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ON-FARM LIME AND FERTILIZER EXPERIMENTS WITH SOYBEANS AND COTTON IN NORTHERN ALABAMA, 1975-1976[1]

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A COOPERATIVE RESEARCH PROGRAM with farmers was begun in 1975 in the following counties of northern Alabama: Cherokee, Colbert, DeKalb, Franklin, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan. This program has a two-fold purpose: (1) to provide up-to-date fertilizer and lime requirements for major crops of the area, particularly cotton and soybeans, and (2) to improve Auburn University's soil testing program and service to farmers in the area. This program is needed because Auburn University's Agricultural Experiment Stations at Belle Mina and Crossville do not adequately represent the variety of soil types and growing conditions that exist in this major agricultural area of the State.

Experiments were located primarily on the fine-textured soils of the Tennessee River Valley, the silty soils of the Highland Rim area north of the Tennessee River, the loamy soils on stream terraces, and the sandy soils of the Appalachian Plateau south of the River. Small areas were selected in farmer's fields that were representative of soil types for the region. Each of these chosen areas was then divided into 8, 12, 16, 20, or 24 plots, depending upon the number of liming treatments or fertilizer treatments planned for the individual experiment. Each lime or fertilizer rate was repeated four times at each location. Each cotton plot consisted of six 35-foot rows; each soybean plot consisted of eight 100-foot rows. Cotton was harvested by hand; soybeans were machine combined.

The experimental areas received no special attention other than the planned lime or fertilizer treatments. Each farmer followed his normal practices of land preparation, planting, cultivation, and control of weeds, diseases, and insects.

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LIME EXPERIMENTS WITH SOYBEANS

A total of 17 lime experiments with soybeans was harvested on farmers' fields in 1975 and 1976, Table 1. Varieties planted were Bragg, Dare, Essex, Forrest, and Lee. Six of the experiments were on Highland Rim soils (Mountview and Dickson series), three were on Tennessee Valley soils (Decatur and Dewey series), two were on stream terrace soils (Holston and Sequatchie series), and six were on Appalachian Plateau soils (Wynnville and Hartsells series).

The Mountview and Dickson series are loamy soils that cover extensive areas of the Highland Rim north of the Tennessee River. They are locally called "gray lands". The Decatur and Dewey series are important agricultural soils of the Tennessee Valley and are called "red lands" because of their dark reddish color. The Holston and Sequatchie series are brown loamy soils that occupy terrace positions along streams of the limestone valleys. The Wynnville and Hartsells series are common on Sand Mountain and other areas of the Appalachian Plateau; they are highly productive when properly fertilized, limed, and managed.

Soil pH of the test areas before liming ranged from 4.5 to 5.7. Soil pH after liming was 6.0 or above. Because drought limited yields in some fields, yields on limed plots ranged between 22 and 45 bushels per acre. Yield increases from liming ranged from none to 20 bushels per acre. In general, liming was less effective where yields were limited by drought; some of these showed no yield increase from lime even where soil pH was as low as 4.9 or 5.0. However, where yields were not severely limited by drought (35-45 bushels per acre), liming increased yields considerably at a soil pH of 5.2 or less.

FERTILIZER EXPERIMENTS WITH SOYBEANS

Eleven experiments were harvested in which phosphorus and potassium fertilizers were applied broadcast prior to planting soybeans, Table 2. Varieties were Bragg, Essex, Forrest, Lee, Mack, and York. Four ex-

periments were on Highland Rim soils (Dickson and Mountview series), three were on Tennessee Valley soils (Allen and Bewleyville series), and two each on stream terrace soils (Capshaw and Sequatchie series) and Appalachian Plateau soils (Wynnville and Townley series).

None of the soils was "low" in potassium, but several were "very low" or "low" in phosphorus. In spite of the low soil-test phosphorus level of several soils, only one showed a marked increase in yield from fertilizer. On a Bewleyville silt loam in Limestone County (E. Black's farm), the soil fertility index for P was only 30 percent, and fertilizer increased yield by 10 bushels per acre. The other experiments failed to show a statistically significant yield increase from fertilizer.

