# ESTIMATION OF INBREEDING AND RELATIONSHIP AMONG YOUNG POLISH BLACK AND WHITE BULLS

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## INTRODUCTION

Improved evaluation of breeding values, modern reproductive technologies and effective selection program have increased inbreeding rates in dairy cattle populations. Several studies describing these changes were summarised by Weigel (2001a). In the USA, Wiggans *et al*. (1995) reported mean inbreeding coefficients of 0.03 for Holsteins during 1990, and similar estimates for this period were given by Short *et al*. (1992). Canadian Holstein bulls showed average inbreeding of 2.5% at the same time (Miglior and Burnside, 1995). In the UK Holstein-Friesian population the inbreeding coefficient decreased from 0.74% to 0.38% in 1992 and remained at that level up to 1997. The measures of genetic diversity in this population were not affected by the large importation of North American Friesians (Roughsedge *et al*., 1999). Introgression of Holsteins has also been taking place in Poland, accelerated in recent years by the modernisation of the dairy industry.

This paper estimates inbreeding and relationship among young bulls entering progeny testing.

## MATERIAL AND METHODS

Data were pedigree files of 1195 bulls entering the AI testing programme from October 1997 to September 2000. Animals born in 1960 and later were included in the computations, and animals without parents were assumed as non-inbred and unrelated. Evaluation of breeding values is done out twice a year, after the winter and summer calving seasons. The number of young bulls tested for the first time in six consecutive seasons are presented in Table 1. The bulls within each season were considered as one cohort. The inbreeding and relationship coefficients were calculated by the tabular method.

## RESULTS AND DISCUSSION

The average inbreeding coefficient for all tested young bulls was 0.65%. Inbreeding coefficients within consecutive cohorts of young bulls fluctuated from 0.52% to 0.87%, with some increasing tendency in the last two seasons (Table 1). Of a total of 1195 bulls, 734 were non-inbred; coefficients of inbreeding for 434 bulls were less than 4%, and above 4% for 27 bulls. As reported by Young and Seykora (1996), inbreeding coefficients in US Holsteins increased very slowly from 1970 to 1990; in 1970 they were estimated at 0.5%, in 1976 at 0.3%, in 1982 at 1.6% and in 1990 at 2.1%. After 1980, inbreeding in Holstein populations in the USA and Canada rose quickly. Wiggans *et al*. (1995) and Short *et al*.(1992) estimated mean inbreeding for 1990 at 3 - 4% in US Holsteins.

In Canadian Holstein bulls, Miglior and Burnside (1995) found an inbreeding coefficient of 2.5% for 1990. Similar estimates of inbreeding coefficient (3%) were obtained for Dutch Black

and White (Braake *et al*.,1994). Our estimates of inbreeding in consecutive groups of progeny-tested young sires were much lower than the average inbreeding coefficients found in the North American and Dutch populations, and slightly higher than those reported for British Friesians (Roughsedge *et al*,. 1999).

**Table 1. Inbreeding and relationship coefficients within cohorts of young bulls**

| Cohort | No. of bulls | Inbred animals [%] | Average inbreeding coefficients [%] | Average relationship within group [%] |
|---|---|---|---|---|
| 1 | 247 | 34 | 0.52 | 3.13 |
| 2 | 182 | 34 | 0.72 | 3.37 |
| 3 | 214 | 40 | 0.57 | 3.59 |
| 4 | 147 | 37 | 0.52 | 3.49 |
| 5 | 235 | 46 | 0.70 | 3.12 |
| 6 | 170 | 52 | 0.87 | 3.37 |
| Total | 1195 | 39 | 0.65 | 2.74 |

Average relationship within cohorts of young bulls remained stable throughout the studied period (3.12% to 3.59%). The average coefficient of relationship between all bulls was 2.74%. Relationships between bulls belonging to different cohorts were lower than within cohorts and ranged from 2.14 to 3.42% (Table 2), with most estimates below 3%. In British Friesians the average coefficient of relationship has been rising slowly since 1992, reaching 1.34% in 1997. (Roughsedge *et al*., 1999). A different pattern was found in US Holsteins, where relationship among cows was much higher and increased markedly between 1970 and 1990, from 5.2% to 10.2%. At the same time the inbreeding coefficient rose very slowly, but as Young and Seykora (1996) concluded inbreeding will become more difficult to avoid in the future. For the same reason increased inbreeding might also be expected in the Polish Black and White dairy population but on a much smaller scale due to the relatively low current level of relationship.

