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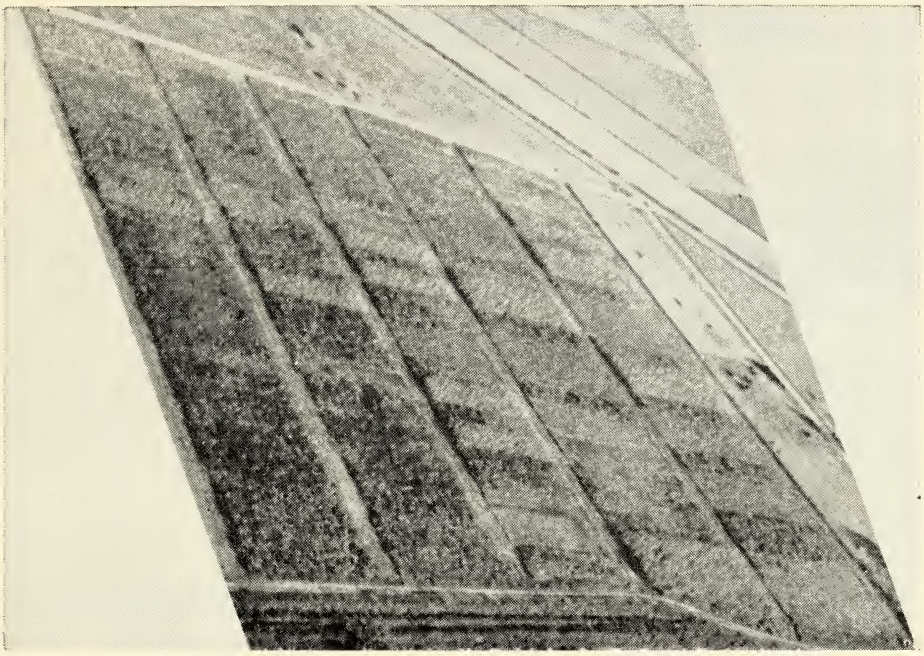

Aerial view of crop rotation plots at Delta Branch Experiment Station.

The Influence Of Cropping Systems On Soil Properties And Crop Production

Mississippi State University

AGRICULTURAL EXPERIMENT STATION

HENRY LEVECK, Director

STATE COLLEGE MISSISSIPPI

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INFLUENCE OF CROPPING SYSTEMS ON SOIL PROPERTIES AND CROP PRODUCTION

By W. I. SPURGEON AND P. H. GRISSOM

INTRODUCTION

Cotton has been grown continuously on many of the Delta soils in Mississippi for more than 50 years. The organic matter content of the majority of these soils is very low (.75-1.5%). An average cotton crop of this area returns approximately one ton per acre of crop residue to the soil annually. The crop residue from continuous cotton may not be sufficient to maintain the existing low level of soil organic matter. A further decline in organic matter could seriously impair the physical properties of the soil.

Physical, chemical and biological methods have been used in an effort to improve soil physical properties. This study is concerned with the biological method. There have been indications that soils are not affected alike by different crops and that pasture crops may have the most beneficial effect on the soil and on the yield of crops that follow. The need exists for information which may be translated into farm practice that will improve soil properties and increase crop production.

The specific objectives of this study were as follows:

1—To evaluate the influence of selected cropping systems on subsequent cotton yields.

2—To measure the residual effect of a sod crop on cotton yields.

3—To study the effect and the duration of the effect of 1, 2, 3, and 4 years of corn, soybeans and sod crops on soil properties and subsequent cotton yields.

[1]Associate agronomist and former agronomist, respectively, Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Miss.

REVIEW OF LITERATURE

The effect of short and long-time cropping systems on soil properties and crop yields have been extensively investigated throughout the humid region.

Numerous studies (1, 5, 8, 12) have shown that winter and summer legumes, when turned under as a green manure crop, increases the yield of crops that follow. The yield increase of crops following legumes is associated with the amount of nitrogen returned to the soil by the legume (5, 8, 12).

Rotations of short and long duration involving legumes and/or sod crops, have increased the yield of various crops compared with continuous cropping of a specific crop (4, 10, 14, 16). Others (2, 18) have reported no yield increase as affected by rotations. The yield increase of crops in rotations has been attributed to various factors. However, one of the most important factors is reported to be an improvement of soil properties.

Rotations involving a sod crop have been reported to increase soil organic matter and total nitrogen (2, 7, 9, 15). In some rotations perennial legumes, such as alfalfa and clovers, have been effective in maintaining and/or increasing soil organic matter and total nitrogen (7, 9, 16). With respect to soil organic matter and nitrogen maintenance long-term rotations have been more effective than short-term ones (2, 7).

Grissom (5) in a 12-year study with Delta soils of Mississippi found that winter legumes slightly decreased soil pH, and exchangeable Ca and Mg. Brage and associates (2) found that available soil phosphorus decreased as the length of rotation increased. Soil pH was not affected by length of rotation.

The effect of various crop rotations on soil physical properties have been reported by numerous investigators (11, 12, 14, 15, 16, 17, 19, 20).

Compared with continuous cropping, rotations with a sod or combination sod-legume crop increases soil aggregation as measured by the percent of water-stable aggregates (11, 14, 15, 16, 17, 20). Olmstead (13) found that cropping systems, of 30 to 40 years duration, had no significant effect on water-stable aggregates on plots of the Dry Land Agricultural Project at Hays, Kansas.

Page and Willard (14) found that yield of corn in rotations was correlated with air space porosity and the degree of soil aggregation. Van Bavel and Schaller (16) also reported that a highly significant positive correlation was found between soil aggregation and corn yields. Conversely, Strickling (15) found no apparent relationship between yield and soil aggregation. He also found no correlation between aggregate stability and volume weight of soil aggregates.

Vhland (17) found no difference in the volume weight of soil from continuous corn as compared with that from a corn-wheat-clover rotation. Williams and Doneen (19) reported that gramineous summer and winter green manure crops improved soil structure as indicated by infiltration measurements during the subsequent growing season. Annual green legumes did not improve infiltration.

To summarize, the literature indicates that cropping systems which include sod and/or legume crops increases the yield of cultivated crops grown within the system. The yield increase of the cultivated crop has usually been correlated with an increase in soil organic matter, or an improvement in soil physical properties.

