

BISONIANA XLII

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Postnatal Development of B_1 Hybrids of European Bison and Domestic Cattle

[With 5 Tables & 6 Figs.]

A description is given of the development of 24 hybrids of generation B_1 ($3/4$ domestic cattle) from birth to 24 months, based on 15 measurements and 8 indices. The data obtained were compared with data on the development of the parent forms (F_1 and black and white breed of cattle). B_1 hybrids were characterized by lower body weight at birth than the initial forms. Males were 84.6% lighter than F_1 and 38% than *bw*, females lighter by respectively 20 and 22%. During the whole development period B_1 hybrids weighed less than the parent forms. The influence of the F_1 hybrid mother was observed on the size and body weight of her calves at birth — *i.e.* B_1 hybrids. F_1 cows, similar in many characters of build and reproduction to female European bison produced, like the latter, small calves. The phenomenon of heterosis occurred sporadically in generation B_1 (3 cases out of 24 animals). B_1 hybrids throughout the whole development exhibit far smaller body measurements than first generation hybrids, and approach the dimensions typical of cattle. B_1 hybrids have a longer body in relation to height than F_1 , are smaller-boned, have small heads and their horns are similar in size and shape to those in cattle. The only character in which the European bison strain dominates is the slightly more powerfully built fore part of the body in relation to hind part, but this disproportion is not as marked as in the first generation of hybrids. The increased percentage of cattle blood in subsequent generations of hybrids results in the predominance of cattle characters in them.

I. INTRODUCTION

Hybrids of European bison and domestic cattle were known as early as the end of the 19th century (Müller, 1852; Ackerman, 1898; Karcov, 1903), but only a small number of researchers continued the experiment in subsequent generations. The chief obstacle consisted in the sterility of males of the first generation (Iwanow & Philiptschenko, 1916; Ivanov, 1950; Zablockij, 1939). Walicki, who

mated the only fertile male in the history of cross-breeding European bison with cattle, obtained eleven hybrids of generation F_2 from 1847—1857 (cf. Karcov, 1903). In the Askania Nova reserve during the period from 1908—1928 F_1 cows were mated with shorthorn bulls and 7 hybrids obtained, and with a bull European bison — 11 hybrids (Zablockij, 1956). During the postwar period between 1961—63 two $3/4$ European bison hybrids were obtained in the Zoo at Płock (Taworski & Woliński, 1960). More extensive studies on hybrids of European bison and cattle have been carried out in the Mammals Research Institute of the Polish Academy of Sciences at Białowieża since 1958. During the first phase (1958—1961) European bison were mated with cattle of the red Polish breed, then from 1961—1965 with black and white lowland cattle. As F_1 bulls were sterile (Krasieńska, 1967a), from 1962 onwards F_1 females were mated with a black and white lowland bull. Up to the end of 1970 a total of 25 hybrids of the $3/4$ cattle generation have been obtained (B_1).

The purpose of the present study was to trace the postnatal development of B_1 generation of hybrids of European bison and domestic cattle during the period from birth to the 24th month of life and to compare it with the development of the parent forms (F_1 and *bw* breed of domestic cattle).

II. MATERIAL AND METHODS

1. Amount of Material and Rearing Conditions of the Hybrids

The object of the observations was formed by 24 B_1 hybrids (Table 1) obtained from mating F_1 females with a bull of the white and black lowland breed (*bw*) during the period 1963—69. B_1 hybrids, like F_1 , were kept in semi-captivity in 10 ha enclosures covered by an old tree stand of the *Quercus-Carpinetum medioeuropaeum* Tx., 1956, type (Krasieńska, 1969). The calves remained with their mothers up to the age of 4 months, and from the end of the first month of life were fed hay, ground oats and fodder beet. Mixture B¹⁾ was fed during the second year of life. During the summer they were put out to grass, their diet being supplemented by natural food — young shoots, leaves and bark of trees and bushes, although they ate less of this food than F_1 hybrids.

Data on the development of F_1 hybrids (Krasieńska, 1969) and lowland black and white cattle reared by the outdoors breeding method (Skolasiński, 1964; Skolasiński *et al.*, 1966), were used for comparison.

2. Body Measurements and Indices

The body weight and linear measurements of the body were taken as measurements of the hybrids' development. Basic indices of build were calculated for more

¹⁾ Mixture B: bran, ground corn, post-extract meal, fodder urea and the addition of Ca, P, Na, Si, Mn, Fe, Cu, Mg, Co.

accurate definition of proportions. The calves were weighed and measured at birth, and then at one- and 3-month intervals, always at the same time of day, before the animals were fed. Measurements were made by means of Lidtin's stick, compasses and tape measure. From 1965 onwards the hybrids were weighed and measured in a metal cage (K r a s i ń s k a, 1967b).

Table 1

List of hybrids F₁ and B₁ of European bison and domestic cattle studied.

