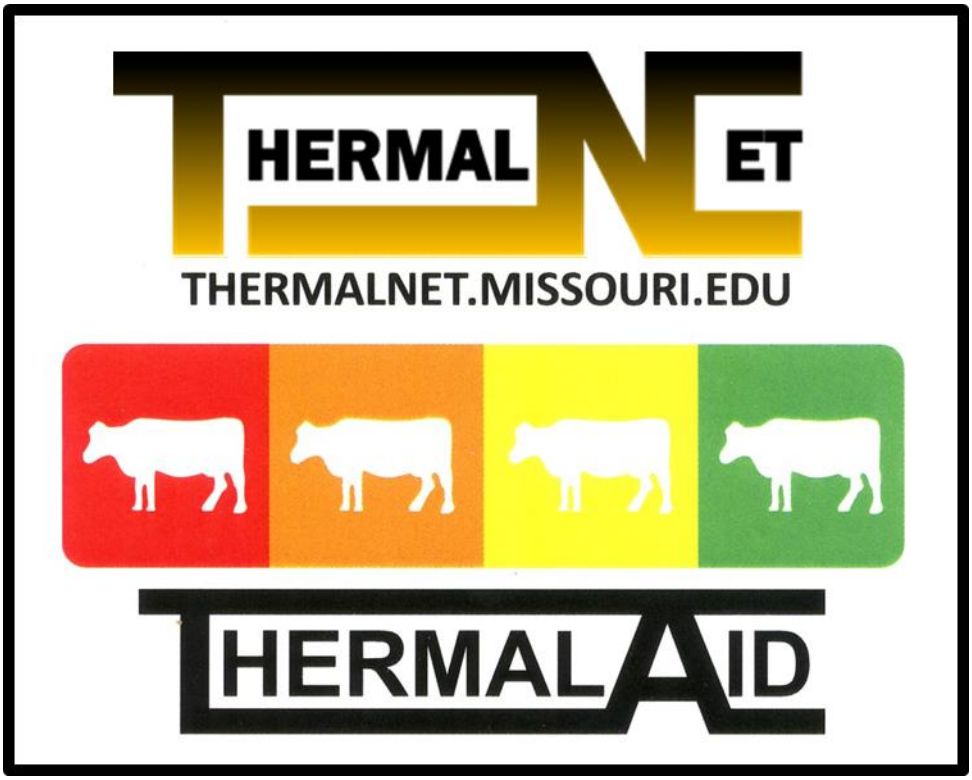

MU Information Technology Committee
Interdisciplinary Innovations Fund
2012-2013 Final Report
ATTN: GeJuan Cochran

A Practical, Multiplatform App for Climate Stress to Aid Animal Producers and Science Education

Faculty Project Leaders:
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Introduction

Initial Project Description:

Climate variability is a concern in a number of sectors, particularly in the Agriculture industry. The National Climatic Data Center for the US announced on September 9, 2011 that last summer was the hottest in 75 years, with the greatest impact in Texas and neighboring states of Oklahoma, Kansas, Arkansas and Missouri. The result was daily appearance of news stories regarding losses of livestock and productivity, which during a normal year amount to $897, 369, and 299 million for dairy, beef, and swine industries, respectively. Thermal stress indices have existed for years for these groups, but are underutilized because they require elaborate combinations of environmental (e.g., weather) and physiological (e.g., body temperature) data. There is also increased concern that student interest in science, at both high school and college levels, is declining, and that the United States could be at a disadvantage in solving complex problems of the future such as climate variability due to a lack of qualified scientists. It has been suggested, that the traditional read, recite, regurgitate models for teaching science are ineffective ways to motivate students to learn science, and help them understand and retain science concepts. D.A. Kolb noted that an experiential approach increases interest of youth in science. Experiential learning in the sciences includes gathering the facts surrounding a problem, reflecting on the findings, formulating ideas, and finally testing them, and generating new knowledge. A mechanism to facilitate this process using advanced instructional technologies that are more engaging to a technology-oriented generation of learners will stimulate interest in and learning of science. Our proposal is to develop a native smart phone app (Apple and Android) that combines weather information (both current and projected) with individual animal information to aid the producer in the decision-making process to reduce heat strain and improve animal welfare. At the same time, the app will be a learning device that attracts and stimulates student interest in climate and environmental stress related to themselves and their production animals. Our approach will use students in the "Team-Based Mobile Application Development" course (College of Engineering, IT Program, and School of Journalism) together with CAFNR undergraduate students trained in environmental physiology to develop the prototype. The educational component will require input from a select group of high school/college students in 4-H and FFA (and related agricultural youth organizations), with backgrounds in animal science and a strong interest in using technology to improve animal production and welfare. These students will collaborate with others in the app design and evaluation course for a truly multidisciplinary learning experience. This product will then be promoted, displayed, and tested in select venues, such as CAFNR field days and at the Missouri State Fair.

Original Project Goals/Objectives:

1. Provide a practical tool for individuals working with large domestic animals that allows them to identify, monitor, and ameliorate heat stress to improve animal welfare;

2. Create an interactive opportunity for high school and undergraduate students to develop a device that combines state-of-the-art instructional technology with an appealing, public relations display that attracts science students and agricultural producers;

3. Contribute to CAFNR's mission of providing research, teaching, and extension support to the citizens of Missouri, and RJI's additional goal to increase public interaction with the news media;

4. Expand on computerized decision-making tools at MU Extension relating animal health and climatology;

5. Generate an educational device that increases student interest in climate and its impact on human and nonhuman animals;

6. Develop a platform that will be a cornerstone of a USDA or NSF grant application to refine the app for public distribution, and ultimately support MU's goal of entrepreneurship.

Original Management Plan:

November 2011:	Select and recruit students in the environmental physiology course; begin cattle training. These animals have a port (i.e., fistula) in their side for placement of state-of-the art temperature transmitters
December 2011:	Assemble faculty to initiate organizational activities; submission of Animal Care and Use Protocol to MU for cattle portion of the work once proposal is approved (this may require up to 2-3 months)
Early January 2012:	Plan information for students in the course; select students from FFA and 4-H
Mid January 2012:	First meeting of all student participants and faculty to discuss proposal and objectives; similar meetings will be held monthly or bimonthly through mid-May
Late January 2012:	Information provided students in app course and app development begins; begin training 4 animals for BEC
Early February 2012:	Students begin assembling databases from BEC to use in app evaluation
Mid February 2012:	Second meeting of all student participants and faculty
Late February 2012:	First workshop for students at Animal Science Research Center with presentations on science education, climate, and heat stress
Early March 2012:	Initial feedback from students in app course with prototype; students begin evaluating app using BEC databases
Mid March 2012:	Third meeting of all student participants and faculty; cattle enter BEC Environmental Chambers to begin adaptation
Late March 2012:	Second workshop for students at Animal Science Research Center with data collection on themselves and cattle in neutral and heat stress environments with involvement of the app
Early April 2012:	Data from the second workshop will evaluated and improvements on the app will be communicated to app developers
Mid April 2012:	Fourth meeting of all student participants and faculty; cattle return to BEC environmental chambers
Late April 2012:	Final workshop for students at Animal Science Research Center with further data analysis from the second workshop, further data collection if

	required, and final evaluation with feedback to app developers; file mid-project report to MUITC
Mid May 2012:	Final meeting of all student participants and faculty; communication with all participants will continue through the summer up to September 2012
Late May 2012:	Presentation of app by students and faculty at CAFNR Southwest Center in Mt. Vernon, MO. Attendees will include both US and New Zealand dairy producers who currently utilize app technology
August 2012:	Students and faculty spent several days at Missouri State Fair (Figure 6) to demonstrate the app in Beef, Dairy, and Swine Pavilions; posters and one-on-one interactions will be utilized
Summer/Fall 2012:	The app will be presented at field days presented by CAFNR throughout the state during this period; final report to MUITC

