Eth. J. Anim. Prod. 2(1)- 2002: 1-10

Milk Production Characteristics of Holstein Friesian Cattle at Holetta Government Dairy Farm, Ethiopia[a]

Mureja Shiberu[1,b], Eskil Brannang[2] and Kano Banjaw[3]

[1] National Artificial Insemination Centre, P.O. Box 22692, Addis Ababa, Ethiopia

[2] Swedish University of Agricultural Sciences, P.O. Box 75057, Uppsala, Sweden

[3] Department of Animal Sciences, Alemaya University of Agriculture, P. O. Box 138, Dire Dawa, Ethiopia

Abstract

Data on milk production were collected from the Holetta Government Dairy farm for the years 1967-1991, and totally 1384 lactations were used. The milk production traits including total lactation milk yield, lactation length and annual milk yield were analysed to know the mean production level of the breed and the environmental components of variances. The independent variables examined were year and season of calving, parity and interaction between these factors.

The average lactation yield was 3357.9 Kg, average lactation length was 351 days and annual milk yield 2783.1 kg. These results are less than those obtained in most other tropical zones, indicating the need for improved management of the Holstein/Friesian cattle in the Ethiopian highlands.

The effect of year of calving was significant for all the traits and this was ascribed to drought cases in some of the years under study and the change in the ownership within the farm.

Least squares mean Lactation yields were 3160.3±71.7 Kg, 3314±76.5 Kg and 3395.0±85.2 Kg for 1st, 2nd and 3rd lactations respectively. Thereafter no increase was found, but a marked decrease was observed from the fifth lactation onwards. The study has shown that cows with at least seven parities had a significantly less milk yield than those cows with fewer parities due to aging of cows. Thus, there is a need for planned culling as of the seventh parity to avoid selection bias and competition of the limited concentrate feed with the productive animals.

The mean annual milk yield, which is a function of both lactation yield and calving interval was much less than the lactation yield indicating that factors affecting the reproductive traits should be treated to bring about an economic dairy productivity.

---

[a] The paper is based on M. Sc. thesis at Alemaya University of Agriculture, Ethiopia in 1994. The full title of the thesis is 'Milk production and persistency characteristics of purebred Holstein/Friesian cattle on the Holetta Government Dairy Farm, Ethiopia

[b] Corresponding author

In general the results in this study indicated the need for improved management, and the need for correcting effects of parity and calving year during selection of animals for dairy merit. In addition the mean results indicated in this study can be used to measure the prospective genetic progress in milk yield for Holstein Friesian breed.

Keywords: Holstein Friesian, Holetta, dairy traits

Introduction

The size and diversity of the major agro-ecological zones of Ethiopia, which vary from arid tropical to temperate climate, make it possible to support large numbers of different classes of livestock. However, milk production from a local cow rarely exceeds 250 kg per year (Brännäng et al. 1990). The low productivity in general is principally due to poor management practices, poor nutrition or low response to improved nutritional inputs, high disease incidence, and low genetic potential.

The problem with the genetic potential can be attributed to natural selection to the tropical environment of the local cattle types on one hand and lack of procedural selection method on the other (Mason and Buvanendran, 1982). Although selection using the local cattle types is helpful to the mixed farming and pastoral systems, the selection differential which can be obtained from local cattle types is so low due to lower mean milk production. Further, when these animals are kept in an improved environment, their production response is low as compared to the pure temperate breeds and their crosses. Thus for urban and peri-urban dairy production, where concentrates and good health management can be offered, keeping high grade dairy cattle is more preferable.

Although most of the milk in Ethiopia comes from private smallholder farms it is mainly state institutions which are involved in milk recording; still these records are not timely evaluated because of which timely correction of breeding and management conditions will not be possible. Therefore, the objectives of this study were to evaluate the milk performance of the Holetta Holstein Friesian in terms of lactation length, lactation yield and annual milk yield, to ascertain the existing production level of Holsteins in Ethiopia and to help estimate prospective genetic progress in milk yield, and to estimate the environmental components of variance.

