

Title: Utilizing RFID Technology in Dairy Herds for Daily Herd Management and Laboratory Sample Submissions

Overview: Minnesota DHIA, Valley Ag Software, and the University of Minnesota's College of Veterinary Medicine are currently conducting a **dairy** project on nine Wisconsin dairies utilizing RFID technology. This project will be exploring potential value-added opportunities for use of cattle RFID. The areas being explored include the use of RFID technology in daily herd management and the incorporation of the RFID identifier into labeling of milk and blood samples for submission to diagnostic labs for disease testing.

**Updates One and Two (Activities August 15 to October 15)
09/15/04 and 10/15/04**

Quantitative Results 08/15/04 to 09/15/04:

Number of premises tagged: 3 premises (3 premises to date)
Number of animals tagged: 2,358 animals (2,358 animals to date)
Number of animals sampled: 2,358 animals (2,358 animals to date)

Summary of Tagging and Sampling Activities

Week of August 30

2,358 animals on three premises were tagged.

Premise	#Tags	Date
Premise#1	989	09/03/04
Premise#2	955	09/01/04
Premise#3	414	08/30/04

A file in USAIP format was produced for these premises.

Whole blood samples were obtained at three premises from 2,358 animals.

Premise	#Samples	Date	Type Sample
Premise#1	989	09/03/04	Whole Blood (DNA)
Premise#2	955	09/01/04	Whole Blood (DNA)
Premise#3	414	08/30/04	Whole Blood (DNA)

During the week of August 30, 2004, the project participants placed RFID eartags in 2,358 adult cattle on three premises, read the eartags using a Bluetooth reader wireless into a Dell Axim, and transferred the data into a dairy management database (DairyComp305). Whole blood samples were obtained for later DNA analysis. Approximately 2,000 of the animals were processed in management rails while the remaining animals were processed in headlocks.

All blood samples were divided in half and labeled with cow information and premise information. The unique 15 digit RFID identifier for each animal was both printed in human readable form and incorporated into a barcode that was

placed on the vial used for ultracold storage. Other information on the label included the DHIA herdcode and the management ID of the animal.

Data were recorded during the tagging and sampling to assess error rates in visual ID recording. ID recording was compared in three ways prior to release of the cattle: By electronic reads of the RFID tag, by paper recording to cross match visual ID to the RFID, and by hand labeling of the initial samples. Error rates were typically 1-2 per hundred animals and largely occurred at the point of the vial labeling (blood samples were obtained from tail vein).

Quantitative Results 09/15/04 to 10/15/04:

Number of premises tagged: 2 premises (5 premises to date)
Number of animals tagged: 130 animals (2,488 animals to date)
Number of animals sampled: 0 animals (2,358 animals to date)

Summary of Tagging and Sampling Activities 09/15/04 to 10/15/04

130 animals on three premises were tagged.

Premise	#Tags	Date
Premise#4	80	10/13/04
Premise#5	50	10/13/04

A file in USAIP format was produced for these premises.

On October 13, 2004, the project participants tagged an additional 130 animals on two more premises. A battery operated BlueTooth reader was utilized in these cases. The tags were read wireless into a Dell Axim and data transferred into DairyComp305. Milk samples will be taken from these herds later.

During early October the participants also finalized the ability to print wirelessly via WiFi and via serial cable from a Dell Axim to a portable Zebra label printer. Labels are being printed that include the cow's management ID, date, DHIA herd code, premises ID, and 15 digit RFID. All information appears on the label as both human readable text and within a barcode. This printer will be used to print labels for sample identification immediately after the reading of an RFID eartag. This will eliminate the need for hand written labeling of samples and should lessen errors considerably.

All information from tagged animals was also incorporated into the proper format for animal identification using the USAIP format. This information was then sent to WLIC for further testing of proper formatting.

Issues Identified in Activities to Date

- Tagging of animals in management rails presents a degree of challenge, especially if the personnel tagging must not interfere with normal parlor flow. Tagging in feedline headlocks presents much less of a problem.
- Errors were present in sample identification. These errors were present in spite of extra care during this project and points out the possibility for (even greater?) misidentification of samples and the need for electronic reading of identification and minimizing hand labeling of samples. Direct printing of labels should lessen or eliminate these errors.
- BlueTooth and handheld computer technology need to be examined more carefully to determine the effect of electrical interference on function.

Update Three (Activities October 15 to November 20)**11/20/04**Quantitative Results 10/15/04 to 11/20/04:

Number of new premises tagged: 3 premises (8 premises to date)
 Number of new animals tagged: 542 animals (3,030 animals to date)
 Number of new animals sampled: 149 animals (2,358 blood, 149 milk total)

Summary of Tagging and Sampling Activities

542 animals on three premises were tagged.

Premise	#Tags	Date
Premise#6	309	11/19/04
Premise#7	176	11/18/04
Premise#8	57	11/18/04

A file in USAIP format was produced for these premises.

