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California Dairy Newsletter

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The Next Generation of Carbon Management

Dr. Deanne Meyer - Livestock Waste Management Specialist, UC Davis & UC ANR

Dairies are in the cross hairs of reducing methane emissions in California. Manure methane emissions are the prime target. The legislative expectation (SB 1383) is to reduce methane emissions by 40% of the 2013 amounts. This is a very ambitious target. Manure maintained in anaerobic conditions (wet) is associated with methane emissions. To reduce methane emissions, manure can be collected and maintained in an anaerobic environment and biogas is collected and used. California has invested in the goal to reduce emissions with cost sharing (up to 1.5 million dollars) for development of anaerobic digesters with biogas used for fuel (not to power a gen-set). Alternatively, manure can be removed or prevented from getting into a liquid stream to reduce methane emissions. Since anaerobic digesters are not for every dairy, California has invested in Alternative Manure Management Practices (AMMP). These practices include:

1. Solid liquid separation in conjunction with: a) open solar drying; b) closed solar drying; c) forced evaporation with natural-gas fueled dryers; d) daily spread; e) solid storage; f) composting in vessel; g) composting in aerated static pile; h) composting in intensive windrows; or i) composting in passive windrows with composting of solids or flush to scrape with composting of solids.

2. Conversion from flush to scrape manure collection in conjunction with one of the “a” through “i” options mentioned above.

3. Eligible pasture-based management practices include: a) conversion of a non-pasture livestock operation; b) increasing the amount of time livestock spend at pasture; and/or c) construction of a compost bedded pack barn.

Feeding Waste Milk to Calves: Reducing Antimicrobial Resistance

Dr. Richard Pereira, Dr. Paolo Tempini, Dr. Sharif Aly – UC Davis Veterinary Medicine

The current request for grant applications is available at https://www.cdfa.ca.gov/oefi/AMMP/. The application process is quite detailed, but technical assistance is available from providers listed on the website. Successful applications receive up to $750,000 to improve manure management at their dairy. Applications are due **May 22, 2018, by 5:00 pm.**

An undesired consequence of the use of antimicrobial drugs in cattle is the presence of drug residues and/or metabolites in feces and urine, or in the milk of lactating animals. In lactating dairy cattle, this translates into production losses due to withholding of non-saleable waste milk containing drug residues. To avoid discarding this valuable product while reducing feed costs, many dairies feed waste milk to preweaned calves.

Regardless of the financial advantages of feeding waste milk to calves, an important question is whether this practice can affect the calves' health and result in unnecessary selection of antibiotic resistant bacteria that could reduce successful outcomes when treating infections with antibiotics.

We conducted a study to get an overview of the drug residues present in waste milk fed to dairy calves, while also collecting herd management data that could provide information to better understand the current scenario and direct future research efforts.

Findings

A total of 25 dairies were sampled in this study, and 15 had drug residues above the limit of detection in the waste milk sampled. The most common drug residues detected in waste milk samples were in the cephalosporin class, namely ceftiofur and cephapirin. Ceftiofur is present commercially in intramammary treatments (e.g. Spectramast LC, Spectramast DC), as well as in injectable drugs (e.g. Excenel, Excede, and Naxcel). Most injectable ceftiofur drugs, if used at the dose indicated in the label, do not result in drug residues in the milk above the tolerance level established by the Food and Drug Administration (FDA). Based on answers from our questionnaire, ceftiofur was the most common drug used to treat mastitis, reproductive diseases, pneumonia, and lameness that warranted systemic antimicrobial treatment.

Cephapirin is also a drug that can be found in drugs used commercially for treatment of cows with mastitis (e.g. Today). Mastitis treatment is the most common use of antibiotics on dairy farms; therefore it is not surprising that most drug residues in waste milk are probably a consequence of treating cows with mastitis. This finding highlights even further the importance of management efforts to reduce the cases of mastitis in the herd, including proper milking procedures (e.g. pre- and post-dipping of teat with disinfectants, milking cows with contagious mastitis last and in a separate string), having mechanisms for identification and accurate treatment of cows with mastitis (e.g. routinely culturing fresh cows and cow returning from hospital pen for mastitis, using drugs to treat mastitis according to bacteria cultured), and reducing environmental challenges (e.g. proper bedding, overall practices that results in cleaner udders).

