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FOLIAR POTASSIUM APPLICATION HAS LIMITED EFFECT ON BERRY COMPOSITION IN GRAPEVINE RED BLOTCH VIRUS-INFECTED GRAPEVINES

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INTRODUCTION

Delayed ripening and altered secondary metabolism in berries are the most commonly reported fruit symptoms in grapevines infected with grapevine red blotch virus (GRBV; Levin and KC, 2020), and have been attributed to impaired sugar translocation (Martínez-Lüscher et al. 2019). Potassium (K) nutrition is closely linked with berry ripening (Rogiers et al. 2017), and early studies on K nutrition in GRBV+ grapevines indicated low K status in GRBV+ leaves (Calvi 2011). Thus, it was hypothesized that foliar K application would improve berry ripening through an improvement of leaf K status.

MATERIALS AND METHODS

Vineyard site. This experiment was conducted in a commercial Pinot noir vineyard block during 2020 near Medford, Oregon (42.3265° N, 122.8756° W). Vineyard was trained to bi-lateral cordons and spur-pruned with foliage trained on VSP trellis. Row orientation was N-S and spacing was 2 m x 1.5 m. Virus status of data vines was confirmed using PCR from petiole samples taken in 2019.

Treatments and Experimental Design. Two commercially available foliar potassium (K) fertilizers – K1 and K2 – of similar analysis (0-0-24) were compared to a water control. Beginning at 50% veraison (31 July), products were applied weekly for four weeks to previously identified healthy (RB-) and infected grapevines (RB+). At each application, the equivalent of 7.5 L/ha. was applied with a backpack sprayer to single-vine replicates. Treatments were arranged in a randomized complete block design with a split-plot factorial treatment structure and eight replications. Virus status was main plot and foliar spray application was split-plot.

Quantifications. Leaf blades were sampled for vine nutrient status both before and after treatment application, and analyzed by a commercial laboratory. Vine yield and berry composition were measured at commercial harvest. Total soluble solids (TSS) were determined using a benchtop refractometer; pH was measured using a benchtop pH meter; titratable acidity (TA) was determined using an autotitrator. Anthocyanins, iron-reactive phenolics and tannins were determined using a microplate spectrophotometer (Heredia et al. 2006).

Statistical Analyses. Data were analyzed using a type III two-way analysis of variance (ANOVA) with Satterthwaite's method using R (v. 4.0.4). Means were separated using Tukey's method (α = 0.05).

Figure 1. Response of leaf blade potassium (K) at veraison, before foliar potassium application, and at harvest, four weeks after foliar potassium application.

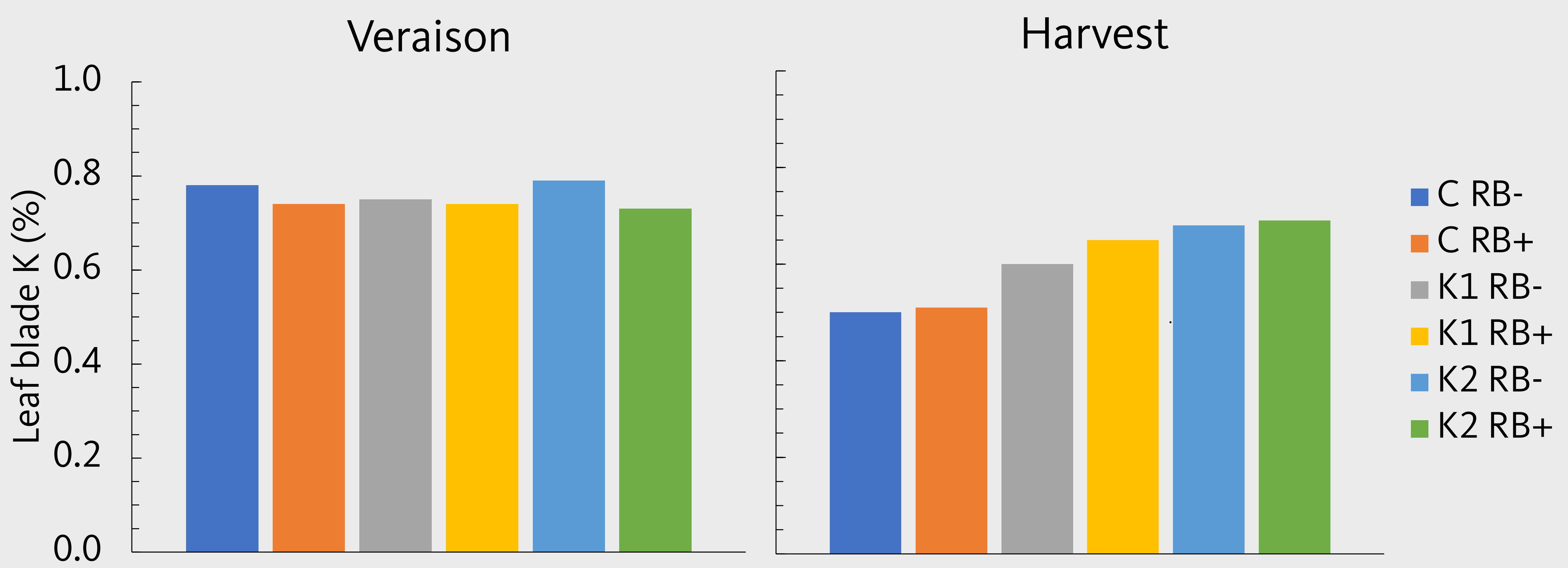

Table 1. Response of yield and primary berry composition to foliar potassium application and GRBV infection. Interaction effects were all not significant, thus only main effects are presented. Means followed by the same letter are not significantly different.

