Increasing soybean field drainage systems to allow farming operations earlier in wet springs and reduce nutrients and soil losses, 62-2023.
Annual Report

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Rationale/Justification:
Soybean is the most important crop in MS in both acreage and value. In 2023, the MS soybean harvested area was 2.13 million acres and had a total value of $1.60 billion. The majority of the annual rainfall in MS occurs in the fallow season from December to April. Flooding or waterlogging has been one of the major concerns that could potentially lead to planting delay, and losses in yield, soil and nutrients through surface runoff and leaching. Installation of agricultural drainage tiles can potentially result in large returns by improving crop productivity and conserving soil and nutrients. In MS, some farmers have started to invest in drain tiles. In East MS, drain tiles installation has now become a practice. In general, tiles are buried 2-3 feet deep, spaced 30-100 feet apart, and sloped at 0.1% or about a 1-2 feet drop over 1000 feet. Most drainpipes are around 4 inches in diameter and can run into 6-8 inches. Drain tiles are designed to drain the excess water from the fields within 24 to 48 hours following rain. The flow velocities range from 0.5 to 1.4 feet per second based on the soil type. In fine sands and silt soils, the flow rate is 1.4 feet per second and in clayey soils, the flow rate is 0.5 per second.
Before installing the drain tiles, growers should have knowledge regarding the soil characteristics of the location such as soil saturated hydraulic conductivity, infiltration and holding capacity. They need to make assessments about the pipes having the correct spacing and slope for effective drainage. Once installed, drain tiles offer various potential benefits, such as early planting, less plant water and nutrient stress, high crop productivity, efficient harvesting, high soil infiltration, and better soil aeration. Fields with good drainage systems can facilitate the integration of cover crops and other conservation practices. To understand how drainage could influence the water table in the soil, there is a need to look at the various forms of soil water. The amount of water that can be drained out of the soil depends on the amount of drainable pore space, which is influenced by soil texture and structure. Thus, any management practice that increases the drainable pore spaces will likely improve soil water holding capacity and infiltration rate and conserve more rainwater in the soil. The effectiveness of drainage system and management practices in increasing drainage efficiency, soil infiltration and water holding capacity, soybean yield, water and nutrient productivity have received little attention, and the financial returns and costs of each option are also unknown. Management practice that can help improve these components is the integration of different cover crops and poultry litter in the existing drainage and cropping systems. Measuring the hydraulic and physical properties of soil, such as field capacity, plant available water, saturated hydraulic conductivity, and soil texture and aggregates, is necessary to understand the impact of cover crops, poultry litter and drainage system on soil health. The improved soil health can further help us determine the drainage conditions of the soil.

Objective 1. Determine cost-effective drainage system design, and best management practices to increase existing drainage tiles efficiency, reduce runoff and loss of soil and nutrients, improve soil infiltration and water holding capacity, and surface water harvest. Our goal is to assist growers make their wet fields drier in spring so that they are able to enter fields and conduct farm operations including planting earlier than current practice. This research will also determine the effectiveness of drainage systems along with cover crops during the fallow season, soil amendments such as broiler litter, municipal biosolids and biochar for improving soil health, water and nutrients productivity, soybean yield and economic return in major soil types and growing environments across MS.

1.1 The field on a private farm (Good Farm) in Noxubee county

Quarter 1: Activities listed for this quarter

The annual rainfall exceeded 1125 mm in 3 out of 4 years over the past 100 years in Mississippi Black Prairie. As high as 70% of the average annual rainfall occurs during the off-crop season between late fall to spring. Farmlands without a proper drainage system is subjected to ponding. This causes water logging/ponding in agricultural fields affects the soil health with decreased porosity, and consequently resulting in delayed planting and yield loss (Fig. 1). Drainage of excess water on agricultural lands is beneficial in improving soil health, reducing soil compaction, nutrient loss, erosion, and increasing soil aeration. This study is aimed to investigate the effects of implementing tile-drain, cover crop and application of poultry litter on water balance, hydrological processes and the number of more days the growers could conduct field operations in wet spring on a commercial farm using geospatial modeling. Application of tile drain is fairly common in the Midwestern United States, whereas it is not prevalent in Mississippi. To our knowledge, hydrologic assessments of tile drain systems have never been done before in Mississippi.

The study was implemented on a 176 ha of the Good Farms located in Noxubee County, MS. The dominant soils in this region contain great percentage of clay and silt, in addition, the soil profile often comprises of a chalk layer at a various depth. Soil types belong to hydrologic soil group D that are poorly infiltrated with an infiltration rate of 3.3 mm/hour. The wet seasons and soil types often delay field preparation until late April or early May that prevent from planting cash crops, terminating cover crop, applying fertilizer, and cultivating fields.

