ab	22.6 ± 3.1 abc	21.7 ± 0.8 abc	19.5 ± 2.1 bc	16.8 ± 0.5 c	21.3 ± 1.1 abc	22.9 ± 1.4ab	21.3 ± 1.8 abc	23.6 ± 2.8 ab	22.1 ± 1.1 abc	26.6 ± 5.1 a
C22	E-3-hexenol	5.03 ± 1.52 a	3.24 ± 0.49 ab	2.99 ± 1.82 ab	2.57 ± 0.48 b	3.43 ± 0.37 ab	3.10 ± 0.71 ab	3.29 ± 0.69 ab	2.88 ± 1.08 ab	2.24 ± 0.90 b	3.33 ± 0.43 ab	3.45 ± 0.22 ab
C23	Z-3-hexenol	16.0 ± 1.3	13.3 ± 1.2	14.8 ± 2.6	15.8 ± 2.1	16.3 ± 2.1	14.0 ± 2.8	13.0 ± 0.5	12.3 ± 1.2	14.9 ± 1.0	15.2 ± 2.7	16.2 ± 1.5
C24	1-octen-3-ol	26.9 ± 6.6 ab	27.5 ± 2.3 a	27.0 ± 2.4 ab	26.5 ± 2.6 ab	19.4 ± 2.0b	25.0 ± 3.5ab	24.1 ± 5.0ab	25.5 ± 1.3 ab	22.0 ± 1.9a b	21.5 ± 1.0 ab	20.1 ± 2.2 ab
C25	2-ethyl-1-hexanol	4.82 ± 0.08 a	4.19 ± 0.10 ab	3.88 ± 0.13 b	3.64 ± 0.51 b	3.85 ± 0.49 b	3.61 ± 0.29 b	3.67 ± 0.53 b	4.12 ± 0.33 ab	3.36 ± 0.35 b	3.51 ± 0.18 b	3.37 ± 0.34 b
C26	isobutyl alcohol[b]	75.7 ± 7.4 bcd	73.2 ± 3.6 cd	88.4 ± 5.5 abc	90.0 ± 4.8 bc	95.2 ± 5.3 a	71.9 ± 5.1 d	77.9 ± 4.1b cd	77.6 ± 6.5 bcd	73.4 ± 11 cd	69.5 ± 1.0 d	71.4 ± 10.1 d
C27	isoamy alcohol[b]	167 ± 16 bc	169 ± 9 bc	208 ± 7 a	213 ± 19 a	203 ± 18 ab	147 ± 15 c	150 ± 8 c	147 ± 11 c	149 ± 24 c	144 ± 6 c	146 ± 21 c
C28	benzyl alcohol	167 ± 9 a	153 ± 9 ab	151 ± 4 ab	167 ± 13 a	124 ± 7 b	167 ± 20 a	163 ± 36 a	160 ± 9 ab	158 ± 10 ab	141 ± 6 ab	142 ± 10 ab
C29	phenylethyl alcohol[b]	3.11 ± 0.28 bc	3.81 ± 0.53 b	4.89 ± 0.41 a	5.42 ± 0.56 a	5.10 ± 0.42 a	2.94 ± 0.22 bc	2.72 ± 0.24 c	2.97 ± 0.16 bc	3.12 ± 0.15 bc	2.97 ± 0.20b c	2.85 ± 0.47 c
	Terpenoids											
C30	linalool	1.33 ± 0.26 ab	0.83 ± 0.23 b	1.43 ± 0.08 ab	1.56 ± 0.23 a	1.17 ± 0.21 ab	1.41 ± 0.51 ab	1.43 ± 0.31 ab	1.44 ± 0.13 ab	1.51 ± 0.24 a	1.34 ± 0.16 ab	1.44 ± 0.12 ab
C31	nerol	0.61 ± 0.19	0.82 ± 0.14	0.66 ± 0.16	0.66 ± 0.09	0.57 ± 0.12	0.57 ± 0.29	0.47 ± 0.34	0.71 ± 0.07	0.72 ± 0.10	0.66 ± 0.09	0.60 ± 0.12
C32	geraniol	1.39 ± 0.15 ab	1.50 ± 0.11 a	1.05 ± 0.12 bc	0.97 ± 0.12 c	1.10 ± 0.11 bc	1.08 ± 0.20 bc	1.22 ± 0.34 abc	1.10 ± 0.11 bc	0.90 ± 0.09 c	1.07 ± 0.11 bc	1.15 ± 0.07 abc
C33	β-citronellol	1.09 ± 0.12 cde	1.23 ± 0.11 bcd	1.38 ± 0.08 abc	1.53 ± 0.13 ab	1.59 ± 0.17 a	0.98 ± 0.10 de	1.04 ± 0.23 cde	1.06 ± 0.04 cde	1.05 ± 0.05 cde	0.82 ± 0.21 e	0.73 ± 0.50 de
C34	α-terpineol	0.23 ± 0.01 c	0.23 ± 0.03 c	0.26 ± 0.02 bc	0.30 ± 0.02 ab	0.35 ± 0.02 a	0.23 ± 0.04 c	0.22 ± 0.04 c	0.22 ± 0.01 c	0.24 ± 0.02 bc	0.24 ± 0.01 c	0.28 ± 0.04 bc

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Supplemental Table 1 *(continued)* Concentrations of volatile compounds in Pinot noir wines according to vine nutrient supply in 2012[a].

