

This is a final project report submitted to The Ceres Trust.

Project Title:

**Evaluation of different winter housing systems for effects on organic dairy cattle production, health, and well-being.**

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Ceres Trust Funding Awarded: \$9,896

Project Period: 2013-2014

### ***Project Summary***

Organic dairy cows at the University of Minnesota's West Central Research and Outreach Center, Morris, MN, that calved during fall and spring calving seasons were used to evaluate production, somatic cell score, dry matter intake, animal hygiene, and behavior of organic dairy cattle housed outdoors on a straw pack or indoors in a compost bedded pack barn. During the two years (2013 and 2014), 165 lactating Holstein and crossbred organic dairy cattle were assigned to a winter housing system (straw pack or compost-bedded pack barn). Organic wheat straw was used as bedding for the outdoor straw packs, which were 40 feet wide by 80 feet long, and maintained to keep cows dry and absorb manure throughout the winter. The open-front compost-bedded pack barn (2 pens in the barn) was bedded with sawdust, and the bedding material was stirred twice per day with a small chisel plow. Cows were fed a TMR that included organic corn silage, alfalfa silage, corn, expelled soybean meal, vitamins and minerals. The straw pack cows had similar milk, fat, and protein production than the compost bedded pack cows. Surprisingly, there were no differences in production between the two winter housing groups of organic cows for milk production or somatic cell score. The groups of cows also had similar dry matter intake, indicating that the cows that were housed on straw packs did not require more feed than cows housed in the compost bedded pack barn. However, cows consumed about 25% more dry matter intake during the winter of 2014 compared to the winter of 2013. The average temperature during the winter months was about 7 degrees colder during 2014 than 2013. Across the two winter seasons, there were no differences for body weight or body condition score for organic cows. For animal cleanliness, the cows housed on straw packs had udders that were cleaner than cows housed in compost bedded packs (udder hygiene score of 1.45 versus 1.73). We saw no difference in rumination time for cows housed outdoors or indoors. In future years, we will focus on the profitability of the two winter housing systems for organic dairy cattle.

### ***Problem addressed***

The number of organic dairies has been steadily growing during the past decade in the United States and the Midwest. However, current research programs do not adequately support the needs of the increasing number of organic dairies in the Upper Midwest, and scientific research on methods of winter housing systems for organic dairy cattle is lacking. The project evaluated organic dairy cow production and health of cows housed in compost barns compared to out-wintered straw packs. We evaluated the herd production performance, animal health and well-being, and use the available data to establish benchmarks to present to farmers interested in out-wintering dairy cattle. Results were disseminated to stakeholders through extension publications, research center field days, and through online educational materials.

### ***Project Objective***

We evaluated different winter housing systems for effects on organic dairy cattle health during winter. We evaluated production, somatic cell score, dry matter intake, animal hygiene, and behavior of organic dairy cattle housed outdoors on a straw pack or indoors in a compost bedded pack barn.

## ***Methodology***

Organic Holstein and crossbred dairy cows were divided into sub-herds balanced by parity, breed, and calving date, and assigned to two different replicated housing treatments. The treatments were outdoor wintering lots bedded with organic wheat straw, or open-front compost barns bedded with organic approved sawdust. The lactating cows were introduced to their respective housing systems after the soil was frozen in December, and were removed when pastures were ready for the grazing in May. Throughout the winter, animals were milked twice a day, and fed a TMR that includes organic corn silage, alfalfa silage, a corn-grain mix, vitamins and minerals.

Two wintering lots were established at the WCROC dairy (~40 total cows per replicate). Each lot was 1 acre in size and contained loafing and feeding areas. An existing coniferous tree line on the north side of the lots served as a windbreak. Each lot had a resting area bedded with organic wheat straw, 40 feet wide by 90 feet long that was maintained as a bedding pack by adding organic straw as needed to keep the cows dry and effectively absorb manure and urine throughout the winter. Cows remained in their lots, except for twice daily milking at the nearby (100 feet) milking parlor. An existing barn at WCROC was divided into 2 independent sections to house the remaining two groups of cows (80 total cows). Initially, 18 to 24 inches of organic-approved sawdust bedding material was added to each section. Thereafter, beds were turned twice daily while the cows are being milked, and fresh bedding was added as needed to keep bedding moisture below 60%.

Daily feed consumption by each sub-herd was monitored as the difference between feed offered and refused, using a TMR feeding wagon equipped with Feed Supervisor herd management software. Milk production was quantified with monthly measures of milk, fat, protein, SCC, and milk urea nitrogen. To evaluate animal health, cow body weights were recorded bi-weekly using a digital scale as cows exit the milking parlor, and all cows in each housing system were visually scored for locomotion, body condition, hygiene, and hock lesions bi-weekly. Lameness was scored using a 5-point locomotion scoring method, with 1 = normal locomotion to 5 = severely lame (Flower and Weary, 2006). Body condition scores were 1 = excessively thin to 5 = excessively fat (Wildman et al., 1982). Hygiene scores were assessed by udder and lower hind leg cleanliness, with 1 = clean to 5 = dirty (Reneau et al., 2005). Hock lesions were classified as 1 = no lesion, 2 = hair loss (mild lesion), and 3 = swollen hock with or without hair loss (severe lesion).