EFFECT OF SELECTED CROPPING SYSTEMS ON THE SUBSEQUENT YIELD OF COTTON

Experimental Procedure

A short-term rotation was initiated in 1953 on a Bosket very fine sandy loam soil. The 8 cropping systems with treatment numbers are shown in Table 1. Hereafter, treatment numbers are used when referring to the various cropping systems.

The experimental design was a randomized block with 4 replications. Plot size was 80 x 242 feet, which allowed twenty-four 40-inch rows for each cultivated crop. Nitrogen, as anhydrous ammonia, was the only fertilizer used on the cultivated crops. Both cotton and corn received 100 pounds of N each year prior to planting. Cotton following a winter legume and/or sweet clover (treatments 2 and 4) received 60 pounds of N as a preplant application. Oats with sweet clover (treatment 4) received no nitrogen and oats alone (treatment 3) were top-dressed with 45 pounds of N per acre as ammonium nitrate.

In 1955 one-half of 12 rows of each cotton, corn and soybean plot were subsoiled. In 1956, 12 rows of same plots were subsoiled; six which had been subsoiled in 1955, and six which had not been previously subsoiled. Therefore, the original 24 row plots were subdivided in 1956 into four 6-row plots consisting of no subsoil treatment, subsoiled in 1955, subsoiled 1955 and 1956, and subsoiled in 1956.

The cropping cycle was terminated at the end of the 1957 season. Cotton was grown on the plots for two additional years (1958 and 1959) in an attempt to

Table 1. Selected cropp ing systems 1953-1959.

Treatment number	Crops for different years						
	1953	1954	1955	1956	1957	1958	1959
1	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton
2	Cotton+W.L.*	Cotton+W.L.	Cotton+W.L.	Cotton+W.L.	Cotton+W.L.	Cotton+W.L.	Cotton
3	Oats	Cotton	Cotton	Oats	Cotton	Cotton	Cotton
4	Oats+S.C.**	Oats+S.C.	Cotton	S.C.	Cotton	Cotton	Cotton
5	Corn	Cotton	Corn	Cotton	Corn	Cotton	Cotton
6	Soybeans	Cotton	Soybeans	Cotton	Soybeans	Cotton	Cotton
7	Soybeans	Corn	Cotton	Soybeans	Corn	Cotton	Cotton
8	Soybeans	Soybeans	Cotton	Soybeans	Soybeans	Cotton	Cotton

*Winter legume. **Sweet clover

Table 2. Crop yields as influenced by cropping systems on a Bosket very fine sandy loam soil.

Cropping systems	1953	1954	1955	1956	1957	1958	1959	Aperage cotton yield[1]	Continuous cotton[2]	Continuous cotton+ W.L.[3]
	Pounds of seed cotton/A and Bu/A of beans, corn and oats									
Continuous cotton	1014	744	2296	861	1297	2103	1687	1429	-------	-------
Continuous cotton+W.L.	1069	658	2354	529	1282	2204	1717	1402	-------	-------
Oats 1 year, cotton 2 years	(75.1)*	798	2333	(68.6)	1768	2373	1862	1827	1625	1643
Oats+S.C. 2 years, cotton 1 year	(75.3)	(64.2)	2557	-------	1066	2196	1952	1943	1846	1889
Corn 1 year, cotton 1 year	(13.4)	973	(58.6)	1004	(83.8)	1995	1844	1455	1349	1277
Soybeans 1 year, cotton 1 year	(4.2)	860	(6.2)	908	(18.2)	2229	1839	1459	1349	1277
Soybeans-corn-cotton	(4.7)	(4.6)	2331	(5.0)	(86.7)	2207	1556	2031	2029	2092
Soybeans 2 years, cotton 1 year	(5.1)	(8.5)	1936	(5.0)	(18.3)	2152	1494	1861	2029	2092

*Bean, corn and oat yields in parenthisis.

[1]Cotton yields for all systems, all years averaged.

[2]Continuous cotton yield for years in which there is a basis for comparison with cotton yield from other cropping systems.

[3]Cotton plus winter legume averaged same as[2].

determine the residual effect of the cropping systems on cotton yield.

Results and Discussion

The bean, corn, cotton and oat yields by years for the different cropping systems are shown in Table 2. The last three columns of Table 2 shows the average cotton yields of the different cropping systems versus those of comparable years for continuous cotton and continuous cotton plus a winter legume. There was very little difference in yield between continuous cotton with or without the winter legume which replaced 40 pounds of nitrogen each year. The only cropping system which increased cotton yield as compared with continuous cotton was the system involving 1 year of oats and 2 years of cotton. The average yields, based upon comparable years, were 1625 pounds of seed cotton per acre for continuous cotton and 1827 pounds for the 1 year of oats and 2 years of cotton.

Subsoiling the soil significantly increased cotton yields in both 1955 and 1956. In 1955 and 1956 the subsoil treatment increased yields 358 and 248 pounds of seed cotton per acre, respectively. There was no indication, as measured by cotton yield, that subsoiling was effective for more than one year.

The climatic conditions varied considerably from year to year over the 5-year period (1953-1957). Two years, 1954 and 1956 had extremely dry growing seasons. The 1957 growing season was exceptionally wet. During the dry years, yields were reduced when cotton followed a winter legume. Apparently the soil moisture reserve was depleted to some extent by the winter legume. In 1957, the wet season, yields were also reduced where cotton followed the winter legume. There was excessive vegetative growth which indicated the cotton plants had access to more N than was needed. Maturity was delayed and an early freeze reduced yield.

RESIDUAL EFFECT OF A SOD CROP ON COTTON YIELDS

Experimental Procedure

In 1955 a Dundee silty clay loam soil, which had been in a Johnsongrass-red clover sod for a period of 4 years, was selected to measure the residual effect of sod on subsequent cotton yields. The experimental design was a randomized block with 8 replications. The plot size was eight 40-inch rows 100 feet long. Starting in 1956 one plot per replication was removed from sod each year from 1956 through 1959 and planted to cotton. After removal of each plot from sod, cotton was grown on them continuously through 1960. Table 4 shows an outline of the treatments for different years.

Adapted cotton varieties were planted each year between May 1 and 20. Nitrogen, as anhydrous ammonia, was applied before planting at the rate of 100 pounds of N per acre. The cultural practices were identical to those followed in general cotton production.