Field survey was conducted for runoff channels (Fig. 2) and existing subsurface drainage pipes (Fig. 3) on Good Fam in March, 2023. We used a Garmin GPS unit with 0.01 m resolution and determined the locations of all severe runoff and existing subsurface drainage pipes.

Fig. 1. It is common excess water was ponded on soil surface during spring in field.

Fig. 2. Many runoff channels as shown on Good Farm were found in March, 2023

The field at the left side in Fig. 1 was selected for monitoring runoff and soil water and nutrients balance. Five ISCO automatic runoff collectors have been purchased. We are going to order soil moisture sensors.

Fig. 3. Outlet of existing subsurface drainage pipes on Good Farm in March, 2023

There are two outlets of existing subsurface drainage pipes that we found. We are going to take water sample samples at the outlets and measure nutrients.

Quarter 2: Activities listed for this quarter

September 13, 2023: five automatic runoff collectors (ISCO Inc., Lincoln, NE) as shown below were installed at the edge of a soybean field at Good Farm. The collectors can automatically measure runoff volume and rate, rainfall, and take runoff water and sediment samples for lab analysis.

Oct. 5, 2023: five treatments were implemented. The treatments are poultry litter (2 ton/acre); poultry litter (2 ton/acre) with gypsum (2 ton/acre); poultry litter (2 ton/acre) with coal biochar (2 ton/acre); poultry litter (2 ton/acre) with gypsum (2 ton/acre) and coal biochar (2 ton/acre). Each treatment is composed of cover crop and without cover crop. Row space is 30 in, 3000 feet long.

Oct. 16, 2023: cover crop, cover crop, elbon cereal rye, was planted at 100 pound per acre.

Fig. 4. Five automatic runoff collectors (ISCO Inc., Lincoln, NE) as shown below were installed at the edge of a soybean field at Good Farm, Noxubee County, MS.

Quarter 3: Activities listed for this quarter

The runoff collectors along with its associated rain gauge started automatically measure the amount of rainfall and runoff. The device contains 24 bottles, it collects one runoff sample in one bottle for every 0.5 inch rainfall. In addition, one pen lysimeter down to 36 in was installed in each plot. Leachate samples were taken the same time as runoff samples were collected right after each rain event.

Quarter 4: Activities listed for this quarter

We have runoff and leachate samples ready for chemical analysis. We are in the process of taking measurements of nutrients/chemicals of runoff samples and drainage water samples.

Objective 2. Apply hydrology and agroecosystem models, in conjunction with commercial farm field trials in Objective 1, to determine optimal drainage system/production/management options for consistent and high soybean yield across typical MS weather conditions and in dominant soil types based on 100-year daily weather records and on predicted daily weather in future 50 years.

Quarter 1: Activities listed for this quarter

Agricultural Policy and Environmental Extender Model (APEX) and Soil and Water Assessment Tool (SWAT) that were developed by USDA-ARS will be employed for this project. The two models are capable of simulating various hydrologic and water quality outputs for different management scenarios are used in this study. The objectives of this study are to suggest a cost-effective and optimum drainage solutions while improving soil and water quality and providing agronomic benefits for farmers. The research which contributed to a dryer field in spring is beneficial to the farmers who could begin field operations at an early date. Results from this study could provide an insight in choosing optimum design of a tile drainage system along with its best management practice to improve drainage for poorly drained soils and induce runoff for effective on-farm tailwater recovery and reuse.

Quarter 2: Activities listed for this quarter

We have set up the models on the domain of Good Farm with approximately 470 ha as shown in Figure 5.