		Control	75% N	50% N	30% N	15% N	50% P	20% P	0% P	50% K	20% K	0% K
	Norisoprenoids											
C35	vitispirane	3.85 ± 0.03	3.87 ± 0.03	3.95 ± 0.01	3.91 ± 0.08	3.87 ± 0.02	3.91 ± 0.04	3.90 ± 0.02	3.86 ± 0.05	3.87 ± 0.05	3.86 ± 0.05	3.85 ± 0.01
C36	β-damascenone	3.45 ± 0.04 a	3.38 ± 0.03 ab	3.35 ± 0.02 ab	3.40 ± 0.05 ab	3.29 ± 0.04 b	3.45 ± 0.09 a	3.43 ± 0.08 a	3.40 ± 0.05 ab	3.38 ± 0.07 ab	3.37 ± 0.03 ab	3.36 ± 0.02 ab
C37	β-ionone[c]	121 ± 3	119 ± 3	119 ± 1	121 ± 3	116 ± 1	120 ± 4	117 ± 1	120 ± 1	120 ± 4	119 ± 2	121 ± 1
	Acids											
C38	hexanoic acid	561 ± 49 ab	536 ± 14 ab	462 ± 16 ab	444 ± 58b c	332 ± 18 c	561 ± 72 ab	500 ± 51 ab	550 ± 53 ab	523 ± 35 ab	511 ± 42 ab	582 ± 85 a
C39	octanoic acid	418 ± 53 a	398 ± 34 ab	383 ± 20 ab	396 ± 39 ab	289 ± 35 b	427 ± 81 a	374 ± 83 ab	417 ± 18 a	413 ± 13 a	381 ± 29 ab	406 ± 41 ab
C40	decanoic acid	68.6 ± 8.6 a	64.8 ± 6.3 ab	60.4 ± 4.3 ab	60.5 ± 6.0 ab	47.7 ± 5.8 b	62.0 ± 8.8 ab	55.7 ± 16.0 ab	62.8 ± 4.0 ab	62.8 ± 1.9 ab	60.1 ± 4.1 ab	61.6 ± 6.0 ab
	Aldehyde											
C41	acetaldehyde[b]	5.61 ± 1.38 b	5.90 ± 0.41 b	6.38 ± 0.58 ab	6.59 ± 0.77 ab	9.81 ± 1.35 a	6.41 ± 1.02 ab	5.94 ± 1.04 b	7.48 ± 0.93 ab	8.37 ± 2.94 ab	7.59 ± 0.55 ab	6.74 ± 0.71 ab
	Sulfur compounds											
C42	hydrogen sulfide	3.60 ± 0.49 b	6.24 ± 1.34 a	3.81 ± 1.32 ab	4.82 ± 1.47 ab	4.60 ± 0.89 ab	3.68 ± 1.28 b	3.45 ± 1.29 b	2.98 ± 0.75 b	2.81 ± 0.87 b	2.47 ± 0.49 b	2.35 ± 0.22 b
C43	methanethiol	1.79 ± 0.17 b	2.50 ± 0.14 a	1.65 ± 0.25 bc	1.38 ± 0.29 bc	1.06 ± 0.16 c	1.75 ± 0.30 b	1.78 ± 0.34 b	1.67 ± 0.33 b	1.48 ± 0.26 bc	1.47 ± 0.15 bc	1.39 ± 0.14 bc
C44	dimethyl sulfide	11.7 ± 0.6 ab	11.9 ± 1.7 a	9.25 ± 1.1 ab	8.75 ± 2.6 ab	ND c	11.7 ± 3.0a b	9.11 ± 1.13 ab	5.11 ± 1.12 abc	5.87 ± 1.12 abc	3.43 ± 0.95 bc	ND c
C45	methyl thioacetate	11.9 ± 3.1	18.2 ± 3.3	13.8 ± 2.6	11.1 ± 7.5	11.3 ± 1.2	12.3 ± 2.0	13.0 ± 0.5	11.4 ± 0.4	14.1 ± 5.8	13.4 ± 4.0	9.92 ± 2.69
C46	dimethyl disulfide	0.29 ± 0.11	ND	ND	ND	0.32 ± 0.07	0.10 ± 0.04	ND	ND	0.47 ± 0.16	0.14 ± 0.08	ND
C47	ethyl thioacetate	0.20 ± 0.09 ab	0.47 ± 0.17 a	0.45 ± 0.13 ab	0.17 ± 0.12 ab	0.28 ± 0.12 ab	0.23 ± 0.10 ab	0.07 ± 0.03 ab	0.19 ± 0.12 ab	0.19 ± 0.11 ab	0.45 ± 0.03 ab	ND b
	Phenols											
C48	guaiacol	41.9 ± 8.7 a	24.7 ± 3.2 b	18.8 ± 4.1 b	19.2 ± 2.6 b	18.5 ± 3.5 b	20.2 ± 4.9 b	21.7 ± 7.2 b	25.2 ± 8.6 b	23.8 ± 5.6 b	23.7 ± 8.2 b	27.2 ± 3.0 b
C49	eugenol	1.30 ± 0.24	1.38 ± 0.10	1.56 ± 0.13	1.59 ± 0.28	1.43 ± 0.43	1.49 ± 0.40	1.55 ± 0.24	1.35 ± 0.37	1.48 ± 0.33	1.49 ± 0.17	1.46 ± 0.25
C50	4-vinylguaiacol	17.2 ± 3.6	19.8 ± 2.2	28.0 ± 8.3	26.2 ± 5.4	26.2 ± 4.9	19.2 ± 3.6	25.7 ± 2.4	22.3 ± 8.6	17.4 ± 5.1	22.0 ± 6.5	22.6 ± 6.8
	Lactones											
C54	δ-decalactone	5.70 ± 0.64	8.59 ± 3.76	6.50 ± 1.22	6.00 ± 0.30	4.11 ± 0.63	6.85 ± 1.56	6.56 ± 0.54	6.73 ± 1.43	5.80 ± 1.34	7.35 ± 0.98	6.85 ± 1.41
C58	δ-dodecalactone	3.10 ± 0.31 ab	3.03 ± 0.14 ab	2.87 ± 0.19 ab	2.70 ± 0.37 ab	2.24 ± 0.38 b	3.30 ± 0.21 a	3.19 ± 0.08 a	3.48 ± 0.86 a	3.04 ± 0.29 ab	3.32 ± 0.22 a	3.17 ± 0.47 a
	Miscellaneous											
C59	vanillin	33.0 ± 7.7	23.9 ± 2.1	34.4 ± 5.6	39.0 ± 5.6	21.2 ± 4.8	38.0 ± 9.9	37.8 ± 10.7	41.9 ± 14.2	45.7 ± 25.9	43.2 ± 16.5	49.3 ± 16.1
C60	methyl vanillate	88.1 ± 9.9	86.5 ± 10.8	103 ± 21	116 ± 15	99.6 ± 25.2	103 ± 8	112 ± 9	106 ± 24	99.2 ± 28.9	120 ± 33	118 ± 25
C61	ethyl vanillate	354 ± 67 abc	302 ± 22 cd	297 ± 75 bcd	286 ± 45 bcd	150 ± 34 d	432 ± 45 abc	445 ± 77 ab	517 ± 146 a	396 ± 109 abc	411 ± 80 abc	391 ± 14 abc
C62	ethyl cinnamate	2.30 ± 0.44 c	2.44 ± 0.58 bc	2.73 ± 0.29 bc	3.31 ± 0.30 ab	3.97 ± 0.38 a	3.13 ± 0.28 abc	2.41 ± 0.33 bc	2.67 ± 0.80 abc	2.45 ± 0.11b c	2.68 ± 0.33 bc	2.61 ± 0.25 bc

[a]Values are means ± SD (µg/L unless indicated otherwise, n = 4 field replicates). Different letters within rows indicate a significant difference between treatments (analysis of variance, $p < 0.05$, post-hoc Tukey's honest significant difference).
[b]Concentrations expressed as mg/L for ethyl acetate, 1-propanol, isobutyl alcohol, isoamy alcohol, and phenethyl alcohol.
[c]Concentrations expressed as ng/L for β-ionone.

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Supplemental Table 2 Concentrations of volatile compounds in Pinot noir wines according to vine nutrient supply in 2013[a].

