South Dakota
Soil Health Coalition
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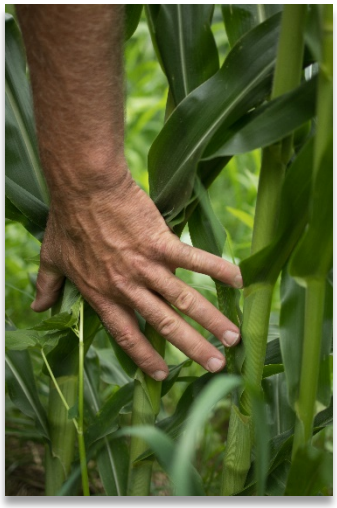
2020 Research Report:
60-Inch Corn Rows Interseeded With Cover Crops

Project Summary:

- Compared corn production management options of 60-inch corn rows with cover crops seeded in the wide rows to standard 30-inch corn rows without cover crops between the rows
- Corn grain yield, moisture, and protein content was compared between the two options.
- Overall, corn yield was reduced by 20-35% across in the wide corn rows in three plots located throughout South Dakota

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. In recent years, interest has risen in managing corn alternatively, planting in wider row arrangements to accommodate the opportunity for cover crop growth between the corn rows. Cover crops are used as a tool to increase biological diversity to the field. This diversity can help to suppress weeds, improve soil structure and tilth, and provide habitat for beneficial predator insects to fight pests and encourage pollinator species. Greater nutrient cycling can also be realized by implementing cover crops. Challenges to incorporating cover crops in the Northern Plains in a corn/soybean crop rotation is the short window of opportunity to establish cover crops before or after the main cash crop. Seeding cover crops between standard 30-inch rows generally delivers inconsistent results of success due to many variables, generally correlating to the amount of sunlight the cover crop receives between the corn rows. Wider corn rows provide opportunity for greater amount of sunlight to reach the cover crop and allow for sunlight to reach greater surface area of the corn plant. The 30-inch or narrower corn rows limit sunlight that reaches the bottom two thirds of the plant – wider rows allow for more efficient sunlight use.

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. 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:

Three plot trials were established across South Dakota near the towns of Garretson (southeast), Twin Brooks (northeast), and Gettysburg (central). Each trial location hosted approximately 10 acres consisting of 4 replicated plots with the 60-inch corn and interseeded cover crops compared to the 30-inch rows without cover crops. To establish 60-inch rows, half of the planter seeding units were disconnected, and the population settings were doubled to achieve the same seed rate per acre. Seed rates per acre were the same between the 30- and 60-inch rows, resulting half the distance between seeds in the 60-inch rows. Each trial used standard corn hybrids, rates, fertilizer, and herbicide rates for their operation. Corn hybrids with the semi-flex ear traits were selected as 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.

All locations for these plots were no-till planted, received pre-emerge herbicide prior to planting corn, and then received a burndown application prior to interseeding the cover crops. Diverse cover crops were planted with different mixes and rates, unique to the producer goals and environment. Uniformly, each producer involved with these plots desired to maintain corn production from the wide rows with cover crops to the narrow rows without, and all were interested in increasing plant diversity and improving soil structure. Additional grazing options were also goals specific to the Garretson and Gettysburg plots. Specific plot protocols unique to each plot are provided in the pages summarizing each plot location. Interseeding cover crops between the wide corn rows took place around the V4-V6 corn growth stages. Prior to V6 is ideal in that corn that is damaged from vehicle traffic will not be terminated.

Corn grain yield was determined by 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 in Brookings, SD. The subsequent crops planted in the 2020 test plot locations will be monitored for plant health and crop yield to see if the cover crop carries impacts into the 2021 crop year.

Results:

Throughout the growing season, the plots were monitored weekly. After record rainfall in 2019 and adequate rain in the spring, all plots started out with enough to borderline excessive moisture. This changed throughout the summer with most of South Dakota becoming dry by fall. Each plot had some challenges with weed pressure and lacked moisture. These issues resulted in an unmet goal of maintaining corn production, as the wide rows suffered 20-35% yield reduction between the three plots. Corn grain test weight, moisture, and protein contents were all similar, with the yield providing the greatest contrast for the comparisons.

