

The Effects of Hand Cultivation, Herbicide, or Monoculture Cover Crops: *Rudbeckia hirta* and *Panicum virgatum* on Grapevine Growth, Pest Populations, and Soil Characteristics

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Introduction

Few practices are described to reduce the accumulation of pests in the soil from perennial growth of grapevines. However, cover crops can be used in rotation with vineyards to improve soil characteristics and suppress pests such as weeds and nematodes. The objective of this study was to compare plots that were hand cultivated, treated with herbicide, or rotated with two monoculture cover crops, and their influence on grape vine growth, weed and nematode proliferation, and soil characteristics.

Materials and Methods

The experiment was conducted at the Iowa State University Horticulture Station, Ames, IA, in an area planted with Seyval Blanc grapevines from 1986 to 1996. The plots were fallowed for four years and then four weed management treatments were established in 2000. Weed management treatments included monoculture cover crops of *Rudbeckia hirta* L. [blackeyed Susan] and *Panicum virgatum* L. [switchgrass], and plots that were hand-cultivated or treated with herbicide. In 2005, cover crops and weeds were chemically treated followed by planting Seyval Blanc grapevines propagated on their own roots or grafted onto C-3309 rootstock. Types (grafted or own-rooted) of plants served as the split plot and were randomized within the weed management plots that were replicated four times. Treatment rows were mulched with straw to cover graft unions for winter protection, which was removed and discarded from rows in the spring. Plots were treated with contact herbicide each month after weed data collection.

Weed growth was evaluated by visual percentage, density, type, and dry shoot weight of weeds. Grapevine shoot growth was determined from cane vigor (length) and pruning weight of the current season growth. Soil characteristics were determined by measuring macroaggregate mass, bulk density, water infiltration, P, K, Ca, Mg, and pH. Nematodes were enumerated from soil by sugar extraction.

Results and Discussion

Weed growth results. Grass weed density and dry weight were lower in plots rotated with *P. virgatum* than plots rotated with *R. hirta* (Table 1). Broadleaf weed density was lower in plots rotated with *R. hirta* than plots rotated with *P. virgatum*. There were no differences among treatments for total percentage weed cover or broadleaf weed shoot dry weight.

Shoot growth results. In 2005, the year of planting, shoot growth of grafted vines was higher in plots rotated with *R. hirta* compared with plots rotated with *P. virgatum* or hand-cultivated (Table 2). There were no differences in growth found among weed management treatments in the own-rooted plots.

In 2006, grape shoot growth was greater on grafted plants in plots treated with herbicide and plots rotated with *R. hirta* than on grafted plants in plots rotated with *P. virgatum* or hand cultivated and all weed management treatments of own-rooted plants (Table 2).

In 2005 and 2007, shoot growth of grafted plants was greater than shoot growth of own-rooted plants in all treatments. However, grafted

plants are susceptible to cold injury and require straw mulch for winter protection.

Soil characteristics. No differences were found between treatments in the variables P, K, Ca, Mg, pH, bulk density, and initial water infiltration in soil collected from the 2006 growing season. Aggregate mass was greater in plots rotated with *P. virgatum* and least in plots treated with herbicide (data not presented).

Continued research. Pruning weights will be collected in the spring of 2008. In addition, soil characteristics and nematode analyses will be completed for the growing season of 2007.

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Table 1. Weed incidence (percentage cover and density) and dry weight in plots of Seyval Blanc grapevines after the rotation with cover crops, hand cultivation, or herbicide treatments.

Treatments	Percentage weed cover (%) ^z	Grass density (no.) ^z	Broadleaf density (no.) ^z	Grass dry wt. (g) ^z	Broadleaf dry wt. (g) ^z
<i>R. hirta</i>	54.9 a ^y	85.5 a	10.9 b	8.66 a	18.62 a
<i>P. virgatum</i>	55.7 a	43.2 b	29.5 a	0.80 b	21.77 a
Hand Cult.	51.7 a	33.8 b	18.0 ab	3.87 ab	16.62 a
Herbicide	61.8 a	66.3 ab	18.8 ab	6.08 ab	21.84 a
LSD $P \leq 0.05^w$	NS	35.7	15.5	6.04	NS

^zData presented are averages of three samples (.25 meter²) per plot.

^yMeans of four replications.

^wData with the same letter are not statistically different. NS = not statistically different.

Table 2. Seyval Blanc shoot length and pruning weight of own-rooted or grafted grapevines after the rotation with cover crops, hand cultivation, or herbicide treatments.

Treatments	Type of plant	Shoot length (cm) ^z			Pruning weight (oz.) ^y
		2005	2006	2007	2007
<i>R. hirta</i>	Own Roots	100.4 c ^x	210.8 cd	377.8 b	1.43 de
<i>P. virgatum</i>	Own Roots	127.6 c	211.8 cd	382.5 b	1.75 cde
Hand Cult.	Own Roots	85.1 c	151.1 d	302.6 b	1.00 e
Herbicide	Own Roots	115.3 c	171.4 cd	411.0 b	1.00 e
<i>R. hirta</i>	Grafted	380.1 a	676.4 ab	1157.8 a	10.71 a
<i>P. virgatum</i>	Grafted	274.6 b	430.1 bc	955.8 a	4.50 bcd
Hand Cult.	Grafted	271.9 b	375.8 cd	1037.4 a	5.00 bc
Herbicide	Grafted	301.8 ab	720.6 a	1006.6 a	6.25 b
LSD $p \leq 0.05^w$		87.15	260.14	5.88	6.65

^zData are the total cm of that one years' growth (pruned second- or third-year growth was not calculated).

^yData were collected in March 2007, which corresponds to grapevine growth in the 2006 growing season.

^xMeans of four replications.

^wData with the same letter are not statistically different.