Results and Discussion

The cotton yields as influenced by the sod crop are shown in Table 5.

Cotton yield the first year after sod was lower each year (1957, 1958 and 1959) as compared with yields from cotton planted 2 and 3 years after sod. In 1958 and 1959 the yields of cotton 2 years after sod was significantly higher than that from cotton 1 year after sod. In 1959 both 1 and 2 year cotton after sod produced significantly less than 3 and/or 4 years of cotton after sod.

The factor responsible for low cotton yields the first and second year that cotton was grown after sod is attributed to a heavy weed infestation. The Johnsongrass sod was difficult to eradicate the first crop year. Competition by the grass

Table 4. Treatments of the residual sod experiment.

Treatment Number	Crops by years 1955	1956	1957	1958	1959	1960
1	Sod	Cotton	Cotton	Cotton	Cotton	Cotton
2	Sod	Sod	Cotton	Cotton	Cotton	Cotton
3	Sod	Sod	Sod	Cotton	Cotton	Cotton
4	Sod	Sod	Sod	Sod	Cotton	Cotton

Table 5. The influence of a sod crop on the yield of cotton.

Treatment Number	Year sod removed and planted to cotton	Pounds of seed cotton per acre 1957	1958	1959	1960
1	1956	1674	1320	1333	2879
2	1957	1476	1177	1416	2908
3	1958	------	710	917	2733
4	1959	------	------	714	2747
L.S.D. @ .05	------	N.S.	440	380	N.S.

for soil moisture and nutrients apparently reduced cotton yield.

If the sod plots had been fallowed for a year or for one summer the Johnsongrass probably would have been easier to control in the subsequent cotton crop. The cotton yields in 1960 were higher and more uniform for all treatments. The grass presented no problem in 1960 because most of it had been eradicated.

INFLUENCE OF CONTINUOUS COTTON AND 1, 2, 3, AND 4 YEARS OF CORN, SOD AND SOYBEANS ON SOIL PROPERTIES AND COTTON YIELDS

Experimental Procedure

One test was started in 1956 on a Dubbs silt loam soil. A similar test was initiated on a Sharkey clay soil in 1957. Both soils had been cropped in cotton for several years.

A split plot design was used, consisting of 9 replications on the silt loam and 6 replications on the clay soils. Three replications were initiated on the silt loam in 1956, three in 1957 and three in 1958. Three replications were started on the clay soil in 1957 and three in 1958. The main plots for both soils were crops consisting of corn, soybeans and sod as Coastal Bermudagrass. Continuous cotton was included as a treatment but was not randomized.

The subplots were crop sequences of 1, 2, 3 and 4 years duration for each crop. One 8-row plot of each crop per replication was initiated annually over a 4-year period. For example, on the silt loam soil, one plot of corn was started in replications 1, 2, and 3 in 1956 and continued in corn through 1959; another plot was started in 1957 with continuous corn through 1959; another in 1958 with continuous corn through 1959; and the last plot was planted to 1 year of corn in 1959. In 1960 all crops of replications 1, 2 and 3 were plowed under and planted to cotton. The same procedure was followed for the other replications and crops except that the initation dates were different.

Cultural practices for all crops were the same as those generally recommended for the area. The cotton planted, after removal of the different crops, received 90 pounds of N per acre as anhydrous ammonia.

Cotton yields were measured through 1963. On the silt loam soil this gave yield

comparisons between the first, second, third and fourth year of cotton after 1, 2, 3 and 4 years of corn, sod and soybeans. On the clay soil, yield comparisons were made between the first, second and third year of cotton following 1, 2, 3 and 4 years of corn, sod and soybeans.

The soil physical properties measured were bulk density and water-stable aggregates. These measurements were made only on the silt loam soil. All soil samples were taken after the crops had been removed and the plots planted to cotton. The soil samples for the two physical measurements were obtained each year in August after the last cultivation. Additional samples were obtained from all plots of both soils to a depth of 6 inches each year prior to planting cotton. These samples were analyzed by the Soil Test Laboratory at Mississippi State University for pH, organic matter, available P_2O_5 and exchangeable potassium.

A modification of Bryant and associates' (3) method was used for the determination of water-stable soil aggregates. The data are expressed as an average of the 2 and 5 minute oscillation periods.

The degree of weed infestation of cotton following the different crops was determined by recording the hoe labor in man hours for each plot.

Results and Discussion

The primary purpose of this study was to evaluate the effect of the cropping systems on soil properties and subsequent cotton yields. However, the yields were recorded for cotton, corn and soybeans during the cropping period for 1956-1961. These data are shown in appendix Table 3.

Corn grown on the soil for more than 1 year reduced subsequent corn yields. The 3-year average (1959-1961) yields for 1, 2, 3 and 4 years of corn on the Dubbs silt loan soil were 67.5, 63.0, 56.6 and 41.6 bushels per acre, respectively. Soybean yields, on the same soil, were not affected when grown for 1, 2, 3 and 4 years.

On the Sharkey clay soil yields of both corn and soybeans were too variable to make any estimate of the effect of cropping sequence on yield. The corn crop in 1960 was a complete failure.

Effect on Soil Properties: Table 6 shows the average bulk density and per-

Table 6. The influence of cropping systems on the bulk density and percentage water-stable aggregates of a Dubbs silt loam soil.

	Bulk density			Percent water-stable aggregates*		
Treatment	1st-year[1] cotton	2nd-year[2] cotton	3rd-year[3] cotton	1st-year[2] cotton	2nd-year[3] cotton	3rd-year[3] cotton
Cotton each year	1.32	1.35	1.34	13.7	12.0	21.4
1 year in corn	1.32	1.35	1.27	14.8	17.8	21.4
2 years in corn	1.31	1.34	1.29	14.9	18.0	25.0
3 years in corn	1.31	1.33	1.29	15.4	14.0	25.0
4 years in corn	1.30	1.33	1.30	15.8	15.6	27.4
Corn average	1.31	1.34	1.29	15.2	16.4	24.7
1 year in soybeans	1.32	1.33	1.31	16.1	12.6	19.0
2 years in soybeans	1.33	1.33	1.32	9.6	11.2	17.0
3 years in soybeans	1.31	1.31	1.32	10.4	10.0	17.8
4 years in soybeans	1.31	1.32	1.33	14.7	13.2	22.0
Soybean average	1.32	1.32	1.32	12.7	11.8	18.9
1 year in sod	1.28	1.35	1.32	12.3	15.0	14.4
2 years in sod	1.28	1.34	1.32	14.0	11.2	18.0
3 years in sod	1.31	1.31	1.31	18.4	12.2	19.8
4 years in sod	1.31	1.31	1.31	18.3	15.4	22.6
Sod average	1.30	1.33	1.32	15.8	13.5	18.7

*Average of 2 and 5 minute oscillations.
[1]3-year average. [2]2-year average. [3]1-year only.

