Evaluation of practices for controlling storm run-off from vegetable fields

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Introduction

Winter storm run-off from agricultural lands can transport sediments, nutrients and pesticides into nearby surface water. Because of the need to plant early in the year, when soils are often saturated, growers are challenged to implement management strategies that will reduce storm run-off and not interfere with early season production. Winter cover crops can often reduce storm run-off and improve soil structure but they can slow down planting operations in the early spring. The large amount of biomass produced by winter cover crops may require multiple tillage operations to fully incorporate material before bed shaping.

The purpose of this project was to evaluate alternative strategies to planting full cover crops, which might control storm run-off with less risk of slowing down early spring tillage operations. One strategy we examined was to pass over listed beds in the late fall with a tillage implement, called a prop, which mounds or "dikes" soil at regular intervals in the furrows so that run-off is retained, allowing more time for water to infiltrate. We also evaluated planting a low stature triticale crop (Trios 102) only in the furrows of a listed field to reduce biomass and to minimize residue on the beds, which may interfere with bed shaping in the early spring. Additionally we evaluated applications of a granular polymer (polyacrylamide) that was applied before storm events at rates ranging between 1.7 and 3.3 lb/acre (Table 1). Polyacrylamide (PAM) was applied by hand to the upper 200 feet of the field. Finally, we evaluated the combined practices of diking and planting a low stature cover crop in the furrows. These 4 alternative practices were compared with a complete cover crop (Merced Rye) planted in the furrows and on peaked beds in late November and to listed beds without any vegetation or other management practice to reduce run-off (untreated control).

The field trial was conducted at the USDA Spence research farm, near Salinas CA, and the soil type was a Chualar sandy loam. Plots measured 600 ft × 3, 40-inch wide beds. The field was listed November, -- 2005 and cover crops were planted Nov -- . The cover crops were germinated from rain fall in late November and early December. Treatments were replicated 4 times in the field following a randomized complete block design.

Summary of Results:

Because rain events in the early winter did not cause run-off at the trial site, overhead sprinklers were used to saturate the soil profile and to induce run-off. The first 5 run-off events were caused by overhead sprinklers and the subsequent 5 run-off events in late winter and early spring were from storms. The amounts of water applied by sprinkler events and precipitation measured from rain storms are presented in Table 1.

The cumulative amounts of run-off measured from plots during sprinkler and rain events are presented in Table 2. In general strategies that relied on vegetation significantly reduced run-off. Almost no run-off was measured from the full-cover Merced rye treatment. The cover crop planted in the furrow bottoms also greatly reduce run-off. The other practices (diked furrow bottom, dike furrows + cover crop, and PAM) did not reduce run-off from sprinkler events. Though, these 3 treatments had less run-off then the untreated control during rain events, the difference were not statistically significant.

The standard cover crop, furrow-planted cover crop, and PAM treatments reduced suspended sediment and turbidity in run-off induced by sprinklers (Table 3). The furrow-diked treatments did not achieve much reduction if any, in suspended sediments and turbidity. Total phosphorus concentration was not significantly reduced by any of the treatments; however, total nitrogen was reduced in the full, cover cropped and furrow-bottom cover cropped treatments. Sediment and nutrient concentrations in rain induce run-off were not significantly different among the control, PAM, and diked furrow treatments. Run-off was not collected from the full cover cropped and furrow bottom cover cropped treatments during this rain event.

Conclusions

Winter cover crops, planted in beds and furrows, or only planted in furrow bottoms, significantly reduce run-off and the concentration of sediments in run-off. By planting in the furrow bottoms with a low growing crop, such as triticale, it should be possible to minimize interference from residue during bed shaping. The diked, furrow bottom treatments did not reduce run-off. Because the furrows were not chiseled in the fall, the diking implement, may have compacted the furrow bottoms, thereby reducing infiltration. We will reevaluate the diking implement after chiseling the furrows during the second year of the trial. Granular PAM reduced sediment loss in sprinkler induced run-off but not under storm induced run-off. Possibly the rate of PAM, which was reduced to 1.7 lb/acre was too low to reduce sediment loss in the February rain event. Nevertheless, applying PAM to the head of the field may not be a satisfactory strategy for controlling storm run-off since the practice did not reduce run-off and was difficult to decide which storm events would require an application of the polymer.

Table 1. Water applied to field trial by overhead sprinklers and rain events.

Date	Precipitation	PAM application
	inches	lb/acre
	----overhead sprinklers --	
2/8/2006	1.89	3.3
2/10/2006	1.16	3.3
2/14/2006	1.23	3.3
2/17/2006	0.63	0.0
2/21/2006	0.79	1.7
	----- rainfall -----	
2/27/2006	0.54	1.7
3/3/2006	0.61	0.0
3/6/2006	0.38	1.7
3/10/2006	0.46	0.0
3/13/2006	0.42	0.0

Table 2. Cumulative sprinkler and rainfall induced run-off expressed in gallons per plot and percentage of applied water (rainfall).

	------------------ Cumulative Run-off ------------------------			
Treatment	Sprinkler induced[x]		Rainfall induced[y]	
	gallons	% of applied	gallons	% of rainfall
Untreated Control	674	5.9	1490	31.0
Standard Cover Crop	19	0.2	21	0.4
PAM[z]	976	8.6	1102	22.9
Furrow Dike	812	7.1	651	13.5
Furrow Dike +Cover	788	6.9	959	20.0
Cover Crop Furrow	191	1.7	--	--
CV (%)	55	55	70	70
$LSD_{0.05}$	475	4.2	914	19.0

[x] 5.7 inches applied between 2/8/06 and 2/21/06

[y] 2.4 inches measured between 2/27/06 and 3/13/06

[z] Total of 11.6 lb/acre applied before 4 irrigations between 2/8/06 and 2/21/06 and 3.33 lb/acre applied before 2 rain events between 2/27/06 and 3/13/06

Table 3. Average sediment and nutrient concentrations in sprinkler induced run-off.

Treatment	Total Suspended Solids	Turbidity	Total P	Total Kjeldahl N
	mg/L	NTU[x]	------- mg/L ---------	
Untreated Control	463	910	1.3	2.4
Standard Cover Crop	75	52	1.4	1.2
PAM[y]	116	119	0.9	2.9
Furrow Dike	448	1025	1.4	2.2
Furrow Dike +Cover	310	753	1.2	1.9
Cover Crop Furrow	189	460	1.3	1.4
CV (%)	21.6	28.1	9.5	16.7
F-test	0.003	0.011	0.110	0.008

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

[y.] Total of 11.6 lb/acre applied before 4 irrigations between 2/8/06 and 2/21/06 and 3.33 lb/acre applied before 2 rain events between 2/27/06 and 3/13/06

Table 4. Sediment and nutrient concentrations of rain induced run-off.

Treatment	Total Suspended Solids	Turbidity	Total P	Total Kjeldahl N
	mg/L	NTU[x]	------- mg/L	---------
Untreated Control	1046	3577	2.7	5.5
Standard Cover Crop	--	--	--	--
PAM[y]	1007	2113	2.5	5.2
Furrow Dike	1450	4290	3.5	6.3
Furrow Dike + Cover	705	2393	2.6	3.7
Cover Crop Furrow	--	--	--	--
CV (%)	52.2	41.6	25.1	27.2
F-test	NS[z]	NS	NS	NS

x. low NTU (Nephelometric Turbidity Units) indicate less turbidity

y. 1.65 lb/acre applied before a 0.54 inch rain event on 2/27/06

z. NS = not statistically significant