THE EFFECTS OF REDUCING HERBICIDES IN NEW ZEALAND VINEYARDS

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Abstract:

Context and purpose of the study – Herbicides are commonly sprayed in the vine row to prevent competition with vines for water and minerals and to keep weeds from growing into the bunch zone. Sprays are applied before budbreak and reapplied multiple times during the season to keep the undervine bare. There is growing concern about the negative effects of herbicides on humans and the environment, and weeds in New Zealand have developed resistance to herbicides. Therefore, it is imperative that we reduce our reliance on herbicides in viticulture and incorporate methods that do not engender resistance.

Material and methods – This trial was conducted in the 2016-17, 2017-18 and 2018-19 seasons in three Merlot and three Sauvignon blanc vineyards in New Zealand. The trial was a split plot, with half the vineyard receiving multiple sprays (the industry standard). The other half received a single spray around budburst, and any subsequent undervine weeding was done using nonchemical methods (mowing or cultivation). In each vineyard half, five sampling locations were established for vine, fruit, and undervine measurements. Vines were assessed for canopy gaps by image analysis, yield, and rot severity. Fruit was sampled during ripening and at harvest to assess differences in chemical composition. The undervine area was surveyed at budburst, flowering, veraison, and harvest to assess differences in bare area and presence/abundance of various plant species.

Results – Reducing herbicide had a dramatic effect on the percent bare area under vines, as well as the species of undervine vegetation from flowering onwards. In most vineyards, canopy growth was similar for both the control (C) and reduced herbicide (RH) treatments, though a few differences were found, generally with the RH treatment having more gaps. A few differences were found in midday water potential, with the RH treatment generally having more negative SWP. Despite differences in canopy gaps and SWP, there were few effects on berry size or soluble solids. There were few other fruit compositional differences, though the RH fruit tended to have lower yeast assimilable nitrogen (YAN) than the C fruit. Yield was generally not affected by reducing herbicide, and rot severity tended to be similar between treatments, indicating no negative effects on fruit quantity or health from allowing more vegetation to become established under vines. These data show that herbicide use can be reduced by 50-75% with little negative effect on grapevines or their fruit. It is anticipated that adopting this technique will reduce herbicide residues in/on fruit and slow or stop the spread of herbicide resistant weeds.

Keywords: Herbicide, resistance, grapevine, weeds, sustainability

1. Introduction.

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Introduction

Herbicides are commonly sprayed in the vine row to prevent competition with vines for water and minerals and to keep weeds from growing into the bunch zone. Sprays are applied before budbreak and reapplied multiple times during the season to keep the undervine bare. There is growing concern about the negative effects of herbicides on humans and the environment (Van Bruggen et al., 2018), and weeds in New Zealand have developed resistance to glyphosate (Ghanizadeh et al, 2013). Therefore, it is imperative that we reduce our reliance on herbicides in viticulture and incorporate methods that do not engender resistance.

Materials and Methods

This trial was conducted in the 2016-17, 2017-18 and 2018-19 seasons in three Merlot and three Sauvignon blanc vineyards in New Zealand. The trial was a split plot, with half the vineyard receiving multiple sprays (the industry standard). The other half received a single spray around budburst, and any subsequent undervine weeding was done using nonchemical methods (mowing or cultivation). In each vineyard half, five sampling locations were established for vine, fruit, and undervine measurements. Vines were assessed for canopy gaps by image analysis, yield, and rot severity. Fruit was sampled during ripening and at harvest to assess differences in chemical composition. The undervine area was surveyed at budburst, flowering, veraison, and harvest to assess differences in bare area and presence/abundance of various plant species.

Figure 1: A photo down the center of the trial taken a month before harvest. The control is on the right and the reduced herbicide treatment on the left.

Results

This study has shown that a single herbicide spray, followed up by either undervine mowing or cultivation, does not negatively affect vines in terms of growth or productivity. There were few significant differences in vegetative growth as measured by canopy gaps at veraison (Table 1), meaning that the vines still had a similar photosynthetic area to ripen fruit.

Groundcover in the vine row was significantly affected by treatment, with the herbicide reduced vines having less bare area undervine (Figure 2). This increased groundcover did not generally lead to reduced yield at harvest (Table 1). Only a single vineyard saw a significant reduction in yield from reducing herbicide (Table 1). There were also very few differences in berry weight or juice composition, indicating that employing nonchemical methods in addition to herbicides does not negatively affect fruit quality.

Vineyard	Treatment	Percent Canopy Gaps			Yield (kg/vine)		
		2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Merlot 1	Cont.	9.55%	13.80%	10.19%	4.82	6.02	3.86
	RH	8.23%	14.20%	13.37%	5.3	6.87	3.48
Merlot 2	Cont.	11.49%	11.55%	16.31%	**8.63 a**	7.51	**7.54 a**
	RH	12.89%	14.18%	16.65%	**6.83 b**	6.27	**5.07 b**
Merlot 3	Cont.	**25.89% a**	8.93%	**13.28% a**	3.28	3.95	1.44
	RH	**12.11% b**	8.25%	**7.64% b**	3.24	3.59	1.13
SB 1	Cont.	4.59%	**2.74% b**	3.73%	5.71	6.65	4.95
	RH	7.75%	**6.90% a**	4.71%	4.95	7.26	5.04
SB 2	Cont.	4.34%	**1.30% b**	**0.55% b**	11.08	10.05	8.77
	RH	3.93%	**2.17% a**	**2.85% a**	10.84	10.68	8.2
SB 3	Cont.	10.66%	15.51%	**18.53% a**	14.49	13.82	11.11
	RH	6.88%	13.80%	**10.70% b**	15.62	13.37	10.76

Table 1: Percent canopy gaps and yield per vine. Values in bold with different letters from the same vineyard in the same year denote significant differences at the p=0.05 level.

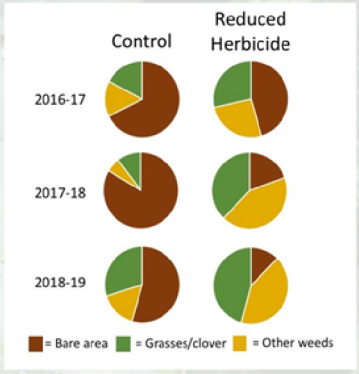

Figure 2: Undervine groundcover at veraison for the period 2016-2019 from the six experimental vineyards

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Conclusion

A single herbicide spray followed by nonchemical weed control did not negatively affect growth, productivity, or basic juice composition. Mixing in nonchemical weed control methods with chemical herbicides is a viable way to both reduce chemical inputs and slow the further development of herbicide resistance in weed species.

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