Table 7. The influence of cropping systems on the available P_2O_5 and exchangeable potassium of a Dubbs silt loam soil.

Treatment	Lbs/A available P_2O_5			Lbs/A exchangeable potassium		
	1st-year[1] cotton	2nd-year[2] cotton	3rd-year[3] cotton	1st-year[1] cotton	2nd-year[2] cotton	3rd-year[3] cotton
Cotton each year	126	156	192	338	331	378
1 year in corn	120	134	206	338	321	419
2 years in corn	145	159	242	368	385	422
3 years in corn	132	170	228	353	373	356
4 years in corn	114	141	206	340	348	465
Corn average	128	151	220	350	357	441
1 year in soybeans	114	134	151	331	305	343
2 years in soybeans	109	123	155	309	289	427
3 years in soybeans	107	126	150	319	296	348
4 years in soybeans	103	128	151	321	295	329
Soybean average	108	128	152	320	296	362
1 year in sod	149	154	174	367	383	452
2 years in sod	124	134	167	379	371	427
3 years in sod	111	132	141	400	383	395
4 years in sod	107	126	171	419	368	403
Sod average	123	136	163	391	376	419

[1]3-year average. [2]2-year average. [3]1-year only.

Table 8. The influence of cropping systems on the percent organic matter and pH of a Dubbs silt loam soil.

Treatment	Percent organic matter			Soil pH		
	1st-year[1] cotton	2nd-year[2] cotton	3rd-year[3] cotton	1st-year[2] cotton	2nd-year[2] cotton	3rd-year[3] cotton
Cotton each year	1.04	1.07	1.00	6.1	6.1	6.0
1 year in corn	1.08	1.07	1.00	6.1	6.0	6.0
2 years in corn	1.09	1.07	1.21	6.1	6.2	6.1
3 years in corn	1.12	1.14	1.05	6.0	6.2	6.3
4 years in corn	1.09	1.13	1.15	5.9	6.1	6.0
Corn average	1.09	1.10	1.10	6.0	6.1	6.1
1 year in soybeans	1.02	0.97	0.98	6.2	6.0	6.0
2 years in soybeans	0.97	0.99	0.95	6.1	6.0	5.7
3 years in soybeans	1.02	1.07	1.05	6.0	6.0	5.9
4 years in soybeans	1.07	1.02	1.02	6.1	6.1	6.0
Soybean average	1.02	1.01	1.00	6.1	6.0	5.9
1 year in sod	1.21	1.06	1.08	6.4	6.4	6.3
2 years in sod	1.14	1.17	1.11	6.3	6.1	5.9
3 years in sod	1.18	1.08	1.08	6.3	6.1	6.0
4 years in sod	1.19	1.18	1.05	6.3	5.9	5.8
Sod average	1.18	1.12	1.08	6.3	6.1	6.0

[1]3-year average. [2]2-year average. [3]1-year only.

cent of water-stable aggregates of the Dubbs silt loam soil for the first, second and third years of cotton following the different cropping systems. Bulk density was not affected by any of the cropping systems. The percentage of water-stable aggregates were significantly reduced in the first- and second-year cotton crops following soybeans. The percentage of soil water-stable aggregates, for both first- and second-year cotton following the cropping systems, were in the order of sod, corn, cotton, soybeans.

The effect of cropping systems on the available P_2O_5 and exchangeable potassium of the Dubbs silt loam soil is shown in Table 7. There was no significant difference in available P_2O_5 as affected by the different crops. However, during the first, second and third years of cotton the available P_2O_5 was lower in the soil from the soybean plots as com-

pared to those of cotton, corn and sod.

As indicated by the first year of cotton (Table 7) the available P_2O_5 was 149, 124, 111, and 107 pounds per acre for 1, 2, 3 and 4 years of sod, respectively. The same trend, although not significant was evident in the first year of cotton following 1, 2, 3 and 4 years of soybeans.

The cropping systems did not significantly affect the amount of exchangeable soil potassium. The soil potassium was lower (Table 7) from cotton following soybeans as compared with cotton following cotton, corn and sod. This same trend persisted through the first, second and third years of cotton following the different crops.

The effect of the cropping systems on soil organic matter and pH is shown in Table 8. The soil organic matter content was significantly increased in the first year of cotton after sod as compared with the first year of cotton after soybeans. During the second and third years of cotton the organic matter content of soil from the sod crop was higher than from soil of the bean and corn plots but not significantly higher.

The soil pH was not affected by any of the cropping systems.

The cropping systems had very little effect on the chemical properties of the Sharkey clay soil. Appendix Table 12 shows the soil pH, available P_2O_5, and percent organic matter as measured during the first and second years of cotton that followed the different crops. The exchangeable potassium is not included because all plots regardless of crops or crop sequence had more than 640 pounds of exchangeable K per acre.

Effect on Weed Control: The effect of the different cropping systems on weed control has been reported in a previous publication (6). The data from this publication are shown in Table 9.

The hoe labor requirement varied considerably for cotton following the different crops. On the Dubbs soil, cotton the first year after corn required about twice the hoe labor as that for continuous cotton and/or soybeans. The hoe labor for the first year of cotton after sod was triple that of either continuous cotton or soybeans. The hoe labor for the second year of cotton was considerably less.

There was very little difference between crops. However, the hoe labor requirement of second year cotton after

Table 9. The influence of cropping systems on the hoe labor requirements in cotton on a Dubbs silt loam and a Sharkey clay soil.