LIME EXPERIMENTS WITH COTTON

Unfavorable weather, diseases, and insects combined to make 1975 and 1976 very disappointing years for Alabama cotton farmers. The on-farm experiments suffered the same fate, and many had to be abandoned because of poor stands, excess weeds, or early freeze.

Yields of the different experiments ranged from a low of 800 pounds to a high of 2,000 pounds of seed cotton per acre, Table 3. Soil pH of the unlimed plots ranged between 4.9 and 5.6, but yields were not greatly affected by liming. The greatest yield increase was 290 pounds of seed cotton per acre on a Mountview silt loam (a Highland Rim soil) at pH 4.9.

NITROGEN RATE EXPERIMENTS WITH COTTON

Four experiments were harvested in 1976 in which nitrogen as ammonium nitrate was added at four different rates: 30, 60, 90, and 120 pounds per acre of N, Table 4. The recommended nitrogen fertilizer rate for cotton on these soils is 90 pounds per acre of N.

As noted earlier, yields were relatively low in 1976 in all experiments with cotton in northern Alabama. This may help explain why 30 pounds of N produced just as much cotton as did higher N rates in every instance. Certainly, the use of higher N rates was not profitable on these farm sites in 1976.

Cotton was picked twice on three of the experimental sites in order to obtain a measure of the effect of N rate on earliness. In general, it has been observed over the years that opening of cotton is delayed by increasing N rates. Two of the experiments in 1976 showed this expected result, while the third experiment showed the reverse effect. No explanation is offered for the results on the J.W. Jeffries farm in Colbert County where cotton receiving the lowest N rate (30 pounds per acre) was the latest to open.

The results with cotton in these two "poor cotton" years are not expected to be a good measure of the nitrogen requirement for high cotton yields during "good" years. Past experience suggests that future experiments in "good" years will show a definite yield advantage for more than 30 pounds of nitrogen per acre.

TABLE 1. EFFECT OF LIME ON SOYBEAN YIELDS, 1975-1976

Farmer	County	Soil type	Soil group[1]	Unlimed soil pH	Per-acre yield Unlimed	Per-acre yield Limed
		Highland Rim soils				
J. LeGrand	Lawrence	Mountview silt loam	2	4.9	**27.2**[2]	**35.1**[2]
H. Ruf	Limestone	Mountview cherty silt loam	2	5.1	29.8	33.4
J.E. Blankenship	Madison	Mountview silt loam	2	4.7	**26.2**[2]	**41.0**[2]
F. and E. Austin	Lauderdale	Dickson silt loam	5	4.9	**17.9**[2]	**25.4**[2]
W. Ridgeway	Limestone	Mountview cherty silt loam	2	5.0	21.8	22.6
E. Zirbel	Limestone	Dickson silt loam	2	5.6	26.2	26.5
		Tenn. Valley soils				
O. Sockwell	Colbert	Dewey silt loam	5	4.9	24.2	22.3
Moore and Hollingsworth	Limestone	Decatur silt loam	2	5.1	19.4	22.3
D. White	Limestone	Decatur silt loam	2	4.5	**13.6**[2]	**22.0**[2]
		Stream Terrace soils				
C. Burton	Marshall	Holston loam	2	4.8	27.4	41.6
C. Jacobs	Jackson	Sequatchie sandy loam	2	5.7	41.7	43.0
		Appalachian Plateau soils				
L. Beck	Marshall	Wynnville sandy loam	2	5.0	30.1	33.6
A.G. Miller	Marshall	Wynnville sandy loam	2	5.0	**32.9**[2]	**44.6**[2]
R. Sloman	Marshall	Wynnville sandy loam	2	4.9	**31.5**[2]	**44.4**[2]
P. Bartlett	Marshall	Hartsells sandy loam	2	4.9	28.1	29.7
R. Rhoades	Marshall	Wynnville sandy loam	2	5.2	**22.9**[2]	**43.4**[2]
L.D. Whisenant	Marshall	Wynnville sandy loam	2	4.8	**7.2**[2]	**23.4**[2]

[1]Based on soil texture and cation-exchange capacity, as classified by Auburn's Soil Testing Laboratory.
[2]Yield is statistically greater on limed plots.

