MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 62-2017 (YEAR 1)
2017 ANNUAL REPORT

TITLE: Stabilizing dryland soybean yield and profit in dominant soils across Mississippi

PI: Gary Feng, Gary.Feng@ARS.USDA.GOV

REPORT OF PROGRESS/ACTIVITY

Progress for Objective 1.

Cover crop and application of poultry litter and biosolids may help dryland grain production by making the soil fluffier (reducing bulk density), increasing organic matter, moisture holding capacity and infiltration rate, and improving aggregate stability and water use efficiency. In order to identify effective management practices for stabilizing or increasing dryland soybean yields and water use efficiency. We started evaluating management of broiler litter, municipal biosolids, and cover crop during the fallow season in 16 soil types at 7 locations/growing environments across east and western Mississippi (Fig. 1-3).

1.1 Irrigation Study at MSU Brooksville Station in Noxubee County

The study was conducted at a 3-acre, furrow-irrigated field which contains Brooksville silty clay soil. Three treatments are replicated three times and completely randomized in the three blocks. Treatments are (i) 'Rainfed', not irrigated, (ii) 'SM', irrigation as root zone soil moisture reaches 50% of plant available water, and (iii) 'ET', irrigation when estimated soil moisture reaches 50% of plant available water, soil moisture estimated in terms of initial soil water at planting date and soil water consumed by daily crop evapotranspiration (ET) calculated using weather data. The amount of each irrigation event is equivalent to 50% of field capacity for both SM and ET treatments. Using a group IV cultivar, Asgrow 4632 was planted at 120,000 seeds per acre on May 9, 2017. The row space is 38 inches. Soybean was harvested on Sept. 23, 2017.

1.1.1 Irrigation amount and timing

Reference ETo during soybean season was 657 mm (26 in) calculated by Penman-Monteith method using data observed at Brooksville weather stations. We adopted the crop coefficient (NE Kc) published by University of Nebraska Extension, as values have not been determined for Mississippi. Average Kc values before R1, from R1 to R3, and from R3 to R6 were 0.21, 0.67, and 0.94, respectively. Crop water requirement ETc was obtained using ETo multipled by NE Kc, which was 477 mm (19 in) from planting to harvest. The average value of 542 mm (21 in) over previous 120 years. Soybean received 496 mm (19.5 in) rainfall during the entire growing season. It is a normal year because this value lies in the range of 340 mm (13 in) to 505 mm (20 in) (mean 421 mm (17 in)) during soybean season in the normal year category classified by 120 years of weather data in Noxubee county. Both SM and ET irrigation treatments were triggered at the same time on July 11 (R3), July 24 (R4), August 1 (R5), 2017. SM treatments were irrigated 63 mm (2.5 in), 50 mm (2 in), and 46 mm (1.8 in), while ET treatments were irrigated 55 mm (2.2 in), 46 mm (1.8 in), and 43 mm (1.7 in) in the three times.

1.1.2 Production

Soybean irrigated based on soil moisture sensor had mean grain yield (n=3) of 2610 kg ha^{-1} (39 bu per acre, based on combine harvest) and a harvest index of 39%. While soybean irrigated based on ET method had mean grain yield (n=3) of 2780 kg ha^{-1} (41 bu per acre) and a harvest index of 38% (Table 1). No significant difference was observed between the two irrigation trigger methods. It appears that both sensor-based method and ET-based method can be used for scheduling soybean irrigation in this region. In comparison with rainfed treatments, irrigation three times in total of 152 mm (6 in) significantly increased grain yield and aboveground biomass by 36%, thousand grain weight by 19%, maximum LAI by 37%, and plant height by 16% (Table 1). Irrigated treatments had 19% more pod numbers as well as thousand grain weight than rainfed treatment, which contributed to the yield increase over rainfed treatment.

1.2 Studies of Cover Crop, Chicken Litter and Biosolid at MSU North Farm in Oktibbeha County

This experiment was initiated in 2016 on a Marietta sandy loam and Leeper clay loam soils to determine the effects of timing and rates of broiler litter and bio-solid class A relative to inorganic fertilizer N on the soil water and rain water use efficiency and grain yield of soybean in the presence or absence of winter cover crop. Experimental design was a split-split plot replicated three times. The main plots were cover crop vs. no cover crop residue, the split plots were fall vs. spring application and the split-split plot included bio-solid, broiler litter, inorganic fertilizer and a control (unfertilized). Biosolid was applied at the rate of 3 tons/acre in both fall 2016 and spring 2017, broiler litter applied at the rate of 3 tons/acre applied only in spring 2017, inorganic fertilizer N applied to corn at the rate of 200 lb N/acre in which 50 N lb applied at planting and 150 lb N applied at knee high (V6 growth stage). Winter cover crop was planted in November 7, 2016 and chemically killed using Roundup on April 5, 2017. Before planting soybean, soil samples were taken from both cover crop and no cover crop plots and analyzed for determination of plant available N. Soybean group 4 variety AG4835 was planted on April 26, 2017 at the seeding rate of 130,000 plant per acre with 38" row spacing. It was harvested on 9/26/2017.