Future Research

One of the future directions of our research team is to conduct studies to evaluate interventions that could reduce unwanted consequences of feeding waste milk, such as increasing resistance of disease causing bacteria. Currently, there is very limited information on how pasteurization and/or other procedures may break down drug residues present in waste milk, extinguishing their unwanted properties. Our future studies will center efforts on that topic, and information from this study has provided important information on areas to focus. The success and relevance of the impact of our research is strongly based on a continued support and collaboration with dairy farmers, so we thank you for your help in this project and potential collaboration in future projects. *To simplify information, trade names of products have been used. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.*

Last June, the Central Valley Water Quality Control Board (RB5) adopted a General Order for Confined Bovine Feeding Operations (R5-2017-0058). Heifer operations and feedyards that supplement feed (confine animals) more than 45 days a year are covered by this Order and include: calf ranches, dairy heifer operations, stockyards, finishing yards, auction yards, veal calf facilities, and corrals or other confinement areas used to finish cattle for slaughter at grazing operations. What is not covered: corrals that are an integral part of a grazing or pasture operation. This order covers limited time operations (auction yards), smaller facilities (with less than 100 animal units), and all other facilities. Although there are reduced monitoring and reporting requirements for the auction yards and smaller facilities, all facilities need to submit a Notice of Intent. RB5 staff identify more than 800 facilities will be covered under this Order.

Do now. The first deadline is coming soon: **<u>July 1, 2018</u>**. The Notice of Intent must be completed by each facility operator/owner and submitted to RB5. It contains basic facility contact information, associated land (if manure is applied to land), and animal populations. Also, it has a brief description of the facility, how manure is handled, existing flood protection, if manure is composted, and where manure ultimately ends up. It will take a bit of time to gather all the necessary information.

Plan for later. You will want to begin the development of both Waste and Nutrient Management Plans. Facility specific information is required. Work with a Certified Nutrient Management Specialist, such as a Crop Adviser, to develop your Nutrient Management Plan (NMP); certification of NMP completion is due **<u>July 1, 2019</u>**. Work with an Engineer to develop a Waste Management Plan (WMP) including a Farm Water Quality Plan, due **<u>December 31, 2019</u>**, which describes current or proposed practices to address surface water monitoring provisions. The WMP is due **<u>July 1, 2020</u>**, including an Operation and Maintenance (O&M) Plan. It is helpful to get a jump start on the O&M to allow the greatest amount of time to modify facility infrastructure if necessary.

What kind of monitoring and reporting are required? Reports are due beginning in 2019. **July 1, 2019**: be sure irrigated cropland is covered in a surface water monitoring program (notify RB5 if you have joined a coalition for surface water monitoring or request permission from RB5 to form a Joint Monitoring Program for surface water monitoring; and notify RB5 of your intent to join a representative groundwater monitoring program or undertake individual groundwater monitoring. **December 21, 2019**: submit a workplan for a surface water Joint Monitoring Program; submit a demonstration of

UC ANR Advisors and Specialist Receive Outstanding Team Award

At the recent statewide conference for University of California Agriculture and Natural Resources (UC ANR), the Distinguished Service Award for Outstanding Team was awarded to the UC team of collaborators who developed materials for and delivered workshops throughout California related to water quality. The UC component of the California Dairy Quality Assurance Program includes Jennifer Heguy, Betsy Karle, David Lewis, Deanne Meyer and Jeff Stackhouse with additional collaboration from: Trish Price, Shannon Mueller, Nick Clark, Marsha Campbell -Matthews, G. Stuart Pettygrove, Thomas Harter, Carol Frate, Larry Schwankl, Allan Fulton, Doug Munier, Josh Davy, Bill Krueger, Carol Collar, Gerald Higginbotham, Alejandro Castillo, E. Robert Atwill, Kenneth W. Tate, Woutrina Miller, Pat Conrad. Non-ANR members include: Denise Mullinax, California Dairy Quality Assurance Program; Paul Martin, Paul Sousa and Melissa Lema, Western United Dairymen; J.P. Cativiela, Dairy Cares; Frances Tjarnstrom and Summer Daugherty, Humboldt County Resource Conservation District; staff from RB1, RB2, and

Use of Gene Editing to Introduce the Polled Trait into Elite Germplasm

no potential to discharge to surface water from your cropland; and submit a Farm Water Quality Plan. The first **Annual Report is due July 1, 2020.** Much work will be needed to establish group monitoring for surface and groundwater monitoring requirements.

