Management of the High Yielding Dairy Cow

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Introduction

Scientific animal management is founded on two principles:[35]

1) The strongest impulse in nature is *survival*
2) The second strongest is *reproduction.*

When things go wrong, one or both of the above fail. Management has been further defined as:

1) Doing many things well, and
2) Leaving the job better than you found it.

Feeding Management

For some dairy farmers, practitioners, consultants, and students interested in high yielding cows, this is all very nice so the following may suit them better: "Management is down the throat." It has been said that we are what we eat and the same is true with the cow. Therefore, this paper will deal first with feeding management. For further information on this subject the reader is referred to a previous scientific paper on Feeding Behavior of Dairy Cattle.[7]

The primary concern of all animals is the gathering of food.[1] All animals evolve as products of their dietary needs: the cow's stomach and the suckling instinct in young mammals are all diet-oriented. An animal is not only what it eats, but is also designed so that it can eat.[14] Dairy cattle responses to various types of feeds and feeding arrangements differ. Dairy farmers can use knowledge of animal behavior to improve cow well-being and yield.[6] For instance, feeding and watering systems must be placed where young or inexperienced animals can find them. Feed accessibility may be more important than the actual amount of nutrients provided. Efforts must be made to reduce the competition for feed, water, minerals and shelter. Also, cow space, cow density, and distribution of feed are closely related factors. Feed intake and consequent milk yield are improved by provision of feed when cows need and want to eat.[29] When one cow eats, another might be stimulated to do likewise whether she is hungry or not. This behavior is an example of social facilitation.[16] When cows eat in groups, they eat more than when they are fed separately. Furthermore, cows kept in groups "are likely to be less fearful, and hence, more contented, healthier, and more productive. The common practice of feeding and milking cows in groups thus has a sound psychological basis".[30]

Dairy cattle are social animals that operate within a herd structure and follow a leader (leadership followership) to and from pasture, the feedbunk and milking parlor. Such behavior can be beneficial (e.g., following a leader onto a scale) or detrimental (e.g., a stampede).[11] Behavior becomes a balance of interacting driving forces: for newly mixed cows, aggression is dominant, but it soon diminishes as the social order becomes established and the feeding drive becomes dominant.[17] Cows exhibit wide differences in temperament, and their behavior is determined by inheritance, prior experience and training.[15] Cows normally are quiet and thrive on consistency and gentle treatment by handlers.[15] If you hear or see a cow bellering, what is she telling you? Handling procedures are more stressful for isolated cows; therefore, attempts should be made to have several cows together during medical treatment, during artificial insemination, or during movement from one group to another.[9,34]

Competition for feed, water and space can be reduced by fence line feeding of TMR, which allows all cows to eat at once. Holstein cows that were fence line fed a TMR or corn silage and concentrates ate 26% longer following feeding than the same size group eating from bunks around which they traveled.[2] Many dairies practice fence line feeding during which cows' heads are in the natural grazing position. Cows eating with their heads in the downward position produce 17% more saliva, which directly affects rumen function, than cows eating with heads held horizontally.[23,24] When fed in shallow elevated bunks, 10% of cows exhibited year-round rooting, snorting, feed tossing behavior, and feed wastage (0 to 5%). Groups fed at ground level or in headlocks showed little or no feed tossing behavior. This apparent livestock engineering problem is remedied

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easily by feeding cows in the natural head down position.[4] Concrete mangers renovated with epoxy-type finishes, wood or tile, aid feed consumption.[5] Palatability has a major influence on feed intake in ruminants, and the sense of taste is highly developed in cattle.[8] Detailed observations, using intact and ruminally cannulated cows, suggest a behavioral need for the cow to rest and to ruminate on her left side.[7]

Competitive Eating Situation

Competition for feed may develop when cows are kept in groups and when manger space is insufficient to allow all cows to feed at once. The critical length of manger space below which competition occurs depends on the time that feed is in the manger. Also, the presence of manger divisions may affect eating behavior of submissive cows, enabling them to eat longer.[13] Friend *et al.*,[18] examined the time that cows spent at the manger and their voluntary intakes when each cow was allowed .5, .4, .3, .2, or .1m (20, 16, 12, 8 or 4 in) of manger space; a TMR including 25% ground hay was available for 21 h/d. Only when the length of manger was below .2m (8 in) were eating time and intake reduced. In another trial comparing mangers of .5 and .25m (20 and 10 in) per cow, time spent by the cows in using the mangers and feed intakes were similar.[19]

Collis (1978, personal communication) conducted a similar study for 60 British Friesian cows comparing 1.1, .5, .3, .25, .2, .18, or .15m (43, 20, 12, 10, 8 or 6 in) of manger space. At the end of each week, before the reduction in manger space, this group of cows was observed continuously for 24 h. Reduction in manger space had no effect on the mean number of visits. The average total feeding times decreased during the 6 week trial, but not significantly. No significant differences occurred between the treatment and control groups for percentages of cows observed standing, lying, or feeding. The average milk yields of both groups decreased, but differences between them were not significant. How this short-term experiment with smaller numbers fits actual current herd conditions is not known. A gradual reduction in manger space for an established group of cows may be accepted more than adaptation of a new group to limited manger space.