1.2.1 Production

Soybean planted following cover crop had higher biomass for application of inorganic fertilizer and biosolid in comparison of without cover crop. However, cover crop did not exhibit yield advantage (Table 1). Leaf area index (LAI) which typically peaked in August, had the greatest value for biosolid and inorganic fertilizer in the presence of cover crop residue than with the absence of cover crop. This indicates the presence of cover crop residue may have some conservation benefits and may prevent nutrients from loss in surface runoff and regulates soil moisture and temperature which are advantageous for plant growth. The lack of yield response with cover crop could be related to tight up of nutrients from biosolid and inorganic fertilizer into cover crop residue and were not released to the soil solution for uptake by plants. This lack of synchronization resulted in less grain yield with cover crop than no cover. Further investigation will be conducted next year.

1.3 Chicken Litter Study at MSU Verona Experiment Station in Lee County

We have evidence that fertilizing soybean with poultry litter results in more grain yield than fertilizing with the traditional synthetic fertilizers. The grain yield benefit may last an additional 2 to 3 years with one relatively high rate (3 ton/ac) application. In other words, the soybean yield benefit of applying 1 ton/ac every year for 3 years may be the same as applying 3 ton/ac one year followed by none in the following 2 to 3 years. The unused nutrients remain in the soil and become available to soybean in the following seasons. In 2015-2017, Group 4 soybean was planted on a

Leeper sandy loam soil in May of each year in plots with a history (2010-2014) of 3.5 ton/acre poultry litter applications and crop rotation schemes. Soybean planted in soil with this history was compared against soybean planted in soil that received P and K fertilizers based on soil analysis and MSU recommendation since 2010. These two treatments were also compared against soybean that received no fertilization since 2010. The rotation schemes in 2010-2011-2012-2013-2014 consisted of CMBBM, CMCBM, CCCCC, and CCMMB; where C=cotton, M=corn, and B=soybean. The target nitrogen rate in 2010-2014 was 180 lbs/acre for corn and 80 lbs/ac for cotton. Soybean received no nitrogen fertilization during this period. Planting density was 137,000 seeds/acre on 38-inch rows. The design was a randomized complete block with a split-plot treatment arrangement where rotation treatments during the first phase of this research were assigned to main plots and litter applications to subplots. Treatments were replicated four times.

As shown in Table 2, manured soils had higher yield than commercial fertilized soils, mainly resulted from greater biomass, higher plant and LAI, most importantly, thousand grain seed weight. Poultry litter application help dryland soybean utilize more rainwater and soil storage water, and improved water use efficiency (Table 2).

1.4 Cover Crop Study at MSU Pontotoc Experiment Station in Pontotoc County

In collaboration with Dr. Mark Shankle, we planted Asgrow 5533 soybean on May 17 at the seeding rate of 128,000 seeds/ac on 30 inch rows. It is an eight acre field which contains 2 types of soils, Atwood silt loam soils. We measured the rainfed soybean growth, water use and yield. From planting to harvest, potential evapotranspiration calculated by Penman Monteith method was 681 mm (27 in), total precipitation was 512 mm (20.2 in), soybean consumed 551mm (22 in) water based on our biweekly measured soil moisture data and water balance equation, we obtained 38 bushel/acre (2555 kg ha^{-1}, based on combined harvest), as result, water use efficiency of the rainfed soybean on the silt loam in Pontotoc was 4.64 kg ha^{-1} mm^{-1} (105 ib ac^{-1} in^{-1}). We cooperated with Dr. Shankle to continue those measurements in winter and spring for different treatments of cover crops planted in the last Fall. Measurements in 2017 could help to understand the benefit of cover crop (Cereal rye, Vetch, Wheat, NRCS mustard mixed with cereal rye and native vegetation) for soybean yield production and water use efficiency in 2018. Cover crops were planted in mid-October 2017 and terminated 2-4 weeks before soybean group IV is planted in late April or early May. Crop growth dynamics were assessed based on measurements of dates to critical growth stages, plant height, leaf area index, and dry biomass at major stages. Soil samples were taken in each plot in Mid-November 2017, soil physical, hydraulic, chemical, and biological properties of those samples are being measured in our lab, these results will be used as initial properties to identify those soil health factors which play major roles in stabilizing dryland soybean yield and improving water use efficiency in upland soils of the state that are often affected by drought.

