DETERMINATION OF BACTERIA AND NUTRIENTS IN RUNOFF FROM BEEF CATTLE GRAZING OPERATIONS

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ABSTRACT: In the summer of 2002, six bermed paddocks, measuring 300 ft X 600 ft and comprising a total of 4.1 ac each, were constructed in an established pasture of mixed common bermudagrass and fungus-infected fescue. A 75-acre pasture was surveyed to establish the parameters for six paddocks and to establish paddocks with approximately the same slope. This insured that runoff water collected from each paddock would travel through each collection paddock at a similar rate. Berms were constructed with a levee plow by pulling loose soil up and then packing the soil with the tractor until the final dimensions of 18 inches high and 36 inches wide were achieved. In June of 2003 the paddocks were plowed and packed for the final time, and fences and an automatic watering system installed in each paddock. Levees were high and wide enough to exclude water from outside sources in order to insure that data generated from runoff water was from that paddock only. A runoff weir, for sample collection, was constructed at the lowest point of the paddock and an automatic sampling device installed in this weir to sequentially sample water from runoff events. The effect of cattle stocking rate density was the first parameter evaluated. Cow/calf pairs were placed on the berms at 4 pairs/4.1 ac; 2 pairs/4.1 ac; and 0 pairs/4.1 ac. The three bacteria that were measured were enterococcus, fecal streptococcus and E. coli. Generally enterococcus and fecal streptococcus were less variable, below 20,000 counts/ml, than E. coli. As expected, E. coli counts generally followed stocking rate density, the lower the stocking rate, the fewer the bacterial load. When cattle were removed from the berms on 11/9/04, counts went from >100,000 counts/ml on 11/2 to approximately 5000 counts/ml on 11/16. Future studies will evaluate the effect of age of animals (calves vs. cows) or type of cattle (steers, replacement heifers, cows); placement of feeding and resting areas; temperature, rainfall frequency and other weather factors on the number and type of bacteria found in runoff water. Future studies may also include nutrient content in runoff water after application of organic and inorganic fertilizers.

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KEYWORDS: Beef cattle; runoff water; fecal bacteria; nutrient runoff.

MATERIALS AND METHODS: In the late summer of 2002, construction of six bermed paddocks was initiated on Houston clay and West Point silty clay soil types. They were constructed in an established 75-ac pasture of mixed common bermudagrass and fungus-infected fescue. The bermed paddocks, measuring 300 ft X 600 ft and comprising a total of 4.1 ac each, were surveyed to determine paddock parameters and the slope of each paddock. Berms were laid out in the pasture so that each berm had approximately the same slope. After the paddocks were laid out, berms were put up with a levee plow around the circumference of each paddock. The berms are approximately 18 inches high, 18 inches wide across the top of the berm, and 36 inches across the bottom. The berms were allowed to settle during the winter of 2003 and were pulled up and packed a final time in the late spring of 2003. This final packing was conducted to insure that the berms were sealed so that runoff water collected from each paddock was water that had fallen in that specific paddock and data collected was from animals confined in that specific paddock. The areas were fenced and an automatic watering system installed in late fall of 2003. A runoff weir was constructed at the lowest point of the paddock. An automatic sampling device was installed in this weir to sequentially sample water from runoff events. Rainfall for the bermed areas was monitored. Water was collected during the winter and spring of 2003-2004 in order to set up the bacterial analysis procedure and to provide background data on ungrazed bermed areas. Cattle were placed in the berms in the spring of 2004 and the first runoff data reported was from a 6/1/2004 runoff event. Duplicate water samples were removed from the 2910 ISCO samplers, placed on ice, and transported to the laboratory for analysis. Numbers of Enterococcus, fecal Streptococcus and E. coli were reported as counts/ml of runoff water.

