OmniGen®

Heat Stress
Reference Guide

The Latest Research, Insights and Management Strategies for Addressing Heat Stress

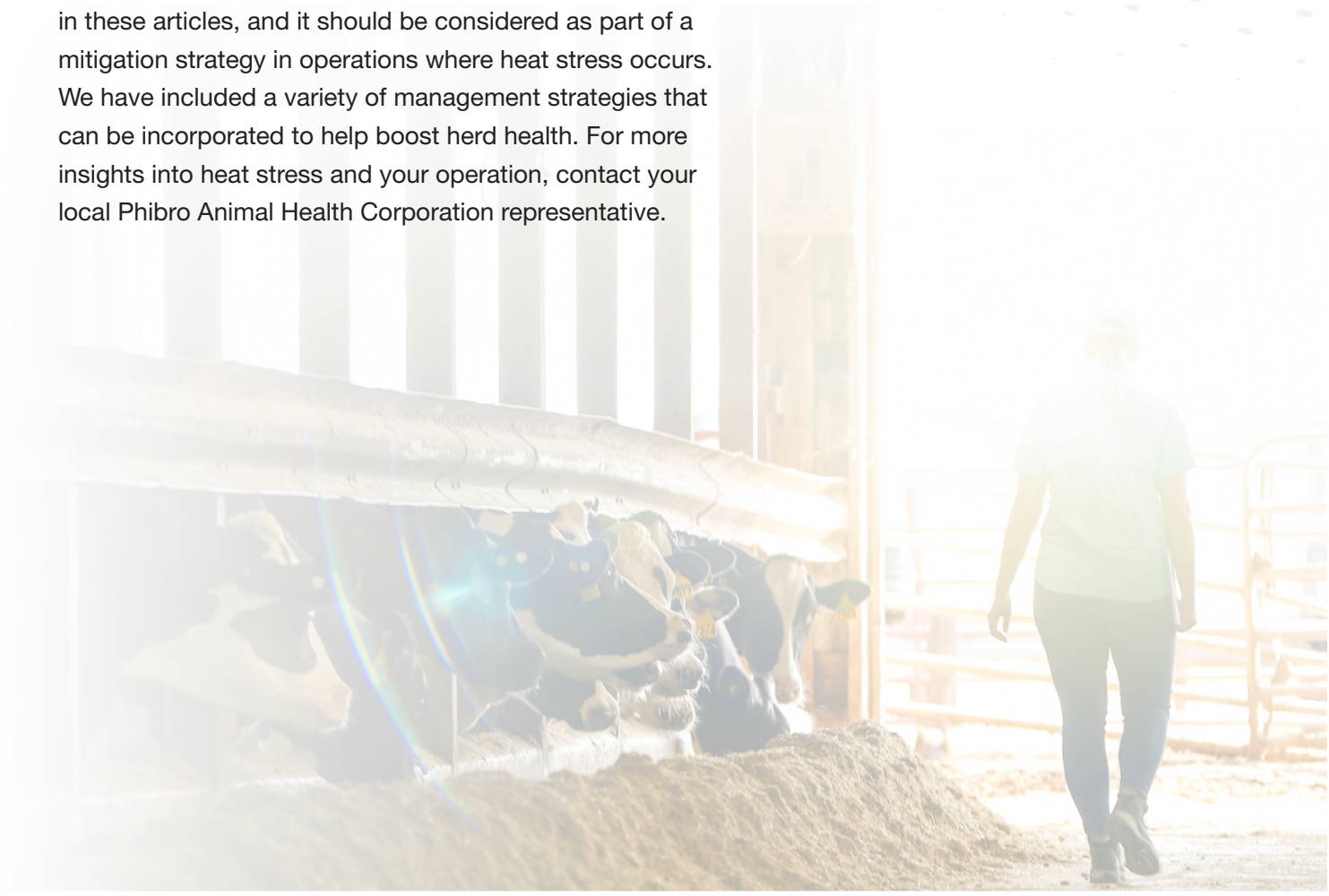
Phibro ANIMAL HEALTH CORPORATION™

OmniGen®

Introduction

Heat stress is one of the costliest issues in dairy operations. The added stress from high heat and humidity reduces productivity and affects reproductive performance in dairy cows. Thanks to continued research, we now know more about heat stress than ever, and this knowledge provides opportunities to minimize the effects of heat stress conditions on cows. We know that traditional measures in combination with nutritional support can help maintain dry matter intake.

This quick-reference guide includes a series of articles covering multiple studies and insights from recent years on the subject of heat stress and its effects on dairy herds. Supporting immune health is a valuable insight covered in these articles, and it should be considered as part of a mitigation strategy in operations where heat stress occurs. We have included a variety of management strategies that can be incorporated to help boost herd health. For more insights into heat stress and your operation, contact your local Phibro Animal Health Corporation representative.



