South Dakota Soil Health Coalition
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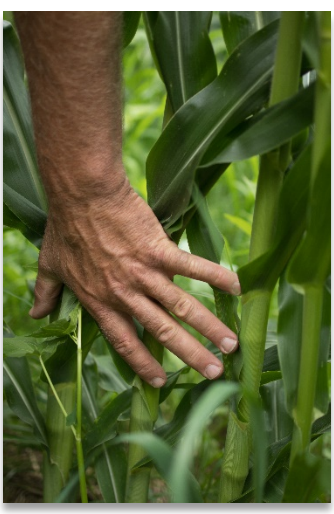
2019 Research Report —60-Inch Wide Corn Rows, Interseeded With Cover Crops

Project Summary:

- Compared field production of the standard farming practice of 30-inch corn grown as a monoculture, to alternative wide row (60 inch) corn grown with diverse cover crops interseeded.
- Compared corn grain measurements included moisture, test weight, protein content, and yield. Completed soil health tests (initial benchmark and future soil sampling), soil moisture, and bulk density.
- Overall, grain yield was greater in the standard 30-inch corn plot, while the 60-inch plot offered much greater plant biomass.

Background:



Throughout the corn belt, most corn fields are planted in rows spaced 30 inches apart and any additional plants that emerge during the growing season are eradicated. This method of corn production aligns with most university recommendations and best management practices while delivering exceptional grain yields. Interest is increasing however, in planting corn with alternative management practices of wider rows and integrating diverse plant species in between the corn rows to improve soil health and field profitability. Wider corn rows offer the opportunity for the entire corn plant to capture sunlight. Narrow corn rows (30-in or less) limit sunlight to the bottom two thirds of the plant as the upper leaves of the plant block sunlight to leaves below.

In order to improve soil function, fertility, and overall soil health, the addition of cover crops, seeded between crop rows, is attractive to many producers. With a properly designed mix, potential cover crop benefits in addition to the ones listed above include, providing feed for livestock, habitat for wildlife, and managing excess soil moisture. Seeding cover crops between narrow row corn has had marginal success due to minimal sunlight reaching the cover crop seedlings through the corn leaf canopy. Cover crop seeding after corn grain harvest in South Dakota generally does not allow enough time for the cover crop to establish as the growing season wanes. The methods of this experiment served two purposes: 1. Determine if 60-inch wide corn rows can achieve similar or greater yield than standard 30-inch rows. 2. Allow cover crop success through access to sunlight between the wide corn rows seeded early in the growing season.

Methods:

The trial was conducted on David Kruger's farm near Twin Brooks, South Dakota. Four 120-ft. (three 16 row planter passes) replicated trials were conducted within the ten-acre field, alternating 30-inch and eight 60-inch rows across the field. 60-inch rows were established by disengaging seeding ability to eight of the planter's rows. Desired population was set to achieve 30,000 seeds per acre in both the 30 and 60-inch trials. As the 60-inch corn rows contained twice the seeds per row of the 30-inch rows, a semi-flex corn hybrid was chosen. Flex varieties allow the corn plant to vary ear size (grain yield) based on the environment. Semi-flex varieties fall somewhere in between fixed and full flex varieties, as fixed ear varieties handle stress well but will not increase ear size as much as a flex variety in favorable growing conditions.

Prior to planting corn, the three year no-tilled field received a burn down herbicide application. Corn seeding followed, with a liquid starter fertilizer placed two inches below and two inches to the side of the seed. Starter fertilizer was not shut off for the skipped corn rows, rather, planter applied fertilizer was applied through every 30-inch row regardless of whether it was a part of a 30 or 60-inch trial. Prior to seeding the cover crop, the entire field received a post emergence herbicide of thirty-two ounces of Roundup to terminate any weed seedlings. After the post emerge herbicide, cover crops were seeded between the 60-inch corn rows using a 10-ft. no-till drill while the corn was at the V-3 to V-4 growth stage. The entire field received a side dressed fertilizer application prior to planting the cover crop. Cover crop seed selection was based on the goals of building soil structure, improving soil health by increasing plant diversity and building organic matter, creating wildlife habitat, and allowing for supplemental livestock grazing.