Project Outcome:

November 2011:	Selected and recruited students in the environmental physiology course; discussions began with students on development of app and what was needed
December 2011:	Assembled faculty to initiate organizational activities;
Early January 2012:	Planned information for students in the course;
Mid January 2012:	First meeting of all student participants and faculty to discuss proposal and objectives; decided that weekly meetings were needed with students
Late January 2012:	Information provided students in app course and app development began; decided that more interaction was needed between the 6 animal science undergraduates and the 6 students taking the app development course; weekly meetings initiated with both groups of students; some animal science students begin attending app development course
Early February 2012:	Instead of collecting additional data for the app, it was determined that the initial app development should be the focus; weekly sessions discuss app appearance and content
Mid February 2012:	Development of first science workshop for 4H and FFA students was delayed until April for more detailed development and allowance for more time to work on app content
Late February 2012:	Decided that a web site should also be constructed to provide more information on heat stress in addition to more educational material than would appear on app
Early March 2012:	Animal science students assigned tasks to gather specific information for web site; continued interaction with students constructing the app
Mid March 2012:	ThermalAid is selected as app name and ThermalNet (Figure 3) is set for the web site; weekly meetings focus on web site content along with videos and development of science boot camp
Late March 2012:	Continued development of ThermalAid and ThermalNet. Work on ThermalNet included development of student videos to be incorporated into the web site.
Mid April 2012:	Science Boot Camp I (Figure 4) was held with participation of the 6 undergraduate students plus graduate students as teaching assistants (see

	Appendix I) . Participants included FFA, 4-H, and underclass students at the University of Missouri. Students were provided ipods to collect videos that would be used in the second boot camp.
Mid May 2012:	*Final meeting of all student participants and faculty; At this point, we were informed that the app was not created by the students in the course and we would have to find an alternate source to create it. Likewise, the establishment of a business plan that was a component of the course was uncompleted. Without a product to promote, we had to redesign the remainder of the project. Drs. McKean and Musser recommended a former graduate of the course (Tyten Teegarden) to create the iOS version of the app and discussions began in May.*
June 2012:	Science Boot Camp II (Figure 5) was held with students who participated in the first camp. This camp was designed to give students experience collecting data and working with cattle. At the same time, they were to use the app prototype to gather data and the ipods to record additional videos. They initially tested themselves in our environmental chambers and then worked with the cattle. They received instructions on creating videos that were completed in the afternoon. A University reporter followed the students throughout the session to produce a document that would later air on National Public Radio.
July 2012:	News reports and coverage began at this time regarding the app that have continued through April 2013 (Appendix III). Preparations began for the Missouri State Fair. The PI on this project reported the findings to date at the International Livestock Environment Symposium in Valencia, Spain.
August 2012:	Students and faculty spent several days at Missouri State Fair to demonstrate the app in Science and CAFNR Pavilions; posters and one-on-one interactions were utilized (Figure 6).
September 2012:	Presented at the MU Southwest Farm Field Day in Mt. Vernon, Missouri. A poster was presented at the Mizzou Technology Day in Monsanto Auditorium.
October 2012:	A pitch was prepared and given for Mizzou Advantage funding to expand and complete work on the ThermalAid app. This was successful and work continues today.
November 2012:	Discussions began with individuals at Missouri Incubator in Columbia for creating a company around ThermalAid and the development of a Small Business Innovation Research (SBIR) proposal. The goal is to develop attachments for the app to monitor animals and their environment. Contact was made with HQ Inc. in Tampa, Florida to be a partner in this venture. Both the CEO and Program Development Officer came to MU at this time to discuss partnership. Likewise, we will visit with them in April 2013.
January 2013:	Computers on the Farm Presentation at Lake of the Ozarks (see Appendix III); MBA students from the University of Missouri accepted as a class project the development of a marketing plan for the app that included surveying both beef and dairy producers.

Mid-February 2013:	The PI presented the first in a series of four webinars entitled "Innovations in Agriculture and Rural Development" hosted by the North Central Regional Center for Rural Development at Michigan State University. The title of the webinar was "ThermalAid: Managing Heat Stress in Cattle".
March 2013:	ThermalAid was presented at a regional livestock specialist meeting held at the University of Missouri. A meeting was held with Teresa Bishop who manages Summers@Mizzou Camps for 4-H and youth development. Our goal is to work with her to create a weeklong session the focuses on science research in the areas of climate and environmental stress. The lessons learned at the 2012 Science Boot Camps (Figures 4, 5) will be utilized in developing this event. A meeting was held with Dr. Troy Sadler (Director - MU Science Education Center) on approaches to incorporate more hands-on experiences in the K-12 system. Plans are underway to work with him in the future in the area of climate and stress.
April 2013:	The iOS version of ThermalAid is completed and submitted to Apple for approval (Figure 2); work on the Android version begins plus work continues to develop a server at MU for logging of data collected using ThermalAid. Both activities are supported by Mizzou Advantage funds.
May 2013:	The MBA students submit the marketing plan for ThermalAid.

Orignal Requested Amount:

Funding for app development by Engineering, Computer Sci, and Journalism students	*$10,000*
iPod Touch 4G 8GB (8 for testing and demonstrations @ $205 each)	*1,640*
Undergraduate students in environmental physiology (4 students @ $500 each)	*2,000*
Incentives for 4-H and FFA students	*800*
Graduate student supervisor for data assembly, workshops, and demonstrations	*7,500*
Posters for demonstrations plus travel expenses for students and faculty to Missouri State Fair	*1,000*
MU BEC Workshop food and transportation costs (3 @ $350 each)	*1,050*
Compiling and maintaining climatology data + partial support for MU Conference "Computers On The Farm"	*1,000*
Total	**$24,990**

Final Expenditure of Funds

Below is a final breakdown of expenditures under the grant.

Total Salary (Includes undergraduate students and former students who returned to assist with the program)	*$9,183.30*
Total Benefits for the individuals	*$681.38*
Food (includes science boot camps and on presentation trips)	*$574.45*
Misc. supplies	*$327.59*
Hardware (includes ipod Touches and ipads for presentations)	*$5,793.02*
Supplies	*$1,332.26*
Server Development	*$1,000.00*
App Development	*$6,000.00*
Travel	*$98.00*
Total Grant Expenditure	**$24,990.00**

Final Goals/Objectives Realized

Goal/Objective 1: Provide a practical tool for individuals working with large domestic animals that allows them to identify, monitor, and ameliorate heat stress to improve animal welfare.
Status: The functionality for the producer side of the app for Apple IOS is complete and submitted to Apple for review. Weather data streams into the app for the appropriate geo-location (latitude and longitude) allowing of calculations leading to improved recognition of heat strain. The user can enter respiration rate for the animal in the field and the data is automatically stored, together with time, location, and ambient temperature for further viewing. This function was not part of the original plan, but after further discussion was thought to be important to help continually update the App. Students in the development class provided the framework for the App and accomplished many of these functions however, they were not completed by the end of the semester. Therefore, an App developer was hired to take what the students created and turn it into a finished product that is now about to be released in 2013 (Figure 2).
To Be Completed: The android version of the app is in development using extra funding from Mizzou Advantage and should be available mid-summer.