No.	Name, sex	Birth day	Father	Mother
F ₁				
1	Filon	M 6 VIII 1960	<i>pr</i>	Ponętna <i>w</i>
2	Filip	M 25 VIII 1960	<i>pr</i>	Podkomorzanka <i>w</i>
3	Fama	F 14 X 1960	Pokorny <i>w</i>	<i>pr</i>
4	Filutka	F 7 IX 1961	<i>pr</i>	Podkomorzanka <i>w</i>
5	Famela	F 30 II 1962	Puk <i>w</i>	<i>pr</i>
6	Facet	M 28 IV 1962	Pokorny <i>w</i>	<i>bw</i>
7	Farad	M 29 IV 1962	Pokorny <i>w</i>	<i>bw</i>
8	Fanny	F 30 IX 1962	Pokorny <i>w</i>	<i>bw</i>
9	Fakir	M 12 VIII 1963	Pokorny <i>w</i>	<i>bw</i>
10	Figa	F 23 VIII 1963	<i>bw</i>	Ponętna <i>w</i>
11	Fatima	F 29 VIII 1964	Pokorny <i>w</i>	<i>bw</i>
B ₁				
1	Fenix	M 4 V 1963	<i>bw</i>	Fama F ₁
2	Feta	F 9 V 1963	<i>bw</i>	Filutka F ₁
3	Fez	M 18 V 1964	<i>bw</i>	Filutka F ₁
4	Fetysz	M 28 V 1964	<i>bw</i>	Fama F ₁
5	Fen	M 14 IV 1965	<i>bw</i>	Fama F ₁
6	Feb	M 26 IV 1965	<i>bw</i>	Filutka F ₁
7	Femina	F 2 V 1965	<i>bw</i>	Fanny F ₁
8	Fey	M 16 IX 1965	jersey	Famela F ₁
9	Fera	F 14 IX 1966	<i>bw</i>	Figa F ₁
10	Feg	M 27 IX 1966	<i>bw</i>	Filutka F ₁
11	Fema	F 17 V 1966	<i>bw</i>	Fama F ₁
12	Feld	M 7 IV 1967	<i>bw</i>	Fama F ₁
13	Festyn	M 25 IV 1967	<i>bw</i>	Figa F ₁
14	Fewa	F 11 V 1967	<i>bw</i>	Filutka F ₁
15	Fern	M 2 VIII 1967	<i>bw</i>	Fatima F ₁
16	Fenny	F 29 VIII 1967	<i>bw</i>	Fanny F ₁
17	Fellach	M 12 IX 1967	<i>bw</i>	Famela F ₁
18	Ferma	F 16 IV 1968	<i>bw</i>	Fama F ₁
19	Feska	F 2 V 1968	<i>bw</i>	Figa F ₁
20	Felpa	F 1 VI 1968	<i>bw</i>	Fatima F ₁
21	Fell	M 28 VI 1968	<i>bw</i>	Fanny F ₁
22	Felly	F 21 VII 1968	<i>bw</i>	Famela F ₁
23	Fest	M 11 IV 1969	<i>bw</i>	Figa F ₁
24	Felon	M 22 IV 1969	<i>bw</i>	Fama F ₁

Abbreviations: *bw* — black white lowland cattle; *pr* — Polish red cattle; *w* — wisent.

A total of 15 basic measurements were made and 8 indices calculated. The principles of the measurements and their definitions are to be found in an earlier study (K r a s i ń s k a, 1969). The way in which the indices were calculated is obvious from Table 5.

III. COMPARISON OF DEVELOPMENT AND EXTERIOR OF B₁ HYBRIDS WITH DEVELOPMENT OF PARENT FORMS

1. Body Weight at Birth

In the B₁ generation sex differences in body weight at birth are not significant. B₁ hybrids of both sexes have a lower weight at birth than their parent forms, males being 84.6% lighter than F₁, and 38% than *bw*, while females are respectively 20% and 22% lighter (Fig. 1, Table 2). Hybrids in generation B₁ thus exhibit lack of vigour. The intensive prenatal development of F₁ hybrids in the combination of *bw* cow × European bison, which is the expression of heterosis (Krasińska, 1969), is not repeated in the backcross hybrids. Out of 24 B₁ hybrids higher body weight at birth was observed in 3 only (»Festyn« — 45 kg, »Fest« —

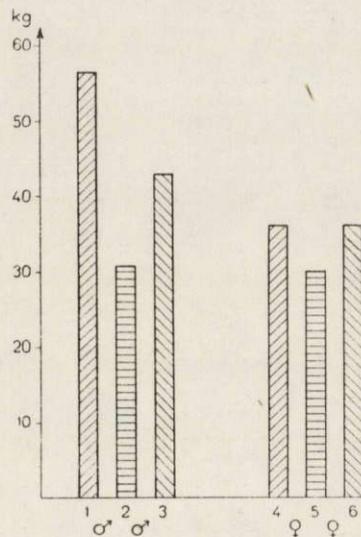


Fig. 1. Comparison of body weights at birth of hybrids F₁ (♂ European bison × ♀ cattle), B₁ and domestic cattle.

1, 4—F₁; 2, 5—B₁; 3—*bw*, after Skolasiński, 1964; 6—*bw*, after Skolasiński et al., 1966.

39 kg and »Fenny« — 39 kg), while the remainder came within the range of variations from 20–35 kg. It is significant that despite the increased percentage of cattle blood in ³/₄ hybrids body weights of B₁ hybrids at birth are lower than those of *bw* calves. The reason for this must be looked for in the strong domination of the European bison strain.

2. Body Weight in Postnatal Development

Analysis of the absolute body measurements of B₁ hybrids shows (Table 2) that in the case of females body weight at the age of 12 months is 8 times, and in young bulls 9.5 times, greater than at birth. During

Table 2
 Comparison of body weights of hybrids F₁, B₁ and domestic cattle.
 Numbers in the head of the table means: 1— F₁ males, 2 — B₁ males, 3 — bw males (after Skolasiński, 1964),
 4 — F₁ females, 5 — B₁ females, 6 — bw females (after Skolasiński et al., 1966)

Age, months	Body weights in kg						Percentage increase of body weight						Age, months	Average daily gains					
	1	2	3	4	5	6	1	2	3	4	5	6		1	2	3	4	5	6
0	56.3	30.5	42.1	35.8	29.6	36.1	100	100	100	100	100	100	0						
3	170.7	125.7	113.5	123.2	100.2	102.1	303.6	410.4	269.7	344.7	333.2	282.8	3	1.27	1.02	0.79	0.53	0.76	0.74
6	283.3	209.0	194.1	207.0	168.9	179.6	502.5	650.4	461.2	579.2	513.1	497.5	6	1.20	0.81	0.89	0.92	0.61	0.86
9	350.0	250.7	276.0	249.7	216.7	240.1	620.1	837.8	656.0	699.3	727.4	665.1	9	0.70	0.61	0.91	0.47	0.52	0.68
12	405.3	289.2	356.1	289.7	256.1	304.2	718.2	855.1	846.3	819.8	825.1	842.7	12	0.62	0.41	0.89	0.45	0.49	0.71
15	478.3	320.5	417.5	374.0	297.1	365.6	846.7	1067.9	992.1	943.8	918.8	1012.7	15	0.79	0.52	0.68	0.59	0.47	0.68
18	535.0	342.7	493.0	386.7	305.1	418.0	947.2	1149.5	1171.6	1089.1	992.6	1157.9	18	0.63	0.32	0.84	0.58	0.27	0.58
21	597.3	389.3	-	350.0	318.6	-	1055.0	1286.8	-	1120.0	1036.5	-	21	0.82	0.37	-	0.19	0.23	-
24	683.3	429.0	-	421.7	360.1	-	1228.0	1425.6	-	1143.2	1153.8	-	24	0.82	0.38	-	0.19	0.35	-

