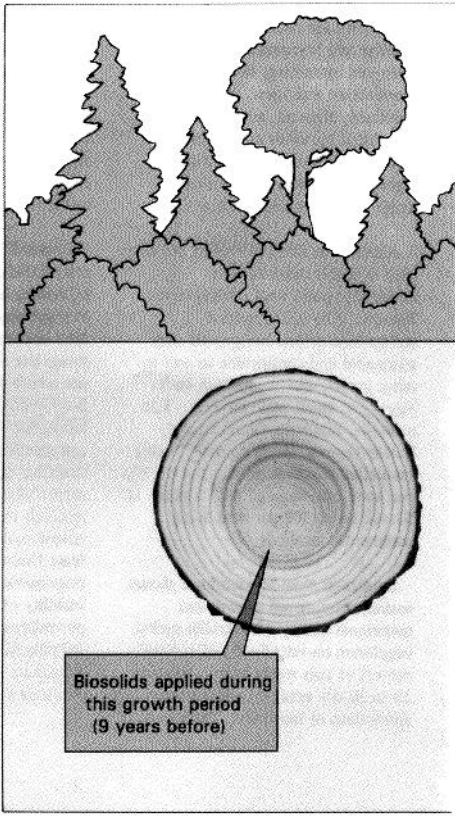
Non Agricultural Use of Biosolids

The beneficial uses of biosolids are not limited to farmland application. Biosolids are used in silviculture to increase forest productivity and to revegetate and stabilize lands that have been harvested or disturbed by mining, construction, fires, land slides, or other natural disasters.

The application of biosolids to forest land can shorten pulp wood and lumber production cycles by accelerating tree growth, especially on marginally productive soils. Studies by the University of Washington in the Northwest, and the U. S. Forest Service in the Southeast, on the use of biosolids as a fertilizer in silviculture have shown as much as a three-fold increase in tree growth compared to controls for certain tree species.



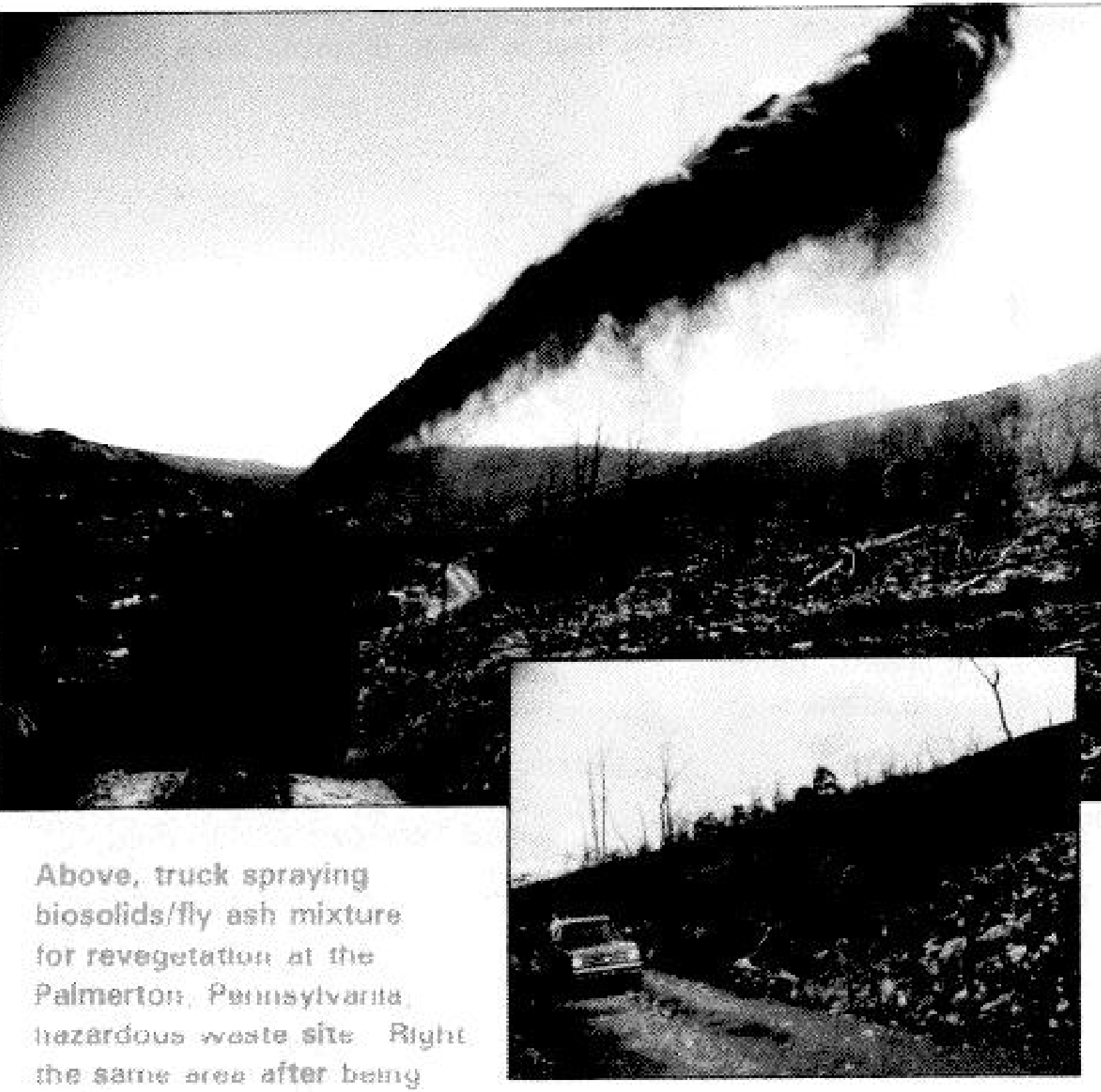
A cross section of a Douglas fir tree demonstrates how biosolids increase tree growth.

