Evaluating Strip and No-Till Establishment and Maintenance of Perennial Groundcovers

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Perennial groundcover (PGC) offers a tenable solution in reducing soil nitrate leaching and natural resources stewardship, as a system compatible with annual row crops grown on three-quarters of the 320 million total United States harvested cropland acres (USDA National Agricultural Statistics Service, 2017 Census of Agriculture). Nitrate leaching reductions by perennial covers generally are assumed to be greater than annual cover crops, because perennial covers are present on the landscape year-round.

Some of the desirable characteristics of grass species as PGC have been recognized as disadvantages in modern turfgrass applications. Dormancy is such an example, as an adaptive condition, or mechanism, which entails an escape from drought stress, and wherein which life cycles are completed prior to the onset of moisture insufficiency. Suppression efficacy is particularly important as compatible groundcovers are developed for groundcover applications, instead of relying on off-the-shelf germplasm as groundcover species; although good results have been obtained with such genetics with comparable grain yield to no-PGC control. Effective suppression and suppression duration are needed to ensure the groundcover does not elicit first the shade avoidance response, or secondarily compete with the row crop during the critical period for weed control.

An experiment was designed to assess the effectiveness of three suppression methods with a groundcover displaying many of the desirable perennial cover crop traits, including two strip tillage implements and one sprayer implement (ETS tillage, Unverferth tillage, and Redball-Hooded band sprayer) each at two widths of 10 and 15 in. (with 20-in. band sprayer) in spring immediately to planting, and the resultant impact on 1) 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 2020-2021 was a randomized complete block with four replications and 11 unique 10 by 20-ft. plots per block. Treatments included the three suppression methods at two widths on Kentucky bluegrass 'Midnight', alternating strips of PGC at 10 and 15 in., plus no PGC with conventional tillage, ETS strip tillage at 10 in., and no PGC, no-tillage for controls.

Plots were fertilized and cultivated prior to maize planting on May 12 in Year 1 and April 30 in Year 2. Herbicides were sprayed as needed. Stand density was measured at early vegetative (V2) and late reproductive (R6) stages. Maize maturity (stage), maize height, and red:far-red (R:FR) ratio were recorded weekly.

A 5-ft row of maize was hand harvested at R6 on September 29, 2020, and 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 8, 2020, and 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

Wider suppression widths generally produced greater R:FR ratio, and R:FR ratio was greater in the conventional tillage no-PGC control.

In 2020, maize grain yield in the alternating strips of PGC at both widths (181 bushels/acre) were similar to the no-PGC, conventional tillage control (203 bushels/ acre), and greater than the continual groundcover strips (160 bushels/acre). However, maize grain yield in the continual PGC treatments was similar to the three no-PGC treatments,collectively. Maize grain yield was similar for systems in 2021, (118 bushels/acre), likely due to abnormally (D0) to severely dry (D2) conditions in central Iowa. Weed community was unaffected by systems in both years.

In 2020, continual and alternating PGC produced similar stover yield, but continual PGC yielded less than the no-PGC treatments and alternating PGC at either width produced less stover than the conventional tillage, no-PGC. In 2021, stover yield between widths and suppression methods were similar. In 2020, total aboveground biomass (TAB_ was similar between suppression widths for each suppression method. In 2021, TAB was similar between treatment widths, but greater in alternating and no-PGC than continual PGC.

In Year 1, rows/ear was similar at 14.4 rows/ear. In Year 2, continual PGC produced fewer rows/ear than the alternating and no PGC. The alternating PGC produced similar row numbers to the conventional tillage with no-PGC.

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 2020-2021. 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	GY	Stover	TAB	HI	RE
	bu./ac.	lb./sc.			#/ear	bu./ac.	lb./sc.			#/ear
	2020					2021				
ETS 10 in.	147	6,135	13,136	0.53	14.3	103	4,474	9,394	0.53	13.2
ETS 15 in.	146	7,064	14,029	0.49	14.5	135	5,367	11,814	0.55	13.5
Unverferth 10 in.	142	7,108	13,904	0.49	14.2	94	3,983	8,457	0.53	12.8
Unverferth 15 in.	151	7,555	14,743	0.48	15.2	112	4,778	10,144	0.52	13.4
Redball 10 in.	166	7,251	15,163	0.52	14.0	112	5,188	10,537	0.51	12.1
Redball 20 in.	166	9,537	17,485	0.46	14.5	102	4,304	9,171	0.52	13.1
Alternating 10 in.	181	7,903	16,556	0.52	14.6	134	5,608	12,011	0.53	13.7
Alternating 15 in.	181	8,260	16,896	0.51	14.6	134	5,546	11,948	0.54	14.1
No PGC-conv. tillage	203	10,153	19,851	0.49	14.7	132	6,840	13,136	0.48	14.1
No PGC-ETS 10 in.	166	7,296	15,244	0.52	13.8	118	5,840	11,475	0.49	14.2
No PGC-no till	138	7,430	14,011	0.47	14.2	120	5,912	11,636	0.48	13.5
	Significant (P > F)									
	0.0071	0.0005	0.0004	0.1920	0.1661	0.4224	0.0085	0.0406	0.8425	0.0002