development sex differences in body weight become evident. Males, which differed very little from females at birth, at the age of one year exceed heifers by 11.3% and at the age of 24 months by 11.9% in weight (Fig. 2).

Slowing down of the rate of increase in body weight of B_1 hybrids of both sexes occurs at the age of 9–12 months and is more strongly marked in males (Fig. 3), and may be connected with the start during this period of sexual maturation of the hybrids (Krasińska, 1971). A second slowing down in rate of increase in body weight occurs in females during the period from the 18th to the 24th month of life.

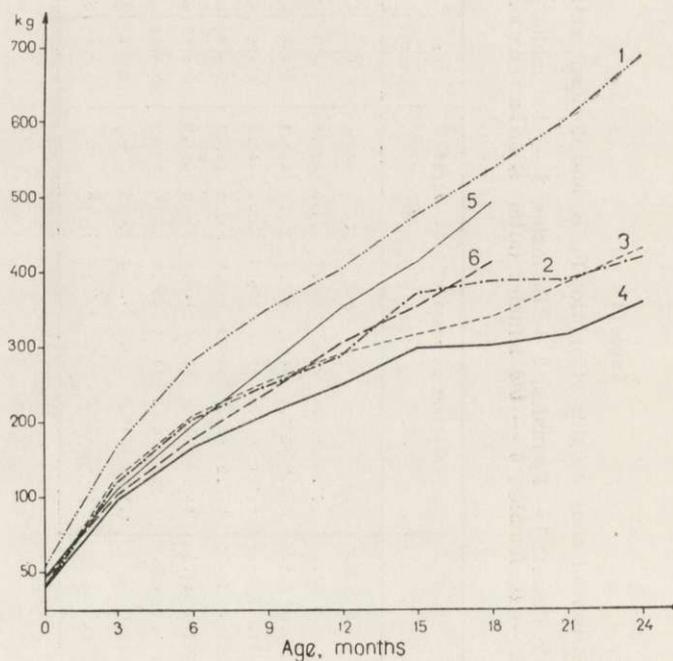


Fig. 2. Age variability of the body weights of hybrids F_1 , B_1 and domestic cattle. 1 — males F_1 ; 2 — females F_1 ; 3 — males B_1 ; 4 — females B_1 ; 5 — males bw , after Skolasiński, 1964; 6 — females bw , after Skolasiński *et al.*, 1966.

Average daily increases during development are greater in males than in females of generation B_1 , the greatest differences being observed during the first six months of life (Table 2, Fig. 4).

Throughout the whole period of development the absolute body weights of B_1 hybrids of both sexes are usually lower than the body weight of F_1 hybrids and bw cattle. It is only during the first six months of life that B_1 males exceed bw (Fig. 2). For example, at the age of 6 months B_1 males are 35.5% lighter than F_1 , and 7.7% heavier than bw . At the age

of 12 months they are 40% lighter than F₁, and 23% lighter than *bw*. B₁ females at the age of 6 months are 12.3% lighter than F₁, and 6.3% lighter than *bw*, whereas at the age of 12 months their weights are respectively 11.3 and 11.9% lighter.

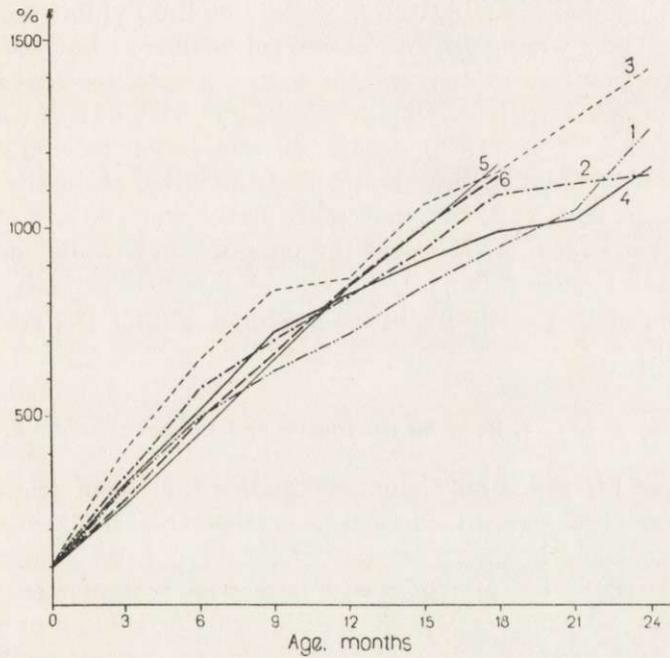


Fig. 3. Increase of the body weights of hybrids F₁, B₁ and domestic cattle. For explanations see Fig. 2.

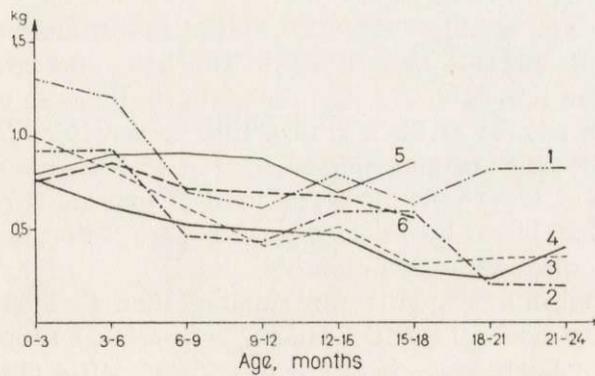


Fig. 4. Age variability of average daily gains of hybrids F₁. For explanations see Fig. 2.

