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Department of Horse Breeding and Utilization, University of Life Sciences in Lublin
20-950 Lublin, Akademicka 13,
e-mail: ryszard.kolstrung@up.lublin.pl

RYSZARD KOLSTRUNG, SEBASTIAN GUT

**Effectiveness of reproductive utilization of Hucul mares
in Poland**

Efektywność wykorzystania rozplodowego klaczy huculskich w Polsce

Summary. The present paper studies reproductive utilization of 136 Hucul mares maintained in Poland in the years 1987-1996. The animals were entered into VIII volume of the Hucul Stud Book; the parameters and indices were established for individual mares and collectively for 14 active dam lines. During those years, the examined mares gave birth to 820 foals, including 433 fillies (52.8%) and 387 colts (47.2%). Individually, the mares had maximum 11 foals – one mare and 10 foals each – three mares, on average 6 foals per mare. The following indices were determined: 88.5 % - fertility (50% of the studied mares achieved 100% fertility), 9.6% - barren, 1.3% - miscarriages, 0.6% - stillbirths. The reproduction index of 68% shows that the breeders make a good use of high reproductive potential of Hucul horses. A very high percentage of born foals were qualified for further breeding: 80.6% mares and 16.8% stallions (data for 2011). There were substantial differences between the individual mare bloodlines resulting from variability of genetic background and the realization of the breeding program aiming at preserving the rare or declining lines.

Key words: Hucul pony, breeding, reproductive utilization of mares

INTRODUCTION

The Hucul horse is a small mountain horse breed originally from the Carpathian Mountains where Huculs were bred for hundreds of years. They are one of the oldest Polish breeds known since the beginning of XVII century. Because of their low number they were about to die out, so currently they belong to breeds endangered with extinction. At present, horses of this breed are bred in Central and Eastern Europe countries: Poland, Slovakia, Czech Republic, Romania, Hungary, Austria and Ukraine. According to the guidelines set forth in the FAO Program for Preserving Farm Animal Genetic Resources, a breed is classi-

fied as endangered when its effective population size falls below five thousand in the area of European Union [Krupiński 2008].

In the year 2004, 6% of the world population of Hucul was bred in Poland. Currently in the Polish Hucul population, there are 14 dam lines and 6 sire lines. The Hucul horses are highly appreciated for their friendly character, undemanding nature, good health and endurance at work. They are good riding horses, especially in difficult mountain terrain, good draft horses and used in hippotherapy. Huculs as primitive horses are distinguished by their excellent ability to adapt to harsh conditions, high level of reproductive indices, especially high fertility, good maternal properties and longevity [Jackowski 2000].

In April 1979, the Horse Breeding Section of Scientific and Technical Council at the Ministry of Agriculture adopted a resolution on necessity of preserving the Polish Hucul in order to maintain national culture heritage, protect nature and save valuable genetic features. The breeding program of Hucul ponies aims at continuation of all sire lines and dam lines [PZHK 2007]. Maintaining of bloodline continuity plays a key role in preserving the genetic variability. It also prevents the loss of genes and reduces the increased levels of inbreeding. Because of small population, the main mating criterion for selection is the degree of relatedness. The appropriate mating system allows to avoid genetic kinship and the inbred depression. For these purposes, efforts have been undertaken to maintain a balanced number of existing sire lines and dam lines [Tomczyk-Wrona 2010]. The breeding program imposes upon the breeders leaving a representative of every bloodline in the herd even if their individual value is small. Appropriate reproductive management strategy of this breed serves the purpose of maintaining and possibly increasing the population of Hucul pony.

The first impregnation of a mare is recommended to take place not earlier than at age of 30 months [Tomczyk-Wrona 2010]. In Hucul pony natural reproduction is generally practiced (hand mating or pasture breeding). Insemination with fresh or cooled semen has been a common procedure.

In elite studs where ovulations and pregnancies are closely monitored, approximately 80 mares out of 100 get in foal. It can be assumed that lower limit of satisfactory fertility is 70%, good fertility – 80% and very good fertility – 90%. In farmer breeding, the average fertility is 50 % [Zwoliński 1980].

The objective of this paper was to assess the degree of Hucul mare reproductive potential utilization expressed as the ratio of actual to theoretical fertility.

