FINAL Report 2012 for OWB Project: 'Determining optimal levels of N, P, and K for Pinot noir based on vine growth, physiology, and fruit quality.'

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Summary:
The application of different rates of nitrogen (N), phosphorus (P), or potassium (K) supply provided to Pinot noir grapevines (Pommard scion on 101-14 rootstock) grown in a pot-in-pot system began in 2012 in four-year-old vines. The following treatments were applied to 4 replicate blocks of 5 vines each throughout the 2012 growing season; Complete Nutrition Control (100%N,P,K), 75%N, 50%N, 30%N, 15%N, 50%P, 20%P, 0%P, 50%K, 20%K, and 0%K. Only a single nutrient was manipulated within each treatment, while all other nutrients (including micronutrients) were held constant at 100% of Control. Data collected thus far for the 2012 season included periodic measures of soil moisture, shoot growth, leaf area, gas exchange, cluster solar exposure, leaf water potential, leaf SPAD, and leaf and petiole nutrients. We also collected data on flowering, fruit set, seed number and weight, yield, and juice sugars, pH and TA. Small scale ferments on all experimental replicates (n=44) were conducted and wines have been stabilized and bottled. Analysis yet to be completed will include berry chemistry profiles (amino acids, anthocyanins, various phenolic classes) and aroma profiles (C6 compounds, terpenes, norisoprenoids). Similar phenolic and aroma profiles will also be examined in wine samples. Results for 2012 have generally shown significant differences occurring in the lowest N supply vines (15%N), although véraison leaf and/or petiole nutrient tests for N, P, or K were significantly reduced in each of the 2 lowest rates for N (30%N, 15%N), P (20%P, 0%P) and K (20%K, 0%K). Leaf and petiole sulfur concentrations were also reduced by the 2 lowest N rates. Shoot length and leaf area of vines was not altered until véraison, when the 15%N vines had lower shoot length (main + laterals) and leaf area compared to the Control vines. Photosynthesis was also reduced in the 15%N vines near the time of véraison, but no treatment differed from the Control before and after that time. Fruit yield and average cluster weights were lower also in the 15%N vines compared to the Control, but flower number, fruit set, and seed number per berry did not differ among treatments. The average number of days for the musts to ferment to dryness increased as N supply decreased (nearly linear) and was significantly greater in the 50%N, 30%N, and 15%N treatments compared to the Control. We suspect that the increased time to reach dryness in the low N fermentations are related to lower YAN levels (YAN in both juice and berries will be determined this winter). Low P and K supply did not alter the time to reach dryness. Vines in all of the reduced N supply treatments (75%N to 15%N) and the lowest P supply treatment (0%P) dropped leaves earlier than the Control vines. The response of these grafted vines to low N supply appears to differ somewhat from our earlier trial using self-rooted Pommard vines. Funding for the continuation of this project has been obtained elsewhere, and we are not asking for further support from OWB. Thank you for helping support this phase of the project.

Table 1. Effect of N, P, or K supply on **Leaf and Petiole Nutrients at Bloom** 2012. (Schreiner et al. unpubl., Pommard on 101-14)
NOTE: these are opposite cluster leaf samples.

Treatment	N (% dry matter)		P (% dry matter)		K (% dry matter)		S (% dry matter)	
	Leaf Blade	Petiole	Leaf Blade	Petiole	Leaf Blade	Petiole	Leaf Blade	Petiole
Complete	2.52 ab[1]	0.69 ab	0.27	0.31 a	0.99	2.38	0.27 a	0.15 abc
75% N	2.34 abc	0.62 abc	0.25	0.32 a	0.96	2.41	**0.23 bcd**	0.14 abc
50% N	2.27 bcd	0.61 abc	0.27	0.33 a	1.04	2.53	**0.22 cd**	0.13 abc
30% N	**2.04 cd[2]**	0.54 bc	0.25	0.33 a	1.02	2.46	**0.21 d**	0.12 bc
15% N	**1.97 d**	**0.52 c**	0.26	0.33 a	1.03	2.25	**0.20 d**	0.11 c
50% P	2.55 ab	0.68 ab	0.23	0.31 a	1.03	2.86	0.27 a	0.16 a
20% P	2.63 a	0.64 abc	0.23	**0.23 b**	1.01	2.30	0.27 a	0.13 abc
0% P	2.58 ab	0.68 ab	0.23	0.27 ab	1.01	2.52	0.27 a	0.15 ab
50% K	2.45 ab	0.67 ab	0.25	0.30 a	0.99	2.50	0.25 abc	0.14 abc
20% K	2.49 ab	0.66 abc	0.25	0.31 a	1.00	2.48	0.26 ab	0.16 a
0% K	2.52 ab	0.70 a	0.25	0.30 a	1.02	2.53	0.25 abc	0.16 ab
p-value	**<0.001**	**<0.001**	**0.006**	**<0.001**	N.S.	N.S	**<0.001**	**<0.001**

[1] Means followed by the same letter within each column do not differ based on Tukeys HSD at 95% confidence.

[2] Means in color differ from Complete Nutrition Control.

Table 2. Effect of N, P, or K supply on **Leaf and Petiole Nutrients at Veraison** 2012. (Schreiner et al. unpubl., Pommard on 101-14) NOTE: these values for combined basal and upper leaf sample (separate basal VS upper data showed some interesting differences).