Average daily increases are analogically lower in B_1 than in the initial forms, only B_1 males exhibiting increases higher than cattle during the first six months of life (Fig. 4).

Rate of increase in the body weight of B_1 males during postnatal development is higher than of the F_1 generation and *bw* cattle only up to 12 months. B_1 females during the first year of life exhibit a similar rate of change in body weight to that of the initial forms, but later on these increases are smaller. In the case of cattle weight increased regularly through the whole period of development (Skolasiński, 1964; Skolasiński *et al.*, 1966). In the B_1 generation rate of increase in body weight decreases at the age of 9—12 months, as in the case of F_1 males, while in female F_1 this took place earlier, at the age of 6 months (Krasieńska, 1969). Whereas throughout the whole development period B_1 males exceed females in rate of increase in body weight, in generation F_1 and in cattle up to the age of 8 months the reverse is the case (Fig. 3).

3. Body Measurements and Indices

B_1 calves at birth are only slightly smaller than domestic calves, but differ in respect of certain characters of their build. They are shorter in relation to their height than domestic calves, have a more strongly developed forepart of the body and narrower hindquarters (Table 3). They are, however, far smaller than F_1 hybrids of similar proportions of body build and head and shallower thorax. In generation B_1 no such strongly marked sex differences were observed at birth as is the case with F_1 (Krasieńska, 1969).

The square shape of the body, characterized by the ratio of body height to body length, is attained by B_1 heifers at the age of 3 months, and slightly later in young bulls (Table 3). At the age of one year the body proportions of B_1 hybrids are reversed. The body increases in length more rapidly than in height with age especially in the case of males. The thorax, which is formed at birth with similar proportions in B_1 hybrids of both sexes, becomes deeper and broader in males with age (particularly at the age of 12—24 months). The head of hybrids is short in relation to breadth at birth, but elongates with age. Horns began to grow in generation B_1 during the first month of life.

Yearling B_1 hybrids are still far smaller than F_1 hybrids and are similar in size to domestic cattle. In respect of body proportions they occupy an intermediate place between F_1 and *bw* cattle (Table 3). They are less strongly built in the sacral region than cattle, with strongly developed fore part of the body. These differences are also maintained

Table 3
Comparison of body measurements of hybrids F₁, B₁ and domestic cattle.
Numbering of columns as in Table 2.

Age, months	Withers height						Sacral region height					
	1	2	3	4	5	6	1	2	3	4	5	6
0	87.3	72.9	72.0	77.7	70.7	71.2	89.3	75.5	75.9	79.6	73.2	76.0
3	109.0	97.4	95.7	102.7	96.0	88.9	110.7	100.4	99.1	104.7	98.5	94.3
6	123.3	112.4	106.2	113.3	106.6	102.0	125.7	114.1	111.2	115.7	108.6	106.4
9	130.0	113.7	113.5	120.7	112.4	108.8	132.0	115.5	117.0	122.3	114.5	113.5
12	136.3	121.5	122.7	125.0	117.0	114.7	139.0	121.3	126.0	127.3	118.8	118.7
15	141.0	124.6	128.0	127.5	121.0	-	144.3	126.1	133.2	132.0	123.2	-
18	146.0	128.6	134.5	131.3	122.7	-	148.7	129.2	137.0	134.3	124.1	-
21	150.3	130.0	-	134.7	123.2	-	151.7	131.1	-	137.0	124.6	-
24	153.7	132.8	-	140.3	130.2	-	154.3	134.0	-	142.0	131.7	-
	Thorax breadth						Thorax depth					
0	22.0	19.3	16.2	18.0	17.9	14.3	36.3	28.3	24.9	30.0	27.7	25.4
3	31.0	28.5	24.2	28.0	26.2	22.7	48.3	42.7	37.4	43.3	38.7	36.7
6	37.0	32.9	31.0	31.0	29.5	28.0	64.3	52.8	48.0	53.7	50.6	45.0
9	38.3	35.1	33.9	34.3	32.8	30.0	71.7	58.1	52.2	58.3	55.9	49.6
12	41.3	37.8	38.0	37.3	34.5	34.0	76.3	63.3	58.2	63.0	59.7	53.1
15	45.3	38.0	43.7	41.0	36.1	-	77.3	64.1	63.6	63.5	62.0	-
18	47.0	40.8	49.7	40.0	37.3	-	78.3	69.6	70.7	66.0	64.3	-
21	47.7	42.8	-	41.3	37.4	-	80.7	71.2	-	68.0	62.8	-
24	48.7	43.7	-	43.3	41.5	-	83.0	72.2	-	73.0	68.1	-
	Fore cannon girth						Pelvis length					
0	11.0	10.6	10.5	10.0	9.5	10.5	26.0	21.9	27.0	23.0	20.2	22.0
3	15.0	13.9	13.4	13.7	11.2	12.9	34.7	33.2	37.0	33.3	29.5	30.8
6	17.5	15.1	15.6	15.3	13.0	14.5	43.0	38.6	42.0	39.0	36.0	36.3
9	19.7	16.2	17.2	16.7	14.2	15.9	47.7	41.3	45.0	42.0	39.1	41.0
12	21.3	17.7	18.2	18.0	17.1	16.5	50.3	44.2	46.0	44.3	42.0	42.7
15	22.3	18.4	19.5	19.0	17.5	-	53.3	45.2	48.0	46.5	43.9	-
18	23.3	19.4	20.4	19.3	18.7	-	54.0	46.9	49.0	48.0	44.5	-
21	24.0	20.3	-	20.0	19.4	-	55.0	48.5	-	49.7	44.6	-
24	24.0	21.2	-	20.3	19.4	-	56.3	50.1	-	51.0	47.9	-
	Pelvis breadth						Body length					
0	22.0	19.0	20.1	18.7	17.2	21.8	79.3	65.4	70.0	67.0	61.2	65.2
3	31.7	29.5	30.4	28.0	26.7	30.3	106.0	96.8	91.7	92.0	96.7	90.4
6	37.3	34.8	37.2	32.0	31.7	34.8	127.3	115.7	109.7	108.0	109.0	106.6
9	39.7	36.6	40.7	36.7	34.5	39.3	138.0	124.0	119.0	117.7	116.8	117.6
12	42.0	37.8	45.4	37.7	37.2	41.1	142.0	130.3	128.7	127.7	124.3	125.0
15	43.3	38.6	49.0	39.5	38.5	-	150.3	136.5	143.0	131.5	132.2	-
18	45.3	39.8	54.0	39.7	38.4	-	156.3	139.7	153.5	138.7	132.4	-
21	46.3	41.6	-	41.7	39.2	-	159.3	143.3	-	143.3	136.8	-
24	47.7	43.2	-	43.3	42.0	-	163.0	148.8	-	147.0	142.6	-
	Hip bone breadth						Heart girth					
0	19.7	16.5	14.9	16.7	15.5	14.7	91.3	78.4	75.0	79.7	73.7	81.2
3	27.7	28.8	23.2	26.0	24.0	23.8	137.0	121.3	105.0	128.3	123.7	108.3
6	34.3	31.6	29.4	30.3	29.2	29.6	161.3	144.2	136.2	145.3	137.9	128.5
9	37.7	34.7	35.5	34.3	33.4	36.0	171.3	155.3	151.2	158.0	149.4	142.0
12	40.3	36.8	38.4	36.3	36.0	37.3	181.7	159.5	164.5	167.3	158.5	152.0
15	43.0	37.4	42.4	38.5	37.9	-	187.3	163.0	179.0	174.5	168.7	-
18	45.3	39.6	46.0	39.7	38.7	-	196.0	166.8	198.2	177.0	176.4	-
21	47.7	41.5	-	42.3	39.8	-	213.0	184.3	-	182.0	175.8	-
24	49.0	43.1	-	43.0	42.5	-	225.0	189.2	-	191.7	186.4	-