1.5 Studies of Chicken Litter and Biosolids at Prewitt Farm in Bolivar County (Soybean will be planted next year)

This study was conducted in a private farm (Prewitt Farm) on Pearson and Waverly silt loam soils in Cleveland Mississippi, Bolivar county, to determine the effects of bio-solid and broiler litter relative to the recommended inorganic fertilizer N applied by the farmer on the water use efficiency and yield of cotton and soil physical, hydraulic, chemical, and biological properties. Before conducting the experiment, background soil samples were taken at the 0-15 cm soil depth and analyzed for both chemical and microbial indicators. Initial soil properties included pH of 6.9, bulk density of 1.27 g cm^{-3}, total C of 10.3g kg^{-1}, soil Mehlich 3 extractable P and K were 66 and

182 mg kg^{-1}, respectively. The experiment was a randomized complete block design with three treatments replicated three times. Both broiler litter and bio-solid were applied on May 17, 2017 at the rate to provide 120 lb plant available N /acre for cotton and incorporated into the soil immediately after application. Cotton was planted on May 18, 2017 at the seeding rate of 44000 plant per acre for a 38" row spacing. The farmer applied inorganic N fertilizer treatment on May 9, 2017. Yield from Prewitt Farm was not reported due to a 500-unit blanket application of N fertilizer that was applied to all treatments in mid-June. This application of fertilizer cancelled out any treatment effects of the original bio-solid and litter applications. This field study was terminated following the 2017 growing season.

1.6 Cover Crop Study at Stoneville Experiment Station in Washington County

A study of cover crop has been initiated on a sandy loam and a clay loam soil in an approximately 3-acre field. Currently, irrigation and rainfed treatments with four random replicates were implemented. Soybean variety Asgrow Ag4232 was planted on April 20, 2017 with a row spacing of 38 inches. During the 2017 growing season, only one irrigation was applied, August 3, 2017. Approximately 2 inches per acre was applied using furrow irrigation system. A tillage radish cover crop was planted on November 15, 2017. The final yield data for the initial year of the study, showed that irrigated plots averaged 3900 lb/ac and non-irrigated plots yielded 4000 lb/ac.

1.7 Studies of Chicken Litter and Cover Crop at Delta Conservation Demonstration Center (DNDC) in Washington County (Soybean will be planted next year)

The objective of this study is to determine whether poultry litter applied in the fall accompanied by winter cover crops can result in benefits of grain yield, soil health and water use efficiency comparable to spring-applied poultry litter. The study is a 2x2x2 full factorial experiment consisting of fall versus spring applied poultry litter, with winter cover crop versus no cover crop, and no-till versus conventional or minimum tillage systems. A farm standard treatment is included for comparison. The soil is a silty clay loam in the Mississippi Delta on a nearly 40-acre field planted to corn. Each year in 2016 and 2017, non-composted raw broiler litter was applied to supply about 50% of the total nitrogen requirement for optimal corn grain production; the other 50% was supplied from commercial synthetic N fertilizers. A mix of three winter cover crop species (cereal rye, Austrian winter peas, and tillage radish) was drill-planted in October 2015 and 2016. The design is a randomized complete block with four replications. Each main plot is a strip of approximately 1100 ft-long rows. Tillage was assigned to main plots, cover crops to sub-plots and cover crops to sub-sub-plots.

Grain yield and health data were collected each year to assess treatment differences. The field will be rotated to soybean in 2018 without litter or synthetic fertilizer applications. The primary objective in 2018 will be to test cover crop benefits to soybean yield and water use efficiency.

1.8 Sensor installation and soil and plant measurements

We have installed soil matric potential sensors (Watermark, Irrometer) and TDR soil moisture sensors (Acclima Inc.) coupled to a datalogger (Campbell Scientific Inc.) at depths of 0-6, 6-12, 12-18, 18-24 inches at the sites of Brooksville, Verona, Pontotoc and Stoneville. Infrared radiometer was installed above soybean canopy at Brooksville and Verona for measuring canopy temperature to detect soil-plant water status.

Soybean developmental growth stage, plant height, canopy cover, plant dry biomass, and gravimetric soil moisture were measured biweekly by taking (3) 30 cm plant harvest in each plot, along with soil samples using a soil probe to measure the gravimetric soil moisture. Leaf Area Index was also measured every sixteen days using a Decagon Inc. AccuPar LP-80.

