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USE OF SEWAGE AND SLUDGE IN AGRICULTURE

Mr Chris Patten, the Environment Secretary, lately announced that the United Kingdom plans to phase out the dumping of sewage sludge at sea. This assertion reflects a growing concern, mainly over the pollution caused by toxic chemicals in sewage and sludge. One of the options that the water companies must now consider is to use more of the sludge for agriculture. At present 39% of British sewage sludge is used in agriculture and 30% is dumped at sea, while most of the remainder is disposed of in landfill sites.[1]

Use of human wastes as a resource in agriculture has a long history. Nightsoil has been applied to fields since ancient times, and as cities throughout Europe and North America installed water-borne sewerage systems in the nineteenth century, many of them established "sewage farms", adopting crop irrigation as their preferred means of wastewater disposal. Owen Chadwick even argued that an improved food supply could be one of the major benefits of sanitation. The practice became less popular as concern mounted at its potential for disease transmission, and it disappeared in many countries soon after the 1914–18 war, as the development of modern wastewater treatment processes in the early years of the century made it possible to discharge effluent to surface waters without causing appreciable pollution.

In recent years it has become clear how widespread the re-use of wastewater still is around the world. When the Institution of Civil Engineers organised a conference on the subject in 1984, the papers mentioned wastewater irrigation schemes in fifteen countries including the United States.[2] At the same time it became increasingly clear that the very strict microbial standards laid down in many countries for effluent irrigation were unnecessarily stringent. They were often derived from the standard of 2 coliforms per 100 ml developed by the California State Health Department some 50 years ago, and based on the premise that all pathogens should be prevented from reaching the fields. In practice, the difficulty of attaining these standards by normal wastewater treatment processes meant that they often prevented all treated effluent from reaching the fields as well—although illegal irrigation with raw sewage frequently continued. The World Health Organisation guidelines for unrestricted irrigation were a little more liberal—a maximum of 100 coliforms per 100 ml[3]—but were still difficult to achieve without disinfection.

The World Bank commissioned a major review of the health risks of wastewater irrigation,[4] focusing on the epidemiological evidence of real attributable risks rather than on microbiological evidence of potential hazards, while the WHO International Reference Centre for Waste Disposal examined the risks of nightsoil and sludge re-use.[5] These two agencies then combined with other international bodies to sponsor a meeting of specialists in Engelberg, Switzerland, in 1985, at which tentative new guidelines were drawn up for the microbiological quality of treated wastewater used in irrigation.[6]

The new guidelines rejected the view that health risks from wastes could be imputed from pathogen survival data, and drew on epidemiological evidence instead. The bacterial guideline, a geometric mean of no more than 1000 faecal coliforms per 100 ml, was roughly three orders of magnitude higher than the old WHO value. The Engelberg guidelines also included a new requirement, of less than one intestinal nematode per litre, in recognition of the strong evidence, both theoretical and empirical,[7] of the risk of infection with intestinal nematodes to consumers of edible crops and to agricultural workers. The Engelberg guidelines have now been adopted, with only minor modifications, by the WHO,[8] which has also lately published detailed guidance on how wastewater, excreta, and sludge can safely be used in agriculture.[9] Such a policy allows a range of options, combining treatment of the wastes with other health protection measures.[10]

A primary motive for the development of the new WHO guidelines was to make it easier for developing countries to make efficient use of a precious resource; wastewater is especially valuable where water resources are scarce, and human wastes are cheaper than artificial fertiliser. The quality guidelines are easily achievable by waste stabilisation ponds, a type of treatment especially suitable for tropical climates.[11] However, the guidelines are equally applicable to the industrialised world, where, as Mr Patten has discovered, recycling can bestow environmental benefits.

