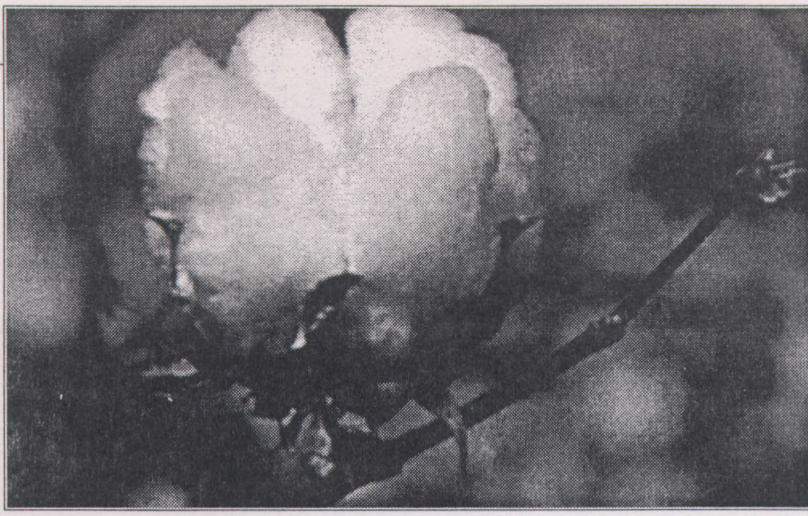

RESEARCH UPDATE 1994

COTTON

Broiler Litter on Cotton

Yield results from three years studies at two locations in Alabama indicate that broiler litter can be used as an alternative source of fertilizer N on cotton.

Dry conditions in 1993 at the E.V. Smith Research Center (EVS), Shorter, resulted in no significant yield differences due to broiler litter or fertilizer N treatment after three years of annual applications. Dramatic yield responses were observed in 1991 and 1992 from broiler litter treatments as high as four tons per acre.

The same yield trends were observed at the Tennessee Valley Substation (TVS), Belle Mina, in 1990-1992. Responses to fertilizer N may be less in dry years than in wet years, and this was the case in 1993. Broiler litter can be applied at or just prior to planting, based on the total N in the broiler litter.

After three years of continuous broiler litter, rank cotton growth might be expected on treatments receiving as much as four tons litter per acre per year [240 pounds total nitrogen (N) per acre per year], but was not observed in these tests.

Pix may be useful in wet years, such as 1992, to control excessive vegetative growth but is not effective in drier years. Unfortunately, no one can predict when July and August will be wet. A commonly used rule of thumb is that a ton of broiler litter contains about 60 pounds of N of which about two-thirds, or 40 pounds N per ton, will be available to this year's crop. Therefore, a cotton crop requiring 120 pounds of fertilizer N per acre on sandy soils, such as those at EVS, would need three tons broiler litter per acre (180 pounds total N). This rate appears to be near the optimum rate at both TVS and EVS over the three-year study.

Additional tests are being conducted on the sites to determine potential soil N lost through leaching from broiler litter applications.

C.C. Mitchell, C.W. Wood, and C.H. Burmester

Seedcotton Yields at Tennessee Valley Substation and E.V. Smith Research Center

			Location and seedcotton yield		
Nitrogen source[1]	Pix[2]	Total N applied	TVS 3-yr avg.	EVS 1993	EVS 3-yr avg.
		lb./ac./yr.			
None[1]	no	0	1,730	1,900	1,600
A.N.	no	60	2,420	2,090	2,170
A.N.	yes	60	2,530	2,150	2,210
A.N.	no	120	2,800	2,160	2,410
A.N.	yes	120	2,880	1,900	2,450
B.L.	no	120	2,660	1,980	2,170
B.L.	yes	120	2,650	1,950	2,170
B.L.	no	180	2,140	2,270	2,330
B.L.	yes	180	2,850	2,150	2,570
B.L.	no	240	2,890	1,880	2,520
B.L.	yes	240	2,130	2,200	2,610

[1] BL = broiler litter, AN = ammonium nitrate.
[2] PIX applied for three years.