Biosolids are used productively to stabilize and revegetate areas destroyed by mining, dredging, and construction activities. Alkaline-stabilized, digested, air-dried, and composted biosolids are frequently used to help revegetate mine spoil, highway embankments and median strips, and other construction sites.

Alkaline-stabilized biosolids are also used as a soil substitute for intermediate and final landfill cover. The use of biosolids in land reclamation efforts has proved very successful and comparable in cost to other commercial methods in both large- and small-scale projects. For example, in a strip-mined area in Fulton County, IL, reclamation using municipal biosolids costs about $3,700 per acre, as compared with a range of $3,400 to $6,300 per acre using commercial methods.

Studies in New Mexico have shown sustained improved growth and nutritional quality of desirable native vegetation on rangeland and reduced run-off of rain water from a one-time, 10 to 20 dry tons per acre surface application of biosolids. Studies in Colorado, with 1 to 15 dry tons per acre of biosolids applied, are being conducted to determine optimum rates to improve range quality and minimize public health and environmental risks. Early results from these studies show similar improvements in range quality and reduced water runoff proportional to the rate of biosolids application.

Biosolids have been used to reclaim over 3,000 acres of lands devastated by mining and smelting activities in Pennsylvania. Biosolids are being used in combination with fly ash to revegetate soils at that Palmerton, PA, site which has been included on EPA's list of Superfund Sites. The Palmerton site was so highly contaminated from 90 years of smelting zinc that all vegetation in the surrounding area was destroyed. The research team members from Allentown, PA, and the Pennsylvania State University, who were responsible for demonstrating the viability of the reclamation procedures, were recognized as winners in EPA's first National Beneficial Use of Biosolids Awards Program (1988).



Above, truck spraying biosolids/fly ash mixture for revegetation at the Palmerton, Pennsylvania hazardous waste site. Right the same area after being reclaimed

Biosolids may be used separately or in conjunction with chemical fertilizers. Figure 3A shows the comparative use of chemical fertilizers with and without 8 dry tons per acre of biosolids applied to sandy irrigated soils near Yuma, AZ. Figure 3A shows the comparative usage during the first year after biosolids application where only about one-fourth as much chemical fertilizer was needed. By the third year of biosolids application, no supplemental chemical fertilizer was required.

Fewer Pounds per Acre of Chemical Fertilizer Nutrients Were Needed When Biosolids Were Used

