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Much dryland cotton in southwestern Oklahoma is grown on sandy soils. During the late fall, winter and early spring, this land suffers severe wind erosion if left unprotected. The most logical solution for wind erosion control is a vegetative cover during those months that cotton is not growing on the soil.

Murphy (2) previously conducted research on double cropping cotton with rye and vetch on a Kirkland silt loam soil at Stillwater. He found that cotton yields decreased when grown in the double cropping system even though the average annual rainfall was 33 inches. He noted, however, that the cover crop effectively reduced the susceptibility to wind and water erosion. The Kirkland silt loam soil is naturally droughty for summer crops whereas many sandy soils are less droughty.

The study reported herein is the result of a 5-year experiment at the Sandy Land Research Station, Mangum, on the effects of a rye winter cover crop and time of fertilization on cotton production.

METHODS

The experiment was started in 1958 on a Miles loamy fine sand, clayey substrata, that was deep plowed in 1953. Table 1 shows chemical and physical analyses for this soil. Total phosphorus was determined by Shelton and Harper's method (3); organic matter by Walkley and Black's chromic acid titration method (4); and nitrogen by the conventional Kjeldahl method. Extractable phosphorus, often referred to as "Bray No. 1" was determined by the method proposed by Bray and Kurtz (1), and exchangeable potassium was determined by replacing the potassium on the soil with ammonium acetate, then determining the amount of potassium with a flame photometer. Additional soil descriptions are given in the appendix. Rainfall and temperature data for the years of the experiment are shown in Table 2.

The first year, cotton was planted uniformly over the selected experimental area to obtain soil uniformity information. In 1959 the experiment was set up in a restricted randomized block, split-plot design

The research reported herein was conducted under Oklahoma Station project 1072.

Table 1.—Chemical and physical characteristics of a deep-plowed Miles loamy sand, Sandy Land Research Station, Mangum.

Depth Inches	pH	O.M. %	N %	Pounds per Acre Total P	Extractable P	Exch. K	Soil Moisture Percentages at the Following Bars of Suction 1/10	1/3	1	3	6	9	15
0-6	6.15	.40	.024	325	47	185	8.8	5.2	4.4	3.1	2.5	2.4	2.3
6-12	6.48	.39	.023	325	46	197	9.2	5.6	4.4	3.2	2.5	2.4	2.3
12-24	6.10	.49	.039	208	4	288	25.6	16.7	13.7	10.2	9.0	8.4	7.8
24-36	6.38	.43	.036	160	2	280	30.6	24.4	18.5	15.0	12.6	12.0	11.1
36-48	6.39	.30	.028	96	0	192	29.4	23.0	18.6	14.0	11.9	11.3	10.6

Table 2.—Average air temperatures and total monthly precipitation. Sandy Land Research Station, Mangum, 1959-1963.

	Average Air Temperature in °F.					Total Monthly Precipitation in Inches				
Month	1959	1960	1961	1962	1963	1959	1960	1961	1962	1963
Jan.	38.0	37.6	36.9	35.3	33.0	0.06	1.55	0.13	0.32	0.05
Feb.	44.8	38.0	44.5	48.8	45.6	0.16	2.48	1.57	0.03	0.46
March	53.1	43.1	51.9	52.7	57.3	0.52	1.30	2.33	0.07	1.02
April	63.2	65.0	60.4	60.9	67.8	2.17	0.18	0.40	3.08	0.79
May	73.3	68.7	70.6	76.2	75.3	6.10	3.27	1.57	1.25	3.76
June	79.0	79.2	75.3	76.1	79.9	1.73	4.16	2.83	7.67	3.11
July	79.3	80.0	79.4	83.3	86.4	3.44	4.95	5.97	3.54	0.34
August	82.7	79.9	80.1	83.1	85.2	1.25	3.24	2.19	0.59	0.92
Sept.	74.9	75.0	72.9	74.1	78.1	3.65	3.26	1.42	3.72	1.09
Oct.	59.0	63.8	65.0	67.3	71.5	3.39	7.95	1.83	3.13	0.60
Nov.	45.9	52.7	46.7	52.2	53.9	0.06	0.07	3.50	1.17	1.87
Dec.	44.9	38.5	39.2	43.9	36.0	4.08	2.03	0.65	0.63	0.24

with four replications. Each plot consisted of six, 40-inch cotton rows 132 feet long. All rows were planted in an east-west direction.

