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EFFECT OF WITHIN HERD ENVIRONMENTAL FACTORS ON MILK, FAT AND PROTEIN YIELDS IN RED DANE CATTLE IN ZIMBABWE

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ABSTRACT: *A study was carried out to establish within herd environmental factors affecting milk yield, butterfat and protein in Zimbabwean Red Dane cattle. 305-day lactation records were obtained from the Livestock Identification Trust (LIT) containing herds with cows that calved from 2004 to 2009. A General Linear Model (GLM) procedure of the Statistical Analysis System version 9.1.3 was used to determine the effect environmental factors on milk yield and composition. Age at calving fitted as covariates, the effect of calving interval and herd-year-season were analysed. Milk yield, fat and protein content obtained increased with an increase in calving interval. It is thus important to pre-adjust data for these environmental factors when carrying out genetic evaluations of production traits in dairy cattle.*

ORIGINAL ARTICLE

Key words: *Environmental Factors, Herd-Year-Season, Calving Interval, Age At Calving*

INTRODUCTION

In animal breeding, environmental factors are factors that are not part of the genetic make-up of an animal. These factors are not transmitted from parent to offspring. Environmental factors tend to obscure the animal's true genetic ability. When the genetic effect on a trait is weak, it is lowly heritable and the environment has the greatest influence on that trait. Environmental variance, which by definition embraces all variation of non-genetic origin, is a source of error that reduces precision in genetic studies. Missanjo (2010) observed that selection within the best environment allowed better gene expression and improved selection response.

Milk, butterfat and protein yields are some of the factors that drive economic profitability of dairy farms. Therefore, striving to increase milk, butterfat and protein yields per animal, while decreasing feed and other costs, can lead to economic gains (Nyamushamba et al., 2013). Whilst it is generally recommended that animals should be selected within the environment in which the animals and their progeny are reared. The magnitude of environmental influence should be considered. Efforts to improve traits that are greatly influenced by the environment should primarily focus on managerial inputs that modify the conditions under which the genotypes are expected to perform. The variation in milk, butterfat and protein yields can be attributed to several non genetic factors. These include age at calving, calving interval, days dry, season (month) of calving, herd and parity. Research has shown that in Zimbabwe, agro-ecological regions affect milk production (Kunaka and Makuza, 2005; Missanjo, 2010). It is therefore critical to provide information on both the genetic and non genetic factors that influence milk production. The information may reveal the need to have mating and hence calving periods that occur at certain times of the year to produce higher yields with less input. A study on the non-genetic-factors affecting milk, protein and butter fat yield in Red Dane cows in Zimbabwe is therefore justifiable. The results can be used as a management tool, to improve selection criteria by accounting for within herd non-genetic factors that affect milk yield and composition.

MATERIALS AND METHODS

Environment

Zimbabwe is located in Southern Africa in the tropical savannah region. The total land is 390,759 km2 and it is divided into five agro ecological regions. Rainfall patterns and crop production progressively deteriorate from regions I to V with region IV and V considered to be more suitable for livestock production compared to cropping

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activities (Gambiza and Nyama 2000). In the regions with low rainfall, dairying is assisted by production of drought-resistant fodder crops. Most dairy farms are located within 40 km of the major cities and towns (USDA 2009).

Data and data edits

The standard 305-day milk production records of pure bred Red Dane were obtained from Zimbabwe Livestock Identification Trust. Nyamushamba (2012) described the data set and the edits. This gave a data set of 1 321 records with cows calving in the period 2004-2009 respectively. Individual animals were grouped by year of birth from 2002 to 2007. Records were of individual cow milk yield, butterfat and protein contents.

Statistical analysis

The data was analysed using an animal model of the General Linear Model (GLM) of Henderson Type III sum of squares in Statistical Analysis Systems version 9.1.3 (SAS, 2009). The data was fitted to the following animal model; $Yij = \mu + HYS_i + CI_j + AC(b1 + b2) + E_{ij}$

Where:

Y_{ij} is the observed value for all milk traits (305-day milk yield; fat and protein content;
μ is the overall mean common to all observation;
HYS_i is the fixed effect of herd-year-season i (i = 1, 2, 3.....n);
CI_j is the fixed effect of calving interval j (i =305, 320, 335.....455);
AC is the age at calving
b1 and b2 are the linear and quadratic regression coefficients respectively on age at calving (AC) in months; and
E_{ij} is the random animal effect, eij ~ (N (0,σ2e)

RESULTS AND DISCUSSION

Environmental factors which significantly affect milk, butterfat and protein yields in Zimbabwean Red Dane cattle are shown in Figures 1, 2, 3 and 4. These results consistent with those observed from previous studies for other dairy breeds. Age at calving, herd year season and calving interval has a significant effect on milk, butterfat and protein yields of dairy cattle in Zimbabwe (Makuza, 1995; Mandizha, 1998; Imbayarwo-Chikosi, 1999; Kunaka, 1999; Missanjo et al., 2011; Nyamushamba et al., 2013).