		Control	75% N	50% N	30% N	15% N	50% P	20% P	0% P	50% K	20% K	0% K
	Esters											
C1	ethyl butanoate	56.8 ± 11.6 a	62.7 ± 11.8 a	49.2 ± 8.74 a	28.1 ± 2.86 b	18.4 ± 2.92 b	53.6 ± 4.01 a	53.5 ± 3.21 a	52.9 ± 3.77 a	53.7 ± 5.84 a	56.8 ± 6.84 a	56.2 ± 4.63 a
C2	ethyl hexanoate	146 ± 23 a	146 ± 28 ab	114 ± 18 ab	92.5 ± 8.8 bc	69.6 ± 7.6 c	146 ± 134 a	142 ± 13 a	136 ± 22 a	136 ± 9 a	139 ± 11 a	146 ± 13 a
C3	ethyl pentanoate	0.73 ± 0.34 c	1.15 ± 0.30 abc	1.41 ± 0.17 ab	1.59 ± 0.12 a	1.35 ± 0.25 abc	0.87 ± 0.15 bc	0.76 ± 0.38 bc	0.92 ± 0.17 bc	0.83 ± 0.26 bc	0.84 ± 0.35 bc	0.92 ± 0.13 bc
C4	hexyl acetate	0.38 ± 0.07 b	0.49 ± 0.04 ab	0.49 ± 0.07 ab	1.11 ± 0.06 a	0.70 ± 0.05 ab	0.29 ± 0.07 ab	0.34 ± 0.04 ab	0.31 ± 0.06 ab	0.33 ± 0.05 ab	0.32 ± 0.01 ab	0.35 ± 0.08 ab
C5	octyl butyrate	0.12 ± 0.01 a	0.11 ± 0.02 a	0.11 ± 0.01 ab	0.09 ± 0.00 abc	0.06 ± 0.01 c	0.09 ± 0.01 abc	0.10 ± 0.01 abc	0.08 ± 0.01 bc	0.10 ± 0.01 ab	0.10 ± 0.01 ab	0.09 ± 0.02 abc
C6	ethyl octanoate	214 ± 20 a	201 ± 34 ab	146 ± 19 bc	108 ± 9c d	75.0 ± 10 d	142 ± 8 bc	133 ± 3 bc	148 ± 17 bc	164 ± 28 bc	138 ± 9b c	122 ± 7 bc
C7	octyl acetate	0.32 ± 0.02 a	0.29 ± 0.01 ab	0.27 ± 0.03 bc	0.23 ± 0.02 cd	0.23 ± 0.01 cd	0.23 ± 0.03 cd	0.23 ± 0.01 cd	0.25 ± 0.01 bcd	0.23 ± 0.02 cd	0.21 ± 0.02 de	0.16 ± 0.04 e
C8	diethyl succinate	52.8 ± 4.8 ab	50.8 ± 7.0 abc	36.9 ± 4.1 cd	23.2 ± 2.4d e	13.7 ± 4.0 e	50.7 ± 3.7 abc	47.6 ± 0.8 bc	50.5 ± 10.7 bc	66.4 ± 11.6 a	58.9 ± 6.1 ab	60.8 ± 7.1 ab
C9	ethyl acetate[b]	26.0 ± 1.6 ab	26.8 ± 1.9 ab	24.9 ± 1.4 abc	21.4 ± 0.6 cd	20.0 ± 1.1 d	28.4 ± 2.3 a	27.5 ± 0.6 ab	27.8 ± 10.2 ab	27.1 ± 1.9 ab	24.9 ± 1.3 abc	24.3 ± 1.6 bc
C10	isoamyl acetate	147 ± 28 cd	261 ± 61 ab	234 ± 31 bc	336 ± 58 a	290 ± 10 ab	129 ± 33 d	134 ± 24 d	129 ± 22 d	169 ± 29 cd	158 ± 4 cd	150 ± 56 cd
C11	ethyl isobutyrate	13.4 ± 1.4	15.7 ± 1.7	15.0 ± 1.3	14.6 ± 1.4	12.4 ± 0.8	13.1 ± 1.6	13.4 ± 1.0	14.2 ± 0.7	14.0 ± 0.7	14.9 ± 1.4	13.7 ± 2.2
C12	isobutyl acetate	23.7 ± 2.6 ab	28.5 ± 1.2 a	25.3 ± 2.5 ab	23.7 ± 1.7 ab	19.7 ± 1.0 b	20.3 ± 4.2 b	20.6 ± 4.6 b	24.0 ± 2.1 ab	22.9 ± 5.7 ab	22.3 ± 1.1 ab	18.4 ± 3.3 b
C13	ethyl isovalerate	1.70 ± 0.27 ab	2.19 ± 0.22 a	2.11 ± 0.30 ab	2.16 ± 0.25 ab	1.90 ± 0.14 ab	1.64 ± 0.13 b	1.68 ± 0.18 ab	1.76 ± 0.14 ab	1.71 ± 0.04 ab	2.07 ± 0.29 ab	1.87 ± 0.25 ab
C14	ethyl phenylacetate	0.33 ± 0.19	0.20 ± 0.06	0.20 ± 0.07	0.17 ± 0.01	0.14 ± 0.01	0.15 ± 0.04	0.16 ± 0.06	0.14 ± 0.04	0.25 ± 0.16	0.12 ± 0.01	0.16 ± 0.07
C15	phenylethyl acetate	2.37 ± 0.27 c	2.62 ± 0.26 bc	2.76 ± 0.49 bc	3.40 ± 0.50 ab	3.91 ± 0.63 a	1.38 ± 0.13 d	1.45 ± 0.19 d	1.44 ± 0.11 d	1.55 ± 0.10 d	1.54 ± 0.13 d	1.30 ± 0.11 d
	Alcohols											
C16	1-propanol[b]	18.8 ± 2.9 b	18.7 ± 4.7 b	12.7 ± 1.0 c	8.08 ± 1.1 de	4.84 ± 0.9 d	23.3 ± 3.0 ab	21.4 ± 2.0 ab	21.2 ± 2.3 ab	24.6 ± 1.1 a	19.8 ± 1.5 ab	21.5 ± 1.5 ab
C17	1-hexanol	620 ± 55 ab	644 ± 53 a	614 ± 69 ab	521 ± 39 bc	436 ± 33 c	577 ± 33 ab	616 ± 9 ab	570 ± 45 ab	621 ± 28 ab	592 ± 47 ab	584 ± 43 ab
C18	1-octanol	293 ± 30 ab	295 ± 22 ab	247 ± 14b c	203 ± 10 cd	164 ± 6 d	285 ± 9 ab	297 ± 9 ab	267 ± 14 ab	296 ± 26 ab	303 ± 39 a	299 ± 25 a
C19	1-nonanol	4.30 ± 0.42 a	4.32 ± 0.82 a	3.74 ± 0.40 ab	2.80 ± 0.29 bc	1.94 ± 0.	3.32 ± 0.39 ab	3.88 ± 0.35 ab	3.55 ± 0.50 ab	3.71 ± 0.58 ab	4.03 ± 0.38 a	3.45 ± 0.18 ab
C20	1-decanol	0.13 ± 0.02 a	0.12 ± 0.01 a	0.10 ± 0.01 b	0.07 ± 0.01 cd	0.05 ± 0.00 d	0.09 ± 0.01 bc	0.10 ± 0.01 b	0.09 ± 0.01 bc	0.10 ± 0.01 b	0.09 ± 0.02 bc	0.10 ± 0.01 b
C21	E-2-hexenol	17.1 ± 1.3 a	16.3 ± 2.4 ab	15.4 ± 2.2 abc	13.7 ± 1.3 bc	9.96 ± 0.62 d	13.1 ± 0.5 bc	13.8 ± 0.8 bc	13.1 ± 1.2 cd	13.9 ± 0.8 bc	13.6 ± 0.7 bc	15.0 ± 1.1 abc
C22	E-3-hexenol	31.7 ± 18.7	31.7 ± 9.0	30.5 ± 3.4	29.1 ± 3.7	29.9 ± 5.8	39.8 ± 5.6	39.9 ± 4.9	34.2 ± 3.6	33.3 ± 0.9	33.3 ± 1.7	34.9 ± 2.4
C23	Z-3-hexenol	99.1 ± 0.5	101 ± 2	101 ± 2	100 ± 1	99.8 ± 0.4	100 ± 2	101 ± 0.5	98.9 ± 0.8	98.6 ± 0.3	99.5 ± 1.1	100 ± 2
C24	1-octen-3-ol	45.1 ± 4.6 a	40.1 ± 7.1 a	26.5 ± 4.5 b	16.9 ± 1.8 cd	10.76 ± 1.3 d	23.8 ± 1.8 bc	21.5 ± 1.1 bc	23.9 ± 1.9 bc	26.6 ± 6.1 b	23.1 ± 1.5 bc	19.1 ± 2.2 bcd
C25	2-ethyl-1-hexanol	1.82 ± 0.28 a	0.64 ± 0.23 b	0.59 ± 0.20 b	0.64 ± 0.23 b	0.84 ± 0.21 ab	0.62 ± 0.23 b	0.40 ± 0.11 b	1.10 ± 0.25 ab	0.86 ± 0.26 ab	0.83 ± 0.25 ab	0.81 ± 0.38 ab
C26	isobutyl alcohol[b]	95.6 ± 4.7	122 ± 30	110 ± 7	113 ± 17	94.1 ± 13.2	94.9 ± 13.86	94.4 ± 7.84	104 ± 9	114 ± 20	96.1 ± 7.2	97.2 ± 14.5
C27	isoamyl alcohol[b]	224 ± 3	261 ± 31	270 ± 19	273 ± 40	237 ± 30	235 ± 16	210 ± 21	213 ± 20	267 ± 67	215 ± 28	236 ± 57
C28	benzyl alcohol	162 ± 26 a	161 ± 16 a	153 ± 13 ab	128 ± 12 abcd	105 ± 9 cd	142 ± 5 abc	136 ± 17 abcd	125 ± 30 abcd	156 ± 24 ab	117 ± 14b cd	94.0 ± 9.9 d
C29	phenylethyl alcohol[b]	3.15 ± 0.16 b	3.80 ± 0.20b c	4.14 ± 0.59 a	4.27 ± 0.25 a	3.93 ± 0.40 a	2.33 ± 0.39 d	2.36 ± 0.23 d	2.32 ± 0.15 d	2.54 ± 0.07 bc	2.74 ± 0.25 d	2.36 ± 0.07 d
	Terpenoids											
C30	linalool	0.30 ± 0.04 ab	0.32 ± 0.04 ab	0.32 ± 0.04 ab	0.40 ± 0.06 a	0.42 ± 0.06 a	0.26 ± 0.02 b	0.25 ± 0.02 b	0.24 ± 0.02 b	0.28 ± 0.06 b	0.28 ± 0.09 b	0.31 ± 0.04 ab
C31	nerol	0.35 ± 0.03 ab	0.36 ± 0.05 ab	0.35 ± 0.04 ab	0.41 ± 0.08 a	0.25 ± 0.07 b	0.26 ± 0.02 ab	0.32 ± 0.05 ab	0.26 ± 0.04 b	0.25 ± 0.10 b	0.26 ± 0.09 b	0.33 ± 0.04 ab
C32	geraniol	0.74 ± 0.10 ab	0.74 ± 0.15 ab	0.84 ± 0.11 a	0.85 ± 0.11 a	0.72 ± 0.04 bc	0.543 ± 0.03 bc	0.59 ± 0.03 bc	0.54 ± 0.05 bc	0.61 ± 0.12 bc	0.53 ± 0.09 bc	0.44 ± 0.05 c
C33	β-citronellol	0.78 ± 0.09 abc	0.90 ± 0.07 a	0.92 ± 0.18 a	0.94 ± 0.09 a	0.84 ± 0.09 ab	0.63 ± 0.05 bcd	0.55 ± 0.02 cd	0.55 ± 0.03 cd	0.49 ± 0.13 d	0.42 ± 0.13 d	0.41 ± 0.06 d
C34	α-terpineol	0.11 ± 0.02 b	0.12 ± 0.01 b	0.18 ± 0.10 ab	0.30 ± 0.13 a	0.33 ± 0.07 a	0.22 ± 0.04 ab	0.30 ± 0.07 a	0.34 ± 0.01 a	0.31 ± 0.03 a	0.24 ± 0.08 ab	0.31 ± 0.06 a

