

COMMERCIAL IN CONFIDENCE

PRO 2(1/92)

Ministry of Agriculture, Fisheries and Food
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Please return to above address within two months of
 project completion.

RESEARCH AND DEVELOPMENT

FINAL PROJECT REPORT

 FOR COMPLETION BY THE CONTRACTOR

1. (a) MAFF Project Code [SP0102]
- (b) MAFF Project Title [120 characters]

Heavy metals in sewage sludge.

2. Please summarise below in layman's terms, the results
 of this project: [16 lines]

Methods were developed for isolating soil solutions and measuring Cu and Zn activities in them. These were related to Cd and Zn uptake by test crops and found to relate to species and water use by the plants. We showed that nitrogen-fixing bacteria of Rhizobium leguminosarum biovar trifolii or R. loti were more sensitive to sludge metals than R. meliloti, and that numbers of R. trifolii decrease markedly in soils with metal concentrations below the UK limits. In addition, the soil microbial biomass as a whole is smaller in sludge-treated soils and has a higher respiration rate than 'control' soils. Less of this biomass is formed per unit of substrate than in controls and there were smaller inputs of root-derived carbon, thus giving less substrate for biomass formation. We think that the above effects were mainly due to Zn, but Cu is also implicated in the effects on soil microbial biomass. Advice and participation was regularly given to MAFF on the assessment of the implications of this work for environmental protection policy.

3. (a) Were the scientific objectives as set out
 in ROAME B? [delete as appropriate]..... YES

If no please give date when amended in
 agreement with MAFF Project Officer nn/nn/199n

- (b) Have the current scientific objectives been
 achieved in full? [delete as appropriate]... YES

If NO, explain the reasons [5 lines]

4. (a) Have the milestones been met: in full? NO
[delete as appropriate] on time? YES

If NO explain the reasons: [5 lines]

The conceptual model for Cd and Zn uptake could not be built as yet because of a lack of understanding of their uptake processes at the plant physiological/biological level.

5. For this project, what was:
(a) the approved expenditure? £ 137 K
(b) the actual expenditure?(to nearest £) £ 139 K
(c) If the project is taking place under a Memorandum of Understanding does the variation in actual expenditure exceed delegated authorisations?
[delete as appropriate] NO

N.B. Any such variation must be notified to MAFF by copying this form to Branch B, Research Policy Co-ordination Division, MAFF.

If notification has already been made please give the date nn/nn/199n

6. For this project what was:
(a) The approved staff input
(man years of direct scientific effort)? UG7 0.9,
SO 0.2, ASO 0.7
(b) The actual staff input
(man years of direct scientific effort)? UG7 0.9,
SO 0.2, ASO 0.7

7. If there were any outputs e.g. published paper, presentations, during this annual reporting period, please list them below:
(If none please type 'NONE') [7 lines]

Publications:

Giller, K.E., Nussbaum, R., Chaudri, A.M. & McGrath, S.P. (1993) Soil Biology and Biochemistry 25, 273-278.
Chaudri, A.M., McGrath, S.P., Giller, K.E., Rietz, E. & Sauerbeck, D.R. (1993) Soil Biology and Biochemistry 25, 301-309.
Angle, J.S., McGrath, S.P., Chaudri, A.M., Chaney, R.L. & Giller, K.E. (1993) Soil Biology and Biochemistry 25, 575-580.
Hirsch, P.R., Jones, M.J., McGrath, S.P. & Giller, K.E. (1993) Soil Biology and Biochemistry 25, 1485-1490.
McGrath, S.P. (1993) Soil quality in relation to agricultural uses. Integrated Soil and Sediment Research: A Basis for Proper Protection. Eds H.J.P. Eijsackers & T. Hamers. Kluwer Academic Publishers, The Netherlands, pp. 187-200.

Presentations:

SCI/BSSS 'Agriculture and the Environment' conference, May 1993;
Rothamsted International Conference, July 1993; EERO course on Risk Assessment of Soil Pollution; 2 industry groups and 3

academic/student groups; International Conference on the Biogeochemistry of Trace Elements in Taipei (invited paper); evidence given to MAFF/DoE committees reviewing the rules for sludge use in agriculture; working party on organic contaminants in food subgroup on sewage sludge.

8. (a) Have opportunities for exploiting any intellectual property arising out of this work been identified ?
[delete as appropriate] NO

If YES, have they been communicated to the MAFF Intellectual Property Liaison Unit?
[delete as appropriate] YES/NO

9. Were the agreed scientific objectives the only development emerging from this project ?
[delete as appropriate] YES

If NO, explain any unforeseen developments: [5 lines]

10. Is this research now complete ?
[delete as appropriate] NO

If NO, please describe what further research might be needed, outlining its purpose and scientific objectives and whether it would be appropriate for Government, industry or LINK funding: [10 lines]

More research is needed on the effects of metals from sewage sludge on other groups of organisms not investigated in this programme. Also, the effects of other constituents of sludge other than metals on microbial populations needs to be assessed. To give unequivocal thresholds for toxicity of metals from sludge on microbial populations and processes, new experiments are needed which have enough metal levels to give well defined response curves, and to enable the modifying effects of soil type and soil pH to be taken into account. The bio-available metal species and activities in sludge-treated soils should also be measured. This will necessitate method development. It would result in a better understanding of why toxic effects do or do not occur under different conditions.

DECLARATION

I declare that the information I have given is, to the best of my knowledge and belief, correct.

Signature *D.S. Powelson* Date *10/6/90*

Name *P. S. POWELSON*
(BLOCK LETTERS)

Position *Head of Soil Science Department*