Foliar-applied K Not Effective in 1993

Foliar-applied potassium (K) as KNO_3 did not increase cotton yields at five locations in 1993. The same test in 1992 resulted in a positive yield response to foliar K at two of the five locations.

Plots in an experiment labeled the Rates of N, P, and K experiment were split, with half of each plot receiving

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ALABAMA AGRICULTURAL EXPERIMENT STATION AUBURN UNIVERSITY
LOWELL T. FROBISH, DIRECTOR AUBURN UNIVERSITY, ALABAMA

Old Rotation Documents Sustainable Cotton Production

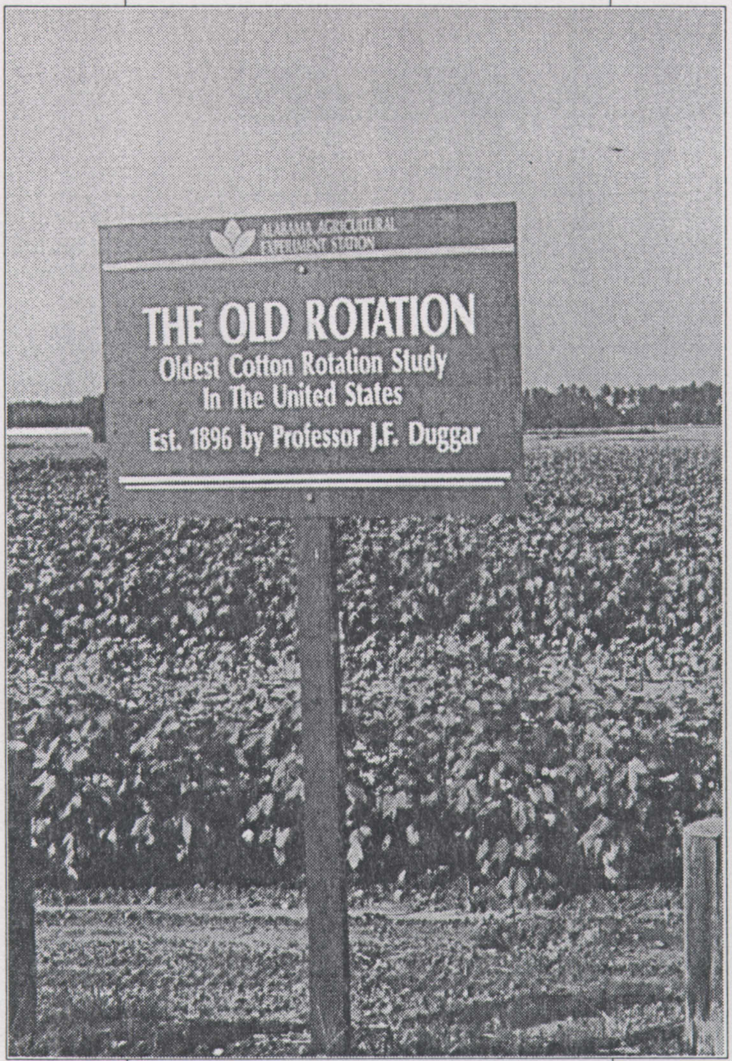
America's oldest, continuous cotton experiment, the Old Rotation at Auburn University, was selected by the Rockefeller Foundation to measure and document the sustainability of cotton production.

Information on the Old Rotation was presented at a symposium held in 1993 at the Rothamsted Experiment Station in England.

The challenge presented by the Rockefeller Foundation was, "How do you measure sustainability?" The agricultural community is concerned about the world's ability to sustain agricultural production for future generations. The challenge of sustainable production is to maintain or enhance agricultural production, reduce the level of production risk, protect the natural resource base (i.e. soil) and the environment, be economically viable for the farmer, and be socially acceptable.

No one has developed a simple way to quantify all these attributes of a cropping system. However, the AAES, with the support of the Rockefeller Foundation and the long-term records of Alabama's Old Rotation experiment at Auburn has measured sustainability of continuous cotton production using the concept of total factor productivity (TFP).

TFP generates an index that allows comparisons from one year to the next even when input and output prices are changing. The index is calculated from all the inputs of a cropping system and the costs of those inputs and all the outputs and the value of those outputs [TFP= (output index)/(input index)].



