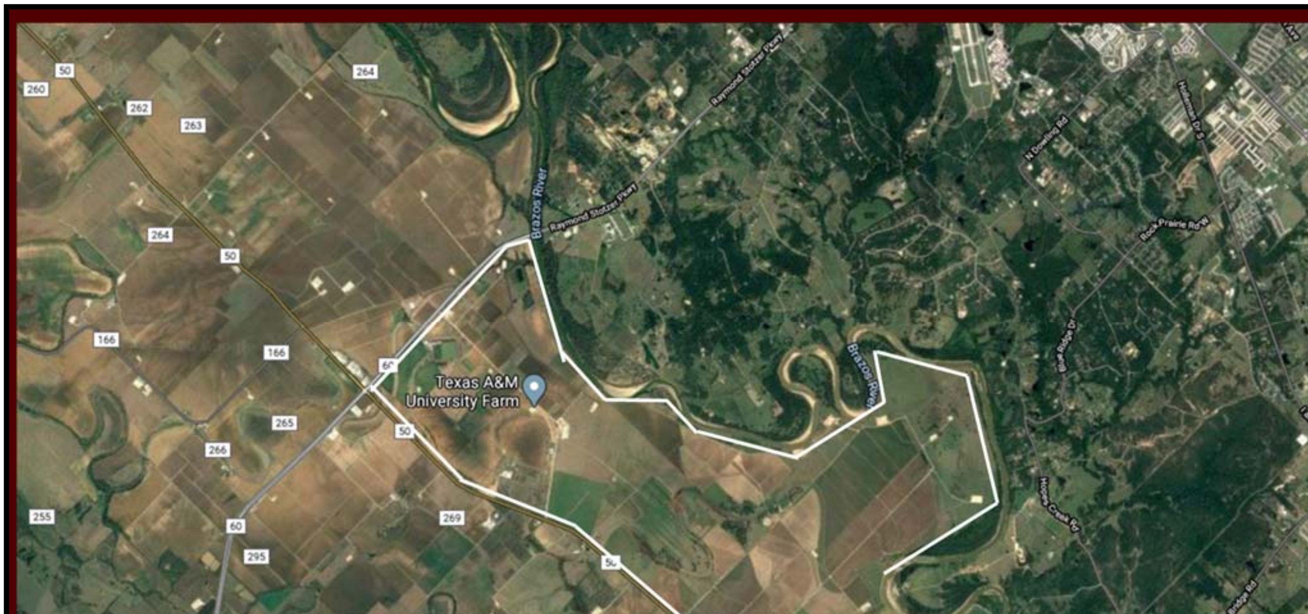
Conservation and Sustainable Agriculture Field Tour

Brazos Bottom Farm | Snook, TX | March 3rd, 2020

Texas A&M AgriLife Research and Extension | USDA NRCS | Southern SARE



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agnr Agriculture and Natural Resources

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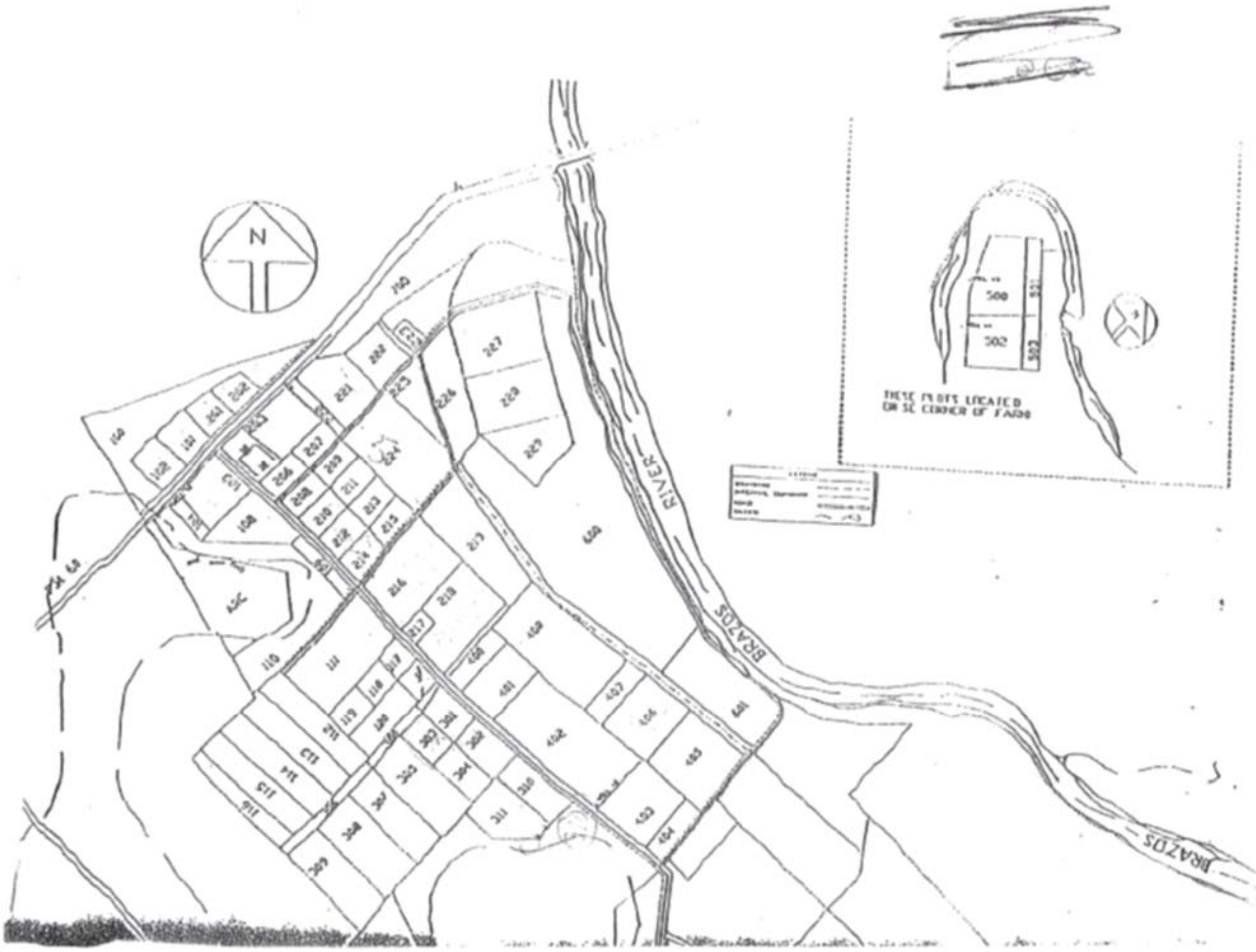

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Field Tour Agenda

9:00 A.M.	Meet at O.D. Butler Animal Science Complex 7707 Raymond Stotzer Pkwy, College Station, TX 77845
9:15 A.M.	Depart to Brazos Bottom Farm for Field Stops
9:30 A.M.—11:30 A.M.	Stops and Speakers

Field 222

1. Organic Cotton Transition Study . . . . Daniel Hathcoat
2. 26 Cover Crop Species . . . . Daniel Hathcoat
3. Residual Herbicide & Cover Crops . . . . Daniel Hathcoat

Field 206

4. Greenhouse Gas Emissions from Cover Crops and Reduced Tillage . . . . Diana Zapata-Rojas

Field 111

5. Cover Crops in Corn and Sorghum . . . . Jack Nielsen

Field 601

6. Legume Species and Seeding Rate Trial . . . . Jake Mowrer
7. Carbon Amendments and Tillage in Corn Production . . . . . . Binita Thapa

IMPACT Field

8. XtendFlex Cotton Stewardship Trial . . . . Rohith Vulchi

11:30 A.M	Depart for Rollie G White Meeting Center
12:00 P.M.	Lunch
12:30 P.M.	SARE Opportunities . . . . John Smith
1:00 P.M. - 2:00 P.M.	Discussion and Round Table
2:00 P.M.	Wrap Up Go Home

Conservation and Sustainable Agriculture Field Tour

Forward:

Sustainable Conservation Practices

Conservation and sustainable practices in agriculture are those that address the goals of our society in meeting the demands for food and fiber products without compromising the right of those who inherit the land and its resources from us to do the same. The long term sustainable productivity of the land for our children and grandchildren will depend on our stewardship of its bounty. Ensuring that we maintain fertile soils, clean water, and viable and adaptable cropping systems are a large part of that responsibility. This field tour is intended to demonstrate and communicate some of the research in the area of sustainable conservation management practices currently underway at Texas A&M University to those professionals responsible for working with farmers to increase adoption.

Geographic Applicability of Research at the Bottom Farm

The results of the research and practices demonstrated in this tour include reduced tillage, cover cropping, IPM strategies, and organic production. The studies showcased in the tour were performed at the Brazos Bottom Farm under conditions (and in soils) that are indicative of the Brazos River Valley from Waco to the Gulf. The same conditions are also commonly encountered on farms in the southern portion of the Colorado River Valley. Therefore, the results presented today and in this book can be reasonably expected to apply to the row crop production systems in both regions. Some of the results may be more widely applied to the Blacklands and Upper Gulf Coast Regions of Texas, as well.

A Word on the Need for Adoption

Texas has the greatest number of acres under cover crops of any state in the U.S. However, Texas is also in the bottom ten states in terms of percentage of arable acres under cover crops. Reduced tillage has not been adopted in the state to the degree it has been adopted in many other states. Texas has a wealth of resources for agricultural production and an immediate opportunity for improvements in sustainable and conservation agriculture. The production systems showcased today highlight the potential for new practice adoption on farms that are located very close to sensitive surface water systems (e.g. Brazos and Colorado Rivers). Increasing adoption of sustainable conservation practices in these areas stands to have the most rapid impact in terms of reducing erosion, reducing runoff of nutrients and chemicals, and improving soil health. Transferring these practices to farmers relies on your participation today… and tomorrow.

Thank you for being a part of it today.

Jake Mowrer, PhD. | Assistant Professor and Extension Specialist

RESEARCH AND OUTREACH TO SUPPORT TRANSITIONING TO ORGANIC COTTON PRODUCTION IN CENTRAL AND GULF COAST TEXAS

Daniel Hathcoat, Nithya Rajan, Jake Mowrer, Josh McGinty, Shyam Nair, and Muthukumar Bagavathiannan

ABSTRACT

Organic cotton farming has a niche market in Central and the upper-Gulf coast regions of Texas, yet taking traditional cotton farming operations to organic production can be challenging in the region. Much of the organic cotton production in Texas is in the High Plains region. Limited research is available for growers in the southern regions of the state for best management practices (BMPs) for organic cotton production through the use of different conservation practices. Much research is needed in this arena to help growers understand the options available and develop improved BMPs for organic cotton production in this region of Texas. This research project is newly initiated and will focus on three main objectives.

The first objective will help producers identify the best defoliation methods available within organic cotton production. This is a critical area of focus specifically for the insurance programs as they relate to organic cotton production.

The second objective will focus on additional agronomic research and on-farm demonstrations on the influence of cover cropping and conservation tillage practices on weed management, water-yield relations, soil nutrient dynamics and health and greenhouse gas emissions. These observations will help develop BMPs that optimize economic returns and ecosystem services in organic cotton production.