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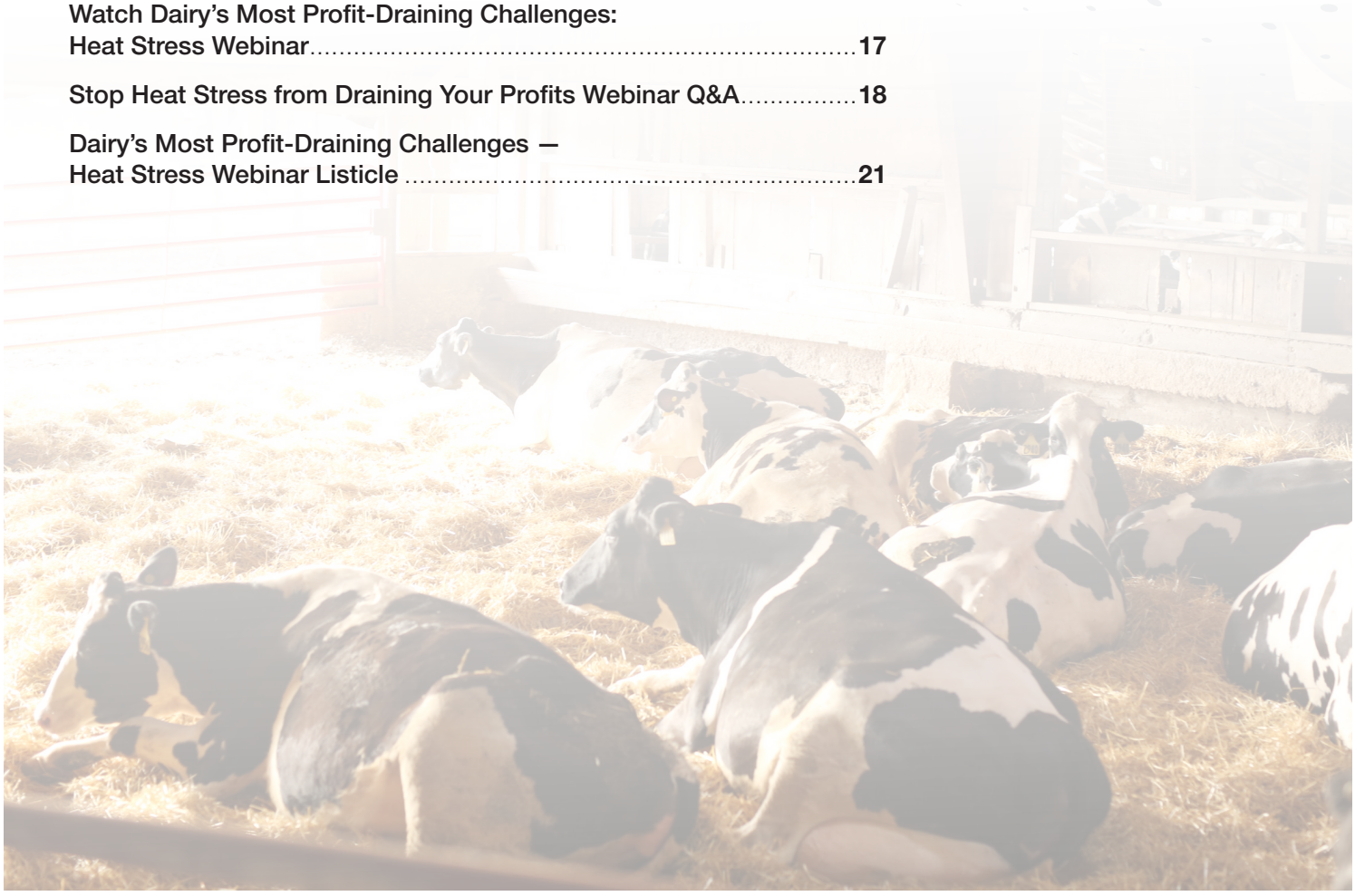
Contents



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HEAT STRESS

NUTRITION'S ROLE IN ALLEVIATING THE EFFECTS

BENEFITS OF REDUCED HEAT STRESS:

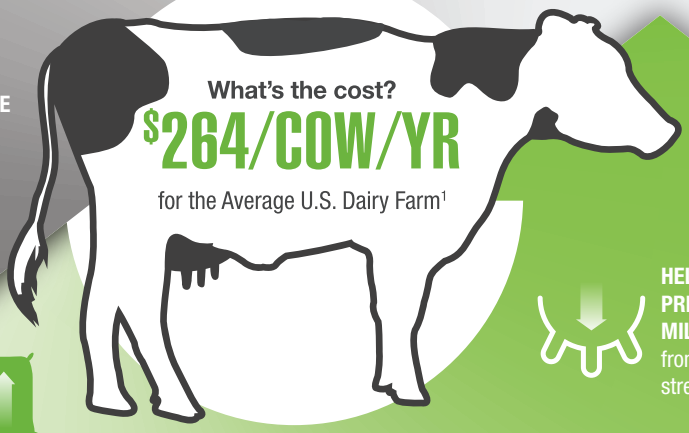
- Animal Welfare
- Productivity
- Reproductive Performance

THE REAL PROBLEM

LOSS OF APPETITE leading to lower dry matter intake due to heat-induced discomfort

INCREASED RESPIRATION RATES AND RECTAL TEMPERATURES[3,4] under heat stress

WEAKENED IMMUNE DEFENSE[2] with increased risk of mastitis



What's the cost?

$264/COW/YR

for the Average U.S. Dairy Farm[1]

HELPS PREVENT MILK LOSS from heat stress[6]

HELPS SUPPORT INTAKE of dry matter during heat stress period[5]

HELPS SUPPORT HEALTHY IMMUNE FUNCTION as shown by elevated expression of IL-8R mRNA gene indicating immune system responsiveness[5]

THE OMNIGEN® ADVANTAGE

OmniGen® nutritional specialty products help your cows handle the effects of heat stress. Learn more about the benefits of OmniGen at **TheOmniGenDifference.com.**

OmniGen®

[1]Key, N. et al., 2014. Climate Change, Heat Stress, and U.S. Dairy Production, Rep. No. 175. [2]Nickerson, S. 2014. UGA Extension Bulletin 1426. [3]Fabris et al., 2017. J. Dairy Sci. 100:6733-6742. [4]Hall et al., 2018. J. Dairy Sci. 101:7095-7105. [5]Hall, L. W. et al., 2014. PAHC Reference OG020414. [6]Fabris, T. F. et al., 2016. PAHC Reference OG010916.

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Technical Bulletin: Heat Stress

Help Your Cows Handle the Heat with OmniGen® Nutritional Specialty Product.

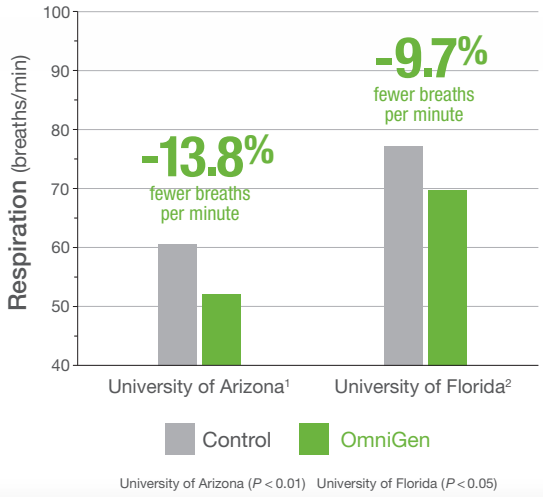
Heat is one of many stressors that can affect your herd's health and productivity. Fortunately, research has shown that cows fed OmniGen nutritional specialty product maintain healthy immune function and overall productivity better than cows who aren't, during and after heat stress conditions.

Here's a closer look at some important results from university and research trials.

The OmniGen Difference Is Clear.

Respiration (Breaths/Min)
Feeding Omnigen may help reduce respiration rates (related to lower body temperature), which may improve metabolic efficiency.

REDUCED RESPIRATION VS. CONTROL
DURING HEAT STRESS



University of Arizona ($P < 0.01$) University of Florida ($P < 0.05$)

A Step Ahead. Every Day.