MATERIAL AND METHODS

The research material comprised 136 mares born in 1987–1996 and bred in Poland, registered in volume VIII of the Hucul Horse Stud Book. There was analyzed reproductive performance of the mares whose reproductive activity could be maintained for at least five breeding seasons. The last reproductive season analyzed was 2003. Each mare was examined individually to determine the number of years (seasons) of reproductive utilization, the number of foals born (in relation to sex), number of daughters and sons that were entered into the Stud Book. Reproductive utilization indices were established for individual mares, while for 14 active female families collective arithmetic means were calculated. The following parameters were determined:

- 1) theoretical fecundity – the theoretical number of years (seasons) of reproductive utilization from 3 years of age to 2003, and at the same time, the theoretical number of foals that could be possibly born in this period of time;

- 2) potential fecundity – the actual number of seasons when the mare was reproductively active (some breeders do not want to have mares mated every breeding season);
- 3) actual fertility – the number of foals born;
- 4) reproductive utilization efficiency index – the ratio of actual fertility to theoretical fertility;
- 5) fertility percentage – the ratio between the number of foals born and the number of seasons when the mare was reproductively active;
- 6) infertility percentage – the ratio of barren mares to the number of seasons of mare reproductive activity;
- 7) miscarriage percentage – the ratio of miscarriages to the number of seasons of reproductive activity of the mare;
- 8) stillbirth percentage – the ratio of stillbirths to the number of seasons in which the mare was reproductively active;
- 9) foal sex ratio;
- 10) percentage of progeny examined mares entered to Breed Book according to sex.

DISCUSSION

The analysis of the pedigree showed that 136 mares under investigation belonged to 14 dam lines. The number of mares varied greatly in each bloodline (Fig. 1).

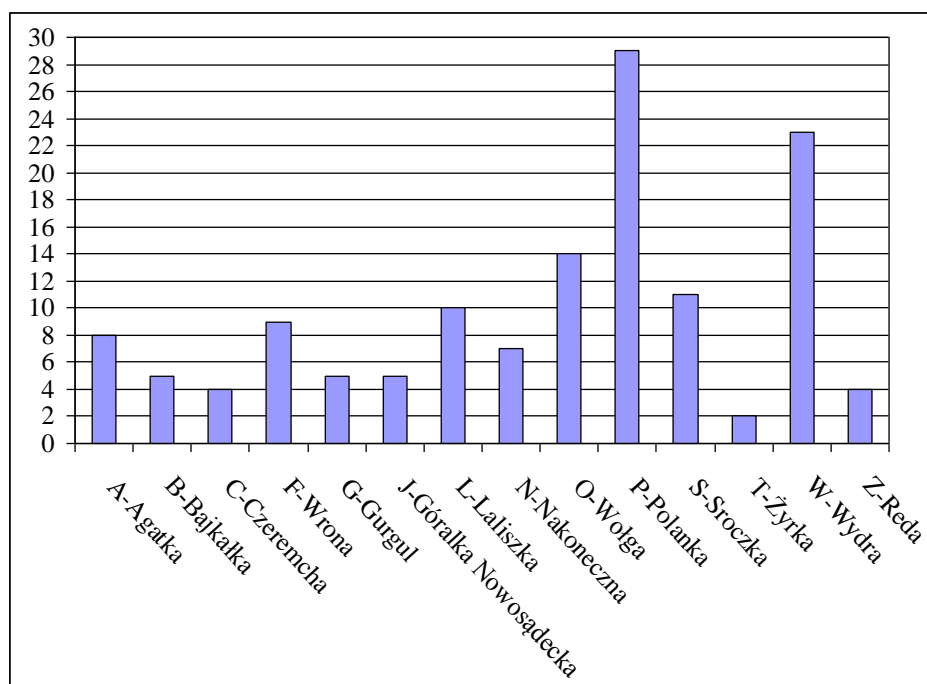


Fig. 1. Number of examined mares from particular Hucul horse mare lines
Rys. 1. Liczebności badanych klaczy z poszczególnych linii klaczy huculskich

Table 1a. Breeding indicators of particular Hucul horse mare lines
Tabela 1a. Wskaźniki rozrodu badanych linii klaczy huculskich