Milk samples were obtained at three premises from 149 animals.

Premise	#Samples	Date	Type Sample
Premise#6	35	11/19/04	Milk (Mastitis Culture)
Premise#7	40	11/19/04	Milk (Mastitis Culture)
Premise#8	31	11/18/04	Milk (Mastitis Culture)
Premise#5	43	11/17/04	Milk (Mastitis Culture)

Summary of Tagging and Sampling Activities

Week of Nov 7

2,000 of the 3,000 loose AllFlex tags were read into the CowCard Axim and assigned to bags of 25 tags. Paper sheets and electronic files listing the EIDs of the 25 tags were produced for each bag.

Nov 15

Met at MNDHIA to finalize upcoming activities, train on program updates, load herd data into computers and Axims, and review hardware setups.

Herds Sampled

Milk cultures with barcoded labels (printing initiated from Axim after reading tags with BlueTooth wand reader) were taken at 4 herds. Labels contain CowID, PremiseID, DHIA Herdcode, 15 digit RFID, and Date in both human readable form and embedded in barcode.

Training materials

Videos and snapshots of procedures associated with tagging, reading of tags, and assignment of tags to management IDs were taken on Nov 18-19 and are being assembled into training materials.

Update Four (Activities November 20 to December 11) 12/11/04

Quantitative Results 11/20/04 to 12/11/04:

Number of new premises tagged: 1 premises (9 premises to date)
Number of new animals tagged: 339 animals (3,369 animals total)
Number of new animals sampled: 217 blood/80 milk
(2,575 blood, 229 milk total)

Summary of Tagging and Sampling Activities 11/20/04 to 12/11/04

Week of Nov 22

All remaining loose AllFlex tags (~800) were read into the CowCard Axim and assigned to bags of 25 tags. Paper sheets and electronic files listing the EIDs in each bag were produced.

Dec 9

One additional premise ID assigned (9th and final herd in project). Herd was tagged and a file in USAIP format was produced for this premise.

Premise	#Tagged	Date
Premise#9	122	12/09/04

207 additional animals tagged at premise Premise#3 (post-project).

Premise	#Tagged	Date
Premise#3	217	Sept thru Dec 2004

Herds Sampled

Milk cultures with barcoded labels were taken at 2 tagged herds. Labels contain CowID (BarnName at Premise#9), PremiseID, DHIA Herdcode, 15 digit RFID, and Date in both human readable form and embedded in barcode.

Premise	#Sampled	Date	Type
Premise#4	40	12/08/04	Mastitis Milk Culture
Premise#9	40	12/09/04	Mastitis Milk Culture

Milk culture results from the previous 4 sampled herds have already been mailed.

Results from the above 2 herds should be completed and mailed prior to Dec 15.

Final Summary

Date:

12/15/04

Quantitative Results 08/15/04 to 12/15/04:

Number of premises tagged: 9 premises

Number of animals tagged: 3,369 animals

Number animals sampled: 2,575 blood, 229 milk

Summary of Tagging and Sampling Activities – Entire Project

Tagging and Sampling Activities Summary (All Bovine, Dairy):

Premise	#Tags	Date	#Samples	Date	Type	Status
Premise#1	989	09/03/04	989	09/03/04	Blood (DNA)	Completed -80C storage Barcoded
Premise#2	955	09/01/04	955	09/01/04	Blood	Completed
Premise#3	414	08/30/04	414	08/30/04	Blood	Completed
Premise#3	217	Ongoing	217	Ongoing	Blood	Post Project
Premise#6	309	11/19/04	35	11/19/04	Milk	Completed Mastitis Culture
Premise#7	176	11/18/04	40	11/19/04	Milk	Completed
Premise#8	57	11/18/04	31	11/18/04	Milk	Completed
Premise#4	80	10/13/04	40	12/08/04	Milk	Completed
Premise#5	50	10/13/04	43	11/17/04	Milk	Completed
Premise#9	122	12/09/04	40	12/09/04	Milk	Completed
Totals	3,369		2,575 Blood (Duplicate samples for DNA @-80C) 229 Milk (Mastitis cultures)			

Sampling Processes

Blood Samples

Tagging

1. Recorded management ID on paper (list of RFIDs in bag of 25 tags)
2. Placed RFID eartag into left ear
3. Read RFID tags with Bluetooth wand reader
4. Sent RFID from reader to Axim PDA after tagging each animal
5. Assigned RFID to proper management ID in Axim PDA

Sampling

1. Drew blood from each animal into vacutainer EDTA blood tube
2. Labeled tube with management ID

Cross-matching of samples and RFID at site of collection:

1. Groups of 25 blood samples were cross-matched with each sheet of 25 RFID/management IDs and with Axim record
2. Potential errors were noted and corrected

Setup after completion of all tagging and sampling (end of each day):

1. RFID read into management software from Axim at end of day
2. RFID read into spreadsheet
3. Computer attached to barcode printer with cryogenic safe labels