Corn Production and Cover Crop Information	
Previous crop (2018)	Spring Wheat
Burndown Herbicide	26 oz. Roundup, 8 oz. 2,4-D LV6, 20 oz. Verdict per acre, AMS, and non-ionic surfactant
Corn Variety & Population	Peterson Farms Seed 78B98 VT2Pro (Semi-Flex) 30,000 seeds/ac
Corn Planting Date	5/4/2019
Post Emerge Herbicide	32 oz/ac Roundup
Cover Crop Seeding Date	6/5/2019
Sidedress Fertilizer Application	35 gal/ac 28% UAN
Total Fertilizer Applied	**N:** 170 lbs./ac **P:** 45 lbs./ac **K:** 23 lbs./ac
Corn Harvest Date	11/5/2019

Table 1: Plot agronomic protocols

Cover crop biomass clippings were documented throughout the growing season. Corn grain yield was determined using the yield monitor on the combine, in addition to calculations performed by weighing the grain and calculating the area harvested. Grain moisture, test weight, and protein content was analyzed and recorded.

Protein content analysis was conducted by SGS Lab and a Haney soil health test was conducted by Ward Laboratories Inc. The soil health test was performed in early spring for benchmark purposes, to gauge if the addition of cover crops would improve soil health. A second soil health test will be conducted in the spring of 2020. Soybeans will be planted in this same field during the spring of 2020 and soybean grain yield, test weight, protein, and soil health properties will be recorded at harvest time. Plot management information and dates are listed in Tables 1 and 2.

Cover Crop Seed Mix (lbs./ac)			
Cowpea	4.5	Winter Wheat	5.9
Sun hemp	0.8	Buckwheat	2.5
Hairy Vetch	0.8	Flax	3.0
Red Clover	0.5	Millet	4.9
Oat	3.5	Rapeseed	0.5
Annual Oregon Ryegrass	1.5		
Total Seed Rate		28.4	

Table 2: Cover crop seed information

Results:

Throughout the growing season, the plots were monitored weekly. As much of South Dakota and the upper Midwest received record rainfall, this created a challenging season. A lot of corn fields near the Twin Brooks area planted in early May emerged with poor crop stands, prompting many producers to replant. Though the spring weather was not ideal and had some setbacks, replanting was not necessary in the trial field. Over the course of the summer, the 60-inch corn with cover crops appeared healthier and displayed vibrant green color. The 30-inch corn did not display the same healthy green color as the 60-inch and began showing signs of nitrogen deficiency from early July through the rest of the season. Initial pre-harvest yield comparisons indicated the corn yield to be equal or even favor a higher yield in the 60-inch plots. At harvest time however, the 30-inch corn without cover crops yielded higher with the 60-inch corn with cover crops resulting in approximately a 10% yield decrease. Table 3 summarizes the average yield from the four replications and the biomass yield from the cover crop. Corn grain test weight and protein content were lower within the 60-inch trials and moisture content was higher than the 30-inch rows.

Overall Plot Yields	
Corn Harvest Plot Average (adjusted to 15% moisture)	**30-in plot**: 192 bu/ac, **60-in plot**: 174 bu/ac
Cover Crop Biomass (lbs./ac) 7/22/2019	14,000 lbs. green weight, 2,250 dry weight/ac
Cover Crop Biomass (lbs./ac) 9/27/2019	23,000 lbs. green weight, 6,500 dry weight/ac