RESULTS AND DISCUSSION: Data collection began in March of 2004. Initial samples are not reported since it was necessary to set up and validate the analysis procedure. The initial study is designed to evaluate the influence of stocking rate on the number of Enterococcus (Figure 1), Fecal Streptococcus (Figure 2) and E. coli (Figure 3) that enter streams, based on water exiting the flume. In this initial study, paddocks stocked at 4 cow-calf pairs/4.1 ac (PB1 and PB4); 2 cow-calf pairs/4.1 ac (PB2 and PB5); or 0 cows-calf pairs /4.1 ac (PB3 and PB6). Generally enterococcus and fecal streptococcus were less variable, below 20,000 counts/ml, than E. coli. As expected, E. coli counts generally followed stocking rate density, the lower the stocking rate, the less the bacterial load. The greater distribution of manure at the 2 pairs/ac stocking rate and the more standing forage in these pastures appeared to not only decrease runoff water volume (visual evaluation), but also to keep bacteria levels near the 0 level. When cattle were removed from the berms on 11/9/04, bacteria counts went from >100,000 counts/ml on 11/2 to approximately 5000 counts/ml on 11/16 and remained at this low level. This indicates that bacteria from grazing cattle disappear from pastured areas very quickly. On the 11/2 date, there was a spike in Enterococcus and E. coli bacteria but the data on fecal coliforms was lost due to media failure. However, counts taken from water samples from another study followed the same pattern. Thereafter counts went back to pre 11/2 levels. This time period coincides with fall bird migrations, but this may or may not be the reason for this spike. Counts from the higher stocking rates had been increasing from the 9/7 collection, which also coincides to decreasing ambient temperatures and lower sun angles. Future studies will evaluate the effect of animal age (calves vs. cows) and/or cattle type (steers, replacement heifers, cows); placement of feeding areas; filter strips; soil compaction; temperature, rainfall frequency and other weather factors; nutrient content of runoff water after application of organic and inorganic fertilizers on the number and type of bacteria found in runoff water.

Due to the limited observations, this data set was not subjected to statistical analysis, but will be pooled with 2005 data and analyzed.

Figure 1. Graph of Enterococcus levels in runoff water collected from the 6 bermed areas and reported as counts/ml water.

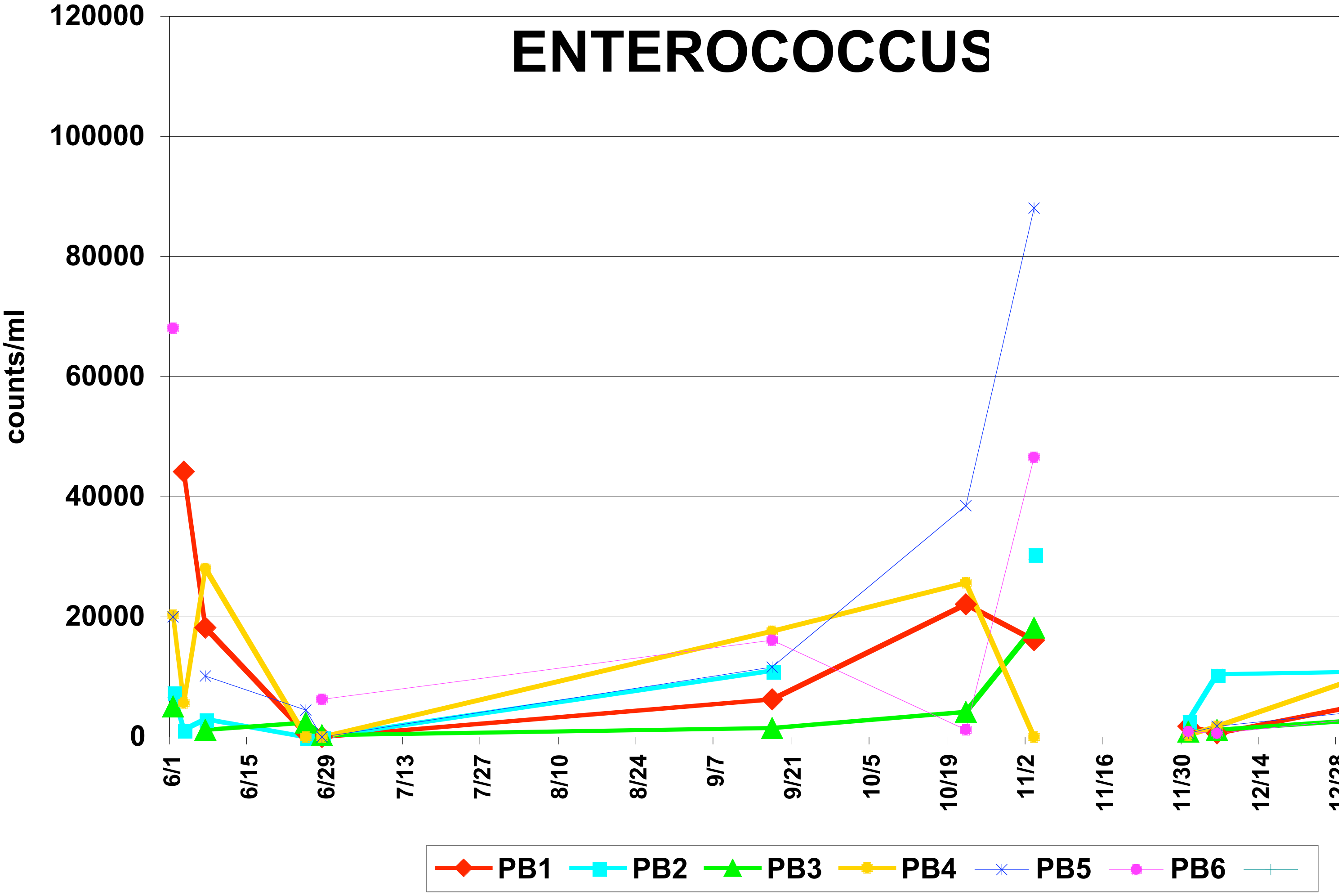

Figure 2. Graph of Fecal streptococcus levels in runoff water collected from the 6 bermed areas and reported as counts/ml water.