Wskaźniki Indicators	Linie klaczy / Mare lines														Ogółem Total
	A-Agatka	B-Bajkałka	C-Czeremcha	F-Wrona	G-Gurgul	J-Góralka Nowosądecka	L-Laliszka	N-Nakoneczna	O-Wołga	P-Polanka	S-Srocza	T-Żyrka	W-Wydra	Z-Reda	
Liczba klaczy Number of mares	8	5	4	9	5	5	10	7	14	29	11	2	23	4	136
Teoretyczna liczba sezonów Theoretical number of seasons	70	41	38	82	47	40	84	61	123	267	96	23	202	31	1230
Plenność teoretyczna Theoretical fecundity	8,75	8,20	9,24	9,11	9,40	8,00	8,40	8,71	8,79	9,21	8,73	11,50	8,78	7,75	8,98
Faktyczna liczba sezonów Number of seasons	55	24	26	58	29	30	63	46	94	207	82	16	168	29	927
Plenność potencjalna Potencial fecundity	6,88	4,80	6,16	6,44	5,80	6,00	6,30	6,57	6,71	7,14	7,45	8,00	7,30	7,25	6,82
Liczba urodzonych źrebiąt Number of foal born	50	21	23	53	26	23	50	43	78	186	77	13	149	28	820
Plenność faktyczna Actual fertility	6,25	4,20	5,44	5,89	5,20	4,60	5,00	6,14	5,57	6,41	7,00	6,50	6,48	7,00	6,03

Table 1b. Breeding indicators of particular Hucul horse mare lines
Tabela 1b. Wskaźniki rozrodu badanych linii klaczy huculskich

Wskaźniki Indicators	Linie klaczy / Mare lines														Ogółem Total
	A-Agatka	B-Bajkałka	C-Czeremcha	F-Wrona	G-Gurgul	J-Góralka Nowosądecka	L-Laliszka	N-Nakoneczna	O-Wołga	P-Polanka	S-Srocзка	T-Żyryka	W-Wydra	Z-Reda	
Płodność (%) Percent fertility	90,9	87,5	88,5	91,4	89,7	76,7	79,4	93,5	83,0	89,9	93,9	81,2	88,7	96,6	88,5
Jałowienia (%) Infertility	3,6	12,5	9,4	6,9	6,9	23,3	20,6	6,3	16,0	7,7	4,8	18,8	8,3	0,00	9,60
Poronienia (%) Misscariage	3,6	0,0	0,0	1,7	3,5	0,0	0,0	0,0	0,0	1,5	1,2	0,0	1,8	3,5	1,3
Martwe urodzenia (%) Stillbirt	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,1	1,0	0,0	0,0	1,2	0,0	0,6
Wskaźnik wykorzystania rozplodowego (%) Reproductive utilization index	71,4	51,2	60,5	64,6	55,3	57,5	59,5	70,5	63,4	69,7	80,2	56,5	73,7	90,3	68,1

Table 2. Indicators breeding effectiveness of studied Hucul mare lines
 Tabela 2. Wskaźniki efektywności hodowlanej badanych linii klaczy huculskich

Wskaźniki Indicators	Linie klaczy / Mare lines														Ogółem Total
	A-Agatka	B-Bajkalka	C-zeremcha	F-Wrona	G-Gurgul	J-Góralka Nowosądecka	L-Laliszka	N-Nakoneczna	O-Wolga	P-Polanka	S-Srocзка	T-Żyrka	W-Wydra	Z-Reda	
Liczba klaczy Number of mares	8	5	4	9	5	5	10	7	14	29	11	2	23	4	136
Liczba źrebiąt urodzonych Number of foals born	50	21	23	53	26	23	50	43	78	186	77	13	149	28	820
Średnia liczba źrebiąt na klacz (szt.) Mean number of the mare foals	6,25	4,20	5,44	5,89	5,20	4,60	5,00	6,14	5,57	6,41	7,00	6,50	6,48	7,00	6,01
- klaczek -fillies	22	10	10	27	11	14	28	25	40	102	37	6	82	19	433
- ogierków - colts	28	11	13	26	15	9	22	18	38	84	40	7	67	9	387
Procent urodzonych klaczek (%) Percentage of fillies	44,0	47,6	43,5	50,9	42,3	60,9	56,0	58,1	51,3	54,8	48,1	46,1	55,0	67,9	52,8
Procent urodzonych ogierków (%) Percentage of colts	56,0	52,4	52,5	49,1	57,2	39,1	47,0	41,9	48,7	45,2	51,9	53,9	45,0	32,1	47,2

Table 3. Number mares and stallions from particular Hucul mare lines entered in the Stud Book
Tabela 3. Liczebność klaczy i ogierów z poszczególnych linii klaczy huculskich wpisanych do Księgi Stadnej