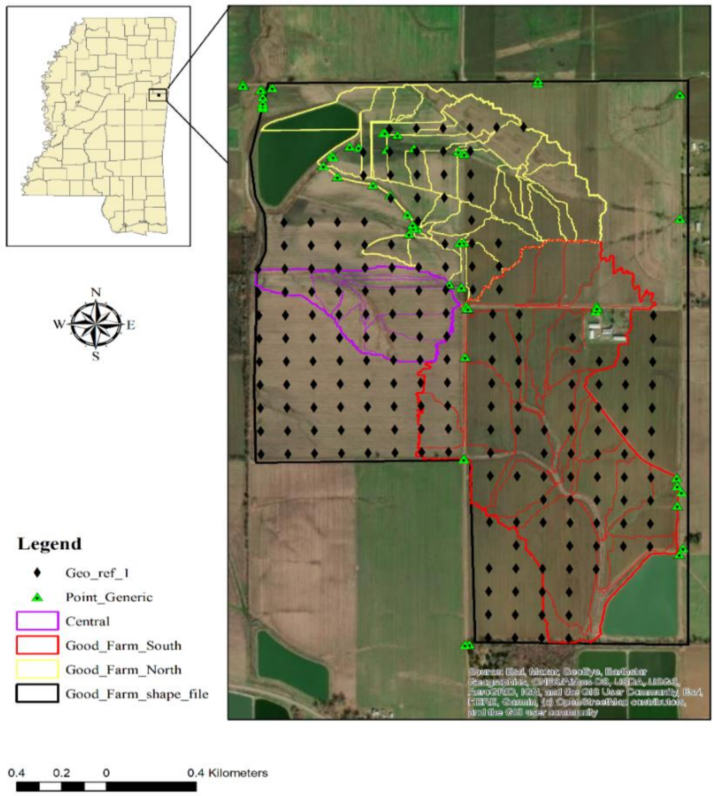


Fig. 5. The model domain on Good Farm.

The model required data of topography, soils, weather, and management were prepared. The Good Farm land use characteristics include agriculture and ponds (NW and SE) are shown in Fig. 1. Soils associated to the farm are silty clay and chalk in some under layers. The primary Data Inputs that are used in the model are, Digital Elevation Models (DEM Higher resolution) (MARIS 1m x 1m), land-use, land-cover (LULC) (USDA-2019), soil – SSURGO database (NRCS, 2019), precipitation and temperature (NOAA, 2019), and crop management practices (MAFES, 2019).

The delineation of Digital Elevation Model produced three major watersheds on the farm. The runoff in the watersheds as shown in yellow and red color were collected in the two ponds in the figure. The runoff of the watershed in pink color will be collected by the 6 automatic runoff collectors we installed at the edge of the field.

Quarter 3: Activities listed for this quarter

Prepared input parameters for simulation study using HYDRUS-3D and DRAINMOD models.

Quarter 4: Activities listed for this quarter

We conducted DRAINMOD simulations to analyze water balance components under continuous soybean production at Good Farm. The primary input data required by the model included soil properties, weather data, crop information and drainage system parameters. The dominant soil, Vaiden silty clay with low hydraulic conductivity and poorly-drained capacity, was derived form the Soil Survey Geographic (SSURGO) database. Daily precipitation and temperature data (1924-2023) in Noxubee county were used as weather inputs files. Based on the long-term experiments at the Black Belt Experiment Station in Brooksville, we summarized desired planting window and growing season length as crop information. Various combinations of 3 drain depths and drain spacings ranging from 5 to 50 m were simulated to assess the efficiency of the subsurface drainage system.

1. Monthly precipitation

Over the 100-year simulation period, the average annual precipitation was 132.6 cm, ranging from 61.2 cm to 194.2 cm. Approximately 57% of annual precipitation typically occurred between November and the following April, contrasting with low precipitation during the crop growing season (Figure 6). The average precipitation in March and April were 138 cm and 125 cm respectively. In April, the average number of rainy days was more than 7, with about 4 days experiencing precipitation exceeding 1 cm. Given the frequent precipitation and poorly-drained croplands, flooding and waterlogging could prevent timely tilling, fertilizing and planting in April.

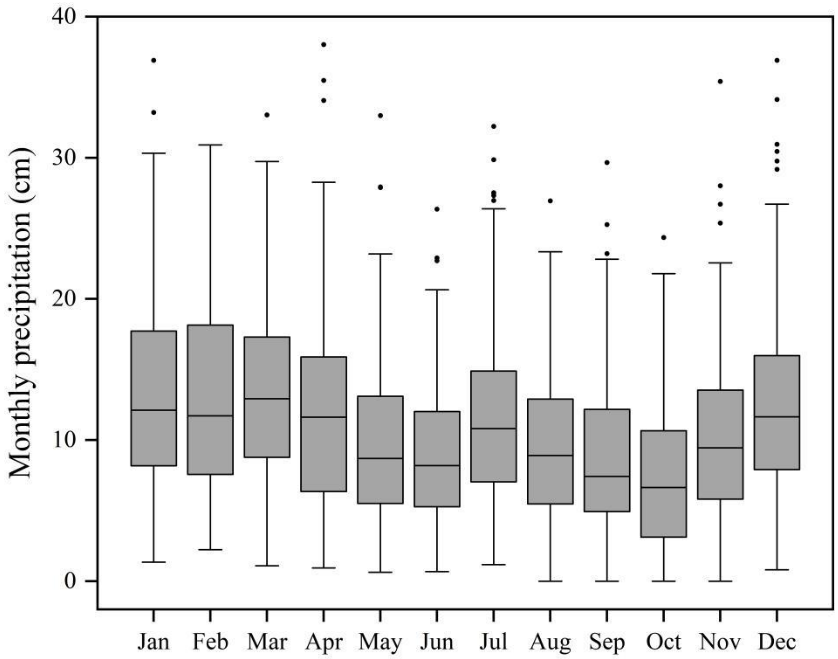
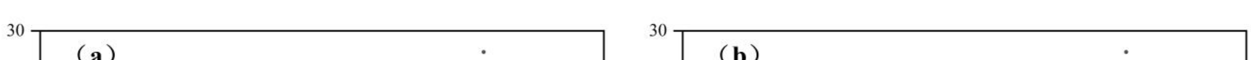