Treatment	Dubbs silt loam		Sharkey clay	
	1st-year[1] cotton	2nd-year[2] cotton	1st-year[2] cotton	2nd-year[3] cotton
	Man hours per acre			
Cotton each year	24	21	86	55
1 year in corn	38	23	105	61
2 years in corn	42	24	114	70
3 years in corn	45	23	112	73
4 years in corn	49	31	114	77
Corn average	44	25	111	70
1 year in soybeans	24	15	71	41
2 years in soybeans	19	13	57	36
3 years in soybeans	19	14	54	39
4 years in soybeans	20	13	58	38
Soybean average	21	14	60	39
1 year in sod	63	27	111	69
2 years in sod	73	30	134	93
3 years in sod	68	22	170	108
5 years in sod	78	24	179	119
Sod average	71	26	149	97

[1]3-year average. [2]2-year average. [3]1-year only.

Table 10. The influence of cropping systems on subsequent cotton yields on a Dubbs silt loam soil.

Treatment	1st-year[1] cotton	2nd-year[1] cotton	3rd-year[2] cotton	4th-year[3] cotton
		Pounds of seed cotton per acre		
Cotton each year	2384	2693	2742	2843
1 year in corn	2668	2876	2810	2799
2 years in corn	2596	2895	2853	2563
3 years in corn	2605	2994	2972	2862
4 years in corn	2715	2889	2889	2885
Corn average	2646	2914	2881	2777
1 year in soybeans	2398	2688	2927	2696
2 years in soybeans	2112	2707	2876	2658
3 years in soybeans	2148	2690	2845	2683
4 years in soybeans	1951	2753	2829	2756
Soybean average	2152	2710	2869	2699
1 year in sod	2475	2887	2829	2919
2 years in sod	2233	2768	2913	2986
3 years in sod	2334	2711	2945	2834
4 years in sod	2072	2792	2938	2913
Sod average	2279	2789	2906	2913

[1]3-year average. [2]2-year average. [3]1-year only.

soybeans was slightly less than that for the other crops. Johnsongrass and nutgrass were the primary weeds that caused the high hoe labor in cotton following the corn and sod crops on the silt loam soil.

On the Sharkey clay soil the hoe labor requirement was very high for both first- and second-year cotton that followed the corn and sod crops. The lowest hoe time was required where cotton followed soybeans. The highest amount of hoe labor was required where cotton followed sod. The weeds which were difficult to control on the Sharkey soil were nutgrass and Coastal Bermudagrass. Nutgrass presented a problem in cotton after corn. The Coastal Bermudagrass was difficult to eradicate in cotton after sod. The Coastal Bermudagrass had not been completely eradicated after the third year of cotton.

The weed infestation in cotton following the sod crop may not have been so severe if the soil had been fallowed for a year after removal of the sod. A combination of Spring fallow plus a soybean crop the first year after sod may also be effective in reducing the weed population in a subsequent cotton crop.

Effect on Subsequent Cotton Yield: The average yields of the first, second, third and fourth years of cotton following the different cropping systems, on the Dubbs silt loam soil, are shown in Table 10.

The greatest yield difference between cropping systems occurred in the first year of cotton. These differences, based on the 3-year average, were not statistically significant. The yields of the first year of cotton following corn, soybeans and sod were 2646, 2152 and 2279 pounds of seed cotton per acre, respectively. The yield of continuous cotton for the same period was 2384 pounds of seed cotton per acre.

A significant interaction of crops x years occurred in the first year of cotton (Appendix Table 1). The first-year cotton yields after soybeans were significantly lower than comparable yields after corn and sod for the years of 1960 and 1961. In 1962 the first-year cotton yields after sod were significantly lower than comparable yields after corn and soybeans. In 1962 cotton yields after sod were reduced by a heavy weed infestation. The yield reduction of cotton after soybeans in 1960 and 1961 cannot be satisfactorily explained. The available P_2O_5

and exchangeable potassium was lower in soil that had been cropped in soybeans. However, subsequent cotton yields could not be correlated with soil P_2O_5 or potassium.

The average yields of the second, third and fourth years of cotton were not affected by the different cropping systems.

Table 11 shows the average yields of the first, second and third years of cotton following the different cropping systems on the Sharkey clay soil.

The cropping systems on the Sharkey clay soil, as on the Dubbs silt loam, exhibited the greatest effect on yield during the first year of cotton. The first year average cotton yields following the corn, soybean and sod crops were 1053, 1426, and 736 pounds of seed cotton per acre, respectively. The yield of continuous cotton for the same period was 1233 pounds of seed cotton per acre.

Two factors were probably responsible for the higher yield of cotton following soybeans. First, the weed infestation of cotton following soybeans was less than in cotton following the other crops. Second, nitrogen loss through denitrification is a problem on the Sharkey soil. The cotton following soybeans probably had access to more soil nitrogen.

The low cotton yield following the sod crop was caused primarily, by competition from residual Coastal Bermudagrass. The Coastal Bermudagrass was difficult to eradicate. This is reflected in the first-year cotton yields following 1, 2, 3 and 4 years of sod. The cotton yields after 1, 2, 3 and 4 years of sod were 1183, 916, 554 and 293 pounds of seed cotton per acre, respectively.

The average yields of the second and third years of cotton were similar for all of the cropping systems. The weed problem was not as severe during the second and third years of cotton following the corn and sod crops.

Table 11. The influence of cropping systems on subsequent cotton yields on a Sharkey clay soil.

Treatment	1st-year[1] cotton	2nd-year[1] cotton	3rd-year[2] cotton
	Pounds of seed cotton per acre		
Cotton each year	1233	1125	1507
1 year in corn	1161	1165	1897
2 years in corn	1008	1198	1853
3 years in corn	894	1285	1996
4 years in corn	1059	1265	1945
Corn average	1053	1228	1921
1 year in soybeans	1493	1135	1748
2 years in soybeans	1384	1039	1897
3 years in soybeans	1350	1086	1576
4 years in soybeans	1478	1041	1746
Soybean average	1426	1075	1742
1 year in sod	1183	1208	1754
2 years in sod	916	1235	1736
3 years in sod	554	996	1941
4 years in sod	293	1039	1864
Sod average	736	1119	1824

[1]2-year average. [2]1-year only.

SUMMARY

A test designed to measure the influence of 8 selected cropping systems on subsequent cotton yield was conducted from 1953-1959. Only one of the 8 cropping systems (1 year of oats and 2 years of cotton) increased cotton yield above that obtained from continuous cotton.

The residual effect of a sod crop on cotton yield was measured over a 4-year period from 1956-1960. Cotton yield the first year after sod was significantly lower than yields from the second and third year of cotton after sod. The yield reduction in the first year of cotton following sod is attributed to a heavy weed infestation.

