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Conference paper

EFFECT OF BODY WEIGHT AT FERTILIZATION OF HEIFERS FROM DIFFERENT GENOTYPES ON THEIR SUBSEQUENT CONFORMATION, FERTILITY AND MILK YIELD

J. Gnyp, Z. Litwinczuk, K. Kamieniecki

Introduction

Good physical body development of heifers at their first fertilization influences their further growht, labour - course and later milk yield and fertility (3, 11). High body weight, quick growth and late maturity is characteristic of the Holstein - Frisian breed of cattle (2, 7). Assuming the same weight standards at heifers fertilization for purebreds (BW) and crossbreds after HF bulls can be incorrect.

The aim of this study was to estimate the influence of differentiated body weight at fertilization of F_1 (HF x BW) crossbred heifers and BW heifers on their later performance in herds with differentiated production levels.

Material and methods

The study material consisted of 312 heifers (156 crossbred and 156 purebred heads) kept in herd with low and high production level (criterion of division - mean primiparas yield amounting 3300 and 4100 kg milk, respectively).

In both herds, crossbred and BW heifers were fertilized at differentiated body weight levels. One group was fertilized at 360 kg body weight and the other at the weight of more than 360 kg. Two months before calving BW and crossbred heifers fertilized at different body weight levels were introduced into herds one by one using the method of analogues. During rearing and milk utilizatin period animals from both geotypes were kept and fed in the same way accroding to the rules used in the respective herds into which they had been introduced.

The following data was collected: body mass (evaluted by weighing) and cow body measurements taken 10 days after the 1st, 2nd and 3rd calving; milk, fat, protein and FCM yield during the 1st, 2nd and 3rd 305 - day lactation periods; number of milking days and milk performance till the age of 5 years

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Jarzy Gnyp, Zygmunt Litwinczuk, Kazimierz Kamieniecki
Agricultural University, ul. Akadeicka 12, 20950 Lublin, Poland

and for 4 years of utilization (calculated by summing up the amounts of milk, fat, protein during full lactation and when corrected for the calving season (10); type of labour course, appearance of around - birth complications; sex and body weight of the calves born; as well as the fertility of heifers and cows after the 1st and 2nd calving. Type of labour - course was described as easy - without help or with 1 person helping (without the use of tools - rope, pliers, etc.); difficult - when a lot of strength and tolls were required; heavy - when the help of a veterinary doctor was necessary (cesarean cut, etc.).

Table 1. - BODY WEIGHT (KG) AND BODY MEASUREMENTS (CM) OF COWS AFTER THE 1ST CALVING

Specification		Low herd dairy performance				High herd dairy performance			
		BW		HF x BW		BW		HF x BW	
		body weight at first fertilization in kg				body weight at first fertilization in kg			
		< 360	> 360	< 360	> 360	< 360	> 360	< 360	> 360
Number of cows		39	40	39	38	37	37	37	38
Body weight	$\bar{x}$	439.4^{A}	462.9^{aBC}	445.1^{bAC}	480.0^{B}	463.4^{A}	496.6^{B}	463.8^{A}	505.4^{B}
	s	20.6	16.4	24.6	27.0	26.2	26.8	22.0	30.8
Height at withers	$\bar{x}$	121.5^{A}	123.3^{AC}	124.9^{aBC}	127.5^{bB}	122.4^{A}	125.8^{B}	126.3^{B}	128.5^{B}
	s	3.0	2.3	3.4	2.7	3.9	3.3	3.1	4.0
Oblique lenght of trunk	$\bar{x}$	144.5^{aA}	148.3^{c}	148.2^{cA}	152.3^{bB}	150.1^{A}	152.8	151.5^{a}	156.2^{bB}
	s	4.7	5.1	4.5	4.9	4.8	4.5	4.8	3.9
Width of forechest	$\bar{x}$	37.6	38.9	38.2	38.8	44.0	45.7	44.1	45.9
	s	2.2	3.3	3.1	4.1	4.1	3.6	5.4	4.6
Depth of forechest	$\bar{x}$	62.5^{A}	64.6	64.4	66.3^{B}	64.8^{a}	67.0	67.6^{b}	68.7^{b}
	s	3.2	2.1	2.9	2.1	4.6	4.0	3.5	3.1
Lenght of rump	$\bar{x}$	45.1^{a}	46.9^{b}	46.0	47.7^{b}	49.6^{a}	51.9^{b}	49.4^{a}	51.2
	s	2.4	2.1	1.9	1.7	3.5	2.9	3.2	2.3
Width of hips	$\bar{x}$	46.7^{a}	49.0^{aBC}	46.6^{bAC}	49.6^{B}	49.8^{a}	52.1^{b}	49.5^{a}	52.0^{b}
	s	2.6	2.2	2.5	2.7	3.5	3.6	3.4	3.7
Width of thurls	$\bar{x}$	44.6	45.0	44.5	45.8	45.7	45.7	45.5	46.4
	s	1.4	1.6	1.9	1.6	3.1	2.6	3.0	2.3
Width of pins	$\bar{x}$	29.3^{aA}	31.0^{bc}	30.3^{ac}	31.9^{bB}	30.0^{aA}	31.8^{b}	30.9	32.4^{B}
	s	1.7	2.1	1.8	2.2	1.9	2.0	2.7	2.3
Forechest girth	$\bar{x}$	175.6^{A}	182.9^{B}	177.5^{A}	184.5^{B}	185.3^{aA}	189.6^{b}	186.3	190.7^{B}
	s	3.9	4.4	5.6	5.1	5.0	6.6	5.4	6.1
Cannon circumference	$\bar{x}$	17.6	17.9	17.3	17.9	18.2^{a}	18.7	18.5	18.7^{b}
	s	0.5	0.5	0.5	0.7	0.6	0.7	0.8	0.7

