Dairy Session III

"Efficient Production of Quality Replacement Heifers"

Moderator: **Charlene McLauchlan**

Opportunities in Replacement Heifer Growth

A.J. Heinrichs
Dairy and Animal Science Department
Pennsylvania State University
University Park, PA 16802

The opportunities that are available to influence replacement heifer growth on a dairy farm are great. To fully understand the process involved in optimizing growth rates, one must consider that the ultimate goal of a dairy heifer raising program is to develop these animals to their full lactation potential as an adult cow, at a desired age, and at minimal expense. Important considerations must be made to aspects of heifer growth that affect reproduction, lactation potential, and economics.

Growth is a function of living organisms that is pliable and in animals, can be accelerated or delayed with little influence on the final mature body size (Crichton *et al.,* 1959; Hansson, 1956). We must therefore look at levels of growth that culminate in the most economical scenario for the dairy farm. Research and Dairy Herd Improvement records show that this economical scenario is often associated with average calving ages of at or near 24 months, with post-calving body weights of 1150 lbs (522 kg), or greater (Gill and Allaire, 1976; Vazquez-Anon and Heinrichs, 1991). Other work has shown that earlier calving heifers produce more milk per day of herd life over older calving herdmates (Schultz, 1969; Gardner *et al.,* 1977; Lin *et al.,* 1986). Growth rates prior to puberty have been shown to be related to an animal's future productive potential. Lin *et al.* (1986) bred 253 heifers at 12 months of age and another group of 249 at 15 months of age. The heifers bred at 12 months of age had longer and more productive herd lives. Average herd life was 730 and 623 days and production per day of herd life was 6.8 vs 5.9 kg for the 12 and 15 month bred heifer groups respectively.

Animal growth and function are highly interrelated as defined by Brody (1945). Growth of domestic animals can be split into two sections when age is utilized as a varible (Brody, 1945). The first phase is the self-accelerating phase, which has a positive slope and the second is the self-inhibiting phase with a negative slope. This comes after the curve inflection and may be a result of the environment.

Diet and rate of growth have major effects on growth and future performance as shown by Swanson (1967). Dairy heifer growth can have marked influence on reproduction and production. Swanson noted that heifers should be developed to their full lactation potential within the desired age, but with minimal expense. Plum and Harris (1968) showed that calves which nursed for longer periods of time and had rapid growth rates, produced only 74% as much milk during the first 6 months of lactation as compared to the conventionally raised calves. Johnson and Obst (1984) showed that beef cattle fed high grain diets gaining over 900 g/day had decreased milk production compared to animals with 670 or 550 g/day gains.

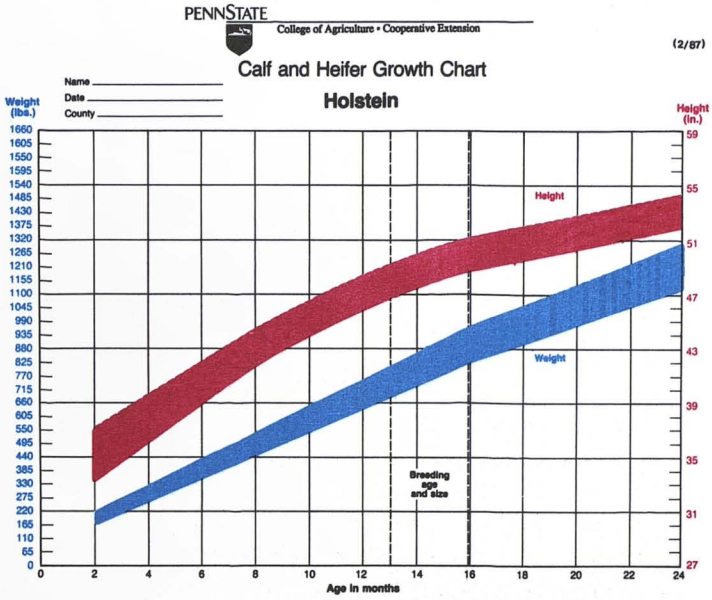
Rate of gain for growth for dairy heifers has a positive relationship to the proliferation of mammary tissue. Growth rates of the mammary gland have been found to be 1.6 times the growth rate of the animal from birth to 2 months of age. This rate increases to 3.5 times the animal's growth rate from 3 to 9 months and 1.5 times the animal's growth rate from 10 to 12 months of age (Sinha and Tucker, 1969). This allometric developmental period is a most critical period of development of the mammary gland (Waldo *et al.,* 1988).