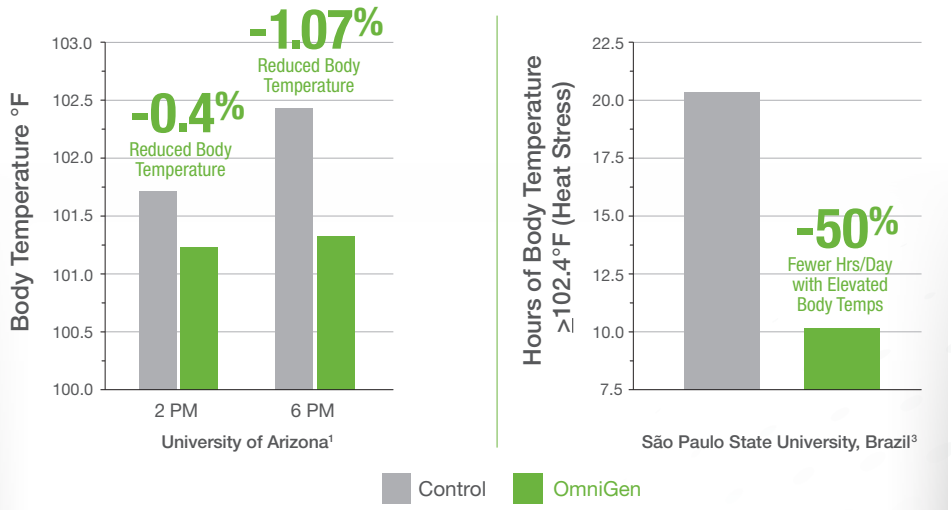
Your dairy cattle may face immunological stressors every day. That's why we recommend feeding your dry, prefresh and lactating dairy cattle OmniGen nutritional specialty product every day—to help promote a healthy immune system as demonstrated in research trials, for a healthy and productive herd.

Water Intake
Lower water intake during heat stress conditions.[1]

Body Temperature

Feeding OmniGen helps to regulate body temperature during periods of high temperature and humidity and reduce the hours per day with elevated body temperatures. This may lead to improved health and productivity as well as reduced reproduction delays associated with heat stress.

BODY TEMPERATURE VS. CONTROL
DURING HEAT STRESS



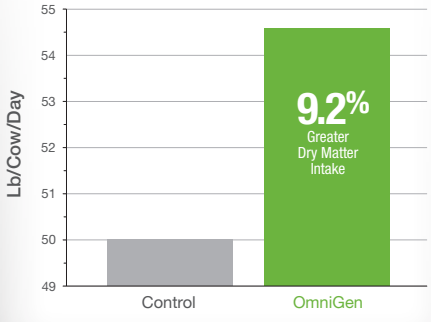
University of Arizona ($P < 0.05$)

São Paulo University, Brazil ($P < 0.05$)

Dry Matter Intake (Lb/Cow/Day)

OmniGen helps support dry matter intake in cows exposed to heat stress conditions to reduce or moderate losses in milk production.

DRY MATTER INTAKE ADVANTAGE VS. CONTROL
DURING HEAT STRESS



University of Arizona ($P < 0.001$)[1]

Milk Yield (Lb/Cow/Day)

OmniGen helps support improved milk yields during and following periods of high temperature and humidity.

INCREASED MILK YIELD
DURING HEAT STRESS

Texas Field Study ($P < 0.001$), São Paulo University, Brazil ($P < 0.02$)
University of Florida ($P < 0.05$)

[1] Hall, L.W., S.D. Anderson, F.A. Rivera, F. Villar, J.D. Chapman, N.M. Long, R. J. Collier. 2013 ***Evaluation of OmniGen-AF in heat-stressed Holstein cows in lactation.*** J. Dairy Sci. vol. 96. E-suppl 1 (abstract)

[2] Fabris, T.F. Laporta, F.N. Corra, Y.M. Torres, D.J. Kirk, D.J. McLean, J.D. Chapman, and G.E. Dahl. 2017. ***Effect of nutritional immunomodulation and heat stress during the dry period on subsequent performance of cows.*** J. Dairy Sci. 100:6733-6742

[3] Leiva, T., R.F. Cooke, A.P. Brandão, K.M. Schubach, L.F.D. Batista, M.F. Miranda, E.A. Colombo, R.O. Rodriques, J.R.G. Junior, R.L.A. Cerri, J.L.M. Vasconcelos. 2017. ***Supplementing an immunomodulatory feed ingredient to modulate thermoregulation, physiologic, and production responses in lactating dairy cows under heat stress conditions.*** J. Dairy Sci. 100:4829-4838

[4] Holland, A.E., J.D. Chapman and L.O. Ely. 2014. ***Milk production, dry matter intake and body condition score evaluated in cross-bred commercial cows supplemented with OmniGen-AF during and following heat stress.*** J. Dairy Sci. vol. 97, suppl. (abstract)

This information has been prepared for industry technical professionals.

The Costly Effects of Heat Stress on Dairy Productivity

Heat stress is an expensive challenge that dairies face year after year. The effects of heat stress are estimated to cost the dairy industry $897 million to $1.5 billion[1] annually, with losses due to lowered milk production, increased metabolic disorders, reduced reproductive performance, reduced dry matter intake and impaired immune function.

For the average dairy farmer, unmitigated heat stress can cost an average of $264 per cow per year.[2] While certain management measures must always be considered (e.g., fans, misters), the role of dairy cattle nutrition in combating the effects of heat stress on dairy cattle is an increasingly prevalent topic of discussion. OmniGen® nutritional specialty products are designed to offer additional support to help cows maintain cow comfort, productivity and reproductive performance throughout periods of increased temperature and humidity.

Immune Function in Cattle During Heat Stress

Cows experience heat stress when the temperature-humidity index, or THI, reaches 68 – and recent research suggests that acute exposure to high THI can cause damage to a cow's digestive tract, allowing pathogens and endotoxins to enter the blood stream. This activates a strong immune response, requiring energy that could otherwise be expended to produce milk.

By supporting healthy immune function (as shown by elevated expression of the IL-8R mRNA gene indicating immune responsiveness), nutritional specialty products like OmniGen not only help protect healthy dairy cattle from the effects of heat stress, but also help support the intake of dry matter during the heat stress period and increase productivity in challenging heat stress conditions.

References:

[1] St-Pierre et al., 2003 J. Dairy Sci. E52-E77
[2] Key, N. et al., 2014. Climate Change, Heat Stress, and U.S. Dairy Production, Rep. No. 175.