**Table 2. Relationship coefficients [%] between cohorts of young bulls**

| Cohort | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| 1 | 2.63 | 2.41 | 2.22 | 2.14 | 2.17 |
| 2 | | 3.42 | 2.97 | 2.55 | 2.35 |
| 3 | | | 3.21 | 2.68 | 2.37 |
| 4 | | | | 3.00 | 2.77 |
| 5 | | | | | 3.03 |

Table 3 shows ten sires with the largest number of sons entering AI progeny testing. These bulls sired almost 50% of all 1195 young bull progeny tested from 1999 through 2001. The remaining 50% of young bulls were sons of 105 bulls, including 37 with single sons. Among these ten most popular bulls were four US, four Canadian, one French and one Polish (son of Marlin). Sires of these ten were six US and two Canadian Holstein bulls. Some sires or grandsires originating from the USA or Canada, like S-W-D Valiant, or To-Mar Blackstar and

Hanoverhill Starbuck, were found to be very influential sires in other countries (Miglior and Burnside, 1995 ; Roughsedge *et al*., 1999). Interbull rankings available for most of the ten sires were low, ranging from 2148 to 59125 position in fat yield. Recently Weigel (2001b) reported that 43% of the US Holstein bulls born in 1995 were sired by the ten most popular sires of sons.

**Table 3. Ten sires with the largest number of sons entering progeny testing**

| Sire | | | | | | Grand sire | |
|---|---|---|---|---|---|---|---|
| Reg. No. | Name | Home country | Birth year | No. of sons | [%][A] | Name | Home country |
| 2026916 | Ambition | USA | 1986 | 107 | 9.1 | Whittier-Farms Ned Boy | USA |
| 2498948 | Marzec | POL | 1986 | 106 | 9.1 | A Loc-Lin-Ma Elev Marlin | CAN |
| 390144 | Bionic | CAN | 1985 | 56 | 4.8 | Sir C Valor | USA |
| 389459 | Broker | CAN | 1985 | 52 | 4.4 | S-W-D Valiant | USA |
| 1929410 | Blackstar | USA | 1983 | 51 | 4.4 | Cal-Clark Board Chairman | USA |
| 384848 | Stardom | CAN | 1985 | 47 | 4.0 | Hanoverhill Starbuck | CAN |
| 3588043313 | Dochalain | FRA | 1988 | 45 | 3.8 | Hanoverhill Starbuck | CAN |
| 1987257 | Rambo | USA | 1985 | 44 | 3.8 | Arlinda Rotate | USA |
| 2009256 | Belle Bang | USA | 1986 | 39 | 3.3 | Whittier-Farms Ned Boy | USA |
| 383160 | Dorset | CAN | 1984 | 36 | 3.1 | A Puget Sound Sheik | USA |

[A] Percentage of total number of young bulls

As presented in Table 4, out of 1195 young sires progeny-tested in six consecutive seasons, 894 were registered as Polish Black and White. Among imported bulls the largest number originated form Germany, France and the USA. Further analysis on the origin of a group of 894 Polish bulls showed that most of them were sons of US (273) and Canadian (232) bulls.

**Table 4. Numbers of bulls in six consecutive cohorts entering AI testing, by country of origin**

| Group | Country of origin | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | CAN | DEU | DNK | FRA | NLD | POL | SWE | USA | |
| 1 | 6 | 14 | 3 | 13 | 8 | 187 | - | 16 | 247 |
| 2 | 2 | 19 | - | 19 | 6 | 126 | - | 10 | 182 |
| 3 | 2 | 14 | - | 9 | 8 | 170 | - | 11 | 214 |
| 4 | 3 | 10 | - | 10 | 5 | 114 | 1 | 4 | 147 |
| 5 | 5 | 27 | - | 19 | 6 | 169 | - | 9 | 235 |
| 6 | 3 | 12 | - | 9 | 8 | 128 | - | 10 | 170 |
| Total | 21 | 96 | 3 | 79 | 41 | 894 | 1 | 60 | 1195 |

The low average inbreeding and relationship coefficients estimated for young progeny-tested bulls are similar in magnitude to those calculated for the whole population of Polish Black and White bulls (Kania-Gierdziewicz, 2002).

## CONCLUSION

The average inbreeding coefficients in young bulls entering progeny testing in six consecutive seasons were low, with some increasing tendency in the last two seasons. Much larger were the relationship coefficients, which might result in a further increase of inbreeding. Average magnitudes of inbreeding and relationship in young bulls were similar to those in the whole population of bulls. The introgression of Holstein-Friesians and the large number of bull sires are probably the major reason for the current low estimates of inbreeding.

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