Several workers have shown that feeding dairy heifers *ad libitum* vs a normal diet will cause marked decreases in milk production (Gardner *et al.,* 1977; Little and Kay, 1979; Sejrsen *et al.,* 1982: Swanson, 1960). These studies all support the concept that there is a negative correlation between the average daily gain in prepubertal heifers and total mammary gland weight and the percent mammary adipose tissue. Proper feeding is essential during prepubertal growth as the mammary gland is undergoing allometric growth.

Optimal rates of growth is therefore best for the fu-

Present Address: NAHMS, Fort Collins, CO 80521

ture production potential of the animal and is often the most economical scenario for the farmer to adopt. The following three figures were developed as population studies of growth rates for Holstein, Guernsey, and Jersey heifers. The Holstein growth charts were developed from Pennsylvania data only, however they have been supported by studies in Wisconsin, (Hoffman and Funk, 1991), and Illinois, (Dill *et al.*, 1991), while the Guernsey and Jersey standards were developed using a more national data base.



RANGE OF RECOMMENDED HOLSTEIN HEIFER WEIGHTS AND HEIGHTS

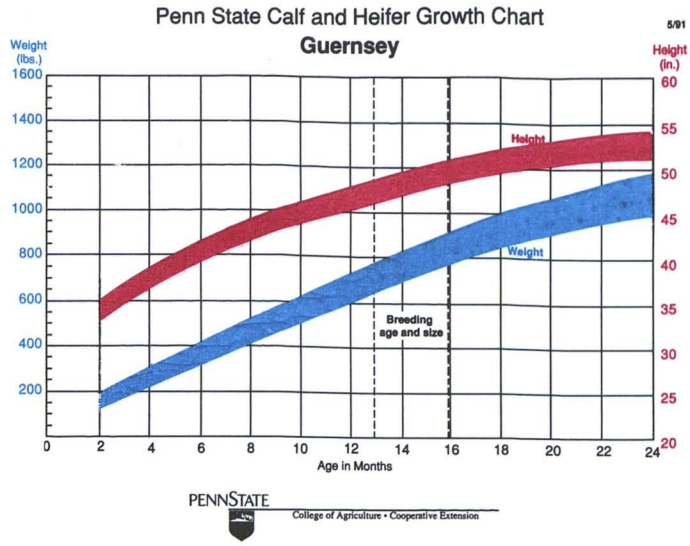
Age (months)	Weight Range (pounds)	Height Range (inches)
1	133-155	31.7-33.2
2	178-209	33.5-35.2
3	225-263	35.2-37.1
4	272-319	36.9-38.8
5	320-374	38.4-40.4
6	368-430	39.8-42.0
7	417-486	41.1-43.3
8	466-541	42.3-44.5
9	514-597	43.4-45.7
10	563-652	44.5-46.7
11	611-707	45.4-47.6
12	659-761	46.3-48.5
13	706-814	47.1-49.3
14	752-866	47.8-50.0
15	798-917	48.5-50.6
16	812-966	49.1-51.2
17	885-1014	49.7-51.7
18	926-1061	50.2-52.1
19	966-1106	50.6-52.6
20	1005-1148	51.0-53.0
21	1041-1189	51.4-53.3
22	1075-1227	51.7-53.7
23	1107-1263	52.0-54.0
24	1137-1296	52.2-54.3

By A.J. Heinrichs
Compiled from *Standards of Weight and Height for Holstein Heifers*, Heinrichs, A.J. and G.L. Hargrove. Journal of Dairy Science 70:653-660.

Issued in furtherance of Cooperative Extension work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. L.F. Hood, Director of Cooperative Extension, The Pennsylvania State University.