Help Alleviate Heat Stress in Dairy Cows

Eighty-four-day study evaluates whether OmniGen® nutritional specialty product is equally effective in grazing vs. confined dairy cows[1]

When the temperature-humidity index (THI) reaches 68 or temperatures climb above 25 degrees Celsius (77 degrees Fahrenheit), dairy cows may present signs of heat stress, including increases in rectal temperature and respiration rate. Cows reduce their own metabolic heat production by decreasing dry matter intake and milk syntheses. Heat stress also causes a cortisol response that inhibits immune system response under heat stress conditions. Both are natural responses that not only lower productivity, but also makes cows more susceptible to disease.

OmniGen nutritional specialty product has immunomodulatory effects and is composed of ingredients shown to help mitigate symptoms of heat stress in confined dairy cows in different physiological states. In previous research, cows fed OmniGen have reported lower respiration rates and greater milk yield production compared to the control group.[2] Fresh cows, when fed OmniGen under heat stress, had lower vaginal temperatures and lower somatic cell counts, compared to the control group.[3]

While this is evidence that OmniGen aids thermoregulation of confined dairy cattle, there was a lack of data on the effects of OmniGen on grazing cattle. So, a team of researchers from the Department of Animal Science at the Universidade Federal da Grande Dourados, Brazil, the Department of Animal Sciences at Kansas State University, and the Department of Animal Nutrition and Animal Production at the University of San Paulo, Brazil, conducted a study at a commercial dairy farm with a rotational grazing system between October 2016 and January 2017.[1]

> **The objective:** to determine the effects of OmniGen on pasture intake, milk yield and composition, blood metabolites, body temperature, and respiration rates of grazing cattle under a high THI environment.

Thirty-six multiparous Holstein cows were assigned to either 0 or 50 g/d of top-dressed OmniGen, which was hand mixed on the 2/3 upper portion of corn silage and concentrate mixture after milking (25 g OmniGen/head twice daily) for 84 days. Cows had free access to water and *ad libitum* access to mineral mixture. They were milked and fed twice daily, and milk samples were collected, measured and analyzed for contents of milk fat, total protein and lactose. In addition, blood samples were collected and total serum calcium and blood ionized calcium were analyzed according to Oetznel (2004). Body weight and body condition score were evaluated both at the onset of the study and at blood collections. Respiration rates, rectal temperatures and body surface temperatures were also regularly measured. Air temperature and relative humidity were recorded and THI was calculated every 30 minutes.

Positive Impacts on Thermoregulation and Milk Production of Grazing Cattle

Cows fed OmniGen showed greater ($P < 0.045$) total dry matter intake, milk yield, milk fat production and milk fat concentration compared to the control group, while neither body weight nor body condition scores were affected. In addition, cows fed OmniGen had lower ($P < 0.043$) body surface, muzzle temperatures and face heat *emission*, as well as lower respiration rates. (There was a treatment and time interaction effect $P < 0.038$.) Cows fed OmniGen also showed decreased somatic cell count while also showing increasing blood glucose and ionized calcium concentrations and decreasing blood aspartate aminotransferase and alkaline phosphatase concentration. This evidence indicates that feeding OmniGen improves performance and helps reduce signs of heat stress in grazing dairy cows in environments with high THI.

Visit www.theOmniGenDifference.com or contact your local Phibro representative to learn more.

References:

[1]Gandra et al., 2019. Livest. Sci. 221:28–32.
[2]Fabris et al., 2017. J. Dairy Sci. 100:6733–6742.
[3]Leiva et al., 2017. J. Dairy Sci. 100:4829–4838.

Nutritional Immunomodulation and Heat Stress: How Are Your Cows Affected?

Study examines the effects of nutritional immunomodulation and heat stress during the dry period on the next lactation performance of dairy cows.[1]

Heat stress during a dairy cow's dry period impacts milk yield in the next lactation. While feeding OmniGen® nutritional specialty product to lactating cows during heat stress may help increase dry matter intake and lower respiration rates and rectal temperature, its effects on dry cows were not known. A group of researchers from the University of Florida, Sao Paulo State University, University of Puerto Rico and Phibro Animal Health Corporation teamed up to study the effects of nutritional immunomodulation and heat stress during the dry period on subsequent performance of dairy cows. Their hypothesis: OmniGen supplementation before, during and after the dry period (approximately 160 days) would help mitigate the effects of heat stress and improve cow performance in the next lactation.

The study was conducted in the summer of 2015 at the University of Florida in Gainesville. Six days before dry off, cows were randomly assigned to OmniGen or control (i.e., placebo) treatments for the last 60 days in milk, based on mature equivalent milk yield in the previous lactation. Before dry off, all cows were kept under cooling systems with normal dairy farm management. Cows not fed OmniGen were fed 56 g/d of bentonite as a placebo control. Cows were dried off 45 days before expected calving and randomly assigned to heat stress or cooling groups. Thus, cows received dietary supplementation during late lactation before they were exposed to either cooling or heat. After dry off, groups included heat stress with placebo, heat stress with OmniGen supplementation, cooling with placebo and cooling with OmniGen supplementation. After parturition, all cows were kept under the same cooling system and management and all cows continued to receive OmniGen or the control until 60 days in milk.

Impact of OmniGen and Heat Stress During the Dry Period

This study led researchers to some impactful conclusions. They found that heat stress during the dry period negatively affects the performance of dairy cows in the next lactation; that is, heat-stressed cows produce less milk compared with cooled cows.

Regarding the effect of OmniGen supplementation, cows fed OmniGen tended to have higher dry matter intake during prepartum and greater milk production on the subsequent lactation. More interesting, feeding OmniGen to heat stressed animals during the dry period eliminated the negative impact of heat stress on milk production at the next lactation; in other words, heat stressed animals during the dry period that were supplemented with OmniGen performed the same as animals cooled during the same period.

Reference:

[1]Fabris et al., 2017. J. Dairy Sci. 100:6733–6742.

A Commonsense Approach to Managing Heat Stress

Simple measures can have a big effect on cow comfort and production

Heat stress can be a daunting issue, costing the average U.S. dairy producer $264 per cow each year[1] and affecting dairy cows in nearly all 50 states. While there's no magic bullet for alleviating heat stress, a commonsense approach to management can reduce the impact that heat stress has on your herd's health and productivity.

"Heat stress in the United States is very prevalent in the dairy industry, and because the metabolic rate is highest in lactating and high-producing animals, those cows are the most susceptible to its effects," says Dr. Glenn Holub, Executive Technical Services Manager for Dairy, Phibro Animal Health Corporation. "Heat stress can affect them on the cellular level and reduce production compared to an animal in a thermoneutral range of temperatures that's not expending energy in an attempt to cool its body."

