INRTERACTIONS BETWEEN FARM EFFLUENT APPLICATION METHODS, TILLAGE PRACTICES AND SOIL NUTRIENTS

A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF APPLIED SCIENCE IN AGRICULTURAL ENGINEERING AT MASSEY UNIVERSITTY, PALMERSTON NORTH, NEW ZEALAND

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1998

ABSTRACT

Land disposal of liquid effluent has benefits for the environment and is economically viable. Firstly, it can reduce nutrient levels from wastes polluting waterways. Secondly, the land application of effluent has been the most common treatment method because it can provide some necessary nutrients for plant growth. In New Zealand, land application of farm liquid effluent is a common method for disposing agricultural wastes. However, there is little comparative information about nutrient recycling in soils treated with effluent using surface application or subsurface injection.

A field trial was conducted to examine the effect of tillage on the transformation of nutrient added through dairyshed effluent. Liquid effluent was either injected at 10 cm depth or broadcast on the surface at the Massey University long-term tillage experiments which include permanent pasture, and crops sown with no-till and conventional tillage as main treatments. In the first experiment, raw dairyshed liquid effluent was applied in August 1997 at the rate of 120 m^3 ha^{-1} (30 kg N ha^{-1} equivalent). This was considered as a low rate of application. In the second experiment starting in December 1997, the application was at the rate of 600 m^3 ha^{-1} (150 kg N ha^{-1}). At this rate, although the hydraulic loading was considered as a high rate, the nutrient loading was considered optimum.

Soil samples were collected before application, after one week, one month, and two months of application, at two depths: 0-10 cm and 10-20 cm and the samples were analysed for total N, total P, NO_3^-, NH_4^+, exchangeable K, available Olsen-P. Throughout the experiments, interactions between nutrient status, methods of application and different tillage practices were analysed. In the case of injection method, soil samples were taken both in the centre of the injected row and 10cm horizontally away from the centre of row.

At the low rate of application (first experiment), soil nitrogen and phosphorus status did not change significantly for up to two months after application. Soil ammonium concentration reduced immediately after one week then reduced slowly. Nitrate concentration reduced slowly during the first month and significantly reduced during the second month after application. Exchangeable K and Olsen-P were not significantly different among treatments.

At the high rate of application (second experiment), levels of soil nitrogen and phosphorus reduced slightly after two months of application. Nitrate concentration in the soil increased in the first month, but steadily reduced during the second month. On the other hand, ammonium concentration reduced gradually over a period of two months. Ammonium in injected plots was higher than that in the broadcast plots. Pasture retained more ammonium concentration compared with no-till and conventional tillage plots. Moreover, nitrate content in the injection plots was similar to that in the broadcast. This may be related to low rainfall during the experiment period that may have restricted the denitrification and reduced nitrate losses through leaching.

Generally, there was higher content of exchangeable K and available P in soil which resulted from effluent application. Method of effluent application had no effects on K and P concentrations.

Overall, there was an increase in nutrients in soil after application of liquid effluent, especially at the topsoil. There was a greater retention of nutrients in no-till soil than the conventionally tilled soil. Subsoil injection of effluent allowed higher level of nutrient retention than the surface broadcast method. This may be due to reduced nitrogen losses caused by volatilization of ammonium.

ACKNOWLEDGEMENTS

Firstly and most importantly, I would like to express my deep gratitude to my chief supervisor Dr. M. A. Choudhary and co-supervisor Dr. N. S. Bolan for their encouragement, continuing stimulation, enthusiastic supervision and valuable advice during my study.

I'm particularly indebted to Mr. Dexter McGhie, Mr. Leo Bolter, Mr. Gerard Harrigan, and Mr. Russell Watson in the Institute of Technology and Engineering, who helped to conduct field and laboratory experiments and construct research equipment' used in this study. My gratitude also goes to all staff and postgraduates in the Institute for their friendship and useful suggestions.

I would like to thank Bob Toes, Lance Currie, Mrs Glenys Wallace and Mr Mark Osborne in the Institute of Natural Resource, who helped me a lot during field and laboratory experiments.

Special thanks are due to the New Zealand Official Development Assistance (NZODA) Programme, New Zealand Ministry of Foreign Affairs and Trade for offering me a postgraduate scholarship.

I am also grateful to the Vietnamese Agricultural Engineering Institute for allowing me the opportunity to avail this scholarship.

Finally, I would like to say special word of thanks to my parents, and my friend, Phuong, who encouraged and supported me throughout my study.

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