Under the Microscope...

Irrigating With Recycled Water in Queensland

Turf researchers in south-east Queensland have evaluated the use of recycled water or treated effluent to irrigate golf courses, sporting fields and council parks over the past three years. The research demonstrated that turfgrasses can be grown satisfactorily on tertiary-treated effluent, supplemented with nitrogen, with savings to sporting clubs and the environment.

Twenty grasses were grown in 100 litre bags for the effluent water study

Recent droughts along much of eastern Australia have forced governments to consider the long-term sustainability of current water use practices. The Queensland Water Recycling Strategy, managed by the Environmental Protection Agency, encourages recycling by government, industry and the community.

In Queensland, 15-20 per cent of treated effluent is used for irrigation compared with 11-14 per cent nationally and 60 per cent in California. In 1999, about 75 golf courses in Queensland used treated effluent, accounting for about 45 per cent of the municipal wastewater being recycled. There were also approximately 60 schemes irrigating sports fields, parks and gardens using over 5000 megalitres per year.

One of the factors adding to this debate is the increasing pressure to avoid the discharge of effluent into rivers, oceans and other waterways. In many parts of Australia, the discharge of this waste has exacerbated the decline of river ecosystems and estuaries and contributed to blooms of toxic blue-green algae.

In south-east Queensland, the Luggage Point Wastewater Treatment Plant (WWTP) near the mouth of the Brisbane River, along with the other WWTPs release 8.2 tons of nitrogen each day and 4.2 tons of phosphorus into Moreton Bay. These discharges will increase by 25-50 per cent over the next 30 years, leading to a further deterioration of the environment.

The Use of Recycled Water

Municipal effluent is ideal for the irrigation of turfgrasses because many areas in northern Australia permit the continuous growth of tropical species, allowing year-round use of the wastewater.

These grasses also have dense shoot and root systems that can remove nutrients and other pollutants from the water. Many species have high water and nutrient requirements and so can utilise a large volume of wastewater and the accompanying nutrients. There are also fewer concerns about health issues compared with the use of effluent on food crops.

The use of wastewater represents a saving to turfgrass managers, with the cost of effluent about half that of potable water. The nutrients in the water also mean that less fertiliser is needed. The price of water is likely to increase substantially in the next few years, putting added pressure on the Australian turfgrass industry. In some areas of the USA, such as California, it is mandatory to use wastewater if it is available.

Wastewater can contain various salts and toxic ions (Na, Cl, B, CO_3 and HCO_3) that need to be managed before they begin to affect the quality of the turf and soil. This needs to be assessed when considering the economic benefits of using effluent. Depending on the quality of the water in terms of human health, there may be restriction on the use of the golf course or park at certain times. Sporting clubs and other groups using effluent must also develop environmental plans to manage the effluent so that there are no impacts off-site.

The Trials

These trials examined the performance of the major turf types in northern Australia, including bermudagrass, Queensland blue couch, buffalograss, carpetgrass, zoysiagrass, paspalum and natives.

The effects of fertilisers and wastewater on the performance of 20 grasses growing in 100 litre bags were studied in Murrumba Downs in Pine Rivers Shire just north of Brisbane. From May to August 2001, control plots were fertilised every month, while unfertilised plots received no fertiliser (Experiment 1). From April to August 2002, control plots were irrigated with potable water and fertilised, while effluent plots received no fertiliser (Experiment 2).

In Experiment 3 from December 2002 to June 2003, control plots were irrigated with potable water and fertilised, while effluent plots were fertilised only with nitrogen. A field experiment also compared plots with potable water and mixed fertilisers, plots with effluent and mixed fertilizers, and plots with effluent and only nitrogen.

Information was collected on clipping weights, leaf nutrient concentrations and water quality. The data on shoot weight and leaf nutrient concentration were used to calculate the amounts of nutrients taken up by the various species. This was then related to the amounts of nutrients applied in the effluent and chemical fertilisers.

The Results

At the end of the first experiment, unfertilised plots were only 10 per cent of the weights of fertilised plots, with turf quality and colour declining as clipping weights were reduced. Centipede, buffalo, Japanese lawngrass and kangaroo grass were the best grasses among the unfertilised group.