The following treatments were selected for the experiment:

1. Rye for winter cover, no fertilizer
2. Rye for winter cover, 40-80-40 on rye
3. Rye for winter cover, 20-40-20 on rye, 20-40-20 on cotton
4. Rye for winter cover, 40-80-40 on cotton
5. No cover, no fertilizer
6. No cover, 40-80-40 on cotton
7. No cover, 40-80-40 on rye
8. No cover, 20-40-20 on rye, 20-40-20 on cotton

Rye was drilled between the cotton rows usually about September 1. After representative rye forage yield samples were taken in the spring, all plots were plowed. Spring applications of fertilizer were broadcast prior to plowing and fall applications were broadcast before rye was planted.

Lankart 57 cotton was planted with a lister on the plowed land. At harvest, fifty feet of the two center rows on each plot were picked by hand. Weights of snapped cotton were recorded and a composite sample was taken from all replications for each treatment to obtain ginning percentages. Statistical analyses were made on the data each year and the pertinent information are included in this report.

EXPERIMENTAL RESULTS AND DISCUSSION

Average lint yields of the various treatments are shown in Table 3. Average yields of rye forage are shown in Table 4.

With the exception of 1963, the rye cover crop increased yields of cotton significantly. In 1963, the average lint yields for cover and no cover plots were essentially the same. Average cotton yields were increased about 60 pounds per acre with the rye winter cover over the five-year period.

Table 3.—Cotton production on sandy land as affected by rye winter cover crop and time of fertilizer application. Oklahoma Sandy Land Research Station, Mangum, 1959-1963.

		Cotton Yields — Pounds Per Acre					
Cover	Fertilizer	1959	1960	1961	1962	1963	Avg.
No	0	105	118	260	196	142	164
Yes	0	209	196	353	340	129	245
No	Spring	183	183	324	431	230	270
Yes	Spring	261	235	417	444	252	322
No	Split	222	222	301	431	217	279
Yes	Split	275	288	355	536	236	338
No	Fall	235	209	317	418	178	271
Yes	Fall	261	288	421	457	179	321
Average Yields							
No Cover		186	183	300	369	192	246
Cover		252	252	386	444	199	307
Yearly		219	217	344	407	195	

Fertilizer applications were as follows:
Spring applications; 40-80-40 pounds per acre applied before plowing.
Fall applications; 40-80-40 pounds per acre applied before seeding rye.
Split applications; 20-40-20 pounds per acre applied before seeding rye in the fall and 20-40-20 pounds applied before planting cotton in the spring.

Table 4.—Yield of rye winter cover crop as affected by time of fertilizer application. Oklahoma Sandy Land Research Station, Mangum, 1959-1962*.

	Rye Forage Yields (Oven Dry) Pounds Per Acre				
Applcation of Fertilizer	1959	1960	1961	1962	Average
0	1971	664	78	87	700
Spring	2009	893	120	104	782
Split	2271	1139	128	105	961
Fall	2054	1950	154	105	1066

*Forage yields obtained by clipping in April were low because the rye was pastured. Yields in 1963 were too low to measure.

The 40-80-40 fertilizer increased cotton yields significantly each year. In 1961, one application, either fall or spring, increased lint yields significantly over yields resulting from the split application. In 1963, the fall application produced significantly less cotton than the spring application.

In general, the spring fertilizer application had very little effect on the amount of rye winter cover. As would be expected, the fall application produced the most rye cover.

Some of the fertilizer which was broadcast and applied in the spring might have been blown from uncovered plots to plots which had the rye cover before the land was plowed. If this were true, the resulting benefits from the cover crop would be due primarily to differences in fertility.