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Supplemental Data for:
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Supplemental Table 2 *(continued)* Concentrations of volatile compounds in Pinot noir wines according to vine nutrient supply in 2013[a].

		Control	75% N	50% N	30% N	15% N	50% P	20% P	0% P	50% K	20% K	0% K
	Norisoprenoids											
C35	vitispirane	3.79 ± 0.02	3.80 ± 0.001	3.79 ± 0.01	3.79 ± 0.02	3.79 ± 0.01	3.31 ± 0.94	3.78 ± 0.01	3.77 ± 0.01	3.77 ± 0.01	3.78 ± 0.01	3.32 ± 0.96
C36	β-damascenone	3.29 ± 0.03 a	3.26 ± 0.02 ab	3.21 ± 0.02 bcd	3.17 ± 0.01 de	3.14 ± 0.01 e	3.21 ± 0.01 cd	3.21 ± 0.01 bcd	3.18 ± 0.01 de	3.23 ± 0.03 bc	3.20 ± 0.01 cd	3.18 ± 0.01 de
C37	β-ionone[c]	113 ± 1 a	112 ± 1 a	111 ± 2 a	108 ± 1 b	107 ± 1 b	108 ± 1 b	108 ± 1 b	107 ± 1 b	108 ± 1 b	107 ± 1 b	106 ± 0 b
	Acids											
C38	hexanoic acid	194 ± 34	225 ± 81	244 ± 25	197 ± 22	122 ± 32	178 ± 73	131 ± 45	136 ± 83	238 ± 69	173 ± 40	247 ± 55
C39	octanoic acid	282 ± 53 a	270 ± 45 ab	199 ± 20 cde	169 ± 15 de	133 ± 14 e	211 ± 28 bcd	236 ± 14 abcd	184 ± 13 cde	230 ± 17 abcd	216 ± 30 abcd	246 ± 29 abc
C40	decanoic acid	36.5 ± 6.2 abc	30.4 ± 7.6 bcd	19.6 ± 1.7 d	19.9 ± 2.5 d	18.9 ± 2.4 d	23.0 ± 3.7 cd	28.8 ± 2.3 bcd	32.7 ± 7.0 abcd	46.2 ± 7.2 a	40.0 ± 9.9 ab	41.9 ± 4.9 ab
	Aldehyde											
C41	acetaldehyde[b]	7.04 ± 1.01 abc	5.24 ± 0.28 abc	5.31 ± 1.44 abc	3.93 ± 0.15 cd	2.70 ± 0.27 c	7.26 ± 1.28 a	9.73 ± 2.77 ab	8.48 ± 2.16 abc	3.86 ± 1.80 cd	2.69 ± 0.74 c	3.81 ± 1.51 cd
	Sulfur compounds											
C45	methyl thioacetate	4.83 ± 0.63 bc	5.49 ± 1.27 a	5.09 ± 0.44 ab	4.90 ± 0.34 ab	4.17 ± 0.63 abc	2.47 ± 0.51 c	3.55 ± 0.66 abc	3.67 ± 1.04 abc	3.70 ± 1.00 abc	5.21 ± 0.59 a	4.12 ± 1.32 abc
	Phenols											
C49	eugenol	2.42 ± 0.22	2.32 ± 0.32	1.88 ± 0.36	2.07 ± 0.24	1.94 ± 0.43	2.44 ± 0.62	2.26 ± 0.17	2.39 ± 0.07	2.50 ± 0.45	2.21 ± 0.15	1.97 ± 0.38
C48	guaiacol	6.69 ± 1.22	7.36 ± 2.25	5.37 ± 1.84	5.88 ± 0.73	7.12 ± 2.38	3.43 ± 2.17	7.21 ± 1.12	4.96 ± 0.61	8.16 ± 2.18	6.60 ± 0.53	5.03 ± 1.78
C51	4-methylguaiacol	1.11 ± 0.63 ab	2.02 ± 0.84 a	1.29 ± 1.12 ab	1.65 ± 0.43 ab	0.64 ± 0.28 b	1.11 ± 0.50 ab	0.86 ± 0.16 ab	0.59 ± 0.09 b	0.84 ± 0.21 ab	0.83 ± 0.35 ab	0.88 ± 0.06 ab
C50	4-vinylguaiacol	8.31 ± 2.03 bc	10.7 ± 2.52 abc	7.80 ± 1.62 c	8.24 ± 1.64 bc	13.9 ± 2.3 a	10.4 ± 3.7 abc	12.0 ± 1.3 abc	8.08 ± 0.68 bc	13.3 ± 2.9 ab	10.7 ± 2.2 abc	8.82 ± 0.38 abc
	Lactones											
C52	whiskylactone	0.91 ± 0.07 a	0.70 ± 0.09 ab	0.63 ± 0.03 ab	0.44 ± 0.13 bc	0.35 ± 0.09 c	0.85 ± 0.24 a	0.69 ± 0.10 ab	0.80 ± 0.11 a	0.75 ± 0.23 ab	0.80 ± 0.09 ab	0.69 ± 0.22 ab
C53	γ-decalactone	1.80 ± 0.62	1.13 ± 0.13	1.00 ± 0.21	0.75 ± 0.17	0.94 ± 0.12	1.08 ± 0.07	1.66 ± 0.67	1.52 ± 0.66	1.67 ± 0.66	2.47 ± 1.31	2.37 ± 1.01
C54	δ-decalactone	7.28 ± 0.88 abcd	7.11 ± 1.33 abcd	5.91 ± 0.52 cde	4.61 ± 0.93 de	3.83 ± 0.41 e	6.55 ± 0.68 bcde	8.78 ± 1.12 abc	9.48 ± 1.65 a	9.20 ± 1.93 ab	7.26 ± 0.74 abcd	7.23 ± 1.76 abcd
C55	γ-undecalactone	0.33 ± 0.06	0.28 ± 0.09	0.28 ± 0.06	0.21 ± 0.06	0.31 ± 0.06	0.22 ± 0.06	0.30 ± 0.12	0.31 ± 0.16	0.30 ± 0.15	0.23 ± 0.06	0.28 ± 0.02
C56	δ-undecalactone	0.42 ± 0.02 a	0.37 ± 0.05 ab	0.30 ± 0.03 bc	0.23 ± 0.06 cde	0.19 ± 0.04 de	0.28 ± 0.05 bcd	0.23 ± 0.04 bcd	0.17 ± 0.03e	0.19 ± 0.04 de	0.15 ± 0.04 e	0.10 ± 0.01 e
C57	γ-dodecalactone	0.18 ± 0.05	0.10 ± 0.02	0.14 ± 0.03	0.09 ± 0.04	0.15 ± 0.07	0.11 ± 0.04	0.11 ± 0.02	0.12 ± 0.02	0.10 ± 0.02	0.12 ± 0.02	0.13 ± 0.03
C58	δ-dodecalactone	2.39 ± 0.31	1.90 ± 0.64	1.80 ± 0.56	2.36 ± 0.77	2.62 ± 0.80	2.48 ± 0.99	3.30 ± 0.56	3.24 ± 0.21	3.32 ± 0.66	2.86 ± 0.55	3.11 ± 0.04
	Miscellaneous											
C60	methyl vanillate	41.1 ± 7.5 d	45.4 ± 5.9 cd	36.5 ± 4.5 d	40.6 ± 11.3 d	51.6 ± 6.5 bcd	53.0 ± 4.9 abcd	65.9 ± 7.0 ab	61.1 ± 7.2 abc	66.6 ± 7.4 ab	69.9 ± 9.5 a	66.4 ± 1.1 ab
C61	ethyl vanillate	162 ± 29 abc	135 ± 32 bc	135 ± 14b c	136 ± 26 bc	87.0 ± 6.2 c	192 ± 34 abc	228 ± 53 ab	233 ± 65 ab	251 ± 65 a	147 ± 27 abc	181 ± 0.4 abc
C62	methyl cinnamate	0.14 ± 0.01 a	0.14 ± 0.03 a	0.13 ± 0.02 a	0.09 ± 0.01 b	0.09 ± 0.01 b	0.12 ± 0.01 ab	0.11 ± 0.01 ab	0.12 ± 0.01 ab	0.12 ± 0.01 ab	0.12 ± 0.01 ab	0.13 ± 0.01 a
C63	ethyl cinnamate	2.67 ± 0.18 abc	2.96 ± 0.47 ab	3.10 ± 0.43 a	2.44 ± 0.18 abc	2.94 ± 0.28 ab	2.35 ± 0.21 abc	2.10 ± 0.19 c	2.36 ± 0.16 abc	2.15 ± 0.39 cd	2.41 ± 0.42 abc	2.51 ± 0.54 abc