Meanwhile, the European Community has also issued a directive on the agricultural use of sewage sludge[12] and a UK National Code of Practice is being prepared.[13] The EC directive allows use of untreated sludge only if it is immediately injected or ploughed into the soil; otherwise, new treatment processes may have to be installed to meet the requirements.[14] The directive is concerned to reduce the risk not only from microbiological pathogens in the sludge but also from toxic substances such as heavy metals. In developing countries, the presence of toxic substances in wastewater is increasing rapidly, and such nations need guidance if they are to take advantage of the microbiological guidelines and use their wastes safely. This is an area to which the international agencies, and perhaps also the UK Overseas Development Administration (Mr Patten's old industry), might now turn their attention.

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ONYCHOMYCOSIS AND TERBINAFINE

Fungal nail infections—onychomycoses—are common in hospital and general practice and are usually caused by dermatophyte fungi. Organisms such as *Candida* spp and *Scopulariopsis brevicaulis* can also invade the nail plate. Only a minute fraction of those affected ever receive treatment and the whole idea of treating such infections is often regarded with suspicion—apart from cosmetic disability, onychomycosis is seldom symptomatic nor does it constitute a serious risk to health. Moreover, therapy is widely regarded as a lengthy and frequently unsuccessful exercise. How true are these assertions?

Oral griseofulvin, which is active only against dermatophytes, is the mainstay of drug therapy. With this agent finger nail infections are cured in 4–7 months; toe nail infections take 9–12 months or longer and at least 20–40% of affected nails fail to respond. Long-term relapse rates, a year after treatment, are high—40–70% for toe nails and somewhat better for finger nails.[1,2] Whilst griseofulvin has stood the test of time as a drug without serious or frequent side-effects, many doctors regard therapy as pointless because of the length of treatment and the unpredictable and poor long-term success rates. Thus treatment is often withheld unless there is a pressing reason other than cosmetic appearance.

What about other approaches? Topical nail preparations hold little promise, although some produce responses in nail disease. A 28% formulation of the imidazole drug, tioconazole, has been developed to treat nail disease. However, although a small proportion of those treated respond completely and duration of therapy with griseofulvin given coincidentally can be reduced,[3] topical tioconazole is not a major improvement on existing treatment. Chemical removal of nails with topically applied 40% urea paste, either in pure form or mixed with 1% bifonazole, is sometimes effective,[4] but its application is time consuming.

Hepatic toxicity with ketoconazole, which is known to occur in about 1 in 10 000 patients, limits the use of this drug in onychomycosis, although it is as active as griseofulvin.[5] Itraconazole, a new broad-spectrum triazole, shows more promise in the treatment of nail disease, including candidosis and dermatophyte infections that have not responded to griseofulvin,[6] but it is not known whether shorter treatment periods can be used with this drug.

Goodfield and colleagues[7] have now reported the use of a new allylamine drug, terbinafine, in the management of dermatophyte nail infections. The time taken to achieve mycological cure of affected nails was half that for clinical recovery (24 *vs* 44 weeks for toe nails), so fungus must be eliminated early in therapy; with other treatments mycological and clinical recovery are generally simultaneous. These results suggest that penetration of terbinafine through the nail plate is considerably more rapid than hitherto believed possible. Moreover, of 20 patients followed-up for a year all remained in mycological remission, a result not normally seen with other treatments. That terbinafine is fungicidal in vitro at low concentrations may explain why there seems to be eradication of fungus rather than mere inhibition of growth.[8] Even with treatment periods of over 6 months no serious-side effects were recorded.

The allylamine antifungals including terbinafine inhibit the formation of the fungal cell membrane by blocking conversion of squalene to squalene epoxide.[9] It is not clear how this action accounts for the fungicidal activity of terbinafine, but early reports show that complete eradication of infection is achieved in other dermatomycoses. Thus at long-term follow-up after 6 weeks' treatment of chronic tinea pedis, terbinafine produced 100% recovery *vs* 42% with griseofulvin.[10] Terbinafine has some disadvantages—eg, although it is active in vitro against a wide range of fungi, after oral administration efficacy is largely confined to dermatophytes—and more comparative and extensive clinical trials are also needed. However, the implication of these results is that treatment with terbinafine may substantially shorten the treatment period for onychomycosis.

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