Soil aggregates, field capacity, plant permanent wilting point water content, saturated hydraulic conductivity and on-site infiltration rate were measured in the field at MSU Verona Experiment Station this spring.

Table 1. Yield, yield components, total above dry biomass (TDM), harvest index (HI), and maximum leaf area index (Max LAI) at MSU experiment stations located in Brooksville and North Farm in 2017.

Location	Treatment		Grain yield bu/ac	Thousand grain weight lb	Pods per plant	Seeds per pod	TDM lb/ac	Plant height in	HI	Max LAI
Brooksville		SM	78.17a	0.36a	39a	3	6098a	49a	0.39a	4.93a
		ET	83.58a	0.36a	37a	3	6758a	49a	0.38a	5.23a
		RF	59.56b	0.30b	32a	3	4741a	42b	0.38a	3.71a
North Farm	No Cover crop	Control	47.96	0.216	60	3	10253	40	0.28	4.92
		Fertilizer	42.73	0.263	35	3	5397	52	0.48	4.28
		Litter	36.65	0.239	46	3	6918	56	0.32	4.32
		Biosolid	55.52	0.289	33	3	5990	56	0.56	5.05
	Cover crop	Control	45.53	0.249	51	3	9325	39	0.29	5.21
		Fertilizer	43.39	0.260	41	3	7240	51	0.36	7.55
		Litter	36.07	0.241	27	3	4547	54	0.48	6.07
		Biosolid	51.75	0.288	53	3	8578	51	0.36	6.95

Table 2. Soybean yield, yield components, total above dry biomass (TDM), maximum leaf area index (Max LAI), and water use efficiency (WUE) at MSU Verona Experiment Station in 2017.

Treatment	Grain Yield (bu/ac)	Thousand Grain Seed Wt. (lb)	Pods Per Plant	Seeds Per Pod	TDM (lb/ac)	Plant Height (in.)	Max LAI	Total ET (in)	WUE (ib/ac/in)
Standard Local Practice	66.1	.31	49	3	8,935	47	8.27	17	3.89
Control	60.4	.29	50	3	9,634	45	7.82	17	3.55
Litter, N based	70.9	.33	49	3	10,201	50	8.7	19	3.73

Progress for Objective 2.

APEX simulated grain yield of rainfed soybean ranged broadly from 2.24 to 6.14 Mg ha^{-1} on nine soil types over the 13 years in the Blackland Prairie. The average yield in wet, normal and dry years was 4.88, 4.51 and 3.74 Mg ha^{-1}, respectively. Simulated yield potential without water stress due to irrigation varied from 4.47 to 6.51 Mg ha^{-1}. Compared with rainfed soybean, the average increase in yield by irrigation ranged from 0.34 to 1.60 Mg ha^{-1} among the nine soils. Griffith, Sumter and Demopolis had the highest average yield gap (difference between yield potential and the rainfed yield), ranged from 1.37 to 1.60 Mg ha^{-1}. Average irrigation amount required to achieve potential yield ranged from 16 to 377 mm across the nine soil types. High variability of water consumption as well as grain yield was observed for both non-irrigated and irrigated soybeans on different soils and on a given soil over different years. Therefore, it is necessary to explore production/management options for different soils that will increase opportunities for consistent yields and profits across years without irrigation.

Progress for Objective 3.

The APEX simulated data are being incorporated with the soybean price and irrigation cost information to the estimated yield-water relationship to build a soybean profit function and solve for the profitability maximization problem using mathematic programming techniques under various constraints (budget, water capacity, *etc*.). The final output will be an interactive budget table, giving the specific supplemental irrigation recommendations under different soils, water costs, and soybean sale prices. The soybean profit functions and the budget table can provide guidelines for producers to determine the economically optimal irrigation operations under various weather and market conditions. Those results allow the producers to accurately weigh returns from increased yields against potential costs by irrigation on their specific fields. That provides a tool to more precisely manage their farm and improve profitability in soybean production.

Fig. 1. Locations of the seven experiment sites for the MSPB project.

