Evaluating Perennial Groundcover Establishment Methods and Timing to Reach Successful Stands Within Corn/Soybean Cropping System Constraints

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The degradative processes of erosion and nutrient depletion impact the health of land and water resources external to specific farming operations. Nitrate leaching that affects the quality of public drinking water is a serious public health concern for which millions of dollars have been spent to reduce nitrate levels and make drinking water safe in Iowa alone, with another projected $30 million for safe water from new well construction (Iowa Public Radio News, 2021). A maximum contaminant level (10 mg L-1 NO3) has been established to reduce the related health risks, as excessively high nitrate levels can contribute to a potentially lethal physiological disorder in humans. However, it has been reported that no significant change in nitrogen fertilizer use has occurred in recent years in Iowa watersheds; future best management practices should therefore extend beyond fertilizer application rates or timing into the development of alternative systems.

Previous studies have found that 50% perennial groundcover (PGC) will decrease erosion and support corn yield in PGC systems. Perennial groundcover also can uptake nitrate as soils warm and natural mineralization and nitrification ramps up prior to the uptake of N by the corn crop.

An experiment was designed to assess the establishment success of groundcover following either corn or soybean with: Fall seeding of PGC–1) in second half of September, and 2) second half of October; Spring seeding PGC–3) frost seeding, 4) late March/early April, and 5) late April; Fall/Spring seeding PGC–6) first half of October and late March/early April; Fall/Spring seeding PGC–7) second half of October and late April; and 8) Control--no cover, for a total of 16 combined treatments. PGC presence was assessed as well as the resultant impact on 1) red:far-red (R:FR) ratios, 2) maize developmental morphology, yield, and yield components, and 3) weed community.

Materials and Methods

Experiment design at the Sorenson Research Farm at Ames, Iowa, in 2021 (Year 1) was a randomized complete block with four replications and 16 unique 10 by 20-ft. plots per block. ‘Midnight’ Kentucky bluegrass was seeded as the PGC in all treatments.

Plots were fertilized at 40-100-110 N-P-K with broadcast spreader on April 20 and cultivated prior to maize planting on April 28. On May 4, corn was fertilized with 151 lb./acre of 43–0–0–4 with Valmar banded spreader. Herbicides were applied as needed.

Stand density was measured at early vegetative (V2) and late reproductive (R6) stages. Maize maturity (stage), maize height, and R:FR ratio were recorded weekly.

A 5-ft row of maize was hand harvested at R6 on September 22, 2021, from the two center maize rows in each plot. The two center rows per plot, less the hand harvest, were combine harvested on October 1, 2021, for moisture, weight, and yield. Plant and ear number, fresh weight of stover and ears were recorded, from which yield and components (kernel rows/ear, kernels/row, and kernels/ear) were estimated.

Grain quality was evaluated by transmittance Near Infrared Spectroscopy (NIRS). Modified grid sampling technique was used post-harvest to assess PGC establishment. Fall, post-harvest weed communities also were measured for weed control benefits of PGC.

Results and Discussion

In 2021, maize yield, stover yield, total aboveground biomass (TAB), and harvest index (HI) were similar for treatments, averaging 172 bushels/acre, 6,674 lb./acre, 14,876 lb./acre, and 0.55, respectively. Rows/ear also was similar for treatments, averaging 14.1 rows/ear. In 2021, the research site and much of central Iowa was in abnormally (D0) to severely dry (D2) conditions (National Drought Mitigation Center, 2021). Treatment effects likely were minimized under the dry conditions, and a larger coefficient of variation (18).

The end-of-season PGC frequency was collected with a 10 by 10 frequency grid (3 in. by 3 in. per square) at the end of the growing season, post-harvest on October 19, 2021, to assess groundcover persistence under maize with 200 cells counted per plot. The 5 by 5 frequency grid for warm-season, grassland grasses (Vogel and Masters, 2001) was refined for enhanced accuracy with smaller squares for cool-season turfgrass frequency estimates. The PGC frequency also was similar for all treatments (averaging 6.1, P > 0.05), likely impacted by the dry conditions in 2021 at the research farm.

Table 1. Treatment averages and significance for grain yield (GY), stover yield, total aboveground biomass (TAB), harvest index (HI), and maize rows/ear (RE), at Sorenson Research Farm in 2021. Grain yield is expressed at 15% moisture content for maize. TAB, stover yield, and HI are on an oven-dry basis.

Treatment†	GY	Stover	TAB	HI	RE
	bu./ac.	lb./sc.			#/ear
Following Corn:					
Fall seeding PGC–Sept. 24, 2020	173	6,637	14,882	0.55	14.1
Fall seeding PGC–Oct. 19, 2020	188	7,397	16,373	0.55	14.3
Spring seeding PGC–frost seeding	145	6,947	13,875	0.50	14.1
Spring seeding PGC–Apr. 1, 2021	169	7,562	15,618	0.51	14.4
Spring seeding PGC–Apr. 27, 2021	200	7,178	16,688	0.57	14.1
Fall/Spring seeding PGC—Sept. 24, 2020 and Apr. 1, 2021	158	6,676	14,186	0.53	14.2
Fall/Spring seeding PGC–Oct. 19, 2020 and Apr. 27, 2021	182	7,117	15,797	0.55	14.6
Control—no cover	171	7,434	15,560	0.52	14.1
Following soybeans:					
Fall seeding PGC–Sept. 24, 2020	177	5,982	14,413	0.57	14.0
Fall seeding PGC–Oct. 19, 2020	145	5,691	12,606	0.54	14.3
Spring seeding PGC–frost seeding	176	5,873	14,257	0.58	14.1
Spring seeding PGC–Apr. 1, 2021	147	6,489	13,487	0.51	14.0
Spring seeding PGC–Apr. 27, 2021	173	5,590	13,848	0.60	13.9
Fall/Spring seeding PGC–Sept. 24, 2020 and Apr. 1, 2021	190	7,138	16,199	0.57	14.5
Fall/Spring seeding PGC–Oct. 19, 2020 and Apr. 27, 2021	163	6,246	14,005	0.56	13.5
Control—no cover	197	6,832	16,224	0.58	13.7
	Significant (P > F)				
Treatment	0.2944	0.4916	0.2252	0.6950	0.5946