

ANCESTRY ANALYSIS OF COWS OF RECORD MILK YIELDS AND ITS CONSTITUENTS

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Abstract. The aim of the research was the pedigree analysis of top yielding cows. The investigation concerned the effects of male ancestors on the productivity of their female progeny. The total of 3,187 pedigrees of Holstein-Friesian cows with lifetime milk production of over 100,000 kg were examined. The cows were descendants of 971 sires. On the basis of the pedigree analysis it had been proved, that the ancestors of top yielding cows had positive effects on the productivity of their daughters, granddaughters and great-granddaughters. It had also been noted, that there were distinguished ancestors found repeatedly in the pedigrees of sires, grandsires and great-grandsires with the greatest number of high producing female descendants. The common descend of some of the champion cows explains their high productivity. The pedigree analysis had also shown, that many of them were related to one another. Looking deeper into the pedigrees of the sires we repeatedly found outstanding, high-ranking bulls. Increasing degree of relationship among many of the analysed bulls and cows may result in further increase of inbred especially in the group of the most valuable individuals.

Key words: milk production, pedigrees, record performance

INTRODUCTION

In the majority of countries in Western Europe, the Holstein-Friesian (HF) breed pushed out, to a considerable extent, local breeds of lower milk production. In the course of the last 20 years, the average milk production per cow increased in

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member states of the European Union by 1,700 to 2,400 kg. This, in turn, resulted in the deterioration of some functional traits, such as fecundity and longevity [Krychowski 2006].

In Germany, at the present time, dairy cows of a number of breeds are under milk recording schemes, including: approximately 2,230,000 cows of HF breed. The entire herd of HF cows comprises 1,980,000 cows of black and white HF and 250,000 red and white cows of HF breed. Three fourths of these cows (1,650,000) are recorded in record books which makes Germany the country with the highest number of cows recorded in record books. In this respect, German breeders outdistance such countries as Italy (1.1 million), USA (1 million), Holland (0.62 million), Canada (0.54 million) and France (0.4 million). Annually, in Germany, 1,037 HF bulls are tested on the basis of the average number of 113.8 daughters, in the USA – 1197 HF bulls – on the basis of the average number of 110.5 daughters, in Canada – 368 HF bulls – on the basis of the average number of 112.2 daughters and in Italy – 320 HF bulls – on the basis of the average number of 115 daughters [www.intergen.com.pl/index.htm 2009].

In the year 2009, the average yields of assessed dairy cows in Poland amounted to: 6,935 kg milk, 282 kg fat, 231 kg protein, while fat and protein content in milk reached: 4.17% and 3.33%, respectively. Average yields for the Polish Holstein-Friesian breed of black and white variety amounts to: 7,041 kg milk, 293 kg fat, 234 kg protein, while the content of these constituents to: 4.16% and 3.32%, respectively [Polish Federation of Cattle Breeders and Milk Producers 2010].

It is worth noting that the record life yield of a cow is connected with her longevity. Cows which attain their life milk yields of over 100,000 kg can usually boast from 8 to more than a dozen lactations. The longer the utilization time of a cow, the more kilograms of milk are obtained from her [Sobek et al. 2005].

The cow longest utilized in Poland was Krasula I which gave 104,268 kg of milk during 17 lactations. Różańska-Zawieja et al. [2008] emphasized that cows' longevity is a characteristic which is very important for milk production cost-effectiveness. Shortening of the production life of a cow leads to increased production costs due to earlier herd replacement.

The objective of the undertaken investigations was to identify ancestors (groups of ancestors) playing a decisive role in the longevity and yields of record cows which achieved their life milk yields of over 100,000 kg.

MATERIAL AND METHODS

The total of 3187 cows of Holstein-Friesian breed of record life milk yields of over 100,000 kg was examined. Data about cows – record milkers derived from years 1993–2009 from two German breeding organizations: RPN Rinderproduktion Niedersachsen GmbH Bremen-Hannover and Osnabrück-Osnabrücker Herdbuch Genossenschaft. Cows included in the study derived from 971 bulls.

Production and pedigree data were obtained for each cow. Pedigree certificates of fathers of record-milking cows were taken from German bull catalogues: “Bullen-Katalog” RPN Rinderproduktion Niedersachsen GmbH Bremen-Hannover, “Besamungsbullen”, “Bullen” MASTERRIND as well as “Osnabrück Holstein Sires”.

Cows of record life yields of over 100,000 kg of milk derived from the investigated material were classified according to their fathers.

The first grouping process was carried out which consisted in that each father of a record cow was assigned the father and grandfathers. Bulls coming from the mother’s side were grouped separately. Lists were then made which comprised fathers of record cows as well as grandfathers of these cows from the father’s side. Next, division into grandfathers’ groups was made. Each grandfather of the record cow (father’s father) was assigned his sons (fathers of record-milking cows). Grandfathers of record milking cows were arranged according to decreasing numbers of their granddaughters.

