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Gail R. Nonnecke

Iowa State University, nonnecke@iastate.edu

Craig A. Dilley

Des Moines Area Community College

Thomas E. Loynachan

Iowa State University, teloynac@iastate.edu

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Integrated soil and weed management production systems for perennial food crops

Abstract

Several alternative weed management tactics for strawberry and grape production were tested for their effects on weed control, crop yield and soil quality enhancement.

Keywords

Horticulture, Agronomy, Biocontrol and Integrated Pest Management, Farming systems, Soils and agronomy, Weed control alternatives

Disciplines

Agronomy and Crop Sciences | Entomology | Horticulture | Soil Science | Weed Science



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Abstract: Several alternative weed management tactics for strawberry and grape production were tested for their effects on weed control, crop yield and soil quality enhancement.

Principal Investigator:

Gail Nonnecke
Horticulture
Iowa State University

Co-investigators:
Craig Dilley
Des Moines Area
Community College

Tom Loynachan
Agronomy
Iowa State University

Budget:
\$19, 933 for year one
\$19, 377 for year two

Q Can Iowa fruit growers use alternative weed management practices to control weeds and, at the same time, maintain crop yield and fruit quality while conserving soil resources?

A Alternative weed management practices reduce herbicide use, which compromises sustainability due to negative environmental impacts. These practices can be used by Iowa grape and strawberry growers to control weeds while maintaining crop yields, fruit quality, and soil quality.



ECOLOGY

Background

Strawberry and grape growers are looking for sustainable weed management options and improved tools to monitor and assess soil quality. The project investigators considered a variety of practices and programs that might work for these specialty crop producers.

Two key objectives were to:

1. Evaluate the viability of two conventional and two alternative weed management systems and their effects on the selected physical, chemical, and biological soil properties in June-bearing strawberry and grape ecosystems in Iowa.
2. Raise the level of awareness among Iowa fruit and vegetable growers about the soil quality concept and provide opportunities for growers to learn how to implement crop and soil management practices that improve soil quality.

Approach and methods

The principal investigators examined weed and soil management by measuring the effects of conventional and alternative strawberry and grape management systems on the physical, chemical, and biological properties of soil. They also quantified the relationships among soil properties, soil quality, and weed and disease pressure in strawberry fields and grape vineyards.

Results and discussion

Strawberry plantings under all weed management strategies exhibited a comparable reduction in weed growth. Living and straw mulches have the potential to manage weed populations similar to other treatments. Bulk density (a measure of soil compaction) was higher in plots treated with herbicides compared to plots covered with straw mulch or living mulch.

Investigators also conducted an on-farm field trial to provide information for farmers. They worked with strawberry and grape growers to establish soil quality trial plots on their farms to evaluate the usefulness of soil quality test kits. Cooperating growers found



Alternative weed management in Junebearing strawberry production, straw-mulch treatment, ISU Horticulture Research Station.

the soil quality information useful, but wanted assistance in interpreting the measurements.

Conclusions

- All weed management systems used in the strawberry and vineyard experiments inhibited weed growth to acceptable levels. Effective alternatives to conventional weed management practices of herbicide and pre-plant soil fumigation used living mulch and straw mulch.
- The alternative management practices used in these experiments maintained or improved soil quality attributes compared to conventional practices. In the strawberry experiments, adding straw mulch for weed control resulted in larger numbers of earthworms and increased cation exchange capacity, which can be considered improvements in soil quality.
- Strawberry plant growth was inhibited by the alternative weed management strategies. The living mulch and straw mulch reduced strawberry plant growth compared to the herbicide and fumigation + herbicide treatments. Additionally, researchers saw the reduced vigor of grapevines in the living mulch treatment. Data correlating the reduced plant growth to yields were indeterminate and further research is needed before this issue can be addressed.
- Certain indicators of soil quality can be improved through the use of alternative weed management strategies of living and straw mulches. Straw mulch treatment plots had the highest level of potassium, and higher levels of organic matter were obtained in the living and straw mulch treatment plots due to the addition of organic matter provided by the treatments.
- The USDA-NRCS Soil Quality Test Kits effectively measured changes in soil quality indicators based on differences in crop management, time of year, and climate conditions.
- Growers believe that the soil quality test kit is a useful tool, but some growers would rather have the measurements interpreted by consultants with more expertise in this area.
- Overall, Iowa berry growers who were surveyed were somewhat aware of the impact that their production practices were having on the quality of their soil, but were not aware that they could monitor the quality of their soil with a test kit. These growers also showed interest in learning how the soil quality test kit could be used to improve their crop yields.

Impact of results

New alternative weed management strategies for strawberry and grape growers were developed for Iowa growing conditions. For Objective 1:

- Effective alternatives to conventional practices for weed management in June-bearing strawberries are available. All weed management systems used in the experiment inhibited weed growth to acceptable levels.
 - Earthworm numbers and cation exchange capacity were improved by the addition of straw mulch in June-bearing strawberry. However, the alternative weed management practices used in this experiment generally did



Cooperator learning how to use a soil quality test kit in his vineyard, Council Bluffs.

not improve measured physical soil quality factors compared to conventional practices within the two seasons measured for this project.

- Reduced yield in June-bearing strawberry in living mulch treatments may be due to competition, and it is possible that sorghum-sudangrass is not an appropriate living mulch for use in strawberry production.
- Living and straw mulches have the potential to manage weed populations as well as or better than herbicides or cultivation in grape vineyards.

- Certain indicators of soil quality can be improved through use of living or straw mulches as weed management practices in grape vineyards, as organic matter and potassium levels were improved.
- In this study, grapevines in the living mulch treatment experienced a reduction in pruning weight compared to the straw mulch and herbicide treatments, but was not reduced as much as vines grown on cultivated plots.

For Objective 2:

- Many growers are open to the idea of managing their soils with alternative methods if economic benefits can be gained from such methods.
- By monitoring their soil with a soil quality test kit, growers will have more information about their soil, which can be used to make soil/crop management decisions that affect the overall profitability of an operation.
- It seemed that strawberry growers were more interested in soil quality measurements that are quick and require little interpretation. It will be a challenge to motivate growers to take all measurements in the soil quality test kit.

• Education and outreach

Results of the project were shared at events sponsored by the Iowa Fruit and Vegetable Growers Association, the Iowa Wine Growers Association, Wisconsin Fresh Fruit and Vegetable Conference, Missouri Fruit Growers Association, American Society for Horticultural Science, and West Iowa Grape Growers Association. Field days were held at the ISU Research and Demonstration Farms and at the Armstrong Research Station. Papers are in preparation for the Journal of the American Society for Horticultural Science and HortTechnology. Research findings were reported in several ISU Extension publications and progress reports. See

www.ag.iastate.edu/farms/05/reports/hort/EffectsofFourWeed.pdf

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- North American Strawberry Growers' Association,
- Iowa State University Department of Horticulture, and
- Viticulture Consortium–East, USDA.

For more information, contact:

Gail Nonnecke, 106 Horticulture Building, Iowa State University, Ames, Iowa 50011; (515) 294-0037, e-mail nonnecke@iastate.edu