Two experiments were initiated, one in 1956 on a Dubbs silt loam and one in 1957 on a Sharkey clay, to measure the effect of 1, 2, 3 and 4 years of corn, soybean and sod crops on soil properties and subsequent cotton yields.

Effects On Soil Properties

The effects of the cropping systems on the soil properties, as measured during the first, second and third years of cotton following the different crops are shown below:

1—The percent of water-stable soil aggregates was significantly reduced by the soybean crop on the Dubbs soil.

2—As compared with continuous cotton, corn and sod the soybeans reduced the amount of available P_2O_5 and exchangeable potassium of the Dubbs soil, but not significantly.

3—The soil bulk density and pH were not affected by any of the cropping systems.

4—The percent organic matter content of the Dubbs soil was significantly increased by the sod crop.

5—The cropping systems had no effect on pH, percent organic matter content, exchangeable potassium and available P_2O_5 of the Sharkey clay soil.

Effects On Cotton Yields

The effects of the cropping systems on subsequent cotton yields are shown below:

1—On the Dubbs soil, 2 out of 3 years (1960-1961) the yield of first-year cotton after soybeans was lower than the yield of first-year cotton after corn and sod. The yield of the first-year cotton after soybeans was also lower than that from continuous cotton.

2—On the Dubbs soil, 1 out of 3 years (1962), the yield of first-year cotton after sod was lower than the yields of first-year cotton after corn and soybeans. First-year cotton after sod also produced less than continuous cotton. The yield reduction after sod in 1962 was caused by a severe weed infestation.

3—On the Sharkey soil, the yield of the first-year cotton after sod was considerably lower both years (1961-1962) than the yields from first-year cotton after corn and soybeans. Yield from first-year cotton after sod was lower than that from continuous cotton. The yield reduction in the first year of cotton after sod was caused by the residual Coastal Bermudagrass which was difficult to eliminate.

4—The yield of second and third-year cotton, following the cropping systems, was not significantly affected by any of the crops on either soil type.

The results of these experiments indicate no particular advantage for any of the rotations or croppings systems. The yield of continuous cotton was equal or superior to the yield of cotton that followed the various crops.

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Appendix Table 1. Analysis of variance of soil properties and cotton yield during first year cotton following the different cropping systems on a Dubbs silt loam soil.

Source	d f	Cotton yield M S	P_2O_5 M S	Potassium M S	Organic matter M S	Water-stable aggregates M S
Crops	2	2218.02	3634.75	46081.46	0.237*	0.377*
Years	2	980.92	25700.25	234878.90**	0.230*	0.251
Crops x years	4	2428.79**	8741.54	16579.63	0.027	0.017
Replications within years	6	251.11	4853.75	5925.82	0.111	0.114
Error a	12	202.83	6742.58	15508.58	0.047	0.055
Sequence within crops	9	185.90	1717.74*	2461.05	0.009	0.091
Sequence within crops x years	18	107.04**	516.54	823.65	0.017	0.059
Error b	54	45.54	532.74	1401.74	0.017	0.026
Total	107					

**Significant at the 1% level. *Significant at the 5% level.

Appendix Table 2. Analysis of variance of yields for first and second year cotton following the different cropping systems on a Sharkey clay soil.

Source	d f	1st-year cotton M S	2nd-year cotton M S
Crops	2	2683.55	139.47
Years	1	9261.61*	4105.69**
Crops x years	2	1055.81*	174.97
Replications within years	4	78.85	57.34
Error a	8	133.39	155.51
Sequence within crops	6	464.81*	54.84
Sequence within crops x years	12	131.31**	15.90
Error b	36	19.45	29.26
Total	71		

**Significant at the 1% level. *Significant at the 5% level.

Appendix Table 3. Average cotton, corn and soybean yields from the Dubbs silt loam and Sharkey clay soils during the cropping sequence period from 1956-1961.

Treatment	1956	1957	1958	1959	1960	1961
				Dubbs silt loam		
Cotton	.....	1804[1]	2510	2710	2316	.....
1 year in corn	67.5[2]	89.9	94.1	69.8	66.3	66.4
2 years in corn	.....	.....	82.3	58.7	65.2	65.1
3 years in corn	.....	.....	75.1	50.2	59.5	60.0
4 years in corn	.....	.....	.....	32.9	52.2	39.6
1 year in soybeans	.....	41.4[2]	41.7	45.6	47.1	.....
2 years in soybeans	.....	38.3	41.3	44.5	48.1	.....
3 years in soybeans	.....	.....	37.2	44.3	45.8	.....
4 years in soybeans	.....	.....	.....	45.2	45.2	.....
				Sharkey clay		
Cotton		1171	787	982	.....	.....
1 year in corn		47.2	34.3	13.9	.....	39.9
2 years in corn		.....	23.7	5.6	.....	44.6
3 years in corn		.....	.....	11.4	.....	40.8
4 years in corn		.....	.....	.....	.....	38.6
1 year in soybeans		12.0	25.3	15.1	29.8	.....
2 years in soybeans		.....	26.4	10.9	35.8	.....
3 years in soybeans		.....	.....	14.1	31.2	.....
4 years in soybeans		.....	.....	.....	34.1	.....

[1]Pounds per acre of seed cotton. [2]Bushels per acre of corn and soybeans.

Appendix Table 4. Average cotton yields from a Dubbs silt loam soil for the first, second and third years following 1, 2, 3 and 4 years of corn, soybean and sod crops.

