

Enhancing Corn Yield in a Winter Cereal Rye Cover Cropping System

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Swetabh Patel, graduate assistant
John Lundvall, research affiliate
John Sawyer, professor
Department of Agronomy

Introduction

Water quality impairment related to nitrogen (N) is a concern in Iowa, including meeting nitrate (NO₃) drinking water standards and reducing the amount of N lost to the Gulf of Mexico. The Iowa Nutrient Reduction Strategy science assessment identified a rye cover crop as an important in-field management practice for reducing N and phosphorus (P) loss from fields (31% NO₃-N and 29% P), and for reducing soil erosion. However, the science assessment identified a corn yield reduction of 6 percent when grown following a rye cover crop. Lower corn yield with use of a cover crop is unacceptable to farmers, so it is important to identify practices that minimize impact on corn establishment, early-season growth, and yield. The objective of this project was to study production practices that might enhance corn yield when grown in a winter cereal rye cover cropping system.

Materials and Methods

The project was conducted in 2014 and 2015 at the Armstrong Research Farm, Lewis (Marshall silty clay loam); Southeast Research Farm, Crawfordville (Mahaska silty clay loam); Northeast Research Farm, Nashua (Floyd loam), and the Northwest Research Farm, Sutherland (Primghar silty clay loam). Corn was grown in rotation with soybean, with winter cereal rye established before the corn crop. The sites had a multi-year history of no-till with rye and no-rye cover crop treatments.

Production practices compared were rye cover crop and no cover crop; no-till and spring disk/field cultivate for corn; and with or without starter N at 30 lb N/acre (urea placed 2 in. to the side and 2 in. below the seed at planting). Plot layout was a split-split-plot arrangement—with cover crop/no cover crop the main plots, tilled/no-till the sub-plots, and starter/no starter the split-split-plots. Winter cereal rye (*Wheeler* variety) was inter-seeded by hand across the top of standing soybean prior to leaf drop in early-to-mid September. Rye seeding rate was 1.5 bushels/acre (84 lb seed/acre) in fall 2013 and 2.0 bushels/acre (112 lb seed/acre) in fall 2014. Rye growth was terminated each spring with Roundup in all plots (no-till and tilled treatments) when rye reached approximately 6- to 8-in. extended leaf height, and as soil conditions allowed. Spring tillage occurred after Roundup application and corn planted approximately two weeks after rye termination. The main N application was side-dress injected urea-ammonium nitrate solution, with total-N rate for all corn plots totaling 150 lb N/acre.

There was no rye cover crop preceding soybean, and soybean was grown with either no-till or fall chisel plow/spring disk-field cultivate tillage to maintain tillage systems. Adapted corn hybrids and soybean varieties were planted in 30-in. row spacing.

Results and Discussion

Aerial inter-seeding rye into standing soybean resulted in a less-uniform stand compared with previous study with drilling rye after crop harvest. Because rye growth was terminated at 6-8 inch height, the amount of rye biomass and N uptake was low (spring 2015 for tilled and no-till: 325 lb dry matter and 13 lb N/acre, and 273 lb dry matter and 10 lb N/acre). Despite the low rye biomass, the rye cover crop did reduce

soil profile NO₃-N (spring at time of rye termination, Table 1). The amount of rye biomass was greater in the plots tilled before soybean, possibly due to better rye seed-soil contact following the aerial seeding, or other soil conditions affecting rye growth. Corn population was not affected by the rye cover crop. Corn grain yield was less with no-till than with the spring-tilled system (Table 2). Despite the small amount of rye biomass at termination, and waiting two weeks to plant corn, there was a 2 percent corn grain yield reduction with the rye cover crop compared with no rye. That yield reduction was similar with no-till and the spring tilled system, however, the tilled system had higher yield than no-till. In both tillage systems with the rye cover crop, corn early growth and yield was improved with the 2 × 2 placed high N starter rate (as studied here with the main N

applied sidedress). Therefore, starter N is a management practice that can offset negative corn yield effects of a rye cover crop.

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Table 1. Effect of rye cover crop (RCC) and tillage system on spring profile soil NO₃-N (0-2 ft) at rye termination, spring 2015 (across sites).

Tillage	Cover crop		Mean
	RCC	No RCC	
	----- lb NO ₃ -N/acre -----		
Till	15	44	29
No-till	13	41	29
Mean	14b	42a	

†Profile soil NO₃-N means followed by different letters are significantly different, P ≤ 0.10.

Table 2. Effect of rye cover crop (RCC), tillage, and starter N on corn yield (across site-years).

Starter	RCC			No RCC			Tillage mean		Starter mean
	Till	No-till	Mean	Till	No-till	Mean	Till	No-till	
	----- bu/acre -----								
Starter	201	197	199	207	200	203	204	198	201a
No starter	198	194	196	204	197	200	201	195	198b
Tillage mean	200	196		206	198		203a	197b	
RCC mean			198b			202a			

†Corn yield means followed by different letters are significantly different, P ≤ 0.10.