MONITORING OF ANTAGONISTIC FUNGI. PERSPECTIVES, NEEDS AND LEGISLATION

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1. Introduction

The opportunities to harness the antagonistic activities of fungi by deliberately releasing them into the environment is of great interest throughout the world and one which has accelerated with the advancing knowledge in the field of molecular biology. Many national and international groups have taken interest in this field. Particularly the Organisation for Economic Co-operation and Development (OECD), through its Directorate for Food, Agriculture and Fisheries, has a co-operative research programme on Biological Resource Management for Sustainable Agricultural Systems, which has just had funding approved to run for a further five years from 1995-1999. Of the four themes, the first is on Safe Exploitation of Micro-organisms in Plant/Soil Systems. The topics covered within the theme are:

- Methods for molecular ecology
- Identification of physiochemical aspects of the soil environment which regulate microbial function
- Risk analysis and toxicology of the use of micro-organisms
- Production and delivery of microbial inocula
- Reduction of the load of chemical pesticides, fertilisers and organic wastes on the soil ecosystem
- Assessment of biodiversity in plant/soil systems

The programme funds fellowships and workshops. It is obvious that the monitoring of antagonistic fungi is very relevant to most of the topics.

OECD has also been very active in provision of a forum for the debate on the use of genetic engineering techniques and on the release of organisms into the environment.
With particular inputs from the Directorates of Science and Technology and of Environment, it first produced a booklet on laboratory safety issues concerning the use of recombinant DNA (OECD, 1986), and this was followed with a booklet on assessing risk following the release of genetically modified plants and microorganisms (OECD, 1992). Most recently a volume has been produced which concerned the scale-up of microorganisms as biofertilisers (OECD, 1995). None of these reports have any legal standing, indeed OECD only ever acts in an advisory role to its member countries. Nevertheless it seems that most countries, including the European Union, have accepted the advice contained within the reports and incorporated them into national regulations. This is not surprising because the reports were drafted by groups of national experts in biotechnology.

Inevitably, in producing the reports the incomplete state of knowledge was identified. This is where the Co-operative Research Programme has had an important role to play. From the workshop element of the programme, published volumes which have included the issues on the mathematical interpretation and prediction of release of organisms into the environment (Bazin and Lynch, 1993), the release of organisms for the biological control of pests and diseases (Hokkanen and Lynch, 1995) and the development of soil inoculants (Elliott and Lynch, 1995). Most recently Lynch and Elliott (1996) have addressed the question of the need for bioindicators as the critical aspect and need for monitoring the environment for both indigenous and introduced organisms and their associated biochemical activities.

In the following brief survey, a few pertinent issues from personal research will be outlined to illustrate some of the complications and opportunities in monitoring antagonistic fungi in soil.

2. Fallacies of Counting Propagule Numbers

Whereas bacteria exist in soil as distinct cells, fungi occur as mycelia and spores. In pure culture, the development of bacterial biomass can usually be monitored satisfactorily by plating aliquots of the culture onto an agar medium and measuring the number of colony-forming units that develop. For fungi, there is no such relationship because, whereas each spore usually gives rise to a colony, only a proportion of the mycelium will give rise to colonies. Inevitably, the situation becomes even more complicated when the microorganisms are in natural environments. Among these complications are:

- determining the proportion of organisms which can actually be cultured on the isolation medium
- separating living, senescent and dead cells
- measuring biomass in solid and opaque substrates, such as soil
- difficulty in distinguishing between fungal and bacterial biomass