The final objective will be to develop and deliver an educational and outreach program for efficient transfer of project results to various stakeholders to facilitate transitioning to organic cotton production in the Central and Gulf Coast regions of Texas.

MATERIALS AND METHODS

A three-year (2019-2022) transitional organic experiment was established at the Texas A&M field research facility near College Station, TX during fall 2019. This experiment has been managed according to NOP-guidelines with large buffer zones, as land is being transitioned to certified organic. The experiment is arranged in a split-plot design with four replications. The main-plot factor is tillage system, with 2 levels: strip-tillage (a conservation tillage practice) and conventional tillage. The sub-plot factor has 10 levels: 4 fall-planted covers (Purple-top Turnips, Heavygrazer oats, Austrian winter peas, and a mix of all three species), with and without a late-summer planted cowpea double cover cropping. The cowpea could not be established in the first year (fall 2019) due to inclement weather conditions. Additionally, a weedy fallow and a weed-free bareground check treatment were included for comparison. Each sub-plot is 8 rows wide x 50 ft long. In the weedy fallow treatments, weeds have been allowed to germinate and grow, whereas in the weed-free check treatments, the area has been maintained clean by periodic application of the non-synthetic burndowns. These check treatments allow us to compare the impact of cover crop practices over conventional practices on a) weed suppression potential, b) soil moisture balance,

2020 Organic Cotton/Cover Crop Project (Field Demo March 3)

Rep 1	Strip Tillage	117: Winter Mix	116: Oat	101: Turnip
Rep 1	Strip Tillage	118: Weed Free	115: Winter Pea	102: Winter Mix
Rep 1	Strip Tillage	119: Oat	114: Winter Pea	103
Rep 1	Strip Tillage	120	113: Weedy Chk	104: Turnip
Rep 1	Conventional Tillage	121: Weedy Chk	112: Winter Pea	105: Winter Mix
Rep 1	Conventional Tillage	122: Winter Mix	111: Oat	106: Winter Pea
Rep 1	Conventional Tillage	123	110: Oat	107: Weed Free
Rep 1	Conventional Tillage	124: Turnip	109	108: Turnip
Rep 2	Conventional Tillage	217: Winter Mix	216: Turnip	201: Winter Pea
Rep 2	Conventional Tillage	218	215: Winter Pea	202: Weedy Chk
Rep 2	Conventional Tillage	219	214: Oat	203: Weed Free
Rep 2	Conventional Tillage	220: Winter Mix	213: Turnip	204: Oat
Rep 2	Strip Tillage	221: Turnip	212: Oat	205: Winter Pea
Rep 2	Strip Tillage	222: Oat	211: Turnip	206: Winter Mix
Rep 2	Strip Tillage	223: Winter Mix	210	207: Weedy Chk
Rep 2	Strip Tillage	224	209: Winter Pea	208: Weed Free
Rep 3	Conventional Tillage	317: Winter Pea	316: Oat	301: Oat
Rep 3	Conventional Tillage	318: Winter Mix	315: Weed Free	302: Turnip
Rep 3	Conventional Tillage	319: Winter Pea	314: Turnip	303: Weedy Chk
Rep 3	Conventional Tillage	320: Winter Mix	313	304
Rep 3	Strip Tillage	321: Weed Free	312: Turnip	305: Turnip
Rep 3	Strip Tillage	322: Oat	311: Winter Mix	306: Winter Pea
Rep 3	Strip Tillage	323: Oat	310: Winter Pea	307: Winter Mix
Rep 3	Strip Tillage	324	309: Weedy Chk	308
Rep 4	Strip Tillage	417: Winter Pea	416: Oat	401: Turnip
Rep 4	Strip Tillage	418	415: Weedy Chk	402: Winter Mix
Rep 4	Strip Tillage	419: Weed Free	414: Winter Mix	403
Rep 4	Strip Tillage	420: Turnip	413: Winter Pea	404: Oat
Rep 4	Conventional Tillage	421	412	405: Turnip
Rep 4	Conventional Tillage	422: Winter Pea	411: Oat	406: Winter Mix
Rep 4	Conventional Tillage	423: Oat	410: Turnip	407: Weed Free
Rep 4	Conventional Tillage	424: Winter Pea	409: Winter Mix	408: Weedy Chk

c) nutrient dynamics, d) GHG mitigation potential, and e) yield and economic returns. The planting timings for cowpea and fall covers were September and November, respectively. The cotton crop will be planted by late-March and harvested by mid-August. The fall-planted cover crops will be terminated using a roller crimper about two-to three-weeks prior to planting cotton.

In conventional plots, primary and secondary tillage operations will be used for pre-plant weed control, incorporation of manure, and seedbed preparation. This system relies entirely on manure for meeting crop nutrient demand. Manure (poultry litter, or other locally available sources) will be applied based on soil-test nutrient requirement. Following planting, inter-row cultivation will be used for weed control. Multiple passes with a cultivator are typically required, depending on the weed species and level of infestation. Weed control in the conservation tillage plots will rely heavily on cover crops, supplemented with hooded inter-row application of a non-synthetic herbicide during mid-to late-season as needed.

RESULTS

Due to the recent initiation of this study, no results are available for discussion at this point. However, excellent cover crop establishment and growth have been observed in the plots. Biomass yields and canopy coverage will be determined upon cover crop termination.

THE SUITABILITY OF 26 SUMMER AND WINTER COVER CROP SPECIES IN SOUTHEASTERN TEXAS BASED ON BIOMASS PRODUCTION, WEED SUPPRESSION, AND IMPACT ON SOIL MOISTURE

Spencer L. Samuelson, A. Daniel Hathcoat, and Muthukumar V. Bagavathiannan

ABSTRACT

With the increased dependence on herbicides and the proliferation of herbicide-resistant weed species, alternative methods of weed control are of great interest and demand. Cover crops have been a successful addition to manage troublesome weeds in North Central and North Eastern US, but this tool has not yet been fully utilized in Southern US. The objectives of this study were to determine a) which cover crop species offer the greatest impact on weed suppression, and b) have the least demand on soil moisture. Twenty-six summer and winter cover crop species were evaluated at the Texas A&M University research farm near College Station, TX during 2017 and 2018. The summer-annual cover crops such as sorghum-sudangrass and sunn hemp, and winter-annuals such as winter pea and triticale showed promising results with respect to weed suppression and moisture demand. Results from this assessment will help develop cover crop systems for this region.

MATERIALS AND METHODS

A randomized complete block design (RCBD) was utilized, with plots measuring 10 x 30 ft with a 5 ft alley between treatments and four replicated blocks. The experiment was first initiated in 2017-2018 followed by a second run conducted in 2018-2019. The study was established at the Texas A&M University Farm (30° 55'28.21"N 96°43'19.6"W).

The summer cover crop species (Table 1) were established in mid-August and were terminated by the first killing frost (December 2017 & November 2018). The winter cover crop species (Table 1) were established in late-October, and were terminated with a lethal dose of glyphosate (RoundUp PowerMax 32 oz/ac) three weeks prior to ideal cotton planting dates (April). All cover-crops were planted using a 5ft-wide grain drill, while species with seeds that were too large for drill seeding, were planted with a broadcast method and incorporated into the soil.

Table 1. List of summer and winter cover crop species used in the experiment

Summer covers	Winter covers
Sorghum-sudangrass	Crimson clover
Cowpea (bush)	Berseem clover
Cowpea (spreading)	Red clover
Buckwheat	Austrian winter pea
Pigeonpea	Mustard (Shield)
Sunn hemp (AU Golden)	Mustard (Caliente)
Sunn hemp (Georgia)	Radish (Tillage)
Soybean	Radish (Sodbuster)
Velvet bean	Purple top turnip
Berseem clover	Cereal rye (Elbon)
Japanese millet	Oats (Cosaque black)
Sunflower	Winter wheat
Peanut (runner)	Triticale
Weedy control	Weedy control
Weed free	Weed free

Soil moisture data were collected by utilizing a Dynamax/Delta-T PR2 profile probe that recorded soil moisture at 4 independent depths (10, 20, 30, and 40 cm), and collected at bi-weekly intervals.

Weed infestation levels were assessed at peak vegetative growth, prior to the killing frost, for the summer cover crops and prior to termination for the winter cover crops in three 0.5 m^2 quadrats in each plot. The total weed infestation (%) was recorded along with three most dominant species and their contribution to the overall weed infestation. For the summer cover crops, an additional measurement was carried out to determine the level of winter annual weed suppression provided by the cover crop residues.

For the summer cover crops, weed and cover crop biomass were collected from two 1 m^2 quadrats $plot^{-1}$ after the first killing frost in the winter. For the fall cover crops, weed and cover crop biomass were collected from two 1 m^2 quadrats $plot^{-1}$ the same day that the chemical termination took place. All biomass collections were separated (weeds from cover crops) and dried at 120°F until they reached a constant mass, and dry weights were recorded.

RESULTS AND DISCUSSION

Successful establishment was achieved the first run of the study in 2017 for both summer and fall planted cover crop species. Berseem clover, velvet bean, pigeonpea and peanut did not have good emergence and establishment in 2017. In 2018, establishment was unsatisfactory for berseem clover, pigeonpea, Japanese millet, and sunflower due to cool temperatures and abundant rainfall following cover crop planting (September 2018). Substantial differences in biomass production was observed across the two years due to differences in weather conditions. For example, in 2017 our highest dry biomass producing

