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ANALYSIS OF REPRODUCTIVE CHARACTERS IN HYBRID PIG COMBINATION (CLW x CL) x (D x PN)

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Abstract

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The aim of the experiment was to analyse reproductive characters in hybrid pig combination (CLW x CL) x (D x Pn). These reproductive traits of sows were studied: number of all, live born and weaned piglets, loses from live born piglets till weaning. These influences with an impact on reproductive characters were monitored: order of litter, number of piglets in a litter, birth weight of piglets, influences of sex and litter order on birth weight of piglets.
An average number of all born piglets per sow and litter it was 13.25 piglets. From this an average number of live born piglets it was 12.48 piglets per sow and litter and from each litter there was 11.40 of weaned piglets. The highest number of live born piglets was reached in sows on the fourth litter – 14.50 piglets. On eighth and nineth litter fertility decreased to 11.60 and 11.00 piglets. Statistical conclusive difference ($P \leq 0.05$) was found between fourth (14.50) and nineth (11.00) litter. Among birth weight in both sexes a statistical conclusive difference ($P \leq 0.05$) was found. Higher birth weight (1.46 kg) was found in boars in comparison with gilts (1.40 kg). The highest birth weights in gilts were reached in litters of sows on the second and nineth litters – 1.49 kg and 1.48 kg. Birth weight decreased on tenth litter with average weight of 1.28 kg.
The highest birth weight in boars was detected on the seventh litter but on the seventh litter piglets of only one sow were weightened so the result 1.67 kg is not objective. The second highest average birth weight was reached on the third litters – 1.53 kg. On the contrary the lowest average birth weight was on the fourth and tenth litters where boars reached weight of 1.28 and 1.25 kg. Statistical conclusive difference ($P \leq 0.05$) was found between the second (1.53 kg) and tenth (1.25 kg) litter.

Keywords: sow, reproductive characters, fertility, litter

INTRODUCTION

In pig breeding it is important to have commercial breeding and realization of reproductive process on a high quality level and intensity to guarantee constant production of healthy piglets. The own process of pork production is starting with reproduction which participates highly on profitability of production. In Europe profitability of production starts after reaching of 20 weaned piglets per sow per year.

Excellent reproduction of sows, viability and balance piglets in litter and their readiness to weaning are key factors for effective breeding. Reproductive characters are characterized by low heritability which means selection on these characters is difficult, lengthy and effect of selection is low. On the other hand because of low heritability in reproductive characters effect of heterosis is high (Čeřovský, Vinter, 1989).

Fertility of sow is not equal during the whole life. It is increasing from specific age and then it stays on the same level or mildly decreases. In sows number of piglets in a litter grows from the first till 3rd–5th litter – period when sow reaches peak of the fertility. On 6th and next litter sows becomes pregnant

reliably but they have more dead born piglets. Birth mortality is accessed by number of dead born piglets in a litter. Among factors with an influence on birth mortality belong: size of litter, order of litter, age of sow, length of interval, birth weight of piglets (Fischer, 2004). Birth mortality is usually higher in less numerous litters or on the contrary in too numerous litters. In highly numerous litters mortality is increasing probably because of insufficient nutrition of fetus i.e. reduced supply of nutrients due to higher number of embryos during intra-uterus (embryonic) development. According to study of Hellbrugge *et al.* (2008) mortality of piglets is a considerable problem.

Birth weight is decisive for survival of piglet from birth till weaning. Weight under 1 kg is believed to be critical. If piglet with such a low weight does not die till weaning low weight has an influence on its next growth. Such a piglet reaches slaughter weight later, fattening takes longer and for breeder it means higher costs for housing and feeding. Limited reserves of energy which has piglet during birth are consumed for thermoregulation and movement to search teat. Next energy and defensive agents are obtained from colostrum. Piglets with a low birth weight quite often die due to starvation because lack of energy prevents them to take colostrum (Václavková, 2010). Piglets with weight up to 0.8 kg are considered as unsuitable for breeding. Magnabosco *et al.* (2015) confirmed in their study that piglets with lower birth weight than 1.1 kg have higher mortality and because of lower intake of colostrum lower growth ability in comparison to piglets with higher birth weight. An optimal birth weight for live born piglet should be between 1.3–1.6 kg.