[a]Values are means ± SD (µg/L unless indicated otherwise, n = 4 field replicates). Different letters within rows indicate a significant difference between treatments (analysis of variance, $p < 0.05$, post-hoc Tukey's honest significant difference).
[b]Concentrations expressed as mg/L for ethyl acetate, 1-propanol, isobutyl alcohol, isoamy alcohol, and phenethyl alcohol.
[c]Concentrations expressed as ng/L for β-ionone.

Supplemental Data for:

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Supplemental Table 3 Concentrations of volatile compounds in Pinot noir wines according to vine nutrient supply in 2014[a].

		Control	75% N	50% N	30% N	15% N	50% P	20% P	0% P	50% K	20% K	0% K
	Esters											
C1	ethyl butanoate	133 ± 44 a	72.4 ± 6.1 bc	41.7 ± 13.6 c	32.6 ± 16.1 c	21.2 ± 8.4 c	99.9 ± 19.5 ab	71.5 ± 19.7 bc	59.7 ± 10.5 bc	63.3 ± 13.3 bc	61.9 ± 19.5 bc	43.9 ± 5.8 c
C2	ethyl hexanoate	120 ± 4a b	121 ± 12 ab	94.5 ± 11.4 bcd	87.7 ± 10.4 cd	72.5 ± 14.4 d	127 ± 16 a	108 ± 9 abc	104 ± 10 abc	97.6 ± 17.2 bcd	102 ± 6 abc	101 ± 7 abcd
C3	ethyl pentanoate	0.65 ± 0.40	0.63 ± 0.26	0.72 ± 0.22	0.97 ± 0.36	0.50 ± 0.14	0.39 ± 0.16	0.59 ± 0.20	0.37 ± 0.11	0.40 ± 0.12	0.76 ± 0.19	0.57 ± 0.14
C4	hexyl acetate	0.81 ± 0.29 ab	0.50 ± 0.13 b	0.57 ± 0.05 b	0.69 ± 0.05 ab	1.04 ± 0.42 a	0.54 ± 0.07 b	0.61 ± 0.12 b	0.53 ± 0.07 b	0.51 ± 0.14 b	0.54 ± 0.08 b	0.44 ± 0.08 b
C5	octyl butyrate	0.31 ± 0.05 ab	0.32 ± 0.12 ab	0.26 ± 0.07 ab	0.23 ± 0.03 ab	0.27 ± 0.10 ab	0.49 ± 0.33 a	0.29 ± 0.04 ab	0.28 ± 0.03 ab	0.23 ± 0.03 ab	0.23 ± 0.03 ab	0.12 ± 0.02 b
C6	ethyl octanoate	162 ± 24b c	218 ± 11 a	145 ± 26 cd	102 ± 15d e	78.8 ± 13.1 e	197 ± 30 ab	164 ± 12 bc	163 ± 16 bc	133 ± 11 cd	136 ± 8 cd	109 ± 11d e
C7	octyl acetate	0.61 ± 0.12 a	0.61 ± 0.07 a	0.55 ± 0.07 ab	0.47 ± 0.07 abc	0.45 ± 0.06 bc	0.51 ± 0.07 ab	0.53 ± 0.03 ab	0.47 ± 0.03 abc	0.43 ± 0.02 bc	0.42 ± 0.05 bc	0.33 ± 0.04 c
C8	diethyl succinate	97.0 ± 16.8 ab	90.5 ± 10.2 ab	64.2 ± 16.3 c	35.9 ± 5.9 d	28.0 ± 2.7 d	103 ± 14 a	82.3 ± 7.9 abc	75.2 ± 7.3 bc	90.4 ± 10.9 ab	91.0 ± 5.2 ab	91.8 ± 3.2 ab
C9	ethyl acetate[b]	66.2 ± 4.9 a	66.6 ± 5.0 a	50.6 ± 4.5 b	48.7 ± 1.1 b	49.0 ± 2.7 b	76.9 ± 6.4 a	71.1 ± 5.6 a	72.9 ± 5.3 a	68.0 ± 9.1 a	67.4 ± 4.3 a	70.6 ± 9.4 a
C10	isoamyl acetate	254 ± 47 d	336 ± 24b c	399 ± 49 b	405 ± 26 b	515 ± 42 a	230 ± 37 d	227 ± 28 d	236 ± 10 d	247 ± 21 d	282 ± 32 cd	239 ± 29 d
C11	ethyl isobutyrate	13.7 ± 4.1 ab	13.4 ± 1.7 ab	14.0 ± 0.9 ab	17.7 ± 5.9 ab	23.7 ± 11.3 a	18.6 ± 4.9 ab	15.1 ± 4.0 ab	11.9 ± 1.5 ab	11.4 ± 1.7 b	15.5 ± 5.7 ab	13.2 ± 1.4 ab
C12	isobutyl acetate	12.2 ± 1.0 c	17.6 ± 2.4 abc	16.2 ± 2.9 abc	28.5 ± 13.7 a	27.9 ± 8.8 ab	22.2 ± 7.6 abc	19.7 ± 5.4 abc	16.5 ± 1.5 abc	13.1 ± 0.7 bc	14.7 ± 3.4 abc	13.1 ± 0.7 c
C13	ethyl isovalerate	2.97 ± 0.45	2.07 ± 0.16	2.01 ± 0.32	2.79 ± 0.99	2.15 ± 1.00	2.25 ± 0.63	2.21 ± 1.00	1.85 ± 0.09	1.31 ± 0.35	2.32 ± 0.42	1.95 ± 0.09
C14	ethyl phenylacetate	0.21 ± 0.02 bcd	0.28 ± 0.06 abc	0.33 ± 0.03 a	0.31 ± 0.07 ab	0.30 ± 0.06 ab	0.21 ± 0.01 bcd	0.18 ± 0.04 cd	0.17 ± 0.03 d	0.19 ± 0.05 cd	0.17 ± 0.03 d	0.15 ± 0.03 d
C15	phenylethyl acetate	3.71 ± 0.07 bcd	4.40 ± 0.64 bc	4.84 ± 0.72 bc	5.86 ± 1.94 ab	8.36 ± 2.59 a	3.38 ± 0.23 bcd	2.53 ± 0.79 cd	2.54 ± 0.29 cd	2.52 ± 0.72 cd	2.52 ± 0.25 cd	1.62 ± 0.23 d