Goal/Objective 2: Create an interactive opportunity for high school students to develop a device that combines state-of-the-art instructional technology with an appealing, public relations display that attracts science students and agricultural producers.
Status: Six students from Departments of Computer Science and Journalism at MU focused on developing the heat stress app (ThermalAid) code. In addition, six undergraduate students in the Division of Animal Sciences, along with a PhD student, worked to provide them with relevant information needed to complete the App. At the same time, they worked to develop the accompanying web site (ThermalNet; Figure 3) which provides additional information to compliment the App. The animal science students also worked to develop the first workshop for high school and college students. Originally this proposal called for 3 workshops or science boot camps with 8 - 10 high school students. This was altered as a result of the unexpected delay in building the app. Two workshops and a trip to the Missouri State Fair (Figure 6) were held instead. Science boot camp I (Appendix I) was held on April 14th with 9 students. The proposal objective was to have only high school students; however, there were difficulties in finding students without conflicts at this time of year so 4 freshmen college students and 5 high school students were used. This work shop established a baseline of understanding of stress and climate and is the framework for Workshop II (Appendix II). The proposal called for the purchase or 8 IPods Touches, however, they were found online for a lower price allowing for the purchase of 2 extra for each student to have one. The Ipods were given to the students to take home between workshops to capture photos and video clips of climate and animal-related stress. The video clips and photos were then turned into Youtube videos by the students during the second workshop (http://thermalnet. missouri.edu/?page_id=1548). The original proposal called for the use of the Brody Environmental Chambers with the workshops. This was changed to working at the University Beef Farm, allowing for greater access to animals and a more realistic scenario.
To Be Completed: Interaction occurred with students at many different levels to construct ThermalAid and ThermalNet, and to use the different systems. Feedback from the students was continuously incorporated into their development throughout. This component of the proposal is complete.

Goal/Objective 3: Contribute to CAFNR's mission of providing research, teaching, and extension support to the citizens of Missouri, and RJI's additional goal to increase public interaction with the news media.
Status: Presentations were given to livestock extension specialist during their in-service training meeting in CAFNR and during the Reynolds Journalism Institute Innovation Week where it was streamed live over the internet. A presentation and proceedings paper entitled "Development of a smartphone application for heat stress detection and mitigation in livestock" was be presented at The Ninth International Livestock Environment Symposium in Valencia, Spain (http://elibrary.asabe.org/conference.asp?confid=iles2012). We also visited to the Missouri State Fair (August) and the Southwest Center Field Day (September) giving out surveys and taking feedback at each presentation (http://aes.missouri.edu/swcenter/aged12/index.stm). A presentation was given at the annual "Computers on Farm" conference which is a dedicated to the discussion of computer technologies for farm applications (http://www.columbiamissourian .com/a/157622/ farmers-technology-conference-introduces-new-phone-apps/, http://agebb. missouri.edu/cotf/). In addition, we have enlisted the help of academic support to create a video to advertise the video as well as to teach the producer how to use the App.
To Be Completed: Feedback from these venues will be combined with other evaluations to improve the functionality of the app.

Goal/Objective 4: Initialize a conduit for input from disconnected animal health and weather-related sources with new, decision-making output that is currently unavailable.
Status: Along with the development of ThermalAid, a website (ThermalNet; Figure 3) was developed. Though not part of the original proposal, it was determined that individuals would not examine a large amount of material in the field. Instead, a website could be the central resource of information for both producer and educators. Jim Reese, a web designed from the division of animal sciences, is helping to update and redesign the website created by the students. In addition, Genevieve Howard in CAFNR, will be critiquing the website design and material.
To Be Completed: The website and App will continue to be updated as needed.

Goal/Objective 5: Generate an educational device that increases student interest in climate and its impact on human and nonhuman animals.
Status: After much discussion with the app development participants, it was decided that instead that the app should focus on the production side and impact of heat stress on livestock. This would then be used for education as well by incorporating a manual component where one simulates any type of environment. Future work will create an education app that utilizes information gathered from the production app. Meanwhile, the new web site that is online serves as a central resource for educational materials, as well as up-to-date information on project research, events, videos, and programs.
To Be Completed: The website and App will continue to be updated as needed.

Goal/Objective 6: Develop a first, generation platform that will be a cornerstone of a USDA or NSF grant application to refine the app for public distribution, and ultimately support MU's goal of entrepreneurship.
Status: A Proposal was submitted to the Agriculture and Natural Resources Science for Climate Variability and Change section of the Agriculture and Food Research Initiative Competitive Grants Program. The grant was unsuccessful and it was suggested to submit an SBIR grant. We are currently working with a company in Florida, HQ Inc. to create an SBIR grant. This company has developed temperature sensors for humans. A pitch was also given to Mizzou Advantage for $25,000 to expand the App to create a network to reduce heat stress. This was successful and we are currently expanding the app and network beyond what was originally described.
To Be Completed: Nothing remains from the original proposal.

Technology Payoffs

The devices that were ultimately created over the last year was the combined effort of students (K-12, undergraduate, graduate), staff, postdoctoral fellow, faculty from multiple disciplines, and a professional app designer. None of this would have been successful without everyone involvement. Additional funding was leveraged as a result of this proposal that is allowing for the expansion beyond the original vision. Discussions with individuals at the Missouri Incubator in Columbia have provided us with future directions that include the development of an android version of the app and creation of attachments that send real-time information on ambient conditions and animals at the user's location directly to the app. A Small Business Innovation Research proposal is being planned to either NSF of DOD to support this work. In addition, we are in discussions with HQ Inc. (Tampa, Florida) to assist in the development of these devices. At nearly every presentation, we receive requests for similar devices for sheep, horses, and pets

that will be possible ventures in the future. Finally, we have received interest to develop such a device for humans. The challenges for all of these devices is to develop something that is inexpensive (less than $25, otherwise no one will purchase them), small, and transmits a reasonable distance. These are technological challenges that can only be addressed through SBIR support. With all of these systems, the ultimate goal is the establishment of a network as shown in Figure 1. The focal point of the network is ThermalAid which incorporates information from both the environment and animal into a product for the user. An arm of the network is the researcher or expert in the field. This will be incorporated into the system at a later date, and essentially allows the user to ask questions regarding their specific situation and receive detailed suggestions to reduce the level of stress.

Conclusions

Both a smartphone app (ThermalAid) and accompanying web site (ThermalNet) were created with a multidisciplinary group of students ranging from Animal Science to Journalism and Computer Science. They had to interact to accomplish this task. Versions of both devices were used in science boot camps with students from K-12 to early college. Results of this experience will be incorporated into future camps. Professional assistance was eventually utilized to create the final version of the app which will be submitted by the end of May 2013 to the Apple Store for release. This product has been presented to producers and described in various news publications. Discussions to expand the app are already in progress to develop the network shown in Figure 1. Ultimately, the goals of increasing student interest in science and providing a technologically advanced tool for producers to reduce livestock heat stress have been realized.