Treatment	N (% dry matter)		P (% dry matter)		K (% dry matter)		S (% dry matter)	
	Leaf Blade	Petiole	Leaf Blade	Petiole	Leaf Blade	Petiole	Leaf Blade	Petiole
Complete	2.06 a	0.43 a	0.15 cde	0.11 bcde	1.09 bc	2.06 bc	0.16 a	0.10 a
75% N	1.97 a	0.41 a	0.16 bcd	0.13 abcd	1.11 bc	2.15 abc	0.15 a	0.09 a
50% N	1.89 a	0.41 a	0.17 bc	0.17 abc	1.13 abc	2.28 abc	0.15 a	0.08 ab
30% N	**1.65 b**	**0.34 b**	**0.18 ab**	0.19 ab	1.21 ab	2.27 abc	**0.12 b**	**0.06 bc**
15% N	**1.42 c**	**0.31 b**	**0.20 a**	**0.20 a**	1.30 a	2.01 bc	**0.11 b**	**0.06 c**
50% P	2.11 a	0.44 a	0.14 def	0.08 ef	1.18 abc	2.35 ab	0.16 a	0.09 a
20% P	2.09 a	0.42 a	0.13 ef	**0.06 f**	1.20 abc	**2.46 a**	0.16 a	0.09 a
0% P	2.11 a	0.43 a	**0.12 f**	**0.06 f**	1.14 abc	2.25 abc	0.16 a	0.09 a
50% K	2.06 a	0.42 a	0.15 def	0.09 de	1.09 bc	1.90 c	0.16 a	0.08 ab
20% K	2.04 a	0.42 a	0.15 def	0.10 cde	1.02 cd	**1.48 d**	0.15 a	0.09 a
0% K	2.05 a	0.42 a	0.15 def	0.10 cde	**0.85 d**	**1.12 d**	0.16 a	0.09 a
p-value	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

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[2] Means in color differ from Complete Nutrition Control.

NOTE Also: 15%N treatment had lower leaf Mg than Complete, and higher leaf B. 15%N & 30%N had lower Pet Mg than Complete, and 0%K had higher Pet Mg than Complete.

Table 3. Effect of N, P, or K supply on **Growth and Physiology** 2012. (Schreiner et al. unpubl., Pommard on 101-14)

Treatment	Main Shoot Length (cm)			Total Shoot Length	Total Leaf Area	Photosynthesis (µmol/m^2 sec)				
	June 6	June 29 Blm	July 20	Aug 28 Ver	Aug 28 (m2)	June 11	June 27	Aug. 14	Aug. 28	Sep. 25
Complete	51	96	138 ab[1]	209 ab	2.77 ab	13	21	13	15 ab	14 ab
75% N	49	95	137 ab	168 abc	2.28 abc	15	22	13	15 ab	14 ab
50% N	43	82	100 ab	138 bc	1.90 bc	13	20	14	14 abc	15 a
30% N	45	86	112 ab	142 abc	1.95 bc	13	19	12	11 bc	11 ab
15% N	47	82	94 b	**123 c**	**1.71 c**	13	19	12	**10 c**	10 b
50% P	51	90	134 ab	204 abc	2.71 ab	14	22	14	16 a	13 ab
20% P	52	105	142 ab	221 a	2.91 a	14	21	15	15 ab	12 ab
0% P	48	94	124 ab	192 abc	2.57 abc	14	24	13	15 ab	12 ab
50% K	49	89	138 ab	199 abc	2.61 abc	13	21	14	15 ab	12 ab
20% K	50	93	148 a	203 abc	2.59 abc	14	22	15	15 ab	13 ab
0% K	46	90	132 ab	194 abc	2.57 abc	15	21	14	15 ab	14 ab
p-value	N.S.	N.S.	**<0.001**	**<0.001**	**<0.001**	N.S.	N.S.	N.S.	**<0.001**	**0.019**

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Table 4. Effect of N, P, or K supply on **Fruit Parameters** 2012. (Schreiner et al. unpubl., Pommard on 101-14)

Treatment	Flower # per cluster	Fruit Set %	Seed # per berry	Yield (g)	Ave Cluster mass (g)	Juice Brix	Juice pH	# days to ferment dry
Complete	346	38	1.39	1585 a	148 a	24.4 a	3.28 b	4.3 c
75% N	286	40	1.35	1430 ab	133 ab	24.8 a	3.39 ab	5.3 c
50% N	294	44	1.53	1384 ab	123 ab	25.1 a	3.34 ab	**7.5 b**
30% N	273	43	1.38	1352 ab	117 ab	23.9 a	3.35 ab	**8.3 ab**
15% N	322	35	1.41	**1115 b**	**101 b**	23.9 a	3.34 ab	**10.0 a**
50% P	348	36	1.40	1533 a	134 ab	24.8 a	3.46 ab	4.5 c
20% P	272	37	1.37	1544 a	132 ab	24.6 a	3.35 ab	4.5 c
0% P	294	41	1.35	1601 a	142 a	24.8 a	**3.50 a**	5.0 c
50% K	293	41	1.37	1472 ab	136 a	24.5 a	3.38 ab	4.3 c
20% K	301	37	1.35	1431 ab	128 ab	24.5 a	3.30 b	4.5 c
0% K	296	40	1.33	1315 ab	115 ab	25.0 a	3.28 b	4.3 c
p-value	N.S.	N.S.	N.S.	**0.010**	**0.002**	**0.042**	**0.010**	**<0.001**

[1] Means followed by the same letter within each column do not differ based on Tukeys HSD at 95% confidence.

[2] Means in color differ from Complete Nutrition Control.

NOTE: Yields for Complete Nutrition Control equates to 2.5 tons/acre.