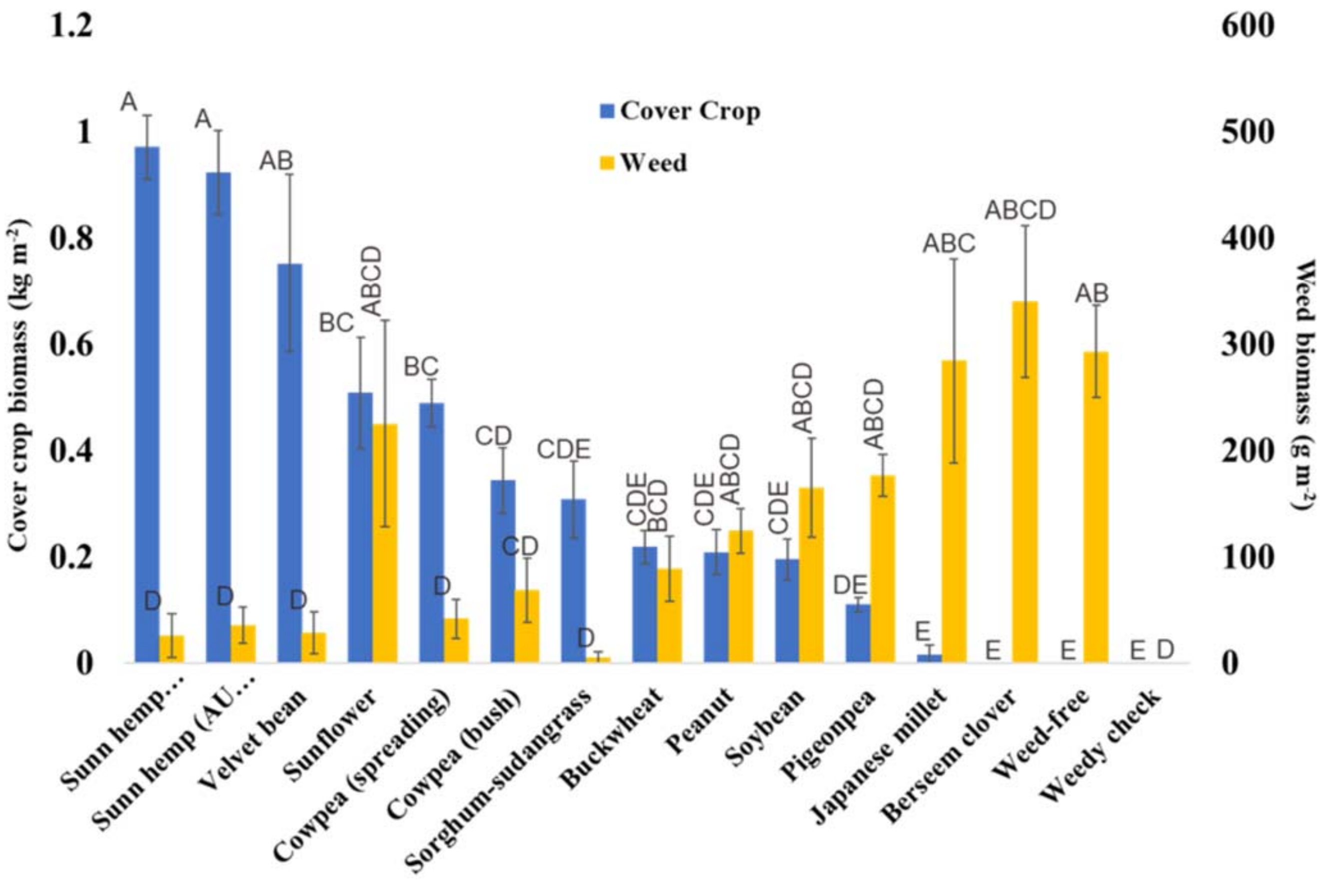

Figure 1. Biomass production by summer cover crops and weeds at termination, pooled across the 2017 and 2018 field studies.

fall cover crop was winter wheat, producing 9,750 lbs/acre, compared to the 4,014 lbs/acre produced in 2018 (Figures 2&3). Austrian winter pea was one of the most consistent fall cover crop species across the two years, producing 4,782 lbs/acre in 2017 and 4,318 lbs/acre in 2018, while still providing excellent weed suppression. This is likely due to slow establishment, followed by rapid biomass accumulation as temperatures increase in February and March (Chen et al. 2006).

Overall, there is a strong correlation between total biomass of the cover crop and the biomass of the weeds. The data pooled across

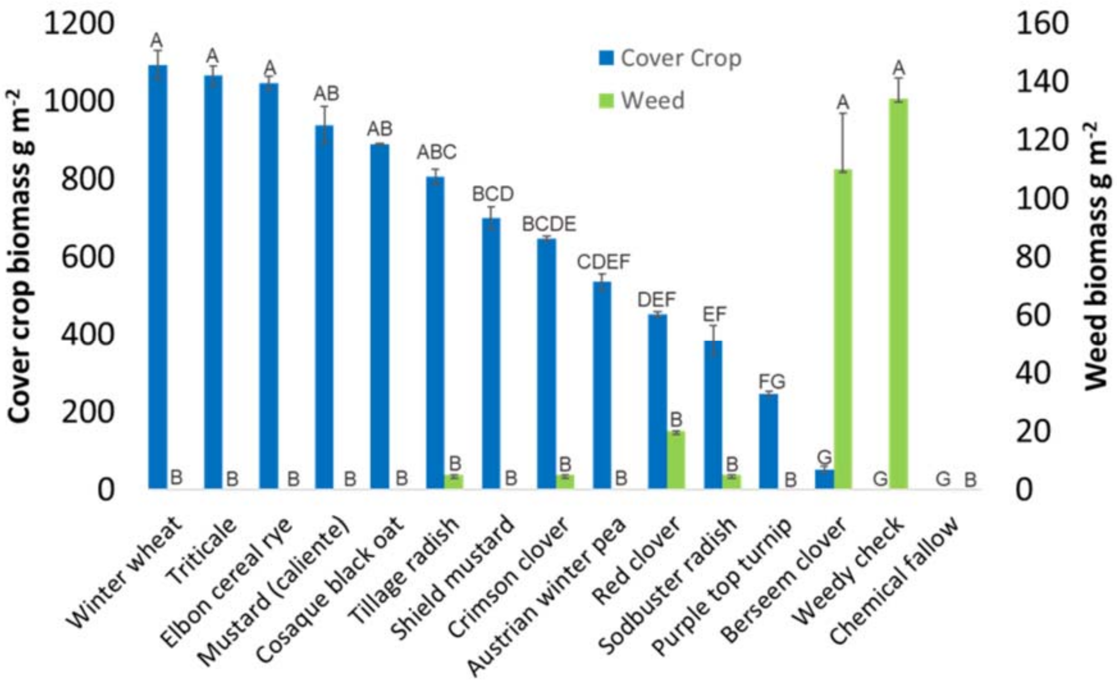

Figure 2. Biomass production by fall-planted cover crops and weeds at the time of termination, in the 2017 experiment.

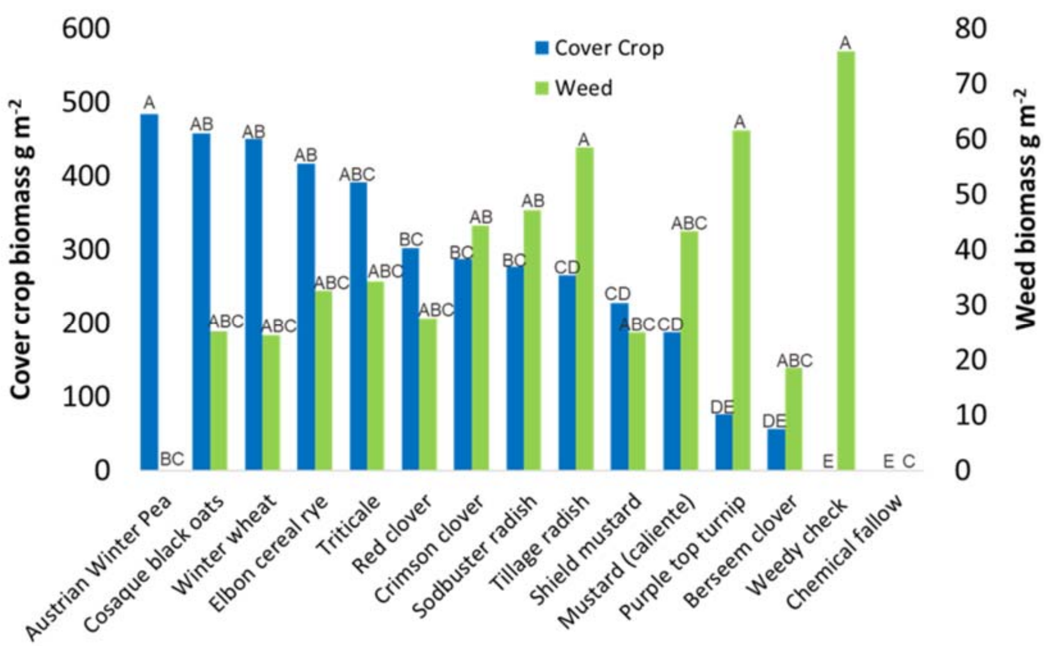

Figure 3. Biomass production by fall-planted cover crops and weeds at the time of termination, in the 2018 experiment.

Table 2. A summary of establishment potential, biomass production, weed suppression and impact on soil moisture by different cover crop species evaluated in the field experiments*

Summer Covers	Impact on Soil Moisture	Biomass Potential	Weed Suppression	Ease of establishment	Planting Rate (lbs/acre)
Sorghum-sudangrass	Poor	Excellent	Excellent	Excellent	25
Cowpea (bush)	Average	Very good	Average	Excellent	25
Cowpea (spreading)	Excellent	Very good	Average	Excellent	25
Buckwheat	Very good	Poor	Excellent	Excellent	25
Sunn hemp	Poor	Excellent	Excellent	Excellent	25
Soybean	Average	Average	Poor	Excellent	25
Velvet bean	Average	Very good	Average	Average	10-15
Berseem clover	Average	Poor	Poor	Poor	8-12
Millet (Japanese)	Poor	Average	Poor	Average	10
Sunflower	Poor	Excellent	Very good	Excellent	5-8
Peanut (runner)	Average	Poor	Poor	Poor	25

Fall Covers	Impact on Soil Moisture	Biomass Potential	Weed Suppression	Ease of establishment	Planting Rate (lbs/acre)
Crimson clover	Average	Very good	Average	Very good	8-12
Berseem clover	Average	Poor	Poor	Poor	8-12
Red clover	Average	Very good	Average	Very good	8-12
Winter pea (Austrian)	Average	Very good	Average	Very good	30-40
Cereal rye (Elbon)	Poor	Excellent	Excellent	Excellent	80-100
Mustard (caliente)	Average	Excellent	Excellent	Excellent	7-10
Radish (tillage)	Very good	Very good	Very good	Excellent	5
Purple top turnip	Average	Average	Average	Excellent	7-10
Mustard (shield)	Average	Very good	Very good	Excellent	7-10
Oats (cosaque black)	Poor	Excellent	Excellent	Excellent	50-80
Winter wheat	Poor	Excellent	Excellent	Excellent	60-100
Triticale	Average	Excellent	Excellent	Excellent	60-80

*some cover crop species are not included in this table due to poor establishment and insufficient data.

the two years showed that sunn hemp and sorghum-sudangrass showed good potential for biomass production and weed suppression (Figure 1), supporting previous reports of USDA (1999). Sorghum-sudangrass biomass was reduced in the 2018 season due to field/environmental conditions, but still exhibited strong potential for weed suppression. When conditions were ideal (i.e. 2017 experiment), nearly all fall cover crop species evaluated had significant impact on weed biomass (Figure 2).

CONCLUSION

Cover crop adoption in south Texas should be promoted among growers, due to the potential for them to improve weed suppression and provide other benefits during the cropping as well as fallow periods. Growers should select cover crop species that fit within their management and meet long-term farm goals. As these data have concluded, there are a broad range of potential cover crop species that can be used to achieve many goals, while having minimal impact on soil moisture for subsequent cash crop.

REFERENCES

Chen C, Miller P, Meuhlbauer F, Neill K, Wichman D, and McPhee K. 2006. Winter pea and lentil response to seeding date and micro- and macro- environments. Agronomy 98:1655-1663

USDA (1999) Sunn Hemp: A cover crop for southern and tropical farming systems. Soil Qual - Agron Tech Note 10

EFFECTS OF COVER CROPPING AND SOIL MANAGEMENT ON SOIL CO_2 EMISSIONS AND SOIL PROPERTIES IN A TRANSITIONING ORGANIC GRAIN PRODUCTION SYSTEM

Diana Zapata[1], Nithya Rajan[1], Ronnie Schnell[1], Kenneth Casey[2], and Jake Mowrer[1]

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ABSTRACT

Quantifying C and nutrient losses from agricultural activities continue to be a challenge due to the complexity of driving factors that regulate nutrient and gaseous fluxes and the time-scale over which soil processes occur. Overall, conservation practices are over-generalized, and recommendations do not consider site-specific factors (i.e., weather variability, soil type). Here, we present preliminary data from two field experiments that were managed according to the National Organic Program (NOP) guidelines and implemented cover crops and soil management practices. Both experiments are located at the Texas A&M University Research Farm (30°32'52" N, 96°26'14" W, 68.6 m a.m.s.l.) located in Burleson County, 16 km from College Station, TX.