If you have a heifer operation that is adjacent to a dairy operation or shares the same land application area with a dairy operation, you may request that the heifer operation be covered under the Dairy General Order. You will want to think this decision through carefully and consider record keeping and reporting requirements as well as flexibility of any future land use decisions.

The Order is available at https://bit.ly/2JvuuG2. Questions? Contact Charlene Herbst (916) 464-4724 or Dale Essary (559) 445-5093 with RB5.

Physical dehorning of dairy cattle is a standard practice to protect both human dairy workers and other animals from injury. However, it is not only costly for producers, but also painful and stressful for the animals. As a result, dehorning is currently facing increased public scrutiny as an animal welfare issue. Despite these factors, 94% of U.S. dairy cattle producers report routine dehorning.

Horns are inherited as an autosomal recessive trait, meaning that horned cattle have two copies (pp) of a recessive allele that results in horns. Naturally-occurring dominant (P) alleles of the *POLLED* gene locus (specific position on the chromosome) are prevalent in beef cattle breeds such as Angus, and also exist at a low frequency

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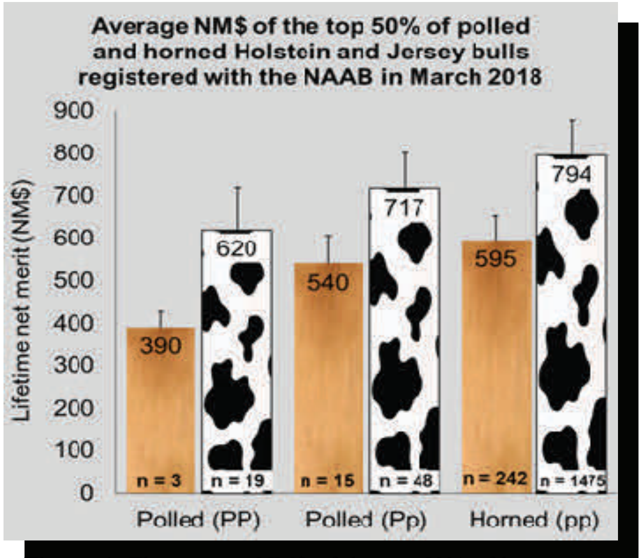

Figure 1. The average NM$ of the top 50% of homozygous polled (PP), heterozygous (Pp), and horned (pp) Jersey (brown bars) and Holstein bulls (black and white bars) registered with the National Association of Animal Breeders

in some dairy breeds. Inheriting a single copy of this P allele results in a hornless or polled animal. However, dairy animals carrying the dominant P polled allele(s) tend to have lower genetic merit (lifetime net merit (NM$)). Horns do not have a cause and effect relationship with dairy genetic merit; rather they happened to come along as genetic hitchhikers when selecting for elite dairy genetics.

The American Veterinary Medical Association (AVMA) has proposed using polled genetics as an alternative to dehorning. However, there are few polled dairy sires with high genetic merit for important economic indexes, so this approach has not been widely adopted. **Figure 1 (see page 5)** shows that animals carrying the P allele tend to have a lower NM$, meaning that daughters of polled sires will earn less over their lifetimes.

Dr. John Cole from the USDA proposed adding the economic value of polled ($40) to selection indices but showed that this is not an effective method for increasing the frequency of polled animals in the population. The frequency of the P allele is very low in U.S dairy cattle (< 0.01), so carriers are unlikely to be among the top-ranked bulls based on NM$. Therefore, only adding the economic value of polled to the NM$ index does not effectively increase the frequency of the P allele (Cole, 2015).