^{a,b} Means denoted with different letters are significantly different at $P \leq 0.05$ within each herd.
^{A,B} Means denoted with different letters are significantly different at $P \leq 0.01$ within each herd.
The same symbols are used in tables from 1 to 4.

Table 2. - COW MILK PERFORMANCE IN BW AND CROSSBREEDS F_1 (HF X BW) IN THE 1ST AND 2ND 305 - DAY LACTATION

Lac-tation	Specification		Low herd dairy performance				High herd dairy performance			
			BW		HF x BW		BW		HF x BW	
			body weight at first fertilization in kg				body weight at first fertilization in kg			
			< 360	> 360	< 360	> 360	< 360	> 360	< 360	> 360
	Number of cows		40	40	39	40	37	37	37	38
	Milking days	LSM	299	299	304	299	280^{A}	290	291^{B}	299^{b}
		SE	2.3	2.1	2.2	2.2	3.6	3.6	3.6	3.4
	Milk (kg)	LSM	2983^{A}	3180^{AC}	3386^{aBC}	3738^{bB}	3694^{A}	3940^{AD}	4092^{CD}	4711^{B}
		SE	108	101	106	106	158	160	158	152
I	Fat (kg)	LSM	114.5^{A}	121.4^{AC}	128.0^{BC}	136.6^{B}	150.9^{A}	161.0^{AD}	166.9^{CD}	195.1^{B}
		SE	4.0	3.7	3.9	3.9	6.7	6.8	6.7	6.5
	Fat (%)	LSM	3.84^{a}	3.82^{A}	3.78	3.65^{bB}	4.09	4.07	4.08	4.14
		SE	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.05
	Protein (kg)	LSM	95.5^{A}	103.3^{AC}	108.3^{BC}	116.0^{B}	114.8^{A}	124.0^{AD}	124.0^{CD}	145.4^{B}
		SE	3.4	3.2	3.3	3.3	4.8	4.9	4.8	4.6
	Protein (%)	LSM	3.20^{a}	3.25^{A}	3.20^{a}	3.10^{bB}	3.11	3.15^{A}	3.03^{B}	3.09
		SE	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	FCM (kg)	LSM	2911^{A}	3093^{A}	3284^{B}	3545^{B}	3742^{A}	3991^{A}	4140^{A}	4811^{B}
		SE	100	94	98	98	161	163	161	155
	Number of cows		30	32	31	33	30	32	30	32
	Milking days	LSM	297	298	301	299	289	291	292	296
		SE	2.6	2.5	2.6	2.5	3.6	3.2	3.4	3.3
	Milk (kg)	LSM	3543^{A}	3833^{A}	3794^{A}	4341^{B}	4414^{A}	4776^{AC}	5229^{aBC}	5799^{bB}
		SE	124	120	124	118	217	197	205	201
	Fat (kg)	LSM	134.4^{A}	152.4^{BC}	142.2^{AC}	160.2^{B}	174.8^{A}	190.8^{AD}	202.3^{CD}	234.9^{B}
		SE	4.8	4.7	4.8	4.6	8.9	8.0	8.4	8.2
II	Fat (%)	LSM	3.79^{a}	3.98^{bA}	3.75^{a}	3.69	3.96	4.00	3.87	4.05^{b}
		SE	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05
	Protein (kg)	LSM	112.7^{aA}	123.8^{b}	119.4^{A}	133.6^{B}	137.5^{A}	151.9^{AC}	162.5^{aBC}	182.1^{bB}
		SE	3.8	3.7	3.8	3.6	6.8	6.1	6.4	6.3
	Protein (%)	LSM	3.18^{a}	3.23^{A}	3.15	3.08^{bB}	3.12	3.18^{bB}	3.11^{b}	3.14
		SE	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	FCM (kg)	LSM	3433^{aA}	3819^{b}	3651^{A}	4140^{aB}	4387^{aA}	4773^{A}	5126^{b}	5843^{aB}
		SE	119	115	119	113	217	197	205	201

