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Effect of Living or Straw Mulch on Weed Management and Soil Quality in Grape Vineyards

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Abstract
The use of herbicides in vineyards has been a cost-effective way for in-row weed management. However, as public concerns about pesticide run-off, ground water quality, and soil erosion have increased, grape growers have become aware of a need for alternative methods of weed management. The overall objective of this project was to identify optimal weed-management practices that maximize grapevine growth and development as well as maintain or improve vineyard soil quality.

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Introduction

The use of herbicides in vineyards has been a cost-effective way for in-row weed management. However, as public concerns about pesticide run-off, ground water quality, and soil erosion have increased, grape growers have become aware of a need for alternative methods of weed management. The overall objective of this project was to identify optimal weed-management practices that maximize grapevine growth and development as well as maintain or improve vineyard soil quality.

Materials and Methods

Two vineyards at the Iowa State University Horticulture Research Station, Ames, IA, were used in the experiment: a mature vineyard (est. 1985) and a three-year-old vineyard (est. 2002). Both projects used a randomized complete block design. The mature vineyard used four weed-management treatments and four replications. The newer vineyard consisted of three management systems and five replications. The grape cultivar used in both studies was Maréchal Foch.

Treatments applied to the mature vineyard: 1) conventional herbicide, 2) cultivation, 3) straw mulch, or 4) living mulch of creeping red fescue (*Festuca rubra*).

Treatments applied to the three-year-old vineyard: 1) conventional herbicide–following standard spray schedule, 2) conventional herbicide–best management practices (BMP), or 3) straw mulch.

Results and Discussion

Mature Vineyard. There were no differences in average fruit yield and cluster number per vine or cluster weight between treatments in the mature Maréchal Foch grape vineyard. The cultivation treatment had greater broadleaf weed shoot biomass in May and August 2006. In July the herbicide treatment had the greatest broadleaf weed biomass (Table 1). The cultivation treatment had the greatest percentage of weed coverage in May and August 2006. In July the cultivation treatment had similar weed coverage as the herbicide treatment. These data reflect that in July there were fewer, but larger weeds in the herbicide treatment plots compared with the cultivation treatment plots. More worms were collected from the straw mulch treatment than in the cultivation or herbicide treatments (data not presented). Nitrogen levels in petioles were higher in the straw mulch and herbicide treatments than in the living mulch or cultivation treatments (data not presented).

Three-year-old Vineyard. The BMP treatment total fruit yield/plot and grape cluster number/vine was similar to the conventional herbicide treatment and was more than the straw mulch treatment (Table 2). Average grape cluster weight/vine was similar among all treatments. Percentage weed coverage was not different among the three treatments. Petiole analysis revealed that there were no differences in the standard nutrients measured with the exception that the level of copper was much higher in the straw mulch treatment, which was the only treatment to receive copper-based fungicide applications (data not presented).

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Table 1. Percentage of ground covered by weeds and shoot dry weight of broadleaf (dicot) and grass (monocot) weeds from four weed-management treatments at ISU in mature vineyard soil quality experiment, 2006.

	Percentage weed cover[y]			Weed shoot dry wt (g) [y]					
Treatment[z]	May	July	August	May dicot	May monocot	July dicot	July monocot	August dicot	August monocot
Living mulch	2.7 bc	3.1 b	4.7 c	1.9 b	2.4	0.4 b	0.2	0.3 b	1.3 b
Straw mulch	1.7 c	1.5 b	3.9 c	0.0 b	0.8	0.6 b	0.0	1.4 b	0.0 b
Herbicide	17.0 b	64.7 a	20.4 b	3.8 b	4.5	24.8 a	5.5	3.3 b	2.1 b
Cultivation	75.8 a	69.8 a	84.0 a	26.0 a	9.6	6.6 b	4.3	8.8 a	7.0 a
LSD[x]	14.4	26.9	14.3	7.6	NS	14.7	NS	4.9	3.7

[z]Means of four replications.
[y]Means obtained from the avg. of three, 0.25m^2 quadrats per plot.
[x]Least significant difference @ $P<.05$; NS = not significant. Values with the same letter are not significantly different from each other.

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Table 2. Maréchal Foch grape yield and percent weed cover data collected from three weed-management treatments in three-year-old vineyard at Iowa State University, 2006.

	Grape yield [z]			Percent weed cover[y]		
Treatment	Total grape yield/plot (kg)	Avg. grape cluster wt/vine (g)	Avg. grape cluster no./vine	May	July	August
Straw mulch	2.2 b	67.2	32 b	27.5	46.9	11.2
Herbicide	4.0 a b	82.8	48 a b	19.3	46.1	18.6
Best management practices	5.9 a	84.3	68 a	18.3	47.0	28.1
LSD[x]	2.5	NS	27	NS	NS	NS

[z]Means of five replications.
[y]Means obtained from the avg. of three, 0.25m^2 quadrats per plot and four replications.
[x]Least significant difference @ $P<.05$; NS = not significant. Values with the same letter are not significantly different from each other.