Winter Cover Crops for Reducing Storm Run-off and Protecting Water Quality in Strawberries.

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Introduction

Winter-planted cover crops are increasingly used to reduce storm water run-off from agricultural lands and to prevent the migration of sediment, nutrients, and pesticides to surface water bodies. Cover crops can also protect ground water by trapping mobile nutrients such as nitrate before they can leach below the root zone.

One way that cover crops minimize storm run-off is by maintaining high soil infiltration rates. By extracting soil moisture, cover crops allow a greater portion of rainfall to infiltrate thereby reducing the portion available for run-off. Cover crops may also enhance infiltration by increasing macropore space in soil. Root exudates and other organic material from the cover crop aggregate soil particles and contribute to the large pores that allow water to rapidly infiltrate into the soil profile. Additionally, cover crops absorb energy from the rain drops which can break down soil aggregates and cause the formation of a crust that seals the soil surface. The thin crust can greatly impede infiltration and increase run-off.

Cover crops can also reduce suspended sediments and turbidity of storm-water run-off by slowing the movement of run-off. Fast flowing water has more energy to detach soil particles and keep sediments suspended than water flowing slowly. Also, slowing run-off permits time for water to infiltrate into the soil.

Despite the many benefits of winter cover crops, they must be compatible with grower practices, and not reduce yield or adversely affect the economics of the commodity being produced. This precaution especially applies to strawberries since they are grown during winter months and are of high value. Most strawberry producers who use cover crops plant the perimeter of fields and irrigation blocks to protect roadways from erosion. Planting cover crops in the furrows between beds would be a better strategy to maximize infiltration and reduce nutrient loss during storm events, but is not a common practice due to potential interference with the production of the spring crop.

Comparing cover crop strategies in strawberries

We conducted a replicated field trial during the 2005/06 winter to investigate if cover crops planted in furrow bottoms could reduce storm run-off and improve water quality in commercial, organic strawberry field. Cover crops were planted in the furrow bottoms for the entire length of the beds on November 11th, 2005. We compared a low stature cover crop (triticale), which was less likely to compete with the berry growth, with a fast growing barley variety. An unplanted control treatment was also included in the trial. The cover crop treatments were mowed once (Jan. 16th) to minimize competition with the strawberries. The unplanted control plots were hand weeded 3 times during the trial. The field was located near Moss Landing on the Elkhorn Ranch and had approximately a 2% fall. Plots consisted of 2, 48-inch wide beds of 312-foot length. Water from one furrow per plot was collected in a sump at the low end of the field. A marine bilge pump and a flow meter were used to measure the amount of collected runoff. Some of the water that was pumped was diverted through a narrow tube into a collection bucket for laboratory analysis.

Rainfall of individual storm events and cumulative rainfall for the season is shown in Figure 1. Most of the heavy storm events occurred during the end of December and early January, resulting in 8 inches of rainfall at the field trial site. The next series of rain events occurred in late February and early March.

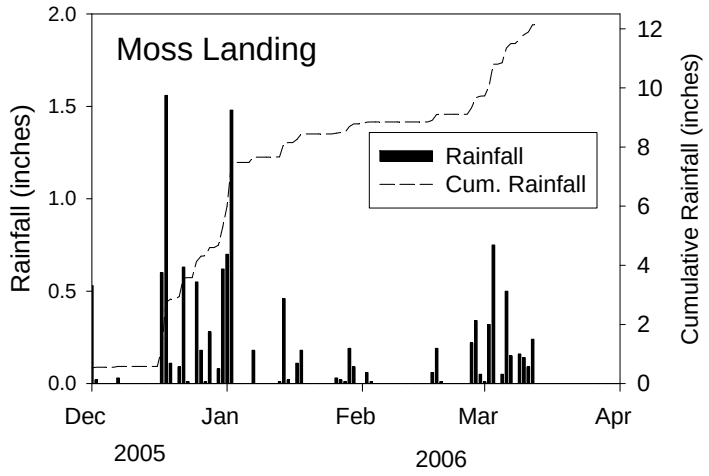

Figure 1. Rainfall amounts from individual storm events and total precipitation for the winter measured at the field trial site near Moss Landing.

Runoff collected from the plots during the late December storm events (Dec 22 – Jan 3) was analyzed for sediments, nutrients, and dissolved salts. Total run-off during this period was similar among all treatments (Table 1). The cover crops may not have reduced run-off because the ground was saturated at the beginning of the sampling period. More than 2 inches of rainfall occurred 3 days prior to collecting the first set of run-off samples. Also an impervious clay layer several feet below the soil surface may have prevented rainfall from infiltrating once the soil was saturated.

Data showing that run-off measured from the plots was slightly greater (0.5 inches) than the cumulative rainfall (4.6 inches) in late December would also suggest that the field was poorly drained. In late February and March, when evapotranspiration was higher and rainfall was less intense, the amount of run-off from all treatments was less than rainfall. Although cumulative run-off in early March was approximately a half inch less in the cover cropped plots compared to the unplanted plots, the differences among treatments were not statistically significant (data not presented).

Despite minimal effects on the amount of run-off, barley and triticale cover crops, planted in the furrow bottoms significantly improved the quality of the runoff (Table 1). Turbidity and suspended sediments were reduced by as much as 70% compared to the unplanted control. Total phosphorus and total nitrogen, which includes the organic fractions of these nutrients was reduce by 40% and 47% respectively in the cover crop treatments relative to the unplanted control treatment (Table 1). Soluble nutrients, such as ortho-phosphate and nitrate, and salts were not different among treatments.

Using triticale, a low stature cover crop, improved water quality as much as barley, which tends to have a tall stature. A low-growing cover crop would reduce the mowing needed during the winter and minimize competition with the strawberries. In this study, a hoeing in mid December which disturbed the soil may have contributed to the high suspended sediments in the control plots. Except for early winter, cultivation of the furrows is often not possible in organic strawberry production due to wet conditions.

Summary

Cover crops planted in the furrow bottoms in strawberries reduced sediment and turbidity in the run-off by as much 70% and reduced total P and total N by more than 40%. Soluble P and nitrate levels in the runoff were not reduced by using cover crops. Run-off amounts were similar in cover crop and unplanted areas, most likely because of inadequate drainage caused by a clay layer a few feet below the soil surface. Providing adequate drainage, either through deep tillage or tile drainage, appears to be prerequisite for cover crops to reduce run-off on poorly drained soils.

Table 1. Comparison of storm run-off collected from cover crop furrow treatments in organic strawberries. Values are averages of analyses from 6 storm events.

Cover Crop Treatment	Cumulative Runoff[Z]	Electrical Conductivity	pH	NO3-N	Total N	Total P	Ortho-P	Total Suspended Sediments	Turbidity
	inches	dS/m		ppm					NTU[Y]
Control	5.42	0.47	7.21	11.49	3.86	1.42	0.56	659	909
Triticale	5.07	0.55	7.41	11.77	2.05	0.89	0.56	222	320
Barley	5.26	0.59	7.45	10.84	2.04	0.80	0.50	205	266
	NS[X]	NS	***	NS	***	***	NS	***	***

[X] NS = not statistically signficant, *** = statiscally significant at the 0.001 confidence level

[Y] low NTU (Nephelometric Turbidity Units) indicate less turbidity

[Z] runoff was collected from 12/22/05 to 01/03/06