Fig. 6. Boxplot of monthly precipitation trends over 100 years in Noxubee county. The upper and lower boundaries of the box represent the 25th and the 75th percentiles, respectively. The horizontal line inside the box denotes the median (50th percentile) of the precipitation data.

2. Field water balance in April

The hydrological processes were simulated across 5 drain spacing (0, 5, 10, 20, 30, and 50 m) at 3 drain depths (Fig. 7). The long-term simulation indicated that 68% (8.56 cm) of average precipitation infiltrated into the soil profile without drainage systems, while the remaining 32% (4.02 cm) of average precipitation was lost as surface runoff in April. As expected, narrower tile spacing significantly increased the average subsurface drainage, consequently enhancing precipitation infiltration and reducing surface runoff. For example, compared with 1.20 cm drainage flow and 3.07 cm runoff for wider drain spacing (50 m), 5 m spacing drains dramatically increased drainage to 3.48 cm and reduced runoff to 2.40 cm. However, narrower drain spacing also led to a notable decline in ET due to less water storage in the soil profile.

Changing the drain depth from 0.75 m to 1.25 m increased the void volume retained in the deep soil profile, significantly boosting the infiltration and drainage while reducing surface runoff following rainfall. Specifically, 76% of the additional infiltration (1.33 cm) was discharged through 5 m spacing drains, while



the remaining moisture (0.32 cm) in the soil profile eventually resulted in a slight increase in ET by 0.33 cm. Moreover, the infiltration and drainage of narrower spacing drains were more susceptible to the effect of drain depths.

Fig. 7. The boxplots showing water balance components at (a) 0.75 m (b) 1 m and (c) 1.25 m drain depths in April based on DRAINMOD simulations (1924-2023).

3. Water content dynamics in April

We simulated the soil water content dynamics under various drainage systems over a 100-year period to estimate the number of work days for supporting typical agricultural vehicle traffic and timely field operations in April. In this study, a suitable workday was defined as one where the soil moisture in the upper 5 cm layer remained below 85% of the field capacity (water content at 330 cm matric suction).