Five Commonsense Measures to Help Manage Heat Stress

1. Provide shade. "It sounds obvious, but shade is the number one way to avoid the effects of heat stress on your cows, because shade reduces about half of a cow's heat load," advises Holub. This is true for both traditional dairy operations and the dry lot dairies more common in the western and southwestern United States.

2. Consider airflow. Sixty-five square feet per cow may sound like a lot, but that's ideal to allow enough space between cows for them to lie down and to promote airflow in shaded areas, according to Holub. While fans can help to move air, he cautions that they can be detrimental if the air temperature around the cows is hotter than the cows themselves, which creates a hot hair dryer effect. Also, holding pens for milking parlors are often the most offending part of the farm. Cows are crowded too close together and airflow is often restricted because of walls on the sides. "Fortunately, most modern parlors are much cooler, with better cross-ventilation and fan movement," Holub says. "You can also give cows a good soaking or provide drinking water as they head back to the pen to keep them hydrated and remove some excess heat."

3. Use misters but, consider the timing. While Holub says that intermittent misters can go a long way in alleviating heat stress, Holub warns producers to time them carefully. "In timing misters and fans, you want to be sure you're not creating an overly wet environment that's conducive to diseases like mastitis that can occur when cows lie down in a wet area or even wet manure," he warns.

4. Adjust nutrition and have plenty of water available. Cows tend to eat more at night during the hot summer months, so you'll want to have feed available then. Holub reminds producers to be sure to provide adequate intake of feed and fresh, clean water. Heat-stressed cows drink up to twice as much water, meaning that a large-bodied cow can drink up to 55 gallons — nearly a full barrel — of water each day. Holub says that some producers also feed cations, such as potassium. These cations are often found in sports drinks to balance human electrolytes, and they offer similar benefits for dairy cows.

5. Optimize immunity. OmniGen® nutritional specialty product is a heat stress management solution that has been proven to support healthy immune function and can help alleviate the effects of heat stress leading to lower respiration rates and rectal temperatures in heat-stressed cows. "We see the greatest change when cows are fed OmniGen before they hit a heat stress slump," Holub says. "Cows produce a huge metabolic amount of heat, so when we add heat stress to the mix, we're just asking for problems if we're not supporting the cow's immune system."

Heat stress occurs gradually and likely earlier than you'd think — typically in April for most of the United States. Fortunately, with these commonsense approaches to managing heat stress, producers can offset most of its effects to help keep their cows healthy and productive.

Reference:

[1] Key, N. et al., 2014. Climate Change, Heat Stress, and U.S. Dairy Production, Rep. No. 175.

Are Your Dairy Cows Heat Stressed?

Dr. Glenn Holub shares heat stress indicators to look for in your dairy herd

If you're a dairy producer in the continental United States, you've probably had to contend with heat stress. A high temperature humidity index (THI) causes dairy cows to become heat stressed — and that not only causes cows discomfort, but also lowers milk production.

"The closer you get to the equator, the higher the prevalence of heat stress," says Dr. Glenn Holub, Executive Technical Services Manager for Dairy, Phibro Animal Health Corporation. "While the southern states have a longer duration of heat stress, even northern states, from the state of Washington to Maine and everywhere in between, have periods of heat stress each year during which cows have to make certain metabolic adjustments to try to curb the effects of heat stress on their bodies."

Since heat stress can come on quickly and can cost the average U.S. dairy producer $264 per cow per year[1], Dr. Holub says that it's important to recognize the signs of heat stress and to have abatement measures in place to keep your cows comfortable and productive.

Five Indications That Your Dairy Cows Are Heat Stressed

1. Increased respiration rates. One of the ways that a cow gets rid of excess heat is through respiration, as she uses energy to take that heat and move it into the air and away from her body. If you see your cows panting, you know they are expending a lot of energy trying to cool themselves.

2. Metabolic pH changes. During times of heat stress and increased respiration rates, cows lose a lot of carbon dioxide from their bodies. Their blood will become slightly alkalotic during this time and then become more acidotic again during cooler parts of the night, when they're able to return to thermal neutral conditions and breathing becomes normal. This cycle of alkalosis and acidosis affects rumen function and buffering capacity and creates problems later in the season or in the lactation cycle when the acidosis and alkalosis changes in pH can manifest as signs such as lameness due to laminitis.

3. Reproductive issues, including more days open. If your dairy cows aren't conceiving, heat stress may be to blame. There's a strong inverse correlation between high temperatures and low conception rates. "The number of days open goes up significantly for cows that are eligible to be bred during hot summer months," says Dr. Holub. "It's not unusual for conception rates to dip down into single digits. During a severe summer with no effective cooling, I've seen conception rates sink to lower single digits on some dairies."

4. Behavioral changes. Heat stressed cows eat less and often eat during the cooler, nighttime hours instead of during the peak heat of the day. They often stand more, and they tend to chew their cuds less because they are panting in an attempt to exchange heat with the environment. These are all signs that your cows may be experiencing heat stress.

5. Decreased production. Heat stress affects cows at the cellular level — and the more energy that they expend trying to cool their bodies, the less energy they have to produce milk. This is compounded by the fact that cows have less dry matter intake during heat stress. "Once we have periods of heat stress lasting more than a few weeks, we start to see cows lose production, and once they've metabolically adjusted to heat stress, it's very difficult to get them back on their lactation curve," warns Holub.

Fortunately, by recognizing the signs of heat stress, producers can introduce management and feeding approaches to help abate the problem – from providing plenty of shade and water to feeding OmniGen® nutritional specialty product, a heat stress management solution that has been proven to help alleviate the effects of heat stress which can lead to lower respiration rates.

Reference:

[1] Key, N. et al., 2014. Climate Change, Heat Stress, and U.S. Dairy Production, Rep. No. 175.

Why High Heat and Humidity Mean Lower Production

Dr. Glenn Holub explains the physiological effects of heat stress

It's a summer conundrum for U.S. dairy producers; as temperatures and humidity levels rise, dairy cow production decreases. But have you ever wondered what's going on with a cow physiologically to cause her to make less milk?

"You may have noticed that your most productive cows are often the ones most affected by heat stress," says Dr. Glenn Holub, Executive Technical Services Manager for Dairy, Phibro Animal Health Corporation. "These highly productive animals have the highest metabolic rates, so heat stress affects them at the cellular level, reducing the amount of production that we're used to seeing from these animals when they are in a cooler, themoneutral temperature range and not having to expend energy trying to cool their bodies instead of making milk. Once a cow has adjusted metabolically to the heat stress, it's very difficult to get her back on the lactation curve to continue in a strong manner."