With increasing number of piglets in a litter their birth weight is decreasing which has an influence on results of weaning and their next life till the end of fattening. Piglets from numerous litters show lower growth ability and next lower carcass value.

Long-term effect of excellent animals in breeding is an important element with an influence on breeding profitability (Fülöp *et al.*, 1994). Length of sow staying in breeding can be influenced by traits of production in period of gilts' growth, their first mating and period of gravidity (Kerr *et al.*, 1996). Main reasons for elimination of sow from breeding are reproductive problems, problems with locomotor system and low milking capacity of the sow (Dourmad *et al.*, 1994). Optimal reproduction can not be reached without securing of good health condition of sow (Lambert *et al.* , 2012).

MATERIALS AND METHODS

The own analysis was carried out in chosen commercial pig breeding in 2015. In breeding open herd turnover is used and gilts for breeding are provided by ZEAS Lysice, a.s. Currently there are 324 hybrid sows of Czech Large White x Czech Landrace (CLW x CL) in reproduction. Insemination doses for production of final hybrids are provided by Insemination station of boars Němčičky. Boars used for insemination of sows in the experiment were combination of breeds Duroc and Pietrain (D x Pn). During experiment 52 sows were put into experimental group that were mated hybrid boars Duroc x Pietrain. For register of reproduction program PlemSoft is used in a company. Directly in a commercial breeding there are stables for pregnant, infertile, delivering and milking sows. Farrowing house is divided to 6 sections each with 16 individual boxes with a fixin cage. Weaner rearing penn of piglets is divided to 8 sections with a capacity of 180 piglets each. Pre-fattening stable with a capacity of 1000 piglets follows weaner rearing penn. Fattening takes place on this and three other farms. Altogether 649 piglets (325 boars and 324 gilts) were weightened. Weighting took place up to 24 hours after birth and digital weighing machine SENCOR SKS 4001 WH was used.

These data were detected in a frame of experiment: number of all born piglets, number of live born piglets, number of weaned piglets, sex, length of interval, length of gravidity, service periode, time from weaning till mating, birth weight of piglets, age of piglets during weaning, number of litters per year, mortality and order of litter. Studied file of sows was divided into groups according to litter order. In experimental group of sows these influences which affect reproductive characters were monitored: influence of litter order on number of live born and weaned piglets, weights of boars and gilts according to litter order.

These basic statistical characterizations were determined in studied file of sows: average, standard deviation, coefficient of variance, minimum and maximum of studied trait. Obtained data were evaluated by statistical program STATISTICA 10 and conclusiveness of differences among groups was tested by statistical ANOVA, Tukey HSD test.

RESULTS AND DISCUSSION

In Tabs. I and II there are results of reproductive traits of experimental group of sows. An average number of all born piglets per sow and litter it was 13.25 piglets. An average number of live born piglets per sow and litter was 12.48 and 11.40 piglets from each litter were weaned (in average). With turnover rate 2.44 litters per year it is reached 30.47 live born piglets and 24.82 weaned piglets per sow and year. Our breedings are quite commonly reaching number of 25 weaned piglets per sow and year (Velechovská, 2013). It is result of good organizing of work, feeding of sows and responsible handling by keepers. Losses in live born piglets till weaning represented 8.63 %. Number of dead born piglets is usually around 5–10 %, higher number of dead born piglets is especially in more numerous litters with 14 piglets and more (Václavková and Lustyková, 2011). Herment *et al.* (1994) mention higher numerousness of litter causes higher percentage of

dead born piglets and it is depending on occurrence of piglets with lower live weight and lower vitality. According to Huml and Klepáč (2003) range of physiological mortality is between 10 – 14 %.