Wskaźniki Indicators	Linie klaczy / Mare lines														Ogółem Total
	A-Agarka	B-Bajkalka	C-Czeremcha	F-Wrona	G-Gurgul	J-Góralka Nowosądecka	L-Laliszka	N-Nakoneczna	O-Wolga	P-Polanka	S-Srocza	T-Żyryka	W-Wydra	Z-Reda	
Klaczki wcielone do hodowli Mares entered in the Stud Book	19	6	8	20	9	13	24	19	36	73	27	4	75	16	32
Klaczki wcielone do hodowli (%) Percentage of mares entered in the Stud Book	86,4	50,0	80,0	74,1	81,8	92,9	85,7	76,0	90,0	71,6	72,9	66,7	91,5	84,2	80,6
Ogierzy wcielone do hodowli Stallion entered in the Stud Book	2	2	1	6	3	3	4	5	6	15	7	1	9	1	65
Ogierzy wcielone do hodowli (%) Percentage of stallions entered in the Stud Book	14,0	18,2	7,7	23,1	20,0	33,3	18,2	27,8	15,8	17,9	17,5	14,3	13,4	11,1	16,8

The most numerous bloodlines were: P-Polanka – 29 mares (number of reproductive seasons – 267), followed by W-Wydra – 23 mares (168 seasons). While the least numerous lines were represented by 4 mares each: Z-Reda (29 seasons), G-Gurgul (29 seasons), C-Czeremcha (26 seasons), B-Bajkała (24 seasons) and T-Żyrka - 2 mares (16 seasons). The examined mares delivered a total of 820 foals, including 433 fillies and 387 colts. The general sex ratio of born foals over the examined period was 52,8% fillies and 47,2% colts.

Assessment of the reproductive performance of mares representing the distinctive dam lines indicates that the parameters maintained at a good level, even though there were differences between the representatives of a particular line.

1. Theoretical fecundity

Theoretical fecundity, defined as the number of foals that could be potentially delivered by a mare from the age of 3 years to the end of 2003, ranged from 5 up to 14. The highest theoretical fecundity (14 foals) was achieved by the mares Płocha from the line P-Polanka, Fuksja from F-Wrona and Jawa from the T-Żyrka line.

Generally in the analyzed period, all the mares that, in view of their age could be used for breeding, could theoretically give birth to a total of 1205 foals (Tab. 1). The highest number, 267 foals, could be delivered by the mares from the P-Polanka family, whereas the lowest, only 23 foals, by the mares from the T-Żyrka family. It is associated with the number of mares in each line. On average, one mare could give birth to 8-9 foals (theoretical fecundity 8,98). The highest average theoretical fecundity was achieved by the mares from the T-Żyrka line (11,50). It is a result of the fact, that those mares were registered in the Stud Book in more advanced age and their mean age was higher as compared to other mares. The lowest value in this respect was reported for the mares of Z-Reda family – 7,75.

2. Potential fecundity

Taking into consideration the fact that the breeders did not decide to have their mares mated every breeding season, the number of seasons when the mare was reproductively active was assumed to be an index of potential fecundity. The sum of all actual reproductive seasons in the examined period was 927. Consequently, the number of reproductive seasons accounted for 76,9% of theoretical capability of a mare in the examined period. The average period of reproductive utilization was 6-7 seasons, while mean value of potential fecundity of the examined mare was established at the 6,81 level. The highest potential fecundity was reported for the following mares: Płonka and Popielatka from the P-Polanka line, Smereka from the S-Srocza line, Liszka and Norma from the W-Wydra line; they could potentially deliver 11 foals each. The highest values of potential fertility for family lines were: 8,0 – for T-Żyrka line and 7,45 – for S-Srocza line. The lowest index was calculated for the mares of J-Góralka Nowosądecka line – on average 6 foals per mare.

3. Actual fecundity

Determination of actual fecundity, i.e. the number of foals delivered by a mare, entailed the mares – mothers born no later than 1996, that is, their first foals were born in 1999 at the latest. A total of 824 foals were born throughout the study period when 136 mares were active reproductively, that gives 6 foals per mare on average.

The largest number of foals (11) were delivered by mare Smereka from the line S - Srocza then Norma and Wysoczanka from the line W-Wydra, Płonka from the line P-Polanka (10 foals each). 13 mares from other lines delivered 9 foals each. The high-

est average number of born foals was recorded for the mares from the S-Sroczka and Z-Reda lines – 7 foals per mare, while the lowest number for the mares from B-Bajkałka line – 4,20.

4. Reproductive utilization index

For all 136 mares under investigation, average reproductive utilization index expressed as the ratio between the number of foals born, actual fecundity, and theoretical fecundity reached 68,1%. The mares under study could be utilized in 1205 breeding seasons, but they gave birth to 820 foals. There were great differences in this index between the dam lines.

