THE EFFECTS OF WINTER COVER CROPS ON COTTON YIELD AND SOIL FERTILITY AFTER 40 YEARS

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Abstract

In 1959, a long-term study was initiated at Louisiana Agricultural Experiment Station's Red River Research Station. This study was initiated to address concerns about the long-term effects of continuous cotton cultivation on native soil fertility and whether or not any negative effects of cultivation could be avoided or corrected by alternating a summer cotton crop with a winter cover crop. The study was also designed to compare the performance of different cover crops under Northwest Louisiana environmental conditions. Each year, data collected includes the amount of dry matter produced by each cover crop, the nitrogen contribution of each cover crop, effects on soil fertility, and cotton yield. 1998 marked the fortieth year of this study that has undergone only minor changes since its beginning in 1959. On average, over the 40 years of this study, cotton following hairy vetch has produced the greatest yields. In 1998, all treatments that included a winter cover crop had significantly greater organic matter at 0 to 6 inches than those that did not.

Introduction

The Red River alluvial soils of Northwest Louisiana have supported cotton production for decades. Unfortunately, as with many agricultural soils, continuous cultivation has resulted in a steady decline in native organic matter. This is especially critical in Northwest Louisiana, because many soils are inherently low in native soil organic matter. Agronomic recommendations prior to the 1950's usually included a winter cover crop in the cropping sequence. It was believed that incorporating the winter cover crop into the soil maintained organic matter and good soil tilth. However, as inexpensive synthetic nitrogen fertilizer became increasingly available, this practice was largely abandoned by farmers in favor of crop monoculture. This trend raised concerns as to the long-term effects on soil chemical and physical characteristics. These concerns were addressed by researchers at the Red River Research Station in Northwest Louisiana, and beginning in 1959 when a study was initiated with the following objectives: (1) to determine the effects of various winter cover crops and fertility regimes on cotton growth, yield, and fiber quality; (2) to determine the effects of selected winter cover crops on soil organic matter content and soil fertility; and (3) to determine cover crops best suited to the sandy soils and climatic conditions of Northwest Louisiana.

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Materials and Methods

This study has been conducted on a 360 x 445 ft. site at the Louisiana Agricultural Experiment Station's Red River Research Station in Bossier City, Louisiana. The soil is a Caplis very fine sandy loam (Typic Udifluvent: fine-silty, mixed, calcareous, thermic). These soils are inherently low in organic matter. Although cover crop studies were initiated on this site in 1956, the test did not take its current form until 1959. Over the years, minor changes were necessary due to seed availability or poor cover crop performance (Millhollon and Melville 1991). Treatment plots consist of six 40-inch rows, 210 feet long, arranged in a randomized complete block design with 4 replications. Cover crops are planted each fall after cotton has been harvested and the remaining stalks are shredded. Cover crops are cut with a flail cutter, then disked under in mid-April of each year. All nitrogen fertilizer is applied pre-plant to cotton. Cotton is planted approximately 10 days after turning under the cover crops. All plots are managed the same regarding the use of herbicides, insecticides, and cultivation. Cotton yields are obtained by harvesting the center rows of each plot with a 2-row spindle picker. In most years a second harvest is conducted.

Results and Discussion

Table 1 shows the differences in biomass production among the different cover crops. There were no significant differences in fresh or dry weight among the different cover crops. Hairy vetch (*Vicia villosa* Roth.) and berseem clover (*Trifolium alexandrinum* L.) produced the greatest cotton yield in 1998 (Table 2). Cotton yields in 1998 were lower than normal due to one of the driest summers on record. On average, over the 40 years of this study, cotton following hairy vetch has produced the greatest yields (Table 2).

The effect of all treatments on soil organic matter at 0 to 6 inches after 40 years is presented in Table 3. All treatments that included a cover crop had significantly greater organic matter than those that did not. The different cover crop and nitrogen combinations also had a significant effect on soil pH at 0 to 6 inches (Table 3). The influence of cover crops on soil organic matter and the resultant effect on cotton yield is clearly shown in the significant linear relationship between these two variables (Figure 1).