STUDY 1.

Goal: Investigate soil CO_2 emissions and changes in soil physical properties in a transitioning organic corn production system.

Overview: The site was uncultivated and remained as unmanaged fallow for 8-years prior to clearing and tilling before establishing the study in September 2016. Organic certified corn (Blue River hybrids 70A47) was planted in March and received broiler litter in 2017 (1,936 kg ha^{-1}) and turkey compost (4,694 kg ha^{-1}). Four cropping systems practices that involved cover cropping (single or double) and tillage practices were implemented in the 2016-2017 and 2017-2018 growing seasons. Both summer (Cowpea) and winter cover crop (Austrian pea only and wheat /barley/Austrian winter pea mixture) residues were incorporated only in conventional tillage plots, whereas in reduced tillage plots, crop residues remained on the surface and tillage was done prior to the planting of cover crops. The soil is characterized as Ships clay (very-fine, mixed, active, thermic Chromic Hapludert) with 44.5% clay, 17.6% sand, and 37.9% silt.

We measured soil CO_2 flux during the growing season of corn using an automated LI-8100A soil chamber system (Model LI-8100A, LI-COR Biosciences). The LI-8100A analyzer control unit was connected to a multiplexer (Model LI-8150, LI-COR Biosciences). The multiplexer controlled eight long-term soil chambers that were located close to the crop row and in between the crop rows to capture the spatial variability in soil CO_2 emissions.

Findings:

- Emissions during 2017 were higher in all treatments compared to 2018, but the average treatment effect was similar between years.
- In 2017, average seasonal soil CO_2 flux from no cover crop in conventional-tillage was 7.15 μmol m^{-2} s^{-1}, followed by the cereal/legume mix in conventional-tillage with 8.49 μmol m^{-2} s^{-1}, the legume-only in no-tillage with 9.28 μmol m^{-2} s^{-1}, and the cereal/legume mix with no-tillage with 9.36 μmol m^{-2} s^{-1}.
- The average soil CO_2 flux in 2018 from the no cover crop in conventional-tillage was of 2.01 μmol m^{-2} s^{-1}, followed by the and the cereal/legume mix in conventional-tillage with 3.39 μmol m^{-2} s^{-1}, legume-only in no-tillage with 3.26 μmol m^{-2} s^{-1}, and the cereal/legume mix with no-tillage with 3.08 μmol m^{-2} s^{-1}.

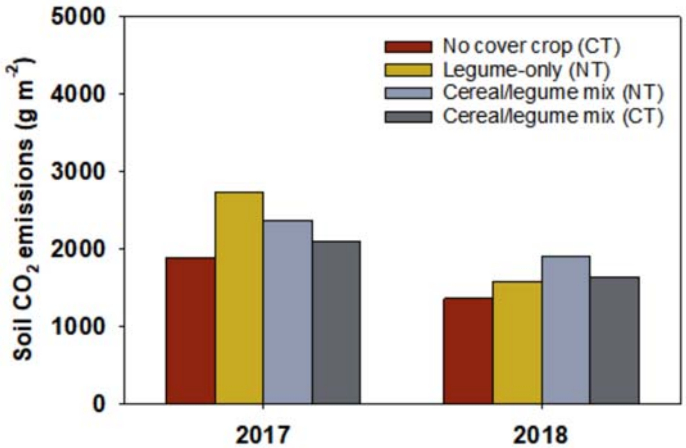


Figure 1. Cumulative soil CO_2 emissions measured during the 2017 and 2018 growing season of

- Cover cropping and reduced tillage increased emissions in both years. In 2017, when comparing emissions against the no cover crop treatment, it was estimated that the legume-only in no-tillage increased emissions by 44.7%, the cereal/legume mix in no-tillage in 47.3%, and the cereal/legume mix in conventional-tillage in 11.6%. During 2018, the legume-only in no-tillage increased emissions by 41.8%, the cereal/legume mix in no-tillage in 47.3% and the cereal/legume mix in conventional-tillage in 61.6%.

STUDY 2.

Goal: Investigate soil CO_2 emissions, crop yield, and biomass productivity from organic and conventional corn and sorghum grain production in southcentral Texas.

Overview: The study was established in March 2019. The soil is characterized as Weswood silty clay loam (fine-silty, mixed, superactive, thermic Udifluventic Haplustepts). Organic certified corn (Blue River hybrids 70A47) and conventional grain sorghum (Blue River hybrids 63C5) were planted. Organically managed plots received an application of mushroom compost at a rate of 3 ton ha^{-1}. The soil was cultivated to reduce weed pressure and incorporate compost. Conventionally managed plots received a pre-emergent herbicide application (Dimethenamid-P, at a rate of 18 oz/A, 15 gal). A synthetic liquid fertilizer (Urea Ammonium Nitrate 32-0-0 at a rate of 112 kg N ha-1) was applied in conventional plots.

We monitored soil temperature and volumetric water content (VWC) continuously at three depths (5, 15 and 25 cm) in conventional and organically managed plots. Soil CO_2 flux was continuously measured during the growing season of corn and sorghum using 11 soil chambers (LI-8100A, LI-COR Biosciences) deployed in the field. Final crop and weed biomass were collected before harvest.

Findings:

Crop management had an effect on soil moisture only in corn, with conventionally managed plots showing on average approx. 16% higher VWC than organically managed plots.

Soil moisture and temperature in sorghum plots were similar between management practices.

Conventionally managed plots showed lower soil CO_2 emissions compare to organic production and differences on CO_2 emissions were more prominent during dry-periods.

The average soil CO_2 fluxes were 20% higher in organic corn (4.03 μmol m^{-2} s^{-1}) compared to conventional (3.36 μmol m^{-2} s^{-1}). However, no significant differences in terms of carbon losses were observed between organic and conventional plots.

Average soil CO_2 fluxes in grain sorghum were 47% higher in organic (2.82 μmol m^{-2} s^{-1}) compared to conventional management (4.16 μmol m^{-2} s^{-1}). This resulted in significant differences in C emissions between organic grain sorghum (3,857.1 g C ha^{-1}) and conventional (2,649.4 g C ha^{-1}).

Corn yield in organic plots was 2,610.5 kg ha^{-1} and in conventional plots 6,269.3 kg ha^{-1}. The 56% decline in yield with organic production was

Automated soil chamber system that measured soil CO_2 flux during the growing season of corn and sorghum in 2019.

due to a higher weed pressure on organic plots (mainly pigweed) and nitrogen limitation (Fig. 2).

Sorghum yield was not affected by crop management. The average organic sorghum yield was 4,510.9 kg ha^{-1} and in conventional plots was 5,218.4 kg ha^{-1} (Fig. 3).

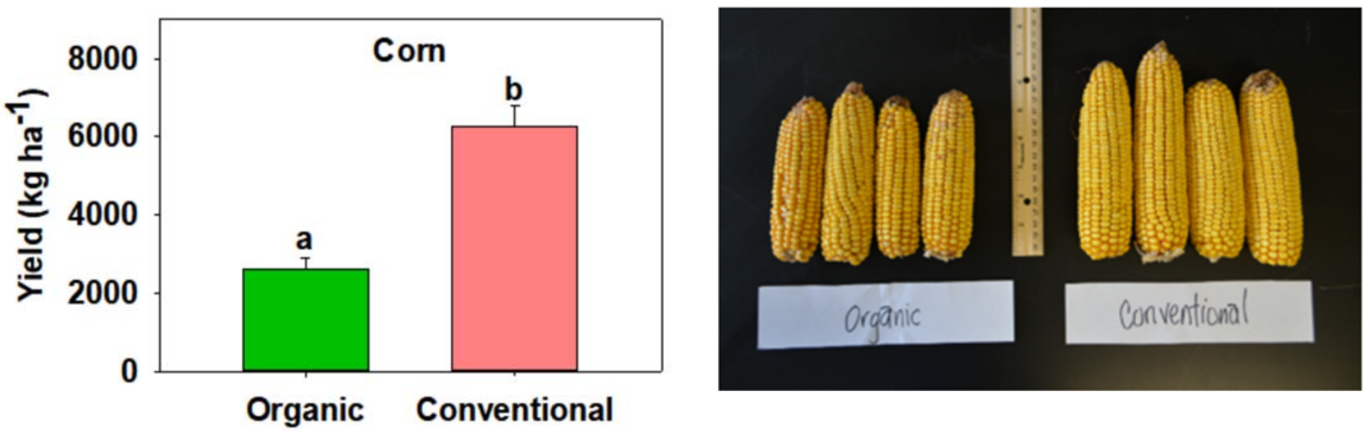


Figure 2. Corn yield from conventional and organically managed plots.

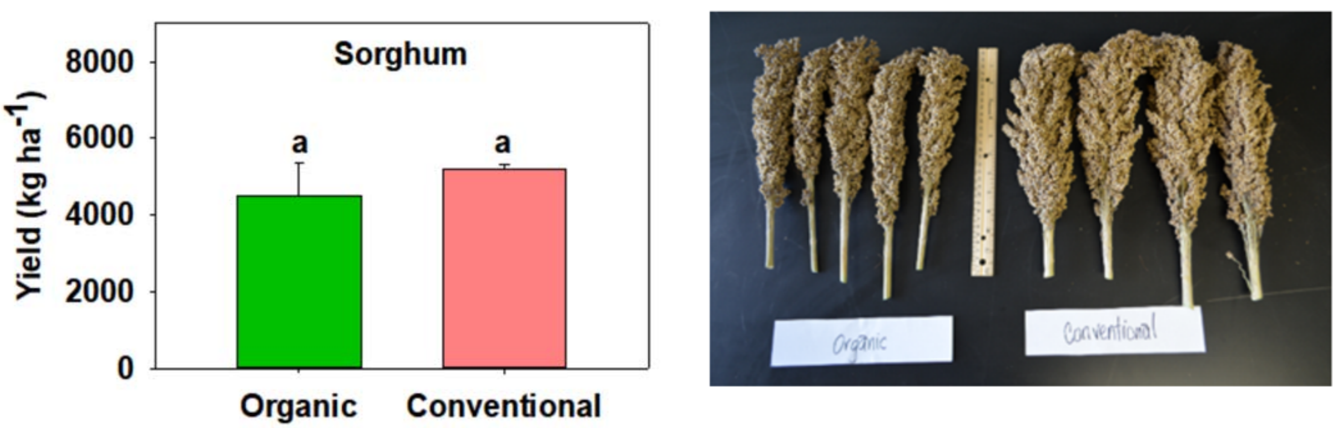


Figure 3. Sorghum yield from conventional and organically managed plots.

