BIOSOLIDS CUT FERTILIZER COSTS BY $200 AN ACRE

First year data indicate that prudent use of biosolids can cut commercial fertilizer use without risking yield loss.

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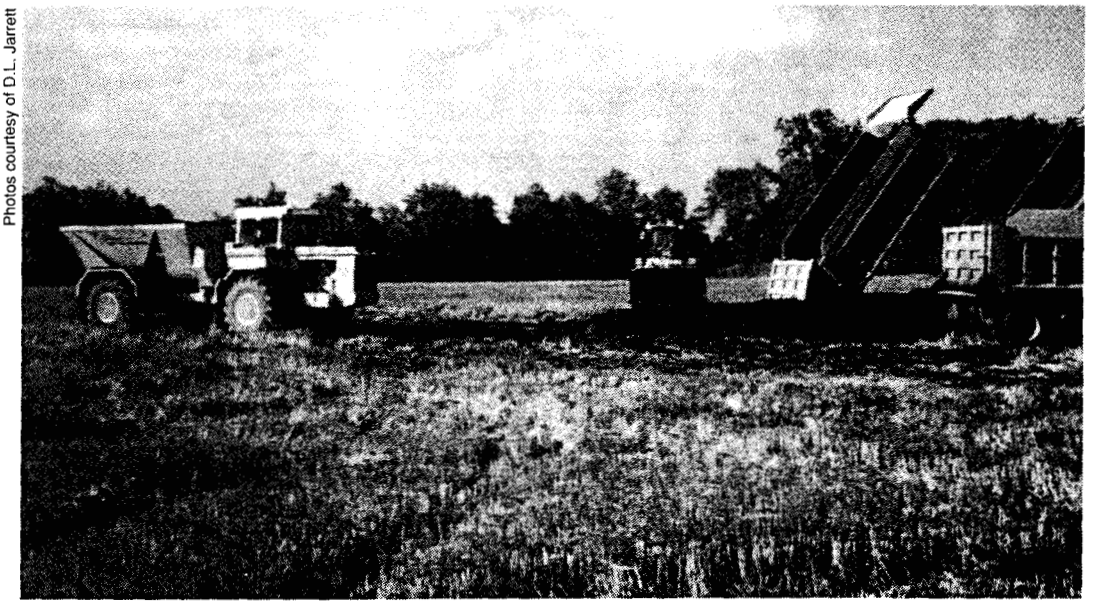
A DECISION to beneficially manage biosolids generated by South Bend, Indiana's wastewater treatment plant was made by city administrators in 1989. Local farm operators were contacted who showed an interest in using the biosolids (at no cost) as an organic amendment in crop production and adequate crop acreage was committed to provide the necessary land to meet South Bend's annual biosolids production needs. An Indiana Department of Environmental Management permit was obtained in June, 1991 which provided three application rate levels of nitrogen based on the crops to be produced (e.g. 50, 100 or 150 pounds of plant available nitrogen (PAN), and the program has since provided cooperating farm operators with an alternative cost saving method of crop production.

In 1993, the city determined that outside agronomic expertise was needed to fine-tune its land application program. Environmental Agronomics, based in Quantico, Maryland with an office in South Bend, Indiana, was retained to provide a link between James White, Organic Residuals Manager, Ken Zmudzinski, Technical Services Manager, and the cooperating farm operators. As part of the process, additional farm sites were added (due to attrition of several original cooperators) and the permit was amended to allow for PAN rates to be set based on historical crop production and soil capability classes at the application site. This has increased addition on most sites above the original three application rates. Winter application on frozen ground also was added in the permit amendment. Through the fine-tuning, it was discovered that the biosolids were being used by farm operators with no regard to the actual nutrient value. As a result, demonstration test plots, yield data and corresponding economic information have been used to help educate area farm operators about the nutrient value of biosolids.

Specifically, a better understanding of early nitrogen release from land applied biosolids was gained through pre-sidedress nitrate-nitrogen testing (PSNT) — a technique used to determine soil nitrate levels when plant growth has reached 10 to 12 inches in height. This methodology only is used when organic sources of nitrogen have been applied. Inaccurate test data will result following any chemical nitrogen application to a field which has received organic residuals. If the PSNT soil test results are

Photos courtesy of D.L. Jarrett



The Truyaert test plot was 1.8 acres in size and represented the major soil types and conditions of a 130 acre corn field.

The plot required no additional fertilizers during the growing season and actual yields met or exceeded expectations.

greater than 25 ppm of NO_3-N (equivalent to 100 pounds nitrogen per acre), no additional nitrogen fertilizer is necessary to carry the crop through to harvest.

A better understanding of nutrient utilization throughout critical growth periods was obtained using tissue sampling and corresponding soil analyses. Plant nutrient status was monitored at different growth stages using standard tissue test methodologies. Finally, the economic viability of alternative fertilizer sources (e.g., South Bend wastewater biosolids) was determined. Current market values of applied nutrients were assigned to develop a realistic cost savings for participating farm operators.