With turnover rate 2.44 an average length of parturition interval was 149.35 days. Sows were on 5.85 litters in average. An average length of gravidity was 113.81 days, service periode 35.17 days and length from weaning till first insemination 7.54 days in average. An average length of gravidity in experimental group of 52 sows it was 113.81 days. Říha *et al.* (2001) mentions range of gravidity length around 109 – 120 days. According to Pulkrábek *et al.* (2005) it is usually longer in less numerous litters. Stupka *et al.* (2009) mentions in young gilts it is for 0.5 – 1 day shorter than in older sows. According to Čeřovský *et al.* (2012) farrowing comes between 112 – 116 days of gravidity. With earlier farrowing than in 112 days of gravidity or if the gravidity takes longer than 116 days number of dead born piglets in litter is growing (Václavková and Lustyková, 2011).

An average length of parturition interval is 149.35 days and number of turnover rates of litters per year and sow it is 2.44 turnovers. Svoboda (2002) mentions length of parturition interval depends on time of weaning. As very good length of interval he mentions border 150 – 153 days when it is possible to gain 2.3 – 2.4 litters per year. Level of changing and utilization of reproductive events of sow for piglet production it is characterized by number of unproductive days of sow. Significant source of unproductive feeding days per sow it is sows returning to service which represents increase for 21 unproductive days and prolongation of interval from weaning till mating. One way how to reduce number of unproductive days it is well-timed and successful mating of sows after weaning of piglets. In studied group of sows an average period from weaning till first insemination it was 7.54 days. It is reported that approximately 15 % of sows in organized breedings are mated later than 10 days after weaning where an optimal interval from a position of minimum number of unproductive days it is mating on 4th – 6th day after weaning (Čeřovský *et al.*, 2012). Behan *et al.* (2005) pronounces with higher intensification of pig breeding interval from weaning till start of oestrus decreased to 5 – 7 days. According to Knox and Rodriguez (2001) in 95 % of sows oestrus starts between 3rd and 8th day after weaning. Gaustad-aas, Hofmo and Karlberg (2004) mention during length of lactation 28 – 35 days the interval from weaning till start of oestrus it is 4 – 5 days. In sows which are milking for longer time interval is a little bit shorter and start of oestrus in a group of sows weaned at the same time it is more concentrated. On the contrary in sows which are milking for shorter time oestrus starts later, irregularly and in longer time period. Říha *et al.* (2001) mentions delay of mating after weaning for one week decreases natality of sow for 0.1 litter and number of produced piglets for 1 piglet per sow per year.

According to Čeřovský (2012) the first two litters are less numerous than following litters, usually

I: *Reproductive traits of studied of hybrid combination (CLW x CL) x (D x Pn)*

Number of litters	52
An average number of all born piglets per litter (piglets)	13.25 ± 1.86
An average number of live born piglets per litter (piglets)	12.48 ± 1.89
An average number of weaned piglets per litter (piglets)	11.40 ± 1.66
An average number of live born piglets per sow and year (piglets)	30.47
An average number of weaned piglets per sow and year (piglets)	24.82
Losses in live born piglets till weaning (%)	8.63
An average length of parturition interval (days)	149.35 ± 6.48
Number of litters per sow and year (average)	2.44 ± 0.09
Order of litter (average)	5.85 ± 3.16
An average length of gravidity (days)	113.81 ± 0.71
An average service period (days)	35.17 ± 6.64
An average period from weaning till mating (days)	7.54 ± 3.16

II: *Basic statistical characterizations of studied reproductive traits of hybrid combination (CLW x CL) x (D x Pn)*

