Innovative Manure Management Techniques for Managing Excessive Cereal Crop Residues

C.J. Macleod[1], D.A. Lobb[1], Y. Chen[2], D.L. Burton[1]

Soil Science[1], Biosystems Engineering[2], University of Manitoba, Winnipeg, Canada R3T 2N2

Introduction

Excessive cereal crop residue is an impediment to crop production due to its adverse effects on equipment performance and crop performance. Crop residues can bind in tilling and planting equipment, delay warming and drying of the soil, slow or prevent seedling germination, and exacerbate crop diseases and weed problems. Of the cereal crops, oats are most problematic, particularly when grown in the Red River Valley. Soil and climate conditions in the Red River Valley produce the largest quantities of cereal straw in Manitoba. Oats produce large quantities of straw and this residue does not break down quickly or easily. As a consequence, many farmers manage oat straw through burning.

The burning of crop residues to manage the excess is an undesirable practice. It can cause health and safety problems, and at the very least it is a nuisance. This situation has resulted in legislative action by the Province to control straw burning. The Manitoba Department of Agriculture and Food budgets $35,000 per year to facilitate the permitting of straw burning. This cost is in addition to the staff time required to carryout the permitting process. The permitting process provides an option for reducing excess crop residues in some instances, but there are concerns that the problems associated with straw burning still exist and that considerable straw burning takes place without permits. The burning of crop residue also represents a cost to the farmer - burning results in a loss of nutrients equivalent to about $9 per acre. Furthermore, the burning of crop residues may have long term-negative impacts on soil quality and climate due to the loss of carbon.

There are several potential alternatives to burning oat straw. The most extreme of these is to grow crops that produce less residue which is less persistent. Another extreme alternative is to harvest and remove the straw from the field. And finally, the use of an agent to reduce the C:N ratio of cereal residues may induce microbial activity such that residues will be significantly reduced in one post-harvest season , thus resulting in efficient performance of tillage and seeding equipment during spring seeding operations.

Objectives

The objectives of this study are to:

- Determine to possibility of using either surface applied or injected hog manure, in conjunction with varying degrees of tillage, to accelerate the decomposition of oat crop residues
- Determine the benefit of using hog manure in place of inorganic fertilizers to supply the nutrient requirements of a hard red spring wheat crop
- Quantify the differences in hard red spring wheat quality parameters when hog manure is used in place of inorganic fertilizers for total crop nutrition

Burning straw in the Red River Valley

Smoky plume near Fannystelle, MB

Methods

The project has been established as a randomized complete block design including eight (8) treatments with four replications of each treatment. Experimental treatments are:

- Chisel plow primary tillage
- Single gang disk primary tillage
- Zero primary tillage
- Chisel plow primary tillage with injected hog manure (10cm depth)
- Single gang disk primary tillage with surface applied hog manure
- Zero primary tillage with injected hog manure (10cm depth)
- Straw burning for residue disposal
- Mechanical removal of oat straw

The effects of the treatments will be evaluated using the following performance measures: before, between and after fall tillage and manure operations and in the spring before and after wheat seeding operations:

- Crop residue levels
- Soil nutrient status
- Soil temperature and moisture
- Soil biological activity

Treatments will be evaluated based on:

- Equipment performance during tillage after oat harvest
- Equipment performance during manure application after oat harvest
- Persistence of crop residue at time of planting wheat
- Equipment performance during planting of wheat
- Emergence, early growth, final yield and quality (protein) of wheat

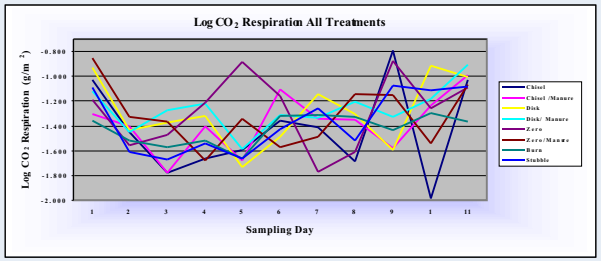

Figure #3 Log CO_2 respiration for all treatments

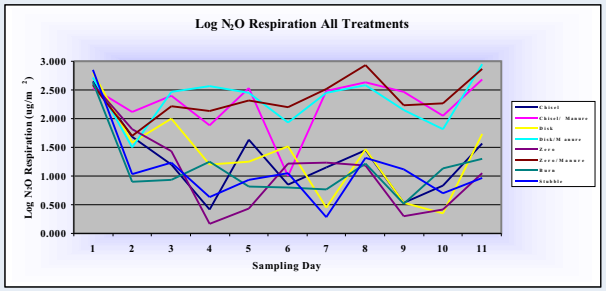

Figure #4 Log N_2O respiration for all treatments

Conclusions

There is a trend towards increased microbial decomposition of cereal crop residues, in terms of CO_2 and N_2O respiration, in the presence of hog manure amended soil, according to the data presented here. Although the positive trend for CO_2 respiration was not significant, there is an observable trend. Perhaps spring pre-seeding GHG sampling will provide a more significant relationship. However, N_2O respiration was significant between treatments, resulting in higher respiration rates for manure amended treatments.

It is clear that there is a relationship between hog manure additions and microbial decomposition of cereal crop residues. Perhaps the relationship is due to an increase in available nitrogen sources, or perhaps the hog manure is providing a source of soluble carbonaceous materials which is stimulating microbial metabolism. In either case, the objectives of this study to determine the effect of liquid manure additions to soils also receiving high rates of crop residues has been fulfilled. Subsequent GHG sampling and analysis, spring soil nutrient status sampling as well as spring wheat seedling emergence counts, seeding equipment performance evaluation and final yield and quality data will provide additional tools with which to analyze and make recommendations regarding the objectives of this study.

Further to the data presented here, soil moisture and temperature data are being recorded, via in situ measurement devices. Analysis of atmospheric and soil climatic data may provide more insight into the mechanisms which are driving the variation in soil respiration measurements and provide more in-depth conclusions as to the processes which are governing the rates of microbial degradation of cereal crop residues.

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