LSM - Least Squaers Mean, Se - Standard Error of LSM

All the data was statistically worked out (9); and while analizing productivity of cows during 305 - day lactation periods the influence of factors such as: genotype, body weight at fertiizatin, year and calving season as well as regression for age at the first calving were taken into account (5).

Results and Discussion

BW and crossbred heifers fertilized at low body weight (up t 360 kg), were in both herds significantly lighter and smaller in size after the first calving than the animals fertilized at high body weight (tab. 1). After the 1st and 2nd calving no significant differences in body weight and body measurements of BW and crossbred animals between fertilized at high and low body weight were observed. The above observation shows high growth compensation that takes place between the 1st and 3rd calving in animals fertilized at low body weight. Other authors found a similar phenomenon in cows fertilized earlier (4).

In both herds BW and F1 heifers fertilized at low body weight (up to 360 kg) had lower yield of milk, fat, protein and FCM during the 1st and 2nd lactations than the animals fertilized at the body mass of more than 360 kg (tab. 2). Differences in most of the milk properties in BW cows were not significant. Far bigger and more significant differences in milk performance during the 1st and 2nd lactations were found in crossbreds (HF x BW) fertilized at high body weight (except the yield of fat, protein and FCM during the 1st lactacion in cows kept in the herd with low production level). The above observation pointed to the unfavourable influence of low body weight of crossbred heifers at fertilization on their subsequent milk performance during the 1st and 2nd lactacion periods in both herds. Crossbred animals when compared to BW heifers showed higher (by 14 g in the herd with low production level; and by 22 g in the herd with high production) daily gain during the period of rearing and reached the low fertilization body weight assumed for the present study earlier (tab.4). Probably, however, they were not prepared for pregnancy, and even less so for the future, exhausting for the young organism, lactacion period. It confirms the opinion expressed by many authors (1, 2, 7) that crossbreds after HF bulls have higher growth rate than BW cattle, but reach breeding maturity later.

During the 3rd 305 - day lactations BW and crossbred animals fertilized for the first time at low body weight (up to 360 kg) showed lower milk performance than the cows fertilized at high body weight (above 360 kg), but the slight differences found in both herds were not statistically significant.

Data shown in table 3 prove that in both herds BW and F_1 animals fertilized at low body weight (up to 360 kg) when compared to fertilized at high body weight (above 360 kg) showed lowe milk, fat, protein and FCM

yield during 5 life-years, as well as lower FCM per one life-year. However, these differences were only slight and not statistically significant. Analyzing milk performance of cows during 4 years of utilization (tab. 3) it was found that i both herds BW and F_1 animals fertilized at body weight less than 360 kg reached markedly lower (from 10 to 21%) milk and its constituents efficiency, as well as lower FCM and the amount of FCM per one year of utilization than the cows fertilized for the 1st time at high body weight (above 360 kg). Even though the differences were quite big, they were not statistically significant.

