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Abstract
One of the challenges regarding implementation of a national animal identification system is the logistics of reading and reporting EID (electronic identification) tag numbers as cattle move through the production cycle. Many small producers would have difficulty justifying the investment required to install an RFID (radio frequency identification) reader system that would only be used seasonally to track relatively small numbers of cattle that are entering commerce. A proposed solution to this issue is to install an RFID reader on commercial cattle trailers so that cattle can have EID tags read as they are loaded and unloaded during transport from one premise to the next. With such an arrangement, the RFID equipment would be used often by a small number of highly trained people in the transport sector and the cost could be spread over a large number of cattle hauled over the life of the reader. The goal of this study was to evaluate the performance of a trailer-mounted RFID reader, in one location, using four prominent brands of commercially available EID tags.

Keywords
Cattlemen's Day, 2007; Kansas Agricultural Experiment Station contribution; no. 07-179-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 978; Beef; Cattle; EID (electronic identification); RFID (radio frequency identification)

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TRAILER-MOUNTED RFID READER SCANS EID TAGS DURING CATTLE SHIPMENTS

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Introduction

One of the challenges regarding implementation of a national animal identification system is the logistics of reading and reporting EID (electronic identification) tag numbers as cattle move through the production cycle. Many small producers would have difficulty justifying the investment required to install an RFID (radio frequency identification) reader system that would only be used seasonally to track relatively small numbers of cattle that are entering commerce. A proposed solution to this issue is to install an RFID reader on commercial cattle trailers so that cattle can have EID tags read as they are loaded and unloaded during transport from one premise to the next. With such an arrangement, the RFID equipment would be used often by a small number of highly trained people in the transport sector and the cost could be spread over a large number of cattle hauled over the life of the reader. The goal of this study was to evaluate the performance of a trailer-mounted RFID reader, in one location, using four prominent brands of commercially available EID tags.

Experimental Procedure

Fifty tags from each of the four selected tag manufacturers were purchased through an independent distributor in an effort to be certain that the tags used in the project were of "off the shelf" quality and typical of what a producer would purchase for commercial use. All of the tags were tested in a laboratory environment using a trolley system that presented the tags to two different brands of panel readers at the best orientation (the front of the tag facing the reader). Read distances for all 200 tags were analyzed to reveal whether the measurements recorded by the two different readers correlated. The correlation between readers was 0.47 which indicated that the read distances from the two readers were not similar or comparable. The tag testing data from the reader produced by a company that is not a producer of RFID tags was used for the experiment, assuming that this reader would be less biased toward any certain brand or design of tag and tuned in a more neutral manner. Average read distances were calculated for each tag brand. Thirty tags from each brand, which were closest to the mean read distance, were selected in an effort to eliminate tags that were inferior or exceptional in read range performance. The tags that were placed in the cattle were randomly selected from the thirty retained from each brand.

Twenty-four mixed breed steers (650 lb) were used for the reader performance testing. These steers were divided into four groups of six head that represented the four tag brands. After completing the brand group testing, these same cattle were reassigned as three groups of eight head with two tags of each brand making up each mixed group. Four hundred reads per brand of tag as brand groups and mixed groups were needed to generate the statistical confidence intervals desired for this experiment.

Reader testing was completed in sessions. Each session consisted of six round trips on

and off the trailer, or twelve runs through the reader. Each tag brand was tested during one session per day over six days. This schedule created seventy-two read opportunities per session multiplied by six sessions, yielding a total of 432 read opportunities per brand. The mixed-tag-brand groups were tested following the brand specific groups. Each of the nine mixed tag testing sessions consisted of eight runs. This schedule also yielded 432 read opportunities per tag brand. By dividing the testing into sessions, the cattle were not overworked, leg and hoof injuries were avoided, and changes in reader performance due to weather or environment could be observed. Unfortunately, the weather conditions varied only slightly throughout the entire testing period.

The cattle were loaded and unloaded through a 31-inch wide, 20-foot long, steel framed, semi-portable loading chute with a wood floor that is quite typical of what would be used at a commercial facility. The trailer used was a 1983 Wilson 96-inch wide by 48-foot long, all aluminum double deck with a 36-inch wide door. This unit is also very typical of what is used for commercial livestock transport. The cattle were loaded and unloaded from the upper deck of the trailer only. Preliminary testing revealed that this was the safest means for the cattle to enter and exit the trailer repeatedly. The floor of the upper deck was covered with rubber stall mats and wood shavings to create a surface that was quiet, dry and easily negotiated by the cattle. The trailer ramp and loading chute floor were also covered with wood shavings to improve the footing and protect the cattle from hoof and leg injuries.

Results and Discussion

Reader performance varied greatly across different brands of tags. Tag construction dictates how sensitive a tag will be to changes in orientation. Orientation is the position that the tag is in when it is presented to the reader. The orientation that produces the best read distance and performance is parallel orientation. This means that the face of the tag is parallel with the reader panel. Perpendicular tag orientation decreases read distance and tag performance. This means that the face of the tag is at a 90-degree angle to the reader panel. Sensitivity to orientation varies greatly across brands of tags and will differ with the use of various readers. Tags from brand A and brand B have copper wire that is wound to form the field used to receive the energy from the panel reader. Because of this design these two brands are less sensitive to orientation changes and therefore have greater read rates. Brands C and D have a flat copper disc used to form the field and receive the energy emitted from the reader panel. This design prevents optimal performance, as the tags read poorly at an orientation perpendicular to the reader panel. The following tables show reader performance using the four brands of tags in brand specific groups, mixed groups, and as an aggregate. Read rates for cattle entering the trailer (loading) are noticeably greater than read rates for cattle exiting the trailer (unloading). This is likely due to the speed and bunching at the door that occurred as cattle were moving through the reader while unloading. Movement through the reader at loading was much slower and the animals maintained a single-file order that resulted in better read rates.

Implications

Performance of RFID systems depends strongly upon tag quality and interactions between tags and readers. Trailer-mounted readers present an option for recording and reporting cattle movements to the proper authorities without the investment and training required with ownership of an RFID system.

Table 1. Read Rates of Tag Brands with Brand Groups and Mixed Groups Combined; Presented as Total Reads, Loading and Unloading

Brands	Read Opportunities	Tags Read	Percentage Read	Percentage Missed
Tag Brand A	734	702	95.6	4.4
Loading	378	360	95.2	4.8
Unloading	356	342	96.1	3.9
Tag Brand B	788	691	87.7	12.3
Loading	402	367	91.3	8.7
Unloading	386	324	83.9	16.1
Tag Brand C	782	349	44.6	55.4
Loading	396	217	54.8	45.2
Unloading	386	132	34.2	65.8
Tag Brand D	716	380	53.1	46.9
Loading	366	221	60.4	39.6
Unloading	350	159	45.4	54.6

Table 2. Read Rates of All Brands Combined; Presented as Total Reads, Loading and Unloading

Brands	Read Opportunities	Tags Read	Percentage Read	Percentage Missed
All Brands	3020	2122	70.3	29.7
Loading	1542	1165	75.6	24.4
Unloading	1478	957	64.8	35.2