Legume Cover Crops Reduce Overall Weed Incidence and Increase Fruit Production of Organically Grown Raspberries

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Introduction

Weed accumulation in raspberry plantings is a primary concern of all producers in Iowa, especially in organic production. Tillage may be used to reduce weed growth as an alternative to herbicides in raspberry plantings. However, tillage leaves soil vulnerable to erosion and potentially depletes the nutrients and organic matter from the topsoil. Growing a living mulch on the soil surface reduces weed seed germination and growth, and it reduces the need for tilling after planting between the rows of raspberry plants. Legume living mulches also can provide nitrogen and fit within organic certification requirements. The overall objective was to determine the best organically certified soil management techniques to be used between rows in a perennial raspberry planting. Specific objectives were to determine soil management treatments' contribution to the soil's physical and chemical properties, weed growth, and raspberry growth and development.

Materials and Methods

Autumn Bliss bare root primocane-fruiting raspberry plants were planted May 13, 2008 at Turtle Farm, Granger, IA. Cover crops were planted May 15, 2008. The soil management techniques to influence soil properties and weed growth included 1) clean tillage every 30 days during the growing season, 2) a living mulch of *Medicago sativa* L. [alfalfa] (seed rate: 12 lb/acre), 3) a living mulch of *Trifolium repens* L. [white Dutch clover] (5 lb/acre), 4) a living mulch of *Lotus corniculatus* L. [bird's-foot trefoil] (8 lb/acre), and 5) a living mulch of *Lolium perenne* L., *Festuca sp*., and *Poa sp*. [turfgrass mix] (5 lb/acre).

Density, dry weight, and percentage cover of weed plants and percentage cover of the cover crop plants were collected in July and August. Density and dry weight of weeds were determined by harvesting weeds; roots were discarded and shoots were dried for 72 hours at 67°C. Percentage weed cover was assessed visually as the total percentage of grass and broadleaf weed cover in the three random 50 cm × 50 cm area within each plot.

Ten soil cores (3.2 cm diameter) were collected from each plot on October 25, 2009 to a depth of 15.2 cm. Field-moist soil cores were sieved through 8 mm mesh for bulk density, gravimetric water, and inorganic N (nitrate and ammonium) extraction and then air dried for 72 hours at 22-23°C and used to analyze percentage stable aggregates and total N.

Results and Discussion

Total number of fruit and harvested weight were greatest in raspberry plots grown with white Dutch clover (Table 1). Plots that were tilled had relatively high yields, but yields were similar to plots of alfalfa and birdsfoot trefoil. The total number of canes growing in plots was similar among treatments, but the

weight of the canes was greatest in plots with white Dutch clover. Considering total yield and biomass weight of canes, data suggest that there was little or no competition from legume cover crops grown between rows of raspberries compared with areas that were tilled and did not have sustained permanent cover throughout the season. Since raspberry plants are irrigated regularly during the season, cover crops grown between rows of raspberries were not competitive and legumes as cover crops may benefit the soil and raspberry plants.

Weed populations were greater overall in June than in July. Plots that were tilled had a greater number of monocot weeds than the cover crop treatments in June (Table 2). In July, monocot weed numbers were greatest in plots of alfalfa and turfgrass. Dicot weed populations in June were greatest in plots of tillage and turfgrass (Table 2). In July, dicot weed populations were greatest in plots of birdsfoot trefoil. Over the complete year, monocot and dicot weed number and weight were lowest in plots with white Dutch clover.

In 2008, there were few differences in soil parameters among treatments, suggesting little affect of cover crops on the soil during the year of establishment. Soil was collected and analyses are being completed for the 2009 growing season for the variables of bulk density, gravimetric water, inorganic N (nitrate and ammonium), percentage stable aggregates, and total N.

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Table 1. Total number of fruit, yield, number of canes and total cane weight of raspberries grown with tillage or living mulches of alfalfa, white Dutch clover, birdsfoot trefoil, or turfgrass in 2009, Granger, IA.[z]

Treatments	Number of fruit	Total yield (g)	Number of canes	Biomass weight (oz)
Tillage	553 b	1241.5 ab	17	31.3 ab
Alfalfa	573 ab	1209.3 ab	16	28.0 ab
White Dutch clover	1000 a	2273.8 a	24	47.0 a
Birdsfoot trefoil	563 b	1208.7 ab	16	23.3 b
Turfgrass mix	449 b	952.1 b	14	15.3 b
LSD $P \leq 0.05$[y]	445	1100.5	NS	23.4

[z]Means are average cover of three treatment replications.

[y]Least significant difference at $P \leq 0.05$; NS = no significant difference; values sharing the same letter are not significantly different from each other.

Table 2. Number and weight of grass and broadleaf weeds of plots receiving tillage or living mulches of alfalfa, white Dutch clover, birdsfoot trefoil, or turfgrass in June and July 2009, Granger, IA.[z]

	Grasses				Broadleaves			
	June		July		June		July	
Treatments	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Tillage	22 a	1.97 a	9 b	1.87 b	10 a	0.73 ab	1 b	0.03 c
Alfalfa	4 b	0.91 ab	23 a	3.41 a	2 b	1.17 ab	1 b	0.51 bc
White Dutch clover	0 b	0 b	4 b	0.39 c	1 b	0.08 b	1 b	0.02 c
Birdsfoot trefoil	2 b	1.06 ab	8 b	0.83 bc	1 b	1.39 ab	3 a	2.47 a
Turfgrass mix	1 b	0.04 b	28 a	1.44 bc	5 ab	2.03 a	3 a	1.14 b
LSD $P \leq 0.05$[y]	5	1.11	12	1.30	7	1.44	1	1.08

[z]Means are average cover of three treatment replications.

[y]Least significant difference at $P \leq 0.05$; NS = no significant difference; values sharing the same letter are not significantly different from each other.