Sewage Sludges for Agriculture

production of high value specialty crops, nursery stock and similar crops possible disposal outlet for treated sewage

R. H. Sciaroni and O. R. Lunt

Studies have shown that various aspects of agricultural production can dispose of large quantities of sewage sludge.

Sewage is usually treated by an aerobic or an anaerobic digestion—or a combination of the two systems—and the resultant sludges differ greatly in their characteristics. Processed aerobically—activated—sludges contain from 4% to 6% nitrogen. Anaerobically processed—digested—sludges contain about 1% to 2% nitrogen.

Activated sludges are widely used in organic fertilizer mixes and often command a premium price. The principal disposal problem occurs with the digested sludges, but—at sufficiently low prices—large quantities could be used.

Digested sewage sludges are of particular value as amendments for soils and vary considerably in their content of soluble salts and extraneous mineral matter. An irrigation—sufficiently heavy to cause some leaching—at the time of planting will generally eliminate the salinity problem if one exists. Usually the bulk density falls in the range of about 0.35 to 0.6.

One of the deterrents to the use of digested sludges—by growers who steam soil mixes—is the toxicity to plants which sometimes occurs following steaming. Such toxicity is a serious problem and sufficient to make the use of sewage sludge unwarranted in many cases. Nevertheless, where ornamental crops are grown under field conditions or where experience has shown a given sewage sludge to be safe—with a particular management program—sludges are of value because of the prolonged period in which nitrogen becomes available to the plant.

The graph illustrates the nitrification rates of two types of sewage sludges in comparison with other long lasting forms of nitrogen. Laboratory data may indicate that very little nitrification takes place with a digested sludge after the initial few weeks but field experience has shown that a very slow mineralization of nitrogen does continue for prolonged periods. When large amounts of sludge are used, the nitrogen becoming available is sufficient to adequately sustain a planting for several months.

Digested sewage sludge can usually be incorporated in soils at the rate of 25% by volume or more. This is important in landscaping operations since quantities of this magnitude improve the tilth of adobe soils by diluting the clay—making the soil much more friable—and increasing the nitrogen reserves of the soil.

In extremely coarse textured soils—but not in loams and clays—the available water is increased slightly. The addition of large quantities of sludge to sandy soils greatly increases the nutritional nitrogen reserves.

Most sludges have little or no value as a physical amendment—such as peat has—when mixes are used for container growing. Under those shallow soil condi-

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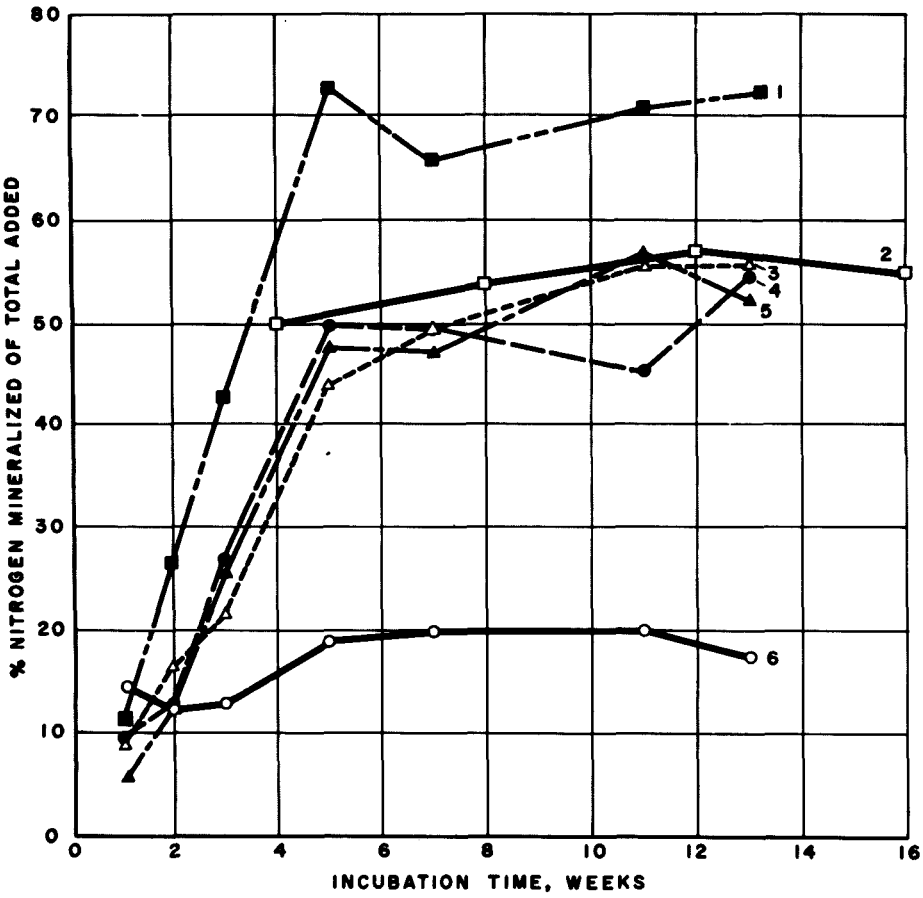
Nitrification rates of various nitrogenous materials. Curve 2 was obtained at 86°F. Incubation temperature for the other materials was 81°F plus or minus 5°F. Code: 1. Hoof and horn meal. 2. Activated sewage sludge—data adapted from M. S. Anderson, Circular 972, USDA. 3. Urea-formaldehyde, Brand A. 4. Urea-formaldehyde, Brand B. 5. Blood meal. 6. Digested sewage sludge.