In periods of heat stress, a cow shifts blood away from her internal organs, which are vital to milk production, to her extremities. This is in effort to get the blood to the skin surface, where it's able to exchange heat before it returns to the center of her body. This weakens her ability to make milk by taking blood flow away from her liver, intestines, heart and other major, vital organs.

A shift in blood flow isn't the cow's only physiological response to heat stress — she also increases her respiration rate to get rid of excess heat. "It's a simple process in that she's just taking heat and moving it into the air and away from her body," says Dr. Holub. "This, too, requires energy — and once she starts panting and once you see her exhaling and inhaling more than once per second, she is really exerting a lot of energy trying to rid herself of excess heat. This also causes her to lose a lot of carbon dioxide from her body, and the byproducts of carbon dioxide support many of her routine systemic buffering functions."

"Due to panting and drooling during the hottest parts of the day, cows go through a cycle of alkalosis and acidosis through the day and night, as the blood shifts from more acidic to more alkaline," explains Dr. Holub. "Later in lactation or later in the season after the heat stress has subsided, we sometimes see lameness due to metabolic acidosis and Subacute Ruminal Acidosis (SARA) which causes laminitis."

Holub advises producers to monitor breathing rates. "When you see a cow get to a respiration rate of 120 breaths per minute, she's on the verge of having a severe crisis in her body," he warns. He says that there are phone apps and devices designed to help producers count breaths during a 20-second interval. (Once the 20 seconds is up, simply multiply the number of breaths times three to get respiration rate per minute.)

"Any time a cow goes over 60 breaths per minute, she's feeling the effects of heat stress, because a normal respiration rate is 30-40 breaths per minute," he says. "Respiration rates of 80 or 90 show that you're not effectively cooling your cows."

The Effects of Heat Stress on Milk Production and Reproduction

The physiological inefficiencies caused by heat stress affect a cow's production — and the declines can be significant. "Milk losses can take a steep decline during hot months and can go down by as much as 10, 15 or even 20 pounds per cow each day when they're not able to sufficiently cool their bodies," Dr. Holub says. "Sometimes, we get small, jagged spikes of production that fluctuate up and down from day to day, but once nighttime temperatures don't allow a cow to cool off, you're really going to see daily drops in production, particularly with a cow that's producing well over 100 pounds of milk."

Mid- to late-lactation cows, which are already on a steep downward production trend, are unlikely to recover much milk at the end of the summer. Holub reminds producers not to forget their prepartum cows which, although not operating at the metabolic rate of milk producers, still suffer the effects of heat stress. "Often, they're in the dry

pen farthest away from the parlor and further from sight, but gestationally, they have a 90-pound conceptus in them that's absorbing physiological energy to be kept alive," says Dr. Holub. "It's not uncommon for cows to calve a week or two earlier than their due date, and this is largely due to the influence of heat stress — then you've got a cow that hasn't finished preparing her udder for the onset of lactation and you have a calf that's stressed when it's born."

Prolonged or severe heat stress can also affect developing embryos. "Many producers report that their herd's reproduction rates wane rapidly in periods of heat stress," says Dr. Holub. "Once the cow's body gets over 102.4 degrees Fahrenheit, the early embryos — those that are just a few cells in size — have a hard time surviving." Producers may not realize a cow has conceived because the embryo dies and the cow cycles back in the next heat cycle, according to Dr. Holub. He says that a cow's number of "days open" also increases significantly during the summer months, when a dairy's conception rates may drop into the single digits.

Despite the physiological effects that heat stress has on dairy cows' comfort, reproduction and production, there is reason for optimism — by offering shade, water, fans or misters, in combination with a heat stress management solution like OmniGen® nutritional specialty product, producers can help alleviate the effects of heat stress and lower respiration rates of their dairy cows.

Cow Comfort and Immunity: The Keys to Abating the Cumulative Effects of Heat Stress

Dr. Glenn Holub shares how a healthy immune system is a cow's first defense against heat stress

Before joining Phibro Animal Health Corporation as Executive Technical Services Manager for Dairy, Dr. Glenn Holub spent years studying and advising producers about heat stress, first as an animal nutritionist and later as a professor at Texas A&M University. Through these roles, he's seen several constants. Each year, heat stress has a tendency to sneak up on producers. And healthy cows — those with strong immune systems — are better able to withstand periods of heat stress.

"Cows can be affected by heat stress when temperatures still feel comfortable to us," says Dr. Holub. "Early in the spring, we see the initial signs of heat stress when temperatures reach about 77 degrees Fahrenheit with a 15% relative humidity. Then by Memorial Day, we see production begin to lag."

Heat stress in dairy cattle is measured with the temperature-humidity index (THI), which uses a formula to combine the air temperature and humidity level to assess the level of thermal stress. At 77 degrees with 50% humidity, the THI is 72 — anything higher, and a producer is apt to see problems.

"In the southern U.S., it's not uncommon to see temperatures climb to over 100 degrees," says Dr. Holub. "Now we're talking about a THI of 91 to 95, which is very dangerous to cows. They're certainly not going to be productive in that environment."

When dairy cows experience heat-related distress, producers will see increased respiration rates. Dr. Holub notes that rates of 120 breaths per minute are an indication that a cow is on the verge of experiencing a severe crisis. And the next day, heat stress is apt to hit her even quicker since her body will be less able to adjust as heat stress continues in duration.

Short-term heat stress lasts for two to four weeks and is typically experienced by herds in the northern states. The cumulative effects of heat stress are much more dire closer to the equator in the southern United States, which might see six or more consecutive weeks of high THI during the summer. During prolonged periods of heat stress cows can start feeling the effects of solar radiation as early as 8:00 a.m. or even at sunrise. Their respiration rates go up, feed intake goes down, and they retreat to darker areas of the barn to try to escape the heat. "This is extremely hard for a cow to overcome, especially if we're not making corrections for her," states Dr. Holub. "It's a rough time to be a dairy cow if environmental adjustments aren't made."

Making Adjustments in Times of Heat Stress

"It's all about cow comfort, because comfortable cows can do what they're supposed to do: eat feed, chew their cud and make milk," says Dr. Holub. "We see heat indexes in areas of the South for up to seven months at a time, so it's not uncommon to see fans and misters running in all but the heart of winter in those areas to adjust the environment and keep cows comfortable and productive."

Cows become inefficient during times of heat stress, in large part because they eat less. "The rumen produces a vast amount of metabolic heat by digesting feedstuffs, which is why cows eat less in the summer," Dr. Holub explains. "Cows are not going to be very efficient when they have a low dry matter intake (DMI), so it's important to monitor DMI."