Penn State is an affirmative action university, equal opportunity university.

DSE-88-4 IVE2d



RANGE OF RECOMMENDED GUERNSEY HEIFER WEIGHTS AND HEIGHTS

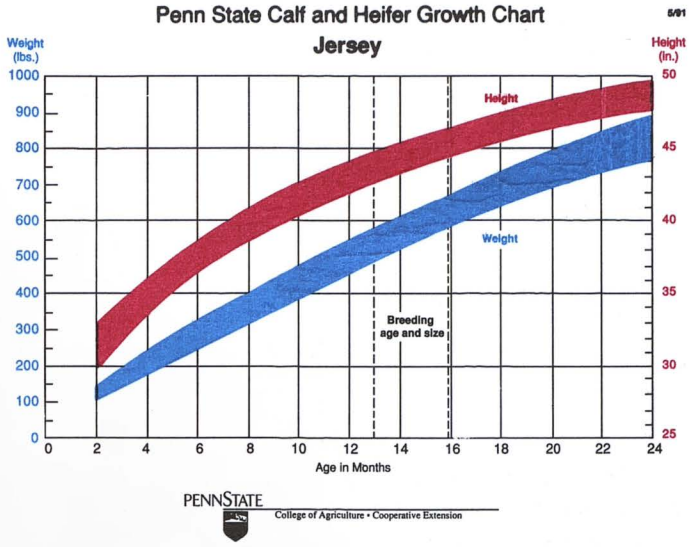
Age (months)	WEIGHT (pounds)	HEIGHT (inches)
1	122-143	31-33
2	166-193	33-35
3	203-233	35-37
4	255-299	37-38
5	299-354	38-41
6	366-434	40-42
7	384-448	41-43
8	433-503	42-44
9	482-568	43-46.5
10	511-588	44-46
11	574-662	45-47
12	576-674	45.5-47.5
13	643-756	46-48
14	696-803	47-49
15	740-866	48-50
16	779-899	49-51
17	830-950	49.5-52
18	864-1001	50-52.3
19	900-1015	51-52.3
20	914-1046	51.2-52.9
21	967-1112	51.4-53
22	996-1123	51.5-53.5
23	1025-1177	51.6-54
24	1026-1178	51.8-54.5

By A. J. Heinrichs
Compiled from *Standard of Weight and Height for Guernsey and Jersey Heifers*, Heinrichs, A. J. and G. L. Hargrove, Journal of Dairy Science.

Issued in furtherance of Cooperative Extension work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. L. F. Hood, Director of Cooperative Extension, The Pennsylvania State University.

DSE-91-15 IVE2d

To be properly utilized, growth charts such as these, are to be used as standards of minimal growth requirements as well as guides to determine if the ratio of skeletal growth is in line with body weight. These growth charts were developed to represent a wide range of values around a population average. The shaded areas in each chart are the population average as determined from a large diverse sampling of a given breed. The lower portion of each shaded area is that population average and the upper line is one standard deviation from that population average. We know from the data used to generate these standards that going below that average level for height or body weight is



RANGE OF RECOMMENDED JERSEY HEIFER WEIGHTS AND HEIGHTS

Age (months)	WEIGHT (pounds)	HEIGHT (inches)
1	93-108	29-22
2	122-146	30-33
3	155-177	32-34
4	183-217	34-36
5	233-278	35-38
6	259-321	36-38.5
7	303-362	38-40
8	335-412	39-41
9	373-436	39.5-41.5
10	391-483	40-42
11	428-499	41-43
12	471-548	42-44
13	500-571	42.5-44.5
14	535-602	44-45
15	565-640	44.3-46
16	583-661	44.6-46.3
17	609-696	45-46.6
18	639-753	45.3-47
19	651-769	45.6-47.3
20	698-813	46-47.6
21	719-827	46.5-48
22	758-860	47-49
23	760-878	47.5-49.3
24	790-893	48-49.6

By A. J. Heinrichs
Compiled from *Standard of Weight and Height for Guernsey and Jersey Heifers*, Heinrichs, A. J. and G. L. Hargrove, Journal of Dairy Science.