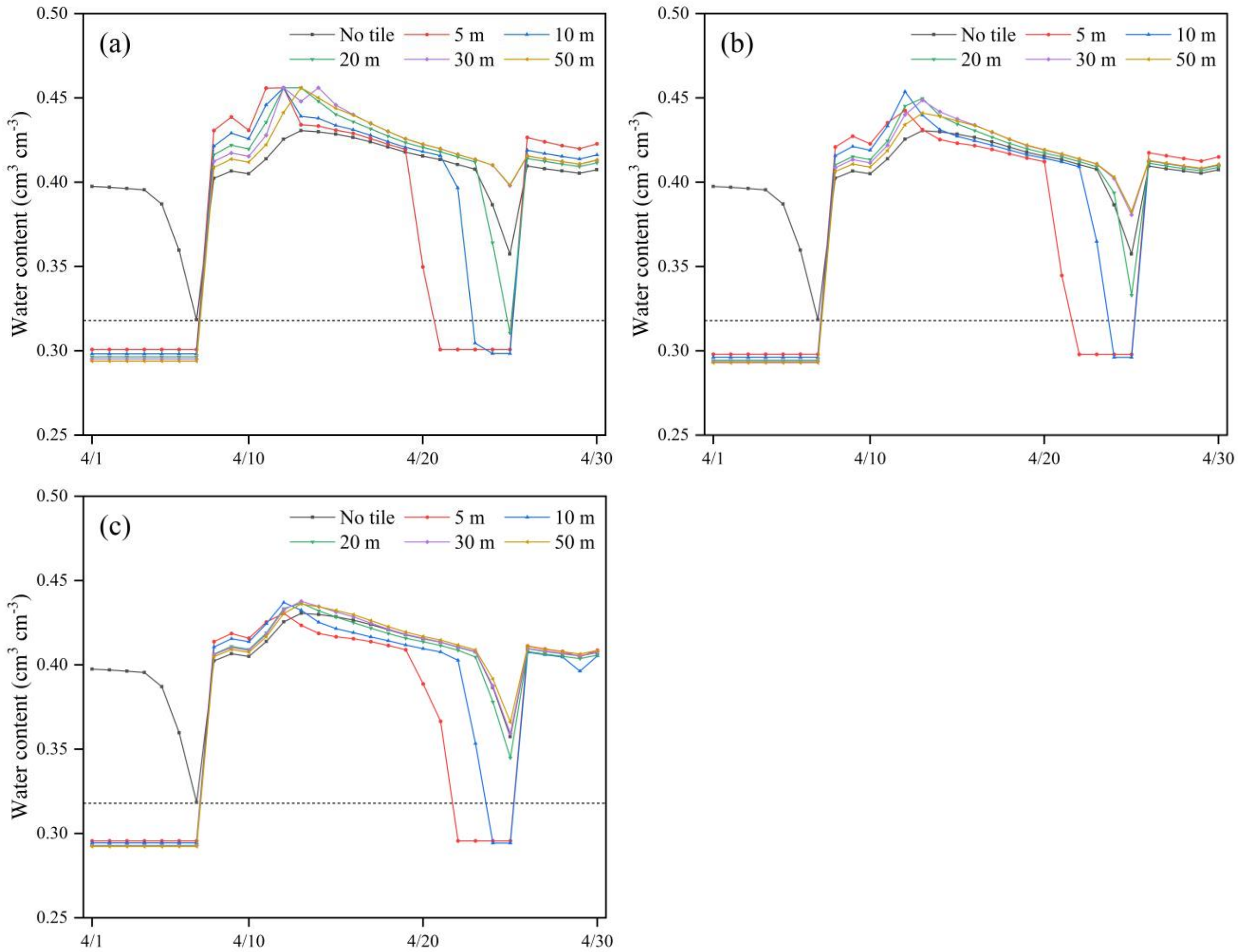


Fig. 8. Soil moisture dynamics (0-5 cm) at drain depths of 0.75 m (a), 1 m (b), and 1.25 m (c) during a representative year (2004), with median precipitation of 11.58 cm based on a 100-year record. The dashed line represents the critical soil moisture threshold (85% field capacity).

Without the installation of drainage systems, soil water content showed slight fluctuations in April, with approximately 20 days where water content exceeded 0.4 cm^3 cm^{-3}. According to the steady-state Hooghoudt equation, narrower drain spacing significantly improved the drainage rate, leading to pronounced fluctuations in soil water content across the profile. For example, following rainfall on April 10th, soil with 5 m spacing drains rapidly reached the saturation within one day. Subsequently, soil moisture quickly declined to the wilting point compared to other drainage systems, and forming a 3 cm thick dry layer on the soil surface (Fig. 8a). In contrast, deep drains at 1.25-m depth sustained a lower steady drainage rate, resulting a relatively stable downward trend in soil water content after the rainfall event April 12th (Fig. 8c). In addition, installing drainage systems at 0.75 m depth with 5-m or 10-m drain spacing provided one more additional work day compared to the other 2 depths.

Overall, shallow drains generally maintained a higher water level and reduced air volume in the soil profile, leading to rapid changes in soil surface water content during rainfall events. Shallow drain depth and narrow drain spacing enhanced drainage rate, facilitating rapid water removal from the soil profile (Figures 8a-c).

4. Work days in April

We determined the dry, normal and wet April based on the 25%, 50% and 75% quartiles of the 100-year precipitation distributions. Then we compare water content dynamic in the upper 10 cm soil during dry, normal and wet condition and calculate the average number of work days.

Table 1

The average number of work days for different drainage systems during dry, normal and wet April condition based on DRAINMOD simulations from 1924 to 2023.