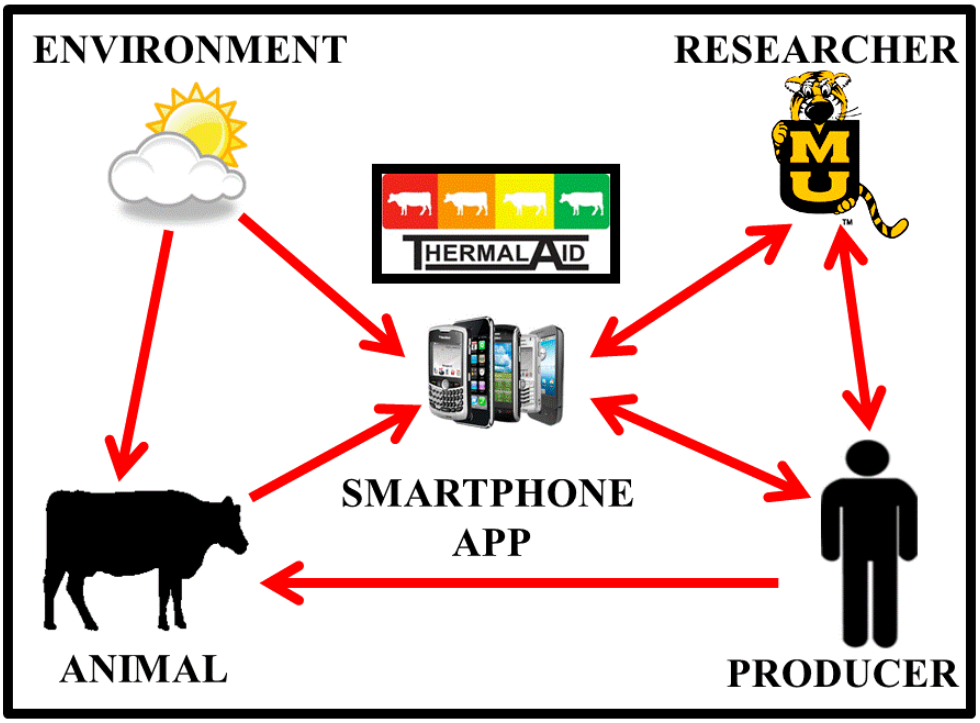

Figure 1: Diagram showing how the smartphone app helps to create an interactive network between the environment, producer, animal, and researchers.

Figure 2: Progression of the main screen design throughout the project from the student design to the product prior to Apple submission.

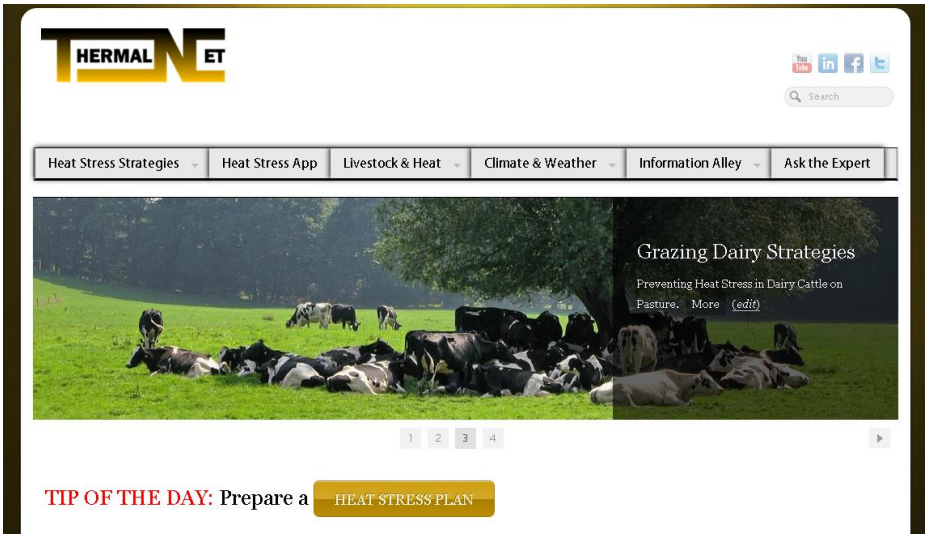

Figure 3: A screenshot of the introductory page for the ThermalNet web site.

Figure 4: Photos taken during Science Boot Camp I. **Right** – Students in the classroom discussing stress, climate, and the environment. **Left** – Students were given a tour of the weather station located in Sanborn Field.

Figure 5: Photos during Science Boot Camp II. **Top right** - Group discussions of the topics discussed during the first workshop. **Top left** – Students using video clips to create YouTube videos dealing with stress, climate, and the environment. **Bottom right and left**– Students taking respiration rate at the south farm.

Figure 6. Students from Science Boot Camps I and II together with undergraduate and graduate students interacting at the Missouri State Fair during Science Day in the Science Pavilion.

Appendix I – Science Boot Camp 1 Program

SCIENCE BOOT CAMP I

Stress and Climate

(April 14, 2012)

1. **Introductions and Survey - 0830 start**
    a. **Who are we?**
    b. **What do you expect this workshop to be?**
2. **Outline of project (30 minutes)**
3. **Science Research in General – (9:15; 30 minutes)**
    a. **What does a scientist really do?**
    b. **What are the problems and issues?**
    c. **Questioning science**
4. **Break (9:45)**
5. **Science of Stress (10:00; 60 minutes)**
    a. **How do you define stress?**
    b. **Things to consider**
    c. **Physiology**
        i. **What is the physiology of stress?**

ii. **Acute stress – Fight or Flight**
iii. **Chronic stress**

6. **Understanding and Working with Stress (11:15; 45 minutes)**
   a. **A few basic concepts**
      i. **Everything needs feedback**
      ii. **Control systems**
      iii. **Homeostasis versus allostasis**
7. **LUNCH – (1200; 60 minutes) –Sapolsky video**
8. **Temperature Stress (1:00; 60 minutes)**
   a. **A balance – heat production and heat loss**
   b. **Heat production**
   c. **Heat loss**
      i. **Conduction**
      ii. **Convection**
      iii. **Radiation**
      iv. **Evaporation**
9. **Break (2:00; 10 minutes)**
10. **Climate and weather – (2:10; 50 minutes)**
11. **Visit to a weather station (Sanborn Field) – (3:00; 60 minutes)**
12. **Bringing it all together (4:00; 60 minutes)**
    a. **Cover ipod touches – use of apps**
    b. **Video contest**
    c. **What have we learned today?**

Appendix II – Science Boot Camp 2 Program

SCIENCE BOOT CAMP II – Stress and Climate

(June 16, 2012)