Table 3: Average yield of the 4 trials and cover crop biomass

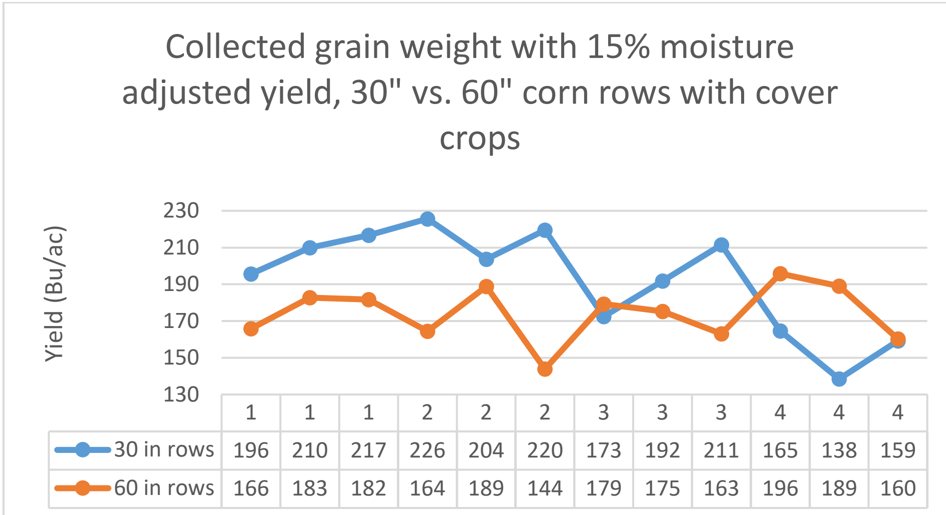


Chart 1: 30-in rows without covers averaged higher yield (grain was weighed with a weigh wagon)

Soil conditions including soil moisture and bulk density recorded at the time of corn tassel revealed less compaction and more moisture in the root zone, values are displayed in Table 4. Bulk density is an indicator of soil compaction which impacts water infiltration, water holding capacity, plant rooting depths, and other plant and soil interactions. Bulk density is the weight of soil in a given volume. Generally bulk density increases deeper in the soil profile and values higher than 1.6g/cm3 tend to restrict root growth. Soil moisture measures the amount of water stored in the soil and is affected by precipitation, temperature, and other soil characteristics. As mentioned previously, lack of moisture was not a limiting factor for this field. Though many more plants were growing/respiring between the wide corn rows, more soil moisture was found in the root zone. Plant root competition and interaction likely contributed to more soil moisture used deeper in the soil profile, maintaining more moisture near the root zone. Numerous other studies confirm diverse plants grown together in a drought conditions will maintain plant health and forage production significantly over single plant species grown alone. Addition of cover crop roots in the wide row plots reduces soil compaction and did utilize excess moisture while reserving plenty of moisture for the corn crop.

Plot Averaged Soil Moisture and Bulk Density		
30” Plot without cover crop	Soil Moisture: 4.95%	Bulk Density: 1.72g/cm3
60” Plot with cover crop	Soil Moisture: 6.25%	Bulk Density: 1.62g/cm3

Table 4: Soil moisture and bulk density plot averages

Discussion/Conclusion:

Though the objective of achieving equal to greater corn yield with the wider 60-inch rows and interseeding of cover crops was not met, the second objective was a success. The cover crop had immense growth and added a large amount of diversity to the field. Successful cover crop growth will most likely contribute to improved soil health within the filed, offered wildlife habitat, and provided ample forage which was available for livestock to graze. Again, soil health measurements will not be fully realized until subsequent growing seasons.

