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Alternative Weed Management Strategies Influence Weed Control and Grapevine Yield in an Established Vineyard

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Abstract
Weeds compromise vineyard productivity by competing with grapevines for water and nutrients. Herbicides and/or cultivation are commonly used to manage weeds by viticulturists. However, these techniques may jeopardize soil sustainability and ultimately affect soil productivity. The need for economically viable alternative weed management strategies that are effective at managing weeds, maintain grapevine performance and quality, and conserve soil resources are of increasing concern. The first objective of this study was to evaluate the effects of four weed management strategies on weed control, grapevine physiological responses, and assayed soil parameters in an established vineyard. Secondly, this study will investigate the influence of irrigation on grapevine growth and development grown with or without a living mulch.

Keywords
Horticulture, Agronomy

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Alternative Weed Management Strategies Influence Weed Control and Grapevine Yield in an Established Vineyard

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Introduction

Weeds compromise vineyard productivity by competing with grapevines for water and nutrients. Herbicides and/or cultivation are commonly used to manage weeds by viticulturists. However, these techniques may jeopardize soil sustainability and ultimately affect soil productivity. The need for economically viable alternative weed management strategies that are effective at managing weeds, maintain grapevine performance and quality, and conserve soil resources are of increasing concern. The first objective of this study was to evaluate the effects of four weed management strategies on weed control, grapevine physiological responses, and assayed soil parameters in an established vineyard. Secondly, this study will investigate the influence of irrigation on grapevine growth and development grown with or without a living mulch.

Materials and Methods

Data for the experiment were collected from a vineyard established in 1985 at the Iowa State University Horticulture Research Station located in Ames, IA. All treatments were replicated four times. Treatments addressing the first objective of the study were established in 2004 within rows of Maréchal Foch and included: 1) cultivation, 2) herbicide application, 3) straw mulch, and 4) a living mulch of creeping red fescue (*Festuca rubra*).

For the second objective, the grape cultivars Reliance and Swenson Red were used. Treatments also included the use of a living mulch of creeping red fescue and Chewings fescue (*F. rubra* and *F. rubra* ssp. *fallax*, respectively), established in fall 2007. Treatments included: 1) herbicide application with irrigation, 2) herbicide application without irrigation, 3) living mulch with irrigation, and 4) living mulch without irrigation. Irrigation regimes were based on fescue evapotranspiration. Due to an abundance of spring and summer rains in 2008, no irrigation was applied.

Weed data were collected in late spring and summer and included visual estimates of percentage weed cover, as well as monocot and dicot weed shoot biomass. Due to flooding, no weed data were collected for Maréchal Foch during June.

Grapevine yield and harvest-related variables were collected. Additional research will be performed on grape berry quality and soil biological, chemical, and physical properties. Similar data as described above will be collected through 2009.

Results and Discussion

Weed data. Percentage weed cover and weed biomass in plots of Maréchal Foch were greatest in the cultivation treatment. In May, the living mulch treatment had the second highest percentage weed cover, whereas it had the lowest weed cover and weed biomass in July (Table 1).

In treatment plots of Reliance and Swenson Red, few differences were observed in weed biomass for the months of May and June (Table 2). Percentage weed cover was lowest in the herbicide treatments for the month of June, whereas it was the highest in July. Similarly, weed biomass in July was highest for the herbicide treatments and lowest in the living mulch treatments.

Yield data. No differences in average grapevine yield were observed across all cultivars and experimental treatments (data not presented). Yield responses to the different soil management treatments may have been ameliorated due to the abundance of rainfall received in early spring and summer of 2008.

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Table 1. Percentage of weed ground cover and shoot biomass of monocot (grass) and dicot (broadleaf) weeds from four weed management treatments in rows of Maréchal Foch, 2008.

	Percentage weed cover		Weed shoot biomass (g)			
Treatment	May	July	May monocot	May dicot	July monocot	July dicot
Cultivation	20.4[z] a	83.1 a	0.74 b	3.23 a	11.52 a	20.29 a
Herbicide	4.9 b	74.7 a	0.09 b	0.84 b	9.01 ab	11.05 b
Living mulch	10.6 ab	0.6 c	7.93 a	0.01 b	0.00 b	0.22 c
Straw mulch	4.1 a	34.3 b	0.59 b	0.03 b	8.67 ab	1.77 c
LSD[y]	11.4	14.1	6.63	1.74	9.08	60.9

[z]Means of four replications; means calculated from averages of 0.25 m^2 quadrats, three quadrats per plot.
[y]Least significant difference at $P < .05$; NS = no significant difference; values sharing the same letter are not statistically different from each other.

Table 2. Percentage of weed ground cover and shoot biomass of monocot (grass) and dicot (broadleaf) weeds from four weed management treatments in rows of Reliance and Swenson Red, 2008.

	Percentage weed cover			Weed shoot biomass (g)					
Treatment	May	June	July	May monocot	May dicot	June monocot	June dicot	July monocot	July dicot
Herbicide	1.6[z] ab	0.0 b	83.7 a	0.00 b	0.14 a	0.00 b	0.00 b	12.16 a	14.64 a
Herbicide + irrigation	0.4 b	0.0 b	66.1 b	0.00 b	0.01 b	0.00 b	0.00 b	14.22 a	9.01 ab
Living mulch	2.5 a	7.5 a	27.8 c	0.03 a	0.07 ab	0.61 a	0.75 a	2.24 b	6.72 b
Living mulch + irrigation	2.3 a	6.1 a	28.3 c	0.01 ab	0.14 ab	0.56 a	0.55 ab	2.64 b	7.07 b
LSD[y]	1.6	2.8	17.4	NS	0.13	0.28	0.57	5.79	5.56

[z]Means of four replications; means calculated from averages of 0.25 m^2 quadrats, three quadrats per plot.
[y]Least significant difference at $P < .05$; NS=no significant difference; values sharing the same letter are not statistically different from each other.