1. **Welcome back (coffee, bagels?) (8:30 – 9:30)**
   d. **Tell how you've used or learned more about things from Science Boot Camp 1**

e. **Talk more about video competition**

2. **Hot and Cold experiment – hot room and freezer (9:30 – 10:30)**
3. **South Farm (11 – 1:30)**
    a. **Tour, Collect data**
    b. **Lunch in classroom, introduce App**
4. **Return to campus – Ag Building (1:45)**
    a. **Learn Movie Maker program; view videos from our group as examples (2 - 4)**
    b. **Use video shot at farm to make competition videos**
5. **Return to ASRC (4:15-5)**
    a. **App review and feedback survey**
    b. **Video competition**
    c. **Set up State Fair demo day**
    d. **Hand out T-shirts**

Appendix III – Press and Quotes

WABG (ABC) - Greenville, MS
Good Morning Mississippi

WABG 9/6/2012 6:02:10 AM: Help for cattle producers to reduce heat- related losses soon will be as close as the nearest smartphone. Livestock researchers at the University of Missouri are developing a smartphone app called Thermal- Aid. It will enable cattle producers to more conveniently and reliably monitor livestock conditions in relation to local temperature and humidity levels. Easy access to temperature/ humidity index readings will help producers more quickly determine when their cattle are heat stressed. A stopwatch-like feature of Thermal-Aid allows producers to count the number of breaths for an animal over a short interval. The producer then records the number and the app calculates the breaths-per- normal minute, or bpm. Respiration rate for cattle is around 40 bpm rates for cattle under heat stress can run as high as 160-to-180.

KQTV (ABC) - St. Joseph, MO

KQTV 9/5/2012 6:12:17 PM: This summer's oppressive heat made an impression on cattle farmers throughout the whole midwest. Researchers from the **University** of Missouri have developed a smartphone app aimed at keeping cattle safe during the hottest part of the year. KQTV's William Seay has more. Thanks to a new smartphone app livestock researchers at the University of **Missouri**'s College of Agriculture, Food and Natural Resources have developed Thermal-Aid which uses local weather conditions to monitor livestock conditions and determine if a farmer's cattle are heat-stressed.

"It's an easy way to not only determine how stressful the environment is but actually how stressful the animals are which is very important. "It 's important because heat stress has effects on a cow's production. The app has a stopwatch that can monitor a cow's breathing rates. High rates are a big indicator of heat stress, and stressed animals won't eat as much. Dairy cows will produce less milk, beef cattle would face lower growth rates. Producers can go in and detect which animals are more heat stressed in a particular setting and go to additional means to reduce the levels in those animals and not necessarily do it for the entire heard; the entire population **of** animals. "The app will help a farmer choose which animals will sit under cool mist, or even just sit in the shade. "The beauty **of** the app over time is that we'll be collecting data from the producers that will go into a large database that allows us to make even better predictions **of** how the animal will respond not only in Missouri, not only in the Midwest, but all over the country, "and that data could help further research which could potentially reduce cost for producers and consumers alike. The thermal aid app is still being developed and improved. Researchers hope the app will be available nationwide and worldwide by late fall.

The heat is on: Stress research gives producers new tools

Written by Heather Smith Thomas

Progressive Cattleman

Tuesday, 24 July 2012 12:00

New student research from the University of Missouri is utilizing data for smartphone apps that give producers the most current info on their cattle's body temperature.

Heat stress – and subsequent loss of production from lower weight gain (and death loss) – costs cattle producers millions of dollars each summer.

The annual impact on the dairy industry is about $897 million per year and estimated at $369 million per year in beef production.

Dr. Don Spiers, from the Division of Animal Science at University of Missouri, has studied heat stress for many years.

His current work involves development of a smartphone application (app) for producers to

identify heat stress at their specific location and its impact on their livestock.

"We're also developing a website for heat stress. Our group received a small grant from the University of Missouri to work with students in computer science and journalism, as well as in animal science, to put together an app that would allow producers to determine how hot their cows are or how hot they are going to be in the near future (during a heat wave) and give feedback on what they might do to prevent losses," says Spiers.

There are already some helpful tools for determining risks. Tami Brown-Brandl at the USDA Clay Center developed a heat stress index for beef cattle that uses respiration rate along with various characteristics of the animal.

John Gaughan at Australia's University of Queensland developed a heat stress index and panting score to help determine if cattle are in danger for heat stroke.

There's also the old temperature/humidity index, which uses air temperature and relative humidity and gives a rough idea of about how stressful it will be for animals.

"The problem is, no one uses these tools," said Spiers. "We need some way to make the information more user-friendly, to take the apps we're developing to the producers.

The apps are not finished yet, but eventually a producer can log in using the app and it will send in the producer's location and animal information to a central location and provide feedback.

"When you log on, it will give the air temperature and humidity in your region and a forecast for the future. We are setting up a prototype – the beginning of a network that we hope will eventually be worldwide."

Angus and Romosinuano breeds are being compared with monitors to gauge heat tolerance at University of Missouri. ***Photos courtesy of Don Spiers.***

It will also advise what to do for animals as heat stress increases during the summer, especially during a heat wave.

"The next step, if a producer wants, is to plug in the respiration rate of individual animals. Respiration rate is always a better indicator of the effect of heat stress than is air temperature and humidity," Spiers said.

Built into the smartphone app will be a stopwatch you can start with one finger while counting

flank movements of the animal.

You can count as many breaths as you want without having to look at a second hand. When you touch the button again on the stopwatch, it will automatically give you the breaths per minute.

"You can log in the animal ID number and respiration rate, and it automatically puts in the air temperature and humidity at that point in time for your location.

This will all go to a database where you can retrieve it later," says Spiers.

"You can look at what individual animals are doing and have a record for how they've handled heat in the past. Producers can keep tabs on this if they want followup on any particular animal," he says.

"The goal of this app is to be able to determine what the climate is going to be, with a focus on heat stress, over the next few days and to be able to collect data on your animals and go back and look at this and determine how they are doing." This will help producers make management decisions.

"One question was how much information do we want on a smartphone for the producer to read. Most producers out in the field won't want to take time to read things on a phone – as opposed to a website."

The website could have additional information, including short videos on how to measure respiration rate in a cow and how to measure body temperature.

"This site also gives more detailed information on what to do for current and future heat stress conditions," said Spiers.

Spiers adds that the app will allow producers to log in their weather data and their own animal data – breed, age and characteristics.

"With the producers' permission we can tap into that data and start to generate more accurate models to better predict the effect of heat stress across different breeds, types of animals, age groups, etc. around the state and the country.

Continuous updates of the app will make it an even better predictor of how much problem heat stress will be for these animals in the future," he explains.

Spiers feels the website will be a big step, enabling producers to utilize important information that can help them make management decisions that will prevent losses due to heat stress.

Genetics play a role in handling heat

Another facet of the Missouri studies has been genetics, looking at various breeds and types of cattle and ability to handle heat.

For several years they have compared different lines of Bos taurus cattle – which normally don't handle heat as well as Bos indicus animals like zebu (which include Brahman).

The researchers have been looking at Romosinuano, a very heat-tolerant Bos taurus breed originally from Costa Rica. The herd used in this study had been maintained for a number of years at a USDA facility in Florida.

"We put them in chambers and compared them with Angus to see what makes them more heat-tolerant. We also had some on pasture, with temperature transmitters in them, to monitor their temperature.

"We found that they do better in the heat, possibly because their metabolic rate is lower (associated with slower rate of growth). They produce less heat and therefore don't need to sweat as much or have as high a respiration rate to dissipate heat," explains Spiers.

