2009-2010 Low Residue Cover Crop Trial – Follow-up Details
Irrigation and Nutrient Management Meeting, February 23, 2011
University of California Cooperative Extension, Monterey County
Richard Smith, Michael Cahn, Aaron Heinrich and Barry Farrara

In November 2009 three treatments were established in a fallow vegetable production field off Old Stage Road, Salinas: 1) bare fallow; 2) winter dormant '888' triticale planted in the furrow bottoms; and 3) 'Merced' cereal rye broadcast seeded and lillistoned into fallow beds. All were seeded on November 13, germinated by rain on November 24 and killed with 2% glyphosate on January 15, 52 days after germination. Cover crop biomass and nitrogen uptake increased until 10 days following glyphosate application and declined thereafter as the residue decomposed (Figures 1 & 2). Cover crop biomass was well established prior to the onset of two intensive periods of rainfall in mid-January and late-February (Figure 3).

We measured quantity and quality of runoff from the cover cropped and bare treatments. 47.2% of rainfall ran off of the bare plots while 2.3 and 9.2% ran off of the rye and triticale plots respectively (Figure 4). Low residue cover crops reduced sediment loss (Table 1).

Nitrate-nitrogen concentrations in leachate were measured on 11 dates; concentration of nitrate in leachate was significantly lower in both cover crop treatments than the bare on five dates (Figure 5). However, the cover crop treatments had greater water infiltration and a higher load of leached nitrate was measured on one sampling date (Table 2).

Clearly, the impact of low residue cover crops has two counter balancing impacts on residual soil nitrate during the winter: they absorb modest amounts of nitrate from the soil and sequester it in their plant biomass (Merced rye absorbed 72 lbs N/A at peak growth), but facilitate greater water infiltration which can leach soil nitrate. In addition, after they are killed to manage cover crop biomass levels and the cover crop decomposes which brings up the question, is the nitrogen contained therein also subject to mineralization and subsequent leaching? We measured an increase in microbial biomass in the cover crop treatments (Table 2), which may indicate that some of the nitrogen contained in the plant biomass may be sequestered in the active fraction of soil organic matter. Deep soil samples at the beginning and end of the season indicated less nitrate in the 2-3 foot depth in the rye cover crop treatment at the end of the trial in March 2010 (figure 6). On the whole, it appears that in situations where there are high levels of available soil nitrate, low residue cover crops will only be able to sequester a small proportion of the nitrate. Under more moderate levels of fall soil nitrate, they can probably sequester a larger proportion.

Low residue cover crops increase water infiltration and this can have a beneficial impact on leaching accumulated salts during winter storm events. We observed more leaching of magnesium, sodium and chloride in the low residue cover crop plots (Table 3), and although not statistically significant, there was a trend indicating lower EC levels at all three soil depths in the rye cover crop treatment at the end of the trial (data not shown).

There was a great deal of variability in the stand of the broccoli planted following the cover crops, but it appeared that there was no impact of the cover crop on the yield of the subsequent crop of broccoli.