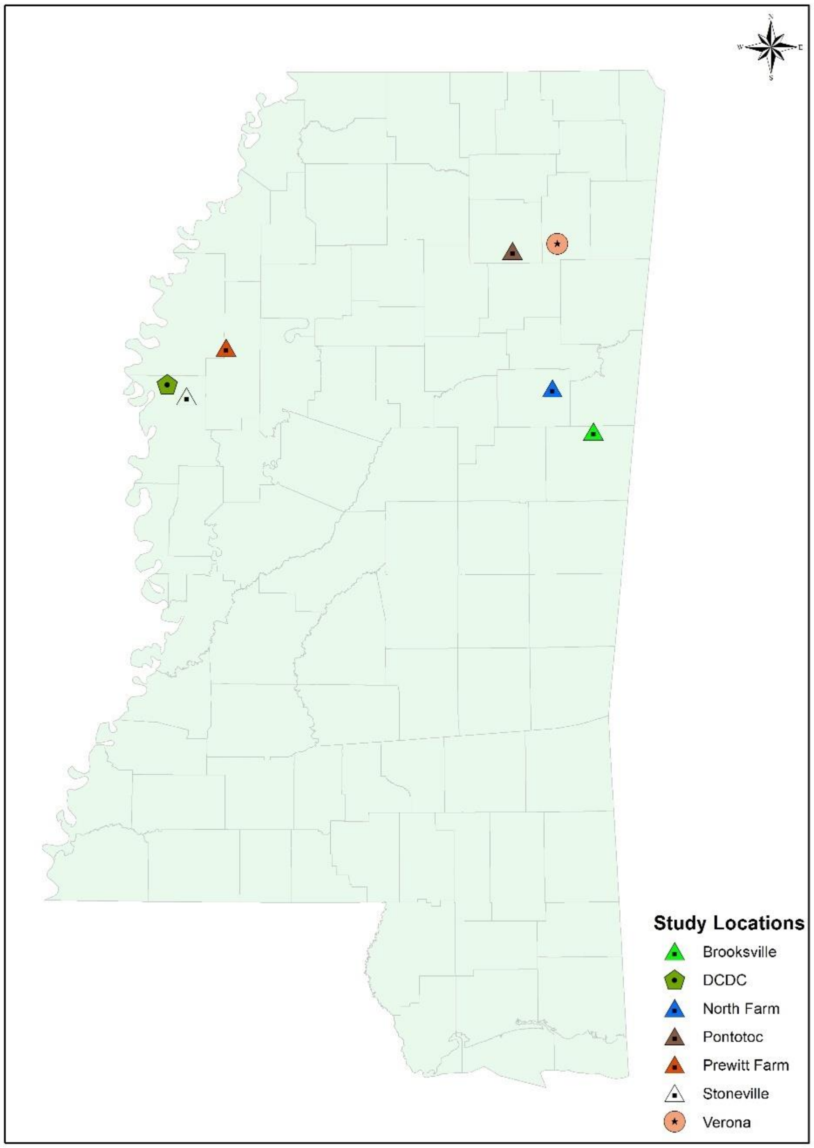


Fig. 2. Soil types and field boundary and acreage of the four experiment sites located in the east-central Mississippi, Blackland Prairie.

