Incidence of Bovine Enterovirus, Coronavirus, and Group A Rotavirus, and Concentration of Fecal Coliforms in Midwestern Pasture Streams

A.S. Leaflet R2442

Douglas A. Bear, research assistant; Yong.-Il. Cho, research assistant; Jim R. Russell, professor of animal science; Steve M. Ensley, veterinarian; and Kyoungjin J.Yoon**,** professor of veterinary diagnostic and production animal medicine

Summary and Implications

The occurrence of bovine enteric pathogens and fecal coliform contamination in streams of 13 Midwestern cow/calf pastures was studied during the 2007-2008 grazing seasons. Water samples (n=812) were collected biweekly at up- and downstream locations on each stream. Incidence of Bovine Enterovirus (BEV), Coronavirus (BCV), and group A Rotavirus (BRV), and concentration of fecal coliforms (FC) were evaluated. The mean incidence of BEV, BCV, and BRV in all samples were 5.42, 1.60, and 0.25%, respectively, over the two grazing seasons. There were farm differences for BEV (P=0.02) and BCV (P=0.01) incidences, but there were no differences (P>0.05) for the incidences of the viruses between samples collected from up- or downstream locations. Cattle presence in the pasture on the day and three days prior to sampling were related (P=0.02, P=0.04), respectively, to BEV, but were not related (P>0.05) to BCV or BRV. However, incidences of BEV, BCV or BRV were not related (P>0.05) to cattle presence seven days prior to sampling. Mean FC were 930 and 938 colony-forming units (CFU)/100ml, respectively, for up- and downstream samples. Differences (P=0.01) were observed between farms for concentration of FC. Preliminary results indicate that the timing and management of grazing may be beneficial in decreasing the incidence of enteric viral pathogens and concentrations of FC in Midwestern pasture streams.

Introduction

Grazing management practices that allow cattle to congregate near pasture streams may result in the loss of vegetative cover, soil compaction and accumulation of manure near the streams. These conditions may cause sediment, phosphorus, and pathogen loading of streams by direct deposition of feces or in precipitation runoff.

Previous research has shown that, when compared to continuous stocking with unrestricted access to pasture streams, management practices like rotational stocking with flash-grazing of riparian paddocks or restricting stream access to stabilized crossings increased the proportion of vegetative cover and sward height of forage while reducing the proportion of ground covered with manure near streams in smooth bromegrass pastures. Therefore, nonpoint source pollution of these streams should be reduced by these practices. However, the efficacy of grazing management practices on sward height, vegetative cover, and concentration of manure are likely related to stocking rate and other factors such as the botanical composition or shade distribution in pastures that influence congregation of cattle near streams.

Grazing of cattle in riparian areas has been associated with increases in the concentrations of fecal coliforms (FC) in pasture streams in some studies. However, in other studies, there has been evidence of significant contributions of FC to pasture streams from other animal species. Furthermore, while the presence of FC has been used as an indicator of the possible presence of pathogenic bacteria and viruses from fecal contamination, a definitive relationship has not been established. Bovine Enterovirus (BEV), Coronavirus (BCV), and group A Rotavirus (BRV) are intestinal pathogens present in cattle feces. If these pathogens are present in water sources, they may result in scours in cattle and, possibly, diarrhea in humans. Therefore, there is a need to determine whether and under what conditions these viruses are present in pasture streams to develop grazing and livestock management systems to ensure the health of both livestock and humans.

The objective of this project was to evaluate effects of stocking rate and season on the concentrations of FC and the incidence of selected enteric viral pathogens in pasture streams.

Materials and Methods

Twelve streams passing through 13 pastures on 12 cooperating farms in the Rathbun Lake watershed were identified as appropriate for the project in the fall of 2006. Pastures ranged in size from 7 to 265 acres and had stream reaches of 948 to 5,511 feet and that drained watersheds of 624 to 13,986 acres. Grazing was controlled by the manager of each farm. Managers of these operations recorded the number of cows, heifers, and bulls stocked in these pastures as they entered and left the pasture from November, 2006 to November, 2008.

Bi-weekly, from May through November, 2007, and March through November, 2008, water samples were taken at up- and downstream locations on all 12 streams. Water samples were analyzed by the Veterinary Diagnostic Laboratory (VDL) at the Iowa State Veterinary School for incidence of BEV, BCV, BRV, and concentration of FC.

