# Fertilizing with sewage sludge

Sewage sludge has long been used, in limited quantities, as a fertilizer because it contains appreciable amounts of plant nutrients. Organic matter in the sludge can also improve the structure and water-holding capacity of the soil.

A fertilizer company annually sells more than 10 000 tonnes of granulated heat-sterilized sludge from the Bolivar treatment plant, near Adelaide, to market-gardeners, orchardists, and home gardeners.

However, this example is exceptional; sludge utilization in Australia is very limited. Usually the material is dumped — either on land or in the sea.

Two major reservations surround sludge as a fertilizer, and we can mostly attribute to these the considerable waste of nutrients that goes on.

Firstly, sludge can harbour many disease organisms. However, provided the sludge is sterilized by heat, this drawback can be overcome. Secondly, people are suspicious of the possibly deleterious effects of heavy metals in the sludge. These metals — principally cadmium, copper, manganese, nickel, lead, and zinc — come from industrial effluents and are therefore most abundant in sludge from treatment plants serving industrial areas.

A given sample of sludge will usually contain heavy metal concentrations below recognized safety limits. However, people fear that regular application of the sludge will build up the levels — since, in general, heavy metals don't leach out. Over time, this may inhibit plant growth or affect human health if the plants are subsequently consumed.

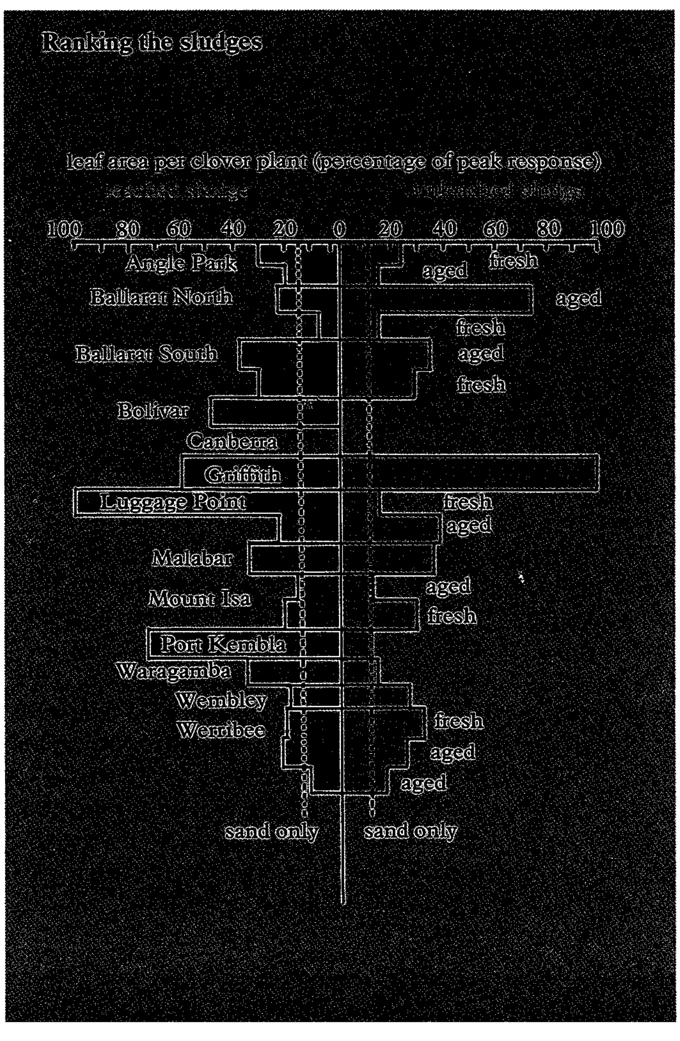
Mr Paul de Vries of the CSIRO Division of Soils has undertaken investigations into what makes a sludge a good fertilizer (or, more precisely, what makes it a bad one). His concern has been to open the way for more widespread utilization of this under-rated resource.

He has analysed 20 sludges from various parts of Australia and studied their effect on clover. This work has led him to the conclusion that the problem with heavy metals is rather exaggerated. High concentrations of water-soluble salts had a greater adverse effect on the growth of plants than the heavy metal content.

And, if the troublesome salts are leached out, many sludges will make perfectly good fertilizer, he found. Correcting any remaining nutrient imbalance (usually a phosphorus or potassium deficiency) should produce a fertilizer any country-show exhibitor would be proud to acknowledge.

**Commercial harvesting of Bolivar sludge from the drying lagoons.**

**The performance of clover grown in standard mixtures of sand and sludge varied greatly. Leaching the sludge had a big effect (generally for the better). The age of the sludges also was important.**




## Sludge and more sludge

Mr de Vries obtained sludge samples from all States except Tasmania. The specific places are listed in the chart.

The largest concentrations of extractable cadmium, copper, nickel, and zinc were found, as expected, in those sludges from industrial areas. The sludge from Port Kembla contained the highest cadmium, zinc, and chloride concentrations, and that from Mount Isa the most copper and lead.

Sludge from Bolivar had the highest concentrations of potassium, magnesium, sodium, and phosphorus, and the second-highest chloride concentration. Its high levels of both heavy metals and soluble salts may make one reticent about using it regularly as a fertilizer, and so this sludge was the subject of separate experiments, discussed later.