Furthermore, we assessed dairy cow behavior daily using the SCR Heatime system ([www.scrdairy.com](http://www.scrdairy.com)). Briefly, the activity and rumination monitoring system use cow activity levels from head movements, and a small collar microphone to listen to rumination activity for cows. At the beginning of the project, all organic cows were fitted with SCR H-Tag behavior recorders. Measurements were carried out for a 24-hr time period for the duration of the winter. This system provided an accurate and dependable way to monitor animal health and behavior for cows in two different winter housing systems.

# Outwintering observations

| <b>Variable</b>                    | <b>Compost</b> | <b>Straw pack</b> |
|------------------------------------|----------------|-------------------|
| <b>Cows</b>                        | <b>84</b>      | <b>81</b>         |
| <b>1964 Holstein</b>               | <b>22</b>      | <b>21</b>         |
| <b>Holstein-sired crossbreds</b>   | <b>20</b>      | <b>20</b>         |
| <b>Jersey-sired crossbreds</b>     | <b>26</b>      | <b>23</b>         |
| <b>Viking Red-sired crossbreds</b> | <b>16</b>      | <b>17</b>         |

Breed groups of cows include pure Holsteins and various crossbreds of Jersey, Holstein, Montbéliarde, Swedish Red, and Normande. Breed groups of cows were: Holsteins (n = 43) maintained at 1964 breed average level, Holstein-sired crossbreds (N = 40), Jersey-sired crossbreds (n = 49), and Viking Red (Swedish Red) crossbreds (n = 33). The distribution of cows by breed group and housing group is in the first table. The four breed groups were variable in number of cows per housing group, but they provided meaningful comparisons.

## *Statistical analysis*

For statistical analysis cow measurements, independent variables were fixed effects of year of study, season of calving (Fall or Spring) nested within year of study, lactation number breed group, housing group, and the interaction of housing group and year of study, and replicated housing group was the experimental unit and was included in the model as a random effect. The MIXED procedure of SAS (SAS Institute, 2014) was used to obtain solutions and conduct the ANOVA. All treatment results are reported as least squares means and significance was declared at  $P < 0.05$ .

## *Results*

Surprisingly, there were no differences between the two winter housing groups of organic cows for milk production or somatic cell score. Energy-corrected milk was similar for the cows in both the compost barn compared straw pack. Milk urea nitrogen numbers are lower than expected, but a lower protein diet is a cause of lower milk urea nitrogen. Organic protein supplements are expensive and are used in lower frequency at the WCROC because of cost.

## Outwintering production

| <b>Variable</b>                       | <b>Compost</b> | <b>Straw pack</b> |
|---------------------------------------|----------------|-------------------|
| <b>Cows</b>                           | <b>41</b>      | <b>42</b>         |
| <b>Milk (lb/day)</b>                  | <b>34.4</b>    | <b>33.3</b>       |
| <b>Fat (lb/day)</b>                   | <b>1.4</b>     | <b>1.3</b>        |
| <b>Fat percent</b>                    | <b>4.1</b>     | <b>4.3</b>        |
| <b>Protein (lb/day)</b>               | <b>1.2</b>     | <b>1.2</b>        |
| <b>Protein percent</b>                | <b>3.5</b>     | <b>3.5</b>        |
| <b>Energy-corrected milk (lb/day)</b> | <b>34.8</b>    | <b>34.2</b>       |
| <b>Somatic cell score</b>             | <b>2.75</b>    | <b>2.88</b>       |
| <b>Milk-urea nitrogen</b>             | <b>6.2</b>     | <b>6.4</b>        |

The groups of cows also had similar body weight (1,157 lbs. versus 1,232 lbs.) and body condition score (3.38 versus 3.08), probably indicating that the cows that were housed on straw packs did not require more feed than cows housed in the compost bedded pack barn.

## Bodyweight and BCS

| <b>Housing</b>         | <b>Compost</b> | <b>Straw pack</b> |
|------------------------|----------------|-------------------|
| <b>Bodyweight (lb)</b> | <b>1,157</b>   | <b>1,232</b>      |
| <b>BCS</b>             | <b>3.38</b>    | <b>3.08</b>       |

For animal cleanliness, the cows housed on straw packs had udders that were cleaner than cows housed in compost bedded packs (udder hygiene score of 1.45 versus 1.73). Furthermore, compost bedded pack cows had bellies that were more soiled than cows on the straw pack (1.86 versus 1.56, respectively). Cow groups did not differ for cleanliness on the tail head or the upper or lower portions of the rear legs.

