SOIL AMENDMENTS TO INCREASE COTTON PRODUCTIVITY ON DROUGHT-STRESSSED SOILS

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INTERPRETIVE SUMMARY

Each year in the U.S.A., a total of 400 million tons of organic wastes are generated. Additionally, paper mills produce large quantities of boiler ash. Historically, these waste products have been stored in lagoons and landfills or incinerated. These methods of disposal are no longer acceptable because they may cause environmental degradation. Beneficial use as soil amendments would be an attractive alternative disposal method for many by-product waste materials. This would recycle plant nutrients that would otherwise be lost and possibly enhance the productivity of land used for cotton production, especially drought-stressed soils. We conducted field experiments from 1996 through 1999 on Gigger-Gilbert silt loam to determine if cotton yields could be increased by soil applications of organic and inorganic waste materials. The waste materials were applied using two methods of application, broadcast incorporated and as vertical mulch directly under the row. The waste materials were municipal biosolids (MB), composted sewage sludge (CSS), papermill sludge (PS), and papermill boiler ash. Applications were made with each material and with selected combinations of the materials.

The method of application had little or no consistent effect on response to the waste materials. Because the broadcast method is less expensive, this would be the preferred method of application. The application of waste materials had positive effects on cotton growth and yield and soil properties. Lint yield and plant height increased with application of MB, CSS, and boiler ash in the year of application and in the following 3 years. Yield increases ranged from 55% for MB applications and 40% for CSS applications. Much of the benefits from the amendments were from the nutrients they contain, especially N. Additionally, some of the amendments increased soil pH and the soil levels of P, K and Ca. In contrast to MB and CSS, application of PS decreased yield 70% and plant height 12 to 26% in the year of application and had no consistent residual effect on yield in the following 3 years. The problem with PS was its high C:N, which caused extensive N immobilization of soil and fertilizer N. Boiler ash proved to be, as expected, an effective liming material and raised the soil pH. This was particularly beneficial in the vertical mulch treatment because of the low pH of the Gigger-Gilbert subsoil that normally contains toxic levels of Al and Mn.

In addition to the nutritional benefits, the amendments had other beneficial effects. We know this is the case because the waste treatments increased yield above that obtained with standard fertilizer and liming practices. The organic components probably provided increased water holding capacity and water infiltration. The vertical mulch treatments eliminated the shallow hardpan directly under the row, which allowed additional water storage and root development. Examination of root development patterns revealed that roots were

limited to the mulched area and did not grow into the undisturbed subsoil. The interface between the mulch and subsoil proved to be the area of greatest root development.

We concluded that waste materials with a low C:N and boiler ash were effective soil amendments that quickly improved soil productivity and cotton yield and that PS, with its high C:N, should not be applied soil-incorporated because of the potential for N immobilization.

(See Full Paper on Page 80.)