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# Farm Management and Soil Quality

An Investigation into the Effects of  
Conventional and Organic Crop Rotation Systems on  
Soil Quality Indicators

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# Abstract

The physical and biological properties of soil from the pasture phase of organic and conventional crop rotation systems were compared. At the same time, a similar comparison was made of soil from the crop phase versus soil of the pasture phase of organic plots.

A search was started for a new biological indicator of soil quality. The potential use of the relative abundance of fluorescent pseudomonad bacteria in rhizosphere soil and on the rhizoplane of plants in conventional and organic plots was explored.

Soil respiration was also evaluated as an indicator of soil quality. Several soil amendments including earthworm casts, rhizosphere soil, compost material and biodynamic "preparation 500" were examined for their effect.

The research has concluded that;

1. The pasture phase of organic crop rotation had superior soil quality to the similar pasture phase of the conventional plot.
2. Though recently cultivated, the pasture phase of the organic rotation system was able to restore appropriate levels of soil quality.
3. The relative abundance of fluorescent soil pseudomonad bacteria was greater in soil from the organic plot.
4. Based on soil respiration activity, none of the organic amendments were able to show a stimulation of soil biological activity in soil from organic or conventional crop rotation plots.

# Preface and Acknowledgements

Environmental issues are a hot item in many parts of the world. I have seen the contribution of farming towards environmental pollution in Europe and Central America. This made me realise that something was wrong with our attitude towards the environment. During my agricultural education I found out that the problem originated from our analytical way of thinking. This way of thinking made it possible that man analysed via a chemical approach all phenomenon's. Man discovered, for example, that plants consisted out of the elements N, P, K, S and other micro elements. With the support of Liebig's theory that plants take up nutrients in inorganic form it became the break through for mineral fertilisers especially soluble nitrogen compounds, phosphorus and potassium.

With the introduction of inorganic fertilisers a new era in the history of agriculture appeared. On every living phenomenon a chemical approach was practised.

Another consequence is that on the basis of sound physical and chemical analysis, individual factors are incorporated into farming practices. The totality of the living system is often lost. This is not only true for plants and animals but also for the

## *Preface and Acknowledgements*

farm and environment. Through this way of thinking a rapid development took place in science and technology that brought us a high level of materialistic welfare. This way of thinking is also considered to be the main cause of our ecological crisis and welfare distribution.

Analytical thinking also causes alienation. The alienation from man and Nature, but also from man to man; man is manipulating nature, but also fellow human beings. A characteristic of alienation is a big emphasis upon thinking. Thinking controls the emotion, feelings, the experience of being connected with your own powers and the powers of nature and other human beings.

All of this turned agriculture into the industry it is today.

To counteract the mode of analytical thinking a new way of thinking has emerged namely systems thinking or holistic thinking. This reaction is becoming stronger every day and I feel obliged to support it as much as practically possible in this thesis.

Chapter 1 of this thesis gives some background information on the research project that is in line with the former mentioned holistic thinking mode. It gives a brief description of the two farming systems that were compared and evaluated on soil quality namely 'conventional farming' and 'organic farming'. It introduces soil quality that is a holistic idea. Soil quality indicators are used to compare and evaluate the plots. Chapter one also gives comprehensive information about the use of crop rotations as the basis of sound agricultural methods. The research objectives and methods will be introduced.

Chapter two gives a holistic literature study on 'organic' crop rotation to show the value of a holistic approach as a complementary tool next to the analytical method. This chapter also includes a literature review of soil quality and the other studies which were; (1) the potential use of fluorescent pseudomonads as possible soil quality parameters, and (2) a laboratory experiment to evaluate the biological activity of some biological soil amendments and their influence on the biological activity of soils that have been treated with these soil biological amendments.

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Chapter three comprises the comparison of the different plot management on soil quality indicators. It deals with materials and methods, and results and discussion respectively.

The next Chapter is about the potential use of fluorescent pseudomonads as indicator Species for soil quality.

Chapter five consists of materials and methods for the laboratory study on soil amendments and the results and discussion of this experiment. Chapter six is the overall discussion of the thesis.

Although the research did not develop smoothly, the encouraging motivation of some kept me going and I especially like to thank Dr. Neil Macgregor for this. He also broadened my horizons during the thought provoking meetings we had. Furthermore thanks to my other supervisor Dr Dave Scotter for his guidance during this work. Thanks also to Dr Ian Valentine who gave me a clearer insight into the changing world of Science, the incorporation of systems thinking in this University is clearly useful. I would also like to thank AgResearch; especially Willy Stiefel and Dr Alan Gillingham for the use of the plots on the organic unit of Flock House and their co-operation and information. Last but not least I like to thank my spouse Josje for her support during this whole process and Dick Kuiper for his last minute contribution in the editing of this thesis.

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