Angus produce more heat because they expend more energy growing faster, like a dairy cow producing more milk. The industry has "revved up" Angus to grow faster.

"So we are looking into how to crossbreed them – how much of the Romosinuano breed to put into Angus to make them more heat-tolerant without losing too much growth."

A student last summer monitored body temperature and respiration rate of both breeds in the pasture and found that, as it got hot, the Romosinuano cattle didn't increase core body temperature at all.

Their respiration rate did go up (but not as high as Angus) because that's how they were getting rid of heat.

The Angus increased internal body temperature and respiration rate. By the end of summer, core body temperature of the Romosinuano cattle still had not changed but their respiration rates had come down (and so did the Angus) – they adapted better to heat.

The primary indicator of heat stress in all cattle is respiration rate. "This is why we are using it in our app. It's better than body temperature and also much easier to measure," says Spiers.

Pg. 56 www.FarmProgress.com – October 2012 Missouri Ruralist

Heat stress? Hey, MU's got an app for that

A NEW tool to help cattle producers reduce heat-related losses soon will be as close as the nearest smartphone. Livestock researchers at the University of Missouri's College of Agriculture, Food and Natural Resources, or CAFNR, are developing a smartphone app called ThermalAid, which will enable cattle producers to monitor livestock conditions in relation to local temperature and humidity levels.

FIELD-TESTED: Don Spiers demonstrates just how simple it is to use the smartphone with the ThermalAid app in the feedlot.
COURTESY UNIVERSITY OF MISSOURI EXTENSION

Easy access to temperature and humidity index readings will help producers more quickly determine when their cattle are heat-stressed, according to Don Spiers, a professor of animal science at MU CAFNR and leader of the research team developing the app. "ThermalAid is designed for use with beef or dairy cattle in pastures, feedlots or barns," says Spiers. "In addition to heat and humidity readings, this simple application will help producers more accurately calculate livestock respiration rates, which have a direct correlation to heat stress."

Farm-level features

A stopwatch-like feature of ThermalAid allows producers to count the number of breaths for an animal over a short interval. The producer then records the number, and the app calculates the breaths per minute, or bpm. Normal respiration rate for cattle is around 40 bpm. Rates for cattle under heat stress can run as high as 160 to 180 bpm. Heat-stressed cattle reduce their feed intake or stop eating completely, which lowers growth rates in beef cattle and milk production in dairy cows. Also, heat stress can compromise cattle immune systems and jeopardize overall health. In the U.S., heat-related losses in the beef and dairy industries can range into the hundreds of millions of dollars annually, says Spiers. ThermalAid is tied to a website, ThermalNet (*thermalnet.missouri.edu*), which the livestock research team developed to offer extensive information on how to detect and reduce livestock heat stress. Recommendations to alleviate stress and reduce body temperatures include providing additional shade or installing mechanical cooling systems, such as fans or misters. Altering the animals' diet is another alternative.

Information-sharing

"The beauty of the app is that over time, we'll collect information from producers.

HANDY HELP: A new smartphone allows livestock producers to calculate heat-stress levels in cattle. for a large database that will allow us to make even better predictions about how animals will respond to heat stress — not only in Missouri and the Midwest, but all over the country," says Spiers. Eventually, a global network will be created between producers and heat-stress specialists to provide site-specific ideas to alleviate the problem, and ultimately reduce costs to producers and consumers. "The science of determining heat stress from the environment has been in the literature for decades," Spiers notes. "Extension specialists have long talked about it with their cattle-producer clients. But ThermalAid can now place timely information immediately in their hands." Record heat in Missouri this summer has allowed the researchers to collect additional data to improve the app's usefulness and predictive value. researchers hope to have ThermalAid available for use by cattle and dairy producers statewide, nationwide and worldwide by late fall.

Source: University of Missouri Extension

Cattle heat-stress app at hand to help producers reduce weather-related livestock losses

University of Missouri Extension

Phil Leslie
Senior Information Specialist
University of Missouri Cooperative Media Group
Email: LesliePP@missouri.edu

http://www.youtube.com/watch?v=n5uNMH1X-pQ&feature=player_embedded

Published: Wednesday, Sept. 5, 2012

Story source:

Don Spiers, 573-882-6131

COLUMBIA, Mo. – A new tool to help cattle producers reduce heat-related losses soon will be as close as the nearest smartphone.

Livestock researchers at the University of Missouri's College of Agriculture, Food and Natural Resources (CAFNR) are developing a smartphone app called ThermalAid enabling cattle producers to more conveniently and reliably monitor livestock conditions in relation to local temperature and humidity levels. Easy access to temperature/humidity index readings will help producers more quickly determine when their cattle are heat stressed, according to Don Spiers, professor of animal science at CAFNR and leader of the research team developing the app.

"ThermalAid is designed for use with beef or dairy cattle in pastures, feedlots or barns," says Spiers. "In addition to heat and humidity readings, this simple application will help producers more accurately calculate livestock respiration rates, which have a direct correlation to heat stress."

A stopwatch-like feature of ThermalAid allows producers to count the number of breaths for an animal over a short interval. The producer then records the number and the app calculates the breaths-per-minute. Normal respiration rate for cattle is around 40 bpm. Rates for cattle under heat stress can run as high as 160-180 bpm.

Heat-stressed cattle reduce their feed intake or stop eating completely, which lowers growth rates in beef cattle and reduces milk production in dairy cows. Also, heat stress can compromise cattle immune systems and jeopardize overall health. In the United States, heat-related losses in the beef and dairy industries can range into the hundreds of millions of dollars annually, says Spiers.

ThermalAid is tied to a website, ThermalNet (ThermalNet.missouri.edu), which the livestock research team has developed to offer extensive information on how to detect and reduce livestock heat stress. Recommendations to alleviate stress and reduce body temperatures include providing additional shade or installing mechanical cooling systems, such as fans or misters. Altering the animals' diet is another alternative.

"The beauty of the app is that over time we'll collect information from producers for a large database that will allow us to make even better predictions about how animals will respond to heat stress, not only in Missouri and the Midwest but all over the country," says Spiers.

Eventually a global network will be created between producers and heat-stress specialists to provide site-specific recommendations to alleviate the problem, and ultimately reduce costs to the producers and consumers.

"The science of determining heat stress from the environment has been in the literature for decades," Spiers notes. "Extension specialists have long talked about it with their cattle-producer clients. But ThermalAid can now place timely information immediately in their hands."

Record heat levels in Missouri this summer have allowed the researchers to collect additional data to improve the app's usefulness and predictive value. Additional testing is planned for the next two months. Spiers indicates the researchers hope to have ThermalAid available for use by cattle and dairy producers statewide, nationwide and worldwide by late fall.

Spiers will demonstrate ThermalAid during field day activities at MU's Southwest Research Center Sept. 14, in Mount Vernon.

Livestock

App beats the heat for cattle

By **RHONDA DEDYNE**

IT'S a fact that heat stress creates problems for livestock and, consequently, for their human caretakers. An estimated $1 billion is lost annually in the dairy, beef and swine industries as a result of heat-stressed animals eating less, which means decreased milk production for dairy cows and less body mass for beef cattle.