Dr. Holub says that producers are so close to their day-to-day routines that it can be helpful to bring in external eyes to help spot inefficiencies. Phibro offers its Stress Assessment for Dairy Cattle to help producers assess what conditions might lead to heat and other stress in the herd. For example, he says that holding areas can be

susceptible because cows often walk some distance to get there and, once there, are in side-by-side proximity to each other. “They’d love to be the only cow in there and to be showered to get rid of that excess heat, but the opposite is true,” he says. “Fortunately, most parlors are considerably cooler and have much better ventilation, but we still need to be careful not to pack them in.”

Dr. Holub suggests that producers feed OmniGen® nutritional specialty product to help improve the cow’s immune system which can lead to a reduction in core body temperature and respiration rates. “Keeping the immune system highly functioning helps a cow better withstand the effects of heat stress and other stressors,” he says. “When I taught college, I offered my students an analogy: think of the last week of school, when you’re staying up all hours of the night for finals. You’re not eating right or getting enough sleep and you’re experiencing stress. Then you go home, and you wind up sick because your body is responding to all the stresses you’ve stacked up and to cracks in your immunological armor. Likewise, it’s important to keep cows comfortable and keep their immunity strong.”

Dr. Holub says he’s seeing more dairies feed OmniGen to their cows during the warmer months, if not year-round. “Many report seeing less panting and fewer cows standing during the heat of the day,” Dr. Holub reports. “More cows were inclined to lie down because they didn’t have to circulate the warmer blood deep inside their bodies to the skin’s surface to be cooled. They tell us that respiration rates are lowered as well. Indications are that OmniGen is an effective tool to use during heat stress — by enhancing the immune system the cow is better able to regulate body temperature, which not only helps cows stay cooler and more productive, but also supports healthy immune function leading to lower respiration rates and lower body temperatures.”

Watch Dairy's Most Profit-Draining Challenges: Heat Stress Webinar

DR. GEOFFREY DAHL
Professor, Harriet B. Weeks Professor, University of Florida

DR. GLENN HOLUB
Executive Dairy Technology Manager, Phibro Animal Health Corporation

This highly informative course explores why and how heat stress negatively affects dairy cow productivity throughout the lactation cycle. Learn from the experts as they explain the degree to which milk yield is reduced with heat stress in lactation, the physiological reasons for those effects, and the profound negative effects of heat stress during the dry period on mammary development, on immune function and ultimately on productivity in the next lactation.

Registration for the webinar series is free on the Phibro Academy website at: **https://academy.pahc.com/catalog/info/id:444.**

For more information on OmniGen, contact your local Phibro representative or visit https://www.theOmniGenDifference.com.

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Stop Heat Stress from Draining Your Profits Webinar Q&A

Dairy research leader Dr. Geoff Dahl answers your hottest questions

Rumen fermentation and lactation require high metabolic heat, making dairy cows particularly sensitive to heat stress whenever the temperature humidity index (THI) exceeds 68. Heat stress can affect cows' milk production, reproduction and health, and it costs the average U.S. dairy farmer an average of $264 per cow[1] per year. It's no wonder that heat stress is a popular research topic.

As the Harriet B. Weeks professor in the Department of Animal Sciences, University of Florida, Dr. Geoff Dahl has led numerous studies examining the effects of heat stress on dairy cows at all phases of production. He recently teamed up with Dr. Glenn Holub, Executive Dairy Technology Manager, at Phibro Animal Health Corporation to host a free webinar titled Dairy's Most Profit-Draining Challenges—Heat Stress, now available on demand from Phibro Academy. Dr. Dahl answered some common questions about dairy cattle heat stress.

Q&A with Dairy Cattle Heat Stress Expert, Dr. Geoff Dahl

What should producers look for as potential early signs of heat stress?

A: The first sign of heat stress is typically that lactating cows, and all cows, are going to have decreased dry matter intake (DMI). We know how important DMI is to maintaining milk yield—when DMI decreases, so does milk yield. What's interesting, though, is that the reduction in milk yield is really beyond what we might expect based on decreased DMI. What's happening is those cows must use additional energy to get rid of that extra heat—so that's energy that is not available for milk production purposes.

How significantly can heat stress affect milk yield, according to your research?

A: We conducted a study that consistently showed the effects of heat stress on a cow's next lactation compared to the milk production of cows that were cooled when they were dry or cows that were heat stressed when they were dry. This and other studies indicated we are looking at about an 8 to 10 lb per day reduction in milk yield if cows are heat stressed during the final phases of gestation during the dry period versus those animals that are cooled. It's not just the one study that shows this, but a number of studies show the same thing. Cooled cows make more milk in the next lactation than cows that are heat stressed when they are dry. Heat stress has a profound and consistent effect on production.

One reason for this is that we do see differences in various aspects of mammary development. We know that the dry period is important not only to have a reduction in older, less productive cells in the mammary gland, but also to regenerate capacity for milk yield in that next lactation. When we look at mammary cells, we see that the structure of mammary gland cells is different in heat stressed dry cows versus cows that are cooled during the dry period.

You've conducted a wealth of research examining the implications of heat stress. What have you seen recently in terms of the effects of heat stress on dry cows?

A: We conducted a study looking at aspects of animals seasonally being heat stressed when dry. We studied more than 1,500 dairy cows in Florida on one farm that had consistent, high-level management but were housed on pasture when dry during June, July and August—the hottest months of the year. We compared this group with another 1,000 cows that were housed on pasture when dry during the cooler months of the year—December, January and February. We saw about 1,100 pounds less milk in the next lactation in those cows that were dry during the hotter months of the year. Drying the cows in cool months improved performance. There is also definitely an effect on disease incidence in animals if they experience heat stress when they're dry. Cows that were dry in hotter months ended up having increased rates of mastitis, respiratory disease and retained fetal membranes. Reproduction was also negatively affected in the cows that were dry in the hotter months.

Do I have to cool cows throughout the entire dry period?

A: We set up a "switch-back study" to determine when we need to start cooling and whether we can just wait to cool cows during the close-up phase. Cows were either cooled from the time they dried off until calving or heat stressed, and then halfway through the period, we switched half of those groups—so we ended up with cows that were either cooled for the entire dry period or cows that were heat stressed for the entire dry period, as well as cows that were cooled and then switched to heat stress and cows that were heat stressed and then cooled. Our results showed that no, you cannot just cool them during the close-up phase. It didn't matter when the cows were stressed in the dry period; whether it was early or late, they all responded the same way as the cows that were heat stressed for the entire dry period. All heat-stressed cows made less milk than cows that were cooled for the entire time. We need to get cows cooled from the initiation of the dry period.