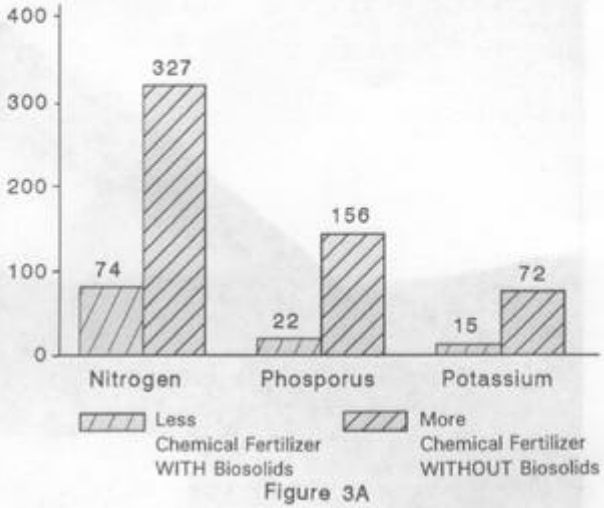
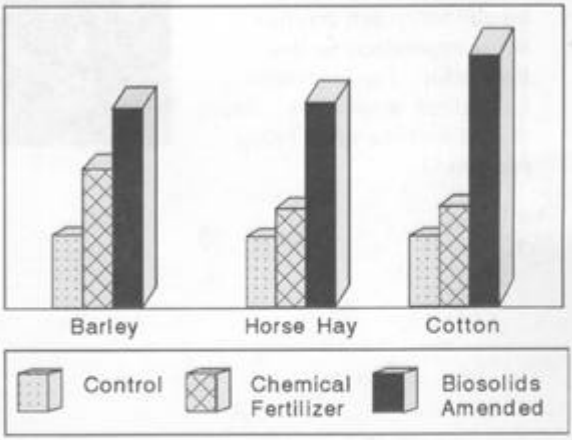


Figure 3A

Figure 3B shows that the yield of three crops was greatly enhanced compared with their yields on both chemically fertilized and unfertilized controls.

Particularly in soils that are low in organic matter, biosolids provide benefits that are not available from chemical fertilization. The biosolids' organic matter content enhances the soil

Comparative Yield of Crops Due to Chemical Fertilizers vs. Biosolids



Ag Tech - 1989

Figure 3B

rooting media thus providing for better water retention, improved air exchange around plant roots, and increased ability of the soil to hold nutrients in a plant-available state (increased cation exchange capacity). In sandy, highly leachable soils, the tendency for biosolids' organic nitrogen to be released at a rate that is consistent with plant uptake, mitigates the loss of excess nitrogen into groundwater.

The biosolids' organic matter had other impacts on the same Yuma, AZ farm that initially might have seemed undesirable. Herbicides became less effective because of their interaction with the changing sandy soil and organic biosolids matrix. Those fields, previously weed-free, now contained more weeds. On the other hand, the plants became more vigorous and better able to compete with weeds and withstand damage from insect pests. The changes that occurred because of biosolids usage allowed the farmer to decrease his costs for fertilizer, herbicides, and pesticides by approximately $170 on each acre of his 12,000 acre farm.

Comparative plant vigor on sandy Yuma, AZ, soil without (left) and with (right) biosolids amendments

In some instances the total yield decreased compared to weed-free fields. However, the farmer's net return per acre increased (more dollars per acre profit). The same Yuma, AZ farmer, because of his enhanced yield and lowered costs from use of biosolids, decided to dedicate 10% of his land each year to producing grains for wildlife. Because of the farming changes that left more cover from weeds on all 12,000 acres and the 1,200 acres left each year with unharvested grain for wildlife, the dove and other wildlife population increased so substantially in 6 years that the Yuma region began to realize an unexpected $3.5 million increased annual benefit from hunting-related activities.

Increased populations of birds over biosolids-amended farm fields in Yuma.

Other Uses for Biosolids

The sale of biosolids products to the public for many kinds of garden, nursery, household, and lawn uses continues to increase. Treatment such as heat-drying, composting, and treatment with alkaline materials convert biosolids into useful products that can be considered "exceptional quality" if pollutant concentrations in the biosolids do not exceed the minimum levels specified in Table 3 of the Part 503 rule. These products are safe for unrestricted use by the general public. Generators of these products are required to have an ongoing monitoring program to ensure that the biosolids continually meet the "exceptional quality" requirements.

Examples of these stabilized products include Milwaukee's heat-dried biosolids product, "MILORGANITE,"* which it has been producing and selling throughout the United States since the 1920's.

Products of this nature have sold in bulk for as for as much as $190 per ton if high in nitrogen content and aesthetically pleasing. Kellogg Supply Company (a private firm in California) has been producing and marketing composted biosolid products

* Vendor and trade names are included for the benefit of the reader and do not imply endorsement by EPA.