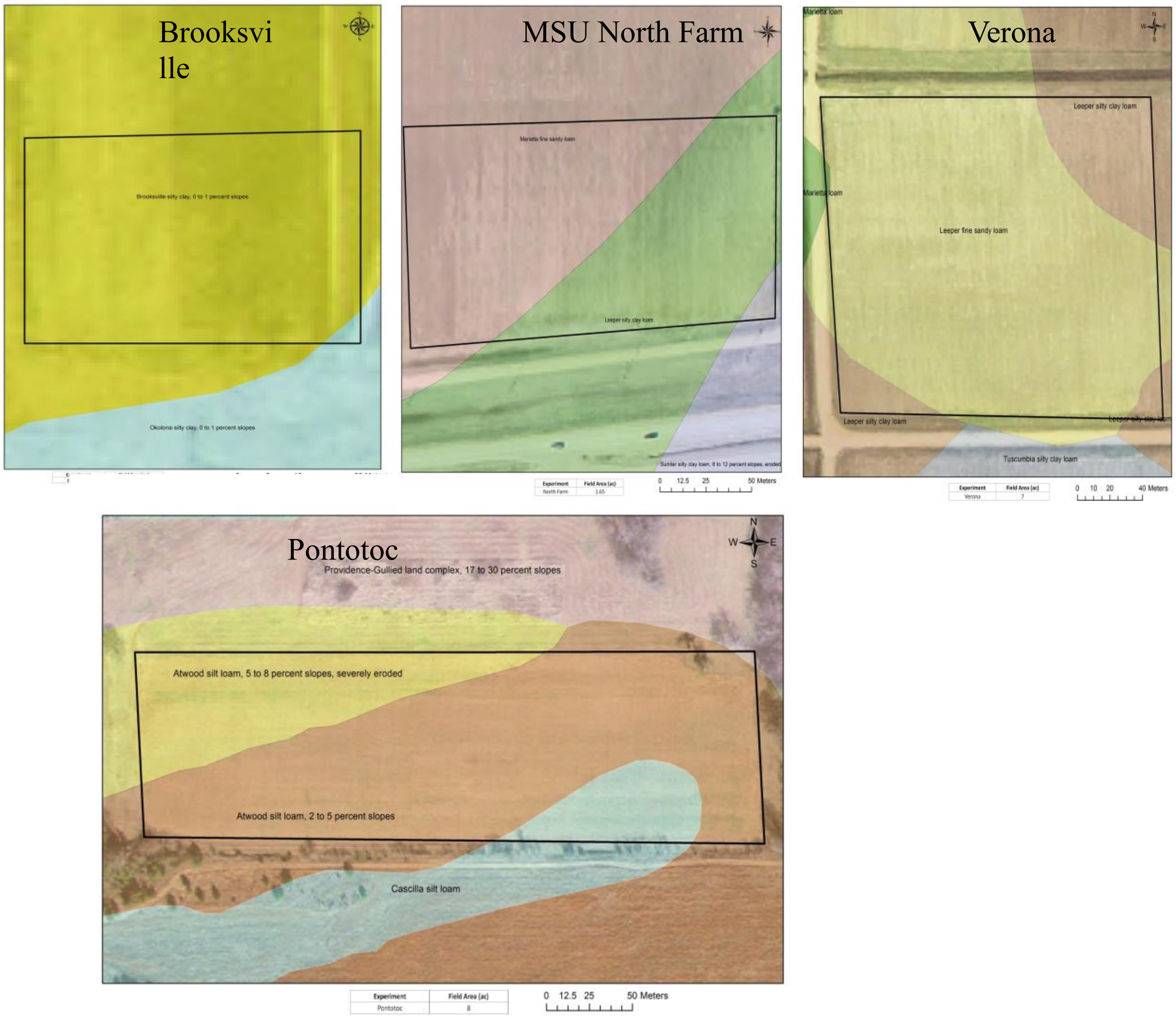
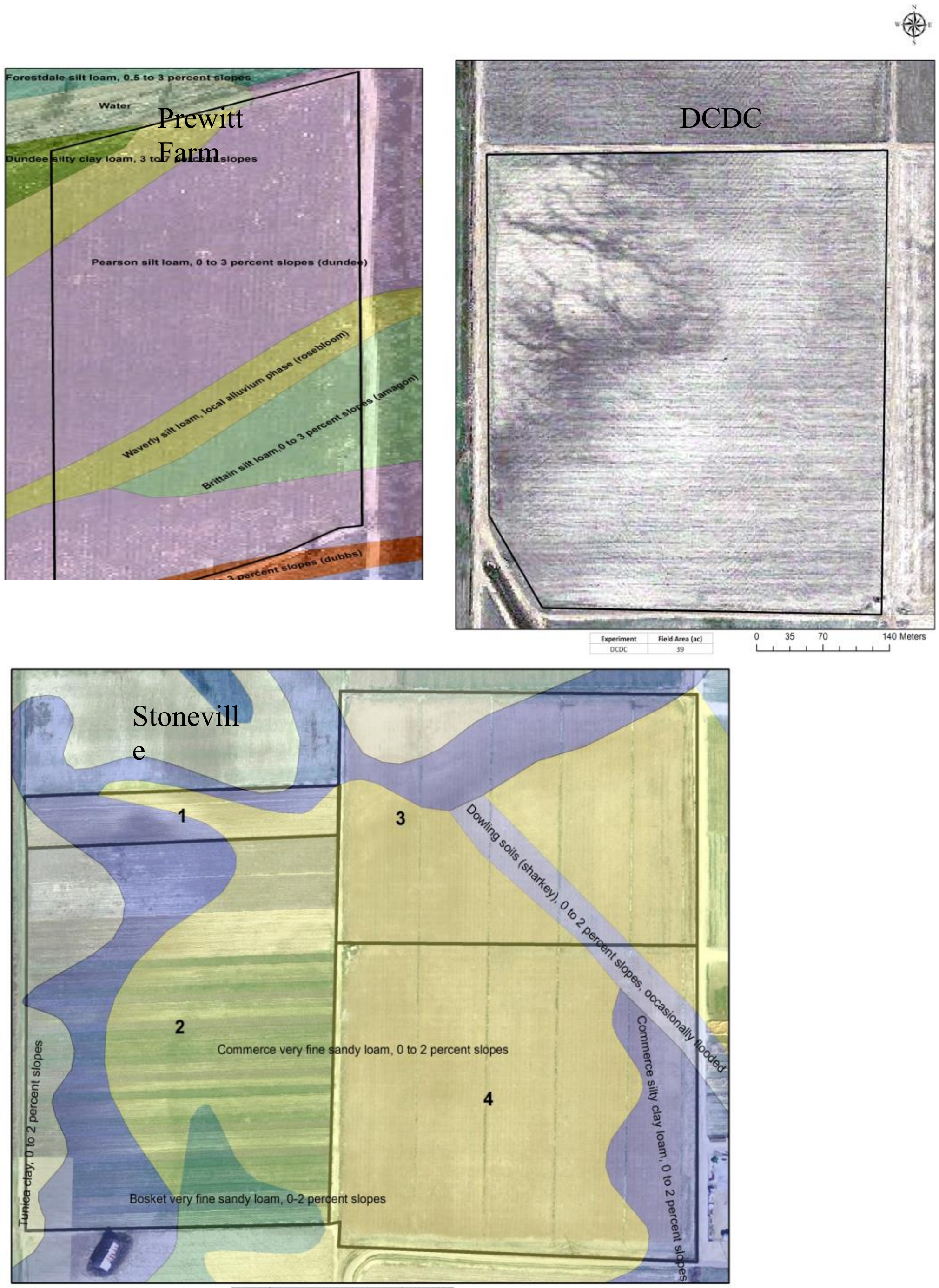