In the next step, in the pedigrees of fathers of record milking cows their great-grandfathers (fathers of the father’s father) on the father side were found. Bulls were assigned to groups as it was done earlier. Each great-grandfather (father of the father’s father) was assigned subgroups of its sons – grandfathers (father’s father) of record-milking cows, whereas each grandfather was assigned its sons (fathers of record milking cows) who derived from the examined material. Great-grandfathers of record milking cows were arranged according to decreasing numbers of their great-granddaughters (record milkers).

Similar procedure was used in the case of the male ancestors of record milking cows on their mother’s side and identical lists were prepared.

The subsequent stage of the pedigree analysis involved attempts to find full sibling groups between fathers of record milking cows of over 100,000 kg milk. In the next step, groups of half-siblings of bulls’ fathers on account of a common mother as well as on account of a common father were identified.

The next step of investigations involved the analysis of some milk constituents. The milk of record milking cows was grouped according to its decreasing percentage value of average protein and fat content per lactation as well as mean

number of kilograms of the above milk constituents per lactation. This was followed by the calculation of the mean percentage protein and fat content per lactation for the examined cow population of record milk yields. The data obtained for record milking cows were compared with the data about values of these milk constituents for the entire German population of cows, for the cow population in the Osnabrück district (OHG) as well as for the Polish population of the Holstein-Friesian breed of the black and white variety.

In the course of pedigree analyses for fathers and grandfathers of record milking cows, further relation links were sought. Attempts were made to identify family groups for the male and female sides (of record milking cows' ancestors).

RESULTS

Information regarding fathers of cows with milk yields over 100,000 kg is collated in Table 1 (only bulls that had more than 5 daughters). The examined cows were daughters of 971 fathers. There were 348 bulls which had more than one record milking daughter, while 623 bulls had only one daughter in the examined material.

The highest number of record milking cows were sired by the bull named Modell (94) followed by Chito – 71 daughters, Aerostar – 68 daughters, Status – 62 daughters as well as Berger and Tober – 54 daughters. The remaining bulls sired fewer than 50 record milking daughters.

Table 2 presents numbers of cows of life record yields in the groups of most numerous grandfathers and their sons. Grandfathers are arranged in a decreasing order according to the number of their granddaughters.

Starbuck was found to have sired the highest number of granddaughters (242) whose 18 sons were the fathers of the examined record milking cows. From among his sons, the greatest number of daughters in the examined population was sired by: Status – 62 daughters, Prelude – 47 daughters and Belt – 31 daughters.

The second examined bull characterized by the highest number of granddaughters was Blackstar – 118 granddaughters. For this bull, his 36 sons (fathers of the analysed cows) were found in the examined material. None of them could boast as many daughters as the best sons of Starbuck. The highest numbers of daughters (more than 10) were sired by: Bilanz (19), Bakkara (13), Bonatus (13) and Juror (11). Among the remaining sons of Blackstar, most of them were found to have sired from 1 to 5 daughters in the group of record milking cows.

The third selected grandfather – Cleitus (117 granddaughters) had 22 sons. The most numerous group of daughters among Cleitus's sons was sired by the bull called Clown – father of 39 record milking cows.

Table 3 supplements Table 2 as it additionally provides information concerning great-grandfathers of cows with record milk yields. Table 3 collates information about the number of great-granddaughters, granddaughters and daughters of bulls taking into consideration the above-mentioned groupings into great-grandfathers' groups as well as sub-groups of their descendents. We succeeded in identifying 24 bulls (great-grandfathers) who had record milking great-granddaughters.

Table 1. Fathers of cows of yields of over 100,000 kg of milk – number of daughters (N)

Tabela 1. Ojcowie krów o wydajności powyżej 100 000 kg mleka – liczebności córek (N)

No.	Father – Ojciec	N	No.	Father – Ojciec	N	No.	Father – Ojciec	N
1	Modell	94	39	Chief Mark	14	77	Lieutenant	8
2	Chito	71	40	Sheik	14	78	Mountain	8
3	Aerostar	68	41	Tab	14	79	Ned Boy	8
4	Status	62	42	Voxer	14	80	Stix	8
5	Berger	54	43	Bakkara	13	81	Stoer	8
6	Tober	54	44	Bonatus	13	82	Venlo	8
7	Prelude	47	45	Diadem	13	83	Vils	8
8	Clown	39	46	Ernie	13	84	Ben	7
9	Blackstar	38	47	Southwind	13	85	Blacky	7
10	Anker	36	48	Etta	12	86	City	7
11	Starbright	35	49	Gallant	12	87	Dombinator	7
12	Very	34	50	Inspiration	12	88	Hau	7
13	Astre	31	51	Raider	12	89	Integrity	7
14	Belt	31	52	Calay	11	90	Mandingo	7
15	Cleitus	30	53	Charmeur	11	91	Ron	7
16	Lad	30	54	Juror	11	92	Sterlan	7
17	Astro Jet	27	55	Noble	11	93	Total	7
18	Jolli	26	56	Pete	11	94	Troy	7
19	Leadman	25	57	Stab	11	95	Veto	7
20	Rudolph	25	58	Stewart	11	96	Waschington	7
21	Piraeus	24	59	Abino	10	97	Ambition	6
22	Fuchs	23	60	Chief Bell	10	98	Bleep	6
23	Schmo	22	61	Edler II	10	99	Elasto	6
24	Cleiber	21	62	Le	10	100	Fortune	6
25	Jep	20	63	Schogun	10	101	Lasso	6
26	Bilanz	19	64	Sturm	10	102	Levi	6
27	Blackred	18	65	Triple	10	103	Makati	6
28	Hillstar	18	66	Verro	10	104	Matt	6
29	Jolly	18	67	Vetter	10	105	Orkan	6
30	Recker	18	68	Bookie	9	106	Pit	6
31	Crassus	17	69	Jubilant	9	107	Reno	6
32	Commander	16	70	Luke	9	108	Storm	6
33	Total	16	71	Star	9	109	Supreme	6
34	Voya	16	72	Starleader	9	110	Tong	6
35	Aristo	15	73	Vandale	9	111	Vic	6
36	Format	15	74	Bell	8	112	Vitus	6
37	Stardom	15	75	Cocco	8	113	Volker	6
38	Casals	14	76	Kopal				