Drain spacing (m)	The number of work days		
	0.75 m drain depth	1 m drain depth	1.25 m drain depth
		Dry April	
No drains	8.80	8.80	8.80
5 m	18.56	18.28	18.12
7.5 m	17.72	17.16	17.20
10 m	17.08	16.64	16.44
15 m	15.80	15.36	14.92
20 m	14.88	14.16	13.96
30 m	13.36	12.56	12.36
50 m	11.44	11.28	11.16
		Normal April	
No drains	1.80	1.80	1.80
5 m	7.84	7.54	7.24
7.5 m	6.74	6.34	6.08
10 m	5.92	5.66	5.50
15 m	4.76	4.26	4.30
20 m	4.14	3.66	3.54
30 m	3.16	2.82	2.72
50 m	2.44	2.32	2.28
		Wet April	
No drains	0.24	0.24	0.24
5 m	4.36	3.84	3.84
7.5 m	3.32	3.16	2.72
10 m	2.76	2.60	2.28
15 m	2.04	1.72	1.68
20 m	1.60	1.32	1.16
30 m	0.96	0.72	0.56
50 m	0.52	0.56	0.48

The results revealed that average number of work days still increased by at least 27% (2.4 d) during dry conditions. It was unnecessary to install drainage systems for extra work days. In normal April, installing subsurface drainage systems could significantly increase the number of suitable work days, ranging from 0.5 to 6 days. Optimum drainage systems extended the working period by up to 4 days during wet April conditions, ensuring at least 2 working days for planting and fertilization.

In conclusion, narrower drain spacing and shallower drain depth effectively increased the number of suitable work days due to higher drainage rate after rainfall events. Moreover, as drain spacing increased, there was no significant difference in the workable days among the 3 drain depths. Ultimately, it was recommended to install 75-cm shallow drains combined with 15-m spacing for minimizing initial investment of the drainage system.

Objective 3. Conduct economic analysis using results of field trials (Objective 1) and simulation studies (Objective 2) to compare the cost and return of using drainage systems, soil organic amendments or/and cover crop in comparison with conventional management practices. The goal is to help soybean growers in different MS environments determine the long-term profit-maximizing management practices for given soil types, topography, precipitation patterns, and other climate conditions found on their farms.

Quarter 1, 2, 3 and 4: Activities listed for this quarter
Wait for data to conduct economic analysis, no activity yet.

End Products (Authors in bold are PI/CoPIs):

Publications and Manuscripts:

(1) Dai, W., **G. Feng**, Y. Huang, H. Tewolde, M. Shankle, and J. Jenkins, 2024. Cover crops and poultry litter impact on soil structural stability in dryland soybean production in southeastern United States. *Soil Science Society of America Journal* 1-14. https://doi.org/10.1002/saj2.20676.

(2) Dai, W., **G. Feng**, Y. Huang, A. Adeli, and J. Jenkins. 2024. Influence of cover crops on soil aggregate stability, size distribution and related factors in a no-till field. *Soil & Tillage Research* 244: 1-9. https://doi.org/10.1016/j.still.2024.106197

(3) Dai, W., **G. Feng**, Y. Huang, H. Tewolde, M. Shankle, and J. Jenkins. 2024. Soil aggregate stability and erosion resistance in response to integration of cover crops and poultry litter in a no-till rainfed cropping system. *Soil & Tillage Research* (under Revision)

(4) Dai, W., **G. Feng**, Y. Huang, H. Tewolde, M. Shankle, and J. Jenkins, 2024. Water-stable soil aggregation and associated carbon in a no-till soil with cover crops and poultry litter *Soil & Tillage Research* (under review)

(5) Dai, W., **G. Feng**, Y. Huang, A. Adeli, and J. Jenkins 2024. Soil aggregates stability and erodibility as influenced by soil amendments and winter cover crop in upland soils. *Soil & Tillage Research* (under internal review)

(6) Sharma, R., J. Kaur, **G. Feng**, Y. Huang, C. Kumar, Y. Wang, S. Sharma, and J. Dhillon. 2024. Maize and soybean yield prediction using machine learning: A systematic literature review (under review).

(7) Chang, T., **G. Feng**, V. Paul, A. Adeli, J. Brooks, and J. Jenkins. 2023. Soil health assessment for different tillage and cropping systems to determine sustainable management practices in a humid region. *Soil & Till Res.* 233 (2023) 105796: 1-14. https://doi.org/10.1016/j.still.2023.105796.

(8) Kovvuri, N., **G. Feng**, **G. Bi**, A. Adeli, and J. Jenkins. 2023. The effect of cover crops on soil water retention and all other soil physical properties. *Vadose Zone Journal* (under review).

(9) **Feng**, **G.**, Y. Ouyang, W. Jin, and Y. Huang. 2023. The role of changing land use and irrigation scheduling in mitigation of groundwater depletion in a humid region. *Ag Water Mangt*. 291 (2024) 108606. https://doi.org/10.1016/j.agwat.2023.108606.

