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Curves of growth in heifers and farm effects

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RIASSUNTO – Curve di crescita di manze frisone e relazione con le caratteristiche aziendali – *La misurazione dell'altezza al garrese e della circonferenza toracica, effettuata in 60 aziende della provincia di Brescia su 2862 manze tra i 5 e i 31 mesi di vita, ha permesso di calcolare una regressione lineare tra il peso corporeo (derivato dalla circonferenza toracica) e l'età delle manze secondo l'equazione: peso (kg) = 70,71 + 20,16 età (mesi) (n=2862; r^2=0,83; DSR=49,9). L'incremento ponderale giornaliero è risultato mediamente di 0,67 kg/d. L'altezza al garrese è risultata più elevata nelle manze nate in estate/autunno rispetto a quelle nate in inverno/primavera. Sono state evidenziate relazioni tra il peso corporeo delle manze, la razione somministrata e le condizioni igieniche.*

KEY WORDS: heifer, growth, body weight, management

INTRODUCTION – Age at first calving and growth rate from birth to calving are the major factors affecting economics of raising dairy replacements and lifetime producing ability of heifers (Mourits *et al.*, 1997; Tozer, 2000; Tozer and Heinrichs, 2001). In 2000 the first calving of Italian Friesian heifers was at 29.2 months on average, while in 1986 it was at 30.6 months, with a very slight improvement of 40 days in 15 years (AIA, 2001). Correlation between body weight (BW) at calving and milk yield at first lactation is positive (Heinrichs, 1993), but excessive rates of average daily gain (ADG) during the prepubertal growing period could have negative effects on mammary parenchima development and milk production in heifers (Hoffman and Funk, 1992; Hoffman *et al.*, 1996; Pirlo *et al.*, 1997, Abeni *et al.*, 2000).

The aim of the present work was to study growth curves of Italian Friesian heifers, to compare these results with american standards and to relate growth performances with some management factors.

MATERIAL AND METHODS – Sixty farms in province of Brescia were visited to measure wither height (WH) and heart girth of 2862 heifers, from 5 to 31 months of age. The measures, collected between January and March, were used to calculate BW according to Heinrichs *et al.* (1992). Pregnancy effect was not considered.

In two farms 36 heifers were also weighed to compare actual and predicted BW.

All measures were compared to Pennsylvania State University standards (1998) to rank heifers and farms in groups as a function of BW and wither heights.

Some management data were collected using a questionnaire: diet components, group intake, number of feeding groups, number of heifer boxes, type of housing, bed replacing interval, age at first AI. Regression and GLM analysis were performed by SAS procedures (1999).

RESULTS AND CONCLUSIONS – The study involved 2862 heifers with 17.2 months of age on average (SD= ± 5.4); the median value was 16.8 months and the mode value was 18.9 months. Regression of heifer BW on age was positive and linear, as reported by other authors (Pirlo *et al.*, 1997; PennState, 1998). The resulted equation was:

BW (kg) = 70.71 + 20.16 age (months) (no.=2862; r^2=0.83; RSD=49.9).

The upper and lower confidence limits of parameter estimates showed small differences for intercept (76.9 and 64.5) and regression coefficient of age (20.5 and 19.8). The estimated ADG was 0.67 kg/d, while Pennsylvania standard curves (1998) proposed a range between 0.66 to 0.73 kg/d. Other authors (Speroni

and Capelletti, 1997) registered daily gain up to 0.77 kg/d. By the equation proposed, heifers weighed on average 373 kg of BW at 15th month of life.

In two farms 36 heifers were weighed and these measures were compared with predicted BW according to Heinrichs *et al.* (1992); linear regression was:

Actual BW = 160.6 + 0.7092 predicted BW (no.=36; r^2 = 0.84; RSD= 32.4)

All actual BW were higher than predicted (on average +11%) and, in addition, most of heifers of the two farms (66%) had a predicted weight higher than the upper limit of Pennsylvania standard curves. These preliminary results could suggest that Heinrichs' equation does not fit very well for Italian Friesian heifers but further investigations are required to study this issue.

The regression of WH on age (in months) was positive and quadratic, as equation:

WH (cm) = 87.93 + 3.52 age – 0.0629 age^2 (no.=2862; R^2=0.80; RSD=3.62)

The regression between WH and BW was better explained by a quadratic equation, as a consequence of quadratic regression of WH on age:

WH (cm) = 86.0 + 0.1468 BW – 0.000102 BW^2 (no.=2862, R^2=0.85, RSD=3.2).

By comparing heifer BW data with Pennsylvania standard curves, proposed for american Holstein (1998), we classified all the heifers in three classes: upper 75% percentile (U), lower 25% percentile (L) and median percentile (M).

The M class was represented by 41.8 % of the heifers, the U class by 32.9 % and the L class by 25.3 %. Wither heights of M heifers were upper than standards for 35 % and lower than standard for only 6 % but wither heights of U heifers were upper than standards for 59 % and lower for only 3 %. The heifers in U class showed a higher ADG (0.737 kg/d) than the heifers in L class (0.603 kg/d).

Eight farms had >50% of heifers in U class (UFARMS), 14 farms had >50% of heifers in M class (MFARMS) and 15 farms had >50% of heifers in L class (LFARMS). The different distribution of heifers in the different BW classes did not showed very clear relationships with fertility parameters: the age at first AI was slightly lower (16.0 months ± 1.1) in the MFARMS than in the UFARMS (16.4 months ± 1.9), and the age at calving was at 26.9 and 27.4 months, respectively. In the UFARMS interval of replacing bedding material was 24,4 d (± 18) while in the MFARMS was 29.3 d (±35.3) and in the LFARMS was 36,3 d (± 18). These differences could suggest a relationship among cleanliness, management level, animal welfare and growth curves of heifers.

Another classification, based on total number of heifers and birth season of heifers, was performed and a GLM analysis was computed to evaluate the effects on BW and WH. The age of heifers was used by covariance effect. Number of heifers did not affect BW or WH, while birth season showed an unexpected effect: heifers born during winter and spring seasons had smaller wither height than heifers born in summer and autumn (127.6 *vs* 128.6 cm; P<0.001).

In 26 farms a single ration was adopted for all heifers: average DM intake was 8.4 kg/d (± 2.0), CP and energy content were 11.2 % DM (± 1.9) and 0.76 MFU/kg DM (± 0.05), respectively (MFU=Milk Fodder Unit). 29 farms adopted two different rations as a function of age (under and over 12 months) but the differences between the characteristics of the two rations were smaller than expected in terms of DM intake (8.2 *vs* 9.3 kg/d), CP (13.7 *vs* 12.1 % DM), and energy content (0.84 *vs* 0.80 MFU/kg DM). Only 5 farms had three different rations for heifers. Most of the MFARMS had two rations for heifers while most of the UFARMS had only one ration, confirming the risk of fattening heifers as a consequence of simplifying farm management.

In all the farms, milking cows TMR ration was the most important component of heifers ration, often associated with hay administered *ad libitum*. All farms used maize silage for heifers, only 35 farms used a commercial mix, while other farms preferred to buy raw materials for milk cows and heifers TMR.

In conclusion the present study confirms the linear regression of predicted heifer BW on age, and suggests some farm effects (diet and management) on growth curves of heifers. Further researches are need-

ed to validate of Heinrichs' equation for Italian Friesian heifers, and to investigate the relationships among management factors, animal welfare, nutritive level and dairy heifer growth.

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