Table 2. Male ancestors of cows with yields over 100,000 kg of milk; N1 – number of daughters, N2 – number of granddaughters (3 example grandfathers with the highest number of granddaughters were selected)

Tabela 2. Przodkowie męscy krów o wydajności powyżej 100 000 kg mleka – N1 – liczba córek, N2 – liczba wnuczek (wybrano trzech przykładowych dziadków o największej liczbie wnuczek)

No.	Grandfather		Father		Grandfather		Father										
	Father's father	N ₂	Dziadek	Ojciec ojca	N ₁	Dziadek	Ojciec ojca	N ₂	Ojciec	N ₁							
1	Starbuck	282	1	Aerostar	68	2	Blackstar cont.	118	21	Blasius	1						
			2	Belt	31				Cont.	22	Bleep	6					
			3	Buckeye	1				23	Bo	2						
			4	Hillstar	18				24	Bobe-Jan	1						
			5	Leadman	25				25	Bollart	1						
			6	Luxus	1				26	Bollius	1						
			7	Prelude	47				27	Bonatus	13						
			8	Raider	4				28	Bonus	2						
			9	Sacher	2				29	Bosch	1						
			10	Samson	2				30	Bosel	1						
			11	Skybuck	1				31	Boss	1						
			12	Starboy	1				32	Brandy	1						
			13	Status	62				33	Brelo	2						
			14	Stix	8				34	Brian	5						
			15	Stockau	1				35	Bussum	3						
			16	Stoer	8				36	Juror	11						
			2	Blackstar	118				17	Street	1	3	Cleitus	117	1	Calay	11
									18	Stry	1				2	Calcutta	1
1	Bakkara	13				3	Calyp	2									
2	Balance	1				4	Carlin	1									
3	Balnok	1				5	Casals	14									
4	Bambus	1				6	Casanova	1									
5	Banos	2				7	Cedes	1									
6	Baron	2				8	City	7									
7	Baske	2				9	Claudio	2									
8	Baugias	1				10	Claus	2									
9	Bauser	1	11	Clavado	1												
10	Bazi	3	12	Cleiber	21												
11	Befino	1	13	Cleimat	1												
12	Beinz	2	14	Clico	2												
13	Bensch	1	15	Clie	1												
14	Benz	1	16	Clim	2												
15	Bilanz	19	17	Clown	39												
16	Bilner	2	18	Cluny	1												
17	Binto	1	19	Clus	1												
18	Bips	4	20	Mohr	2												
19	Birko	1	21	Slocum	1												
20	Blacky	7	22	Tonic	3												

The greatest number of great-granddaughters, i.e. 334 cows, was from the bull Elevation. Sons of this bull included: Recker, Starbuck, Very and Tradition. From among 23 grandsons of Elevation, the greatest number of record milking cows were sired by: Aerostar (68), Status (62), Prelude (47), Belt (31), Cleitus (30) and Leadman (25). Elevation's remaining grandsons sired smaller numbers of daughters than 25.

Table 3. Males ancestors of cows with milk yields of over 100,000 kg – N1 – number of daughters, N2 – number of granddaughters, N3 – number of great-granddaughters (example great-grandfather)

Tabela 3. Przodkowie męscy krów o wydajności powyżej 100 000 kg mleka – N1 – liczba córek, N2 – liczba wnuczek, N3 – liczba prawnuczek (przykładowy pradziadek)

No.	Great-grandfather Father of father's father Pradziadek Ojciec ojca ojca	N ₃	No.	Grandfather Father's father Dziadek Ojciec ojca	N ₂	No.	Father Ojciec	N ₁
1	Elevation	334	1	Recker	2	1	Ramses	2
			2	Starbuck	282	1	Aerostar	68
						2	Belt	31
						3	Buckeye	1
						4	Hillstar	18
						5	Leadman	25
						6	Luxus	1
						7	Prelude	47
						8	Raider	4
						9	Sacher	2
						10	Samson	2
						11	Skybuck	1
						12	Starboy	1
						13	Status	62
						14	Stix	8
						15	Stockau	1
						16	Stoer	8
						17	Street	1
						18	Stry	1
			3	Very	11	1	Noble	11
			4	Tradition	30	1	Cleitus	30
			5	–	2	1	Bert	2
			6	–	7	2	Ron	7

