Manipulation of Photoperiod to Enhance the Sustainability of Illinois Dairy Farms

Principal Investigators:
Geoffrey Dahl, Michael Hutjens, and David Fischer, Department of Animal Sciences and Cooperative Extension, UIUC
Richard Wallace, College of Veterinary Medicine and Cooperative Extension, UIUC
Gary Schintkey, Department of Agricultural and Consumer Economics and Cooperative Extension, UIUC

Executive Summary:
Management of photoperiod (the duration of light a cow is exposed to each day) in dairy cattle is a profitable tool for producers in many economic situations. Properly implemented, photoperiod technology leads to immediate milk production responses, requires little capital investment, and has a quick asset turnover. These features make the investment particularly attractive to help producers meet the current challenges and improve long term viability of the Illinois dairy industry. This project emphasizes a combination of outreach education and applied research to demonstrate, optimize and develop novel photoperiod management techniques, and thereby facilitate widespread awareness and adoption of them on dairy farms in Illinois. Outcomes of the project include:

- A heavily visited and used website on that contains photoperiod management information, economic assessment spreadsheets, and facility design aids for light installation
- Saturation of the Illinois dairy industry with informational meetings regarding the application of photoperiod management
- Cooperation on a national survey of dairy producers to assess the level of integration of photoperiod management
- New knowledge regarding photoperiod management in growing heifers that yielded 2 peer-reviewed articles in the *Journal of Dairy Science*

Outreach and Applied Research Objectives:

Outreach Performance Target 1 - Within three years of the initiation of the project, 7.5% (117 farms) of the approximately 1,566 dairy farms in Illinois will implement photoperiod management on their farms. Also within this period, at least 25% of farmers (392 farmers) will make an informed consideration of adopting photoperiod management on their farms.
Outreach Performance Target 2 - By the end of the project (three years) at least 20 scientific, popular press, extension or industry articles, presentations or newsletters will be disseminated, based on interaction with personnel involved, or on information developed, as part of this project. A primary conduit for this information will be Illinois TRAILL, developed with previous C-FAR support.
Applied Research 1 – Photoperiod management increases production efficiency and profitability on Illinois dairy farms.
Applied Research 2 – Photoperiodic responses can be attained year-round in lactating dairy cattle, and in more than one lactation.

Outcomes and Impacts:

With regard to Outreach activity, in each year presentations were made at numerous extension and industry sponsored events that reached at least 300 dairy producers and allied industry representatives in the Illinois-Iowa-Minnesota-Wisconsin region. In the first year of the project, photoperiod was a topic at the Illinois Dairy Days series, which was attended by over 900 individuals and is estimated to have reached 500 producers. Other examples include an invited presentation at the 6th International Workshop on the Biology of Lactation in Farm Animals co-sponsored by the American Society of Animal Science and the European Association of Animal Production in Quebec City, Canada, the World Dairy Expo in Madison, WI, seminars for continuing education credit to veterinarians in California, Vermont and Guelph, Canada, a week-long seminar series to 200 dairy producers in Ontario, Canada sponsored by Ontario DHIA, and invited presentations to veterinarians and allied professionals at the Penn-State Nutrition Conference, Pacific-Northwest Animal Nutrition Conference, and the Tri-State Dairy Nutrition Conference. Coupled with those presentations are numerous Symposium Proceedings articles (see bibliography).

Information on photoperiod management is available at any time at the revised "photoperiod website" at *http://www.traill.uiuc.edu/photoperiod/*; the site includes data summaries, installation instructions and worksheets for estimating installation costs and economic benefits. The site continues to have high activity, with recent expansion to include information on lighting design for dry cow barns. Using key words "dairy" and "photoperiod" the site continues to rank first on the search engines Google, Hotbot, Lycos, Yahoo, AOL and others.

We estimated stakeholder interest in the general area of research from results of a survey in *Hoard's Dairyman*. We were asked to submit a question regarding adoption of photoperiod by dairy producers to the annual management survey that the magazine conducts. In response to the question: "Do you use **supplemental (photoperiod) lighting** to extend daylength for your milking herd?", 32.4% of respondents answered yes vs. 67.6% no (There were 367 respondents). To give that some context, 29.8% said that they had used bST in the past year (805 respondents). The survey went out to a total of 3000 producers and had an overall response rate of 43.6%. Not all producers received all of the sub-sections of the survey, which explains the difference in "n" for respondents. For the third year use of photoperiod management was over 30% of the responding herds. This is a national survey that reaches a broad group of producers across the U.S., and the results indicate that dairy producers are using the technology and suggest that new findings in this area are of interest.

As for the applied research objectives of the project, the first field study testing the viability of photoperiod management in Illinois ran for two years on commercial farms. This study involved pairs of farms of similar production and management levels; within each pair one farm installed lighting and is applying long day treatment to the lactating herd and the other herd serves as a control of no treatment. Milk production, herd health and implementation costs were followed for six months. We are continuing to summarize the results. A second study examining the impact of photoperiod manipulation to speed heifer growth and eventual entry into the milking herd has been summarized and two papers were published in the *Journal of Dairy Science* based on the results of the heifer study. This study replaced the original objective related to multiple lactation responses to long days because a suitable commercial partner could not be identified for that study, and there was no ability to conduct that study at the UI Dairy due to limited numbers

of cows available. However, the heifer study is of great interest to dairy producers and has generated an invitation to speak at the Professional Dairy Heifer Growers Association Annual Meeting in 2007.