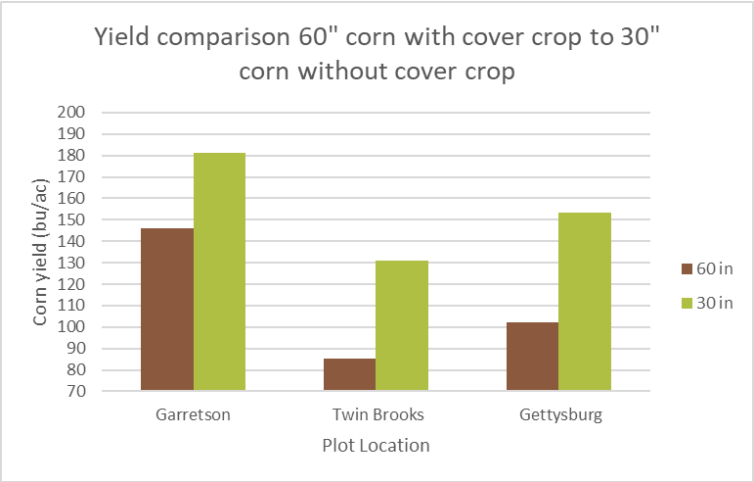


Chart 1: 30-inch rows without covers averaged higher yield. (Grain was weighed with a weigh wagon.)

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, all plots increased the biodiversity of the field and helped to improve soil structure. Some challenges were experienced – the significant yield hit on the wide rows likely compounded from the weed issues and the competition between the corn, weeds, and cover crops. Though these plots did not deliver the expected results, this is another option for managing corn and cover crops that may be favorable in other environments. Testing new management is always encouraged in small areas to minimize financial risk.

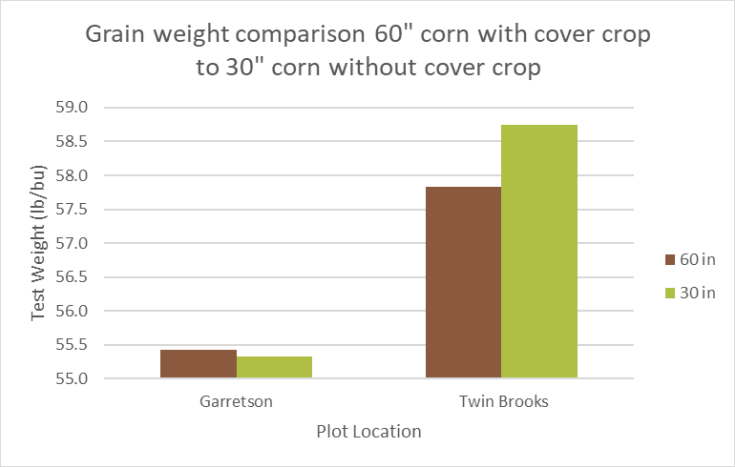


Chart 2: Grain test weight was collected at two plot locations.

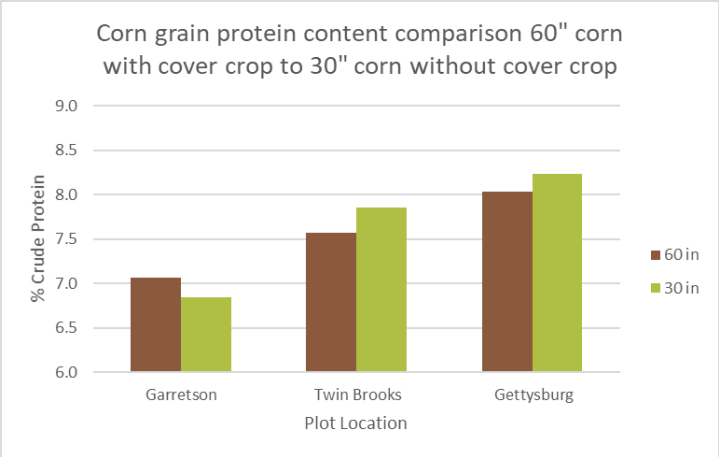


Chart 3: 30-inch corn without cover crop had higher protein content at two plot locations.

