BCRC Research Review Facts

RESEARCH AND TECHNOLOGY DEVELOPMENT FOR THE CANADIAN BEEF INDUSTRY

Effect of Antimicrobials

ON SOIL AND WATER

PROJECT TITLE

The Occurrence, Fate, and Ecotoxicological Effects of Veterinary Antibiotics Used In the Beef Cattle Industry

THE BEEF CATTLE RESEARCH COUNCIL
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PROJECT LEADER

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Since the 1990s, studies have shown that trace amounts of pharmaceuticals, mainly those prescribed to humans, can be found in surface water supplies. It's believed that human-prescribed pharmaceuticals, which are not removed by standard sewage treatment, are excreted in urine and sometimes disposed of by flushing down toilets. Because pharmaceuticals (such as antimicrobials) are also used in livestock production, and manure is frequently spread on farmland as a fertilizer, it's important to understand whether residual antimicrobials in manure make their way into surface and groundwater and what effect they might have on soil microbe ecology.

Research was carried out on monensin (trade name: Rumensin, an ionophore antimicrobial used to improve feed efficiency), tylosin (trade name: Tylan, used to treat and prevent respiratory infections thus improving growth), tetracyclines (used to prevent illness in feedlot cattle) and sulfamethazine (used to treat illnesses such as shipping fever and foot rot).

There were three aspects to this study: a field trial to determine if traces of livestock antimicrobials were present in surface waters; laboratory testing of sediment soils to determine if trace antimicrobials affect the ecology of soil bacteria; and laboratory studies to determine the persistence and mobility of antimicrobials in field soil.

Determining if trace amounts of livestock antimicrobials are present in surface waters

A field study was carried out in a southern Ontario watershed in an agricultural area. Twenty-two

Effect of Antimicrobials

ON SOIL AND WATER *continued*

livestock antibiotics and 11 prescribed livestock pharmaceuticals were sampled for. Residues for 14 of the substances were detected in surface waters. The most commonly detected were lincomycin, monensin and sulfamethazine. Increases in concentrations of the most frequently detected pharmaceuticals did not coincide with increases in runoff. Rather it appears that increases in concentrations are the result of the release of these substances from soil sediment during periods of low water flow.

It was concluded that the antibiotics evaluated in the study, at current environmental concentrations, do not pose a significant risk to freshwater sediment bacterial communities.

Laboratory testing of sediment soils to determine if trace antimicrobials affect the ecology of soil bacteria

Sediment microbial communities play a fundamental role in the ecosystem and so it was important to determine if trace antimicrobials impact the ecology of sediment soils. The effect of tetracyclines and tylosin was studied. Little evidence of an impact was found. Impacts that were noted were only found at residue concentrations exceeding those measured in surface waters. It was concluded that the antibiotics evaluated in the study, at current environmental concentrations, do not pose a significant risk to freshwater sediment bacterial communities.

Laboratory studies to determine the persistence and mobility of antimicrobials in field soil

A study was carried out to determine how long antimicrobials remain in manure-treated field soil and how deep in the soil they could be detected. Tylosin, chlorotetracycline, and monensin were studied. Concentrations of tylosin reduced by half every 4.4 days; chlorotetracycline every 20 days; and monensin every 13.5 days. At a depth of 25 – 35 cm, no tylosin or monensin and very little chlorotetracycline was observed. The low mobility of these antimicrobials in soil suggests their movement to groundwater would not be expected in most agricultural soils.

This research provides scientific data on the impact of spreading manure from antimicrobial-treated livestock on ground and surface water. This data may help defend the sustainability of current agricultural practices.

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