In a Michigan herd of approximately 600 cows over 200 d, milk yield, conception, animal health, behavior and labor input at 61 versus 46 cm (24 vs. 18 in) of bunk space where checked and there were no differences.[5,32] High building investments suggest that the most efficient use should be made of dairy facilities. Therefore, 46 cm (18 in) of bunk should be provided instead of 61 cm (24 in) of space per cow for heavy corn silage diets or complete feeds. With cows averaging 36 kg (80 lb) /d, no difference in milk yield was found, but Bill Bickert, an agricultural livestock engineer, asks the question: "What is the effect if cows are averaging 45 or 57 kg (100 or 125 lb) /d of milk or more per day?"[12]

A field study was initiated to look at feeding behavior and bunk use patterns in two high producing herds in New York.[25] One group from each herd was selected with the highest milk production per cow and the highest DMI. One would expect this group to exert the most pressure on the feed bunk.

Table 1. Characteristics of study herds.

	Herd 1	Herd 2
Total Cows	270	370
RHA (Rolling Herd Average)	23,349	23,400
Milking Frequency	3X	3X
Type of Housing	6 row drive-thru	6 row drive-thru
Feeding Program	TMR	TMR
Feeding Frequency	2X	3X
Cows in Study Group	90	88
Stalls in Study Group	96	75
Linear cm Bunk Space/Cow	37 (1.22 ft)	40 (1.33 ft)
Average Production/Cow	41.4 kg (91 lb)	40 kg (88 lb)
Average Daily DMI	23.6 kg (52 lb)	24.5 kg (54 lb)

A video camera was mounted above and slightly behind the feeding area to give the best view of activity at the feed bunk. Each herd was videotaped for a 24 h period during August 1993. Temperatures were normal for August with highs of around 27° C and lows near 16° C.

The video was reviewed and stopped at 15 minute intervals, based on the on-screen video clock. The density of animals at the feed bunk was judged, and a score recorded for each 15 minute period. This provided 96 data points of feed bunk activity for one hour period. The scoring was based on a 0-10 system. Zero would indicate that no animals were at the feed bunk whereas a 10 score would indicate that the bunk space was completely occupied with no room for additional animals to eat. These scores were then plotted against time to develop graphs of feed bunk usage (See Graphs 1 and 2).

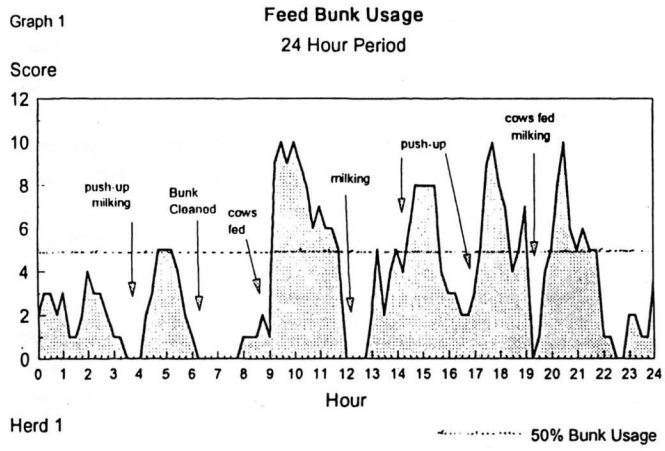
Observations of other barn activities were also noted. These activities included milking, feeding, feed push-up, bunk cleaning, etc. The time, and type of activity was then superimposed on the graph of feed bunk activity.

Several questions were of major concern in doing this study. Did feed bunk space affect feed bunk pressure? How often was feed bunk space not available for additional cows to eat? How did cows utilize feed space throughout a 24 hour period? How did other practices and activities affect feed bunk usage?