The second great-grandfather – Chairman – had 112 great-granddaughters. Chairman sired two sons: Enhancer and Blackstar who sired, respectively, 107 and 5 granddaughters of record milk yields. Enhancer had one son – Edmund, father of 5 cows of record yielding. Blackstar sired 36 bulls, fathers of record

milking cows. The greatest number of daughters were sired by Bilanz (19) as well as Bonatus and Bakkara – 13 cows each. Blackstar's remaining sons, i.e. Chairman's grandsons had a couple of daughters of record milk yields.

Further in the ranking list of great-grandfathers of the highest numbers of great-granddaughters of record life milk yields were: Starbuck (77), Star (70) and Bell (48). In the case of the remaining bulls, numbers of their great-granddaughters did not exceed 30 animals.

Table 4 presents fathers of bulls' mothers, in other words, great-grandfathers of record-yielding cows on the side of record milking grandmothers – mothers of fathers and fathers of record milking cows. Fathers of bulls' mothers are arranged according to the decreasing numbers of their granddaughters. Each father of a bull's mother is assigned only those grandsons who had daughters among record milking cows. Valerian was found to have the greatest number of great-granddaughters of record life milk yields – 125 cows. Valerian had also 16 grandsons who sired cows of record milk yields with Status (62) and Belt siring the greatest numbers of daughters, 62 and 31, respectively. The remaining grandsons of Valerian sired only several daughters of record milk yields.

The second bull – great-grandfather of record milkers on the maternal side of the father of record milk-yielding cows who had a high number of record milking granddaughters was Edler II (70). Edler II had 3 grandsons: Veto, Maritim and Tober. Tober sired 58 cows of record milk yields, while Edler's II two remaining grandsons sired only several daughters of record milk yields.

The third in the ranking of great-grandfathers with the highest number of great-granddaughters of record life milk yields was a bull called Rockman – 54 great-granddaughters and all of them were daughters of Berger. The fourth and fifth great-grandfathers with the highest number of great-granddaughters record milkers were: Enhancer (43) and Very (36). The remaining bulls from among 122 great-grandfathers of cows of record milk yields could only boast numbers of great-granddaughters, record milkers which did not exceed 33 animals. The total number of record milkers, i.e. great-granddaughters of bulls on the maternal side of fathers of record milking cows amounted to 969 cows.

Table 5 presents great-grandfathers of cows of milk yield exceeding 100,000 kg on the side of the bull's mother and father who was the father of record milkers. These are the same great-grandfathers that can be found in Tables 3 and 4. The bulls (great-grandfathers of record milkers) were assigned numbers of their great-granddaughters (record milking cows). The total of 135 great-grandfathers of record milking cows was found. The bull called Elevation had the highest number of great-granddaughters – 334 cows. They were Elevation's great-granddaughters, both on the side mother of the great-granddaughter's father (record milker) as well

as the great-granddaughter on the side of father's father. The second bull with the greatest number of his great-granddaughters of record yields was the bull called Valerian – 134 granddaughters followed by Chairman – 116 great-granddaughters, Star – 87 and Edler II – 70.

Table 4. Numbers of cows of milk yields exceeding 100,000 kg after fathers of record milkers (N1) as well as after fathers of mothers of these bulls (N2)

Tabela 4. Liczebności krów o wydajności powyżej 100 000 kg mleka po ojcach rekordzistek (N1) oraz po ojcach matek tych buhajów (N2)

Father of bull's mother			Father of bull's mother			Father of bull's mother			Father of bull's mother		
No. Nr	Ojciec matki buhaja	N ₂	No. Nr	Ojciec	N ₁	No. Nr	Ojciec matki buhaja	N ₂	No. Nr	Ojciec	N ₁
1	Valerian	125	1	Status	62	2	Edler II	70	1	Tober	58
			2	Belt	31				2	Veto	7
			3	Abino	10				3	Maritim	5
			4	Pit	6	3	Rockman	54	1	Berger	54
			5	Brix	2	4	Enhancer	43	1	Clown	39
			6	Bo	2				2	Exakt	1
			7	Calyp	2				3	Leandro	1
			8	Claudio	2				4	Minimo	1
			9	Bernhard	1				5	Strom	1
			10	Cato	1	5	Very	36	1	Lad	30
			11	Casanova	1				2	Colon	5
			12	Cleimat	1				3	Aigo	1
			13	Nassau	1	6	Sheik	33	1	Cleiber	21
			14	Navio	1				2	Makati	6
			15	Nudo	1				3	Clico	2
			16	Stockau	1				4	Chub	1
									5	Blasius	1
									6	Ariovist	1
									7	Clavado	1

Table 6 presents fathers of cows of record milk yields who were full siblings. When analyzing pedigrees of record milking cows, pairs of full siblings were sought for fathers of cows with life record milk yields. Six pairs of full siblings were identified of which three pairs derived from the same bull – Blackstar, two pairs after Cleitus and one pair after Reckers Ace.