(10) Zhang, Y., **G. Feng**, T. Chang, **G. Bi**, and J. Jenkins. 2023. Effects of organic farming

systems on soil total organic carbon, nutrients and soil health under high tunnel conditions. *Soil Sci. Soc. Am. J.* (submitted).

<u>*Presentations and Published Abstracts:*</u>

(1) *Dai, W*., **G. Feng**, X. Zhang, and D. Reginelli, 2024. Alterations of aggregation in soils under various cover crops and poultry litter addition. SSSA Bouyoucos Summer Conference. San Juan, Puerto Rico. June 10-12, 2024.

(2) *Dai, W*., **G. Feng**, X. Zhang, and D. Reginelli, 2024. Cover crop application affecting soil chemical properties in a silt loam soil. SSSA Bouyoucos Summer Conference. San Juan, Puerto Rico. June 10-12, 2024.

(3) **Feng, G** and D. Reginelli. 2024. Improving Soil Health, Sustainable, and Resilient Crop Production Systems in the United States. University of Padova, Padova, Italy. May 15, 2024 (invited presentation).

(4) *Dai, W*., **G. Feng**, Y. Huang, H. Tewolde, M. Shankle, and D. Reginelli, 2024. Influence of land use change on soil aggregation and organic carbon in the Southeast USA. 100 years of Soil Science, Past Achievements and Future Challenges. Centennial Celebration of the International Union of Soil Science. Florence, Italy. May 19-21, 2024.

(5) *Zhang, Y*., **G. Feng**, T. Chang, **G. Bi**, S. Yu, D. Reginelli, and J. Jenkins. 2024. Changes in land use alter soil health and organic carbon, nutrients, hydraulic properties of silt loam soils in southeastern USA. 100 years of Soil Science, Past Achievements and Future Challenges. Centennial Celebration of the International Union of Soil Science. Florence, Italy. May 19-21, 2024.

(6) *Zhang, Y*., **G. Feng**, T. Chang, **G. Bi**, D. Reginelli, and J. Jenkins. 2024. Changes in land use alter soil health and organic carbon, nutrients, hydraulic properties of silt loam soils in southeastern USA. 100 years of Soil Science, Past Achievements and Future Challenges. Centennial Celebration of the International Union of Soil Science. Florence, Italy. May 19-21, 2024.

(7) *Chang, T*., **G. Feng**., Y. Zhang, D. Reginelli, and J. Jenkins. Soil health as influenced by agricultural land use changes in a humid subtropical climatic region of the United States. Centennial Celebration of the International Union of Soil Science. Florence, Italy. May 19-21, 2024.

(8) **Feng, G.**, and D. Reginelli. 2024. Improve soil and water health and productivity by changing land use. 100 years of Soil Science, Past Achievements and Future Challenges. Centennial Celebration of the International Union of Soil Science. Florence, Italy. May 19-21, 2024.

(9) *Dai, W*., **G. Feng**, Y. Huang, A. Adeli, J. Jenkins, and D. Reginelli, 2024. Soil health indicators and crop production in response to land use and management change. 100 years of Soil Science, Past Achievements and Future Challenges. Centennial Celebration of the International Union of Soil Science. Florence, Italy. May 19-21, 2024.

(10) *Peng, R.*, **G. Feng**, W. Dai, **G. Bi**, D. Dodds, J. Jenkins, and D. Reginelli, 2024. Subsurface drainage system design and monitoring methods on crop fields in Mississippi state. Conservation Drainage Network Annual Meeting. Columbus, OH. April 3-4, 2024.

(11) **Feng, G.**, R. Peng, **G. Bi**, D. Dodds, J. Jenkins, and D. Reginelli. 2024. Determining drainage and runoff potential for agricultural drainage management in a humid region. Conservation Drainage Network Annual Meeting. Columbus, OH. April 3-4, 2024.

(12) *Dai, W*., **G. Feng**, Y. Huang, H. Tewolde, M. Shankle, and D. Reginelli, 2024. Cover crops, poultry litter and no-till to improve soil and water quality. Conservation Drainage Network Annual Meeting. Columbus, OH. April 3-4, 2024.

(13) *Dai, W*., **G. Feng**, Y. Huang, A. Adeli, J. Jenkins, and D. Reginelli, 2024. Impact of cover crops on soil properties responsible for drainage design. Conservation Drainage Network Annual Meeting. Columbus, OH. April 3-4, 2024.

(14) *Dai, W*., **G. Feng**, Y. Huang, A. Adeli, J. Jenkins, and D. Reginelli, 2024. Changes in soil aggregate stability and associated factors following cover crop management in Northeastern Mississippi. The 88th Annual Mississippi Academy of Sciences Meeting. Hattiesburg, MS. Feb. 29-Mar 1, 2024.