Materials and Methods

The study site

The Holetta farm is located 44 km South-West of Addis Ababa at longitude 38^0 30' East and latitude 9^0 3' North. The maximum altitude is 2400 metres. The rainfall pattern is bimodal over the months; average moisture is 56% (Holetta, 1990). The farm was established by the Ministry of Agriculture in 1955 and was run by the Ministry till 1981. Thereafter, it has been transferred to the Ministry of State Farms. The farm called "Holetta 1 Dairy Farm", has an estimated land holding of 160 hectares, much of which consists of natural pasture grazed as open system.

Cattle management

Feedstuffs for the herd include hay, green feed and concentrates. Dairy cows receive a daily maintenance ration of about 2 kg concentrate with an additional production ration of up to 1/2 kg per kg of milk yield. Cows over seven months pregnancy are provided with up to 4 kg concentrates per day. Bulls receive up to 6 kg per day depending on availability of feed. Feedstuff for the other classes of livestock include mainly hay and green feed.

Newborn calves suckle their dams until five days from birth to get colostrum. Thereafter they are bucket fed and the amount varies according to age. From 5 to 35 days of age calves receive up to 5 litres of milk per day, from 35 to 65 days of age to 4 litres and from 85 to 100 days of age up to 2 litres. Thereafter they are given about 1 liter of milk per day until they are weaned at the age of 120 days. Besides, both grazing and hay feeding is undertaken except for calves under the age of one month.

Diseases and parasites of economic importance in the area include black leg, CBPP, foot and mouth, mastitis, liver fluke, foot-rot and tick infestation. Black leg and CBPP are controlled using vaccinations. Treatment of the other diseases varies each year depending on availability of drugs.

Breeding operation

The parent stock of these purebred Holsteins was imported from the USA and Kenya in 1955 and 1959, respectively. The aim of the farm was milk production. The breeding operation before 1980 was maintenance of the pure breed by using Friesian sires and deep frozen semen from Europe. Since 1980 Semen has been produced at and obtained from the AI center at Kallitti, Ethiopia.

Breeding weight for heifers is 300 kg. Rest period allowance for cows is 45 to 60 days. Cows are culled if they require greater than 4 insemination services per conception, attained the age of 10, and have serious mastitis infections.

Male animals not selected for future breeding purpose are culled under a yearling age.

Data material and statistical procedures

The data used include individual lactation records and reproduction records for 25 years (1967-1991). The number of milking cows per day varied between 55 and 122. A database was built up using ILCA's Data Entry and Analysis System, IDEAS, 1986. Extraction of data from IDEAS was done using dBase IV programmes. Lactation length, lactation yield and annual milk yield were computed from the records.

The analyses were done by Mixed Model Least Squares and Maximum Likelihood Computer Program of Harvey (1990). The model to analyse the fixed environmental effects on each of the dependent variables can be described as

$Y_{ijkl} = u + b_i + c_j + d_k + (bc)_{ij} + Bx_{ijk} + e_{ijkl}$ where u = the overall mean of the individual observations; b_i = the fixed effect of i^{th} season; c_j = the fixed effect of j^{th} year; d_k = effect of k^{th} parity, $(bc)_{ij}$ the interaction between year and season; B = the linear regression coefficient of the traits on age at first calving; x_{ijk} = the deviation of individual age at first calving from its mean; e_{ijkl} = individual phenotypic deviation from the subgroup mean.

Results

The overall means, standard deviations, and coefficients of variation for the whole data material are presented in Table 1. The least squares mean for lactation length was 327.5±4.3 days. That for lactation yield was 3157.4± 82.0 kg and for the annual milk yield 2771.5±165.0.

Table 1. Overall mean, standard deviation (SD), coefficient of variation (CV) and least squares means (LSM) of each trait for the Holetta herd

Trait	Mean	SD	CV	LSM±SE
Lactation length (days)	351.0	113.8	39.0	327.5 ± 4.3
Lactation yield (kg)	3357.9	1314.3	32.4	3157.4 ± 82.0
Annual milk yield (kg)	2783.1	927.7	33.3	2771.5 ± 165.0

In Table 2 the analyses of variance are shown, using the fixed model. It is indicated that parity and year of calving significantly affected all the traits.