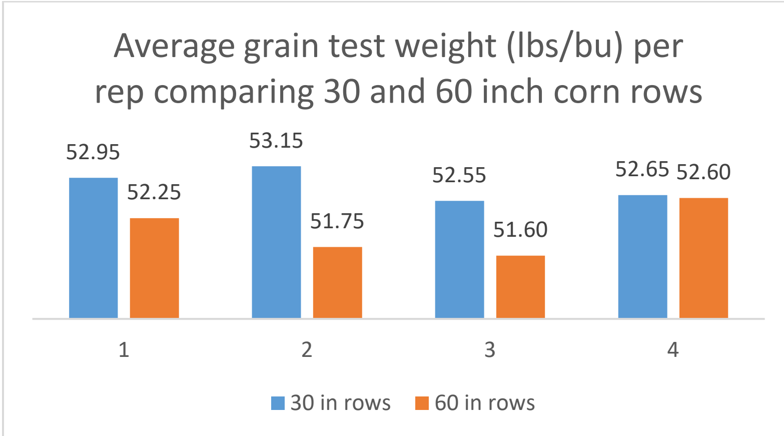


Chart 2: Grain test weight was higher with 30-in corn without cover crop

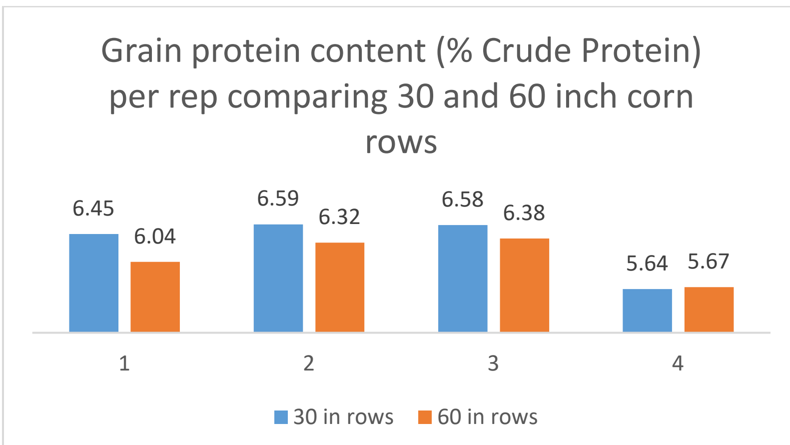


Chart 3: 30-in corn without cover crop had higher protein content

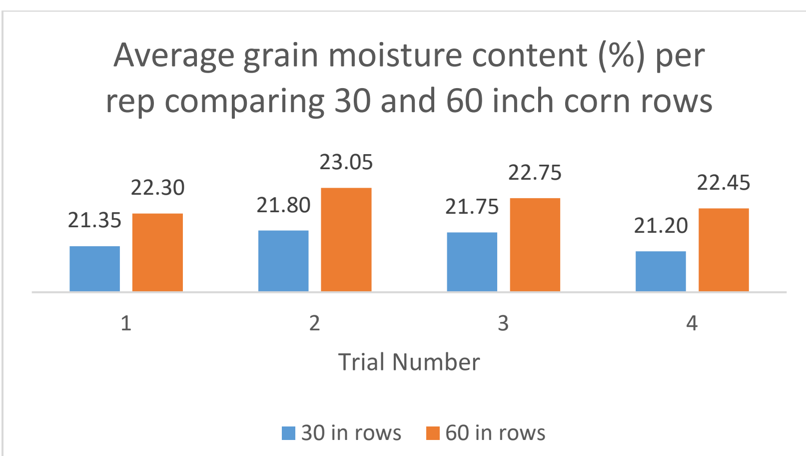
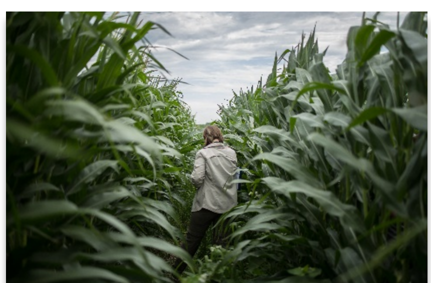


Chart 4: 30-in corn without cover crop contained less moisture

Over the last 30+ years, production agriculture has moved towards incorporating less diversity onto the landscape. Diversity is important in order to disrupt crop pest cycles and provide habitat for a diverse array of insects, many of which are beneficial. Organisms below the soil surface also benefit as diverse roots collectively contribute to diverse biological life. This diversity aids in nutrient cycling, relieving some need for added fertilizers, although the ability to reduce fertilizer inputs does take time. This 60-inch corn demonstration will require ongoing analysis and monitoring of the 2020 crop and soil conditions. Some theories as to what might have caused the yield reduction observed within the 60-inch corn include, the millet in the cover crop mix which became dominate was a warm season grass species (same as the corn), which could have been taking necessary nutrients from the corn crop. Cover crop selection should avoid like plant species as a major mix component that will compete throughout the growing season, rather, alternate crop types (grasses/broadleaves) as the diverse species favor companion rather than competition. Also, the uneven emergence seemed to certainly contribute to more of a reduced yield in the 60-inch rows compared to the 30-inch rows. The 60-inch corn required reduced planting speeds to achieve the desired seed singulation of twice the population as half of the planter rows were shut off.

The SD Soil Health Coalition is preparing for the 2020 growing season, to field test other alternative crop production methods to serve the purpose of improving soil health and other natural resources while maintaining producer profitability. 2020 research goals of the coalition include the measurement of additional soil health parameters and the increased collection of data at both existing plots as well as future plots, working to answer a variety of soil health questions. A big thank you to David Kruger and his family for their dedication to this project and hosting numerous field tours throughout the summer. Stay tuned and visit the SD Soil Health Coalition website and social media pages to learn more about upcoming field tours and experimental plot projects. Individuals interested in conducting their own field research please contact a SDSHC staff or board member.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Our Mission: **Promote improved soil health**