Issued in furtherance of Cooperative Extension work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. L. F. Hood, Director of Cooperative Extension, The Pennsylvania State University.

DSE-91-16 IVE2d

aware that going above these ranges may not be economical unless the producer is taking advantage of cheaper feed costs or reduced age at calving. In addition, the proportion of height and weigh should remain constant regardless of where animals fall on the graphs. Severe nutrition or management problems are usually the result of animals that deviate from these normal ratios of height to weight. Use of these standards as guidelines can be of benefit for some producers to see how far above average their heifers are, and for others to be a goal to obtain. For either operation, monitoring growth rates is often the only way to assure that heifer rations and management are being done as recommended.

References

Brody, S. 1945. *Bioenergetics and Growth.* Reinhold Publishing Corp., New York, NY Crichton, J.A., J.N. Aitken, and A.W. Boyne. 1959. The effect of plane of nutrition during rearing on growth, production, reproduction and health of dairy cattle. I Growth to 24 months. Animal Production 1:145. Dill, D.E., M.C. Musselman, and M.F. Hutgens. 1991. Illinois heifer hustle program. J. Dairy Sci. 74(1):199. Gardner, R.W., J.D. Schuh, and L.G. Vargus. 1977. Accelerated growth and early breeding of Holstein heifers. J. Dairy Sci. 60:1941-1948. Gill, G.S. and F.R. Allaire. 1976. Relationship of age at first calving, days open, days dry, and herdlife to a profit function for dairy cattle. J. Dairy Sci. 59:1131-1139. Hansson, A. 1956. Influence of rearing intensity on body development and milk production. Proc. British Soc. Anim. Prod. 1956:51-66. Hoffman, P.C. and D.A. Funk. 1991. Growth rates of Holstein heifers in selected Wisconsin dairy herds. J. Dairy Sci. 74(1):212. Johnsson, I.D. and J.M. Obst. 1984. The effects of level of nutrition before 8 months of age on subsequent milk and calf production of beef heifers over three lactations. Anim. Prod. 38:57-58. Lin, C.Y., A.J. McAllister, T.R. Batra, A.E. Lee, G.L. Roy, J.A. Vesley, J.M. Wauthy, and K.A Winter. 1986. Production and reproduction of early and late bred dairy heifers. J. Dairy Sci. 69:760-768. Schultz, W.E., 1969. Relationship of rearing rate of dairy heifers to mature performance. J. Dairy Sci. 52:1321-1327. Little, W. and R.W. Kay. 1979. The effects of rapid rearing and early calving on the subsequent performance of dairy heifers. Anim. Prod. 29:1037-1047. Plum, M. and L. Harris. 1968. Rearing intensity and milk production of Holstein heifers. J. Anim. Sci. 32 (1):224. Sejrsen, K., J.T. Huber, H.A. Tucker, and R.M. Akers. 1982. Influence of nutrition on mammary development in pre- and postpubertal heifers. J. Dairy Sci. 65:793-800. Schultz, L.H. 1978. Relationship of rearing rate of dairy heifers to mature performance. J. Dairy Sci. 52:1321-1328. Sinha, Y.N. amd J.A. Tucker. 1969. Mammary development and pituitary prolactin level of heifers from birth through puberty and during the estrous cycle. J. Dairy Sci. 52:507-512. Swanson, E.W. 1960. Effect of rapid growth with fattening of dairy heifers on their lactation ability. J. Dairy Sci. 43:377-387. Swanson, E.W. 1967. Optimum growth patterns for dairy cattle. J. Dairy Sci. 50:244-252. Vazquez-Anon, M. and A.J. Heinrichs. 1991. Changes in first lactation PA DHI production from 1985 to 1990 for Holsteins and Jerseys. J. Dairy Sci. 74(1):236. Waldo, D.R., A.V. Capuco, and C.E. Rexrod, Jr. 1988. Growing dairy heifers for optimum milk production. Cornell Coop. Ext. Dairy Nutr. Seminar. 417-424.