Gene editing has the potential to resolve these economic concerns by producing high-genetic merit polled bulls, thereby eliminating the need for dehorning (Carlson et al., 2016). Gene editing refers to a category of new tools that can be used to precisely edit or change the genetic code. It enables useful alleles to be introduced into elite germplasm without traditional crossbreeding. This often brings in a lot of undesired genetic information, known as "linkage drag," and refers to all of the unwanted traits that come along with the desired allele when practicing traditional crossbreeding. Breeders then must spend several generations breeding out the unwanted genetics while retaining the desired allele.

As the name "gene editing" suggests, these technologies enable researchers to add, delete, or replace letters in the genetic code. In the same way that spell check identifies and corrects single letter errors in a word or grammar errors in a sentence, gene editing can be used to identify and change the letters that make up the genetic code (i.e. DNA) within an individual.

The currently available set of gene editors, known by acronyms ZFN (zinc finger nuclease), TALEN (transcription activator-like effector nuclease), and the trendy CRISPR (clustered regulatory interspersed short palindromic repeat)-Cas9 associated system, are effectively precise molecular scissors. They can be targeted to the POLLED locus that is responsible for horn development and used to replace 10 base pairs of the dairy "p" allele with 212 base pairs of the naturally-occurring "polled" P allele. This P allele sequence introduced by gene editing is exactly the same allele that is found in beef breeds, and

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when inherited it results in the polled or hornless phenotype in the resulting calves, making them genetically dehorned. The edits can take place at the single cell stage of embryogenesis (i.e. just after fertilization), or in cell culture lines which can then be cloned following confirmation that the intended edits have been successfully written into the genetic code.

Given the extensive use of artificial insemination (AI) in the dairy industry, even if only a small proportion (1%) of elite AI sires were gene edited to be homozygous PP, the P allele could be rapidly disseminated to the dairy population while maintaining the rate of genetic gain. This would be superior to using existing polled genetics. Recent simulation studies in both Holstein and Jersey populations found that if existing homozygous polled sires were used exclusively, it would both slow the rate of genetic gain and dramatically increase inbreeding in both the Holstein and Jersey breeds (Mueller et al., 2018a,b).

While there are a lot of possibilities for gene editing in animal breeding, the regulatory status of animals carrying intentional gene edits, such as the P allele discussed above, is unclear. A 2017 draft FDA guidance 187, [Regulation of Intentionally Altered Genomic DNA in Animals] (FDA, 2017) proposes that intentional genomic alterations, such as those introduced by gene editing, but not those introduced by selective breeding and random mutagenesis, will be subject to mandatory, multigenerational premarket "new animal drug" evaluation.

The FDA draft Guidance specifies that additional "new animal drug" regulatory oversight will be triggered by intentional nucleotide insertions, substitutions, or deletions introduced by gene editing. It further specified that in general, each specific genomic alteration will be considered a separate "drug" subject to new animal drug approval requirements, irrespective of the novelty of the alteration or the existence of any hazards in the resulting product (Van Eenennaam, 2018).

This is diametrically opposed to the approach announced by the USDA on regulating gene edited plants. In a March 28, 2018 press release, U.S. Secretary of Agriculture, Sonny Perdue, clarified that the USDA does not have any plans to additionally "regulate plants that could otherwise have been developed through traditional breeding techniques." Historically, neither plant nor animal breeding have been formally regulated. Rather, US law prohibits the commercial sale of unsafe food, irrespective of

production method.

2017 Dairy Needs Assessment Results

JP Martins – UCCE Tulare & Kings, Betsy Karle – UCCE Northern Sacramento Valley & Jennifer Heguy – UCCE Merced, Stanislaus & San Joaquin

Last year, we mailed a survey to all Grade A dairy producers in California (n = 1,080) with the objective of better understanding dairy producer needs and how to best direct and deliver Cooperative Extension (CE) programming. **Survey response was 15.4%** (n = 166) and herd size averaged 1,405 milking cows (range 83 - 5,500). The geographic distribution of survey responses was representative of the distribution of dairies throughout the state.

Producers were asked to indicate the level of concern for a predetermined list of issues. Rank of concern had three numeric levels: (1) very concerned, (2) somewhat concerned, or (3) not concerned. The **top five concerns/obstacles** indicated were: (1) milk price, (2) labor availability/quality, (3) environmental issues/regulations, (4) labor costs and (5) water quality/availability.

