EROSION AND SOIL PRODUCTIVITY IN THE BLACKBELT

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The Blackbelt, a natural prairie, occupies approximately 4.5 million acres in Mississippi and Alabama. Blackbelt soils have T values ranging from one to five tons per acre per year, with depth to Selma chalk (the parent material) being a primary consideration in determining tolerable soil loss. These soils are adapted to grasses and clovers and have been used to support livestock and produce Johnsongrass hay in the past. Cotton was the major row crop until the mid-1950's. Cotton yields had already declined significantly by the mid-1930's in the Blackbelt even with the use of mechanized tillage equipment (Jones et al., 1941). There is little doubt that excessive fall and winter tillage used in cotton production on these soils severely damaged major portions of the Blackbelt. Sheet and rill erosion went unrecognized for years. Many of the same areas are now in soybean production and are being degraded even further.

Increasingly, soil scientists and researchers are being asked to provide information on land productivity. Many soil conditions have been correlated to yield (Sakar et al., 1966). Some of these characteristics are moisture-holding capacity, organic matter, pH and cation exchange capacity. Munn et al. (1978) found that thickness of the A1 horizon (mollic epipedon) was the soil characteristic that correlated most closely with rangeland productivity of 23 soils in western Montana. Sopher and McCracken (1973) found that corn yields of both Udultic and Aquultic soils in North Carolina were highly correlated with moisture holding capacities, certain combinations of clay and sand, extractible phosphorus, percent base saturation, and other properties related to soil acidity and amount of charge on the cation exchange complex. Most of these type studies did not consider how soil characteristics may have been influenced by previous erosion.

Our primary objective was to determine how depth to chalk, a parameter directly related to accelerated surface erosion in the Blackbelt, relates to yield. A secondary objective was to determine long term productivity under various tillage systems and measured or calculated erosion rates.

Materials and Methods

The study was initiated in 1982, using three farmers' fields in the Blackbelt near Brooksville, MS. The study makes use of sequential testing which is essentially a reversal of the idea of locating experiments or data collection points on uniform soils. Sequential testing consists of deliberately locating experiments and data collection points on contrasting soils across the landscape to evaluate selectively the effects of soil differences.

Mini-plots (19.2 ft.^{2}) were used for data collecting points in this particular study but did not follow a true grid due to the wide variability in chalk depth. Twenty to 28 plots were selected in each field where chalk depth ranged from 4 to 60 inches. The test crop was soybeans and data were collected on mature height and grain yield. Soil samples were collected from the 0 to 6 and 6 to 12-inch depths (where appropriate), and analyzed for pH, organic matter and available nutrients. Depth to firm chalk was determined by use of an auger or probe.

Two of the three fields used in 1982 were studied again in 1983. Four additional fields were selected for study in 1984. Fields have slopes that range from 2 to 8% and the type of catena that could have resulted from surface erosion. Upland soils were generally of the Okolona series and graded downslope through Binnsville to chalk outcrops on the side slopes and into Griffith or Leeper series on the footslopes and bottoms.

Rainfall data was computed from recording rain gauges. Regression analyses were used to make statistical comparisons.

Results and Discussion

Soybean yield was more highly correlated with depth to chalk than any other soil parameter measured in 1983 (see table below).

Variable correlated with Soybean Yield	(r) Field 1	Field 2
Depth to chalk (inches)	.825	.922
pH	-.254	-.501
P (available-lb/a)	.541	.563
K (available-lb/a)	.638	.762
Organic matter (%)	.546	.790
Mature plant height (inches)	.933	,802
Significant coefficient at .05 level	i.388	i.451
Significant coefficient at .01 level	i.496	±.575

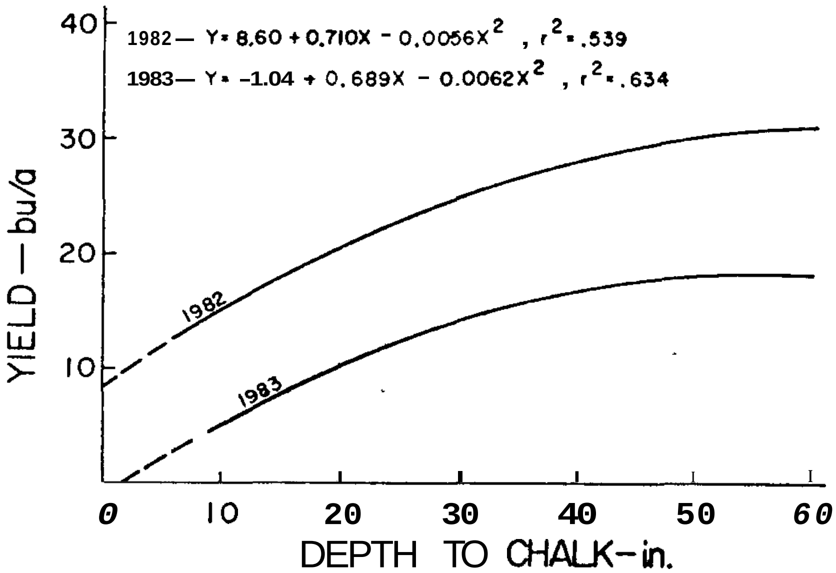
However, soybean yield was significantly correlated with all the other soil parameters with the exception of pH in Field 1. The negative correlation with pH is reflected in the fact that pH becomes more alkaline (approaching 8.3) with decreasing depth to the calcareous chalk. Apparently, higher pH has a depressing affect on yield. As expected; soybean yield was highly correlated with mature plant height.