The highest reproductive utilization index was achieved by the mares of the Z-Reda line – 90,3% followed by the lines S-Sroczka – 80,2% and W-Wydra – 73,8%. The mares from the B-Bajkałka line had the lowest value of this index – 51,2%.

5. Fertility percentage

Average fertility percentage for all mares used for reproduction reached 88,5%. Fertility index of 100% was achieved by 68 mares, that is a half of the examined mares. It means that throughout the period of their reproduction activity, they foaled every breeding season. The highest fertility 96,6% was established for the mares of line Z-Reda, followed by those of line S-Sroczka – 92,9%, and the mares from lines N-Nakoneczna, F-Wrona, A-Agatka, P-Polanka, G-Gurgul with fertility of 90%. The lowest fertility showed the mares from line J-Góralka Nowosądecka – 76,7%.

The Hucul ponies as primitive horses are noted for their high fertility – the studies on the mares under the Rzeszów Regional Department of Horse Breeding Association (HBA) indicated 80,6% fertility index [Gancarz 2002]. Other breed of primitive horses of equal significance, Koniki Polskie, achieved average fertility index of 81,6%, that is 1% lower [Balińska 2007]. For comparison, this index in purebred Arabian horses was 79,8% [Sobczuk 2005], and for Małopolskie horses 72,7% [Budzyński 1990].

It may be presumed that the fertility of the mares could be even higher and the reason for reduced fertility is barrenness. It occurs as a consequence of man negligence about mating effectiveness or simply inappropriate timing of mating the mare. It is likely to happen in the human-controlled horse breeding. Whereas in a part of the examined Hucul mares managed under the pasture breeding conditions, the breeding attempted at an inappropriate time happens more rarely [Kosiniak-Kamysz 2003].

6. Infertility percentage

In the examined group of 136 mares, barrenness was found to be the most frequent cause of lowered fertility. The mean infertility percentage per mare was 9,6% against the number of seasons. As many as 76 mares did not show barrenness. The lowest infertility percentage was determined for line Z-Reda – 0%, while the highest among the mares from lines J-Góralka Nowosądecka – 23,3%, L-Laliszka – 20,6 %, T-Żyrka – 18,7%. The greatest percentage of seasons barren (50%) was reported for the mare Ikra from line J-Góralka Nowosądecka, namely 3 out of 6 seasons. It is worth mentioning that 12 mares were non-pregnant after the first season of mating, which was 14,6% of all barrens. That may be associated with a young age of the mares, not fully physically developed. Stress may also be a potential reason because the mares could get scared changing the familiar surroundings at mating.

7. Miscarriage percentage

Out of 136 examined mares, loss of pregnancy occurred only in 10 of them. Miscarriage percentage averaged 1,29 in relation to the number of seasons when the mares were reproductively active. Only two mares have aborted twice: Asturia from A-Agatka line and Frezja from W-Wydra line.

The highest miscarriage percentage was noted in A-Agatka line – 3,64, G-Gurgul line and Z-Reda line – 3,45%. In the examined group, 2 mares aborted their first foals: Gejsza from G-Gurgul line and Sękowa from S-Srocзка line, which constitutes 18,31% of all pregnancy loss cases.

No abortions were recorded in 126 mares from 7 lines.

8. Stillbirth percentage

In the study group of 136 mares, stillbirth cases were reported in 7 mares – stillbirth percentage was 0,85% in proportion to the number of seasons of the mare reproductive activity. Abortions occurred in the mares only from lines A-Agatka, W-Wydra, P-Polanka, O-Wołga. As for other lines, that are 130 mares, stillbirths were not noted. Among the mares which delivered stillborn foals, 3 of them were first-time pregnant mares, and the stillbirth percentage constituted 50% of all stillbirths.

9. Number of foals born according to their sex

Throughout the study period, more fillies (433) than colts (387) were born, which accounted for 52,8% of all foals born (Tab. 2). Some mares had only colts or only fillies. Mare Agawa delivered 8 colts, Wenus – 4 colts; mares Rexona and Rysa 5 fillies each, Federa and Karen – 4 fillies.

A higher number of fillies born was reported in Z-Reda line – 67,8% and J-Górkalka Nowosądecka line – 60,9%, while more colts were born to mares from G-Gurgul line – 57,7%, C-Czeremcha line – 56,5% and A-Agatka line – 56, 0%.