Mr de Vries found that the age of a sludge was important in determining its suitability as a fertilizer. Those sludges that had been exposed to the elements for a year or more showed distinctly lower levels of soluble salts than the younger samples. Age had little effect on the heavy metal content, however.

The importance of soluble-salt content showed up in trials in which each sludge sample, mixed with sand, was rated as a growth medium for subterranean clover. In general, more clover seedlings survived when grown in sludge that was leached.

Sludges from industrial areas (replete with heavy metals) generally promoted clover growth as well as did those from purely residential areas.

Nevertheless, the various sludges differed considerably in the degree of stimulation to growth they provided. This can be seen in the accompanying chart.

Unleached Griffith sludge was the best, whereas unleached sludges from Canberra, Bolivar, and Port Kembla actually prevented clover seeds planted in them from germinating. Some sludge and sand mixtures performed worse than sterile sand, while a number of others were not much better.

Keep in mind, however, that the tests are only suggestive, and do not reflect actual soil conditions; the availability and toxicity of compounds in a sludge depends on the soil with which it is mixed. Rates of application, and the particular crop, also lead to different effects. Mr de Vries' clover seedlings were grown in small plastic cups in a temperature-controlled glasshouse and received a dose of sludge mixed into the sterile sand medium equivalent to 26 tonnes per hectare.

The Bolivar and Port Kembla samples, which when not leached killed seedlings, made good fertilizer when leached. Both of these sludges had high chloride levels to begin with.

The Canberra sludge's poor performance can be attributed to its high pH (it undergoes treatment with lime), and in fact it can make a good fertilizer when properly utilized in soils. Experiments under way in Canberra, by Dr Ian Willett of the

**Sludge helps radishes to grow. Bolivar sludge was applied at rates of (left to right) 0, 8, 24, and 72 tonnes per hectare.**

Division of Soils and Mr Paul Jakobsen of the Division of Water and Land Resources, are showing this.

Mr de Vries analysed the water that had been allowed to leach elements from the sludges, and found it generally high in salts, particularly sodium, that would be expected to inhibit plant growth. He attributes the better plant nutrition provided by the aged sludges to the removal of these salts by rain.

The leach water contained insignificant quantities of heavy metals, Mr de Vries found, and young and old sludges contained similar levels of these elements. He doesn't think the levels of these metals shown in his analyses should cause any problems.

Sludge from Werribee comes from a long-operated treatment plant, and build-up of heavy metals, if it is a problem, should have shown up in this sample. However, this sludge had a heavy metal content well below that in some of the others, particularly the Bolivar sludge. No symptoms of heavy metal toxicity have shown up either in the plants grown at the Werribee farm or in animals grazing the area.

A similar story could be told about the health of plants and animals at the abandoned drainage bays at Angle Park, S.A.

Some bare patches of land occur there in among areas of lush growth, and Mr de Vries analysed the soil seeking the cause of the difference. He found that, while heavy metal levels were somewhat higher on the bare sites (and they were quite high everywhere), the most outstanding difference — which he thinks explains the situation — was the very low phosphorus level at bare locations.

### Bolivar sludge

Since Bolivar sludge had high levels of heavy metals, and is widely used, Mr de Vries carried out some field trials with it. He applied high rates to outdoor plots as well in an attempt to induce heavy metal toxicity in wheat grown in them.

Earlier experiments with the sludge had shown problems — cucumber seedlings in a commercial glasshouse and young celery plants in the field had been killed by application of 72 tonnes of the sludge per hectare. The latest work, using up to 200 tonnes per ha, showed that the difficulty probably lies with excess salt or nitrogen released by the sludge.

In the most recent experiments, the sludge was given time for rain to leach out the excesses before planting took place. Growth was good in the first year, and even more spectacular in the second year, with yields higher than those produced in control plots that received 1200 kg of NPK fertilizer per ha.

There was no evidence of zinc, nickel, or copper toxicity in the plants, which will show such symptoms long before a level is reached that is hazardous to humans consuming the plants.

Cadmium, however, can build up to levels dangerous to us without the plants being affected. For this reason, Mr de Vries believes it sound practice not to apply metalliferous sludges to land on a regular basis, especially where leafy crops (such as spinach) are planted, as the cadmium concentrates in the tops.

Although he has carried out experiments showing that cadmium in plants grown on Bolivar sludge doesn't reach dangerous levels (see *Ecos* 21), the availability of cadmium and other heavy metals after they have been in the soil a long time is still unknown.

Even so, Mr de Vries wishes to encourage the use of sewage sludge as a fertilizer. Some sludges will provide better plant nutrition than others, but the soil will be better served by receiving it than not, provided the following precautions are taken:

- the sludge is leached of excess soluble salts, and given time to age before planting crops

- the nutrient balance of the sludge is adjusted to suit crop requirements
- no leafy vegetables are grown on land treated with metalliferous sludges

The lush growth shown in the picture demonstrates what can be achieved.

*Andrew Bell*

Investigations on twenty Australian sewage sludges — their evaluation by means of chemical analysis. M.P.C. de Vries. *Fertiliser Research*, 1983, **4**, 75–87.

Investigations on twenty Australian sewage sludges — effect on clover plants. M.P.C. de Vries. *Fertiliser Research*, 1983, **4**, 231–8.