The ability to accurately measure an animal's heat stress prior to that reduction in food intake would be advantageous for producers and critters alike.

Guess what? Now there's an app for that.

Thermal Aid is a smartphone app that combines information on both weather and respiration rate of livestock, which allows producers to make crucial decisions regarding environmental stress and animal welfare, says Don Spiers, a professor of environmental physiology at the University of Missouri, where the app was piloted and developed.

DON SPIERS

"Animals that experience rapid high and low temperature shifts can't adapt quickly to those changes," Spiers says, citing heat and drought conditions during the past two summers as an impetus for the research that led to Thermal Aid. "Incidences of temperature extremes are increasing, and while the Temperature Humidity Index has been around for a long time, most producers don't make good use of the charts, and it's really not the best tool. Thermal Aid delivers easy-to-use information and saves the data for future use."

How it works

The first step is to download the app. The Phase 1 version of Thermal Aid released in April is designed for iPhones; an Android platform should be available by fall. Information on a specific animal type can be entered via the device's touch screen.

Each animal's respiration rate is determined by counting its flank movements and using the built-in stopwatch feature to time cow breaths, similar to taking a human pulse. That number is plugged into the app together with the current air temperature and humidity, which automatically appear. The combined information of respiration rate and THI creates a visual picture of the animal's physical well-being.

Key Points

- Detecting heat stress in livestock has economic benefits.
- Smartphone app combines information on weather and respiration rate of livestock.
- Thermal Aid is not yet available for other animals besides cattle.

"Producers are able to view all the information to determine which animals show signs of heat stress," Spiers says, citing time as a benefit in preventing animals from becoming overly stressed. "Producers can limit their losses by early detection. Typically, it takes about three days for heat stress to affect an animal's feed intake, so heat stress detection early on will allow time to reduce the impact."

The price is right, too — cost of the Thermal Aid app is 99 cents.

"It was very important that this be inexpensive, as well as being able to provide timely, usable data," Spiers says.

Thermal Aid Pro next step

While Thermal Aid Phase I provides significant advantages compared to the cumbersome THI mathematical calculations, it does have limitations.

"Phase 1 is very general; there's no ability to define stressors by breed or allow for age and growth differentials. Plus, weather data that's pulled from GPS may not necessarily reflect what's happening across an entire operation at multiple feed lots or barns," Spiers says, noting cost is a factor in developing the second generation of Thermal Aid. "Ideally, we need temperature modules that could be placed in different locations on the farm site that will allow for real-time readings and inputs — that development is costly."

Spiers and the Thermal Aid team are working on securing grant funding or money from potential businesses to produce reasonably priced sensors.

Another challenge is data input and the increased potential for using additional information. "Manual entry is not ideal; getting an entire herd entered is difficult," Spiers says, adding that automated temperature sensors for each animal is an answer. But like the real-time temperature modules, cost is a factor. "You need to have a price point that's reasonable and producers can afford."

Thermal Aid Pro will also be equipped in the future to track heat stress on other livestock like swine, sheep, goats and poultry, as well as horses and pets.

"We know there's a lot of interest in using Thermal Aid for animals other than cattle, but that requires developing accurate heat stress equations for each animal type similar to how THI works. It will take time to gather the data and create those equations," Spiers says, adding that's also the case for different breeds within each category. "We simply don't have the equations yet for different breeds."

Getting the word out

What better way to disseminate information about a new app than via technology and its assorted mediums. In addition to the current ThermalNet website, users will be able to pick up how-to skills by watching YouTube videos and through social media sites and webinars. Producers in Michigan and adjoining states got a sneak peek at Thermal Aid before its April debut through a free webinar sponsored by the North Central Regional Center for Rural Development. The reception was good, according to webinar moderator John Mann.

"We had a lot of positive feedback from the participants," the post-doctoral fellow for NCRC says, noting that interest seems to fall into three groups. "Most questions from the webinar came from individuals who own livestock or work in related ag businesses, producers with technical questions and who have an interest in future apps for other types of livestock like sheep and horses, and academic folks — they're interested in the potential of data gathering for other applications and the collection process itself."

The diverse interest is music to the ears of Spiers. "In addition to being a benefit to producers, a goal of Thermal Aid is to create a network that will improve communication between producers and researchers and help create realistic models for future applications," he says, noting the increased awareness and visibility is valuable for another reason: funding. "Exposure can generate potential funding sources, and that will help us take the Thermal Aid app to the next level."

To view the NCRC webinar, visit *connect.msu.edu/p2jt71jqcz7*. Details on Thermal Aid is at *thermalnet.missouri.edu*.

Thermal Aid quick facts

- Smartphone application measures heat stress in animals using weather information and respiration rate of livestock.
- It is downloadable on iPhone and iPod devices; it will be available for Android platforms this fall.
- Cost is 99 cents.
- Information at the ThermalNet website, *thermalnet.missouri.edu*.

Dairy Briefs

Grant to look at Johne's disease resistance

A $3 million grant from USDA will study the genetic basis of resistance or susceptibility to Johne's disease over the next five years. The gastrointestinal disease, which is a contagious, untreatable and fatal, is ranked as one of the most costly diseases of dairy cattle. The objective of the study is to understand why only some cattle get sick following infection, and to determine if it is possible to breed cattle that are more resistant to the disease.

Outlook for dairy exports optimistic

U.S. dairy producers are boosting output, and that added production is heading overseas. Paul Rovey, U.S. Dairy Export Council chairman, notes that since 2003, U.S. milk production has risen 18%, and more than half that added volume, or 56%, has been sold overseas. Worries of a global oversupply of milk in 2013 may dwindle as the global market improves. Tom Suber, USDEC president, says "global economic signs are starting to move in a more positive direction." He notes even as milk powder inventories grow, stock levels appear manageable.

Cutting Cattle Losses - New Thermal App Lets Your Phone Pinpoint Heat Stress Mon Oct 1, 2012 11:01 AM CDT

By Virginia H. Harris
Progressive Farmer Associate Editor

A new phone app, ThermalAid, uses local weather conditions and a respiration rate calculator to identify heat-stressed animals. Don Spiers (shown) says the app is a way of putting Extension into

producers' hands. In the wake of a drought that won't soon be forgotten by farmers, students at the University of Missouri are putting the final touches on a smartphone app that will help cattle producers determine levels of heat stress in their animals. Don Spiers, professor of animal science at the University of Missouri, says the app, called "ThermalAid", is a way of putting Extension services in producers' hands. "The whole idea is wouldn't it be nice if we had an app that would put the heat stress level and recommendations right there in front of producers," Spiers explains. Heat stress raises normal cattle respiration rates from 40 breaths-per-minute (bpm) to as high as 160-180 bpm. Cattle suffering from this ailment reduce feed intake or stop eating completely, lowering growth rates in beef cattle and reducing milk production in dairy cows. Heat stress can also compromise the immune systems and damage overall health. Heat-related losses in the beef and dairy industries can reach hundreds of millions of dollars annually. Spiers says heat-stress indices have been available for nearly 50 years, but this app will be the first to put information directly in the producers' hands while in the pasture, barn or feedlot. He notes: "One of the earliest challenges was trying to determine what producers will use that's not too much information, but enough that they can make decisions." Those decisions can be made quickly because the app provides a summary of possible remedies for heat-stressed cattle. The app uses the producer's zip code to display local temperature and humidity conditions, and has a timer feature that allows calculation of an animal's respiration rate. As respiration rate has a direct correlation to heat-stress, this information can help producers tailor treatment for individual animals. Some of recommendations include adding sprays or misters to heat-stressed animals, only moving them prior to 8 a.m. or after sunset or altering their diets. Spiers says with the use of the app, producers can choose to save their information on a server located at the University of Missouri. This will allow farmers to track heat stress levels, while helping researchers formulate better predictions about animals and their responses to heat stress and heat stress remedies. ThermalAid is tied to a website, ThermalNet (ThermalNet.missouri.edu), which provides extensive information about detecting and reducing livestock heat stress. The app will be available in the Apple iTunes store in early November, with an Android version to follow later. To see a video of the app in use go to: www.youtube.com/watch?v=n5uNMH1X-pQ