Comparison of Two Sewage Sludges and Peat as Amendments for Yolo Loam When Used in Shallow Containers

The water and air relations are those which would occur 5" and 10" from the bottom of a container when drainage ceases following an irrigation.

Soil mix	Bulk density	Percentage by volume			
		Water *	Air *	Water **	Air **
Yolo loam	1.19	48.7	5.6	46.2	8.0
Yolo loam plus peat[1]	.69	60.9	6.3	55.1	12.0
plus sludge A[1]	1.08	49.7	5.1	47.9	6.7
plus sludge B[1]	1.04	48.4	5.5	46.0	7.8

[1] Amendments were used at the rate of one part by weight to nine parts by weight of soil.
* Conditions prevailing 5" from bottom of container.
** Conditions prevailing 10" from bottom of container.

marked holes. This method reduced the planting time by 50%. However, a close follow-up irrigation—by furrow or sprinkler—is necessary to settle the plants.

A good crew is important in the use of the labor transport and once a crew has been trained the men should be kept to work together.

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Growers Tom Imaizumi, Valley Center, and Fred M. Yasukochi, San Luis Rey, constructed the equipment and cooperated in the study reported here.

BUDDING

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that a perfectly smooth union would ultimately be obtained.

The critical height of budding with the various combinations of scions and stocks is unknown but—apparently—8″ should be considered a bare minimum with lemons and probably a greater height would be safer and more advantageous.

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MARKETING

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of supply could not be controlled by the state lemon products marketing order which had been introduced to regulate the flow and price of lemons used in processing. A situation developed wherein the lemon products marketing order was terminated as of September 30, 1957.

The effects of these developments were not limited to the lemon products, but spilled over into the fresh lemon market which has always been the mainstay of profitable earnings for California lemon growers. Canned lemon juice and frozen concentrated lemonade compete with fresh lemons. Studies indicate that, although the demand for fresh and processed lemons combined continues to increase, the growth is absorbed by the demand for lemon juice products while the demand for fresh lemons is gradually decreasing.

However, California has the advantage of being able to ship fresh lemons of high quality throughout the year. A profitable outlook for the California lemon industry depends on the maintenance and expansion of the fresh lemon market. In this respect, the orange and lemon situations are the same; both are tied to the fresh-use markets.

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RAPID PACK

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thus make it easier for the packer to pick up the front row. Front fruit is held in place by a thin strip of wood kept as low as possible, but high enough to prevent fruit from rolling over the edge.

The rollboard must be sufficiently deep so that fruit is free of the baffle and has time to settle into a single layer before reaching the edge.