What are the effects of heat stress on the developing fetus?

A: We see significant effects of heat stress on the fetus that's developing within that animal. While we tend to look at the effect on the cow as sort of programming her for less milk yield in that next lactation, the effects on the fetus program it for lower productivity and lower survivability in the herd. So, it's a lifetime effect. In fact, the effects on the fetus may be even greater, when we look at them in aggregate, than the effects on the cow herself in the next lactation.

What has your research shown about the effects of feeding OmniGen® nutritional specialty product to cows that are heat stressed?

A: We looked at cows that were heat stressed from the time they were dried off until calving versus cows that were cooled for the entire dry period, and we fed OmniGen (or did not feed OmniGen to our control group) late in lactation and continued those treatments during the dry period. We continued those OmniGen treatments into lactation. Cows that were heat stressed and fed OmniGen during the dry period performed better once they freshened than those that were heat stressed and not fed OmniGen during the dry period. That suggests there is some benefit to feeding OmniGen. We also saw a reduction in respiration rates and rectal temperatures—which was similar to research responses done with heat stress cows—in the cows fed OmniGen.

What factors determine how a cow recovers from heat stress?

A: The severity and duration of the heat stress and the stage of lactation affect how a cow responds to and recovers from heat stress. Based on our data, it seems like cows that are further along in lactation may be more profoundly affected long term from heat stress than animals that are early in lactation. And certainly, cows that are dry are going to be profoundly impacted by heat stress. So, it's really a combination of how severe that heat stress is, how long it has persisted, and what physiologic stage the animal is in. All these factors determine how much of a recovery the animal will be able to make, if any, from heat stress.

What surprises people the most about heat stress?

A: People are always surprised how much time of the year, and where, heat stress poses an issue. Really the only state where you don't have to worry about heat stress is Alaska, but there obviously aren't a lot of cows there either. Places that always tend to surprise people are the upper Midwest or the Northeast in terms of how much time of the year they experience heat stress. On average, across the top dairy states in the U.S., we've got about three months of heat stress each year, defined by an average THI for the day being greater than 68. This means that for at least a quarter of the year, animals are potentially heat stressed. And it's not just in southern states like Florida or Arizona. There's also significant potential impact of dry period heat stress in places like Indiana, Pennsylvania and even Michigan and Wisconsin. That's a lot of unrecognized heat stress.

Reference:

[1] Key et al., 2014. Climate Change, Heat Stress and U.S. Dairy Production, Rep. No. 175.

Dairy's Most Profit-Draining Challenges—Heat Stress Webinar Listicle

Dairy health experts discuss the potential long-term effects of heat stress

Heat stress is estimated to cost the dairy industry $897 million to $1.5 billion annually with losses caused by lowered milk production, increased metabolic disorders, reduced reproductive performance, reduced dry matter intake and impaired immune function.[1] For a U.S. dairy producer, this loss translates to an average of $264 per cow[2] per year.

Most producers are aware of the significant impact heat stress can have on milk production and their bottom line, but there's likely much about heat stress they don't know. A free, on-demand webinar is now available from Phibro Academy as the first of a four-part webinar series titled "Dairy's Most Profit-Draining Challenges."

Dr. Geoffrey Dahl (Harriet B. Weeks Professor, Department of Animal Sciences, University of Florida) and Dr. Glenn Holub (Executive Dairy Technology Manager, Phibro Animal Health Corporation) explore some of the lesser-known effects of heat stress on dairy cows and share practical tips to help abate those effects.

Five Things You Might Not Have Known about the Effects of Heat Stress on Dairy Cows

1. Seasonal influence is profound, and it might not occur when you'd think. Milk production tends to peak in March and April and bottom out in September or October. Plot this trend against the highest average daily temperatures, and it's interesting to see that the highest temperatures do not overlap with absolute production lows. This indicates that not all effects of heat stress are seen immediately. In addition to the acute effects that producers usually see, heat stress has lingering effects that vary according to the duration of the heat stress period and the stage of lactation.

2. Cooling dry cows increases milk in the next lactation. You're looking at a reduction in milk yield of 8 to 10 pounds per day if cows are heat stressed during the final phases of gestation during the dry period. Numerous studies show that cooled dry cows make more milk in the next lactation, demonstrating that heat stress has a significant and consistent effect on production. This is due in part to various aspects of mammary development. The dry period is important not only to reduce the number of older, less productive cells in the mammary glands, but also to regenerate capacity for milk yield during the next lactation.

3. There's a lot happening early in the dry period that can be affected negatively by heat stress. It doesn't matter whether cows are heat stressed early or late in the dry period; they respond the same way as cows that are heat stressed for the entire dry period. In numerous studies, all heat-stressed cows produced less milk than cows that were cooled. This finding shows the importance of cooling cows at the beginning of the dry period.

4. Heat stress has a lifetime effect on calves before birth. While we tend to look at the effects of heat stress on the dry cow as sort of programming her for the next lactation, the effects on the fetus are likewise programming it for lower productivity and lower survivability in the herd. This carryover effect on the fetus, when aggregated, can be even greater than the effect on the cow herself.

5. Most cows are potentially heat stressed for at least a quarter of the year. Almost every cow endures heat stress (defined as days with the temperature humidity index exceeding 68) for three months of the year—and not just in southern states like Florida and Arizona. There is a significant potential for dry period heat stress in places like Indiana, Pennsylvania, Michigan and Wisconsin. In fact, unless your dairy is in Alaska, your cows are subject to heat stress. And given that most cows are dry during the hottest months of the year, that equates to a lot of unrecognized heat stress.

The effects of heat stress can be daunting. Fortunately, there are effective measures available to producers to help mitigate these effects. It is imperative to cool your cows during the dry period, right from the initiation. Feeding OmniGen® may help reduce respiratory rates[3] and vaginal temperatures[4] during periods of heat stress, which can keep your herd comfortable and productive.

Registration for the webinar series is free on the Phibro Academy website at: https://academy.pahc.com/catalog/info/id:444.

Reference:

[1] St-Pierre et al., 2003. J. Dairy Sci. 86:E52-E77.
[2] Key et al., 2014. Climate Change, Heat Stress and U.S. Dairy Production, Rep. No. 175.
[3] Fabris et al., 2017. J. Dairy Sci. 100:6733-6742.
[4] Leiva et al., 2017. J. Dairy Sci. 100:4829-4838.

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