Table 3. - COW MILK PERFORMANCE IN BW AND CROSSBREDS F_1 (HF X BW) DURING 5 YRS OF LIFE AND 4 YRS OF UTILIZATION

Specification		Low herd dairy performance				High herd dairy performance			
		BW		HF x BW		BW		HF x BW	
		body weight at first fertilization in kg				body weight at first fertilization in kg			
		< 360	> 360	< 360	> 360	< 360	> 360	< 360	> 360
Number of cows		40	40	39	40	37	37	38	38
During 5 life years:									
milking days	LSM	745	719	786^{a}	698^{b}	729	716	765	749
	SE	27	27	27	27	31	31	31	31
milk (kg)	LSM	7794^{a}	7867^{a}	8598	9080^{b}	11158^{a}	11442	12733	13142^{b}
	SE	406	406	411	411	651	660	651	642
fat (kg)	LSM	299	314	328	340	443^{A}	464^{a}	510	541^{bB}
	SE	16	16	16	16	26	26	26	25
protein (kg)	LSM	251	259	277	286	355^{a}	365	401	418^{b}
	SE	13	13	13	13	21	21	21	20
FCM (kg)	LSM	7597^{a}	7859	8360	8725^{b}	11132^{a}	11539^{a}	12737	13355^{b}
	SE	394	394	399	399	642	650	642	633
FCM per	LSM	1519^{a}	1572	1672	1745^{b}	2226^{a}	2308^{a}	2547	2673^{b}
1 life year (kg)	SE	79	79	80	80	128	130	128	127
During 4 years of utilization:									
miliking days	LSM	916	983	1001	984	870	915	948	1010
	SE	51	51	51	51	51	52	51	50
milk (kg)	LSM	9782^{A}	11441	11372	13060^{B}	13757^{A}	15111^{a}	16333	18238^{bB}
	SE	753	753	763	763	1057	1071	1057	1043
fat (kg)	LSM	375^{A}	454	433	487^{B}	551^{A}	614^{a}	658	749^{bB}
	SE	29	29	29	29	42	43	42	42
protein (kg)	LSM	315^{A}	375	365	410^{B}	440^{A}	484^{a}	516	581^{bB}
	SE	24	24	24	24	34	34	34	33
FCM (kg)	LSM	9537^{A}	11387	11051	12533^{B}	13774^{A}	15260^{a}	16420	18569^{bB}
	SE	730	730	739	739	1053	1068	1053	1039
FCM per 1 year	LSM	2384^{A}	2847	2763	3133^{B}	3444^{A}	3815^{a}	4105	4642^{bB}
of utilization (kg)	SE	182	182	185	185	263	267	263	260

It has been found that BW and crossbred heifers fertilized at body weight less than 360 kg were characterized by highly and significantly lower (by 3.9 and 4.2 months in the herd with low production level and 3.8 and 4.2 in the herd with high production level, respectivel) age at first fertilization and insemination index than the animals fertilized at the body weight higher than 360 kg (tab. 4). Earlier start of milk utilization in cow fertilized at low body weight results in the decrease of their rearing costs and increase in the profitability of milk production (8).

Table 4. - FERTILITY INDICES OF HEIFERS AND TYPE OF BIRTH AND AROUND - BIRTH COMPLICATIONS IN COWS AT THE 1ST CALVING

Specification		Low herd dairy performance				High herd dairy performance			
		BW		HF x BW		BW		HF x BW	
		body weight at first fertilization in kg				body weight at first fertilization in kg			
		< 360	> 360	< 360	> 360	< 360	> 360	< 360	> 360
Age at first	$\bar{x}$	17.5^{A}	21.4^{B}	17.6^{A}	21.8^{B}	16.0^{A}	19.8^{B}	15.8^{A}	19.2^{B}
fertilization (months)	s	2.6	2.8	1.7	1.9	1.9	2.5	1.3	2.6
Body weight at	$\bar{x}$	340.9^{aA}	400.0^{B}	352.7^{bA}	411.2^{B}	347.7^{A}	416.2^{B}	352.5^{A}	419.1^{B}
first fertilization (kg)	s	13.2	27.0	6.3	19.8	15.5	23.9	7.3	11.1
First inemination index	$\bar{x}$	1.53^{A}	2.63^{B}	1.53^{A}	2.55^{B}	1.42^{A}	2.55^{B}	1.47^{A}	2.50^{B}
	s	0.74	1.16	0.55	0.84	0.63	1.41	0.82	1.25
Type of birth (%):									
easy		47.5	57.5	46.1	51.3	44.7	54.1	42.1	50.0
difficult		42.5	37.5	46.2	43.6	47.4	40.5	52.6	47.4
heavy		10.0	5.0	7.7	5.1	7.9	5.4	5.3	2.6
Type of complications (%):									
abortion		-	-	2.5	2.5	-	2.6	-	-
still-born		7.5	5.0	5.0	5.0	10.5^{a}	2.6^{b}	5.3	2.6
lying after labour		2.5	2.5	2.5	2.5	2.6	2.6	2.6	-
ruptures of prolapse		7.5	-	5.0	-	5.3	-	7.9	-
vagina prolapse		2.5	-	-	-	-	-	-	2.6
retention of placenta:									
- partial		5.0	2.5	-	5.0	5.3	5.3	2.6	2.6
- total		2.5	5.0	10.0^{a}	2.5^{b}	-	-	2.6	2.6
Total (%):									
births with cimplications		27.5	15.0	25.0	17.5	23.7	13.1	21.0	10.4
births without complications		72.5	85.0	75.0	82.5	76.3	86.9	79.0	89.6