FIELD TEST PLOTS

A field test plot was established in spring, 1995 on an irrigated site which had received biosolids just prior to planting. Farm operators Jim and Ivey Truyaert incorporated the biosolids by lightly discing prior to planting. The test plot was 1.8 acres in size, representing major soil types and conditions of a 130 acre corn field. To accommodate the Truyaert's planting, spraying, and harvesting equipment, the plot was planted 24 rows wide (30 inch rows) with a length of 1,325 feet.

All 130 acres received 5.8 dry tons of biosolids per acre which provided an adequate level of PAN to produce the target yield goal of 150 to 160 bushels per acre. The entire field — with the exception of the test plot — received an additional 20 pounds of nitrogen starter fertilizer. Potassium was added to the entire field at a rate of 200 pounds per acre. Pioneer seed variety 3525 was planted at a population level to ensure a finished stand of 29,000 plants per acre. Herbicides and insecticide also were applied. Following the biosolids application, extensive soil sampling was performed over the entire production field.

The entire 130 acre field received 5.8 dry tons of biosolids per acre.

By June 12, 1995, corn on the Truyaert Test Plot had reached the 10 inch level of growth and was ready for PSNT sampling. With the exception of one sample, all were well above the 25 ppm level considered to be adequate to provide necessary nitrogen for the target yields. As the crop matured, tissue and soil sampling were used to examine the availability of other nutrients which play a crucial role in crop health and yield.

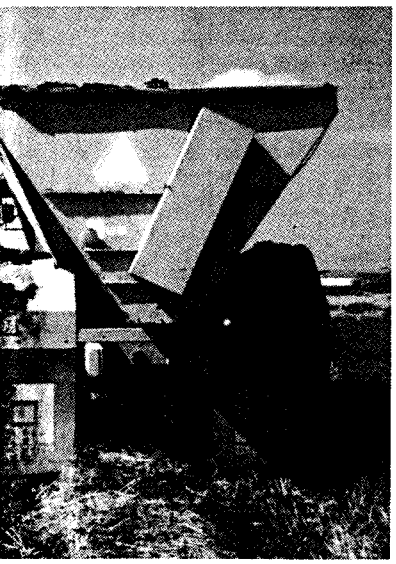
Some interesting changes were noticeable in the nutrient status in a relatively short period of time. Results from whole plant sampling indicated that all analyzed nutrients were present at sufficient levels to produce a full season crop. All other nutrients tested either were within or above expected ratios or levels. Likewise, soil nutrient levels ranged from medium to very high for all nutrients tested. Interestingly, tissue sampling (ear flag leaf) at tasseling indicated a *lower* available level of zinc and manganese. While these micronutrients tested lower in the plant tissue, soil levels were adequate and no yield loss associated with these tissue levels was apparent. High levels of phosphorus in the soil — a combination of ambient soil phosphorus with the applied biosolids phosphorus — may have contributed to the zinc and manganese becoming less available for plant up-

take later in the growing season. These results were detected past the time any nutrient addition through foliar feeding would have been effective. Test plots for 1996 are being monitored closely with additional tissue samples in an attempt to determine if the zinc and manganese again become less available and the growth stage in which it occurs.

The 1995 crop year was not without problems. Grey leaf spot mold was noted throughout the field as well as an extremely high incidence of European corn borer which weakened the stalks and reduced yields. Also, an early ice storm occurred just prior to harvest which flattened the 130 acres of corn. Preharvest yield tests in the test plot as well as in the production field indicated stand yields of 155 to 160 bushels per acre. At harvest, losses from the European corn borer, grey leaf spot mold and ice damage caused a net yield of 110 dry bushels per acre. Real field loss following harvest was determined to be an average loss of 45 to 55 bushels per acre throughout the field.

ECONOMIC ANALYSIS

Any major change in the management of crop production must be in a positive direction and measured. As with any cost analysis, least cost per unit produced is the measurement by which success or failure of a program must be made. In the case of the Truyaert test plot, no additional fertilizers were added during the growing season and actual yields met or exceeded expectations. There will be additional savings of lesser value for years two and three from the continued mineralization of the applied biosolids organic matter fraction. There has been no cost estimate included for the value of organic matter additions which adds soil tilth and water holding capacity.



In conclusion, first year data indicate that prudent use of biosolids as an alternative fertilizer source can replace several major costs of commercial fertilizers without risking yield loss. The reduced cost of plant nutrients can most likely provide the producer with the lowest cost per unit of production. As such, even with a lesser yield — which was not evident in this study — profits will be larger than conventional production due to the noted cost reduction. Use of biosolids produced equal or greater yields without the need for supplemental commercial fertilizer. In a short term companion study on the use of biosolids for seed corn production, the participating farm operator was experiencing yield depression with commercial fertilizer, and yet has indicated a yield increase during each of two years of biosolids use.

The cost savings by using the biosolids on the Truyaert production field are in excess of $200 per acre. This estimate does not reflect any cost attributable to the addition of potassium which is very limited in the biosolids and an essential macronutrient. ■

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