Summary

Forty years after the beginning of this long-term study, the benefits of winter cover crops, particularly hairy vetch, for superior yields and organic matter maintenance are evident. The development of cotton production systems that preserve our non-renewable natural resources is essential. Winter

cover crops clearly provide a solution to this problem by decreasing soil erosion during the winter and supplying residue for organic matter maintenance, thus maintaining soil quality, increasing soil water conservation, and nitrogen availability.

References

Millhollon, E. P. and D. R. Melville. 1991. The long-term effects of winter cover crops on cotton production in Northwest Louisiana. Bulletin no. 830. Louisiana State University Agricultural Center, Louisiana Agricultural Experiment Station. 35 p.

Table 1. Harvested cover crop weights in 1998.

	Fresh Weight	Dry Weight
Treatment	(Tons Per Acre)[1]	
Wheat + 60 lbs. N/A	1.45	0.89
Crimson Clover	2.68	1.82
Hairy Vetch	2.96	2.33
Berseem Clover	3.14	1.97
Hairy Vetch + 40 lbs. N/A	2.26	1.72

[1] There were no significant differences among the different cover crops in fresh or dry weight.

Table 2. 1998 and 40-year average seed cotton yield resulting from the different cover crop treatments.

	Seed Cotton Yield (lbs/A)[1]	
Treatment	1998 [2]	40-Year Average
Wheat + 60 lbs. N/A	707 ab	2020 b
Crimson Clover	756 ab	1837 c
Hairy Vetch	927 a	2139 a
Winter Fallow, 0 N	460 b	1095 d
Berseem Clover	872 a	2006 b
Hairy Vetch + 40 lbs. N/A	781 a	2103 a
40 lbs. N/A	792 a	1855 c
60 lbs. N/A	643 ab	1978 b

[1]Means within a column followed by the same letter are not significantly different (DMRT, P≤0.05).
[2]Yields in 1998 were lower than normal due to one of the driest summers on record.

Table 3. Percent organic matter and pH in plots of the different cover crop treatments at the 0 to 6-inch depth.

Treatment	Organic Matter (%)[1]	pH[1]
Wheat + 60 lbs. N/A	0.36 ab	7.08 ab
Crimson Clover	0.43 ab	7.05 ab
Hairy Vetch	0.50 a	6.90 ab
Winter Fallow, 0 N	0.28 b	7.28 a
Berseem Clover	0.50 a	7.03 ab
Hairy Vetch + 40 lbs. N/A	0.39 ab	6.58 b
40 lbs. N/A	0.32 b	7.15 ab
60 lbs. N/A	0.31 b	7.05 ab

[1]Means within a column followed by the same letter are not significantly different (DMRT, P≤0.05).

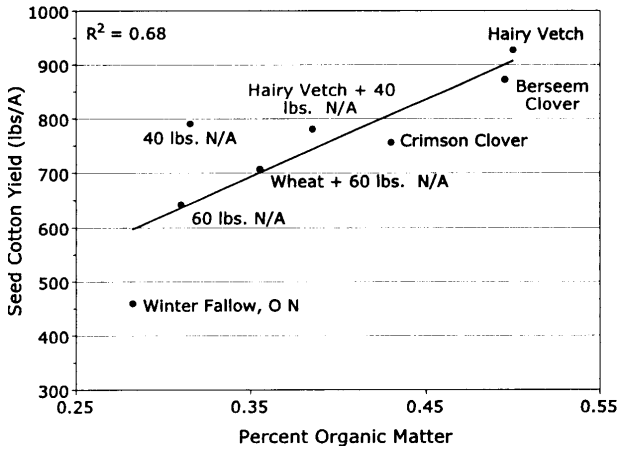

Figure 1. The relationship between percent organic matter in the different cover crop treatment plots at 0 to 6 inches and the resultant seed cotton yield in 1998.