IMPACT OF COVER CROP ECOSYSTEM SERVICES ON CORN (ZEA MAYS) AND GRAIN SORGHUM (SORGHUM BICOLOR (L) MOENCH) PRODUCTION

Jack Nielsen & Ronnie Schnell

ABSTRACT

Fall cover crops may give growers a way to suppress herbicide resistant weeds while at the same time providing other benefits that would otherwise be lost were the land to remain fallow. While there is economic support through NRCS to adopt cover crops in some regions, questions still remain about both the benefits and the potential risks of cover crop adoption in Texas. It is our goal to determine the impact of contrasting fall cover cropping systems on ecosystem services by measuring soil health, weed pressure, and herbicide efficacy in conventionally managed corn (*Zea maize)* and grain sorghum (*Sorghum bicolor* (L.) Moench.)

MATERIALS AND METHODS

This two-year field experiment was established at the Texas A&M research farm located in Burleson County, TX to evaluate the impact of cover crops on Texas cropping systems. The field was split for planting corn and grain sorghum and rotated in the second year. Within each grain crop, three replications of 20 cropping systems practices were arranged in a strip-plot design. Cover crop systems were planted in replicated strips (strip-plot) and comprise five treatments of four cover crop species/ cover crop mixes and one fallow soil. Herbicide management serve as whole plots. Herbicide treatments include a single pass system and three two-pass systems for application of soil active herbicides. Experimental units were 100 ft long and 10 ft wide.

Cover crops evaluated include four systems of individual cover crop species and cover crop mixes compared to fallow soil. Individual species are spring and winter wheat (*Triticum aestivum*), a mix including 75% rye (*Secale cereal*) and 25% hairy vetch (*Vicia villosa*), and our final mixture contains five species which are triticale (× *Triticosecale*), oat (*Avena sativa*), Austrian winter pea (*Pisum sativum* var. *arvense*), hairy vetch, and crimson clover (*Trifolium incarnatum*). The spring wheat, winter wheat, and the rye/vetch mix were planted at a seed density of 100 lb ac^{-1}. The five species mixture were planted at a seed density of 50 lb ac^{-1}. The cover crops were planted in October using a John Deere 8100 grain drill. Approximately two weeks prior to corn and grain sorghum planting, cover crops were chemically terminated using Glyphosate at a rate of 18 oz ac^{-1} and Sharpen (Saflufenacil) at a rate of 0.7 oz ac^{-1}.

Four herbicide treatments were imposed following planting of corn and grain sorghum. Pre-emergent herbicide were applied at planting for all treatments for corn and grain sorghum. Herbicide application will include Dual Magnum (S-metolachlor) 1.25 lb ac^{-1} and Atrazine 1.0 lb ac^{-1}. We will then apply herbicides as an early post at three different time points. We will apply 2.5 lb ac^{-1} of dual magnum and 1.0 lb ac^{-1} of atrazine at three time points; 21 days after planting, 28 days after planting, 35 days after planting, and the fourth herbicide treatment will not receive an early post emergence herbicide application. Glyphosate was included with early post applications to corn as needed. After planting, weed density was assessed weekly using visual ratings to estimate percent weed coverage. Rating of 1 = no weeds, 9 = 100% weed coverage. Ratings for weed coverage (broadleaf and grass weeds) will be related to the amount of cover crop residue present at the time of ratings.

Above ground cover crop biomass was collected at termination, dried, and weighed to estimate biomass production from the different cover crops. A portion of the collected cover crop biomass will then be ground and sent for nitrogen and carbon analysis**.** To measure cover crop decomposition in the field, cover crop biomass was placed in a 1-mm mesh polyester bag. The mass used was representative of the biomass production at the site. Biomass samples were removed at 5 time points (21, 28, 35, 49, and 63 DAP) in the growing season. Soil sampling will also be performed to look at the impact that the different cover crops have on soil nutrients. We will take six soil cores from each subplot in our experiment. Soil cores were taken from three depths, 6 in, 12 in and 24 in. The six cores from each sub plot were combined and sent for nutrient analysis.

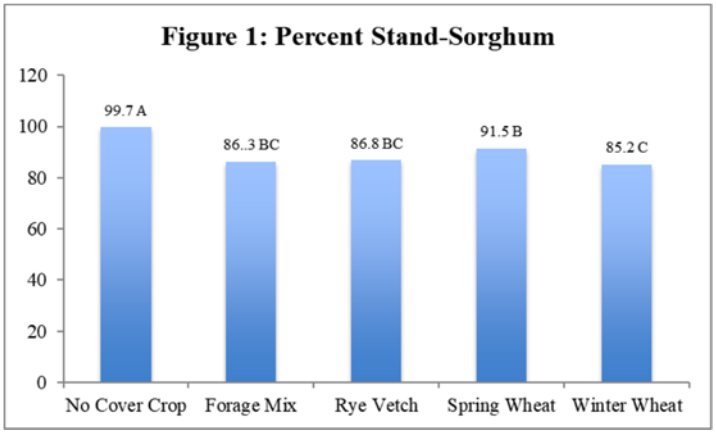
RESULTS AND DISCUSSION

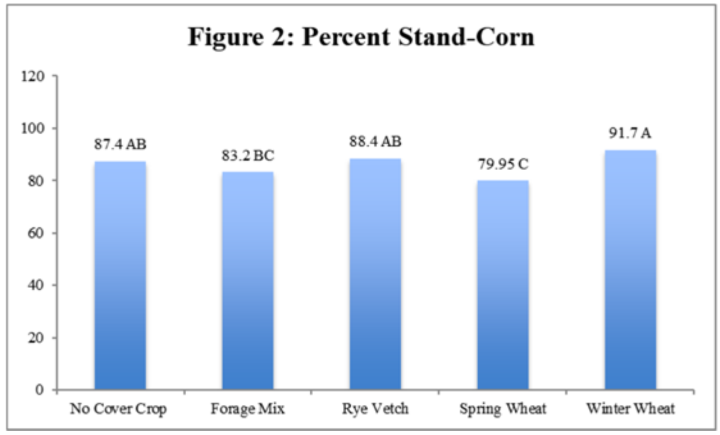
A similar pattern of biomass production was observed in both the corn and sorghum part of this experiment. Spring wheat produced significantly more biomass than the other cover crops, whereas the other cover crops produced similar biomass amounts .

Significant differences were observed in the percent stand in both corn and sorghum plots. In sorghum, all cover crops had significantly lower stand counts in comparison to the no cover crop (Figure 1.) For corn, the pattern is less clear despite significant difference (Figure 2.) Heavy residues may have affected soil moisture and planting operations. Greater moisture in heavy residue resulted in seed trenches opening upon drying, which may have reduced plant stands.

Table 1. Cover crop biomass

Cover Crop	Corn-Biomass lb/acre (2/19/19)	Sorghum-Biomass lb/acre (3/22/19)
Spring Wheat	3480 A	3660 A
Five Species Forage Mix	1780 B	2410 B
Rye Vetch Mix	1700 B	2590 B
Winter Wheat	1780 B	2140 B

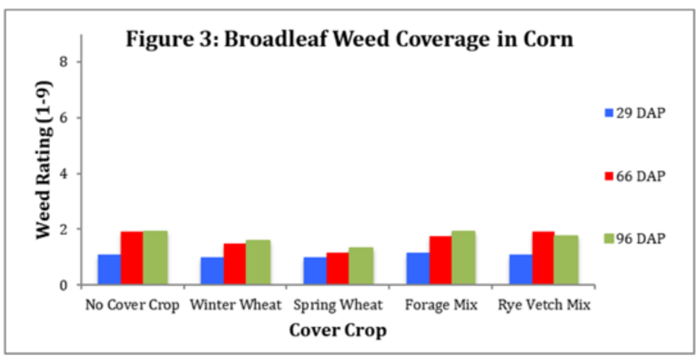


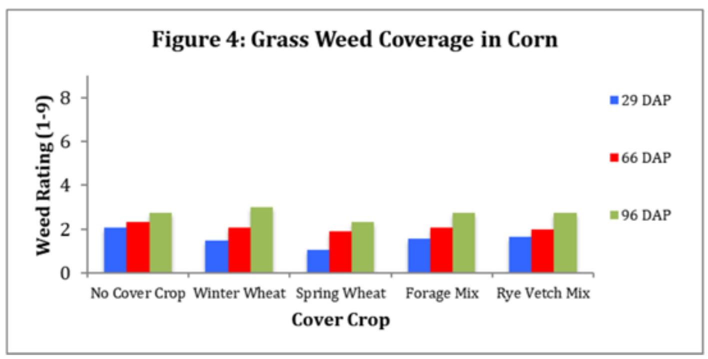


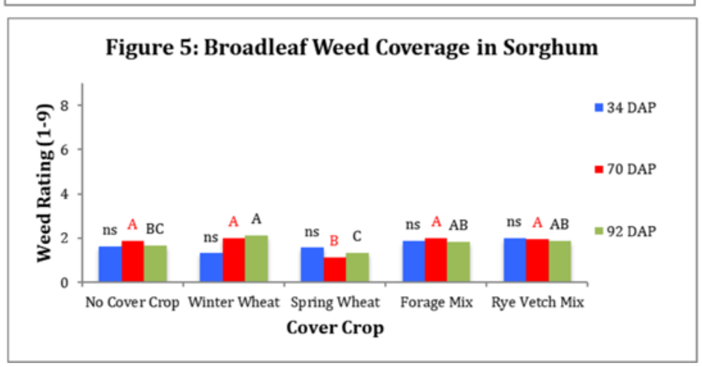
Figures 2&4. Percent stand in Sorghum and Corn

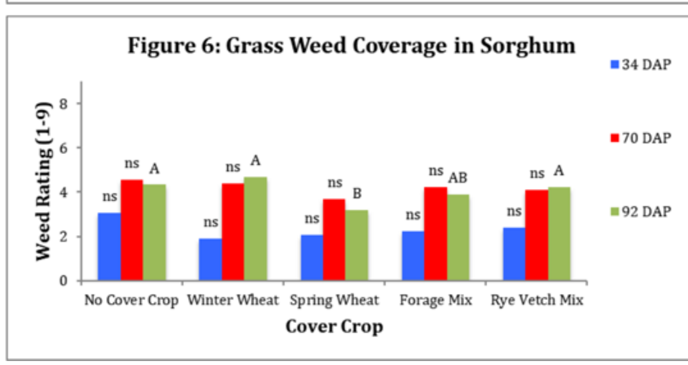
Weed coverage was estimated throughout the growing season for both broadleaf and grass weed species. These ratings were taken approximately 30 days apart in the growing season. For corn, there was no significant effect on weed pressure due to cover crop for broadleaf or grass weed species (Figures 3 and 4). For sorghum, spring wheat did reduce broadleaf weed coverage from mid-season onward and reduced grassy weed coverage late in the season (Figure 5 and 6).