If the index is greater than 1.0, the amount of output produced per unit of input is increasing over time and the system can be considered sustainable. With input and output data for the Old Rotation back to 1896, trends in TFP over almost a century of continuous cotton production and an era of tremendous change in technology and markets can be observed.

The Old Rotation experiment, which was started in 1896, includes different rotations of cotton with corn, soybeans, small grains and winter legumes (crimson clover and vetch). Three of the continuous cotton systems were analyzed in this study: (1) no legumes and no fertilizer nitrogen (N), (2) winter legume N, and (3) fertilizer N only (120 pounds N per acre per year as ammonium nitrate).

The output index is simple to calculate. It's the yield of cotton lint and seed and the price received for each product. Input measurements are more complicated. They include seed and fertilizer, pesticides, harvest and ginning costs, machinery costs, fuel and labor (see table).

Externalities also were factored into the TFP measure of sustainability. These are inputs with indirect costs, such as soil erosion associated with each cropping system and the potential off-site costs of using pesticides (damage to environment, human health, etc.). Externalities are difficult to quantify. Values based on previous research were used as references in the calculations.

Using 1990 as a reference point to compare trends in TFP, the figure illustrates no constant trend in TFP or sustainability. The treatment using fertilizer N did not begin until 1956. There have been periods (1900-1925 and 1965-1980) when productivity was declining in all systems.

From the late 1940's until the 1970's, productivity increased. A

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dramatic increase occurred around 1960. A single, technological advancement at this time overwhelmed all other input factors. This was the adoption of the mechanical cotton picker that forever reduced the labor costs associated with cotton harvest. The large increase in TFP associated with this one advancement points out the tremendous influence technology can have on agricultural sustainability.

All three Old Rotation treatments fulfill at least one criteria required for a system to be sustainable (i.e. output per unit input is higher in 1991 than in 1896, even when externalities are valued). The external effects of soil erosion and pesticide use have only a modest effect on measured productivity. However, the "low input" system with neither chemical nor organic N is less productive than the other two systems. The organic and chemical sources of N have similar productivity impacts.

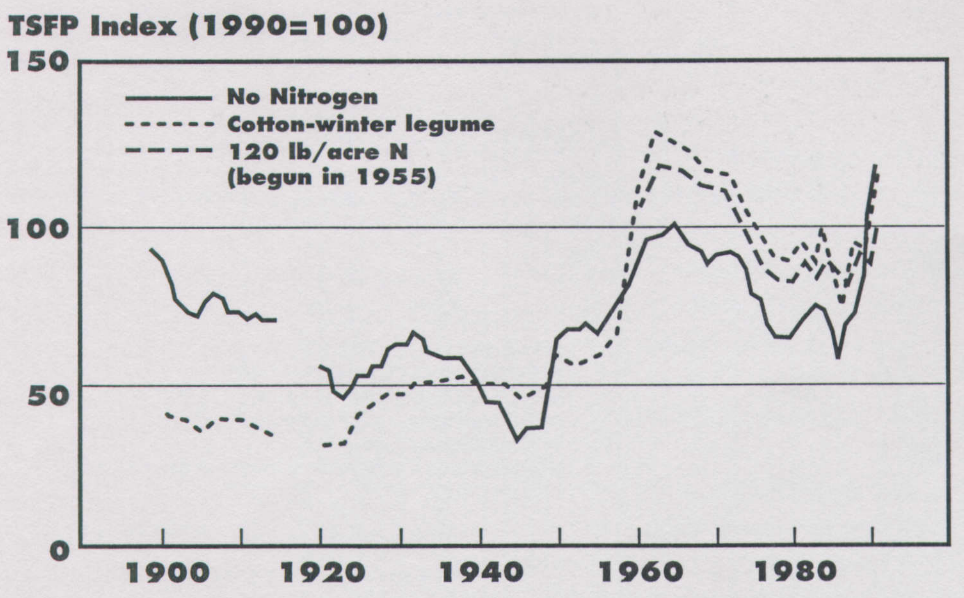
So, what does all this mean to Alabama cotton farmers who are interested in sustainable cotton production? These data prove that continuous cotton production can be sustainable. However, the effect of weather, management, pests, technological advancements, and other factors can create productivity cycles that may last for several decades.