Treatment	Vine yield (kg)	Pruning weight (kg)	Berry weight (g)	Sugar per berry (g)	TSS (°Brix)	pH	TA (g/L)
C	2.70 a	0.64	1.04 a	0.23 a	22.0 b	3.42	6.22
K1	2.69 a	0.65	0.96 b	0.23 a	24.0 a	3.45	6.61
K2	2.40 a	0.73	0.91 b	0.21 a	23.0 ab	3.42	6.89
RB-	2.22 b	0.61	0.96 a	0.25 a	25.4 a	3.44	6.54
RB+	2.97 a	0.73	0.98 a	0.20 b	20.6 b	3.42	6.60

Table 2. Response of berry phenolic composition to foliar potassium application and GRBV infection. Interaction effects were all not significant, thus only main effects are presented. Means followed by the same letter are not significantly different.

Treatment	Anthocyanins (mg/g)	Iron-reactive phenolics (mg/g)			Tannins (mg/g)		
		Skin	Seed	Total	Skin	Seed	Total
C	0.76	1.93	3.26 b	5.19	0.89	1.38	2.27
K1	0.75	1.92	3.69 ab	5.61	0.90	1.52	2.42
K2	0.76	1.89	3.74 a	5.63	0.86	1.56	2.43
RB-	0.81	1.77 b	3.48	5.26	0.74 b	1.46	2.20 b
RB+	0.70	2.06 a	3.64	5.70	1.03 a	1.52	2.55 a

RESULTS AND DISCUSSION

In general, vine K status decreased from veraison to harvest as previously reported (Williams and Biscay, 1991), and all vines were in the normal range at veraison (Schreiner and Osborne 2019; Fig. 1). However, foliar K application beginning at veraison resulted in higher K status at harvest (Fig. 1). On average, K status at harvest was 24 and 36% higher in K1 and K2, respectively, compared to controls, regardless of virus status. At harvest, there were no significant interaction effects between K application and RB factors for all measured variables, with only significant main effects. Vine yield was not significantly impacted by K application (though it trended lower), but berry weight was significantly reduced (-10%) in vines sprayed with K (Table 1). Accordingly, berry TSS at harvest was increased by both K fertilizers independent of virus status, but there was no significant effect of K application on sugar per berry nor on pH (Table 1). There were also no significant effects of K application on berry phenolic composition, only significant virus effects as previously reported (Levin and KC, 2020; Table 2).

CONCLUSIONS

The lack of treatment effects on berry composition suggests that though foliar K application has limited effects on fruit quality in GRBV+ grapevines, the increased TSS may advance harvest date in late ripening and/or heavily GRBV-infected blocks with a potentially small yield penalty.

LITERATURE CITED

1. Calvi, B.L. 2011. Effects Of Red-leaf Disease On Cabernet Sauvignon At The Oakville Experimental Vineyard And Mitigation By Harvest Delay And Crop Adjustment. Master's Thesis, University of California - Davis, Davis, CA.
2. Heredia, T.M., D.O. Adams, K.C. Fields, P.G. Held, and J.F. Harbertson. 2006. Evaluation of a Comprehensive Red Wine Phenolics Assay Using a Microplate Reader. American Journal of Enology and Viticulture 57:497-502.
3. Levin, A.D., and A.N. KC. 2020. Water Deficits Do Not Improve Fruit Quality in Grapevine Red Blotch Virus-Infected Grapevines (Vitis vinifera L.). Front Plant Sci 11:1292.
4. Martínez-Lüscher, J., C.M. Plank, L. Brillante, M.L. Cooper, R.J. Smith, M. Al-Rwahnih, R.Z. Yu, A. Oberholster, R. Girardello, and S.K. Kurtural. 2019. Grapevine Red Blotch Virus May Reduce Carbon Translocation Leading to Impaired Grape Berry Ripening. Journal of Agricultural and Food Chemistry 67:2437-2448.
5. Rogiers, S.Y., Z.A. Coetzee, R.R. Walker, A. Deloire, and S.D. Tyerman. 2017. Potassium in the Grape (Vitis vinifera L.) Berry: Transport and Function. Front Plant Sci 8:1629.
6. Schreiner, R.P., and J.P. Osborne. 2020. Potassium Requirements for Pinot noir Grapevines. American Journal of Enology and Viticulture 71:33-43.
7. Williams, L.E., and P.J. Biscay. 1991. Partitioning of Dry Weight, Nitrogen, and Potassium in Cabernet Sauvignon Grapevines from Anthesis Until Harvest. Am J Enol Vitic 42:113-117.

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