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# Reducing pesticide use in Iowa vineyards: Alternatives to herbicides for vineyard weed management

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## **Abstract**

Mulches can play a role in vineyard management. This project explored the optimum uses and practices for applying various mulches to grape agroecosystems.

## **Keywords**

Horticulture, Agronomy, Grapes wine and viticulture, Weed control alternatives

## **Disciplines**

Agronomy and Crop Sciences | Horticulture | Viticulture and Oenology | Weed Science



## Reducing pesticide use in Iowa vineyards: Alternatives to herbicides for vineyard weed management

### Abstract:

Mulches can play a role in vineyard management. This project explored the optimum uses and practices for applying various mulches to grape agroecosystems.

### Principal Investigator:

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#### Budget:

\$13,655 for year one  
\$12,121 for year two

**Q** What are viable strategies for Iowa grape growers to successfully manage weeds and/or reduce pesticide usage while maintaining grape productivity and soil quality?

**A** Knowledge of optimal ways for achieving weed management in Iowa vineyards will enable growers to sustainably manage this unique agroecosystem. Methods of weed control that jeopardize soil quality and grapevine productivity can be avoided. Sustainable weed management that includes living or soil mulches minimizes some of the environmental risks of pesticide usage and maintains soil quality and grape productivity. The long-term success of Iowa's grape and wine industry promotes increased diversification of Iowa's farming enterprises that strengthens the state's economy.



**ECOLOGY**

### Background

The number of commercial vineyards in Iowa grew from 15 in 1999 to nearly 400 in 2010, some of which serve 74 state-licensed wineries. Grape and wine production also has increased in other Midwestern states. As this industry continues to evolve, it is important to develop and encourage the use of sustainable land management practices that are environmentally sound, economically viable, and socially responsible. One aspect of sustainable grape production includes the use of weed management practices that maintain grapevine performance and conserve soil quality.

Previous research supported by the Leopold Center suggests the alternative practices of straw and living mulches accomplish these goals of productivity and protection. However, living mulches may compete with grapevines for water and nutrients jeopardizing grapevine performance.

The overall objective of this project was to investigate weed management practices that minimize some of the risks associated with herbicide use, maintain grapevine performance, and promote soil quality in Iowa vineyards. Specific objectives were to:

- Evaluate two conventional and two alternative weed management systems and their effects on weed control and selected chemical, physical and biological indicators of soil quality within grape agroecosystems in Iowa.
- Evaluate conventional and alternative (living mulch) weed management systems and the influence of trickle irrigation on weed control, grapevine growth and development, and soil quality.
- Raise the level of awareness among Iowa fruit and growers about alternatives to herbicides for vineyard weed management in Iowa and its impact on soil quality.

### Approach and methods

Measurements taken in the course of the project include: efficacy of weed control, grapevine performance (including fruit quality), and chemical, physical and biological indicators of soil quality. In the first experiment, conventional and alternative weed management practices were compared in an established vineyard with 'Maréchal Foch' grapevines. Conventional



*Cultivation*

weed management practices investigated include herbicide application and cultivation, while alternative practices consisted of straw mulch and a living mulch of creeping red fescue. In the second experiment, living mulches and herbicides, with and without irrigation, were compared in established rows of ‘Reliance’ and ‘Swenson Red’ grapevines.

## Results and discussion

For the first experiment, both straw and living mulches controlled weed populations, while cultivation was least effective at controlling weeds. Yield was the same across all treatments, which may be due to the unseasonably wet growing conditions and resulting lack of water competition during the study period. Fruit quality was slightly reduced in straw mulch plots. Pruning weights, which are indicative of the vegetative growth in response to the imposed treatments, were lower in cultivated plots, possibly due to root destruction from the tiller. Several indicators of soil quality, most notably infiltration, were improved in plots with living or straw mulches. Earthworm populations, a biological indicator of soil quality, were greatest in straw mulch plots.

Similarly to the first experiment, living mulches controlled weeds and promoted several indicators of soil quality. Living mulches and irrigation had no consistent effect on grapevine performance, again suggesting little-to-no competition existed between the grapevines and living mulches during the study period. Twenty-two fruit growers were surveyed regarding their knowledge and awareness of weed management practices and soil quality. Overall, growers were aware of soil quality and considered the quality of their soils when making land management decisions. However, many were cautious about implementing alternative practices that promoted soil quality. Growers indicated they needed more information about how alternative practices impact crop productivity and quality before adopting these practices.

## Conclusions

Both alternative weed management practices of straw and living mulches controlled weed populations. Grapevine performance was maintained under both mulch systems, while fruit quality was slightly reduced in grapes receiving the straw mulch treatment. Several indicators of soil quality were improved in both mulched plots, most notably infiltration and earthworm counts. No evidence of competition between the living mulch and grapevines was found. Abnormally wet growing seasons during the period in which the study was conducted may have masked any competition that could occur under normal climactic conditions.

What remains to be answered is if irrigation mitigates any existent competition between grapevines and living mulches. The study says “perhaps,” but arrival at a definite conclusion is difficult due to the growing conditions in which the study was conducted. One year in which the study was conducted was accompanied by large amounts of rainfall and flooding. During the abnormally wet growing season, no consistent evidence of competition was detected. Both grapevine performance and fruit quality were maintained under no- and full-irrigation treatments, demonstrating water was not a limiting resource for grapevines grown with living mulch. Results from the irrigation study should be interpreted cautiously due to the potentially confounding effect of rainfall. In Iowa, water may become limiting for grapevines grown with living mulch, causing a reduction in grapevine growth and development.

Survey results also show that Iowa fruit and vegetable growers are interested in alternative weed management practices that promote the quality of their soils. However, growers are



Living mulch

cautious about the implementation of untested practices that may compromise crop yield and quality.

## Impact of results

Information generated from this project promotes the evolution of alternative weed management systems that maintain and/or enhance soil quality while optimizing vineyard productivity. Both straw and living mulches provided effective weed control, maintained grapevine performance and fruit quality, and promoted several attributes of soil quality. When compared to conventional herbicide- and cultivation-based weed management systems, mulches have the potential to impact growers' enterprises by decreasing the amount of inputs they have to invest to maintain productivity. For example, by reducing the amount of or eliminating herbicide applications, growers save money. Money is saved by negating the costs of purchasing herbicide products, as well as by reducing the amount of fuel (gas and diesel) expended to apply products within a field. Growers also have reduced health risks associated with potential misapplication and/or accidents that can occur with exposure to agrichemicals. The environment can be positively impacted through reduced herbicide usage and the conservation of soil quality through the presence of a consistent groundcover. While the alternative practice of living mulches is not at the point of recommending to commercial growers, it remains a promising avenue for sustainable land management in Iowa. Prolonged studies would advance understanding on the long-term effects of living mulch-based systems of weed management.

Future studies that focus on grape quality are warranted to further understanding of how these management practices impact fruit, and subsequent wine, quality. Conducting and disseminating research on alternatives to conventional weed management and engaging growers in research projects elevated the level of awareness on soil quality and land management. With changes in grower knowledge, they may be more receptive to management practices that contribute to aspects of sustainability.

## Education and outreach

Project results were shared at several ISU horticulture field day events, at the American Society of Enology and Viticulture Eastern Section annual conference, the Western Iowa Grape Growers Association field day, the Iowa Wine Growers Association and the Iowa Grape and Wine Commission. Manuscripts are in preparation for the *American Journal of Enology* and *Viticulture and HortTechnology*. Two reports appeared in the ISU Horticulture Research Station Annual Progress Reports for 2008 and 2009.

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