Table 7 presents fathers of record milking cows who were half-siblings on their mothers' side. There were 17 of those pairs but only in two cases were there

Table 5. Great-granddaughters of cows with milk yields of over 100,000 kg on the side of the mother and father of the bull who was the father of record milkers (N – number of great-granddaughter – example great-grandfathers)

Tabela 5. Pradziadkowie krów o wydajności powyżej 100 000 kg mleka ze strony matki i ojca buhaja będącego ojcem rekordzistek (N – liczba prawnuczek – przykładowi pradziadkowie)

No. Nr	Great-grandfather's name Nazwa pradziadka	N	No. Nr	Great-grandfather's name Nazwa pradziadka	N	No. Nr	Great-grandfather's name Nazwa pradziadka	N
1	Elevation	334	11	Very	36	21	Rotate	20
2	Valerian	134	12	Sheik	33	22	Triple	20
3	Chairman	116	13	Fond Matt	32	23	Neil	16
4	Star	87	14	Telstar	27	24	Cleitus	15
5	Edler II	70	15	Commerce	26	25	Apache	14
6	Bell	69	16	Ned Boy	25	26	Jemini	13
7	Rockman	54	17	Juwel	25	27	Chef II	12
8	Conductor	54	18	Aerostar	24	28	Victor	11
9	Enhancer	43	19	Astronaut	24	29	Apostel	10
10	Blackstar	38	20	Starbruck	23	30	Astro Jet	10

Table 6. Fathers of cows with milk yields over 100,000 kg – full siblings

Tabela 6. Ojcowie krów o wydajności powyżej 100 000 kg mleka – pełne rodzeństwo

No. Nr	Number of groups of full sibs Liczba grup pełnego rodzeństwa	Bulls (full sibs) Buhaje (pełne rodzeństwo)	Mothers of full sibs Matki pełnego rodzeństwa	Fathers of full sibs Ojcowie pełnego rodzeństwa
1	1	Boss	Birte	Blackstar
2		Bambus	Birte	Blackstar
3	2	Bazi	Diana	Blackstar
4		Binto	Diana	Blackstar
5	3	Bips	Jello	Blackstar
6		Bilanz	Jello	Blackstar
7	4	Casals	Liane	Cleitus
8		Mohr	Liane	Cleitus
9	5	Clavado	Olive	Cleitus
10		Clico	Olive	Cleitus
11	6	Ron	Paula	Reckers Ace
12		Pirrot	Paula	Reckers Ace

groups made up of three half-siblings. Among these groups of half-siblings, some fathers' fathers of cows of record milk yields appeared several times. In table 7, bulls Leadman and Valerian occur four times and Chief Mark – three times.

After performing the value analysis of basic milk constituents, it was found that the mean protein content in the milk of the examined cows amounted to 3.24% and that of fat – to 4.08%. The highest protein content in milk was determined in the cow called Rena, Starbuck's daughter. Moreover, Rena was also classified high with respect to the mean fat content in milk; she occupied the 11th position among the examined material with the result of 5.13%. This record milking cow reached the yield of 100,000 kg of milk in her 11th lactation. The highest mean fat content in milk of 5.32% was recorded in the cow called Samba, daughter of the bull Blackstar; her mean protein content in milk was 3.53%. Samba reached the yield of 100,000 kg of milk in her 10th lactation. The lowest protein content in milk – 2.76% (fat – 3.27%) was recorded in the cow called Amra, daughter of the bull Berni, whereas the lowest fat content in milk – 2.44% (protein – 2.99%) was noted in the cow called Hilary, daughter of the bull Juror. The above value varied significantly from the mean fat content in the milk of the examined record milkers. In the entire examined population of cows, there were only 7 with the fat content in milk below 3%.

Table 8 makes it possible to compare protein and fat content in the milk of the examined record milking cows from the Osnabrück breeding region (OHG) with the entire German population as well as with the Polish population of cows. Differences in mean protein and fat contents in milk between the domestic populations of cows and the examined record milking cows were non-significant. Despite this, bearing in mind so large numbers of populations, it should be emphasized that the mean fat content in the milk of the examined record milkers in relation to the Polish population was by 0.02% higher, whereas in comparison with the cows from PHG, the record milking cows were by 0.04% fat better.

In their lineages the same sires have been found, either on the father's or the mother's side. Analysis of three generations deep lineages of sires did not always show their relationship, however deeper investigation often showed that analysed bulls had had the same ancestors. The above mentioned ancestors appeared to be very good sires. In general this means that the frequency of genotypes of outstanding bulls' parents has been reflected in the genotypes of champion cows. Their high productivity is the measurable effect of that.