at a later period of life. The shape of the hindquarters changes with age similarly in B_1 and F_1 hybrids and in *bw* cattle. Hip bone breadth is smaller at birth than pelvis breadth, but the reverse proportions are observed at the age of 18—24 months. These differences are, however, greater in *bw* cattle than in hybrids of the two generations (Table 3).

When comparison is made of the growth percentages of all the body measurements of B_1 hybrids it is found that in females the following increase most slowly with age: fore cannon girth (up to 10 months) and the two body heights, average rate of growth is exhibited by thorax

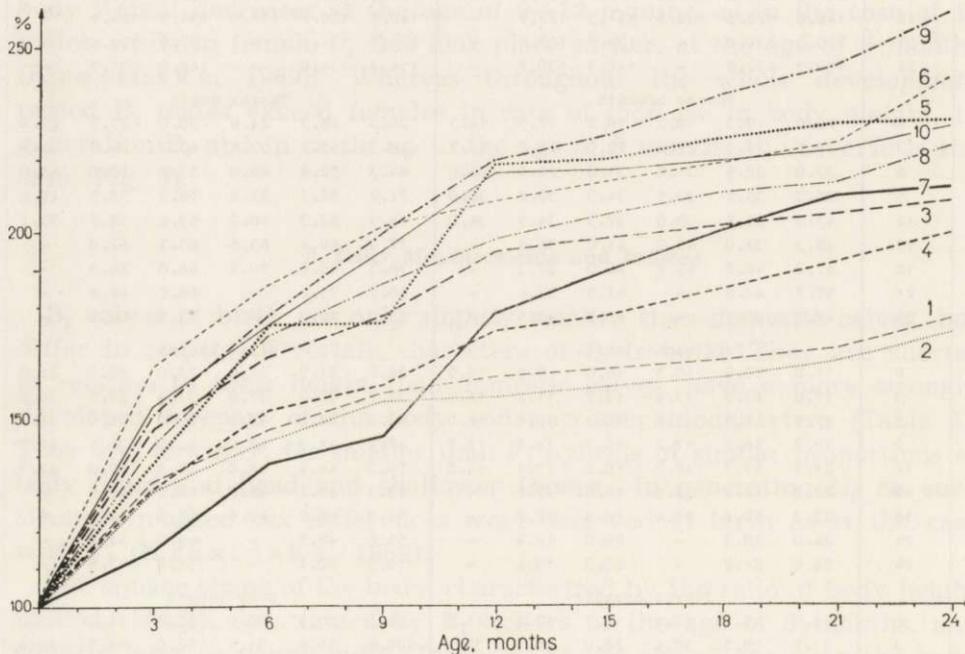


Fig. 5. Rate of increase of body measurements of females hybrids B_1 (in per cent). 1 — wither height; 2 — sacral region height; 3 — body length; 4 — thorax breadth; 5 — thorax depth; 6 — heart girth; 7 — fore cannon girth; 8 — pelvis length; 9 — hip bone breadth; 10 — pelvis breadth.

breadth, length of body and pelvis length and — up to 9 months — thorax breadth. The group of most intensively increasing measurements includes — pelvis breadth and heart girth (Fig. 5). In males both body height and fore cannon girth increase at a similarly slow rate. Intermediate rate of increase is exhibited by thorax breadth and pelvis breadth and also pelvis length. The following increase most quickly: thorax depth and heart girth and also body length and hip bone breadth (Fig. 6). The differences observed in the rate of changes in body build in B_1 hybrids during

postnatal development lead to the formation of sex differences. Males two years old are higher and longer in comparison with females, the forepart of the body is more strongly built, the head longer and broader, the horns more massive and larger.