The carton is seated on a board placed tight in front of, but below, the edge of the rollboard and should be tipped toward the packer enough so that the first row of fruit in it will stay in place.

The waxed slip board system for moving a packed carton to a conveyor used at Santa Paula appears to be very practical.

How much faster a packer can work with the rapid pack system has not yet been determined but studies are being made to determine the rate of pack that may be anticipated.

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SLUDGES

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tions sludges neither appreciably increase nor decrease the water or air content of a soil.

The value of sludges to the grower using containers lies in the fertilizer value. An increase in the air space of an artificial growing mix is easily provided by the incorporation of peat, wood shavings, fir bark or other similar materials.

To determine the feasibility of using sewage sludges in ornamental production, material from a new process in use at Redwood City was selected for trial because—primarily—of the excellent physical conditions of the product. In the Redwood City process, sewage is digested—by standard anaerobic methods—in large closed tanks for 60–90 days before the sludge is pumped into drying basins spread with filtering layers of peat, sand, rice hulls, or wood shavings, either pine or redwood.

After a short period of drying, the basins are rototilled which results in aeration of the sludge and the creation of aerobic biological conditions. Sludge handled in such a manner is well aggregated, light and porous rather than a moist sticky mass. Subsequent new layers of anaerobic sludge can be pumped on top of the tilled material in the basins, and again rototilled two or three weeks later. After a final short period of rototilling and aeration the sludge is ready for use. Digested sludges processed in different ways usually have less desirable physical properties and may be fine and dusty and difficult to wet.

Greenhouse Trials

Sewage sludge—primarily based on peat and wood shavings—from the Redwood City processing plant was tried on chrysanthemums, roses, carnations, and camellias.

In a greenhouse trial with chrysanthemums peat based sludge was added to fine sand in 8″ raised beds at the rate of one half by volume. The mixture was not steam sterilized. An excellent crop of chrysanthemums was grown—in 120 days from the planting of rooted cuttings to flower harvest—without additional fertilization.

The same experiment was tried on greenhouse roses with the exception that the mixture was steam sterilized after the sewage sludge was added. Subsequent growth of the roses indicated that some toxic effects resulted from the steaming. Other observations indicate that steam sterilization of sewage sludge mixtures may result in a hazardous risk of crop damage.

A mixture of 25% sludge—peat or wood shavings base—by volume has proven satisfactory with carnations grown in the greenhouse on raised beds. After-steaming toxicity was held in check by leaching with heavy application of irrigation water at planting. Additional fertilizers and amendments—single superphosphate at four pounds, one and one half pounds sulfate of potash, and 10 pounds of agricultural lime—were added per 100 square feet of plantbed area shortly before planting. No nitrogen fertilizer was added for a period of several months.

In other trials sludge has been used successfully on canned Meyer lemons, camellias, junipers, and daphne with 25% by volume sludge—either peat or wood shavings base—mixed with fine sand. No additional fertilizer was added

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SLUDGES

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for 6–8 months. The mixture was fumigated under plastic sheeting with methyl bromide for tomato seed control. Fumigation greatly reduces but does not kill all the tomato seeds in the mixture. However, growth of the crop plants has been good.

Experiments and observations under actual growing conditions indicate that anaerobically processed—digested—sewage sludge may be successfully used in a growing program. After-steaming toxicity and the enormous growth of tomato seedlings from the sludge are the two main difficulties that have arisen during these experiments.

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DONATIONS FOR AGRICULTURAL RESEARCH

Contributions to the University of California for research by the Division of Agricultural Sciences, accepted in September, 1957.

BERKELEY

Mrs. Jesse C. Colman $500.00
For watershed studies

Daniel E. and Eleanor H. Koshland Trust $1,000.00
For watershed studies

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American Dehydrators Assn. $2,500.00
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California Cooperative Rice Research Foundation $445.36
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National Science Foundation $6,500.00
For research on correlation of larvae and adults of polytrichous trombidiform mites. (First payment on grant of $16,800 over three years)

Olin Mathieson Chemical Corp. $3,300.00
For soil fungicide screening program in plant pathology

Shell Chemical Corporation $500.00
To assist with source of phosphorus experiments on vegetable crops in southern California

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