Figure 1. Nitrogen in cover crop biomass

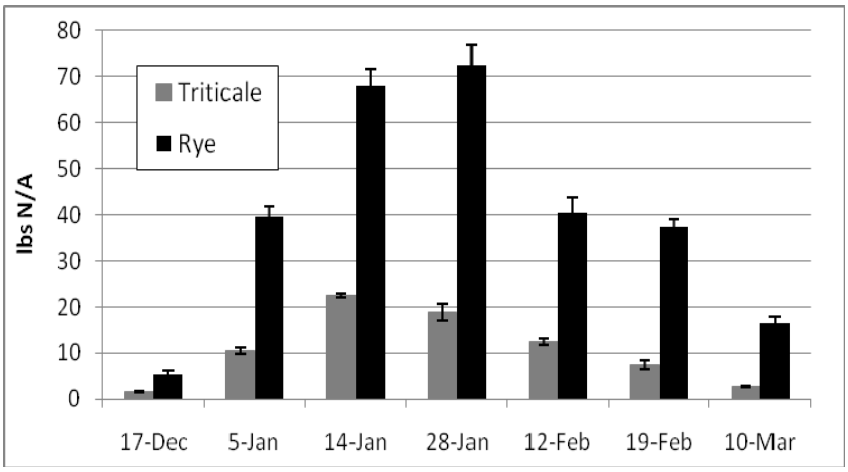
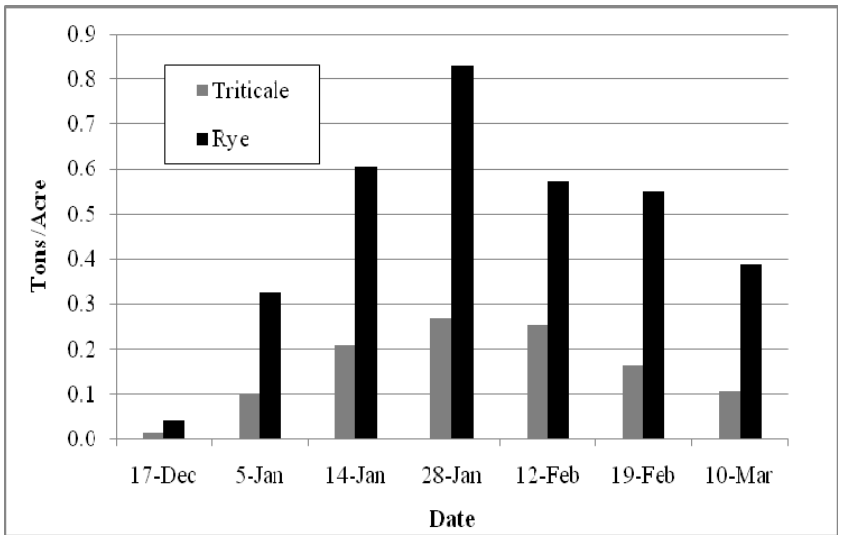