Although there are a number of differences between the graphs of Herd 1 and Herd 2, it appears that feed bunk space is limiting for only brief periods through-

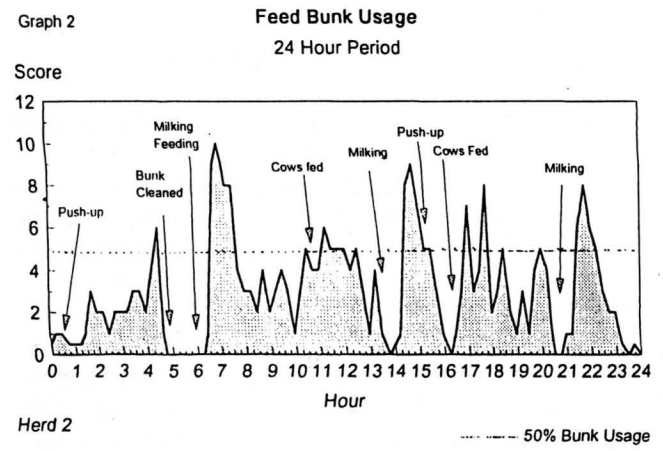
out the day. Herd 1 (Graph 1) shows four periods when the bunk was fully occupied. These periods were brief, lasting 15 minutes, plus or minus.

Graph 1



Herd 2 (Graph 2) shows only one brief point of restricted bunk space and two other points of nearly full utilization. It does not appear that the bunk space of 37 and 40 cm per cow in herds 1 and 2 respectively, causes a restriction in possible feed intake. In both herds, peak feed bunk usage is followed, in most cases, by a rapid decline in feed bunk usage which would indicate the absence of slug feeding behavior, particularly in Herd 2.

Graph 2



Additional video studies of high producing herds are needed to further define the effect of feeding management, bunk space and barn design on animal behavior.[25]

Stress

Stress has been defined in a variety of ways. Hans Selye, Nobel Prize winner from Canada for his classical work on stress, calls it the non-specific response of the body to any demand made upon it.[31] Stress = Situations that Release Emergency Signals for Survival. Stressors are events outside the animal which stress it and the final effect on the animal is distress. Distress is a term used to describe the damaging or unpleasant aspects of stress, some of the latter being needed each day to keep animals alert, alive and attuned to their environment and its dangers.

There are many ways proposed to measure stress in high yielding animals such as thyroid hormones, corticoids, cathecholamine levels, blood glucose, immune function, acute phase proteins, changes in heart or respiration rate and somatic cells in milk.[22] Behavioral signs of stress include "displacement activities" where for example animals in the middle of a fight may stop to graze[21,24] or stereotypic responses such as the pacing or circular walking of confined zoo animals round their cage.[27]

Farm animals can usually tolerate the effect of a single stressor over a short period without undue effect on production. If the animal has to cope with a number of stressors at the same time, health and performance are affected and sickness leading to death may result. Trouble often arises as some of the disease stressors may be sub-clinical and not seen (e.g. mastitis or internal parasites).[22]

Design of Facilities

The design of handling facilities is vital to successful animal handling where the work must be done with minimal stress or injury to both humans and animals. Facilities are often inadequate because they have been designed from a human point of view and the animal's viewpoint has been ignored. For example, cows prefer to be able to see while drinking water to avoid being butted, and more can drink at once from long, narrow troughs than from round troughs. Round troughs are more efficient when placed against fences rather than in the center of pastures (paddocks) but still provide water for several cows when split by the fence between two fields. Under dry conditions several small troughs in the same field would provide better watering for large herds at little extra cost. On pasture it is important to have adequate water (space and flow) to allow the herd to drink as a group activity after they finish grazing as a group especially in drought periods, otherwise production can be affected.[22] Similar comments can be made for shade as in the hot summer months with elevated temperature and humidity, cows become "solar collectors." Shade and cow coolers with fans (misters) to enhance evaporative cooling are being used in Arizona where year-round production with over 2,300 cows in the top herd is at 28,000 pounds of milk per cow as well as in Saudi Arabia where milk production is now in the 24 to 25,000 pound range.[8,10]

Farmers or consultants need to check on animal handling and facilities by noting on a balance sheet both

positive and negative factors at work. A milking parlor is a good example where such items as sharp turns, slick floors, doors (instead of a common holding pen-parlor), stray voltage, electrified crowding gates, electric prods, fluctuating vacuum, worn out teat cup liners and the number of stocks to beat the cows with, etc., can be noted. Beating animals may be good therapy for an angry farmer, but it does little to accomplish what is required of the animals.[22] Most tests of will between the animal and the farmer are won by the animal.

During her world milk yield record, U.S. Holstein, Beecher Arlinda Ellen, ate hay at floor level.[3] Evidence exists[23,24] that cows eating with their heads in the downward position produce considerably more saliva than cows eating with their heads held horizontally, which directly influence the efficiency of ruminal functions. A 24-h behavioral watch[3] has been summarized in Table 2.

Table 2. Behavioral profile (24-h) of cow yielding world milk record.