In corn, both the winter wheat and spring wheat cover crops resulted in significantly lower yields than the other cover crops or winter fallow soil. The five species forage mix and the rye/vetch mix did not differ in yield than the plots with no

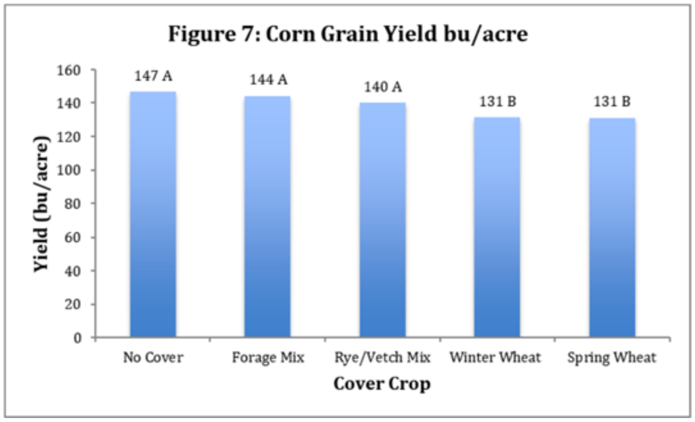


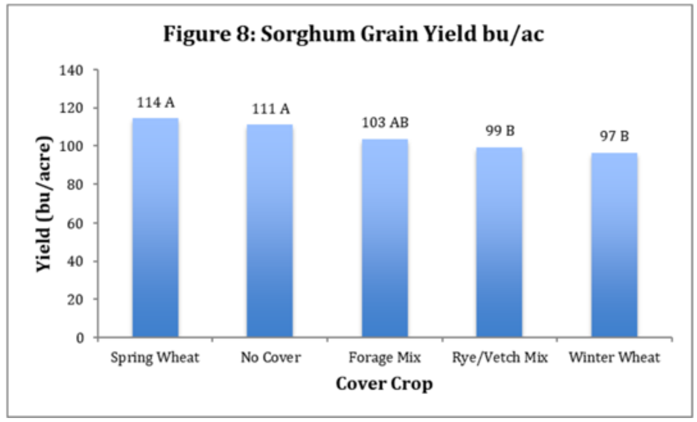






Figures 3-6. Estimation of weed coverage in corn and sorghum for contrasting cover crops in corn and sorghum, with 1 = no weeds and 9 = complete weed coverage.





cover crop (Figure 7.) For sorghum, spring wheat plots had the highest yields, but it did not differ from winter fallow soil. The rye/vetch and winter wheat plots had significantly lower yields with the five species forage mix falling between the groups (Figure 8.)

CONCLUSIONS

Spring wheat produced the most biomass of the cover crops and had a significant impact on weed control in sorghum while not negatively impacting grain yield. It did not improve corn yields or weed control in corn. Spring and winter wheat reduced corn yields. Nitrogen cycling in wheat residues may have limited corn yields as cover crops that included legumes did not reduce grain yields. This is only one year of data. Future years of data will help to reveal sources of variation in grain yield and weed control for cover crop systems.

EFFECT OF TILLAGE AND CARBON AMENDMENTS ON CORN YIELD

J. Mowrer, B. Thapa, & D. Coker

ABSTRACT

Brazos alluvial soil is vulnerable to erosion including wind, water, tillage or inappropriate farming practices. Conventional tillage leaves soil unprotected against the forces of wind and water, resulting in watershed degradation, eutrophication by increased nutrient loading, and increased sediment and bacteria loading. Major priorities in this agricultural system include increasing adoption of sustainable conservation practices, improving soil health, and improving economic returns for farmers. Promoted strategies aligned with soil health outcomes include no- and/or reduced tillage and building soil carbon. However, the reluctance of farmers to adopt these practices is related to the perception that the practices will not result in improvements to the economics of farming. This study shows that corn production on river valley soils using sustainable conservations practices will increase profits.

MATERIALS AND METHODS

Site: Corn *(Zea mays, var Terral REV 25BHR26)* was planted at Texas A&M University's farm at Snook, TX. The soil type is Weswood silt loam. The carbon amendments were applied as 500 kg C / ha basis and nutrients were applied on all plots based on soil test result regardless of treatment.

Parameters	Nitrogen (lb/acre)	Phosphorus (lb/acre)	Potassium (lb/acre)
Composted Biosolid	22.29	15.36	2.59
Biochar	1.39	3.32	24.09

Table 1: Nutrient content supplied by carbon amendments. P and K measured as plant available, or Mehlich III extractable. Total N measured by combustion method.

Experimental Design: Individual plots were 4 rows wide (3m) x 5 meters. Forty eight plots were laid out in randomized complete block design with 3 treatments and 8 replications. Treatments were tillage at two levels- conventional and no-tillage with carbon amendments biochar, biosolids and control.

Yield was determined by hand-harvesting the center two rows of each plot. Results were expressed on a 12.8% moisture basis. Statistical Analysis was performed using SAS software. Comparison of means (Fisher's protected LSD) was performed using PROC GLM (α = 0.10).

RESULTS AND DISCUSSION

- Plant stand was affected by tillage.
- More variability in plant stand was observed with no-till but average was less than tilled.
- Yield was related to plant stand. e.g. *Fewer plants = higher yield*
- Potential to look at lower seedling rates in no-till in future research.

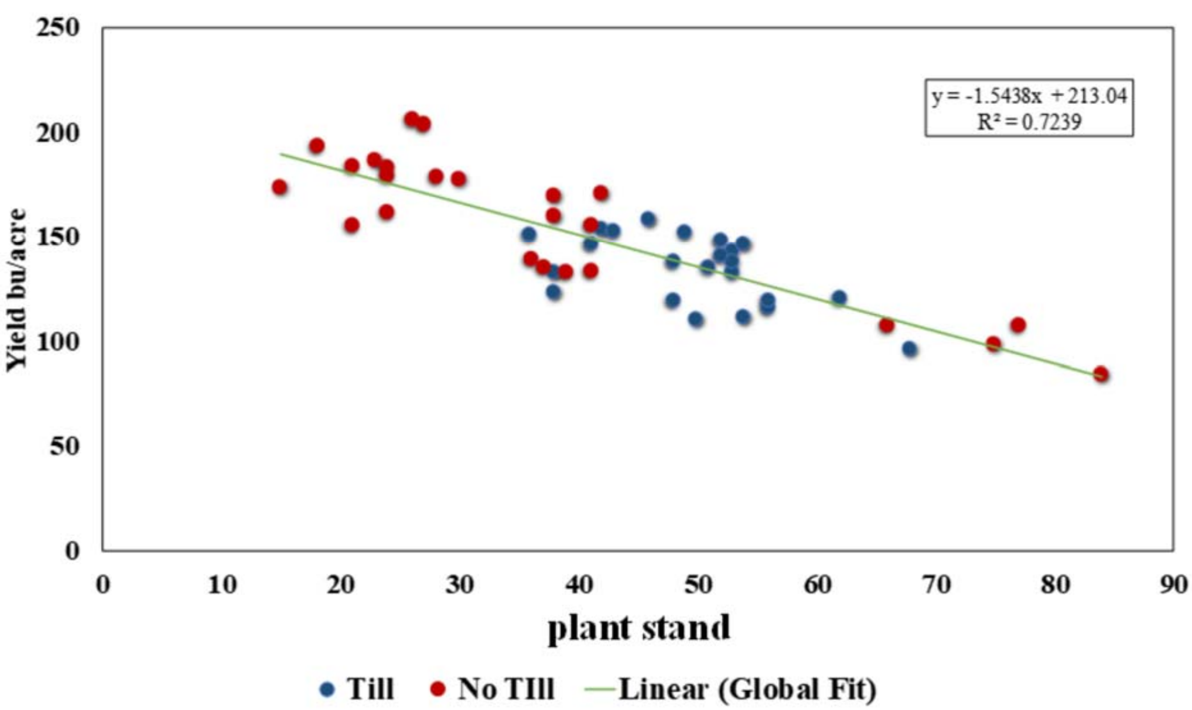


Figure 1: Scatter plot of yield and plant stand

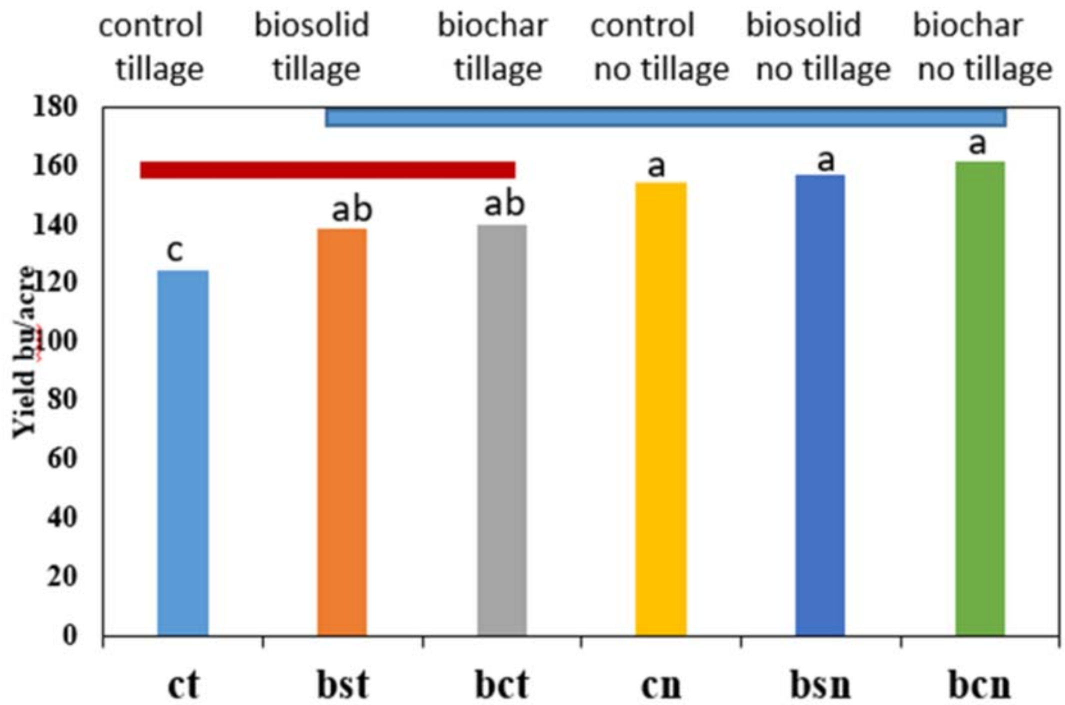


Figure 2: Corn yield by treatments. Treatments with same letters do not significantly differ

- Yield was significantly increased in no-till compared to tillage. Difference in yield was 23 bu/acre.
- In tillage treatments carbon additions resulted greater yields than no carbon even though fertilizer nutrients were already supplied at sufficient levels.
- In no-till, carbon additions resulted in numerically greater yields with the same pattern as tillage.
- Biochar gave numerically greater yield than composted biosolids.
- The long term stability of biochar (~5000 yr) does not cause problem with nutrient tie up under the same fertilizer conditions.
- Placement of carbon amendments on surface did not result in negative results.

CONCLUSION

- Brazos river valley soils show potential for economic improvement for farmers adopting conservation practices such as reduced tillage and carbon amendment.
- Brazos, Colorado and other nearby river valleys could be targeted areas for increasing adoption of conservation practices because of the sensitivity of surface water resources to soil erosion and nutrient loss.
- Positive Economic benefit of total \$133/acre (\$89 dollar with increased 23 bushel corn assuming corn price \$3.89/bushel and \$44 by reducing seed rate by 1/3 assuming seed cost \$132/acre) may be generated.

Future goals for the study site are to investigate the response of corn root and soil micro-organisms to carbon amendments. We will continue to monitor the longevity of the two different carbon sources, and the effect this has on crop productivity and soil health.