Fig. 3. Soil types and field boundary and acreage of the four experiment sites located in the western Mississippi Delta.



Experiment	Field Area (ac)
DCDC	39

Field Id	Field Experiment	Field Area (ac)
1	Soybean Cover Crop vs No cover Crop	2.75
2	Cotton tillage/Cover Crop Study	20.37
3	Corn Variable Rate Irrigation Study	15.52
4	Soybean Variable Rate Irrigation Study	19.40

End Products:

Manuscripts:

(1) **Feng, G**., Y. Ouyang, A. Adeli, J. Read and J. Jenkins. 2018. Rainfall deficit and irrigation demand for major row crops in the Blackland Prairie of Mississippi. *Soil Sci. Soc. Am. J.* doi:10.2136/sssaj2017.06.0190.

(2) Tang, Q., **G. Feng**, D. Fisher, H. Zhang, Y. Ouyang, A. Adeli, and J. Jenkins. 2018. Rain water deficit and irrigation demand of major row crops in the Mississippi Delta. ASABE 61(1): https://doi.org/10.13031/trans.12397.

(3) Zhang, B., **G. Feng**, L. Ahuja, X. Kong, Y. Ouyang, A. Adeli and J. Jenkins. 2018. Determine water production functions of soybean over years on different soils using APEX model in a humid region. *Agricultural Water Management*. https://doi.org/10.1016/j.agwat.2018.03.024.

(4) Gao, F., **G. Feng**, Y. Ouyang, H. Wang, D. Fisher, A. Adeli, and J. Jenkins. 2017. Evaluation of reference evapotranspiration methods in arid, semi-arid and humid regions. *Journal of the American Water Resources Association (JAWRA)*. 53(4), 791-808. DOI:10.1111/1752-1688.12530.

(5) **Feng, G**., and R. Sui. 2017. Evaluation and calibration of soil moisture sensors in undisturbed soils of Mississippi. *Soil Sci. Soc. Am. J.* (under review).

(6) Gao, F., **G. Feng**, Y. Ouyang, J. Jenkins, and C. Liu. 2018. Simulating weekly available streamflow and pond water resources potential in Mississippi Delta. *Agricultural Water Management* (under review).

(7) Ouyang, Y., **G. Feng**, T. Leininger, J. Read, and J. Jenkins. 2018. Pond and Irrigation Model (PIM): Couple evaluation of crop irrigation demand and pond water availability. *Journal of Water Resources Management*. https. //doi.org/10.1007/s11269-018-1967-8.

(8) Gao, F**., G. Feng**, M. Han, P. Dash, C. Liu, and J. Jenkins. 2018. Simulating spatiotemporal variability of surface water resources in Mississippi Delta using coupled SWAT-MODFLOW model. *Hydrological Sciences Journal* (Submitted).

(9) Zhang, B., **G. Feng**, and X. Kong. 2018. Soybean yields and irrigation dataset across soils among three category years in a humid region of Mississippi, Southeast USA. Data in Brief (under review).

Presentations:

(1) **Feng**, G., Y. Ouyang, D. Reginelli, and J. Jenkins. 2017. Water consumption and yield variability of nonirrigated and irrigated soybeans in Mississippi dominant soils across years. The Annual Mississippi Water Resources Conference, Jackson, MS. April 11-12, 2017.

(2) Han, M., **G. Feng**, Y. Ouyang, and F. Gao. 2017. Groundwater dynamic modeling and sustainable management in Big Sunflower River Watershed. The Annual Mississippi Water Resources Conference, Jackson, MS. April 11-12, 2017.