10. Foals entered into the Stud Book

Regarding the group of fillies born during the investigated period, 349 animals that is 80,6%, were qualified for breeding and registered in the Stud Book, while from the group of 387 colts born, 65 (16,8%) were approved for breeding and entered into the Stud Book (Tab. 3). It is connected with higher requirements for stallions to be selected as a sire. The stallions have more substantial influence on changes in breeding than the mares, because they can have far more offspring. Notably, the demand for stallions decreases because one stallion can effectively mate several dozen of mares. At present one Hucul stallion covers on average 5 mares during a season.

The highest percentage, that is 92,8% of fillies after the mares from J-Górkalka Nowosądecka line obtained the license. As for the W-Wydra line, it was a percentage of 91,4%, from O-Wołga line – 90%. The lowest number of fillies that were granted the license was in B-Bajkalka line – only 50%. Considering the number of heads per line, most fillies entered into the Stud Book came from the W-Wydra line – 75 heads, then from P-Polanka line – 73 heads. The fewest number was in T-Żyrka line – 4 heads.

A percentage of colts accepted into the Stud Book after the mares representing each female family is as following: the relatively highest percentage of colts born by mares from J-Górkalka Nowosądecka line was entered into the Stud Book – 33,3%, then N-Nakoneczna line – 27,7%, F-Wrona line – 23,1% and G-Gurgul line – 20%. The licensed stallions from the lines represented by 2-4 mares (C-Czeremcha, T-Żyrka, Z-Reda) con-

stituted 7-14% of their male offspring. Proportionally, most stallions were licensed from line P-Polanka - 15 heads and W-Wydra – 9 heads.

Summing up, it should be underlined that the licensed mares and stallions were entered into the Stud Book not only because they were the best, but for the important practical reason to save the rare bloodlines in population of Hucul horses and protect their future.

CONCLUSIONS

1. The Hucul breed is characterized by excellent reproductive indices. Fertility percentage calculated for a group of 136 mares reached 88,4%. Half of the examined mares achieved 100% of fertility (they delivered a foal each season they were mated). The highest value was determined for Z-Reda line – 96,5%.

2. Average theoretical fecundity for the whole examined group was 8,98 heads. Individual theoretical fecundity index varied from 5 to 14, while potential fertility was 6,81 heads.

3. Average actual fertility was 6 foals per mare. On average, the highest number of foals was born by the mares from S-Sroczka and Z-Reda line – 7 foals per mare.

4. The reproductive utilization index established for all the mares was 68%, while other reproductive parameters varied between individual mare lines, 51,2% – 90,3%.

5. Throughout the examined period, slightly more fillies (436 heads, that is 52,9%) than colts (388 heads) were born.

6. Out of the offspring of the studied mares, 65 stallions, i.e. 16,79% of all colts born by the mares, and 352 mares, that is 80,6% of all the fillies born were entered into the Stud Book.

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Streszczenie. Niniejsza praca prezentuje wykorzystanie rozplodowe 136 klaczy huculskich urodzonych w Polsce w latach 1987–1996, które zostały wpisane do tomu VIII Księgi Stadnej Koni Rasy Huculskiej. Parametry i wskaźniki ustalono dla poszczególnych klaczy oraz zbiorczo dla 14 aktywnych rodzin żeńskich. W okresie lat badane klacze urodziły 820 źrebięta, w tym 433 klaczki (52,8%) i 387 ogierków (47,2%). Indywidualnie klacze maksymalnie urodziły: 11 źrebiąt – jedna klacz i po 10 źrebiąt – 3 klacze, średnio na jedną klacz przypadało 6 źrebiąt. Ustalono wskaźniki: płodność – 88,5% (połowa badanych klaczy uzyskała 100% płodności), jałowienia – 9,6%, poronienia – 1,3%, martwe urodzenia – 0,6. Wskaźnik wykorzystania rozplodowego 68% świadczy o tym, że hodowcy koni huculskich dobrze wykorzystują ich wysoki potencjał rozrodczy. Do dalszej hodowli został zakwalifikowany bardzo duży odsetek urodzonych źrebiąt: 80,6% klaczek i 16,8% ogierków (stan na rok 2011). Pomiędzy poszczególnymi liniami klaczy występowały znaczące różnice wynikające ze zmienności o podłożu genetycznym, a także z realizacji programu hodowlanego zakładającego ochronę linii mało licznych lub zanikających.

Słowa kluczowe: konie huculskie, hodowla, wykorzystanie rozplodowe klaczy