Because major technological breakthroughs cannot be predicted, future sustainability cannot be predicted. Producers can only use those practices that appear to provide the highest total factor productivity in today's systems.

C.C. Mitchell, G.J. Traxler, and J.L. Novak

Output and Input Shares on the Old Rotation, 1896 and 1991

Output	1896	1991
	Pct.	*Pct.*
Seed	7	11
Lint	93	89
Input	**1896**	**1991**
	Pct.	*Pct.*
Seed	8	6
Fertilizer	11	4
Herbicide	0	5
Insecticide	2	9
Drying/ginning	28	39
Defoliant	0	1
Labor	34	7
Machinery	17	29



Total factor productivity index (five-year averages with externalitites of erosion costs and off-site pesticide costs.

Textile Sludge Boosts Yields

In an effort to recycle and keep potentially valuable materials out of landfills, more and more materials are being evaluated for their potential as soils amendments. One of these materials is dewatered sludge from a lagoon at Alabama's West Point Pepperell mill in Opelika. This sludge has resulted in impressive cotton yield increases at the E.V. Smith Research Center(EVS), Shorter, in 1993.

An earlier analysis of the sludge indicated that it contained approximately five pounds nitrogen (N) per wet ton. Other primary and secondary nutrients were low and the sludge met EPA's criteria for "exceptional quality sludge," meaning it could be applied with no restrictions. Therefore, 20 tons would supply a total of 100 pounds of N per acre. However, samples of the sludge taken the day it was applied indicated that it contained 18 pounds of N per ton. This resulted in more than three times as much N applied to the sludge treatments as planned.

Sludge was applied and incorporated at 20 tons, 40 tons, and 80 tons per acre in replicated plots at EVS just prior to planting cotton in late April. A control treatment receiving no N and a treatment receiving 100 pounds of N as ammonium nitrate also were included. The sludge rates were suppose to represent 100, 200, and 400 pounds total N per acre. If only 30% of the total N is available, then an optimum rate should be between the 40- and 80-ton rate. Of course, the actual amount of total N applied was 360, 720, and 1,440 pounds N per acre, rates high enough to create excessive vegetative growth if rainfall is high. In a relatively dry season, such as 1993, the treatment effects were dramatic and quite visible throughout the season. Sludge-treated plots produced from 50% to 73% more cotton than the conventionally fertilized treatment. There were no significant differences in yield between the 20-

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Systemic Insecticides Have Large Impact on Cotton Growth and Yield

Use of systemic insecticides, applied in-furrow at planting, is a recommended practice for Alabama cotton farmers. These insecticides are used to help control early season thrips and aphids on seedling cotton.

A part of a recent research project, conducted at the Tennessee Valley Substation, Belle Mina, in 1992 and 1993, examined how effective and important these in-furrow treatments are to Alabama farmers. Cotton stand counts were made weekly after cotton emerged. Thrips and aphid populations were estimated by rinsing five whole plants in alcohol, and then filtering. Insects were counted under a microscope. Cotton was harvested twice for yield in both years of 1992 and 1993. Earliness was measured by cotton harvested in the first picking.

Both insecticides tested (Temik 15G at four pounds per acre and Di-syston 15G at five pounds per acre) were effective in controlling thrips and aphids in this test. Aphid counts totaled only 0.5 per five plants in treated cotton versus more than 9.5 in the nontreated cotton. Although thrips populations in 1992 and 1993 were average to below average, cotton stands were still affected by thrips. When no systemic insecticide was applied, cotton stands were reduced by three to more than 5,000 plants per acre compared to treated plots. Cotton maturity also was delayed by the early season thrips damage as measured by a 5% to 7% reduction in first picking. Finally, average yields in the nontreated cotton were only 83% and 87% compared to cotton treated with Temik and Di-syston, respectively.

These results reaffirm the importance of early season thrips control for cotton in Alabama. The use of in-furrow systemic insecticides applied at planting in this test greatly improved yields and promoted cotton earliness.