Surveyed respondents were also asked to determine the level of priority of a predetermined list of CE research and educational opportunities. Producers ranked topics as (1) high priority, (2) medium priority, or (3) low priority. The five highest priority research topics were: (1) herd health, (2) environmental issues, (3) reproduction, (4) milk quality, and (5) water quality. The five highest priority educational topics were: (1) herd health, (2) milk quality, (3) reproduction, (4) environmental issues, and (5) calf and heifer management.

Producers were then asked to identify the target audience for CE information delivery and preferred information delivery method. Most respondents indicated that the **target audience** should be dairy owners (93%) or managers (66%). Fewer producers indicated a target audience of dairy employees (27%) or allied industry (23%). Preferable information **delivery methods** were newsletter/magazine articles (81%), half-day /short meetings (47%), and on-farm training/meetings (39%). Webinars and 2- or 3-day destination meetings were the least preferable methods (27% and 9%, respectively). We will use the results of this survey to develop future dairy Cooperative Extension dairy programs in California, and we have already put some information into practice by bringing our 2018 statewide dairy conference back to the San Joaquin Valley.

Although this survey exercise is complete, we are ALWAYS looking for suggestions that will help us improve our programs. Please contact any dairy advisor with your feedback:

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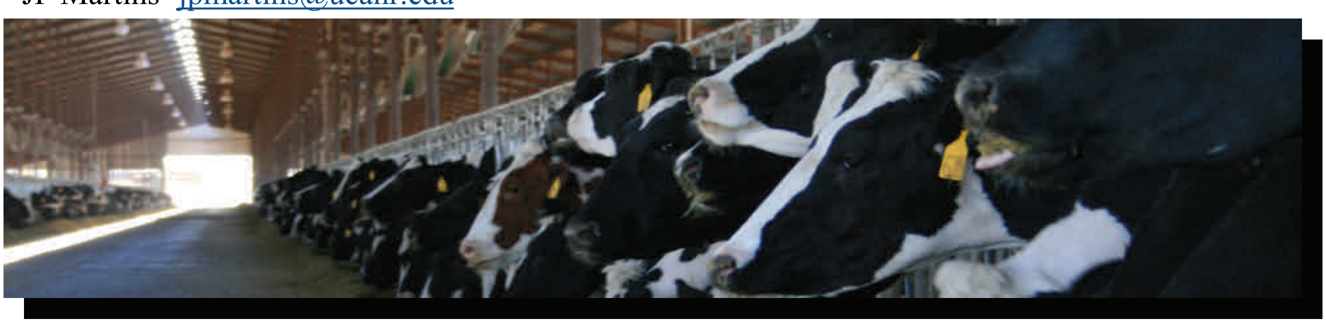

Other animal agriculture industries have voiced concern about the FDA draft guidance. In a position paper on “Regulation of Gene Edited Animals”, the National Pork Producers Council (NPPC) wrote of the proposed FDA approach, “*This regulatory path will result in a lengthy and expensive approval process, and functionally make any gene edited animal a living animal drug—and every farm raising them a drug manufacturing facility. It does not allow for a risk-based approach that takes into consideration the familiarity or complexity of the genetic changes, and the fact that they could be achieved through conventional breeding techniques (though at the expense of time and genetic improvement from decades of animal breeding). The FDA approach is also out of step with the regulatory pathways under development in the rest of the world.*”

The proposed FDA regulatory approach will introduce additional regulatory oversight on animals produced using gene editing that are no different to those that could have been obtained using conventional breeding. Unfortunately, lengthy process-based regulation triggered by human “intention,” rather than novel product risk, may effectively preclude animal breeders from employing gene editing to introduce beneficial genetic alterations like polled into our food animal populations.

References available upon request.

Considerations for a Successful Sorghum Silage Crop

Nicholas Clark – UCCE Kings, Tulare & Fresno Counties &

While wet winters have caused sorghum acreage to decrease in recent years, early projections of water deliveries indicate that sorghum planting may once again be a necessity for some in 2018. We all know that sorghum is not corn, but successfully harvesting a quality sorghum crop became more complicated in 2016, with the appearance of sugarcane aphid (SCA). Below are some management practice tips that may contribute to a higher quality feedstuff this fall.