Table 7. Groups of fathers' half-siblings of cows with milk yields exceeding 100 000 kg (half-sibs on account of common mother)

Tabela 7. Grupy półrodzeństwa ojców krów o wydajności powyżej 100 000 kg mleka (półrodzeństwo z tytułu wspólnej matki)

No. Nr	Groups of half-sibs Grupy pełnego rodzeństwa	Fathers of record mil king cows (half-sibs) Ojcowie krów rekordzistek (półrodzeństwo)	Father of half- sibs Ojciec półrodzeństwa	Father of mother's half-sibs Ojciec matki półrodzeństwa
1	1	Lucky	Edelgold	Leadman
2		Dorado	Edelgold	Dominator
3	2	Lektor	Eleganz	Luke
4		Imperial	Eleganz	IgaleMasc
5	3	Vier	Grietje	Valerian
6		Marius	Grietje	Addison
7	4	Menol	Holli	Chief Mark
8		Carlin	Holli	Cleitus
9	5	Danton	Liane	Database
10		Attila	Liane	Aerostar
11	6	Lusaka	Lulu	Leadman
12		Inspiration	Lulu	Valerian
13	7	Emil	Maigold	Esquimau
14		Aigo	Maigold	Aerostar
15	8	Chirkan	Monique	Chief Mark
16		Graso	Monique	Glow
17	9	Brandy	Ned Boy	Hortensie
18		Brelo	Ned Boy	Penelope
19	10	Lombard	Operette	Leadman
20		Vapiti	Operette	Vic Kai
21		Comic	Operette	Cutlass
22	11	Immo	Priska	Inspiration
23		Boot	Priska	Bell Rex
24	12	Volker	Raphaela	Valerian
25		Spencer	Raphaela	Spirit
26	13	Colon	Sheila	Chief Mark
27		Sheik	Sheila	Juwel
28	14	Benz	Sitta	Blackstar
29		Lotharas	Sitta	Leadman
30	15	Reston	Sonate	Raider
31		Index	Sonate	Inspiratio
32	16	Minimo	Tenne	Michael
33		Bult	Tenne	Bell Troy
34	17	Veto	Tessa	Valerian
35		Maritim	Tessa	Chief Mark
36		Tober	Tessa	Troy

DISCUSSION

Cows with record milk yields have aroused interest of breeders for many years [Sobek 1986, 1988a, b]. Unfortunately, until now investigations usually involved record yields of cows for lactation. It is difficult to find, in literature on the subject, articles dealing with cows whose life yields exceeded 100,000 kg of milk. If there are any, they are usually papers giving short descriptions of cows attaining such results [Osten-Sacken 2009, Słupski 1960] and there are no investigations focusing on the causes of the occurrence of such high life yields.

Together with the increase in the severity of selection, a regular increase in the breeding progress was observed. Values of record milk yields of cows increased from year to year. Unfortunately, high yields are usually offset by the deterioration of the general health condition, fertility, problems with drying, higher sensitivity to udder inflammations or more frequent occurrence of metabolic diseases. This leads, among others, to lengthening of the calving interval to 420 or even up to 450 days [Guliński and Salamończyk 2007, Grodzki 2009]. Such unnaturally high milking yields can hardly be considered as a physiological yields. It may seem that the word “physiology” does not apply here any longer. Maximal utilization of possibilities of high-yielding cows causes that they are used shorter than cows of average yields and hence culling of the former takes place already after 2-3 years [Grodzki 2009]. Heigelmann [2009] maintains that the maximum production level of cows, as a rule, falls on the fourth lactation. In the current breeding system, it often happens that the lactation yield achieved by a cow would allow her to win the title of a record milker with respect to lactation yields. However, due to early culling from the herd, this cow has no chance of becoming a record milker of life yields over 100,000 kg of milk.

Further breeding progress may cause that no more cows of life milk yields of over 100,000 kg will be recorded if the longevity traits are not taken into consideration in breeding programs.

There are reports, in the literature on the subject, regarding milk production profitability. It turns out that from the point of view of economy, cows should be utilized for 6–7 lactations, i.e. to the age of 8.5 to 9.5 years. Due to the fact that cows are used for a longer period of time, costs that are incurred by cattle breeders during the non-productive period will be spread over time Heigelmann [2009].

On the other hand, Sobek et al. [2005] maintain that a cow should be allowed to live for at least 7–8 years because her production peak falls on the 3rd – 5th lactations. In addition, the above researchers maintain that culling young cows from the herd incurs very high costs associated with the necessity to introduce

new heifers in their stead before the culled young cow could pay back costs of her rearing.

In the period from 1959 to August 2008, the limit of life milk yields of 100,000 kg was exceeded by 14,160 cows in the Netherlands, of which 1310 cows were daughters of the bull Sunny Boy. In the year 2007, his daughters comprised 1109 cows, so it is very clear that the number of his daughters – record milking cows increased rapidly and, most likely will continue to grow because the gene impact of the Sunny Boy bull is huge in the population of dairy cattle all over the world [www.CRVall.com2008]. Further on the list of bulls with the highest number of daughters with milk yields of over 100,000 kg are taken up by: Tops Monitor Legend (1104 daughters), F16 Rocket C (387 daughters) and Etazon Celsius (244 daughters). Such effects are possible thanks to steadily growing yields of cows under individual milk control [Osten-Sacken, 2009].