Leaf nitrogen concentrations fell by 50 per cent in the unfertilised plots (3.3-1.6 per cent N), along with phosphorus, potassium, sulphur and magnesium. Maximum uptake of nutrients per hectare over a year was 324 kg N, 48 kg P and 238 kg K compared with typical applications of 500-800 kg N, 50-200 kg P and 250-800 kg K ha for tropical turf species. This data suggests that many sporting fields are being over-fertilised.

In Experiments 2 and 3, the electrical conductivity, ECw, of the effluent (0.7 dS per m) along with sodium (87 mg per L) and chloride (78 mg per L) were at the low end of the toxic range. The sodium hazard for the soil as determined by the sodium absorption ratio, SAR (3.8) and ECw of the effluent was low.

The residual sodium carbonate (RSC) indicated a slight excess of bicarbonate compared with calcium and magnesium (0.4). Concentrations of nitrogen (7 mg per L), potassium (18 mg per L), calcium (24 mg per L), and magnesium (10 mg per L) were in the low range for irrigation waters, while phosphorus (5 mg per L) was high.

At the end of the second experiment, the average clipping weight of the effluent plots (without fertilisers) was 15 per cent of that of the potable plots. Carpet, centipede, buffalo and kangaroo grass were less affected by the low nutrient supply than the other species.

Leaf nitrogen concentrations fell by 40 per cent in the effluent plots, along with phosphorus, potassium and sulphur. Nitrogen concentrations were below the optimum for turfgrasses (1.8 per cent), while phosphorus (0.46 per cent), potassium (1.6 per cent) and sulphur (0.28 per cent) were in the optimum range. The effluent supplied 13 per cent of the nitrogen required for maximum shoot growth, 70 per cent of the phosphorus and potassium, and 300-500 per cent of the sulphur, calcium and magnesium.

In Experiment 3, the average weight of the effluent plots (with nitrogen fertiliser) was close to the weight of the potable plots, suggesting that the grasses performed similarly on potable water or effluent. Leaf nutrient concentrations were also similar, suggesting that fertiliser applications (effluent plus chemical fertilisers) were optimum for plant growth.

In the field experiment, mean clipping weights and leaf nutrient concentrations were also similar in the three treatments (potable plus fertilisers, effluent plus fertilisers and effluent plus nitrogen), indicating that the grasses could be grown on effluent, supplemented with nitrogen.

Implications

When properly fertilised, the growth of the turfgrasses was similar on potable water or effluent. Low concentrations of nitrogen reduced the growth of the effluent plots when they were dependent on the wastewater for their nutrients. In contrast, the effluent supplied large amounts of phosphorus, potassium, sulphur, calcium and magnesium that could be used by the plants. The salinity and sodium hazards in the effluent were low.

There are significant benefits in the use of effluent for sporting clubs and the environment. The use of effluent represents savings in irrigation and fertiliser costs to turf managers, and reductions in the discharge of nitrogen and phosphorus to local waterways.

Effluent is currently about 50 per cent the cost of potable water, with a saving of about $8000 per hectare per annum in water costs for a typical sporting field. Specific recommendations for the use of recycled water include:

- Check the quality of the effluent to determine whether it is suitable for irrigation, especially in terms of salinity (electrical conductivity or total dissolved salts), and concentrations of specific toxic ions such as sodium, chloride and boron.
- Tertiary-treated effluent has inadequate concentration of nitrogen for most turfgrass species, and must be supplemented with chemical fertilisers.
- Effluent contains high concentrations of phosphorus, potassium, sulphur, calcium and magnesium that can be used to support plant growth. These nutrients represent savings in fertiliser costs.
- Fertiliser applications should be based on the results of regular leaf tests.
- Data on nutrient uptake indicate many examples of over-fertilisation, with reductions in fertiliser applications of 30-50 per cent appropriate in many situations.
- The salinity and sodium hazards in effluent need to be monitored and appropriate amendments applied to maintain long-term soil and turf quality. This will add to the cost of using effluent.
- Do not over-water, as this leads to increased growth and mowing costs, and the possibility of nutrients being leached off-site into rivers and waterways.

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