JOURNAL OF THE NACAA

ISSN 2158-9459

VOLUME 16, ISSUE 1 – JUNE, 2023

Editor: Linda Chalker-Scott

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Identification of Effective Planting Times of Cover Crops Interseeded into Corn in Utah

Abstract

Utah agriculture producers have become interested in interseeding cover crops as a companion crop in corn. Although interseeding has been successful in Midwest states, little research exists on interseeding cover crops in the Intermountain West. To address this need, a state-wide research trial was conducted that focused on identifying the most effective planting times (corn growth stage) to interseed cover crops by measuring corn silage yield and quality. No effect ($P > 0.05$) on corn silage yield or quality was found due to cover crop interseeding time. However, from a corn management perspective the V4 – V6 period became an ideal planting time due to the various timelines of managing corn in the intermountain west.

Abbreviations: NDF = Neutral Detergent Fiber, ADF = Acid-Detergent Fiber, TDN = Total Digestible Nutrient, GMO = Genetically Modified Organism

Keywords: corn, interseeding, cover crop, nutritive value, biomass yield.

Introduction

Many corn producers have been searching for innovative ways to add cover crops into their cropping practices. Increasing soil organic matter, creating alternative fall grazing, and reducing soil erosion are reasons interested producers list for wanting to interseed cover crops in corn. Producing enough cover crop biomass in corn cropping systems is challenging because of the short growing period between corn harvest and killing frosts (Belfry and Van Eerd, 2016).

To increase the effectiveness of utilizing cover crops in a later maturing crop system, like corn, producers have begun interseeding cover crops into the standing crop. In contrast, agricultural professionals worry that interseeded cover crops may negatively impact corn yields. Belfry and Van Eerd (2016) conducted a 3-year study and found that corn yield was not affected by interseeded cover crops.

Successful cover crop establishment is dependent on the timing and method of planting. Cover crops need to be established early enough to allow for root establishment and absorption of solar radiation (Noland et al., 2018). It is also important that cover crops are planted late enough that they will not be in direct competition with the primary cash crop (Noland et al., 2018).

Research from the Midwest and Eastern U.S. has examined the effects that the timing of interseeding cover crops has on overall corn yield and biomass (Brooker et al., 2020; Curran et al., 2018). Curran et al. (2018) found that, across the Mid-Atlantic region, cover crop interseeding timing affected corn grain yields ($P = 0.01$). Grain yields were lower when cover crops were interseeded at the V2 stage compared to yields when covers were interseeded at V5 or V6 growth stages (Curran et al., 2018). The V growth stages in corn represent the number of exposed leaf collars (V2 = 2 leaf collars exposed). A study in Michigan found that cover crops interseeded in the V2-V7 corn growth stages did not reduce grain yield (Brooker et al., 2020). It should be noted when comparing the two studies that each study used different species of cover crops, which could be responsible for the different findings.

Hogge et al. (2020) provided one of the few research studies in the Intermountain West located in south central Idaho. They found interseeding cover crops at V6, after herbicide treatment and before the corn canopy closed, was the most ideal time to plant. The data suggested that corn silage yield was not affected due to cover crop competition (Hogge et al., 2020).

As the results of cover crop research differ from region to region, it is essential that more cover crop interseeding research be carried out in the Intermountain West. Irrigation, drought, alkaline soils, and shorter growing seasons are unique challenges to the Intermountain West and more research is needed to determine how to successfully interseed cover crops into corn. The main objective of this research study was to identify the best timing for interseeding cover crops into established corn fields in Utah and determine if there is a reduction in corn yield by interseeding cover crops.

Methods

Research trials were conducted in major corn growing regions in Utah, with corn growers in Box Elder, Cache, Weber, and Sevier Counties participating during the summer of 2021. Five experimental field plots were evaluated within producer-owned fields: Box Elder, Cache, Weber, Sevier East, and Sevier West.