Welcome to the Port-A-Cool Blog!
Smartphone App Helps Monitor Heat Stress in Cattle
Posted by Jane Burt on Thu, Sep 06, 2012 @ 08:44 AM

Cattle farming is going high tech with a new smartphone app. Researchers at the University of Missouri's College of Agriculture, Food, and Natural Resources have developed Thermal Aid, an app aimed at keeping cattle safe in the heat. The app uses local weather conditions to monitor if livestock may be suffering from heat stress. Thermal Aid is a smart phone app that combines information on both weather and/or respiration rate of livestock that allow producers to make crucial decisions regard environmental stress and animal welfare. The app is also a learning device that attracts and stimulates student interest in climate and environmental stress related to themselves and their production animals. "It's an easy way to not only determine how stressful

the environment is, but actually how stressful the animals are which is very important," said Don Spiers, MU professor of animal science at CAFNR and leader of the research team developing the app. It's important because heat stress has effects on a cow's production. The app has a stopwatch that can monitor a cow's breathing rates; high rates are a big indicator of heat stress. Stressed animals won't eat as much. Dairy cows will produce less milk; beef cattle could face lower growth rates. "Producers can go in and detect which animals are more heat stressed in a particular setting and (then use) additional means to reduce the levels in those animals and not necessarily do it for the entire herd; the entire population of animals," Spiers said. The app will help a farmer choose which animals will sit under a evaporative cooling unit like Port-A-Cool portable evaporative cooling unit, or just sit in the shade to cool down. "The beauty of the app over time is that we'll be collecting data from the producers that will go into a large database that allows us to make even better predictions of how the animals will respond not only in Missouri, not only in the Midwest, but all over the country," Spiers said. And that data could help further research which could potentially reduce costs for producers and consumers alike. Thermal Aid app is available now for iPhone in the iTunes store and for Android in the Google Play.

Heartland Connection
New app protects cattle
By Brian Doogs
Posted: 09.25.2012

KIRKSVILLE, MO -- Record heat across the Heartland this summer have allowed researches at the University of Missouri to put the final touches on a new smartphone app that aims to help cattle producers monitor the extreme conditions.

Livestock researchers at the University of Missouri's College of Agriculture, Food, and Natural Resources have developed a smartphone app called "ThermalAid," enabling cattle producers to more conveniently and reliably monitor livestock conditions in relation to local temperature and humidity levels.

Easy access to temperature and humidity index readings will help producers more quickly determine when their cattle are heat stressed. ThermalAid is designed for use with beef or dairy cattle in pastures, feedlots or barns.

"Producers can use this app to reduce the heat stress in their animals. Producers can go in and detect which animals are more heat stressed in a particular setting and go to additional means to reduce the levels in those animals not necessarily do it for the entire heard; the entire population of animals," University of Missouri Animal Science Professor Don Spiers said.

A stopwatch-like feature of ThermalAid allows producers to count the number of breaths for an animal over a short interval. The producer then records the number and the app calculates the breaths-per-minute.

Heat-stressed cattle reduce their feed intake or stop eating completely, which lowers growth rates in beef cattle and reduces milk production in dairy cows. Also, heat stress can compromise cattle immune systems and jeopardize overall health.

ThermalAid is tied to a website, ThermalNet, that the research team has developed to offer extensive information on how to detect and reduce livestock heat stress. It is also an area that data from producers can be input.

“The beauty of the app over time is what we’ll be collecting data from the producers that will go into a large database that allows us to make even better predictions of how the animals will respond not only in Missouri, not only in the Midwest, but all over the country,” said Spiers.

Eventually a global network will be created between producers and heat stress specialists to provide specific site recommendations to alleviate the problem, and ultimately reduce costs to the producers and consumers.

Additional testing is planned for the next two months. The researchers hope to have ThermalAid available for use by cattle and dairy producers statewide, nationwide and worldwide by late fall.

Missouri farmers share tips at annual technology conference

By LAUREN GATCOMBE
news@ColumbiaMissourian.com

OSAGE BEACH — Tan-Tar-A Resort, with its lakefront view and water park, might not seem like an ideal destination in January, but it is for those who attend the annual Computers on the Farm conference, a place for farmers to share new technologies that are helping make their often time-consuming jobs a little easier.

Cows, for example, now have an iPhone app developed just for them. Farmers interested in the animals' health can record how many breaths-per-minute a cow produces and then determine if it is under heat stress.

Brad Scharf, a post-doctoral fellow in animal science at MU, unveiled the 99-cent app, called Thermal Aid, to about 25 attendees using a real-time video projector.

If a cow is overheated, Scharf said, the app offers useful tips, like "Modify diet and maintain food intake" or "Wet the animals and/or the ground." The goal is to make the app, which will be available at the end of January, compatible with goats and pigs.

Six undergraduate students at MU, including three journalism majors and three computer science majors, began developing the app with Scharf and their teacher, Animal Sciences professor Don Spiers, in the fall of 2011.

Funding came from two grants from Mizzou Advantage and Mizzou's Interdisciplinary Innovations Fund. The overall cost of development was about $10,000, Scharf said.

The more than 30-year-old conference, which was held on Friday and Saturday, is sponsored by MU's College of Agriculture, Food and Natural Resources and the Department of Agricultural Economics.

Nine presentations filled the agenda at this year's conference, including a session on how to use a cow calculator to measure the profit of a cow and a look at useful agriculture mobile apps.

A free app, YieldCheck, created by Precision Planting in 2011, allows users to record the amount of corn they have planted and then calculate the amount of bushels expected to grow that season, which can help farmers combat the drought, said Kent Shannon, natural resource engineering specialist at MU Extension.

YieldCheck can also tell farmers how much money each additional ear per acre would earn, Shannon said.

John Travlos, coordinator of the conference, first attended the gathering in 1985 while he was a graduate student at MU. The following year he helped plan the conference.

Travlos said it is easy to keep the conference fresh because attendees are constantly utilizing new technologies.

"Just like technology keeps moving, our group moves with it," Travlos said.

MU Extension Agriculture Business Specialist Brent Carpenter introduced an efficiency spreadsheet, Probable Fieldwork Days Model.

It advises farmers about how to manage time based on their crop acreage and type of equipment. The spreadsheet utilizes survey data collected by the USDA National Agricultural Statistics Service during the past 30 years.

The tool is the first of its kind, Carpenter said.

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