In the analyzed herds cows of both genotypes fertilized for the first time at lower body weight exhibited better fertility after the first calving (lower insemination index shorter interpregnancy period) than the animals fertilized at

the body weight higher than 360 kg but the differences were not significant. On the other hand, considering fertility indices in cows after the 2nd calving, it was found that in both herds crossbred animals fertilized at low body weight showed insignificantly worse fertility (higher insemination index, longer inter - pregnancy period) than the cows fertilized for the first time at higher body weight. Fertility indices of purebred BW cows fertilized at different body weight after the 2nd calving in the herd with low production level were similar; whereas in the herd with high production level animals fertilized at body weight less than 360 kg continued to have better fertility characteristics.

No significant influence of differentiated body weight of heifers at their fertilization on sex and body weight of their progeny was found after three consecutive calvings. However, it was observed that in both herds body mass of heifer calves and bull calves born by BW and F1 (HF x BW) cows that were fertilized for the first time at body weight above 360 kg was slightly higher than the body weight of calves from the mothers fertilized for the first time at body weight less than 360 kg. BW and crossbred heifers fertilized at body weight up to 360 kg had more difficult and heavy births after first calving, by respectively 10.0 and 5.2% in the herd with low production level and respectively, by 9.4 and 7.9% in the herd with high production level than the animals fertilized at the body weight higher than 360 kg (tab. 4). It seems to confirm the statement that both body weight at calving (12) and the age of cows (4, 6) influence the frequency rate of difficult labour - courses. Data in table 4 show, moreover, that BW and crossbred heifers fertilized at low body weight (up to 360 kg) in these herds had from 1.5 to 2 times more around - birth complications after first calving than the animals fertilized at the body weight higher than 360 kg. In the group of heifers fertilized at the low body weight there were from 1.5 to 4 times more still - born calves and higher rate of placenta retention (expecially in the herd with low production level), together with the appearance of inner reproductive organs damage (from 5.0 to 7.9 %). After the 2nd calving no significant differences in labour - courses and the number of around - birth complications were found in the animals from both genotypes fertilized for the first time at the body weight up to and above 360 kg in both herds.

Conclusions

Fertilization of crossbred F_1 (HF x BW) and BW heifers with low body mass (less than 360 kg) enables significant decrease in the number of services per one fertilization and shortening of the period of rearing. However, it causes decrease of the milk performance of cows being in the 1st and 2nd lactation (significantly in crossbreds), increase in the number of difficult and heavy labour-courses and around-birth complications in cows at first calving.

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UTJECAJ TJELESNE TEŽINE PRI OPLODNJI JUNICA RAZLIČITIH GENOTIPOVA NA NJIHOVU KASNIJU GRAĐU, PLODNOST I MLIJEČNOST

Sažetak

Cilj ovog istraživanja bio je procijeniti utjecaj različite tjelesne težine pri oplodnji križanaca junica F_1 (HF x BW) i BW na njihogu kasniju performancu u stadima različite proizvodne razine.

Oplodnja junica križanaca F_1 (HF x BW) i junica BW niske tjelesne mase (manje od 360 kg) omogućuje znatno smanjenje broja servisa po jednoj oplodnji i skraćenje razdoblja uzgoja. To, međutim, prouzrokuje smanjenje performance mlijeka krava u prvoj i drugoj laktaciji (značajno kod križanaca), porast broja teških i mučnih trudova te komplikacije oko porođaja u krava pri prvom telenju.

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