C.H. Burmester and B.L. Freeman

Effects of Systemic Insecticides on Cotton Growth and Yields, Tennessee Valley Substation, 1992-1993

	Seedcotton lb./ac.	First picking	Total thrips	Total aphids	Plants/ ac.
		Pct.			
Check	2,990	74.9	13.9	9.7	28,600
Temik	3,600	82.7	3.6	.5	31,900
Di-Syston	3,440	81.1	4.8	.5	34,100

Foliar-applied K, continued

four applications of KNO_3 at 10 pounds KNO_3 per application beginning one week after first bloom. The other half of each plot received an equivalent amount of nitrogen (N) as urea (1.3 pounds N per acre per application). The Rates of N, P, and K experiment has treatments that have received incremental rates of N, P (phosphorous), and K (potassium) since 1954. Plots exist at each location that are low to high in soil P and K. Cotton at most locations showed visible symptoms of K deficiencies in the low K treatments.

In 1993, yields at the Brewton and Monroeville Experiment Fields and at the Wiregrass Substation (Headland) increased as soil K increased. At the Prattville Experiment Field and Tennessee Valley Substation, Belle Mina, there was no relationship between soil K and yield. However, regardless of soil K or degree of K deficiency observed in 1993, foliar-applied K did not increase cotton yields as it did in 1992.

Because of the hot, relatively dry summer of 1993, the statewide cotton crop matured earlier and was lower yielding than the 1992 crop. he effect of weather on cotton yields seems to overwhelm any modest effect that foliar-applied nutrients may have on the crop.

The Effect of Foliar-applied Urea and KNO_3 on Average Cotton Yields Across All Soil K Treatments at Five Locations, 1992 and 1993

	Location[1]				
Treatment	BEF	MEF	PEF	TVS	WGS
1992					
Urea	1,940	2,200	3,600	3,550	2,010
KNO_3	1,900	2.480[2]	3,880[2]	3,460	2,170
1993					
Urea	2,050	3,070	1,660	2,390	1,450
KNO_3	2,060	3,080	1,720	2,380	1,420

[1] BEF=Brewton Experiment Field
MEF=Monroeville Experiment Field
PEF=Prattville Experiment Field
TVS=Tennessee Valley Substation
WGS=Wiregrass Substation
[2] Average yields significantly different at 5% probability.

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Preemergence Annual Grass Control in Conservation Tillage Cotton

The increase in conservation tillage cotton acreage in Alabama and the Southeast has shown the need for soil-applied herbicides that will consistently provide annual grass control without incorporation.

Field studies were initiated in 1992 and continued in 1993 at the Tennessee Valley Substation in Belle Mina, Prattville Experiment Field, and Wiregrass Substation in Headland. The study evaluated several preemergence treatments for crop injury and control of annual grasses, primarily large crabgrass, in conservation tillage cotton.

All trials were planted into desiccated wheat stubble. The Belle Mina and Prattville trials were planted no-till using modified John Deere Maxemerge™ planters. Trials at Headland were planted using a RoTill/International Planter system. Roundup at one quart per acre was used at all locations to kill wheat covers. Each preemergence treatment was evaluated alone or tank-mixed with fluometuron (Cotoran/Meturon) at two pounds active ingredient per acre. Post-directed treatments of MSMA were used at Prattville and Headland after early season weed control ratings to provide supplemental broadleaf weed control. Crop stand counts, visual injury ratings, and seed cotton yield were obtained at each location. The table presents average data from all three locations.

Stand Counts, Visual Crop Injury Ratings, Large Crabgrass Control, and Seedcotton Yields Provided by Surface-Applied Herbicides

Treatment	Stand ct.	Crop Injury	Grass control +Cot	Grass control -Cot	Cotton yield +Cot	Cotton yield -Cot
Lb. a.i./ac.	*No./30 ft.*	*Pct.*	*Pct.*	*Pct.*	*Lb.*	*Lb.*
None	105	3	63	4	2,297	1,370
Command, 1.0	103	10	88	84	2,472	2,197
Zorial, 1.0	103	7	~90	78	2,424	2,041
Prowl, 1.0	102	6	90	84	2,388	2,356
MON 13200, 0.2	98	6	89	83	2,204	1,960
MON 13200, 0.38	96	9	91	89	2,203	2,249
Dual, 1.0	92	16	81	63	2,398	1,976
Dual, 1.5	81	20	81	69	2,309	1,858

