Evaluation of overseeding of cover crops in dryland soybeans at different timings.
Project # 16-2021

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Background and Objectives

In Mississippi, the rainfall distribution is not uniform throughout the year and the greatest rainfall occurs from November to June. Off-season soil conditions are characterized by high soil temperatures and long-term soil saturation causing anaerobic conditions. Also, soils in the Mid-South United States are low in organic matter, have poor infiltration, soil compaction and crusting, and susceptible to erosion and runoff losses. Cover crops can be used as a best management practice for reducing nutrient losses through erosion, runoff, and leaching, increasing organic matter in the soil by cover crop residues and ultimately, enhancing nutrient cycling and soil fertility. Improved soil health with the use of cover crops results in higher yields and economic returns. Previous or ongoing studies on cover crops in Mississippi have focused on the effects of cover crops on crop yield, soil properties, pests, and weed suppression. Cover crops are planted during the off-season after cash crop harvest and drilling is the most common method for seeding cover crops. However, in Mississippi, frequent rainfall events occurring during the off-season after soybean harvest results in wet soil conditions, which shortens the planting time for cover crops due to the inability to operate machinery in wet conditions. The solution to this problem can be overseeding cover crops in the standing soybean crop. However, there is limited information available on overseeding cover crops effects on soybean crop response, cover crop biomass production, and soybean yields. In addition, it is also important to identify the optimal soybean growth stage when overseeding of cover crops can be done.

OBJECTIVE(S):

1. *Determine the optimal cover crop species or mix for overseeding in the dryland soybean crop and its influence on soybean plant population, seed yield, and quality.*
2. *Determine the optimal timing for overseeding of cover crops during soybean growing season.*
3. *Evaluate the effect of overseeding various cover crop species on weed suppression.*

Report of Progress/Activity

1. *Determine the optimal cover crop species or mix for overseeding in the dryland soybean crop and its influence on soybean plant population, seed yield, and quality.*

   Cover crop species impacted the cover crop biomass production, its C and N content, CN ratio, N uptake, soybean seed yield and protein content (Table 1). Highest cover crop biomass was produced by the cereal rye + crimson clover cover crop treatment, whereas the radish has lowest biomass production in 2021 (Table 2). Soybean plant population was not affected by the crop species or their overseeding timing. Averaged over planting

times, all cover crops reduced soybean yield in 2021 compared to the no cover crop control except, radish, wheat+radish+turnip, and wheat cover crops (Table 2).

2. *Determine the optimal timing for overseeding of cover crops during soybean growing season.*

   Overseeding cover crops in standing soybean at R6 growth stage resulted in 1380 and 32.5 kg ha^{-1} greater cover crop biomass and N uptake than the overseeding after harvest. However, the cover crop overseeding at R6 stage reduced the succeeding soybean yield by 307 kg ha^{-1} than the treatments overseeded after harvest. Based on first year of this study, we recommend that overseeding of cover crops should be done after soybean harvest to avoid soybean yield loss in the next year.

3. *Evaluate the effect of overseeding various cover crop species on weed suppression. Cover crops reduced weed emergence and weed biomass production compared to the no cover crop control treatment.*

Impacts and Benefits to Mississippi Soybean Producers

Based on first year of this study, best available cover crop option for dryland soybean production in MS delta can be radish, wheat+radish+turnip, and wheat. Overseeding of cover crops should be done after soybean harvest to avoid soybean yield loss in the next year.

End Products–Completed or Forthcoming

***Graduate Student Advising**: Michael Pruden is an M.S. degree graduate student in the Department of Plant and Soil Sciences, Mississippi State University and working on this research for his thesis project. He started working on this project in 2021 and will be graduating in 2023. Michael Pruden is the Mississippi State University's extension agent for Coahoma County in Clarksdale.*

Presentations at conferences/meetings:

1. *Pruden, M., G. Kaur, G. Singh, T. Irby, and T. Bararpour. 2022. Impact of Cover crop overseeding on soybean production in the Mississippi Delta. Mississippi Academy of Sciences 86th annual meeting, Biloxi, MS. Mar 31st - Apr. 1st, 2022*
2. *Kaur, G., and G. Singh. 2021. Cover crop overseeding at different timings impacts cover crop establishment and soybean production. American Society of Agronomy-Crop Science Society of America- Soil Science Society of America International Annual Meeting. Salt Lake City, UT, Nov. 7-10. https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134587*

***Publications**: After two years (2021-2022 and 2022-2023) of this research, the data will be published by the graduate student in his thesis as well as a peer-reviewed journal article.*

Graphics/Tables

Table 1. *Probability values and numerator degree of freedom related to the sources of variation for different parameters measured in this study.*

Source of variation	*df*	*Cover crops*						*Soybean Plant*		*Soybean Seed*		
		Aboveground biomass	*C*	*N*	*CN ratio*	*N uptake*		*Population*		*Yield*	*Protein*	*Oil*
		P-values										
Planting time (PT)	*1*	*<.0001*	*0.3146*	*0.2774*	*0.1493*	*<.0001*		*0.5900*		*0.0131*	*0.1275*	*0.5638*
Cover crops (CC)	*9*	*<.0001*	*0.0376*	*<.0001*	*<.0001*	*0.0003*		*0.8243*		*0.0300*	*0.0294*	*0.2102*
PT x CC	*9*	*0.401*	*0.5456*	*0.7585*	*0.4801*	*0.3387*		*0.7530*		*0.9778*	*0.8696*	*0.2272*

Table 2. *Cover crop aboveground biomass production, carbon and nitrogen content, CN ratio, and N uptake as well as soybean seed yield and protein content as affected by the cover crop species used in this study. Means followed by the same letter within a column are not significantly different (α= 0.05).*

Cover crops	Cover crops						Soybean Seed	
	Aboveground Biomass	C	N	CN ratio	N uptake		Protein	Yield
	kg ha^{-1}	%			kg ha^{-1}		%	
No cover crop control	2251de	38.51ab	2.22cd	17.64cd	50.49b		38.91c	3750a
Cereal rye	5557a	42.10a	1.62e	26.26a	91.24a		39.18abc	3119bcd
Hairy vetch	2440cde	41.00a	2.77ab	15.82d	66.41ab		39.51a	2790d
Wheat	2808cde	39.32a	1.51e	26.47a	41.11b		39.26ab	3336abc
Radish	1599e	35.27b	2.35abc	15.83d	43.15b		39.15bc	3603ab
Crimson clover	3815bc	40.31a	2.30bc	17.81cd	86.84a		39.33ab	3001cd
Hairy Vetch + Radish	3243cd	40.39a	2.86a	16.54cd	94.57a		39.09bc	3189bcd
Cereal Rye + Crimson clover	5642a	41.02a	1.75de	23.77ab	97.30a		39.23abc	3031cd
Wheat + Crimson clover	4804ab	39.06a	2.00cd	20.14bc	93.05a		39.15bc	3133bcd
Wheat + Radish + Turnip	3500bcd	39.59a	1.50e	26.55a	53.33b		39.51a	3351abc