	Pounds of seed cotton per acre									
	1st-year cotton			2nd-year cotton			3rd-year cotton		4th-year cotton	
Treatment	1960	1961	1962	1961	1962	1963	1962	1963	1963	Average
Cotton each year	2121	2573	2459	2714	2256	3109	2450	3033	2843	2618
1 year in corn	2797	2636	2571	2763	2675	3190	2542	3078	2799	2783
2 years in corn	2493	2756	2540	2819	2731	3136	2542	3164	2563	2749
3 years in corn	2529	2764	2523	2982	2822	3179	2813	3131	2862	2845
4 years in corn	2641	2789	2714	2822	2748	3098	2648	3129	2885	2830
Corn average	2615	2736	2587	2846	2744	3151	2636	3125	2777	2802
1 year in soybeans	2430	2305	2460	2634	2485	2945	2512	3342	2696	2645
2 years in soybeans	1600	2182	2554	2657	2470	2995	2666	3085	2658	2541
3 years in soybeans	1884	2073	2488	2626	2532	2912	2472	3217	2683	2543
4 years in soybeans	1295	2030	2528	2679	2617	2963	2564	3093	2756	2503
Soybean average	1802	2148	2507	2649	2526	2954	2553	3184	2699	2558
1 year in sod	2665	2798	1962	2780	2723	3158	2602	3055	2919	2740
2 years in sod	2596	2660	1443	2936	2434	2934	2753	3073	2986	2646
3 years in sod	2434	2826	1741	2855	2419	2858	2902	2987	2834	2651
4 years in sod	2271	2786	1159	2928	2467	2982	3035	2840	2913	2598
Sod average	2492	2767	1577	2875	2510	2983	2823	2989	2913	2659

Appendix Table 5. Average cotton yields from a Sharkey clay soil for the first, second and third years following 1, 2, 3 and 4 years of corn, soybean and sod crops.

	Pounds of seed cotton per acre					
	1st-year cotton		2nd-year cotton		3rd-year cotton	
Treatment:	1961	1962	1962	1963	1963	Average
Cotton each year	1610	855	859	1390	1507	1244
1 year in corn	1669	653	895	1435	1897	1310
2 years in corn	1406	610	980	1415	1853	1253
3 years in corn	1238	729	945	1624	1996	1306
4 years in corn	1269	848	951	1579	1945	1318
Corn average	1396	710	943	1513	1921	1297
1 year in soybeans	2181	804	1005	1265	1748	1401
2 years in soybeans	1948	819	900	1178	1897	1348
3 years in soybeans	1839	861	879	1292	1576	1289
4 years in soybeans	2134	821	933	1148	1746	1356
Soybean average	2026	826	929	1221	1742	1349
1 year in sod	1713	652	888	1527	1754	1307
2 years in sod	978	854	830	1640	1736	1208
3 years in sod	708	399	790	1202	1941	1008
4 years in sod	220	363	733	1344	1864	905
Sod average	905	567	810	1428	1824	1107

Appendix Table 6. The effect of 1, 2, 3 and 4 years of corn, soybean and sod crops on the water-stable aggregates of a Dubbs silt loam soil as measured during subsequent cotton crops.

	Percent water-stable aggregates*				
	1st-year cotton		2nd-year cotton	3rd-year cotton	
Treatment:	1960	1962	1962	1962	Average
Cotton each year	14.8	12.6	12.0	21.4	15.2
1 year in corn	15.2	14.4	17.8	21.4	17.2
2 years in corn	16.8	13.0	18.0	25.0	18.2
3 years in corn	13.6	17.2	14.0	25.0	17.5
4 years in corn	19.2	12.4	15.6	27.4	18.7
Corn average	16.2	14.3	16.4	24.7	17.9
1 year in soybeans	18.8	13.4	12.6	19.0	16.0
2 years in soybeans	11.2	8.0	11.2	17.0	12.3
3 years in soybeans	11.6	9.2	10.0	17.8	12.2
4 years in soybeans	18.4	11.0	13.2	22.0	16.2
Soybean average	15.0	10.4	11.8	18.9	14.0
1 year in sod	15.0	9.6	15.0	14.4	13.5
2 years in sod	15.4	12.6	11.2	18.0	14.3
3 years in sod	21.4	15.4	12.2	19.8	17.2
4 years in sod	18.2	18.4	15.4	22.6	18.7
Sod average	17.5	14.0	13.5	18.7	15.9

*Average of 2 and 5 minute oscillations.

Appendix Table 7. The effect of 1, 2, 3 and 4 years of corn, soybean and sod crops on the bulk density of a Dubbs silt loam soil as measured during subsequent cotton crops.

	Bulk density						
	1st-year cotton			2nd-year cotton		3rd-year cotton	
Treatment	1960	1961	1962	1961	1962	1962	Average
Cotton each year	1.30	1.36	1.29	1.38	1.31	1.34	1.33
1 year in corn	1.30	1.35	1.31	1.37	1.33	1.27	1.32
2 years in corn	1.25	1.36	1.31	1.33	1.34	1.29	1.31
3 years in corn	1.27	1.36	1.31	1.32	1.34	1.29	1.32
4 years in corn	1.26	1.34	1.29	1.36	1.31	1.30	1.31
Corn average	1.27	1.35	1.31	1.35	1.33	1.29	1.32
1 year in soybeans	1.31	1.33	1.31	1.34	1.31	1.31	1.32
2 years in soybeans	1.30	1.39	1.29	1.35	1.31	1.32	1.33
3 years in soybeans	1.31	1.32	1.31	1.31	1.31	1.32	1.31
4 years in soybeans	1.30	1.34	1.28	1.33	1.32	1.33	1.32
Soybean average	1.31	1.35	1.30	1.33	1.31	1.32	1.32
1 year in sod	1.28	1.28	1.29	1.38	1.31	1.32	1.31
2 years in sod	1.24	1.29	1.31	1.38	1.30	1.32	1.31
3 years in sod	1.28	1.34	1.32	1.32	1.30	1.31	1.31
4 years in sod	1.28	1.34	1.32	1.31	1.30	1.31	1.31
Sod average	1.27	1.31	1.31	1.35	1.30	1.32	1.31

Appendix Table 8. The effect of 1, 2, 3 and 4 years of corn, soybeans and sod crops on the available P_2O_5 of a Dubbs silt loam soil as measured during subsequent cotton crops.

	Pounds per acre of available P_2O_5						
	1st-year cotton			2nd-year cotton		3rd-year cotton	
Treatment	1960	1961	1962	1961	1962	1962	Average
Cotton each year	156	109	113	162	150	192	147
1 year in corn	159	90	111	144	123	206	139
2 years in corn	222	87	127	203	114	242	166
3 years in corn	222	71	104	226	114	228	161
4 years in corn	162	66	114	179	103	206	138
Corn average	191	79	114	188	113	220	151
1 year in soybeans	127	99	116	133	134	151	127
2 years in soybeans	118	93	116	121	125	155	121
3 years in soybeans	113	91	117	127	124	150	120
4 years in soybeans	111	92	106	132	124	151	119
Soybean average	117	94	114	128	127	152	122
1 year in sod	162	131	153	149	158	174	155
2 years in sod	138	108	127	135	132	167	135
3 years in sod	121	106	106	122	142	141	123
4 years in sod	118	97	105	127	124	171	124
Sod average	135	111	123	133	139	163	134

Appendix Table 9. The effect of 1, 2, 3 and 4 years of corn, soybean and sod crops on the exchangeable potassium of a Dubbs silt loam soil as measured during subsequent cotton crops.