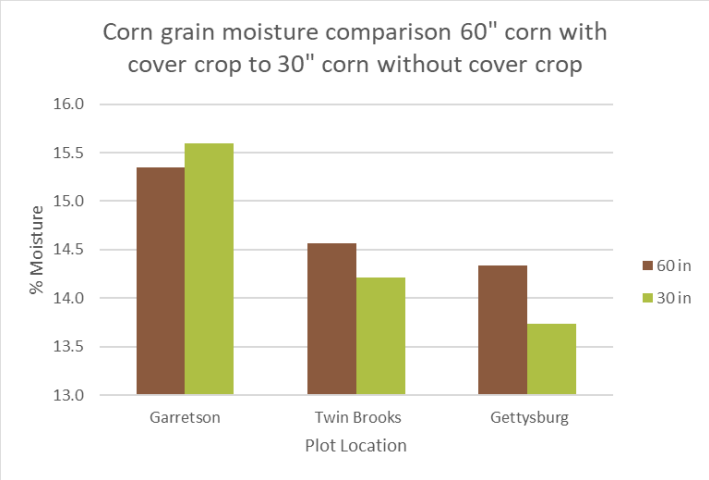


Chart 4: 30-inch corn without cover crop contained less moisture at two plot locations.

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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 2021 crop and soil conditions. Some theories as to what might have caused the yield reduction observed within the 60-inch corn include the fact that most of the cover crop mix was 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, cover crop selection should alternate crop types (grasses/broadleaves), as the diverse species favor complementation rather than competition. Also, the uneven emergence certainly contributed to a reduced yield. 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. High population planting with those eight rows contributed to the uneven emergence.

The South Dakota Soil Health Coalition is preparing for the 2021 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. The 2021 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, Ryan Larson, and Cronin Farms for their dedication to this project. Stay tuned and visit the South Dakota 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.

This material is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under agreement NR206740XXXXC010. Photo Credit: SD Soil Health Coalition & USDA-NRCS South Dakota.

SD SOIL HEALTH COALITION
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Our Mission: **Promote improved soil health**

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60-Inch Corn Trial With Interseeded Cover Crops

2020 Gettysburg, SD

Producer: Cronin Farms

Logistics

Corn Planting Date: 5/12/2020

Corn Variety: Dekalb 4816

Cover Crop Planting Date: 6/12/2020

Corn Harvest Date: 11/3/2020

Field History: Long term no-till

Fertilizer: 111 lbs. nitrogen on first 9 strips

124 lbs. nitrogen on 10th strip

Pesticides: S-Metolachlor or Dual II

Roundup right when cover crops were planted

Cover Crop Planting Equipment Used: John Deere no-till drill

Cover Crop Mix: 34.71 lbs./acre

- Forage Barley 10%
- Oats 10%
- Cereal Rye 10%
- Dwarf Grain Sorghum 10%
- Flax 20%
- Collards 5%
- Kale 5%
- Sunn Hemp 6%
- Safflower Baldy 6%
- Hubam Clover 9%
- Field Peas 9%

Data

Corn Harvest: 30in Plot Averaged 153 bu/acre

60in Plot 43,350 Population Averaged 101 bu/acre

60in Plot 51,000 Population Averaged 102 bu/acre

Conclusion

The trial consisted of nine replicated strips of 60-inch corn with interseeded cover crops and 30-inch corn without interseeded cover crops on 30 acres. It is important to limit acres on experimental studies to reduce the level of risk associated with trials. Within the strips there was a population study in the 60-inch corn with interseeded cover crops. Three strips of 60-inch corn were planted at a population of 51,000, and three strips were planted to 43,350. The 30-inch rows were planted at a population of 25,000.

The strips were monitored throughout the growing season for differences in plant health, cover crop growth, and yield differences between 60-inch rows with interseeded cover crops with varying populations and 30-inch rows without cover crops. This plot location experienced a harsh drought during the growing season. There was also a large presence of pigweed throughout the plot. The 60-inch corn with interseeded cover crops did experience a yield drag this growing season.

There was a 10th strip in the plot which had increased nitrogen (124 lbs.). The corn in this strip had an increased protein level compared to the rest of the plot.

This plot was grazed; however, a biomass sample was not collected in time to report accurate biomass available for grazing.

60-inch corn with interseeded cover crops would increase the biodiversity in a rotation and have significant impacts on soil health. The field displayed good soil health over all due to good prior management, showing lots of aggregation. Had the field been in poor condition, we may have seen a greater difference in soil health when comparing the 30-inch rows to the 60-inch rows with cover crops.

Impacts to watch for and why?