## Outwintering hygiene

| <b>Variable</b>         | <b>Compost</b>          | <b>Straw pack</b>       |
|-------------------------|-------------------------|-------------------------|
| <b>Tailhead</b>         | <b>2.25</b>             | <b>2.30</b>             |
| <b>Upper Leg</b>        | <b>2.27</b>             | <b>1.98</b>             |
| <b>Lower Leg</b>        | <b>2.61</b>             | <b>2.53</b>             |
| <b>Belly</b>            | <b>1.86<sup>a</sup></b> | <b>1.56<sup>b</sup></b> |
| <b>Udder</b>            | <b>1.73<sup>a</sup></b> | <b>1.45<sup>b</sup></b> |
| <b>Hock score</b>       | <b>1.02<sup>a</sup></b> | <b>1.11<sup>b</sup></b> |
| <b>Locomotion score</b> | <b>1.05</b>             | <b>1.01</b>             |

For cow activity, cows that were in the compost bedded pack had higher activity levels than the straw pack cows because these cows had to walk further to the milking parlor than the straw pack cows. We saw no difference in rumination time for cows housed outdoors or indoors.

# Daily activity and rumination by housing group

| Variable   | Activity <sup>1</sup> | Rumination <sup>2</sup> |
|------------|-----------------------|-------------------------|
| Straw pack | 477 <sup>a</sup>      | 474                     |
| Compost    | 531 <sup>b</sup>      | 495                     |

Columns with common superscripts are not different ( $P < 0.05$ )

1 = measured in activity units from SCR Dairy

2 = min/day

Rumination time for cows housed outdoors or indoors increased during the cold months of December, January, and February compared to March and April. Cows were consuming more feed during the cold months to maintain body heat, and therefore, had higher rumination levels. Activity levels were higher in March and April because the weather was warming and cows tend to be more active when the weather is not extremely cold.

## Daily activity and rumination

| Variable | Activity           | Rumination         |
|----------|--------------------|--------------------|
| December | 465 <sup>a</sup>   | 499 <sup>a</sup>   |
| January  | 461 <sup>a,b</sup> | 486 <sup>b</sup>   |
| February | 487 <sup>c</sup>   | 502 <sup>a,c</sup> |
| March    | 528 <sup>d</sup>   | 462 <sup>d</sup>   |
| April    | 576 <sup>e</sup>   | 499 <sup>d</sup>   |

Columns with common superscripts are not different ( $P < 0.05$ )

## ***Conclusion***

There are several obvious benefits to out-wintering; building costs are lower, diseases associated with close confinement and poor ventilation are avoided, animals are generally cleaner, bedding costs could be reduced, feeding may be simplified, and herd size may be adjusted if weather conditions change quickly. There are five key messages to consider when considering outwintering, 1) provide adequate wind protection, 2) additional feed may be required for cows and heifers, 3) lactating cow teats should be dry before they leave the milking facility during cold weather, 4) health problems tend to be fewer than cows housed indoors or in confinement facilities, and 5) housing under the stars may not be for everyone.

In future years, we will focus on the profitability of the two winter housing systems for organic dairy cattle. Economically, animals outdoors may require about 15 to 20% more feed for the season than animals kept in confinement housing, so improvements in animal health and welfare from out-wintering will need to exceed increased feed costs if out-wintering is to be a profitable option.

## ***Outreach and Extension***

Preliminary results of this research were presented at:

- American Dairy Science Association/American Society of Animal Science meetings (July 2014, Kansas City, MO)
- MOSES Organic Conference (February, 2014, LaCrosse, WI)

eOrganic webinar on outwintering cattle. <http://www.extension.org/pages/71817>

In the future, scientific results will be published in the Journal of Dairy Science, and an extension fact-sheet will be published with on the University of Minnesota Dairy Extension website. These results will be a portion of Lucas Sjostrom's Master's thesis.

## ***Publications authored by Investigators***

1. Heins, Brad. 2014. Considerations for out-wintering the dairy herd. <http://www.extension.umn.edu/agriculture/dairy/facilities/considerations-for-out-wintering-the-dairy-herd/index.html> December 13, 2014
2. Heins, B. 2014. Outwintering of the WCROC Dairy herd. Morris Sun Tribune. December 27, 2014
3. Heins, Brad. 2014. Considerations for Out-Wintering the Dairy Herd. University of Minnesota, West Central News, December 10, 2014
4. Heins, Brad. 2014. Winter housing systems for organic dairy cows. 2014 Morris SunTribune Farm Progress Supplement, March 8, 2014, pp
5. Heins, B. 2014. The cows talking to us 24 hours a day! Are we listening? Morris Sun Tribune. February 22, 2014.
6. Heins, Brad. 2014. Winter housing systems for organic dairy cows. University of Minnesota, West Central News, February 19, 2014

7. Sjostrom, L. and B. Heins. 2014. Evaluation of different winter housing systems for effects of animal health and economics of organic dairy cows. MOSES Organic Conference Poster, LaCrosse, WI, February, 27 – March 1, 2014.
8. Sjostrom, L. S., B. J. Heins, M. I. Endres, R.D. Moon, U. S. Sorge. 2014. Effect of two winter housing systems on production, body weight, somatic cell count, BCS, and dry matter intake of organic dairy cows. *J. Dairy Sci.* 97 (E-Suppl. 1):295. Abstract 588

*Photos*



Group housing of organic dairy cows during the winter



Cows on compost bedded pack



Cows on straw pack