TABLE 2. EFFECTS OF PHOSPHORUS AND POTASSIUM FERTILIZER ON SOYBEAN YIELD, 1975-1976.

Farmer	County	Soil type	Soil group	Soil-test values P Lb/A	P Rating	K Lb/A	K Rating	Fert. rate[1] P_2O_5-K_2O	Per-acre yield No fert.	Per-acre yield Fert.
								Lb/A	*Bu.*	*Bu.*
		Highland Rim soils								
W. Darby	Lauderdale	Dickson silt loam	5	8	60L	132	80M	120-120	21.7	24.6
J. Black	Limestone	Mountview silt loam	2	8	40L	98	80M	80-80	25.1	27.9
F. and E. Austin	Lauderdale	Dickson silt loam	2	10	40L	116	80M	130-130	22.4	25.4
E. Zirbel	Limestone	Dickson silt loam	2	46	100M	128	90H	80-80	22.5	24.8
		Tennessee Valley soils								
E. Black	Limestone	Bewleyville silt loam	2	5	30L	134	90H	120-120	**19.4**[2]	**29.7**[2]
L. Hitt	Morgan	Allen sandy loam	2	15	60L	129	90H	100-100	29.2	32.8
J. Clift	Madison	Bewleyville silt loam	2	25	70L	86	70M	150-150	34.9	34.9
		Stream Terrace soils								
J. Rowe	Morgan	Capshaw loam	2	17	60L	76	70M	80-80	41.0	42.6
C. Jacobs	Jackson	Sequatchie sandy loam	2	118	240VH	156	100H	100-100	45.2	43.0
		Appalachian Plateau soils								
L.D. Whisenant	Marshall	Wynnville sandy loam	2	18	60L	98	80M	80-80	20.2	23.4
J.L. Beck	Marshall	Townley loam	2	28	80M	118	80M	80-80	31.2	27.0

[1]All fertilizer broadcast prior to planting.
[2]Yield is statistically greater on fertilized plots.

TABLE 3. EFFECT OF LIME ON YIELD OF SEED COTTON, 1975-1976.

Farmer	County	Soil type	Soil group	Unlimed soil pH	Per-acre yield Unlimed	Per-acre yield Limed
					Lb.	*Lb.*
		Highland Rim soils				
P. and T. Williamson	Limestone	Mountview silt loam	2	4.9	1,380[1]	1,670[1]
		Tenn. Valley soils				
G. Johnson	Lawrence	Dewey silt loam	2	4.9	830	840
J. Newby	Limestone	Decatur silty clay loam	5	5.1	950	1,100
D. Bridgeforth	Limestone	Emory silt loam	5	5.2	2,060	1,970
M. Haney	Limestone	Decatur silt loam	5	5.4	1,560	1,580
P. Byrd	Lawrence	Waynesboro sandy loam	2	5.6	560	630
		Stream Terrace soils				
G. Brown	Cherokee	Holston silt loam	2	5.5	1,390	1,490

[1]Yield is statistically greater on limed plots.

TABLE 4. EFFECT OF NITROGEN (N) RATES ON YIELD OF SEED COTTON, 1976.

Farmer	County	Soil type	Soil group	N rate	Per acre yield[1]	Bolls open at 1st pick
				Lb/A	*Lb.*	*Pct.*
		Tenn. Valley soils				
Mauldin Farms	Lawrence	Emory silt loam	5	30	1,060	33
				60	1,010	29
				90	1,020	27
				120	940	25
J.W. Jeffries	Colbert	Dewey silt loam	2	30	960	49
				60	930	60
				90	750	67
				120	930	69
B. Lovelady	Jackson	Decatur silt loam	5	30	1,050	-
				60	1,010	-
				90	1,160	-
				120	1,160	-
		Stream Terrace soils				
W. Davis	Cherokee	Holston loam	2	30	1,740	52
				60	1,760	44
				90	1,710	37
				120	1,520	37

[7]Nitrogen rates had no effect on yields.