Plots were created as a randomized complete block design with four replications. Corn was seeded in 30-inch rows in late April or the beginning of May by the cooperators depending on each locations last spring freeze date and the proper timing for seeding corn in that county. Plot sizes were 15 ft. wide (6 rows of corn) by 30 ft. long. Treatments included a control (no interseeding) and interseeding of a cover crop mix at V2, V4, V6, V8 or V10 stages of corn growth for each field in the trial. Species used in the cover crop mix are shown in Table 1. A total of 24 plots (6 treatments x 4 replications) were established in each field. Treatments were applied with a five-row Jang vegetable seeder, but only two-rows (12 inch spacing) were utilized to match a commercial cover crop interseeder. Plots were interseeded at 18 lbs. per acre at ¼ inch depth during the appropriate growth stage. Overall management and care (irrigation,

fertilizer, pest management, etc.) of corn fields were provided by the cooperators following standard corn-growing practices.

Table 1. Cover crop mix species composition

Kind	Variety	Type	Percent of Mix
Daikon Radish	Buster	Brassica	12.4%
Kale	Sub Zero	Brassica	6.5%
Turnip	Purple Top	Brassica	3.5%
Yellow Mustard	VNS*	Brassica	3%
Buckwheat	VNS*	Broadleaf	6.9%
Intermediate Ryegrass	Green Spirit	Grass	18.4%
Annual Ryegrass	Tetrastar	Grass	6.9%
Hairy Vetch	VNS*	Legume	22%
Red Clover	VNS*	Legume	13%
Brown Flax	VNS*	Oilseed	6.4%

*Variety Not Specified

Prior to silage corn harvest, Extension faculty collected individual plot data by harvesting 10 ft. long sections of the two middle rows of each plot. Harvest was accomplished by using a machete to cut the corn to the proper corn silage harvesting height and then weighed using a digital weigh wagon for yield comparison. Three randomized corn stalks were randomly selected from the harvested sample and processed using a woodchipper. A random grab sample from each plot was dried in a forced air drying oven at 55 ^{o} C until dry. Samples were ground, using a Wiley Mill, down to 1mm and analyzed for nutritional value. Corn quality samples were analyzed for digestibility and nutrient content at an accredited lab using a Near Infrared Spectrometer (NIR). The data were statistically analyzed to determine corn yield and nutritional differences among treatments. Data were analyzed using the MIXED procedure of SAS. Due to significant variability among research sites, each research site was analyzed individually.

Results

Timing of cover crop interseeding (V2, V4, V6, V8, V10) had no effect ($P > 0.05$) on corn yield at any of the five sites. However, interseeding timing did have an effect ($P < 0.05$)

on nutritional qualities at the Richfield West site (Table 1). It was found that acid-detergent fiber (ADF) (P = 0.04), neutral detergent fiber (NDF) (P = 0.03), and total digestible nutrient (TDN) (P = 0.04) were all affected by the timing of cover crop interseeding at the Richfield West site. Corn interseeded with a cover crop at the V4 stage had significantly lower (P < 0.05) levels of ADF and NDF and thus, higher TDN levels than corn interseeded at V2, V8, and V10 stages (Table 2). The control plot had significantly lower (P < 0.05) ADF than corn interseeded at the V10 stage, and significantly lower (P < 0.05) NDF than corn interseeded at the V8 and V10 stages. The control plot had significantly higher (P < 0.05) TDN levels than corn interseeded with a cover crop at the V10 stage (Table 2). Lower values of ADF and NDF indicate that animal feedstuffs are more nutritious or easily digestible, while higher levels of TDN indicate the same thing. A major reason for inverted trends between ADF/NDF versus TDN is the equation to calculate TDN utilizes both NDF and ADF.