Multiple linear regression analysis was used to see how much the relationship between soybean yield and depth to chalk could be improved by including the other soil parameters (see table below).

Soybean yield regressed with:	r^2 or R^2	
	Field 1	Field 2
Depth to chalk	.680	.849
Depth to chalk + pH	.730	.854
Depth to chalk + available P	.739	.880
Depth to chalk + available K	.811	.904
Depth to chalk + organic matter	.726	.850

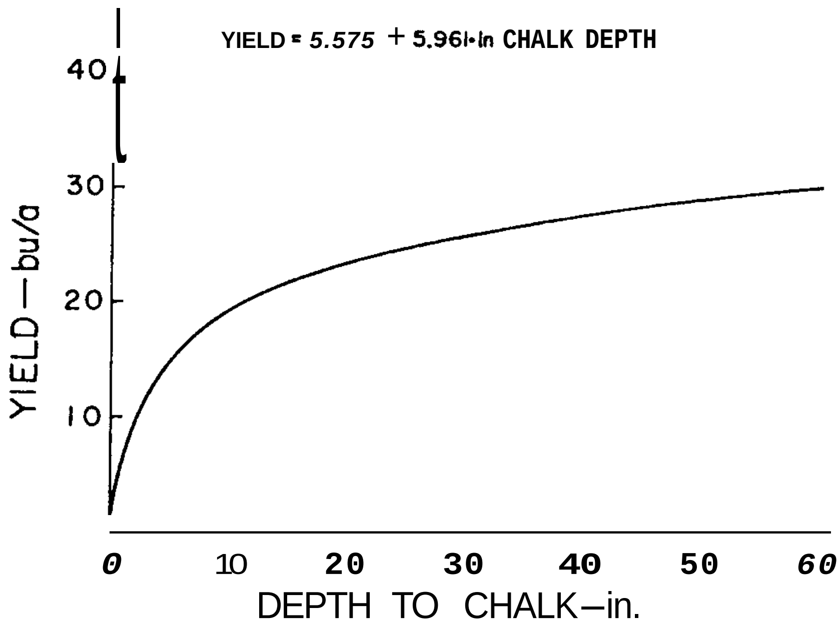
Depth to chalk alone accounted for 68 and 85% of the yield variability in Fields 1 and 2, respectively. Although organic matter decreased as depth to chalk decreased and was significantly correlated with depth at the .05 level, it improved yield predictability very little in Field 1 and none at all in Field 2. The most significant improvement was seen with available soil K where predictability was improved 13 and 5.5% respectively for Fields 1 and 2.

All 1982 and 1983 data were combined for a general graphical interpretation of ttie relationship between soybean yield and depth to chalk (see illustration below).



The best relationship was non-linear and represents three fields and two soybean varieties in 1982 and two fields and two varieties in 1983. Depth to chalk alone accounted for 54 and 63% of the yield variability in 1982 and 1983, respectively, when combining the data in this fashion. The trend was very similar both years. The lower yields in 1983 were due to later planting and below normal rainfall during July and August.

Blackbelt soils generally have low infiltration rates that range from <.06 to .22 inches per hour and water supplying capacities that range from 0.12 to .22 inches per inch of soil. Therefore, without supplemental water, soil depth can become critical as far as moisture supply is concerned. Since 1982 was a more normal rainfall year, data from Field 1 in 1982 was used to determine the best logarithmic relationship between yield (Centennial variety) and depth to chalk (see figure below).



Soybean yields increased an average of 1 bu/a per inch of depth increase between 5 and 10 inches above chalk. Between 10 and 20 inches depth, yield increased about 5 bu/a and with greater than 20 inches yield increased approximately .2 bu/a for each inch of soil to a 60-inch depth.

Literature Cited

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