(3) Gao, F., **G. Feng**, M. Han, and J. Jenkins. 2017. Evaluating the effects of irrigation management practices on groundwater recharge and storage in Mississippi Delta. The Annual Mississippi Water Resources Conference, Jackson, MS. April 11-12, 2017.

(4) Ouyang, Y., and **G. Feng**. 2017. Estimate 120 years vadose zone water dynamic, crop irrigation demand, and groundwater conservation on an agricultural land in Mississippi. Seventh Unsaturated Zone Interest Group Workshop & Information Exchange, Land-Use Change, Climate Change, and Hydrologic Extremes: Unsaturated Zone Responses and Feedbacks. University of Florida, Gainesville, April 4-6, 2017.

(5) Gao, F., **G. Feng**, M. Han, Y. Ouyang, and J. Jenkins. 2017. Development of irrigation strategy for sustainable utilization of groundwater resource in Mississippi Delta. The MidSouth SETAC Regional Chapter annual meeting, Oxford, MS. May 18-19, 2017.

(6) **Feng, G.** 2017. Water management strategies. Mississippi State University Pontotoc Ridge-Flatwoods Branch and Mississippi Chapter-American Society of Agronomy Auxin Technology Field Day. June 29, 2017.

(7) **Feng, G.**, A. Adeli, D. Reginelli, and J. Jenkins. 2017. Effects of poultry litter application on soil physics and hydraulic properties for increasing crop water use efficiency. Agronomy Abstract. Soil Science Society of America Annual Meeting, Tampa, FL. Oct. 20-26, 2017.

(8) Gao, F., **G. Feng**, H. Ming, Y. Ouyang, and J. Jenkins. 2017. Impact of irrigation water withdrawals from surface and groundwater on groundwater dynamics. Agronomy Abstract. Soil Science Society of America Annual Meeting, Tampa, FL. Oct. 20-26, 2017.

(9) Li, X., **G. Feng,** D. Reginelli, and J. Jenkins. 2017. Developing economically optimal irrigation for soybean production in east central Mississippi. Agronomy Abstract. Soil Science Society of America Annual Meeting, Tampa, FL. Oct. 20-26, 2017.

(10) **Feng, G.**, F. Gao, Y. Ouyang, and J. Jenkins. 2017. Declining groundwater level and irrigation to row crops in the Lower Mississippi River Basin, current situation and trends. AGU Fall Meeting, New Orleans, Louisiana. Dec. 10-16, 2017.

(11) Gao, F., **G. Feng**, H. Ming, Y. Ouyang, and J. Jenkins. 2017. Impacts of irrigation practices on groundwater recharge in Mississippi Delta using coupled SWAT-MODFLOW Model. AGU Fall Meeting, New Orleans, Louisiana. Dec. 10-16, 2017.

(12) **Feng, G.** Oct. 23, 2017. Measurement and modeling of soybean water requirements. Agronomy Abstract. Soil Science Society of America Annual Meeting, Tampa, FL. Dec. 20-26, 2017.

(13) Ouyang, Y. and **G. Feng**. 2018. A Pond and Irrigation Model (PIM) for simultaneously predicting crop irrigation demand and pond water availability: A case study in Mississippi. 2018 UF Water Institute Symposium "Sustainable water resources, complex challenges, integrated solutions. Shaping our water future". February 6-7, 2018. University of Florida, Gainesville, FL.

(14) Gao, F., G. Feng, P. Dash, P., and Y. Ouyang. 2018. Impact of Different Ratios of Surface Water and Groundwater for Row Crops Irrigation on Groundwater Level in Mississippi Delta. Oral presentation at the 2018 Mississippi Water Resources Conference in Jackson, Mississippi, USA, April 3-4, 2018.

(15) **Feng, G.**, F. Gao, Y. Ouyang, and P. Dash. 2018. Evaluating surface available water as alternative and developing sustainable groundwater management practices using coupled SWAT-MODFLOW modeling. 2018 UF Water Institute Symposium "Sustainable water resources, complex challenges, integrated solutions. Shaping our water future". February 6-7, 2018. University of Florida, Gainesville, FL.

(16) **Feng, G.** March 29, 2018. Strategies and approaches for mitigation of crop water stress and groundwater depletion in the Southeast. Biosystems Engineering Department, Auburn University, AL.

(17) Yang, W., **G. Feng**, A. Adeli, and J. Jenkins. 2018. Long-term effect of cover crop on water use efficiency in manured and rainfed soybean-corn rotations. The Annual Mississippi Water Resources Conference, Jackson, MS. April 3-4, 2018.