B₁ hybrids exceed *bw* cattle and F₁ hybrids in respect of rate of increase in body length (females up to 6 months only) and heart girth (up to 9 months). Like F₁ hybrids, they are inferior to cattle in respect of rate of increase in thorax breadth and hip bone breadth. B₁ hybrids exhibit similar rate of change to *bw* cattle in respect of both breadths of the body and fore cannon girth (Table 4).

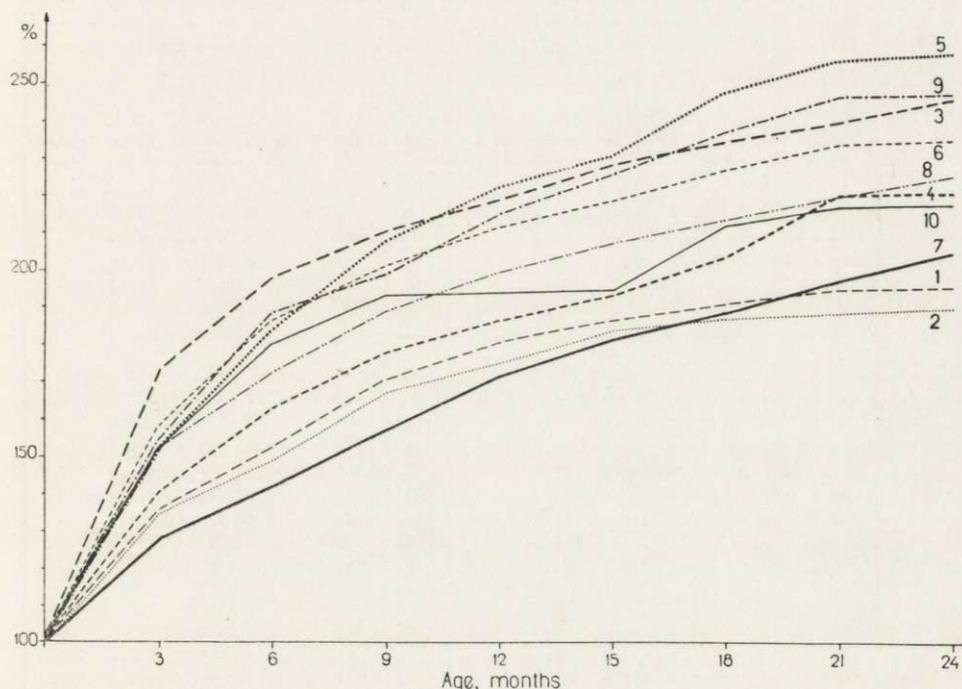


Fig. 6. Rate of the increase of body measurements of male hybrids B₁ (in per cent). For explanations see Fig. 5.

The differences observed in the build of B₁ hybrids and the initial forms are confirmed by analysis of build indices (Table 5). B₁ hybrids occupy an intermediate place between *bw* cattle and F₁ hybrids in respect of withers height-thorax depth $\times 100$ /withers height. Withers height $\times 100$ /body length changes with age similarly in the three groups of animals, but its values in B₁ generation as growth proceeds become similar to those of cattle. This shows that similar body proportions to those of cattle are formed with age. The body in B₁ hybrids is longer in

Table 4

Comparison of rate of the increase of body measurements of hybrids F₁, B₁ and domestic cattle. Numbering of columns as in Table 2.

Age, months	Withers height						Sacral region height					
	1	2	3	4	5	6	1	2	3	4	5	6
0	100	100	100	100	100	100	100	100	100	100	100	100
3	125.7	135.9	133.0	128.7	132.8	124.9	125.1	135.3	130.6	132.6	131.1	124.1
6	141.2	152.5	147.6	145.0	149.6	143.2	140.6	149.3	146.6	132.4	145.0	140.0
9	149.9	159.8	157.6	155.6	157.5	152.5	148.1	156.6	154.2	155.0	155.0	149.3
12	156.0	170.2	170.5	161.3	161.3	161.0	155.6	165.0	166.1	161.5	157.7	156.1
15	161.4	175.9	177.8	158.4	162.7	-	161.5	171.8	175.6	161.9	159.0	-
18	167.1	180.4	186.8	168.6	165.9	-	163.0	175.6	180.6	170.3	161.3	-
21	171.8	183.6	-	173.6	169.6	-	170.3	177.7	-	173.6	165.8	-
24	175.6	183.7	-	181.0	176.7	-	172.7	178.7	-	180.0	173.0	-
	Heart girth						Fore cannon girth					
0	100	100	100	100	100	100	100	100	100	100	100	100
3	150.1	158.9	140.0	161.0	164.6	133.4	136.4	127.9	127.3	136.7	115.4	122.8
6	176.6	185.9	181.7	182.6	186.4	158.2	157.6	142.2	148.8	153.3	138.6	138.5
9	187.4	201.3	201.7	198.1	202.5	174.8	175.8	157.4	164.3	166.7	146.5	151.4
12	198.8	210.8	219.3	209.5	209.1	187.2	193.9	170.7	173.8	173.3	178.9	156.1
15	204.9	218.3	240.0	215.5	214.0	-	203.2	180.7	185.7	190.0	190.1	-
18	214.4	227.2	264.3	222.2	219.0	-	212.1	187.4	194.0	190.0	201.8	-
21	232.9	233.4	-	228.4	224.4	-	218.2	196.1	-	200.0	209.6	-
24	245.9	233.4	-	240.7	241.3	-	218.2	203.4	-	200.0	213.0	-
	Pelvis breadth						Thorax breadth					
0	100	100	100	100	100	100	100	100	100	100	100	100
3	144.0	153.5	150.9	150.9	154.1	139.0	140.9	140.4	149.2	155.3	132.0	158.7
6	169.5	180.6	185.1	173.0	176.2	159.6	164.9	163.7	190.8	171.7	152.6	195.8
9	180.1	192.6	202.5	197.2	195.8	180.2	174.0	178.7	208.4	190.6	169.0	221.6
12	187.7	192.6	225.5	200.6	215.8	185.5	186.2	187.0	233.8	207.5	174.5	237.7
15	196.8	192.6	243.5	217.0	217.5	-	205.8	193.3	269.2	222.1	178.1	-
18	205.9	211.0	268.4	213.3	219.2	-	213.4	202.7	306.1	222.5	185.4	-
21	210.4	217.1	-	224.2	222.9	-	216.5	219.9	-	229.6	192.8	-
24	214.5	217.1	-	233.3	229.2	-	221.0	219.9	-	242.1	200.0	-
	Body length						Thorax depth					
0	100	100	100	100	100	100	100	100	100	100	100	100
3	133.6	163.1	131.7	137.9	148.5	126.8	133.2	152.0	150.3	145.2	138.2	142.3
6	160.5	188.1	156.8	162.2	167.1	163.5	177.3	184.2	193.0	179.1	175.1	176.1
9	174.0	210.2	170.0	177.6	178.5	180.3	199.0	207.6	210.1	194.8	175.9	185.7
12	179.0	219.1	183.9	192.3	195.0	191.7	210.0	220.8	234.2	210.6	217.8	200.0
15	189.6	228.2	204.3	193.9	199.1	-	213.2	229.6	255.8	203.3	220.3	-
18	197.1	233.9	219.3	213.8	202.2	-	215.5	246.6	284.5	220.3	225.2	-
21	201.6	239.1	-	215.8	205.4	-	222.3	255.1	-	227.2	228.9	-
24	205.5	245.1	-	221.0	208.0	-	228.9	257.1	-	244.2	230.2	-
	Pelvis length						Hip bone breadth					
0	100	100	100	100	100	100	100	100	100	100	100	100
3	132.4	152.0	150.6	146.7	144.3	140.0	141.0	153.5	156.4	156.0	151.0	161.9
6	165.6	171.8	183.9	170.0	173.9	165.0	174.9	187.9	197.4	182.2	177.7	201.4
9	183.6	187.9	201.7	183.0	187.0	166.3	191.7	197.7	238.7	206.0	201.3	244.9
12	194.0	199.6	220.1	193.2	198.4	194.0	201.7	215.0	258.0	218.5	218.3	253.7
15	205.7	206.8	234.5	194.2	205.0	-	218.5	225.1	284.9	227.4	226.5	-
18	208.2	211.8	247.7	209.6	211.6	-	230.3	237.2	309.3	238.6	237.0	-
21	212.2	219.6	-	216.4	213.0	-	241.9	246.8	-	254.2	245.6	-
24	217.5	224.4	-	222.5	222.9	-	248.9	246.6	-	270.8	259.0	-