	Pounds per acre of exchangeable potassium						
	1st-year cotton			2nd-year cotton		3rd-year cotton	
Treatment	1960	1961	1962	1961	1962	1962	Average
Cotton each year	426	259	328	337	324	378	342
1 year in corn	438	248	327	339	303	419	346
2 years in corn	500	266	338	460	309	422	383
3 years in corn	495	236	329	420	325	456	377
4 years in corn	464	235	321	384	312	465	364
Corn average	474	246	329	401	312	441	367
1 year in soybeans	411	246	337	316	293	343	324
2 years in soybeans	384	229	314	303	274	427	322
3 years in soybeans	398	229	329	309	282	348	316
4 years in soybeans	391	234	339	307	282	329	314
Soybean average	396	235	330	309	283	362	319
1 year in sod	419	315	366	334	432	452	386
2 years in sod	431	338	369	339	403	427	385
3 years in sod	436	378	386	339	427	395	394
4 years in sod	502	389	367	377	358	403	399
Sod average	447	355	372	347	405	419	391

Appendix Table 10. The effect of 1, 2, 3 and 4 years of corn, soybean and sod crops on the organic matter content of a Dubbs silt loam soil as measured during subsequent cotton crops.

	Percent organic matter						
	1st-year cotton			2nd-year cotton		3rd-year cotton	
Treatment	1960	1961	1962	1961	1962	1962	Average
Cotton each year	1.17	0.95	0.99	1.17	0.96	1.00	1.04
1 year in corn	1.08	0.95	1.21	1.21	0.92	1.09	1.06
2 years in corn	1.18	0.96	1.13	1.18	0.95	1.21	1.10
3 years in corn	1.15	0.92	1.28	1.18	1.09	1.05	1.11
4 years in corn	1.12	1.05	1.09	1.20	1.05	1.15	1.11
Corn average	1.13	0.97	1.18	1.19	1.00	1.10	1.10
1 year in soybeans	1.02	0.95	1.08	1.05	0.89	0.98	1.00
2 years in soybeans	0.90	0.93	1.08	1.08	0.89	0.95	0.97
3 years in soybeans	1.11	0.94	1.02	1.15	0.98	1.05	1.04
4 years in soybeans	1.08	1.02	1.12	1.08	0.95	1.02	1.05
Soybean average	1.03	0.96	1.08	1.09	0.93	1.00	1.02
1 year in sod	1.12	1.28	1.24	1.18	0.93	1.08	1.14
2 years in sod	1.02	1.08	1.32	1.32	1.02	1.11	1.15
3 years in sod	1.19	1.05	1.31	1.20	0.95	1.08	1.13
4 years in sod	1.18	1.11	1.28	1.34	1.02	1.05	1.16
Sod average	1.13	1.13	1.29	1.26	0.98	1.08	1.15

Appendix Table 11. The effect of 1, 2, 3 and 4 years of corn, soybean and sod crops on the pH of a Dubbs silt loam soil as measured during subsequent cotton crops.

	Soil pH					
	1st-year cotton		2nd-year cotton		3rd-year cotton	
Treatment	1961	1962	1961	1962	1962	Average
Cotton each year	6.1	6.1	6.2	6.0	6.0	6.1
1 year in corn	6.0	6.1	6.2	5.8	6.0	6.0
2 years in corn	6.1	6.1	6.4	5.9	6.1	6.1
3 years in corn	5.9	6.0	6.4	6.0	6.3	6.1
4 years in corn	5.8	5.9	6.2	6.0	6.0	6.0
Corn average	6.0	6.0	6.3	5.9	6.1	6.1
1 year in soybeans	6.2	6.1	6.2	5.7	6.0	6.0
2 years in soybeans	6.1	6.1	6.1	6.0	5.7	6.0
3 years in soybeans	6.1	5.9	6.0	5.9	5.9	6.0
4 years in soybeans	6.1	6.1	6.2	6.0	6.0	6.1
Soybean average	6.1	6.1	6.1	5.9	5.9	6.0
1 year in sod	6.6	6.2	6.3	6.4	6.3	6.4
2 years in sod	6.1	6.4	6.1	6.0	5.9	6.1
3 years in sod	6.1	6.5	6.1	6.1	6.0	6.2
4 years in sod	6.1	6.4	6.1	5.7	5.8	6.0
Sod average	6.2	6.4	6.2	6.0	6.0	6.2

Appendix Table 12. The effect of 1, 2, 3 and 4 years of corn, soybean and sod crops on the pH, available P_2O_5 and organic matter content of a Sharkey clay soil as measured during the 1962 cotton crop.

	Soil pH		Lbs/A available P_2O_5		Percent organic matter	
Treatment	1st-year cotton	2nd-year cotton	1st-year cotton	2nd-year cotton	1st-year cotton	2nd-year cotton
Cotton each year	6.2	6.0	162	170	1.93	2.29
1 year in corn	6.2	6.2	177	199	2.07	2.34
2 years in corn	6.3	6.1	163	162	1.92	1.80
3 years in corn	6.2	6.1	173	178	1.90	2.17
4 years in corn	6.3	6.2	168	167	1.99	2.15
Corn average	6.3	6.2	170	176	1.97	2.12
1 year in soybeans	6.2	5.9	184	181	2.18	2.15
2 years in soybeans	6.2	6.0	184	205	2.14	2.43
3 years in soybeans	6.2	6.0	171	209	1.84	2.39
4 years in soybeans	6.3	5.9	174	197	1.98	2.39
Soybean average	6.2	6.0	178	198	2.04	2.34
1 year in sod	6.3	6.2	182	175	1.96	2.07
2 years in sod	6.4	6.0	172	169	2.14	2.22
3 years in sod	6.4	6.3	181	170	2.34	2.34
4 years in sod	6.4	5.9	169	157	2.18	2.33
Sod average	6.4	6.1	176	168	2.16	2.24