	Alcohols											
C16	1-propanol[b]	61.6 ± 8.3 a	37.9 ± 4.4 bc	27.8 ± 4.3 cd	19.0 ± 1.5 d	14.9 ± 2.1 d	53.0 ± 7.2 a	54.6 ± 5.8 a	51.4 ± 4.2 a	56.2 ± 8.9 a	50.0 ± 4.3 ab	57.9 ± 1.4 a
C17	1-hexanol	769 ± 204	506 ± 40	603 ± 93	631 ± 135	555 ± 150	746 ± 120	766 ± 172	703 ± 36	693 ± 77	684 ± 117	632 ± 37
C18	1-octanol	413 ± 49 a	434 ± 13 a	366 ± 34 a	275 ± 20 b	245 ± 9 b	417 ± 44 a	425 ± 26 a	416 ± 26 a	406 ± 29 a	364 ± 23 a	375 ± 25 a
C19	1-nonanol	7.75 ± 0.58 a	6.18 ± 0.75 bc	5.01 ± 0.35 cd	3.56 ± 0.30 e	2.78 ± 0.29 e	5.79 ± 0.48 bc	7.14 ± 0.32 ab	6.68 ± 0.56 ab	6.10 ± 1.17 bc	4.18 ± 0.51 de	3.61 ± 0.37 de
C20	1-decanol	0.55 ± 0.15 a	0.52 ± 0.03 ab	0.45 ± 0.08 abcd	0.29 ± 0.05 df	0.29 ± 0.06 df	0.45 ± 0.05 abc	0.38 ± 0.05 bcde	0.40 ± 0.03 bcde	0.32 ± 0.06 cdef	0.30 ± 0.02 def	0.21 ± 0.01 f
C21	E-2-hexenol	22.4 ± 3.2	20.5 ± 4.7	21.5 ± 4.6	23.1 ± 4.4	20.7 ± 3.0	28.9 ± 2.9	25.1 ± 4.1	27.1 ± 1.2	21.5 ± 2.5	24.2 ± 3.3	25.4 ± 4.5
C22	E-3-hexenol	4.67 ± 0.47 cd	8.43 ± 0.11 ab	5.79 ± 0.66 bcd	4.74 ± 2.29 cd	9.97 ± 0.78 a	7.31 ± 1.13 abc	6.70 ± 0.08 abcd	4.53 ± 1.06 cd	3.40 ± 1.68 d	5.16 ± 1.20 bcd	6.80 ± 0.85 abcd
C23	Z-3-hexenol	107 ± 11 a	95 ± 3 ab	90 ± 2 b	99 ± 8 ab	100 ± 12 ab	101 ± 4 ab	93.7 ± 2.2 ab	90.4 ± 2.3 b	90.3 ± 6.7 b	100 ± 5 ab	98.6 ± 3.4 ab
C24	1-octen-3-ol	19.7 ± 2.3 cde	30.2 ± 1.5 a	25.8 ± 4.0 abc	18.1 ± 2.5d e	13.5 ± 2.7 e	26.9 ± 2.7 ab	22.6 ± 1.3 bcd	21.4 ± 0.6 bcd	18.7 ± 0.4d e	19.5 ± 2.7 cde	14.7 ± 4.3 e
C25	2-ethyl-1-hexanol	2.25 ± 0.52 a	1.81 ± 0.69 ab	1.44 ± 0.11 ab	1.22 ± 0.48 b	1.23 ± 0.09 b	1.12 ± 0.15 b	1.18 ± 0.13 b	1.17 ± 0.23 b	1.29 ± 0.10 ab	1.15 ± 0.08 b	1.14 ± 0.07 b
C26	isobutyl alcohol[b]	104 ± 2 f	155 ± 15 bcd	193 ± 12 a	179 ± 9 ab	175 ± 12 abc	126 ± 9 ef	144 ± 6d e	153 ± 10c d	144 ± 15 de	137 ± 5 de	106 ± 5 f
C27	isoamyl alcohol[b]	223 ± 8 d	314 ± 32 abc	345 ± 21 a	329 ± 9 ab	349 ± 22 a	241 ± 15 de	248 ± 6d e	242 ± 15d e	296 ± 36 bc	275 ± 16 cd	231 ± 11 de
C28	benzyl alcohol	290 ± 38 a	187 ± 9 bc	148 ± 32 cde	130 ± 15 def	108 ± 27 ef	211 ± 8 b	217 ± 22 b	226 ± 5 b	181 ± 34 bcd	117 ± 13 ef	76.8 ± 6.8 f
C29	phenylethyl alcohol[b]	3.30 ± 0.18 cd	4.98 ± 0.88 ab	5.85 ± 0.44 a	5.81 ± 1.12 a	5.84 ± 1.19 a	3.71 ± 0.33 bc	3.31 ± 0.24 cd	3.00 ± 0.40 cd	3.12 ± 0.85 cd	2.95 ± 0.25 cd	1.80 ± 0.10 d
	Terpenoids											
C30	linalool	0.68 ± 0.25 ab	0.83 ± 0.11 ab	0.84 ± 0.04 ab	0.87 ± 0.05 a	0.93 ± 0.04 a	0.62 ± 0.02 abc	0.50 ± 0.23 bcd	0.20 ± 0.09 d	0.27 ± 0.05 cd	0.30 ± 0.06 cd	0.25 ± 0.06 d
C31	nerol	0.75 ± 0.11 ab	0.96 ± 0.28 a	0.40 ± 0.18 b	0.41 ± 0.14 b	0.64 ± 0.26 ab	0.55 ± 0.23 ab	0.44 ± 0.17 b	0.64 ± 0.19 ab	0.53 ± 0.17 ab	0.26 ± 0.11 bc	0.20 ± 0.05 c
C32	geraniol	0.68 ± 0.19	1.13 ± 0.71	0.86 ± 0.39	0.86 ± 0.35	0.56 ± 0.09	0.71 ± 0.22	0.48 ± 0.03	0.49 ± 0.09	0.40 ± 0.07	0.42 ± 0.08	0.59 ± 0.32
C33	β-citronellol	1.22 ± 0.36 a	1.44 ± 0.18 a	1.42 ± 0.32 a	1.32 ± 0.26 a	1.43 ± 0.27 a	1.09 ± 0.11 ab	1.04 ± 0.06 ab	1.13 ± 0.09 ab	0.92 ± 0.19 abc	0.60 ± 0.21 bc	0.38 ± 0.12 c
C34	α-terpineol	0.23 ± 0.03 bcde	0.27 ± 0.03 bcd	0.27 ± 0.02 abc	0.29 ± 0.03 ab	0.32 ± 0.04 a	0.21 ± 0.03 bcde	0.18 ± 0.02 e	0.20 ± 0.04 cde	0.18 ± 0.04 e	0.19 ± 0.03 de	0.18 ± 0.03 e