5 SPECIES WINTER LEGUME SEEDING RATE TRIAL

J. Mowrer, S. Seehaver*, B Gerrish, J. Meyer, & D. Coker
*North Carolina State University

ABSTRACT

What is the appropriate seeding rate for cover crops in eastern Texas? To answer this question, we have frequently borrowed data from other parts of the U.S., or provided recommendations based on anecdotal evidence from farm to farm. This study evaluates 4 rates of 5 species of winter legume cover crops both drill-seeded and broadcast-seeded to provide an experimental basis for future recommendations. Two termination dates aligned with the timing of corn and cotton planting will be examined for total biomass. The study is part of a 22 site collaboration with the Southern Cover Crop Council replicated in 14 states and territories across the Southeastern U.S.

MATERIALS AND METHODS

Five (5) species of winter legume cover crops were planted with a no-till drill at four rates during the second week of October 2019 into plots 5' x 10' in size. Each of the rates of application were duplicated in the field. All species and rates were additionally mixed with cereal rye at a single rate to study the effect of legume species and seeding rates in a mix. This study, and all of the treatments above, was repeated as a broadcast seeding evaluation as well. No fertilizer was applied.

Harvest of biomass was performed by placing a 2' x 2' square quadrat onto each plot and removing biomass to 1" of the soil surface. Plant matter was dried at 147F for 3-4 days and weighed for total mass. Species will be separated for individual mass, as will any weeds found in the plots. Biomass harvest for 'corn planting' was performed on 02/14/2020.

Species (abbr)	Low Rate (lbs/acre)	Mid Low Rate (lbs/acre)	Mid High Rate (lbs/acre)	High Rate (lbs/acre)
% Recommendation	25%	50%	100%	150%
Berseem Clover (BC)	3	6	12	18
Common Vetch (CV)	5	10	20	30
Crimson Clover (CC)	3	6	12	18
Hairy Vetch (HV)	5	10	20	30
Winter Pea (WP)	20	40	80	120
Cereal Rye*	30			

Table 1. Seeding rates and species. * Cereal rye seeding rate in mixes kept constant at 30 lbs / acre

RESULTS AND DISCUSSION

Biomass collection results from the drilled study mid-February indicate that Winter Pea and Hairy Vetch would produce more above ground plant matter than the other three species. Seeding rate made more of a clear difference in some species (Common Vetch and Crimson Clover) by the corn planting termination date. When mixed with Cereal Rye, all plots produced more total biomass than those same species planted alone. In fact, Cereal Rye biomass accounted for the majority of the biomass in these plots, providing some competition that reduced legume mass production compared to legume-only plots. Seeding rate of legumes had no

Figure 1. Plot layouts for drilled and broadcast portions of the legume rate trial study.

Drilled seeded study (to right hand side when facing river not flagged)

Brazos River (left) — Ditch / Bridge Side (right)

Block																						
Block 2	5'	68 WP, Wyo 40	56 CC, Dixie 30	64 HV, AU Merit 20	54 HV, AU Merit 30	60 CV 20	46 BC, Frosty 3	62 HV, AU Merit 5	50 BC, Frosty 12	44 CC, Dixie 10	78 WP, Wyo 80	76 WP, Wyo 120	52 CC, Dixie 5	48 CV 5	66 CC, Dixie 20	58 CV 30	70 CV 10	80 BC, Frosty 6	42 WP, Wyo 20	72 BC, Frosty 18	74 HV, AU Merit 10	with rye strip
	Plot #	240	238	236	234	232	230	228	226	224	222	220	218	216	214	212	210	208	206	204	202	
	5'	73 HV, AU Merit 10	77 WP, Wyo 80	47 CV 5	75 WP, Wyo 120	57 CV 30	49 BC, Frosty 12	43 CC, Dixie 10	65 CC, Dixie 20	71 BC, Frosty 18	79 BC, Frosty 6	51 CC, Dixie 5	45 BC, Frosty 3	53 HV, AU Merit 30	55 CC, Dixie 30	67 WP, Wyo 40	69 CV 10	63 HV, AU Merit 20	59 CV 20	61 HV, AU Merit 5	41 WP, Wyo 20	
	Plot #	239	237	235	233	231	229	227	225	223	221	219	217	215	213	211	209	207	205	203	201	
Block 1	5'	24 BC, Frosty 12	40 HV, AU Merit 5	12 BC, Frosty 18	38 WP, Wyo 80	34 WP, Wyo 120	10 CV 10	16 HV, AU Merit 30	4 HV, AU Merit 20	2 CC, Dixie 30	6 WP, Wyo 20	26 BC, Frosty 3	20 CC, Dixie 10	28 CV 20	22 BC, Frosty 6	14 CC, Dixie 20	18 CV 30	36 HV, AU Merit 10	30 WP, Wyo 40	32 CV 5	8 CC, Dixie 5	with rye strip
	Plot #	140	138	136	134	132	130	128	126	124	122	120	118	116	114	112	110	108	106	104	102	
	5'	33 WP, Wyo 120	29 WP, Wyo 40	25 BC, Frosty 3	7 CC, Dixie 5	37 WP, Wyo 80	35 HV, AU Merit 10	1 CC, Dixie 30	9 CV 10	27 CV 20	19 CC, Dixie 10	3 HV, AU Merit 20	31 CV 5	21 BC, Frosty 6	15 HV, AU Merit 30	39 HV, AU Merit 5	11 BC, Frosty 18	5 WP, Wyo 20	17 CV 30	23 BC, Frosty 12	13 CC, Dixie 20	
400'	Plot #	139	137	135	133	131	129	127	125	123	121	119	117	115	113	111	109	107	105	103	101	0'

Scatter seeded study (to left hand side when facing river blue flagged)

Brazos River (left) — Ditch / Bridge Side (right)

Block																						
Block 2	5'	62 HV, AU Merit 5	44 CC, Dixie 10	48 CV 5	42 WP, Wyo 20	52 CC, Dixie 5	68 WP, Wyo 40	76 WP, Wyo 120	66 CC, Dixie 20	70 CV 10	72 BC, Frosty 18	56 CC, Dixie 30	58 CV 30	78 WP, Wyo 80	54 HV, AU Merit 30	50 BC, Frosty 12	64 HV, AU Merit 20	80 BC, Frosty 6	60 CV 20	74 HV, AU Merit 10	46 BC, Frosty 3	with rye strip
	Plot #	240	238	236	234	232	230	228	226	224	222	220	218	216	214	212	210	208	206	204	202	
	5'	75 WP, Wyo 120	79 BC, Frosty 6	65 CC, Dixie 20	55 CC, Dixie 30	73 HV, AU Merit 10	53 HV, AU Merit 30	57 CV 30	63 HV, AU Merit 20	45 BC, Frosty 3	41 WP, Wyo 20	61 HV, AU Merit 5	43 CC, Dixie 10	71 BC, Frosty 18	51 CC, Dixie 5	59 CV 20	67 WP, Wyo 40	49 BC, Frosty 12	47 CV 5	77 WP, Wyo 80	69 CV 10	
	Plot #	239	237	235	233	231	229	227	225	223	221	219	217	215	213	211	209	207	205	203	201	
Block 1	5'	36 HV, AU Merit 10	18 CV 30	6 WP, Wyo 20	10 CV 10	12 BC, Frosty 18	14 CC, Dixie 20	38 WP, Wyo 80	2 CC, Dixie 30	16 HV, AU Merit 30	20 CC, Dixie 10	28 CV 20	34 WP, Wyo 120	4 HV, AU Merit 20	24 BC, Frosty 12	26 BC, Frosty 3	22 BC, Frosty 6	30 WP, Wyo 40	32 CV 5	40 HV, AU Merit 5	8 CC, Dixie 5	with rye strip
	Plot #	140	138	136	134	132	130	128	126	124	122	120	118	116	114	112	110	108	106	104	102	
	5'	36 HV, AU Merit 1	18 CV 30	6 WP, Wyo 20	10 CV 10	12 BC, Frosty 18	14 CC, Dixie 20	38 WP, Wyo 80	2 CC, Dixie 30	16 HV, AU Merit 3	20 CC, Dixie 10	28 CV 20	34 WP, Wyo 120	4 HV, AU Merit 2	24 BC, Frosty 12	26 BC, Frosty 3	22 BC, Frosty 6	30 WP, Wyo 40	32 CV 5	40 HV, AU Merit 5	8 CC, Dixie 5	
400'	Plot #	139	137	135	133	131	129	127	125	123	121	119	117	115	113	111	109	107	105	103	101	0'

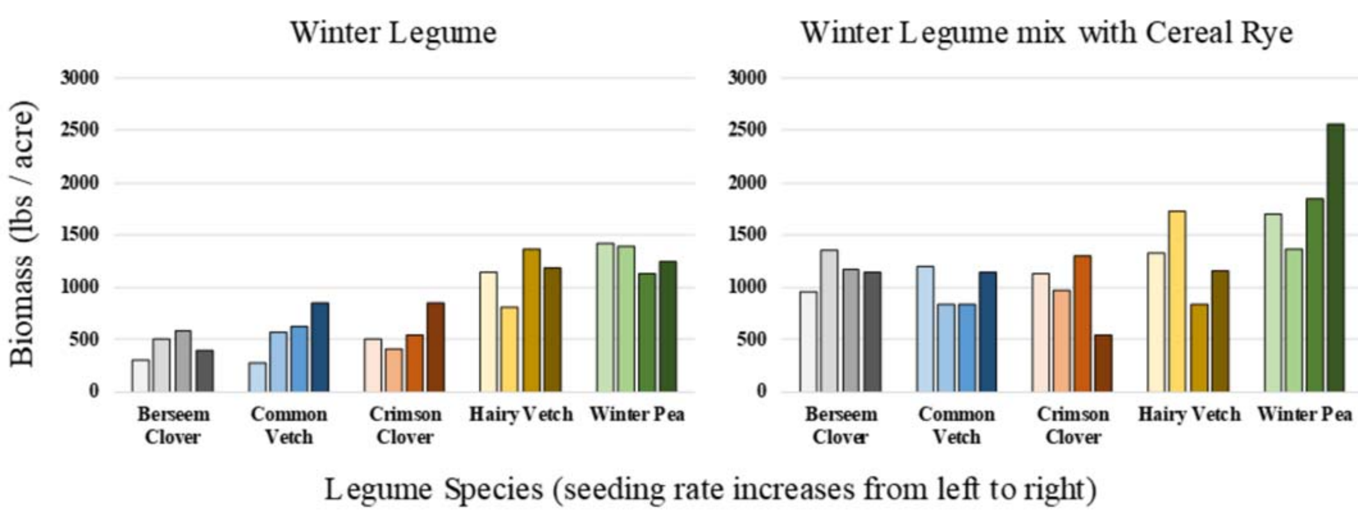
significant effect on total biomass in the mixes. Data was not summarized for the broadcast plots, but it is clear that these plots produced substantially less biomass than drilled plots, and that emergence was less uniform.