Table 5 shows, however, the only appreciable difference in any of the soil constituents measured was slightly more exchangeable potassium in plots which had a winter cover crop. This difference was not great and could just as easily have occurred by the cover crop preventing

Table 5.—Effect of Soil Treatment on Nitrogen, Phosphorus, and Potassium Percentage in the Surface Foot of Soil after Five Years.

Cover	Method of Fertilization	% O.M.	% N	Pounds Per Acre Total P	Extractable P	Exchangeable K
			0-6" depth			
Yes	0	.38	.025	256	14	176
No	0	.36	.020	256	15	156
Yes	Spring	.42	.022	369	77	182
No	Spring	.36	.022	360	65	174
Yes	Split	.45	.022	340	43	194
No	Split	.40	.025	328	54	196
Yes	Fall	.43	.030	340	52	218
No	Fall	.37	.028	336	58	190
Average						
Cover		.42	.025	326	46	192
No Cover		.37	.024	320	48	179
			6"-12" depth			
Yes	0	.36	.025	252	14	184
No	0	.35	.020	256	16	162
Yes	Spring	.40	.022	396	74	218
No	Spring	.38	.025	324	43	188
Yes	Split	.44	.025	316	54	214
No	Split	.38	.022	364	64	212
Yes	Fall	.44	.025	380	55	208
No	Fall	.38	.022	364	64	212
Average						
Cover		.41	.024	336	49	206
No Cover		.37	.022	327	47	193

leaching as by its collecting wind-blown fertilizer. Also, differences in total phosphorus between plots having the cover crop and those having no cover were very little. It seems, therefore, that beneficial effects of the rye winter cover crop were not due to the accumulation of wind-blown fertilizer.

Results of this five-year experiment show that rye winter cover crop is desirable when growing cotton on sandy soil of the type represented by the Sandy Land Station. The most desirable feritlizer treatment was a split application of 20-40-20 with the cotton and 20-40-20 with the rye. This split application produced as much cotton as the spring application and almost as much rye cover as the fall application.

SUMMARY

This study has shown the feasibility of using a 1-2-1 fertilizer and a cover crop for growing cotton on sandy land in southwestern Oklahoma. Subsequent fertility studies may show that other fertilizer ratios may be more desirable than the 1-2-1,

Table 6 gives a general summary of the effects of fertilizer and cover crop. These data show that for the five years of the experiment, fertilizer and a rye cover crop were profitable.

Table 6.—Effects of fertilizer and cover crop on cotton and rye yields, five-year averages.

Comparisons	Cover Crop Only	Fertilizer only Application			Fertilizer + Cover Application		
		Spring	Split	Fall	Spring	Split	Fall
		Pounds per Acre					
Increase in lint yields above check	81	106	115	107	158	174	159
Increase in forage yields above check after grazing	--	---	---	---	82	261	366

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APPENDIX

Description of a deep plowed, cultivated, Miles loamy fine sand, clayey substrata, 0-1% slopes.

A_1 0-18″ Light yellowish brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; contains a few small lumps and lenses of light sandy loam in the lower part; single grain; loose; pH 6.5 (Hellige); clear boundary.

B_1 18-22″ Reddish brown (5YR 4/4) light sandy clay loam, dark reddish brown (5YR 3/4) moist; weak coarse prisms crushes easily to weak granules; friable; pH 6.0; clear boundary.

B_{21} 22-38″ Reddish brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky, almost porous massive; friable; pH 6.0; gradual boundary.

B_{22} 38-45″ Dark brown (10YR 3/3 moist) clay loam, common, fine and medium, distinct reddish brown, yellowish red and gray mottles; a few bright, medium-blue crystals in seams; weak subangular blocky; firm; pH 6.3; gradual boundary.

C 45-55″ Colors similar to above but having less reddish and more gray mottles; heavy clay loam; weak medium and coarse subangular blocky; very firm; pH 6.5.