Sample processing of each tube:

1. Management ID read from tube
2. Label produced from spreadsheet:
 - a. Human readable text:
 - i. Date
 - ii. Management ID
 - iii. RFID (15 digits)
 - iv. DHIA herdcode
 - b. Barcode: 15 digit RFID (barcode 128)
3. Blood poured into 2 cryogenic storage tubes
4. Labels placed on both tubes
5. Position in storage rack noted
6. Placed into regular freezer for 24-48 hours
7. Transported to University and placed in -80C freezer

Sampling Processes

Milk Samples

Tagging

1. Recorded management ID on paper (sheet had list of RFIDs in bag of 25 tags)
2. Placed RFID eartag into left ear
3. Read RFID tags with Bluetooth wand reader
4. Sent RFID from reader to Axim PDA after tagging each animal
5. Assigned RFID to proper management ID in Axim PDA
6. RFID read into management software from Axim at end of tagging

Sampling during milking

1. RFID tag read by BlueTooth wand
2. Cowcard with management ID displayed by PocketDCPrint Axim
3. Label produced directly from Axim to Zebra QL320 via 802.11b
 - a. Human readable text:
 - i. Date
 - ii. Management ID
 - iii. RFID (15 digits)
 - iv. DHIA herdcode
 - b. Barcode: 15 digit RFID (barcode 128)
4. Milk sample obtained and labeled with printed label
5. Placed on ice immediately, then frozen within 12 hours
6. Transported to University for cultures
7. Cultured for mastitis bacteria
8. Results mailed to dairies

Equipment utilized

Portable Digital Assistant

Dell Axim X30 Intel 624MHz, 64 ROM, 64MB RAM, 802.11b WiFi, BlueTooth

Portable Printer

Zebra QL320 Printer with WiFi 802.11b

BlueTooth Wands

ABS/AgInfoLink TagTracker Wand

Digital Angel BlueTooth Wand

CryoLabel Printer

Zebra TLP3842 (300 DPI DeskTop Printer) USB connection

Software utilized

PDA software

CowCard (PocketDC) Valley Ag Software

CowCardPrint (PocketDCPrint) Valley Ag Software

PrinterCE.NetCF SDK FieldSoftware Products

{Windows Mobile Print Drivers}

PC software

DairyComp305 ValleyAgSoftware

Excel Microsoft

LabelVista Zebra

Data Transfers

PocketPC ↔ DairyCOMP305 → Excel

Dell Axim Computer

VAS Microsoft

Hardware Interfaces

- Dell Axim ↔ Computer
USB, WiFi 802.11b
- Dell Axim ↔ Zebra printer QL320
WiFi 802.11b, RS232 serial cable
- Dell Axim ↔ RFID readers (AgInfoLink and Digital Angel)
BlueTooth
- Computer ↔ Zebra printer TLP3842
USB cable

Findings

1. Placing eartags, recording data, and taking samples in management rail or in parlors takes a great deal of organization and labor in order to not interfere with parlor flow. These same processes are much easier in feedline lockups and individual chutes.
2. These items greatly ease cross-checking and tracking of tags:
 - a. Manufacturer packages tags in bags of 25.
 - b. Manufacturer produces an electronic file of RFIDs by bag.
 - c. Paper form to record management ID for PDA backup useful.
 - d. Consecutively numbered tags (not yet available) should decrease mistakes.
3. Mistakes with recording management IDs onto blood tube labels were typically 1-2 in 100 animals. These errors occurred despite having a very competent person assigned to this task. Since hand recording on labels is still the most common method in the industry and is likely not done as carefully, this implies error rate for mislabeled samples in other conditions may be higher. This re-enforces a definite need for the premise of this project – integrated electronic identification of animal and samples.
4. Bluetooth readers may have issues with electrical interference.
5. Considerable battery power for PDAs with wireless is required.

Accomplishments

1. Identification of equipment and software for use in the project
2. Label printing
 - a. Interfaced Axim directly to Zebra QL320 portable barcode printer
 - i. Located Axim print drivers (Fieldsoftware – PrintCE)
 - ii. Developed WiFi peer-to-peer Axim to Zebra interface
 - iii. Developed RS232 serial cable interface Axim to Zebra
 - iv. Refined barcode label options
 - b. Developed print drivers for barcoded labels
 - i. Directly print from Axim PocketDCPrint to portable Zebra printer
 - ii. Print from Excel for desktop Zebra for cryogenic labels
 - c. Identified labels for various uses
 - d. Developed barcodes with HerdID, PremiseID, Date, CowID,
3. Refinement of system for initial tagging and RFID assignment
 - a. Restraint of animals
 - b. Axim management software
 - c. Tag organization
 - d. Paper records for reference
 - e. Crossmatching
 - f. Interface with management software on PC
4. Information in USAIP was submitted from the 9 premises (3162 animals).
5. Training material was assembled.