This plot location experienced a drought throughout the growing season, causing increased competition for moisture between the corn and cover crop. There was substantial weed pressure (pigweed) throughout the growing season as well. The grower advised that if they repeat the trial, they would simplify the cover crop mix, increasing the amount of rye, barley, grain sorghum, and flax within the mix. In further trials we would not trial population density and would continue with a double population in the 60-inch rows.

Soil tests show the plot has substantial nutrient residual available for next year's growing season. There were 43 lbs. carryover nitrogen in the 0-24 inch soil, and the Bray showed 21 ppm phosphorous.

Next year

The 2020 trial location will be planted to forage sorghum in the 2021 growing season. We will closely monitor the strips and any differences in yield or plant health.

Special thanks to Daniel Forgey and Cronin Farms for their dedication to and work on these trials. Cronin Farms works hard to continue building their soil health and are dedicated to soil conservation.

This material is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under agreement 68-6740-17-010.

Interested in setting up an experimental test plot? Would you like information on how to incorporate soil health in new ways on your operation?

Contact a member of our team today!

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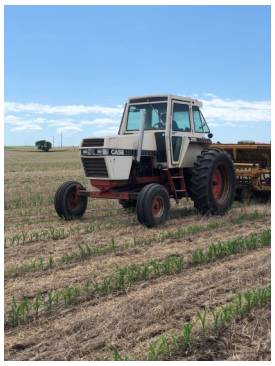
60-inch Corn Trial With Interseeded Cover Crops

2020 Twin Brooks, SD

Producer: David Kruger

Logistics



Corn Planting Date: 4/25/2020

Corn Variety: Peterson 78B98 VT2Pro (Semi-flex)

Cover Crop Planting Date: 6/4/2020 (Corn V5 Stage)

Corn Harvest Date: 10/14/2020

Field History: 20+ years no-till

Fertilizer: 250 lbs. 27-18-9 starter 2x2
35 gallons 28-0-0, side dressed

Pesticides: 26 oz. Roundup, 8 oz. LV6,
20 oz. Verdict

Cover Crop Planting Equipment Used: 10 ft. drill

Cover Crop Mix: 24 lbs./acre

- Cowpeas 8%
- Sunn Hemp 5%
- Hairy Vetch 5%
- Red Clover 21%
- Oats 5%
- Mung Bean 5%
- Buckwheat 5%
- Flax 10%
- Rapeseed 10%
- Phacelia 10%

Data

Cover Crop Biomass Samplings:

11/4/2020 : 225 grams green weight average,
10,488 lbs. green weight – 5,713 lbs. dry weight

Corn Harvest: 30in Plot Averaged 136 bu/acre
60in Plot Averaged 92.2 bu/acre

Conclusion

The trial consisted of four replicated 120 ft. strips of 60-inch corn with interseeded cover crops and 30-inch corn without interseeded cover crops. The cover crop mixture was adjusted this year from the 2019 cover crop mix, taking out a few species such as millet, winter wheat, and adding mung bean, phacelia, and barley (forage). The strips were monitored throughout the growing season. The plot went through a lengthy drought period, which had a major impact on the plant health and, ultimately, the yield of the trial. There was a dramatic impact on the yield of the 60-inch corn rows.

60-inch corn with interseeded cover crops would increase the biodiversity in a rotation and have significant impacts on soil health. The increase in biomass provides excellent grazing resources for producers with livestock, adding value to this system.

Impacts to watch for and why?

It was concluded that the yield deficiency that was experienced in the 60-inch corn plots due to the severe drought they experienced, it is unknown whether the increased competition for moisture between the cash crop and the cover crop was to blame or the close proximity of the corn plants competing for moisture.

The cover crop mixture was altered in 2020 in order to reduce competition with the corn for late season nitrogen. Lack of moisture created an added obstacle this growing season.

Next year

The 2020 trial location will be planted to soybeans in the 2021 growing season. We will closely monitor the strips and any differences in yield in the soybeans.

The 2019 trial location was closely monitored throughout the 2020 growing season to observe for differences in plant health, pest issues, and yield. There were no significant differences between the soybeans planted where there had been 60-inch corn with cover crops and 30-inch rows without cover crops.

Special thanks to David Kruger and the entire Kruger family for their dedication to and work on these trials. The Kruger family works hard to continue building their soil health and are dedicated to soil conservation.