Table 3 indicates the change in lactation yield, lactation length and annual milk yield in the different parities. Yield increment was indicated from first to third parity, followed by constant performance up to fifth parity, and then a decrease from the sixth parity onwards.

Table 2. Analysis of variance for dairy traits in the Holetta herd - Mean squares and significance levels

Source of variation	Degrees of freedom	Lactation length (days)	Lactation yield (kg)	Annual milk yield (kg)
Calving year	20	71566***	18647821***	9137272***
Calving Season	2	37179	4577140	1438009
Parity	6	99815***	4527269*	4143538***
Calving year x season	40	16768	1791329	84408
Remainder	1315	12960	1727317	860736

* => p<0.1; ** => p<0.01; *** => p<0.001

Table 3. Least squares means with standard errors of dairy traits tested over parity in the Holetta herd

Parity	No.	Lactation yield (kg)	Lactation length (days)	Annual milk yield (kg)
1	372	3160.3±71.7[b]	367.7 ± 5.9[c]	2643.0 + 59.6[a]
2	331	3314.5±76.5[b]	351.0 ± 6.6b[c]	2796.2 + 64.6[a]
3	264	3395.0±85.2[b]	328.9 ± 7.4b[c]	2995.3 + 75.7[b]
4	181	3474.8±102.1[b]	334.5 ± 8.8b[c]	3099.7 + 93.7[b]
5	116	3328.2±126.6[b]	332.8 ± 11.0[bc]	2601.1 +121.8[a]
6	72	3136.9±161.3[b]	312.9 ± 11.0[b]	
7+	48	2798.7±196.7[a]	266.3 ± 17.0[a]	
	1384			

Means followed by the same letter in each row within a trait do not differ each other at 0.05 level of significance

Season of calving did not affect the dairy traits significantly (Table 2). However, cows that calved during February to May (season 1) yielded less than those which calved in other seasons (Table 4). Lactation length also followed similar trend.

Table 4. Least-squares means with standard errors of dairy traits tested over calving seasons

Calving season	No	Lactation yield	Lactation length
1	518	3141.5 ± 71.0	318.5 ± 6.1
2	387	3200.0 ± 83.7	326.6 ± 7.3
3	479	3348.1 ± 73.3	337.5 ± 6.3

Year of calving significantly affected all the traits under study (Table 2). Further trend of each trait over the calving years also is shown in Table 5. Lower performance was obtained in 1974-75, and 1984-85. On the other hand, abrupt increment was indicated in 1980-81.

Table 5. Least-squares means with standard errors of dairy traits tested over calving years in the Holetta dairy herd

Calving year	No.	Lactation yield	Lactation length	Annual milk yield
1971	58	3114.4±172.4^{abcde}	298.5±14.9^{b}	2607.5±185.5^{abc}
1972	39	2832.8±210.3^{abcde}	305.5±18.2^{b}	2583.9±197.8 ^{abc}
1973	62	2717.1±166.8^{abcd}	322.9±14.4^{b}	2529.2±156.7 ^{abc}
1974	74	2648.5±152.6^{abc}	329.3±13.2^{b}	2348.4±135.3 ^{abc}
1975	87	2524.7±140.8^{ab}	362.1±10.7^{b}	2153.6±132.5 ^{abc}
1976	58	2617.8±172.4^{abc}	366.8±14.9^{b}	1912.6±131.2^{a}
1977	73	3083.8±153.7^{abcde}	371.6±13.3^{b}	1965.1±156.8^{ab}
1978	96	3294.2±134.0^{bcdefg}	359.0±11.6^{b}	2431.6±136.7^{abc}
1979	80	3341.1±146.8^{bcdefg}	317.1±14.1^{b}	2497.3±129.9^{abc}
1980	104	3938.9±128.7^{fg}	350.6±11.2^{b}	2648.5±146.7^{abc}
1981	113	3843.2±123.5^{efg}	362.1±10.7^{b}	3230.5±115.1^{cde}
1982	88	3721.6±139.9^{defg}	348.3±12.1^{b}	2965.8±115.9^{bcd}
1983	79	4046.8±147.7^{fg}	357.7±12.8^{b}	3200.2±143.1^{cde}
1984	58	3185.6±172.4^{bcdef}	329.2±14.9^{b}	2951.2±154.6^{bcd}
1985	49	3068.0±187.6^{abcde}	312.4±16.3^{b}	3023.9±141.4^{bcd}
1986	46	4228.9±193.6^{g}	335.9±16.8^{b}	3771.1±163.9^{e}
1987	65	3664.5±162.9^{defg}	317.3±14.1^{b}	3621.8±156.8^{de}
1988	55	3268.7±177.1^{bcdef}	333.4±15.3^{b}	2783.7±189.3^{abcd}
1989	46	3369.5±193.6^{cdefg}	287.4±16.7^{b}	3243.2±247.9^{cde}
1990	54	2168.5±178.7^{a}	209.2±15.5^{a}	