Figure 2. Cover crop biomass 2009 to 2010



glyphosate applied January 15, 2010

Figure 3. Rainfall during the winter of 2009 to 2010

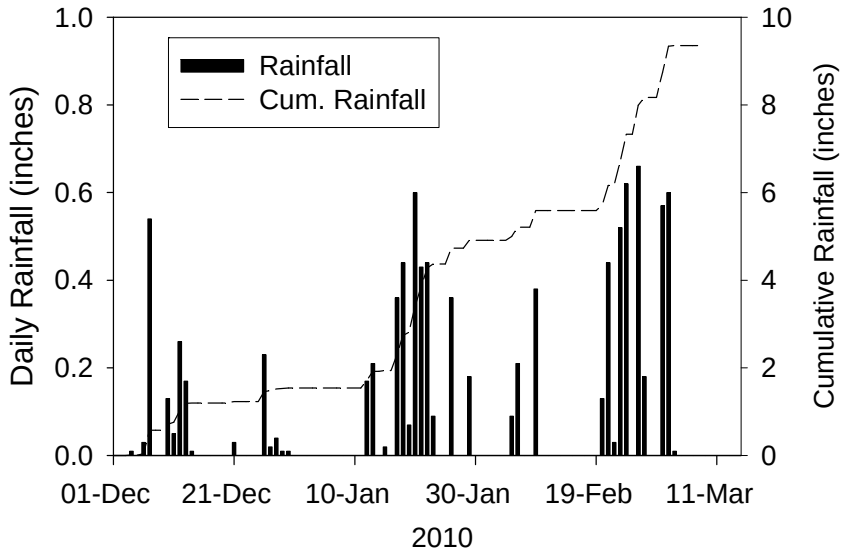


Figure 4. Total runoff in the three cover crop treatments

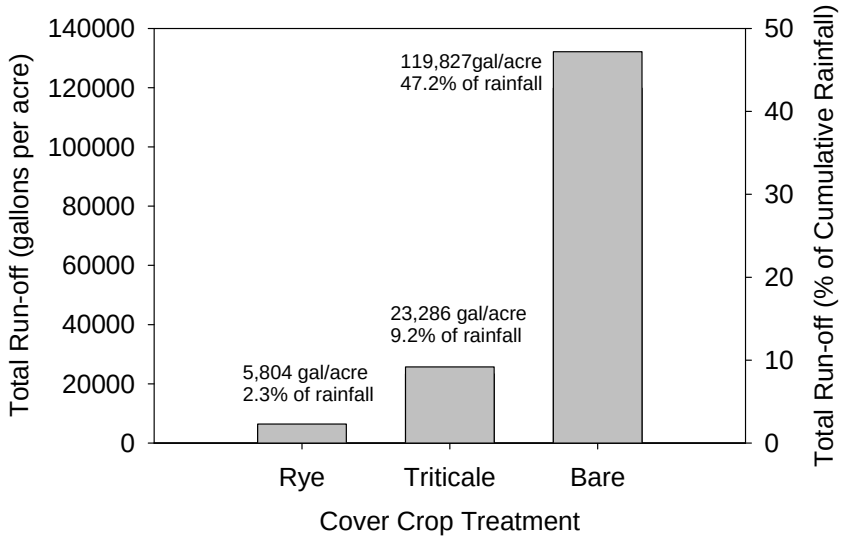


Figure 5. Nitrate concentrations in lysimeter extracts. Error bars represent the SE n=9.

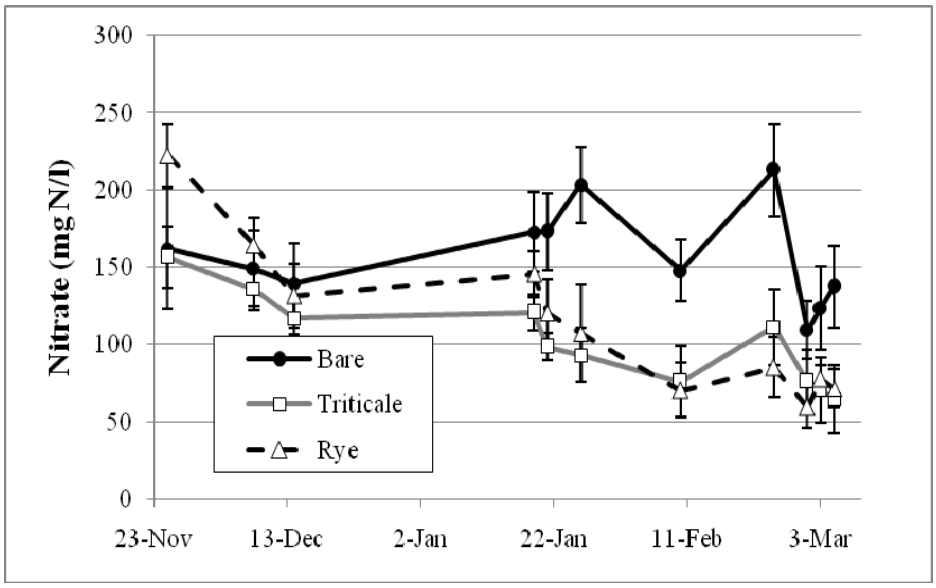


Table 1. Estimated sediment loss for cover crop treatments

	Suspended sediment concentration (ppm)		
Cover Crop Treatment	1000	2000	3000
	---------- sediment loss (lb/acre) ---------		
Bare-Control	376	753	1129
Rye-Full	9	19	28
Triticale-Furrow bottom	66	131	197

Figure 6. Nitrate and ammonium concentrations in the soil profile. Upper graph: November 23, 2009 prior to cover crop germination and lower graph: March 8, 2010 prior to tillage operations. Error bars represent the SE n=6.