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Supplemental Table 3 *(continued)* Concentrations of volatile compounds in Pinot noir wines according to vine nutrient supply in 2014.

		Control	75% N	50% N	30% N	15% N	50% P	20% P	0% P	50% K	20% K	0% K
	Norisoprenoids											
C35	vitispirane	3.93 ± 0.05 e	3.95 ± 0.01 de	4.00 ± 0.02 bcde	4.09 ± 0.002 bc	4.07 ± 0.07 bcd	3.98 ± 0.03 cde	3.94 ± 0.02 e	4.01 ± 0.04 bcde	3.93 ± 0.02 e	4.11 ± 0.09 ab	4.22 ± 0.06 a
C36	β-damascenone	3.74 ± 0.20 abc	3.84 ± 0.14 a	3.74 ± 0.12 abc	3.55 ± 0.13 abc	3.41 ± 0.10 cd	3.75 ± 0.08 ab	3.69 ± 0.09 abc	3.59 ± 0.17 abc	3.59 ± 0.18 abc	3.49 ± 0.11 bcd	3.20 ± 0.11 d
C37	β-ionone[c]	131 ± 11 a	132 ± 2 a	132 ± 10 a	123 ± 4 ab	120 ± 5 ab	130 ± 2 a	128 ± 5 ab	130 ± 3a	121 ± 6 ab	118 ± 4 ab	113 ± 3 b
	Acids											
C38	hexanoic acid	264 ± 96 b	481 ± 41 a	392 ± 125 ab	254 ± 34 b	250 ± 43 b	435 ± 157 ab	362 ± 82 ab	390 ± 33 ab	345 ± 43 ab	341 ± 36 ab	344 ± 31a b
C39	octanoic acid	379 ± 52 abc	442 ± 53 ab	315 ± 114 bcd	266 ± 63 cd	193 ± 37 d	504 ± 69 a	345 ± 35 bc	344 ± 66 bc	278 ± 47 cd	292 ± 39 cd	234 ± 15 cd
C40	decanoic acid	60.2 ± 9.3 abc	66.6 ± 6.5 ab	52.1 ± 19.3 abcd	48.6 ± 11.8 abcd	31.6 ± 6.3 d	69.7 ± 12.3 a	45.4 ± 7.2 abcd	48.1 ± 10.7 abcd	38.0 ± 8.1 cd	42.7 ± 5.3b cd	34.1 ± 2.3 d
	Aldehyde											
C41	Acetaldehyde[b]	0.64 ± 0.44 b	0.99 ± 0.31 b	1.52 ± 0.58 b	1.20 ± 0.50 b	4.63 ± 1.94 a	0.68 ± 0.11 b	0.87 ± 0.30 b	1.04 ± 0.25 b	0.87 ± 0.33 b	1.36 ± 0.60 b	2.39 ± 1.06 b
	Sulfur compounds											
C43	methanethiol	3.00 ± 0.20 a	2.20 ± 0.34 ab	1.46 ± 0.11 ab	1.30 ± 0.20 ab	1.05 ± 0.01 b	2.72 ± 0.24 ab	2.29 ± 0.37 ab	3.00 ± 0.89 a	3.10 ± 1.25 a	2.45 ± 1.07 ab	2.11 ± 0.28 ab
C44	dimethyl sulfide	39.3 ± 4.2 a	29.9 ± 3.2 ab	25.4 ± 3.2 bc	19.1 ± 2.1 cd	13.2 ± 2.3 d	31.6 ± 2.4 ab	32.2 ± 5.0 ab	39.1 ± 9.4 a	30.9 ± 5.0 ab	30.4 ± 1.9 ab	29.3 ± 1.1a bc
C45	methyl thioacetate	4.72 ± 1.38 a	4.88 ± 0.19 a	2.15 ± 0.44 b	NDc	NDc	4.88 ± 1.14 a	3.35 ± 0.57 ab	3.15 ± 0.94 ab	3.69 ± 0.73 ab	2.74 ± 0.66 b	2.45 ± 0.33 b
	Phenols											
C48	guaiacol	19.1 ± 6.5 a	19.6 ± 5.9 a	17.6 ± 6.6 ab	19.2 ± 7.3 a	10.8 ± 4.4 ab	13.0 ± 4.3 ab	19.0 ± 7.6a	14.9 ± 4.2 ab	14.1 ± 2.6 ab	10.6 ± 2.0 ab	5.95 ± 2.98 b
C49	eugenol	5.98 ± 0.67	6.44 ± 1.06	6.58 ± 1.94	7.21 ± 2.01	5.87 ± 1.45	8.17 ± 1.60	6.45 ± 0.84	7.60 ± 0.83	7.64 ± 0.89	6.67 ± 0.39	5.14 ± 1.66
C50	4-vinylguaiacol	26.0 ± 7.4 b	40.2 ± 5.0 ab	47.0 ± 16.9 ab	58.3 ± 17.8 a	45.8 ± 19.0 ab	41.0 ± 9.7 ab	42.9 ± 13.0 ab	33.9 ± 8.1 ab	42.2 ± 10.6 ab	30.3 ± 5.8 ab	18.3 ± 7.7 b
	Lactones											
C53	γ-decalactone	1.05 ± 0.11	1.08 ± 0.11	1.23 ± 0.29	1.12 ± 0.22	0.99 ± 0.34	1.12 ± 0.20	1.14 ± 0.02	1.08 ± 0.19	1.29 ± 0.18	1.42 ± 0.28	1.12 ± 0.45
C54	δ-decalactone	9.73 ± 2.35 a	8.87 ± 0.40 ab	6.48 ± 0.98 bbc	5.24 ± 1.28 cd	4.16 ± 0.33 cdef	2.78 ± 0.58 def	2.05 ± 0.63 efg	1.58 ± 0.62 fg	1.67 ± 0.29 fg	4.41 ± 2.00 cde	ND g
C55	γ-undecalactone	2.37 ± 0.19 ab	3.09 ± 0.27 a	2.41 ± 0.48 ab	2.08 ± 0.24 ab	0.91 ± 0.44 c	2.46 ± 0.11 ab	1.47 ± 0.85 bc	1.97 ± 0.17 bc	1.83 ± 0.21 bc	1.85 ± 0.19 bc	1.83 ± 0.11 bc
C56	δ-undecalactone	0.28 ± 0.10 b	0.26 ± 0.12 b	0.19 ± 0.10 b	0.18 ± 0.03 b	0.16 ± 0.06 b	0.38 ± 0.12 ab	0.33 ± 0.13 b	0.26 ± 0.13 b	0.33 ± 0.13 b	0.29 ± 0.07 b	0.67 ± 0.22 a
C57	γ-dodecalactone	0.13 ± 0.01	0.13 ± 0.02	0.15 ± 0.03	0.18 ± 0.05	0.17 ± 0.05	0.37 ± 0.12	0.21 ± 0.08	0.11 ± 0.01	0.44 ± 0.17	0.13 ± 0.02	0.11 ± 0.02
C58	δ-dodecalactone	3.89 ± 0.86 a	3.24 ± 0.33 ab	2.93 ± 0.92 ab	2.40 ± 0.49 ab	2.16 ± 0.58 b	3.52 ± 0.55 ab	3.17 ± 0.77 ab	2.72 ± 0.74 ab	3.00 ± 0.73 ab	3.09 ± 0.19 ab	2.68 ± 0.66 ab
	Miscellaneous											
C60	methyl vanillate	56.2 ± 11.6	57.2 ± 12.4	58.8 ± 18.4	75.5 ± 28.0	60.4 ± 22.6	54.4 ± 15.9	67.4 ± 17.2	64.1 ± 13.3	60.7 ± 16.5	48.5 ± 14.5	36.5 ± 10.6
C61	ethyl vanillate	302 ± 60 ab	266 ± 18 abc	237 ± 50 abc	194 ± 55 bcd	122 ± 36 de	268 ± 57 abc	323 ± 33 a	289 ± 58 abc	254 ± 60 abc	177 ± 22 cde	77.0 ± 27.5 e
C62	ethyl cinnamate	0.96 ± 0.17 ab	1.27 ± 0.22 ab	1.28 ± 0.46 ab	1.52 ± 0.36 ab	1.59 ± 0.79 a	1.00 ± 0.31 ab	0.67 ± 0.09 b	0.69 ± 0.14 b	1.14 ± 0.25 ab	0.94 ± 0.09 ab	1.04 ± 0.42 ab