(15) **Feng, G.**, Y. Huang, D. Dodds, and D. Reginelli. 2024. Determining time-to-trafficability in spring for Mississippi agricultural soils after wet winter season. The 88th Annual Mississippi Academy of Sciences Meeting. Hattiesburg, MS. Feb. 29-Mar 1, 2024.

(16) *Dai, W*., **G. Feng**, Y. Huang, H. Tewolde, M. Shankle, and D. Reginelli. 2024. Effects of cover crops and poultry litter on soil structural stability in upland soil. The 88th Annual Mississippi Academy of Sciences Meeting. Hattiesburg, MS. Feb. 29-Mar 1, 2024.

(17) *Dai, W*., **G. Feng**, Y. Huang, A. Adeli, J. Jenkins, and D. Reginelli, 2024. Response of soil physiochemical properties to cover crops in Northeastern Mississippi. ASA Southern Regional Branch Meeting, Atlanta, GA. Feb. 1-6, 2024.

(18) **Feng, G.**, Dai, W., Dodds, D., and Reginelli, D., 2024. Subsurface drainage system for row crop production in the Southeast USA. ASA Southern Regional Branch Meeting, Atlanta, GA. Feb. 1-6, 2024.

(19) *Dai, W*., **G. Feng**, Y. Huang, H. Tewolde, M. Shankle, and D. Reginelli, 2024. Impacts of cover crops and poultry litter on soil aggregate stability in soybean production. ASA Southern Regional Branch Meeting, Atlanta, GA. Feb. 1-6, 2024.

(20) *Dai, W*., and **G. Feng**. Influence of cover crops on selected soil properties in Northeastern Mississippi. ASA Southern Regional Branch Meeting, Atlanta, GA. Feb. 1-6, 2024.

(21) Shammi, S., Y. Huang, **G. Feng**, H. Tewolde, J. Jenkins, and M. Shankle. 2023. Application of UAV multispectral data to monitor soybean biophysical parameters and yield. AGU Fall Meeting, San Francisco, CA. Dec 11-15, 2023.

(22) **Feng, G**., Y. Ouyang, and D. Reginelli. 2023. An on-farm circular water use approach for reducing soil, water and nutrient loss and sustainable soybean production in an integrated cover crop and poultry litter cropping system. International symposium entitled "Advancements in Water Management and Irrigation Strategies for Sustainable Crop Production and Ecosystem Resilience" at the ASA-SSSA-CSSA Annual Meeting, St. Louis, M. Oct. 30, 2023 (invited presentation).

(23) *Khanal, P*., **G. Feng**, Y. Huang, and D. Reginelli. 2023. Assessing farmland wetness and accessibility, runoff and drainage in the Southeast USA. The ASA-SSSA-CSSA Annual International Meeting, St. Louis, MO. Oct. 29-Nov. 1, 2023.

(24) *Kovvuri, R.N*., **G. Feng**, **G. Bi**, M. Shankle, and H. Tewolde. 2023. Soil health, soybean growth parameters as influenced by the integration of cover crops and poultry litter on upland soils. The ASA-SSSA-CSSA Annual International Meeting, St. Louis, MO. Oct. 29-Nov. 1, 2023.

(25) *Kovvuri, R.N*., **G. Feng**, **G. Bi**, A. Adeli, and J. Jenkins. 2023. Impact of different cover crops and crop rotation on soil physical and soil chemical health. The ASA-SSSA-CSSA Annual International Meeting, St. Louis, MO. Oct. 29-Nov. 1, 2023.

(26) *Khanal, P*., **G. Feng**, Y. Huang, and P. Liu. 2023. Investigating the influence of rainfall and other weather-forcing factors on soil moisture and soybean yield using the APEX Model. Mississippi Academy of Sciences Summer Science & Engineering Symposium. Mississippi State University, Starkville, MS. July 25, 2023.

(27) *Khanal, P*., **G. Feng**, Y. Huang, and P. Liu. 2023. APEX model-based analysis of rainfall and soil water storage on soybean leaf area index, biomass, and yield. Summer Undergraduate Research Symposium. Mississippi State University, Starkville, MS. Aug. 2, 2023.

(28) *Khanal, P*., **G. Feng**, Y. Huang, and H. Ming. 2023. Analysis of big spatiotemporal data: soybean acreage and yield prediction in the southeast USA. Spring Undergraduate Research Symposium. Mississippi State University, Starkville, MS. April 14, 2023.

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