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60-Inch Corn Trial With Interseeded Cover Crops

2020 Garretson, SD

Producer: Ryan Larson

Logistics

Corn Planting Date: 5/1/2020

Corn Variety: Golden Harvest G02W74 (Semi-flex)

Cover Crop Planting Date: 6/5/2020

Corn Harvest Date: 10/15/2020

Field History: 2nd year no-till into soybean stubble (conventionally tilled by prior land manager)

Fertilizer: 6 ton composted manure, 5 gal 10-34-0, 1 qt zinc (applied in furrow at planting)

Total Estimated Nutrients Applied (lbs./ac)

N: 160 P: 25 K: 55

Pre-Emerge Herbicide: 32 oz. Roundup, 16 oz. 2-4D, 20 oz. Verdict, AMS, non-ionic surfactant

Post-Emerge Herbicide: 32 oz. Roundup/ac (before cover crop seeding)

Cover Crop Planting Equipment Used: 15 ft. grain drill

Cover Crop Mix: 26.9 lbs/ac

- Forage Peas 5%
- Hairy Vetch 8%
- Cowpeas 11%
- Radish 8%
- Cereal Rye 15%
- Flax 5%
- Barley 10%
- Berseem Clover 10%
- Annual Rye 12%
- Rapeseed 9%

Data

Cover Crop Biomass Samplings:

10/12/20: 4,962 lbs. dry weight per acre

Corn Harvest: 30in Plot Averaged 181.1 bu/acre

60in Plot Averaged 146.1 bu/acre

Average Yield Difference: 35 bushels

Plot objectives and results

This trial consisted of four replicated 120 x 1500 ft. strips of 60-inch corn with interseeded cover crops compared to 30-inch corn without cover crops. The strips were managed the same with corn seed and population per acre, fertilizer, and herbicide applications with the only differences being the row spacing and cover crops seeded between the 60-inch rows. Ryan was interested in seeding a small amount of his corn acres in this manner to determine if this system would maintain corn grain yield and provide additional forage for his beef cow herd. Ryan's prior experience with interseeding cover crops into 30-inch corn rows maintained corn yield but did not provide much additional forage for grazing after harvest. The wide-row option was initially appealing for the increased forage potential. In addition to the expected increase of forage biomass, cover crops grown between the corn rows increases diversity of the field, helps to improve soil structure and alleviates soil compaction all while protecting the soil from erosion potential in season and throughout the winter.

Throughout the growing season, all eight strips were evaluated. During corn seedling emergence, the 60-inch corn emerged less consistently than the 30-inch rows. This is attributed to the high population rate the planter was set to (double the population, shut off half the planter rows to achieve the same seed rate per acre). The cover crop grew very well; however, this field did have some weed pressure that is believed to have impacted some of the cover crop success and corn yield later in the season. These weeds emerged after the last burn down herbicide application prior to seeding the cover crops. Where weeds were not an issue, the cover crop produced dry matter well over 5,000 pounds per acre. Areas of the plot with the weed issues outcompeted many of the cover crop species, and at harvest primarily rapeseed, radish, and flax remained. The weed issues originated from some portions of the field being prevent plant in 2019, and then some of the manure that was applied in the spring may have contained some weed seeds.

Conclusion

For this particular plot, the goal of maintaining corn grain yield was not met. The growing season started out with good moisture, and mid summer through fall turned dry. Lack of moisture and some weed issues decreased the expected cover crop growth late in the season. Weed pressure, lack of moisture, and competition from the corn plants in the wide rows being half the distance apart as in the 30-inch rows all compounded to deliver a plot average yield reduction of 35 bushels in the wide rows compared to the standard 30-inch rows. Benefits of increasing diversity to help unlock nutrients in the soil, providing habitat for predator insects, improving soil structure, and providing livestock forage are all potential positive outcomes when managing corn in this manner. Different environments and field conditions may yield more favorable results for this style of production. This 10-acre plot reaffirmed wise advice to minimize profit risk and keep new management plots small.

Next year

The 2020 trial location was planted to cereal rye in the fall and will be used as a calving area in the spring of 2021 followed with no-till soybeans. The soybean yield will be collected to evaluate any impacts that carry through from the 2020 corn trial. Ryan continues to experiment with cash and cover crop arrangements to meet profitability and soil health goals specific to his operation.

Photo by Joe Dickie, *for the USDA Natural Resources Conservation Service*

Special thanks to Ryan Larson's dedication to and work on these trials. Ryan works hard to continue building his soil health and is dedicated to soil conservation.

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