Fluometuron alone (none plus Cotoran) provided 63% late season crabgrass control and yields equal to all soil-applied treatments used with fluometuron. The no-herbicide check (none minus Cotoran) resulted in reduced yield as expected due to severe grass competition. Command, Prowl, and the high rate of Mon 13200, an experimental herbicide from Monsanto, provided the best late season crabgrass control when used without fluometuron. Stand counts were lower and crop injury ratings were higher for Dual at the 1.5-pounds-per-acre rate compared to other treatments. Yield from Dual treatments with fluometuron was equal to all other treatments used with fluometuron, indicating the early season injury ratings and reduced stand counts did not translate to yield reductions. Although not shown, Command, Prowl, and Mon 13200 also provided significant control of Texas panicum at the Headland location.

M.G. Patterson, B.E. Norris, D.P. Moore, and L.W. Wells

Foliar-applied K, continued

Researchers, extension specialists, and cotton growers throughout the cotton belt are struggling to explain why they sometimes see a yield response to foliar-applied K but, as of now, are unable to predict this response.

C.C. Mitchell, G.L. Mullins, and C.H. Burmester

Textile Sludge, continued

ton and 80-ton rate, although the higher rate produced more vegetative growth. Obviously, the excess N applied did not produce the negative effects that were expected. Instead, the improved physical condition of the soil from the organic material and the increased water holding capacity during a dry year may have contributed to the dramatic yield increase from the sludge.

Soil profile analysis will help determine if nutrients are leaching below the rooting zone from the excessive sludge application rates. In the meantime, it appears that what was a waste product could have positive agronomic benefits for some cotton producers.

C.C. Mitchell and J.W. Odom

EDITOR'S NOTE

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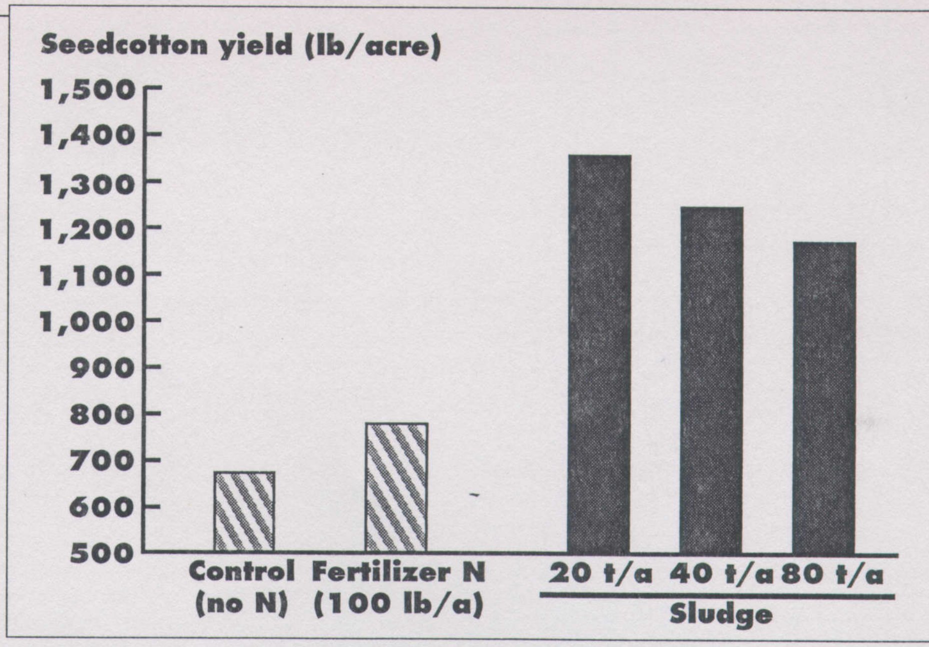

Seedcotton yields from the application of 100 pounds N per acre as fertilizer and 20, 40, and 80 tons per acre of wastewater sludge.

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