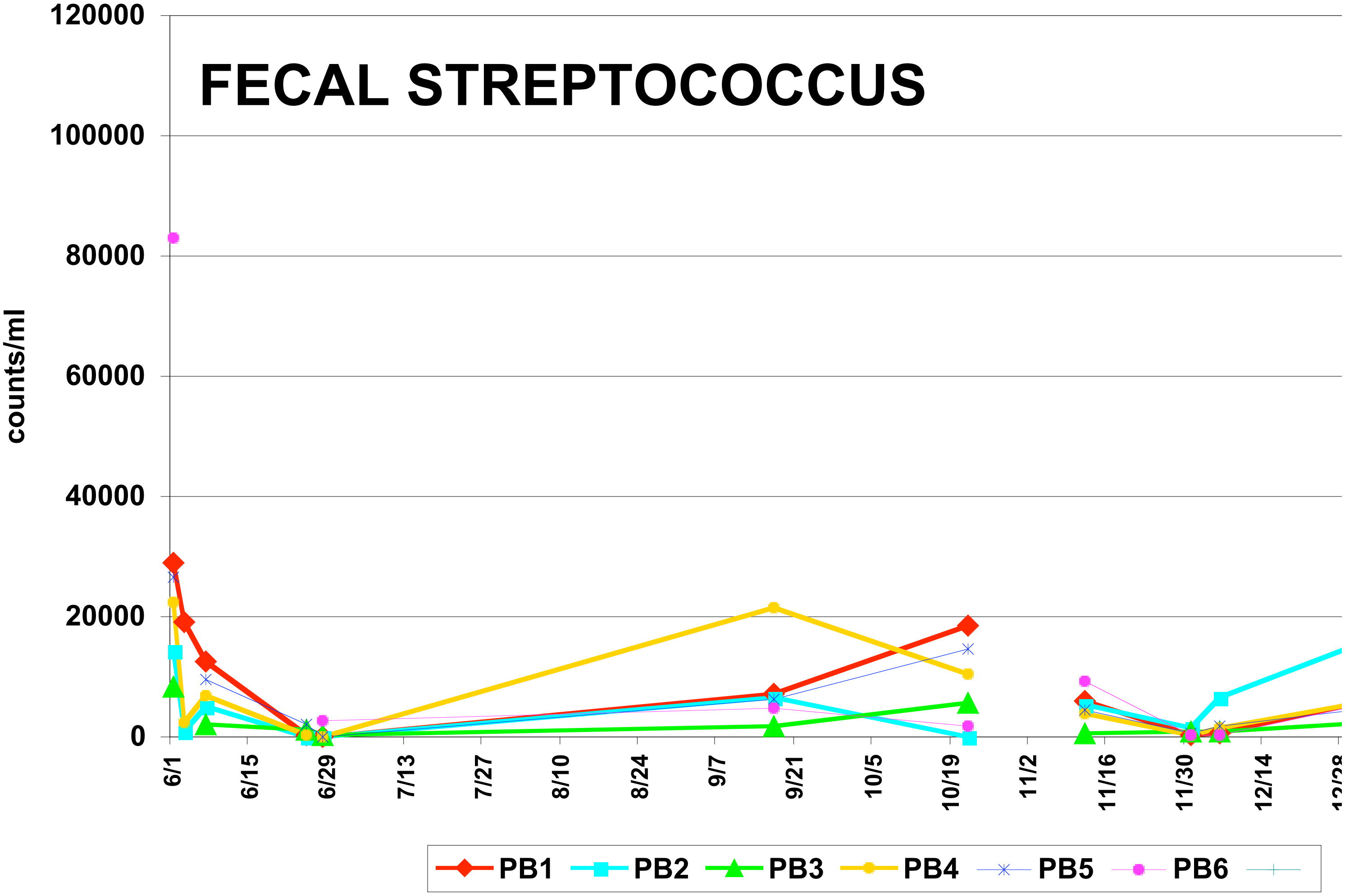

Figure 3. Graph of the E. coli levels in runoff water collected from the 6 bermed areas and reported as counts/ml water.