Means followed by the same letter in each row within a trait do not differ each other at 0.05 level of significance

Discussion

Lactation length

The lactation length obtained in this study was higher than 315.4±17.4 days reported by Parmar (1988) in India, 302.2±5.5 days by Dabdoub (1988) in Iraq, 316±5 days by Ribas *et al.* (1985) in Canada and 295 days by Alpan *et al*. (1971) in Turkey.

Lactation Yield

In this study the least squares mean lactation yield was 3157.4±82.0 kg. This is lower than the results obtained by various researchers including Car *et al.* (1983) in Portugal, Ornelas *et al*. (1981) in Mexico and Moharram (1988) in Egypt who reported, 4330±230 and 4571±689 and 3201 kg, respectively. Higher yields were also reported in Brazil by Freitas *et al*. (1983) and by Combellas (1980) in Australia (as 4334±230 and 4213±120 kg, respectively). On the other hand, the yield in the present study is higher than 2827±617 kg, which is reported by Sitorus *et al*. (1983) in West Java.

Annual milk yield

The annual milk yield is calculated as milk yield per day of calving interval times 365. It involves both milk yield and reproductive capacity although it has little inheritance due to environmental variation in both lactation yield and calving interval. The least squares mean annual milk yield was 2771.5±165 kg compared to 3157.6±82.0 for lactation yield, and this is due to the wider calving intervals.

Factors affecting the analysed traits

The effect of calving year was highly significant for all traits (P<0.001). It was clearly indicated that there was a marked decrease of the traits in the drought years 1974-75 and 1984-85. There was also a significant increase in the traits in the first few years after exchange of ownership from Ministry of Agriculture to Ministry of State Farms.

The effect of season of calving was not significant for all the traits studied. However, calving in season 3 (October to January) gave the best yield. This is logical as cows calving in the dry season will at the end of the lactations benefit from the rains in seasons 1 (February to may) and season 2 (June to December) (Kiwuwa et al., 1983).

Parity had a significant effect on all traits (0.05 < P < 0.001)(Table 2). The effect of each parity is further differentiated to help indicate the time when significant deterioration of milk yield and milking duration take place. Each of the traits (Table 3) follows the trend which is generally known, i.e. they increase from the first lactation to the third and then are about constant in the following 2 parities. Thereafter they tend to decrease to the 6th and 7th parities. However, Table 3 also shows that significant differences only occurred between cows calving seven or more times and those with fewer calvings. The difference in yield over parities is due to the age of the cows. Mature cows require less energy for growth, and produce more milk. After the fourth parity production decreases as older ages predispose to weakness and diseases.

Conclusions

Based on the results of this study the effects of calving year and parity were significant. The effect of calving year was due to drought cases in some of the years under study and also due to a change in the ownership within the farm. This indicates the need for improved management to increase milk yield performance.

The wider variation of the traits over calving years, as compared to performance in the tropics, may indicate that pure breed animals can be kept if the level of management is improved. The mean performance result in the present study is useful to know the prospective genetic progress with the breed.

The average level of yield, however, is evidently much below the genetic potential of the animals. The sparse yield of the cows in this study is more clear if the calving intervals are considered. The annual milk yield, which is a function of both lactation yield and calving interval was less than the lactation yield. Thus factors affecting the reproductive traits should be considered and resolved for an economic dairy productivity.

It was shown that cows which calved for at least seven times had a significantly less milk yield than the earlier ones due to aging of cows. Thus, there is a need for planned culling of cows with low production to avoid competition of the limited concentrate feed with the productive animals. On the other hand, old cows with good yield in early lactations are genetically valuable and may be kept as long as they are fertile considering the herd performance.

