SANITATION OF FEEDLOT SOIL

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INTRODUCTION

The coliform bacteria are among those that inhabit the intestine of man and animals. They can be differentiated into two groups, the total coliforms and the fecal coliforms, on the basis of their ability to grow at elevated temperatures. Both groups grow at 37°C (98.6°F), but only the fecal coliforms are able to grow at 44.5°C (112°F).

The most important member of the fecal coliforms is *Escherichia coli (E. coli).* The bacterium *E. coli* is one of many microbial agents that are able to cause diarrhea in newborn calves, lambs and piglets.

The total coliforms and fecal coliform groups also differ in their ecology. The studies of Geldriech (3) have shown that coliforms are normal inhabitants of unpolluted soil. However, fecal coliforms are not found in normal unpolluted soil, and are found in soil only after it has been contaminated with animal or human feces.

In the fall of 1979 the NDSU Departments of Veterinary Science and Bacteriology began a two-year cooperative study of the microbial environment of the calf with diarrhea. The results of that study appeared in Farm Research Volume 40:17-28. We reported the existence of a reservoir of potentially pathogenic *E. coli* in barnyard soils contaminated with bovine feces.

After finding this "reservoir of infection" in barnyard soils, studies were initiated to find simple yet effective methods to control potentially disease causing *E. coli* in contaminated soils. This article describes a two-part study conducted at the NDSU Beef Barns in which four chemicals commonly used to disinfect feedlot and barnyard soils were applied. Their efficiency in reducing the number of total coliform bacteria and fecal coliforms, specifically *E. coli* in heavily contaminated soils, was determined.

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MATERIALS AND METHODS

In the first part of this study, three chemicals: quicklime (calcium oxide), ground limestone (calcium hydroxide), and livestock salt (sodium chloride) were applied to a contaminated feedlot at a rate of 25 pounds per square foot. In addition, a control plot to which no chemical was applied was sampled throughout the five-week study. Soil samples were taken weekly from the test plots and the chemicals were re-applied after each sampling. Cattle were kept in the lot throughout the course of the study and served as a continuous source of coliform contamination.

In the second part of this study, the three chemicals and 19-19-19 fertilizer were applied to a feedlot after the lot was cleared of manure and soiled straw. This second lot was level and well drained. The soil was dry down to approximatey 3 inches deep at the beginning of the experiment. Samples were taken from control plots before chemicals were applied.

Soil samples were tested for the presence of coliform and fecal coliform bacteria. Coliform bacteria were counted by the multiple tube fermentation method (1) and fecal coliform bacteria were counted using the multiple tube fermentation-elevated temperature method (1).

RESULTS

The first part of this study was done to determine whether any of the various chemicals would have a disinfectant effect on the number of total coliforms and fecal coliforms found in the feedlot soil while cattle were present in the feedlot.

No significant change was seen in total coliforms and fecal coliforms from their respective initial number of 48,000,000 and 33,000,000 per gram of soil during the first week of the study. In the second week, after 1.25 inches of rain had fallen since the previous sampling, an increase of both total and fecal coliform numbers was observed. The number of fecal coliforms rose to 2,450,000,000 per gram of soil in the control and salt treated plots, and to 360,000,000 per gram in the plot treated with quicklime. However, a reduction of the total coliform as well as the fecal coliform number was observed in the plot treated with two applications of

ground limestone. The total coliform number and fecal coliform number were both equal to 650,000 per gram of soil, representing a four-fold decrease from the numbers found in the control plot. This finding is not in agreement with our earlier study in which ground limestone was reported to have no disinfectant effect. However, in the previous study only one application of chemical was used at a different application rate in freezing weather conditions.

In the second part of this study, the same chemicals used previously were applied to a feedlot to determine if the number of coliforms could be further reduced after clearing manure and debris from the lot.

Initially, the total coliforms were detected in three out of four control plots in an average of 340,000 per gram of soil. In the following four-week sampling period, the total coliforms were found in the control plots in number ranging from 1,000,000 to 10,000,000 initially compared to 1,000 to 10,000 at the end of the experiment (August, 1982).

At the beginning of the second part of this study the average initial number of fecal coliforms was 59,000 per gram of soil. After the second week a reduction in the control as well as in the experimental plots to 55,000 per gram of soil was observed. Interestingly, a significant decrease in both control and experimental plots to 450 fecal coliforms per gram soil was estimated after the third week, leading us to the conclusion that the application of chemicals had no effect, since after the fourth week no detectable number of fecal coliforms were seen in any of the plots.

DISCUSSION

In the first phase of this study done in feedlot conditions with cattle present, a decrease in both total coliforms and fecal coliforms in the test plot treated with ground limestone after 1.25 inches of rain had washed the chemical into the soil affirms that ground limestone is useful during wet spring calving conditions to reduce the numbers of potentially pathogenic *E. coli* found in contaminated soil. Salt and quicklime did not appear to have any value as soil disinfectants in these conditions.

The pattern of coliform survival in soils observed in this study was similar to survival patterns reported in the literature (2). Although *E. coli* is known to die off rapidly in soils, the survival of enteric bacteria in soil is increased and regrowth is possible when sufficient organic matter and moisture are present (4). This pattern of *E. coli* regrowth was observed in the control plots and the plots treated with quickime and salt. The cattle present in the feedlot served as a continuous source of coliforms and organic material. The increase in total coliforms and fecal coliforms after 1.25 inches of rainfall in the control plots was expected.

The reduction of total and fecal coliform numbers seen in second part of this study done on a feedlot that had been initially cleared of manure, straw and contaminated debris is consistent with the above observations. Cleaning the lot and allowing it to dry thoroughly was sufficient to greatly reduce, if not eliminate, fecal coliforms from the soil, making the application of chemical disinfectants to further "clean up" the soil unnecessary for the conditions of this experiment.

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