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This evidence that it is possible to achieve successful growth without the addition of costly topsoil convinced the Colorado DOT (CODOT) to experiment further with the application of Biosol. Wes Goff, a resident engineer with CODOT, says the department is now using a mixture of Biosol and Humate on steep slopes with little or no topsoil. "We're getting growth I've never seen before," he says. "We're actually establishing a self-rejuvenating ecosystem."

Goff adds that because of the difficulty of accessing cut or fill slopes that may be longer than 30 m (100 ft.) and as steep as 1:1, CODOT does not add any maintenance applications of fertilizers there. "The big cost is not the fertilizer, it's the application on these difficult sites," he points out, "so we put a pretty heavy application of Biosol and Humate on initially and then let that self-rejuvenating ecosystem take it from there. This approach is working well. For example, we spread a single application of Biosol at a rate of 1,800 pounds per acre on an I-70 cut at 10,000-foot elevation near the Eisenhower Tunnel. It's been four years now, and the growth has been and continues to be excellent."

### The Case for Chemical Fertilizers

Not everyone believes that organic fertilizers should replace chemical fertilizers. For one thing, there is the premium price to be paid for organic fertilizers. Roger Vander Wende, vice president of Community Recycling and Resource Recovery in Bakersfield, CA, takes an unusual view for a supplier of compost. He doesn't expect composts will replace chemical fertilizers, nor does he believe that laws prohibiting chemical fertilizers would be a good thing. "We're producing a product that makes smaller amounts of chemical fertilizers more effective because it holds them closer to the roots. I see a middle road between those who want to ban chemical fertilizers altogether and those who say fertilizing must be kept commercially viable. Organic compost is a tool that can enable farmers to reduce the application of chemicals on tens of thousands of acres. I think that's preferable to insisting that we restrict fertilizing to just a few thousand acres in order to be completely chemical-free."

Neil Anderson of Reforestation Technologies Inc. (RTI) thinks the issue of organics versus chemicals begs the point. He believes the fundamental issue should be fertility management—getting adequate nutrients to the plants in a form they can use and when they can best use it. He, too, frowns on taking chemical fertilizers designed for chemically dependent

done to enhance or support the dunes or their plantings since the original project," he says.

### **SUPERthrive**

Of course, fertilizers are not the only plant growth enhancers used today. Landscape designers and nursery personnel are strong advocates of hormones used as a supplement to fertilizers to stimulate plant growth. Perhaps the best known of these is a concentrated plant growth formula with the trade name of SUPERthrive, which has been used internationally for more than 50 years.

According to the developer and manufacturer, Dr. John Thomson of Vitamin Institute in North Hollywood, CA, SUPERthrive is a proprietary formula of "over 60 carbon, hydrogen, and oxygen compounds that would normally be made by a plant." The product's most widely reported application is that of transporting large trees in such high visibility projects as Disneyland, DisneyWorld, and 20th Century Fox Studios. In the latter application, Thomson recalls, 1,800 mature (60- to 75-year-old) trees were dug from the grounds at the studio, treated with SUPERthrive injected in their root-balls, and stockpiled for two years. They then were replanted as the street trees in the then-new Century City high-rise development "without the loss of a single tree."

The product also has been widely used in hydroseeding applications to speed grass germination. Ted Burton of J.S. Burton & Sons of Hyattsville, MD reports that they hydroseeded banks along a new freeway in Maryland, adding 15 ml (0.5 fl. oz.) of SUPERthrive per 380 l (100 gal.) of hydroseed mix. The application of this mixture resulted in widespread germination in just one week, as compared to three weeks in an area where the hormone product had been omitted inadvertently from the hydroseeding mixture.

### **Biosol**

While all fertilizer manufacturers promote the fact that their products produce healthy plants, only Rocky Mountain Bio-Products is in a position to claim that its product, Biosol, treats plants with penicillin. What's more, that claim is true. During the manufacture of penicillin, a fungal biomass is produced by the fermentation of raw materials such as soybean meal, cottonseed meal, sucrose, and lactose under constant sterile conditions. After the penicillin is removed, the remaining biomass is dried to eliminate the residual antibiotic and to reduce the moisture. Then 3% potassium-magnesia from a naturally occurring source is added to the dried biomass to produce Biosol.

According to Johanna Jensen of Rocky Mountain Bio-Products, Biosol has an N-P-K of 6-1-3, and the organically fixed nitrogen releases with the help of microorganisms at a slow release rate determined by the soil temperature and moisture. The difference between this product and a chemical fertilizer with an equivalent N-P-K is its 70% organic compound which becomes the building block for the formation of humus. Regular application of Biosol, she reports, leads to an annual increase in humus of 0.2% to 0.3%, a buildup of humus in the soil that fosters successful revegetation over the long term. In addition, she estimates that plants treated with Biosol "end up with three times the normal root base."

Manufactured in Austria, Biosol is packaged in 25-kg (55-lb.) bags and lists for between 37 and 43 cents/lb., depending on quantity. Since Biosol does not burn vegetation, the application rates can be adjusted to fit any special soil or nutrient requirements. For reclamation projects with poor soils, the manufacturer recommends an initial application (by broadcasting or hydroseeding) at a rate of 1,704 to 2,045 kg/ha (1,500 to 1,800 lb./ac.) and an annual maintenance at a rate of 1,704 kg/ha (1,500 lb./ac.).

Thus, there is a substantial cost differential between Biosol and chemical fertilizers, Jensen concedes, but points out that "in the long run chemical fertilizers can't provide the long-term results needed. Tests have shown that you can actually get away without topsoil using Biosol, and that alone will yield savings far in excess of the fertilizer cost differential."

The tests Jensen refers to were conducted 10 years ago at a road cut near Berthoud, CO at an elevation of 3,353 m (11,000 ft.). The soil on this 2:1 slope was extremely poor and rocky, with little or no topsoil. In conducting these tests, topsoil and chemical fertilizer were added to one side while the other side was left in its original state, except that it was treated with Biosol at a rate of 2,045 kg/ha (1,800 lb./ac.). Both plots were seeded with high-altitude seed mix and covered with straw mulch. No water was applied other than natural rain and snowfall.

After one year, both plots supported vegetation. While the plot with topsoil appeared to have more dense growth, it was found to contain a large number of weeds, presumably from weed seeds that were present in the topsoil when it was added. Eight years later, the plot without topsoil showed continued healthy growth, although no additional Biosol or other fertilizers had been applied since the original treatment in 1987.