Table 2. Effect of different cover crop interseeding times on corn nutritional parameters at the Sevier West research site

	Nutritional Parameters (P = 0.03)		
Treatments[2]	**ADF[3]**	**NDF[4]**	**TDN[5]**
V4	21.0^{a}	38.3^{x}	73.0^{m}
Control	21.9^{ab}	39.9^{xy}	72.4^{mn}
V6	23.9^{abc}	41.8^{xyz}	71.1^{mno}
V2	25.5^{bc}	44.5^{yz}	70.1^{no}
V8	25.8^{bc}	44.8^{z}	69.9^{no}
V10	26.4^{c}	45.1^{z}	69.4^{o}

Note: n=4, values only from one research site
[1]Timing of cover crop interseeding had a significant effect (P < 0.05) on corn nutritional parameters at the Sevier West research site
[2]Treatments consisted of a control with no interseeded cover crop, and cover crop interseeded at V2, V4, V6, V8, and V10 corn growth stages
[3]Acid-detergent fiber, superscripts ^{a,b,c} denote differences among treatments (P < 0.05)
[4]Neutral detergent fiber, superscripts ^{x,y,z} denote differences among treatments (P < 0.05)
[5]Total Digestible Nutrient, superscripts ^{m,n,o} denote differences among treatments (P < 0.05); Table was ordered according to highest TDN values to lowest.

Discussion

The data from this preliminary study suggest that interseeding cover crops anytime from the V2 – V10 corn growth stage would have a limited effect on corn yield. However, as this study was only conducted for one-year, further research is needed before drawing certain conclusions. With regards to nutrition parameters, the Sevier West research site would suggest interseeding cover crops at the V4 stage provides higher corn nutrition levels than interseeding at V2, V8, or the V10 growth stages. However, these data were only found to be significant on one research site out of five total. Utah's climate poses unique challenges. The data collected were still useful despite facing some unprecedented setbacks during the trial period.

Drought

During 2021, Utah and the Intermountain West faced one of the worst droughts on record. Little to no spring precipitation resulted in producers relying on irrigation to get crops germinated and established. As soil moisture levels were low, often germination would not occur until the next irrigation, which became problematic as cover crop interseeded at V6 might not germinate until V8. In a year with normal precipitation, adequate amounts of soil moisture would be present to help cover crops germinate.

Weed pressure

Another issue within the study was weed pressure. Two research sites, not mentioned in this article, were eliminated from the study due to significant weed pressure. When interseeding a cover crop into corn it is essential to have a weed management strategy in place to allow cover crops to get established. The fields with the most success were planted with glyphosate-tolerant corn where glyphosate could be utilized as a weed management method. An increasing number of producers are growing crops for non-GMO livestock consumption. These producers typically use a long residual herbicide to control weeds in their corn. However, to allow cover crops to establish, herbicides cannot have residual properties. Producers in a non-GMO crop rotation face considerable challenges balancing weed control and cover crop establishment. When

considering timing, V2 is too early to interseed cover crops as this coincides with traditional weed management methods.

Furrow irrigation

Utah relies on irrigation to grow crops and furrow irrigation is necessary for producers who flood irrigate corn. One field (Cache) utilized sprinkler irrigation and four fields (Box Elder, Weber, Sevier West, Sevier East) were flood-irrigated. To furrow irrigate producers must cultivate fields to create furrows down each or every other corn row. Furrows are created between the V3 and V4 corn growth stages. As this study included interseeding at the V2 corn growth stage, some plots were cultivated and furrowed after planting. While furrows did not create a total loss of cover crop, it did not provide ideal conditions for cover crop germination and growth.

Conclusions

The data collected from this study found that there is no detrimental effect on corn yield when a cover crop is interseeded during the V2, V4, V6, V8, and V10 corn growth stages. However, when aligning interseeding a cover crop with corn management practices, interseeding during the V4 and V6 growth stages become the most understandable selection in the Intermountain West. When attempting to interseed corn at the V2 corn growth stage problems were created with weed management strategies and furrow irrigation. Interseeding a cover crop into corn past the V6 growth stage results in corn that creates a canopy and makes cover crop establishment difficult. It also can be difficult to interseed cover crop into tall corn without damaging the corn when utilizing a commercial interseeder. This preliminary research provides a foundation for future studies and research. To create consistent base-line recommendations for interseeding cover crops in the Intermountain West, more research is needed.

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