Variety Selection. Work with your seed representative and nutritionist to select a variety best suited for your milk production needs. Consider yield potential and feed quality, as well as which animals will be consuming the forage. Brown midrib (BMR) trait varieties tend to be lower yielding and may be more susceptible to sugarcane aphid (SCA), but can have a higher relative feed quality (RFQ). See the 2017 Sorghum Forage Report for California Dairy for more information on variety performance. For weed management programs that include a pre-emergent herbicide, select seed that has been safened. Also consider a neonicotinoid-treated seed in order to have early protection from SCA for up to 40 days.

Stand Establishment. For optimum stand establishment, plant when there is adequate soil moisture and soil temperatures are 60 F. Target a plant population of 100,000 plants/acre (usually about 10 lbs. seed/acre, but seed weights vary). Don’t allow water stress during plant establishment, as this phase is critical for forming deep roots that make the plant more drought resilient. Control weeds which compete for water, and host diseases and pests, e.g. SCA in Johnson grass.

Fertility & water relations. Nitrogen

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requirements for forage sorghum are 7.9 lbs N/ton at 30% dry matter. A 20-ton crop on N deficient soil will require an application of about 150 lbs. N. A high yielding, adequately irrigated forage sorghum will evapotranspire about 20" of water. The crop will utilize more stored soil water when water is withheld before or after flowering, but there is significant yield loss when moisture stress is experienced before the crop flowers probably because there is less deep root development – inability to utilize deeper soil water. If water is short, try to deficit irrigate after flowering.

Sorghum is tolerant of soil salinity up to 6.8 dS/m before there is a yield loss. Corn, for comparison, will tolerate 1.8 dS/m before yield loss. However, beware of potential delays in crop maturity under salinity and drought stress which can increase the opportunity time of SCA to infest the field – i.e. more insecticide treatments would be needed to protect yield.

Sugarcane Aphid Management. Why? In 2016, when comparing the nutrient composition of SCA infested samples with non-infested samples, SCA caused significant decreases in starch and non-fibrous carbohydrates (NFC), with higher crude protein, acid detergent fiber (ADF) and ash content. Talk with your seed provider or pest control advisor (PCA) to obtain neonicotinoid-treated seed. Clothianidin and imidacloprid treated seed have been shown to offer protection from SCA for up to 40 days after planting, delaying the need for foliar applications of insecticide. During the season, scout for SCA starting in July or in the early vegetative stages, whichever is first, weekly until the aphid is found, then semi-weekly until the threshold is reached. The PCA or scout should look at four corners of the field away from edges or irrigation borders and pick the bottom green leaf and top expanded leaf of 15 plants in each corner. Average the number of aphids per leaf. When 25% of plants have 50 aphids/leaf (a cluster about the size of a pinky fingernail), pull the trigger to spray.

Flupyradifurone (Sivanto Prime) is the only product registered in CA that is shown to consistently knock down and have good residual control of SCA in sorghum in research across the US. Trials are currently underway in CA to explore the efficacy of other registered and experimental materials. Foliar coverage of the insecticide is as important as the timing of the application once the insect population threshold is reached. Thus, ground applications are preferable whenever field conditions allow. If an aerial application is required, use as much water as is affordable. Based on the experiences of growers in the SJV since 2016, it would be wise to include the cost of at least two over the top treatments into your production budget to evaluate potential costs for the 2018 crop year.

Harvest. Prior to harvest, communicate your goals with your silage team (nutritionist, harvester, etc.). The animals consuming the sorghum silage may dictate optimal chop length, stage of maturity at harvest, etc. Generally, it is recommended to harvest when the grains ripen to the milk to soft dough stage. This is typically the optimal timing for quality and yield as the plant is virtually done adding biomass and the grains might be chewable by the cow or destructible by the chopper, making the nutrients more available to the animal. Deciding by grain

color or days after planting can be deceiving since not all varieties have reddening grain, and

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