Analysis results of basic milk constituents among the examined record milking cows failed to exhibit significant differences for mean fat and protein contents in milk in comparison with the German and Polish cow populations of the Holstein-Friesian breed, although a certain tendency for the advantage of the record milkers regarding fat contents was noticeable.

In addition, “double” record holders can be found among the examined cows of record milk yields, namely cows which, apart from breaking the 100,000 kg milk limit, also produced milk with the highest protein and fat content.

Looking at the genealogical tree of the best bulls – ancestors of record milkers, it is quite evident that the best bulls were closely related with one another. This is hardly surprising because most breeders select for the insemination semen of the best bulls in the population. A growing degree of inbreeding in the best populations is very common. In their studies, Koenig and Simianer [2006] demonstrated that in the case of the German Holstein-Friesian cattle population inbred among cows amounted to less than 2% and among the best cows – slightly below 4%. Although, these are not high inbred values, nevertheless it should be remembered that the inbred will continue to grow because relatedness, especially between the best bulls, increases and kinship between potential mothers and fathers of bulls amounts to about 8%. The bull called Elevation is related with cows randomly selected from the population at the level of 12.1%, HannoverhillStarbuck – 11.2%, ArlindaChief – 9.7%, S-W-D Valiant – 8.1%, Leadman – 8.1%, To-Mar Blackstar – 7.5%, Chairman – 7.2%, Ivanhoe Bell – 5.5% [Koenig and Simianer 2006]. All the bulls described by these authors are among the bulls examined in our study – ancestors of cows with record milk yields.

It is well known that the better parents are used, the higher chances for obtaining very good progeny. Our own investigations corroborate appropriateness

of conducting breeding on lines based on outstanding ancestors. It is possible to indicate such bull lines as the line of Elevation (RoundOak Rag Apple Elevation), where we can find, among others, Starbuck, Aerostar, Prelude, Tradition, Cleitus or Clown, as well as Star line (Ivanhoe Star) or his son Bella and also Star's grandson – Celsius as well as ArlindaChief line with such outstanding bulls as – Chairman, Blackstar, Conductor, Sunny Boy or Valiant who began successive generations of record milkers. Some great-grandfathers and grandfathers of record milking cows are fathers of bulls who sired sons that were fathers of successive record milkers. The above-mentioned lines are characterized by longevity and exceptional milk yields.

Table 8. Comparison of basic milk constituents (protein and fat) in the examined record milkers of the Osnabrück breeding region (OHG) with the entire German population as well as with the Polish population of cows (according to: Milk production in Osnabruck 2010, Polish Federation of Cattle Breeders and Milk Producers 2010)

Tabela 8. Porównanie zawartości podstawowych składników mleka (białka i tłuszczu) u badanych krów rekordzistek, niemieckiej populacji krów z okręgu hodowlanego Osnabrück (OHG), całej niemieckiej populacji oraz krów z polskiej populacji (wg Milkproduction in Osnabruck 2010, Polska Federacja Hodowców Bydła i Producentów Mleka 2010)

Trait	Examined record milkers Badane rekordzistki %	Cows from OHG (2007) Krowy z OHG (2007) %	German population (2007) Populacja niemiecka (2007) %	Polish population (2007) Populacja polska (2007) %	Differences between columns Różnice między kolumnami %		
					1-2	1-3	1-4
Cecha	1	2	3	4	5	6	7
Mean protein content in milk Średnia zawartość białka w mleku	3.24	3.40	3.42	3.36	-0.16	-0.18	-0.12
Mean fat content in milk Średnia zawartość tłuszczu w mleku	4.08	4.04	4.13	4.06	0.04	-0.05	0.02

CONCLUSIONS

1. A number of bulls siring top producing cows have been descendants of excellent Dutch, American and Canadian Holstein-Friesian sire lines.
2. Some of the bulls siring a large number of champion daughters are related to one another.
3. Analysis of the lineages of those sires showed, that several of the breeding lines had been created by inbreeding.
4. Lineage analysis indicate that certain sire lines produce more top producing cows.
5. Champion cow lineage analysis proves that the selection for longevity is justified, as cows producing over 100 thousand kg of milk usually live up to 8th lactation.