Eating time[1]	6 h 15 min
Resting (lying)[2]	13 h 55 min
Other[3]	3 hr 50 min
Chew per min. no.	60
Chews between swallows, no	82

[1] In a 24-h period in late lactation, Beecher Arlinda Ellen consumed different feeds: hay, 13 times; grain, 12 times; straw, 2 times; water, 7 times and mineralized salt, 5 times.

[2] Eyes closed for 30 min, broken into about four periods of 5 to 10 min. each. Cow spent 7 h 30 min ruminating (5 h 5 min on her left side and 1 h 50 min on her right side). Of the 14 h lying, 8 h were spent lying on her right side and 6 h on her left side.

[3] Ruminating while standing, 30 min; defecating 12 times and urinating 7 times; milked twice daily in a milking parlor; grooming; interaction with other cows, calves, cats, humans, and idling.

The world record milk producing cow for 17 years, Beecher Arlinda Ellen, has died and had her record broken five times since 1992. Currently, there are two Colorado cows in high producing herds with over 60,000 pounds of milk in a one year lactation period.

The environment of dairy cattle should be clean, dry and comfortable.[20] Ellen and these other great cows were given the very best of care, feeding and management. Great effort was made to provide maximum comfort. Some recent research work indicates blood flow to the udder increases substantially (28 percent increase) when a cow is lying down compared to standing. Changes in blood flow with posture may be indicative of a repartitioning of flow within the body and to the mammary gland and thus yield, since blood flow is related to the level of milk production.[20,26]

Many believe that milk is being made only when the cows are eating. The above fact of more blood flow to the udder when the cow is lying down should give them some pause to reflect. Since cows are crepuscular, meaning they are more active near sunrise and sunset, major feeding or grazing cycles take place. (Cattle have a distinct diurnal grazing pattern, which includes a major meal beginning approximately at sunrise. By mid-morning they are full and seeking the shade and down time for ruminating.) Providing they are comfortable, there is plenty of time during the day and night for cows to rest, check their cuds and ruminate.[7]

Also, sand or cow mattresses (with rubber pellets) are now recommended.[33] At Purdue University last June there were 30 or 40 cows in a tie stall barn with hock lesions. Following installation of rubber-filled mattresses last summer, the number of hock problems had fallen to 7 abnormal hocks by December 1st. Another management rule has fallen by the wayside, namely having 100 cows in a group.[3] In the South West, group size has risen to 260 cows in a group within large herds. With good and timely management, well-designed milking parlors, corral space of 500+ square feet per cow, fence line feeding with adequate manger space and headlocks for each cow, there does not appear to be any problem with 260 cows in a group.[8] Currently, in several Western states and Saudi Arabia, plans are being made to have 400 cows in a group.[8,10] Is that too many? I don't know, but future research should be done to find out.

Grazing-Back to the Future?

When I was in New Zealand studying large dairy herd management and animal behavior some 25 years ago, with rotational grazing I observed 300 Jersey cows per acre. Is that too many? I'm not sure, but it was being done with lush pastures (New Zealand clover and grass), temperate climate (no shade) and volcanic ash soil (no need to take cows off pasture during heavy rains). Like most people returning from New Zealand I wondered when the "GP's" (Grazing Pioneers, Grazing Practitioners) would make grazing work in the Lake Central States. These states have variable soil types (clay to sandy loam), hot weather (need for shade) and drought conditions to mention a few differences. It is exciting to see dairy farmers making rotational grazing and seasonal dairying work. There are now grazing herds averaging 20,000 lb. milk per cow. What is the world record for a cow on pasture? Proponents of grazing claim feed costs, cow health problems, labor needs and even producer stress all drop when dairy cows start harvesting some of their own forages. Milk production may drop too (for a while) but for these dairy producers the trade-off is worth making, economically as well as emotionally. For most people, the sight of a dairy herd contentedly grazing evokes an image of a gentler past.

A small but growing number of U.S. dairy producers see something else in the form of grazing/seasonal dairying for a better future for themselves and their animals.[36]

Epilogue

Earlier, two papers were prepared by Mr. Harold L. Beecher, Twelve Mile, Indiana, owner and developer of Beecher Arlinda Ellen, who held the world's record milk production record for 17 years. She produced 55,661 pounds of milk on 2x milking in a 365 day lactation. Ellen's record has been broken five times since 1992.

Harold Beecher wrote two articles for the International Stockman's School, San Antonio, TX, January 10-13, 1977. They were published in the Dairy Science Handbook Vol. 10:203-205. 1977 as Man's Rapport With the Dairy Cow and The Relationship Between the Cattleman and His Veterinarian Vol. 10:239-241. 1977.

I was asked to speak at the same School in 1981 and a paper featuring Ellen and the Beecher Family was published as Behavior and Management of High Yielding Dairy Cows in the *Dairy Science Handbook* Vol. 14:343-350. 1981.

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