(e.g., NITROHUMUS, TOPPER, GRO-MULCH) mostly in California, Arizona, and Nevada for a similar period of time. Their products include composted biosolids that have come predominantly from Los Angeles County, CA, wastewater treatment facilities. Both MILORGANITE and NITROHUMUS have been used to establish and maintain grass playing fields in sports stadiums across the country -- including the Rose Bowl. A composted biosolids product from Philadelphia called EARTHGRO has been used with great success for growing container plants and chrysanthemums. Even the White House has used composted biosolids to reestablish its lawns. Several years ago, 825 tons of composted biosolids (COMPRO) were used in this highly successful project. Similarly, the lawns at Mount Vernon, the Washington Monument Grounds and the Governor's Mansion in Annapolis, MD, were renewed with COMPRO. The first use of composted biosolids on the Washington, DC Mall (nearly 6,000 tons) was in 1976 to establish the Constitution Gardens in time for the United States Bicentennial Birthday celebration. COMPRO is currently being sold for $10 to $50 per cubic yard in bulk depending on quantity

Research projects have yielded impressive results. Corn plants on the left were grown in biosolids amended soil.

delivery. The cost for their bagged product is $5 to $6 per cubic foot.

Current research by Heneghan, et.al. regarding the potential use of biosolids to remediate soils containing high levels of lead by reducing the soil lead bioavailability shows promise. The research is indicating that appropriately produced and applied biosolids may help protect child health because the biosolids matrix reacts with the lead in contaminated soils to reduce the bioavailability of the soil lead. The research involved the feeding of laboratory animals an otherwise completely balanced diet that also containing 9% of either a low or high-lead containing urban soil mixed with 1% of different biosolids products.

Comparative Percentage Uptake of Lead from Soil With and Without Biosolids into Bones of Test Animals

(In the Test, Complete Diets for the Test Animals were Amended With 9% High-Lead Soil With and Without 1% of Five Different Types of Biosolids)

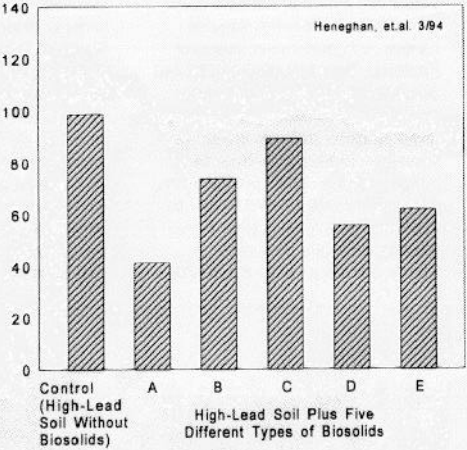


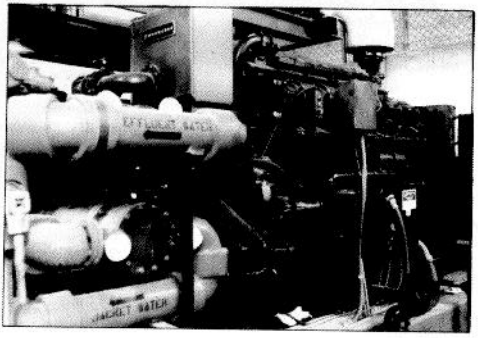
Figure 4. Biosolids can reduce the bioavailability of soil lead

The preliminary results from these animal feeding studies, depicted in Figure 4, show up to 50% reduced bioavailability of ingested lead, (i.e., reduced absorption of ingested soil lead into the blood and body tissues reflected by bone levels). Such data suggest that children ingesting biosolid-treated soil and dust may have a decreased absorption of lead into the blood stream, thus lessening the potential for lead-induced nerve and brain damage. Additional research is needed with laboratory animals to determine the best form of biosolids to use and the reduction of bioavailability that is possible.

Another stabilization method that is

commonly used by many wastewater treatment works is anaerobic digestion. This stabilization process generally yields a Class B biosolids product as defined in EPA's Part 503 rule that has been spread for years on agricultural land in liquid form and as a dewatered product. One of the most economical and agriculturally beneficial methods for using biosolids is the land application of this type of stabilized product.

Methane gas is generated during the anaerobic digestion process and has considerable value. For example, the Tampa, FL, treatment works recovers about $700,000 worth of electricity each year from methane it produces during anaerobic digestion. This is equivalent to approximately $65 worth of net electricity being produced per dry ton of volatile biosolids removed from the digester. Tampa also uses the heat removed from the electrical generators to provide more than 95% of the warmth needed for the digesters. All but 10 to 15% of Tampa's anaerobically digested biosolids are being heat-dried and marketed for between $85 to $120 per dry ton. The balance is being land applied in dewatered form. Tampa was recognized for this highly efficient operation in EPA's 1992 Beneficial Use of Biosolids Awards Program.



A 500-kilowatt engine and generator using biosolids digester gas to produce electricity.