REFERENCES

- Grodzki H., 2009. Zmiany w chowie bydła w Polsce w ostatnim 25-leciu [Changes in cattle in Poland in the last 25 years]. *Przeg. Hod.* 11, 1–4 [in Polish].
- Guliński P, Salamończyk E., 2007. Ocena wybranych wskaźników użytkowości mlecznej, długości laktacji i stanu zdrowotnego wymion wysoko wydajnych krów rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej [Evaluation of selected indicators of milk performance, length of lactation and udderhealth status of high-yielding cows Polish Holstein-Friesian variety of black and white]. *Rocz. Nauk. PTZ* 3(1), 29–36 [in Polish].
- Heigelmann G., 2009. Cel: dłuższe życie krów [Objective: The longer life of cows]. *Hoduj z głową bydło* 5, 46–48 [in Polish].
- Koenig S., Simianer H., 2006. Approaches to the management of inbreeding and relationship in the German Holstein dairy cattle population. *Livest. Prod. Sci.* 103(1-2), 40–53.
- Krychowski T., 2006. Tendencje w hodowli bydła mlecznego w Europie Zachodniej – perspektywa najbliższego 10-lecia [Trends in dairy cattle breeding in Western Europe, the prospect of the forthcoming 10 years]. *Przeg. Hod.* 5, 1–5 [in Polish].
- Milk production in Osnabrück, 2010. www.ohg-genetic.de/cgi-bin/ohg/en/profil/osnabrueck.html, data dostępu 05.2009.
- Osten-Sacken A., 2009. Nowy rekord wydajności mlecznej [New record of milk yield]. *Top Agrar Polska* 6, 26 [in Polish].
- Polska Federacja Hodowców Bydła i Producentów Mleka, 2010. Ocena i Hodowla Bydła Mlecznego. Dane za rok 2009 [Evaluation of dairy cattle. Data for 2009]. Warszawa [in Polish].
- Róžańska-Zawieja J., Nienartowicz-Zdrojewska A., Nowacki P., Sobek Z., 2008. Długowieczność i przyczyny brakowania krów mlecznych [Longevity and reasons for culling dairy cows]. *Prac. Mater. Zootech.* 65, 59–66 [in Polish].

- Słupski K., 1960. Anita. Przeg. Hod. 3, 29–32 [in Polish].
- Sobek Z., 1986. Rola krów rekordzistek w doskonaleniu populacji [The role of recorded cows in improving the population]. Przeg. Hod. 7, 7–9 [in Polish].
- Sobek Z., 1988a. Synowie krów o rekordowej wydajności [Sons of cows with a record performance]. Przeg. Hod. 13, 14–16 [in Polish].
- Sobek Z., 1988b. Zależność pomiędzy wykorzystaniem krów o rekordowych wydajnościach, a postępem hodowlanym [The relationship between the use of cows with record yields, and the progress of the breeding]. Acta Acad. Agric. Tech. Olst. Zootech. 2, 1–7 [in Polish].
- Sobek Z., Dymarski I., Piekarska O., 2005. Analiza długowieczności i przyczyny brakowania krów mlecznych w stadzie ZZD IZ Pawłowice [Analysis of longevity and causes of culling of dairy cows in the herd of ZZD IZ Pawłowice]. Acta Sci. Pol. Zootechnica 4 (2), 97–112 [in Polish].
- www.CRV4all.com, 2008. Sunny Boy Millionaire. Highlights CRV, English edition, data dostępu: 05.2009.
- www.intergen.com.pl/index.htm, 2009. Made in Germany – Niemiecka ocena wartości hodowlanej dla rasy hf. Intergen Sp. Z o.o., Skierszewe, data dostępu: 05.2009.

ANALIZA POCHODZENIOWA KRÓW O REKORDOWYCH WYDAJNOŚCIACH MLEKA I JEGO SKŁADNIKÓW

Streszczenie. Celem pracy było dokonanie analizy pochodzeniowej krów o rekordowych wydajnościach mleka i jego składników. Zbadano, czy przodkowie krów rekordzistek mieli wpływ na wydajność swoich córek. Analizą rodowodową objęto 3187 krów rasy holsztyńsko-fryzyjskiej o rekordowej wydajności życiowej powyżej 100 000 kg mleka. Badane krowy pochodziły po 971 buhajach. Odszukano dalsze powiązania krewniacze dla ojców i dziadków krów o rekordowej wydajności. Na podstawie uzyskanych wyników analizy pochodzeniowej stwierdzono, że przodkowie krów o rekordowej wydajności mieli pozytywny wpływ na wydajności swoich córek, wnuczek i prawnuczek. Okazało się również, że w rodowodach buhajów – ojców, dziadków, pradziadków, którzy mieli najwięcej żeńskich przodków o rekordowej wydajności, odnaleziono powtarzających się wybitnych męskich przodków. Wspólne pochodzenie niektórych rekordzistek pozwala wyjaśnić wysoką wydajność mleczną tych krów. Analiza rodowodowa wykazała także, że wiele krów rekordzistek jest ze sobą spokrewnionych. Sięgając głębiej w rodowody ojców krów rekordzistek odnajdujemy często powtarzających się wybitnych buhajów, którzy zajmują wysokie miejsca w top rankingach buhajów ras mlecznych. Spokrewnienie pomiędzy wieloma z badanych buhajów i krów stwarza obawy o dalszy wzrost spokrewnienia, zwłaszcza w tej grupie najcenniejszych osobników.

Słowa kluczowe: produkcja mleka, rekordowe wydajności, rodowody

Accepted for print – Zaakceptowano do druku: 6.12.2012