Beneficiaries:
Dairy producers are clearly the primary beneficiaries of this project and work on photoperiod in general. The response has been shown repeatedly to be economically positive, with returns of $0.25/cow/d at milk prices at the farm gate of $11.00/cwt. That translates to an extra $76.25/cow/lactation profit.

Publications resulting from the project:
Refereed Journal Articles:
1. Rius, A.G., E.E. Connor, A.V. Capuco, P.E. Kendall, T.L. Auchtung-Montgomery, and G.E. Dahl. 2005. Long day photoperiod that enhances puberty does not limit body growth in Holstein heifers. *J. Dairy Sci.* 88:4356-4365.
2. Rius, A.G. and G.E. Dahl. 2006. Short communication: Exposure to long day photoperiod prepubertally increases milk yield in primiparous heifers. *J. Dairy Sci.* 89:2080-2083.

Proceedings:
3. Dahl, G.E. 2001. Photoperiod management of dairy cattle. pp. 110 – 117 in Leading Edge 2001 – Proc. of the 7th Ontario Large Herd Operators Symposium, Toronto, Canada.
4. Dahl, G.E. 2001. Photoperiod management of dairy cattle. pp. 27-30 in Proceedings of the Western Dairy Management Conference, Las Vegas, NV.
5. Dahl, G. E., T. L. Auchtung and P. E. Kendall. 2001. Efecto de fotoperiodo en el crecimiento, salud y reproduccion de bovinos de leche. pp. 137- 148 in Proc. of the 4th Simposio Internacional de Reproduccion Animal, Cordoba, Argentina.
6. Dahl, G. E., T. L. Auchtung and P. E. Kendall. 2001. Manipulacion de fotoperiodo para incrementar la produccion de leche en vacas. pp. 211- 222 in Proc. of the 4th Simposio Internacional de Reproduccion Animal, Cordoba, Argentina.
7. Dahl, G.E. 2001. Update on photoperiod management of dairy cows. pp. 139 - 142 in Proceedings of the 4-State Applied Nutrition and Management Conference, Midwest Plan Service Publication #MWPS-4SD11.
8. Dahl, G.E. 2002. Accelerating post-weaning growth in heifers. pp. 11 - 16 in Proceedings of the 4-State Dairy Management Seminar, Midwest Plan Service Publication #MWPS-4SD12.
9. Dahl, G.E. 2002. Photoperiod management of dairy cattle. pp. 27 - 32 in Proceedings of the 4-State Dairy Management Seminar, Midwest Plan Service Publication #MWPS-4SD12.
10. Dahl, G.E. 2002. Lighting the way to optimal cow performance. pp. 92-96 in Proceedings of the 35th Annual Conference of the American Association of Bovine Practitioners.
11. Dahl, G.E., T.L. Auchtung, J.L. Salak-Johnson and D.E. Morin. 2003. Photoperiod and immune function in dairy cows. pp. 20-25 in the Proceedings of the 5th International Dairy Housing Conference, American Society of Agricultural Engineers, K.A. Janni ed. and pp. 175-181 in the Proceedings of the 42nd Annual Meeting of the National Mastitis Council.
12. Dahl, G.E. 2003. Photoperiod management of dairy cattle for production and health. pp. 347 - 354 in Proceedings of the 21st Western Canadian Dairy Seminar. J. Kennelly, ed., ISBN 1-896110-19-3.

Extension Reports:
13. Dahl, G.E. Increased lighting improves production and profit. Pg. 41-43 in 2001 Illinois Dairy Report.

14. Dahl, G.E., D.H. Lattz and G.D. Schnitkey. Marginal costs versus marginal returns: Why cutting costs is not always the answer. Pg. 45-47 in 2001 Illinois Dairy Report.
15. Buyserie, A., M. Gamroth and G. Dahl. Managing light in dairy barns for increased milk production. 2001. Oregon State University Extension Service.

Popular Press:

16. "Increase lighting to increase milk production and profits". *Midwest Dairy Business*, 1/01.
17. "Lighting management for dairy cattle". *Illinois Agri-News*, 1/5/01.
18. "Lights, BST, action". *Hoard's Dairyman*, 1/10/01.
19. "Photoperiod management of dairy cattle". *Feedstuffs*, 6/11/01. (Reprint of presentation at 2001 Western Dairy Management Conference).
20. "Lichtprogramme richtig planen". Elite (German Dairy Magazine), 1/24/04.

External Funding Leveraged by the Project:

USDA-BARD Award #US-3201-01. $370,000 . 2001-04. "Environmental manipulation during the dry period of ruminants: Strategies to enhance subsequent lactation" G. Dahl, (PI) S. Mabjeesh, T. McFadden, A. Shamay, (Co-PI's).

USDA-NRI Award #2002-35206-12839. $200,000. 2002-04. "Manipulation of prolactin sensitivity in transition dairy cows". G. Dahl, (PI), T. McFadden (co-PI).