Table 5

Comparison of indices of the body structure of hybrids F₁, B₁ and domestic cattle. Numbering of columns as in Table 2.

Age, months	Withers height x 100/body length						Heart girth x 100/body length					
	1	2	3	4	5	6	1	2	3	4	5	6
0	110.1	120.1	102.8	116.5	112.8	109.2	115.1	128.9	107.1	119.8	129.6	124.5
3	102.9	100.8	104.3	111.7	98.3	98.3	129.3	125.6	114.4	139.7	128.3	119.8
6	96.8	96.8	96.8	104.8	97.7	96.2	126.9	126.7	124.1	134.0	126.8	120.5
9	94.4	91.1	95.4	102.6	95.5	100.8	124.0	125.4	127.1	134.3	128.4	120.7
12	96.3	93.1	95.3	97.9	93.7	91.8	127.9	124.2	127.8	130.7	127.6	121.6
15	93.5	91.6	89.5	96.9	91.4	-	124.7	122.5	125.7	132.3	125.6	-
18	93.5	90.8	87.8	95.9	93.3	-	125.4	127.3	129.1	129.0	133.0	-
21	96.6	91.2	-	94.0	90.5	-	133.5	126.6	-	127.0	122.7	-
24	94.5	90.7	-	95.8	91.8	-	137.9	126.6	-	130.5	130.9	-
	Sacral region height x 100/withers height						/Withers height - thorax depth/ x 100 withers height					
0	102.3	103.6	105.4	101.7	103.2	106.7	58.4	60.8	57.9	61.4	60.8	64.3
3	101.5	103.0	103.5	102.0	102.5	106.1	55.6	56.5	61.0	57.8	59.7	58.7
6	101.9	101.5	104.7	102.1	101.8	104.3	47.9	53.2	54.8	52.6	53.0	55.9
9	101.6	101.4	103.1	101.3	101.7	104.3	45.1	48.9	54.0	51.4	50.0	54.4
12	102.0	101.4	102.6	101.9	101.6	103.4	44.1	47.0	52.5	49.6	49.0	53.7
15	102.3	101.0	104.1	103.6	101.6	-	45.2	48.6	50.3	50.1	48.9	-
18	101.8	100.7	101.8	103.0	101.0	-	46.4	45.7	47.4	49.5	47.2	-
21	100.9	100.7	-	101.7	101.9	-	46.4	45.3	-	49.3	48.9	-
24	100.4	101.3	-	101.2	101.1	-	46.0	46.2	-	48.5	47.8	-
	Heart girth x 100/withers height						Fore cannon girth x 100/withers height					
0	104.6	107.5	104.1	102.6	104.1	114.0	12.6	14.6	14.6	12.9	14.0	14.7
3	125.7	124.4	109.7	125.0	128.9	121.8	13.8	14.3	14.0	13.3	12.0	14.5
6	130.8	130.2	128.2	127.1	129.4	126.0	14.1	14.1	14.7	14.1	12.1	14.2
9	130.4	136.5	127.9	130.9	132.5	130.5	14.8	14.2	15.2	13.2	12.6	14.6
12	133.2	134.1	134.0	133.6	136.1	139.5	15.8	14.4	14.9	14.4	14.6	14.4
15	132.8	135.1	140.4	136.9	134.9	-	15.8	14.7	15.2	14.8	14.6	-
18	134.1	139.2	147.4	135.5	143.3	-	16.0	15.1	15.1	14.8	14.8	-
21	141.5	140.2	-	135.1	136.8	-	15.9	15.5	-	15.0	14.8	-
24	146.2	140.5	-	135.7	141.9	-	15.6	15.9	-	14.5	14.9	-
	Thorax depth x 100/withers height						Thorax breadth x 100/thorax depth					
0	41.6	39.1	34.5	38.6	39.2	35.7	60.7	66.2	65.3	60.6	64.8	56.3
3	44.3	43.1	39.0	42.9	40.3	41.3	64.0	71.8	65.0	64.6	68.1	61.8
6	52.1	46.5	45.1	47.8	47.9	44.1	57.5	63.2	64.6	57.3	57.9	62.2
9	54.9	51.1	46.0	48.4	49.7	45.6	53.5	55.3	64.8	58.8	58.8	60.5
12	55.9	52.0	47.4	50.4	51.0	46.3	54.2	59.6	65.2	59.4	57.9	64.0
15	54.8	51.4	49.7	49.8	51.1	-	56.0	59.3	68.8	64.7	55.4	-
18	53.6	54.3	52.2	50.5	52.3	-	60.0	58.4	70.3	61.0	58.0	-
21	53.6	54.7	-	50.5	52.1	-	59.0	59.3	-	60.7	58.3	-
24	54.0	53.8	-	52.0	52.3	-	58.6	60.1	-	59.6	61.4	-