[a]Values are means ± SD (µg/L unless indicated otherwise, n = 4 field replicates). Different letters within rows indicate a significant difference between treatments (analysis of variance, $p < 0.05$, post-hoc Tukey's honest significant difference).
[b]Concentrations expressed as mg/L for ethyl acetate, 1-propanol, isobutyl alcohol, isoamy alcohol, and phenethyl alcohol.
[c]Concentrations expressed as ng/L for β-ionone

Supplemental Data for:

Yuan F, Schreiner RP, Osborne J and Qian MC. 2018. Effects of soil NPK supply on Pinot noir wine phenolics and aroma composition. Am J Enol Vitic 69:371-385. doi: 10.5344/ajev.2018.17077.

Supplemental Table 4 Total C13-norisoprenoids in wine according to vine nutrient supply.[a]

		Control	75% N	50% N	30% N	15% N	50% P	20% P	0% P	50% K	20% K	0% K
2012	Vitispirane	17.4 ± 1.7 ab	18.7 ± 1.1 ab	19.8 ± 1.6 ab	18.0 ± 1.3 ab	20.6 ± 2.3 a	16.0 ± 0.9 b	18.1 ± 1.7 ab	15.9 ± 2.2 b	16.5 ± 2.1 ab	17.8 ± 2.1 ab	16.6 ± 2.6 ab
	TDN	11.7 ± 0.5 bcd	11.8 ± 0.5 bcd	12.6 ± 0.4 b	12.3 ± 1.0b c	14.9 ± 0.9 a	9.70 ± 0.32 e	10.4 ± 0.6 cde	10.7 ± 0.4 bcde	10.2 ± 0.7 de	11.4 ± 1.6 bcde	11.8 ± 1.1 bcd
	β-Damascenone	6.30 ± 0.29 a	6.12 ± 0.23 ab	5.76 ± 0.12 bc	5.53 ± 0.17 cd	5.12 ± 0.09 d	5.95 ± 0.19 abc	6.04 ± 0.18 abc	5.91 ± 0.39 abc	5.66 ± 0.10 bc	5.70 ± 0.23 bc	5.62 ± 0.16 bcd
	β-Ionone[b]	29.6 ± 1.9	27.4 ± 3.6	28.9 ± 1.1	27.2 ± 1.6	24.8 ± 1.2	24.3 ± 2.4	24.7 ± 2.5	25.5 ± 2.7	26.0 ± 2.9	27.7 ± 4.2	30.4 ± 2.7
2013	Vitispirane	10.8 ± 0.8 ab	12.2 ± 0.9 a	12.1 ± 0.8 a	10.7 ± 3.0 ab	10.5 ± 2.3 ab	10.7 ± 0.6 ab	10.4 ± 0.7 ab	11.2 ± 1.3 ab	9.92 ± 1.5 ab	10.4 ± 0.9 ab	8.36 ± 1.9 b
	TDN	7.19 ± 0.46	6.37 ± 0.79	6.85 ± 0.39	6.78 ± 0.99	6.70 ± 1.08	6.25 ± 0.35	6.11 ± 0.34	6.15 ± 0.31	5.95 ± 0.56	7.27 ± 0.85	7.50 ± 0.74
	β-Damascenone	4.31 ± 0.18 ab	4.45 ± 0.42 a	4.24 ± 0.10 abc	3.93 ± 0.09 bcd	3.73 ± 0.10 d	4.18 ± 0.06 abc	4.19 ± 0.08 abc	4.10 ± 0.10 abcd	4.25 ± 0.17 abc	4.05 ± 0.05 abcd	3.88 ± 0.20 cd
	β-Ionone[b]	9.37 ± 1.52 a	8.16 ± 0.78 ab	8.54 ± 0.36 ab	6.47 ± 0.84 b	6.86 ± 0.96 b	8.21 ± 1.00 ab	7.37 ± 0.41 ab	7.89 ± 0.80 ab	7.87 ± 0.82 ab	7.55 ± 0.68 ab	7.57 ± 0.62 ab
2014	Vitispirane	22.1 ± 4.2 ab	21.4 ± 1.7 ab	23.3 ± 1.9 a	23.2 ± 2.9 a	20.6 ± 3.3 abc	19.7 ± 3.3 abc	19.2 ± 3.7 abc	20.4 ± 3.5 abc	16.1 ± 1.6 bc	14.2 ± 1.6 cd	8.69 ± 1.21 d
	TDN	14.5 ± 2.0 ab	13.4 ± 1.4 ab	15.8 ± 2.2 a	15.1 ± 0.7 ab	15.2 ± 1.4 ab	12.1 ± 1.9 ab	10.2 ± 1.8 b	10.4 ± 1.0 b	10.4 ± 1.1 b	14.3 ± 4.4 ab	11.8 ± 2.7 ab
	β-Damascenone	7.61 ± 0.49 a	7.14 ± 0.50 ab	7.11 ± 0.47 ab	5.50 ± 0.13 de	4.76 ± 0.27 e	6.90 ± 0.69 abc	6.43 ± 0.64 abcd	5.96 ± 0.74 bcde	5.81 ± 0.42 cde	5.74 ± 0.58 cde	5.20 ± 0.40 de
	β-Ionone[b]	24.6 ± 7.0 ab	26.2 ± 5.9 ab	31.2 ± 3.3 a	20.9 ± 0.7 ab	17.5 ± 3.4 b	27.1 ± 2.7 ab	25.7 ± 5.8 ab	23.7 ± 4.9 ab	21.6 ± 6.5 ab	23.8 ± 4.0 ab	20.9 ± 2.4 ab

[a]Values are means ± SD (µg/L unless indicated otherwise, n = 4 field replicates).
[b]Concentration expressed as ng/L. Different letters within rows indicate a significant difference between treatments (analysis of variance, $p < 0.05$, post-hoc Tukey's honest significant difference).