CONCLUSION

Depending on the target termination date, recommended seeding rates for legumes can be changed from those currently in place. In many cases, the 50% recommended rate produced as much biomass as the 100% rate. Winter Pea was the best single species performer in this single year trial. Berseem Clover, Crimson Clover, and Common Vetch did not perform as well by early (February) termination. It is important to note that Hairy Vetch, although a better performer than the clovers or Common Vetch, can return as a 'volunteer' in the summer *or* the following winter and cause problems with subsequent crops due to small hard seeds that persist for several years in the topsoil. When mixed with Cereal Rye, the grass dominated the mix of species in all plots at the early termination date.

Future work will include the measurement of biomass in broadcast plots and the biomass collection for a Cotton planting termination date (~mid March). Future years and different sites are needed to support final recommendations for winter legumes and their best seeding rates. All data from this study will be compiled into a Southeastern Cover Crop Council website based cover crop selection tool. For more information please visit the SCCC website (page bottom):

Figure 3. Biomass harvested from drilled plots



https://southerncovercrops.org/

XTENDFLEX COTTON STEWARDSHIP TRIAL

Rohith Vulchi [1], Scott. A. Nolte[1], Joshua McGinty[2]
Texas A&M University, College Station, TX [1]
Texas A&M University, Corpus Christi, TX[2].

ABSTRACT

XtendFlex cotton (DP 1646 B2XF) is a stacked trait variety which allows the Post-emergence (POST) application of Dicamba, Glyphosate and Glufosinate. This cotton variety was grown on more than 22.3% of the 5.4 million hectares of total upland cotton grown in the US in 2019 (USDA, 2019). After the advent of transgenic varieties, herbicides slowly replaced the use of different indigenous tillage practices and crop rotation systems for weed control. However, in recent times, weed biotypes resistant to multiple modes of action, especially glyphosate, were reported in different parts of the United States. Palmer amaranth (AMAPA) resistant to multiple modes of action (Kumar et al., 2019) is a serious threat to cotton production. This brought us to a point where weed control must include other management options like tillage, cover cropping, crop rotations along with herbicide programs and test them for their long-term benefits in terms of weed control, cost effectiveness and sustainability of herbicide resistance management. Therefore, field level research is being carried out at three locations in Texas for three years integrating two herbicide programs, one with residual herbicides and one without, in cover cropping, strip till and conventional till systems and rotating cotton with sorghum during second year. During 2019, herbicide programs with residual herbicides provided better season-long weed control, yield and returns in most tillage practices. Cover cropping at College Station and conventional till at Stiles Farm gave the best weed control, yield and returns.

OBJECTIVE

To test the % AMAPA control of HI and LI herbicide programs in different tillage systems and compare their lint yields, total costs, and net returns.

MATERIALS AND METHODS

- Experimental Design: Split Plot design with 8 replications.
- Main factor: Tillage type (80 ft X 120 ft)
- Sub factor: Herbicide Program (10 ft X 30 ft)
- Expresso variety is planted at 95 lbs/ acre rate as a cover crop using a no-till planter with 7” spacing.
- Deltapine 1646 B2XF was planted on flat ground at a rate of 112,500 seeds/ha.
- Cotton was spaced 30 inch between rows at College Station and Stiles, 40 inch at Corpus Christi.
- Entire trial area was fertilized according to the soil testing reports at all the three locations.

DATA COLLECTED

- % weed control 14 Days after PREs were applied.
- 14, 21, 28, 56 days after POST application and One week before harvest.
- Seed cotton Yield and Lint yield.

RESULTS

1. HI program gave better control of AMAPA in most of the tillage practices.
2. At College Station, cover cropping gave better yields and returns whereas at Stiles farm, conventional till gave better yields and returns.

DATA COLLECTED

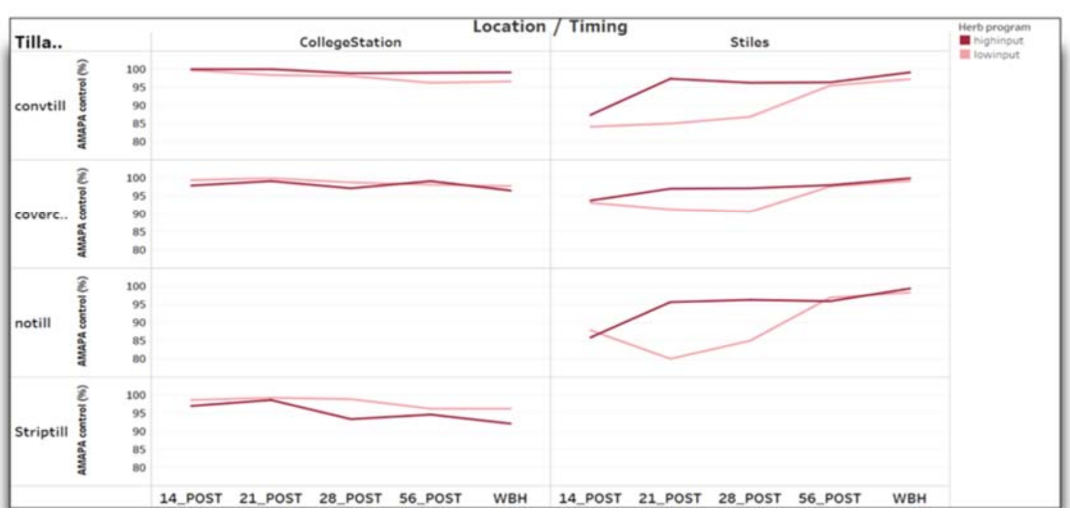
- % weed control 14 Days after PREs were applied.
- 14, 21, 28, 56 days after POST application and One week before harvest.
- Seed cotton Yield and Lint yield.

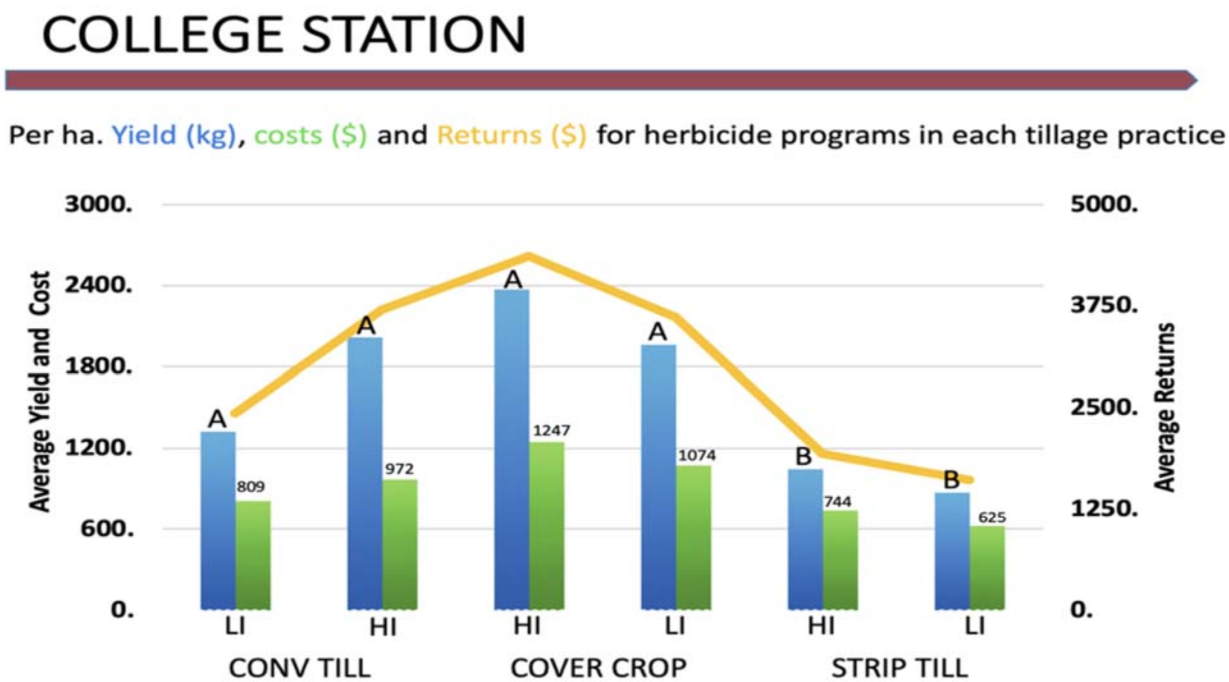
Location	Tillage types followed		
College Station	Cover crop	Strip Till	Conventional Till
Stiles Farm	Cover crop	No till	Conventional Till
Corpus Christi	No till	Strip till	Conventional till

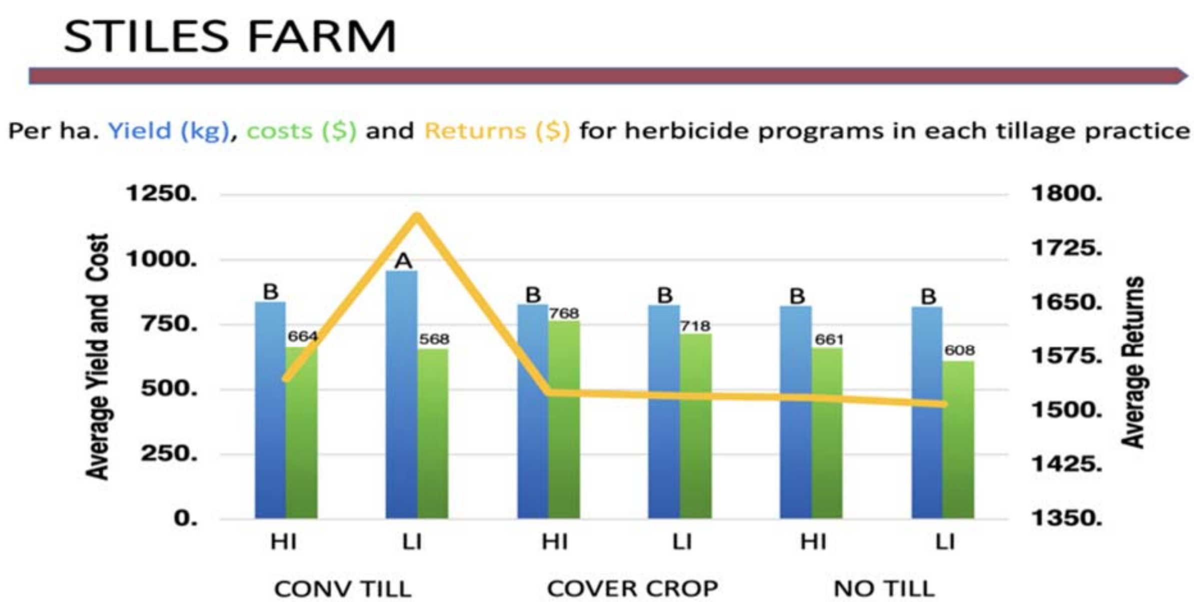
Herbicide programs at College Station and Stiles (Rates in kg a.i/ha)

Application timing	Low input program (LI)	High input program (HI)
1st Burndown	2,4-D Amine + Roundup PowerMax	2,4-D Amine + Roundup PowerMax
2nd Burndown	Xtendimax + Roundup PowerMax	Xtendimax + Roundup PowerMax
Pre-emergence (PRE)	N/A	Cotoran
Early POST	Xtendimax +	N/A
Mid POST	N/A	Xtendimax + Roundup PowerMax + Warrant

Trend in the performance of POST applications at 5 different timings in respective tillage practices at both the locations







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NOTES