Demonstrating Cover Crop Mixtures on Iowa Farmland: Management, Soil Health, and Water Quality Benefits

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Introduction

Cover crops are an important component of the Iowa Nutrient Reduction Strategy, which calls for a high level of adoption to reach the goals of reducing nitrate-nitrogen and phosphorus. Iowa landowners and farmers are increasingly seeing the value of single species cover crops and incorporating them into their cropping systems. However, in Iowa and the Upper Midwest, there is limited research on using cover crop mixtures.

In theory, cover crop mixtures have the same advantages as natural ecosystems like prairies, which are diverse mixtures of species. The most important advantage would be greater and more stable total plant growth. Including multiple species with complimentary characteristics, a mixture of plant species can take advantage of multiple niches and environmental conditions in space, time, weather, and seasons. For example, fast growing non-winter hardy annual plants can be combined with slower growing winter hardy biennial or perennial species.

The project's goal is to evaluate management techniques that will increase growth and improve the overall environmental benefits of cover crops in improving soil health and reducing nutrient losses.

Materials and Methods

Cover crop mixture plots were established at six ISU Research and Demonstration sites. The plots compare three treatments: no cover crop, single species cover crop, and a mixture cover crop. Each treatment is replicated four times at each site, for a total of 24 plots at each farm. The plots range from 6 to 12 rows wide and are all 50 ft in length.

Preceding the corn crop, the single species is oats and the mix contains hairy vetch, oats, and radish. Preceding the soybean crop, the single species is rye and the mix contains rapeseed, rye, and radish. The sites were established for the third season with hand seeding between August 25 and September 4, 2015.

For all project sites, cover crop biomass, late spring nitrate-nitrogen, and cash crop yield data is collected to evaluate the establishment of the cover crops and potential yield impacts.

Groundwater lysimeters were installed at five of the research plots to collect and analyze water samples for nitrate. These samples are collected at least once a month, and twice a month through the wetter portions of the year.

The project also has an on-farm demonstration component with nine farmer partners who aerially established cover crop mixture demonstration plots for the second year in 2015 and are demonstrating two treatments: no cover crop and a mixture cover crop.

Results and Discussion

Corn grain yields were not statistically affected by the single species or mixture cover crop treatments in 2014 or 2015 (Table 1). The fall 2014 oat biomass growth was different at the various locations, but not statistically different within locations. Late spring nitrate samples were not statistically different within a location, but were much lower at Lewis, Iowa.

Soybean grain yields at Sutherland in 2015 were affected by the cover crop treatments, where the winter cereal rye alone resulted in lower soybean yields (Table 2). Both the fall 2014 and spring 2015 winter cereal rye biomass was greater for the single species treatment compared with the cover crop mixtures treatment.

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Table 1. Corn grain yield, biomass growth, and late spring nitrate-nitrogen concentration for a no cover control, single species (oats), and cover crop mixture (oats, radish, hairy vetch) at six locations across Iowa.

Location	Treatment	Corn yield 2014	Corn yield 2015	Fall 2014 oat biomass	Fall 2014 radish biomass	Fall 2014 hairy vetch biomass	Late spring nitrate test
		bu/ac	bu/ac	lb/ac	lb/ac	lb/ac	ppm
Sutherland	No cover	187.2	228.9	-	-	-	40
	Single	186.1	218.7	453.3	-	-	32
	Mix	192.5	226.8	490.9	53.6	31.2	39
	Pr > F	0.7018	0.5055				0.8234
Kanawha	No cover	145.1	214.0	-	-	-	42
	Single	141.9	209.4	303.9	-	-	47
	Mix	148.5	211.1	225.7	24.8	21.7	44
	Pr > F	0.6054	0.6981				0.7973
Nashua	**No cover**	**161.6**	**244.7**	**-**	**-**	**-**	**47**
	Single	**170.1**	**246.3**	**267.1**	**-**	**-**	**55**
	Mix	**167.3**	**246.4**	**307.4**	**40.8**	**15.1**	**46**
	Pr > F	**0.6598**	**0.8712**				**0.9287**
Lewis	No cover	227.6	238.4	-	-	-	5
	Single	216.3	245.0	139.1	-	-	6
	Mix	220.0	257.4	183.8	104.4	28.8	7
	Pr > F	0.4986	0.3654				0.1256
McNay	No cover	211.2	231.2	-	-	-	23
	Single	221.2	231.6	NSG	-	-	30
	Mix	232.3	234.4	NSG	NSG	NSG	35
	Pr > F	0.5307	0.9629				0.4102
Crawfordsville	No cover	221.2	234.3	-	-	-	64
	Single	212.2	239.5	NSG	-	-	61
	Mix	209.5	237.1	7.8	10.0	17.3	59
	Pr > F	0.5057	0.3945				0.7300

NSG, not sufficient growth.

Table 2. Soybean grain yield and biomass growth for a no cover control, single species (winter cereal rye), and cover crop mixture (winter cereal rye, rapeseed, radish) at six locations across Iowa.

Location	Treatment	Soybean yield 2014	Soybean yield 2015	Fall 2014 cereal rye biomass	Fall 2014 rapeseed biomass	Fall 2014 radish biomass	Spring 2015 cereal rye biomass
		bu/ac	bu/ac	lb/ac	lb/ac	lb/ac	lb/ac
Sutherland	No cover	61.5	70.4	-	-	-	-
	Single	57.9	63.7	102.2	-	-	5230.0
	Mix	58.9	68.0	55.2	30.0	35.8	3085.9
	Pr > F	0.0021	0.0407				
Kanawha	No cover	36.8	55.7	-	-	-	-
	Single	42.1	48.9	199.7	-	-	8745.3
	Mix	44.9	53.4	107.9	25.7	26.8	7422.4
	Pr > F	0.2437	0.2251				
Nashua	**No cover**	**70.9**	**75.8**	**-**	**-**	**-**	**-**
	Single	**71.4**	**75.4**	**187.1**	**-**	**-**	**2197.2**
	Mix	**71.0**	**74.1**	**127.9**	**24.7**	**25.9**	**1430.0**
	Pr > F	**0.9536**	**0.5498**				
Lewis	No cover	79.2	76.3	-	-	-	-
	Single	77.4	72.3	471.0	-	-	1647.1
	Mix	78.7	72.5	184.3	97.1	153.7	1186.0
	Pr > F	0.8640	0.5405				
McNay	No cover	74.6	58.9	-	-	-	-
	Single	71.7	51.5	93.0	-	-	1450.3
	Mix	73.6	48.9	85.2	NSG	NSG	868.1
	Pr > F	0.7712	0.4354				
Crawfordsville	No cover	62.9	57.9	-	-	-	-
	Single	63.4	57.5	80.4	-	-	850.3
	Mix	62.1	59.9	30.6	NSG	NSG	425.1
	Pr > F	0.9110	0.6238				

NSG, not sufficient growth.