relation to height than in F₁. Heart girth × 100/withers height and body depth index increase intensively during the first months of life in all animals. Proportions of the build of the thorax in B₁ hybrids are intermediate to those of the initial forms. Thorax breadth index has lower

values during development in B_1 and F_1 hybrids than in cattle, which indicates that their thorax is narrower than in cattle. Sacral region height $\times 100$ /withers height is greater in B_1 and F_1 than in *bw* cattle, pointing to the more horizontal line of the back. Fore cannon girth $\times 100$ /withers height increases most intensively with age in F_1 , and its values in B_1 hybrids and cattle are similar.

IV. DISCUSSION

To sum up it must be said that B_1 hybrids are characterized by body build intermediate between the initial forms. The influence of the greater percentage of domestic cattle blood is observed in the change in the proportions of the body (the body is longer in relation to height than in F_1 hybrids), the more delicate structure of the skeleton and formation of horns similar to that in cattle (except for »Fewa«). A character revealing domination of European bison is the slightly more strongly developed thorax and narrower hindquarters than in cattle.

The mother was found to exert a strong influence on size and body weight at birth of B_1 hybrids. F_1 cows, similar in many characters of build and reproduction to European bison, like the latter produce small calves of generation B_1 . The maternal influence regulating the size of the calves in the mother's uterus observed in this case has also been observed in many mammals and birds (Ellis *et al.*, 1955; Hammond *et al.*, 1958; Meyer, 1964).

From the point of view of possible economic advantages generation B_1 does not afford such promising prospects as the first generation of hybrids. As the vigour of hybrids occurs sporadically in this generation, no high daily increases or intensive rate of development during the first year of life was observed in them, as is the case with F_1 hybrids. Only resistance to unfavourable climatic conditions and mechanical injuries are observed. B_1 hybrids, like F_1 , do not need barns in order to survive the winter. In this generation there are some hybrids, but not all, with the temperament of their wild forebears, and this fact renders breeding work more difficult.

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ROZWÓJ POSTNATALNY MIESZAŃCÓW B₁ ŻUBRA Z BYDŁEM DOMOWYM

Streszczenie

Przedstawiono rozwój 24 mieszańców pokolenia B₁ (Tabela 1) w okresie od urodzenia do 24 miesięcy w oparciu o 15 pomiarów i 8 indeksów. Uzyskane dane porównywano z danymi o rozwoju form rodzicielskich (F₁ i bydła rasy ncb).

Mieszańce B₁ charakteryzowały się niższym ciężarem ciała przy urodzeniu niż formy wyjściowe. Samce były lżejsze od F₁ o 84,6% a od ncb o 38%, samice odpo-

wiednio o 20 i 22% (Ryc. 1 i Tabela 1). Również w czasie całego rozwoju krzyżówki B_1 wykazywały mniejszy ciężar ciała niż pierwsze pokolenie mieszańców i było rasy ncb (Tabela 2, Ryc. 2, 3, 4). Tak np. samce B_1 były w wieku 6 miesięcy lżejsze od F_1 o 35,5%, a samice o 12,3%, a w wieku roku odpowiednio samce o 40%, a samice o 6,3% (Ryc. 3).

Zaobserwowano wpływ matki — krzyżówki F_1 na wielkość i ciężar ciała rodzonych przez nie cieląt — krzyżówek B_1 . Krowy F_1 podobne w wielu cechach budowy i rozrodu do żubrzc, rodziły podobnie jak one niewielkie cielęta.

W pokoleniu B_1 zjawisko heterozji tak silnie występujące u mieszańców F_1 , występowało tylko sporadycznie (3 wypadki na 24).

Mieszańce pokolenia B_1 przez cały okres rozwoju znacznie ustępują wymiarami ciała mieszańcom pierwszego pokolenia, a bliskie są wymiarom bydła (Tabele 3, 4). Również proporcje budowy wskazują na wzrost podobieństwa do bydła w tym pokoleniu w porównaniu z F_1 (Tabela 5). Mieszańce B_1 mają dłuższy tułów w stosunku do wysokości niż F_1 , są drobnokościste o małych głowach, rogach zbliżonych kształtem i wielkością (oprócz Fewy) do bydła. Jediną cechą w której odbija się wpływ żubra (choć w małym stopniu) jest silniej rozbudowany przód ciała w stosunku do tyłu. Jednak dysproporcja ta nie jest tak silna jak w pokoleniu F_1 .

Wzrost procentu krwi bydła w dalszych pokoleniach mieszańców prowadzi u nich do przewagi cech bydła.