The FREQ and LOGISTIC procedure of SAS was used to test the incidence of viruses found on the probability of the cattle being in the pasture on the day, and 3 and 7 days prior to sampling, along with the rainfall events on the day of sampling, 24, 48, and 72 hours prior to sampling by calculating an odds ratio to determine the effect of each unit change in the stocking and rainfall variable. Proc GLM was used to test the means for FC for up- and downstream samples taken for both grazing seasons using farms as replicates. A P-value of 0.05 was determined significant.

Results and Discussion

Mean incidence of samples (n=812; Table 1), for BEV (44 incidences), BCV (13 incidences), and BRV (2 incidences) in water samples collected both up- and downstream were 5.42, 1.60, and 0.25%, respectively. There was no difference (P > 0.05) for incidence of BEV, BCV, or BRV between up and downstream samples across all farms, implying that if a pathogen was present, its source was often upstream of the sampled pastures. Incidence of BEV in up- and downstream samples was related to cattle presence on the day (P=0.02) and three days prior (P=0.04) to sampling, but the incidence of BCV and BRV was not related to the presence of cattle on the day of sampling (P > 0.05), and three days prior (P > 0.05), to sampling. Incidence of BEV, BCV, or BRV was not related to the presence of cattle in pasture seven days prior (P > 0.05) to sampling. Incidence of BEV, BCV, and BRV will be regressed by stocking densities of farms and by possible seasonal effects. Using Proc LOGISTIC, incidence of BEV, BCV, and BRV in up- and downstream samples dramatically decreased because of rainfall on the day of sampling or 24, 48, and 72 hours prior to sampling.

Means of concentrations of FC (n=680) for up- and downstream samples were 930 and 938 CFU/100 ml, respectively (Table 2). Differences (P=0.01) were observed by farms, but large variations in concentrations occurred between up- and downstream samples.

Preliminary results imply that while grazing cattle may contribute to loading of pasture streams with fecal coliforms and enteric viruses, substantial numbers of the bacteria and viruses may be present in stream water entering pastures. The relationships between the incidences of enteric viruses and cattle presence or rainfall imply that the incidences of the enteric viruses may be short-lived. Therefore, both infection of cows and calves and loading of streams with enteric viruses may be controlled by grazing management practices that alter the temporal/spatial distribution of grazing cattle.

Acknowledgements

The authors would like to thank the cooperating producers, USDA-NRCS personnel, and technical staff of the VDL at Iowa State University for their assistance with this project, and Garritt Page for assistance with statistical analysis. The material in this report is based on the work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Award No. 2007-35102-18115. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the U. S. Department of Agriculture.

Table 1. Incidences of BEV, BCV, and BRV in water samples collected at upstream and downstream locations from 13 pastures on 12 farms in 2007 and 2008.

	Incidence					
Pasture	**BEV**		**BCV**		**BRV**	
	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
1	1	1	0	0	0	0
2	3	3	0	0	0	0
3	0	0	0	0	0	0
4	0	2	0	0	0	0
5	2	3	2	0	1	0
6	0	0	0	1	0	0
7	1	5	3	2	0	0
8	2	3	2	0	0	0
9	1	2	0	0	0	0
10	4	4	0	1	0	0
11	1	0	0	0	0	1
12	3	1	1	1	0	0
13	1	1	0	0	0	0
Incidence	19	25	8	5	1	1
Total Samples	407	405	407	405	407	405
Percent Incidence	4.67	6.17	1.97	1.23	0.25	0.25

Table 2. Mean concentration of fecal coliforms in water samples collected at up- and downstream locations from 13 pastures on 12 farms in 2007 and 2008.

	Sampling location	
Pasture	**Upstream**	**Downstream**
	CFU/100 ml	
1	647[cd]	1356[abcd]
2	1944[a]	1897[ab]
3	890[bc]	583[cd]
4	583[cd]	576[cd]
5	457[cd]	770[cd]
6	469[cd]	639[cd]
7	1090[abcd]	1343[abcd]
8	1066[abcd]	1089[abcd]
9	723[cd]	752[cd]
10	1226[abcd]	928[bc]
11	539[cd]	563[cd]
12	1432[abcd]	872[bc]
13	1021[abcd]	824[cd]
Total Samples	341	339

a,b,c,d superscripts differ by (P=0.05)