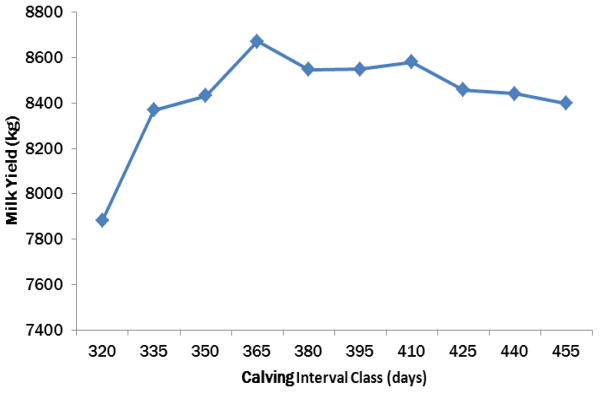

Figure 1 - Effect of calving interval on milk yield of Red Dane cattle

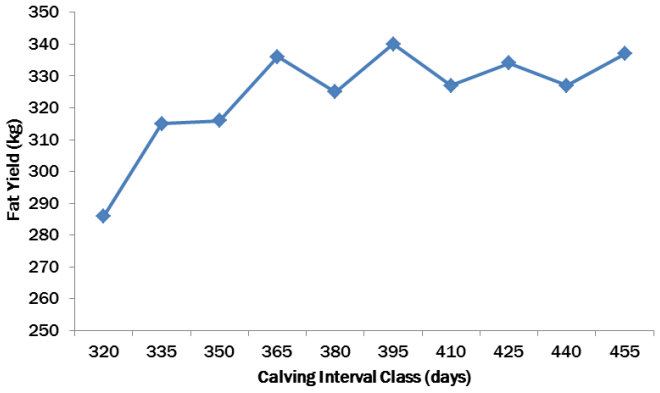

Figure 2 - Effect of calving interval on fat yield of Red Dane cattle

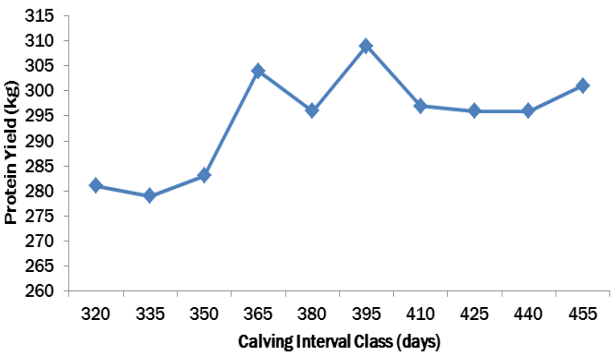

Figure 3 - Effect of calving interval on protein yield of Red Dane cattle

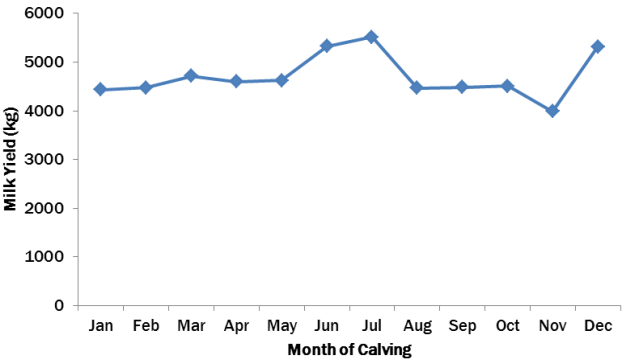

Figure 4 – Effect of month of calving (season) on milk yield of Red Dane cattle

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Effect of Calving Interval on milk yield and composition

Milk, butterfat and protein yields of the Red Dane cattle were significantly affected by calving interval (P<0.0001). These production traits demonstrated a continual increase in yield as the calving interval increased (Figures 1, 2 and 3). These results are in line with those reported by Muchenje (1997), Mandizha (1998), Imbayarwo-Chikosi (1999) and Missanjo (2010) that calving interval significantly affect milk yield and composition of dairy cattle. The ideal calving interval is 365 days for dairy breeds whereby the producer is assured of one calf from each cow annually. This would also ensure that the cow can replenish its body reserves and regenerate secretory tissues without over-conditioning.

Effect of Herd-Year-Season (HYS) on Milk Yield and Composition

Herd-Hear-Season had a significant (P<0.0001) effect on milk, butterfat and protein yields of Red Dane dairy cattle in Zimbabwe. The months of June and July gave the highest milk yield whilst in August to November its milk yield decreased. This is because the breed is not heat tolerant during the hot season and during the winter season there is high voluntary feed intake.for the Red Dane cattle. The results reported in this study are consistent with literature (Imbayarwo-Chikosi, 1999 and Missanjo, 2010) that herd-Year-Season significantly affects milk yield and milk composition in dairy cattle in Zimbabwe. It is therefore expected for different herds to exhibit different levels of production because of variations in the level of management. Different agro-ecological zones can also contribute to the differences between herds in Zimbabwe (Kunaka, 1999).

CONCLUSION

Herd-year-season and calving interval significantly affected milk, butterfat and protein yields for Red Dane cattle in Zimbabwe. Milk, butterfat and protein yields increased with an increase in age in both breeds. It is thus necessary to pre adjust data for these environmental factors when carrying out genetic evaluations of production traits in Zimbabwean Red Dane.

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