Acknowledgements

We are thankful to the Dairy Development Enterprise of the Ministry of State Farms is for allowing us utilize the data material. The Holeta Dairy Farm office is to be remarked for cooperation in offering reliable information about the farm background. Many thanks to the former officers in Animal Science Department of Alemaya University including Dr. Alemu Yami, Ato Ashebir Sewalem, and Ato Adnan Beker for facilitating the study in one way or another. Ato Admasu Mammo and W/t worknesh Aberra of the National AI Centre are also remarkable for facilitating the write up of the paper.

References

Alpan, O. and M. Sertalp (1971). Some performance characters of Holstein-Friesian and Brown Swiss cattle at a private farm in central Anatolia. *Lalahan Zooteknic. Arast. Enst. Derg.*, 11 (3-4): 29-55. [Turk. with Eng. Summ.] [Vet fac., Ankara]

Brännäng, E. and S. Persson (1990). Ethiopian Animal Husbandry, a Handbook. Swedish University of Agricultural Sciences, Uppsala, Sweden.

Car, M. and N. Stipic (1983). Milk production and reproduction of Holstein Friesian cows in tropical Venezuela. *Poljoprivredna - Znanstvena -Smotra.* 61, 249-256.

Combellas, J. (1980). Information obtained over ten years (1970 - 1980) on a herd of Holstein-Friesian cattle in Maracay, Venezuela. *Informe Anual, Instituto de Produccion Animal, Universidad Central Venezuela*. pp. 87-101.

Dabdoub, S. A, S. Abdul- Zahra, A. K. Nasser, and N. Ibrahim. (1988). Milk production in pure-bred Friesian, Sharabi and crossbreeds in Northern Iraq. *Mesopotamia Journal of Agriculture.* 20:3, 175-192.

Freitas, Mar, De, R. B. Lobo, F. Naufel and FAM Duarte (1983). Effect of various non-genetic factors on milk production of Holstein - Friesian cows. *Arquivo - Brasileiro - de - Medicine Veterinaria - e - Zootecnica.* 35:4, 575 - 590.

Harvey, W. R. (1990). User's Guide for LSMLMW AND MIXMDL PC-2 Version Mixed Model Least Squares and Maximum Likelihood Computer Program.

Holetta Centre of Research 1990. Climatic Data of Holetta (1967- 1990). Holetta, Ethiopia.

ILCA's Data Entry and Analysis System, IDEAS, 1986. ILCA. Addis Ababa, Ethiopia.

Mason, I. L. and V. Buvanendran (1982). Breeding plans for ruminant livestock. FAO Animal Production and Health Paper. No. 34. FAO, Rome.

Moharram, A. A. (1988). Reproduction and dairy performance of Holstein-Friesian cattle in Egypt. *Revue - d' Elevage - et - de - Medecine -Veterinaire - des - Pays - Tropicaux.* 41: 2, 209 - 213.

Ornelas-Gutierrez, T., H. R. Ponse and G. T. Ornelas (1981). Some environmental effects on birth weight of Holstein-Friesian and Brown Swiss calves in the tropics. *Memoria Associacion Latino Americana de Produccion Animal.* 16, 118; Proceedings of the eighth meeting of the Latin American Association of Animal Production, held in the Dominican Republic on 8 Oct. 1981.

Parmar, O. S. and G. S. Gill (1988). Comparative performance of imported and farm-bred Holstein-Friesian heifers during first lactation. *Journal of Research, Punjab Agricultural University.* (4): 619-620.

Ribas, N. P, C. L. Santos, M. E. Barbieri, H. S. Koehler and S. G. Franco (1985). A study of the lactation period in Holstein-Friesian cows imported from Canada. Dep. Zootechnica, Univ. Fed. Do Parina Caixa Postal 672, 80,000 Curitiba, Parana Brazil.

Sitorus, P. (1983). Productivity of Friesian dairy cattle in Indonesia and their offspring resulting from out-breeding with imported semen. *Ilmu. Dan-Peternakan*. 1:2, 72-74.