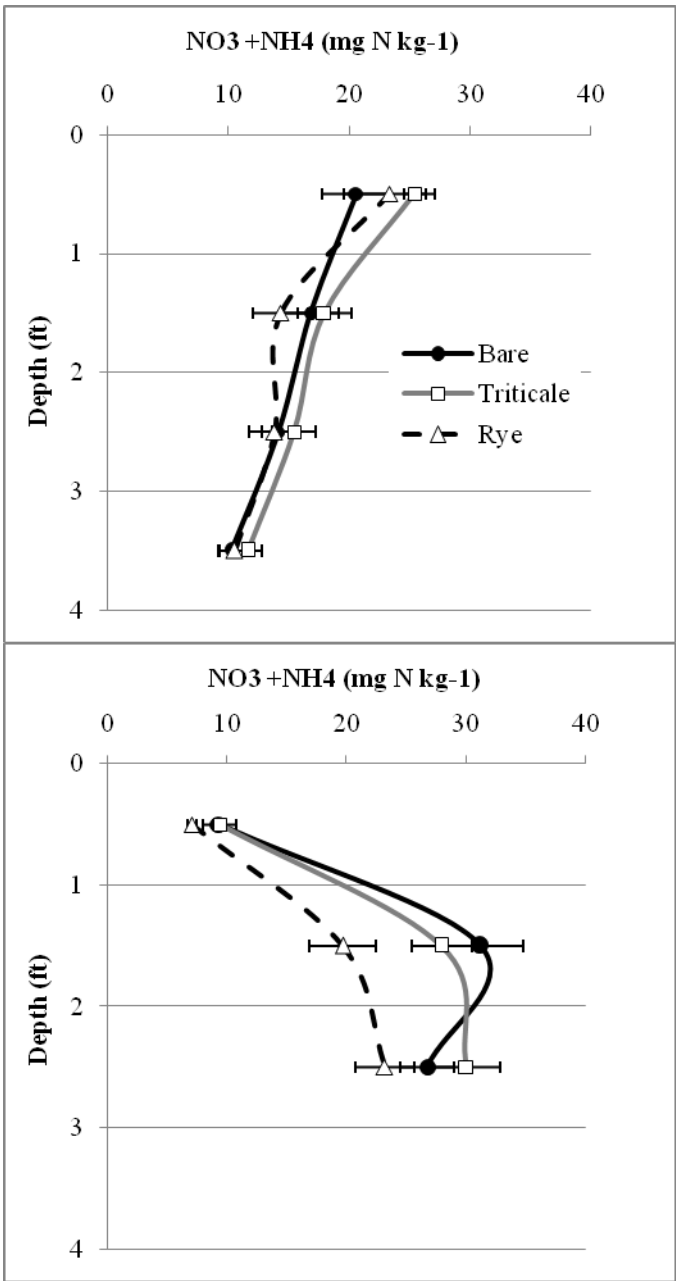


Table 2. Estimates of nitrate leaching (lbs N/A), inches water percolated through soil, percent rainfall that percolated through soil, microbial respiration and net mineralization of N in each treatment.

Treatments	Lbs nitrate-N/A leached							Water percolated through soil (in)	% of rainfall drained past 2'	Microbial Respiration mg CO_2-C/kg/hr	Net N mineralization mg N/kg soil
	Dec 8	Dec 14	Jan 26	Feb 10	Mar 1	Mar 5	Total				
Bare	15.1	7.8	18.8	7.5	15.3	3.9	68.5	2.36	24.08	0.36	15.9
Triticale	17.8	3.6	33.8	5.4	36.6	13.0	110.2	5.22	53.19	0.48	22.4
Rye	15.8	4.6	37.4	7.4	30.7	15.7	111.5	5.30	53.94	0.49	20.3
Pr>F treat	0.861	0.411	0.248	0.695	0.245	0.008	0.252	0.015		0.033	0.043
Pr>F block	0.690	0.904	0.407	0.354	0.827	0.184	0.762	0.662		0.859	0.721
LSD 0.05	NS	NS	NS	NS	NS	5.4	NS	1.7		0.11	5.0

Table 3. Estimate of cations and anions leached

	Nutrient leached (lbs/A)					
Treatment	K	Ca	Mg	Na	Cl	SO4-S
Bare	9	133	32	88	158	36
Triticale	18	216	55	178	275	60
Rye	16	226	63	191	289	69
Pr>F treat	0.260	0.179	0.074	0.008	0.062	0.120
Pr>F block	0.258	0.998	0.991	0.589	0.519	0.812
LSD 0.05	NS	NS	27	50	115	NS