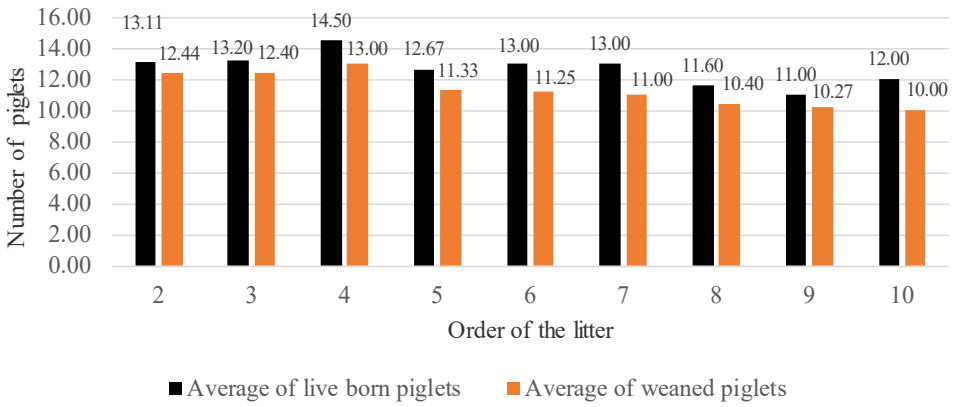
Trait	All born piglets	Live born piglets	Weaned piglets
number (animals)	689	649	593
average	13.25	12.48	11.40
S_x	1.86	1.89	1.66
V_x (%)	14.03	15.11	14.52
X_{min}	7	6	6
X_{max}	17	16	14

for one – two piglets. Their chance for survival till weaning is approximately for 50 % lower than in piglets from next litters. Number of piglets is increasing with an order of litter till approximately sixth litter. From seventh litter there are higher losses because o dead born piglets (with the same number of all born piglets). Sows on the second – tenth litters weru put into the experiment. Tab. IV shows number of live born and weaned piglets in individual litters. The second litter show 13.11 and the third 13.20 live born piglets. The highest number of live born piglets was reached in sow o the fourth litter – 14.50 piglets. An average number of piglets on the fifth and sixth litter it was 12.67 and 13.00 piglets. An average number of piglets (13) on the seventh litter it is not objective because in this group there was only one sow. Fertility decreased on 11.60 and 11.00 piglets on the eighth and ninth litter. On tenth litter number of piglets grew for 1 piglet in comparison with ninth litter. Statistical conclusive difference ($P \leq 0.05$) was found between fourth (14.50) and ninth (11.00) litters.

Sows older than on seventh litter and more are not appropriate mothers because of having more dead born piglets in a litter, they have problems with milking, with unbalanced teats, higher keeping feeding amount and they kill more piglets because of overlaying (Čeřovský *et al.*, 2012).

Tab. III and Fig. 1 are the average values of live born and weaned piglets according to litter order.

From values in Tab. III it is evident that the highest number of weaned piglets was after sows on the second – the fourth litter. From fifth till tenth litter number of weaned piglets was decreasing. From fifth till seventh litter values of weaned piglets were mostly the same (11.33, 11.25 and 11.00). The lowest number of weaned piglets (10.00) was found on tenth litter. Statistical conclusive difference ($P \leq 0.05$) was found between the second



1: *Number of live born and weaned piglets according to order of the litter*

III: *Number of live born and weaned piglets according to order of the litter*

Order of the litter	Number of litters	Average of live born piglets per litter	Average of weaned piglets per litter
2	9	13.11 ± 1.20	12.44^{b} ± 0.83
3	5	13.20 ± 1.17	12.40 ± 0.80
4	4	14.50^{a} ± 1.50	$13.00^{b,c}$ ± 1.22
5	9	12.67 ± 1.49	11.33 ± 1.25
6	4	13.00 ± 1.00	11.25 ± 1.30
7	1	13.00 ± 0.00	11.00 ± 1.26
8	5	11.60 ± 1.74	10.40 ± 1.02
9	11	11.00^{a} ± 2.22	10.27^{c} ± 1.81
10	4	12.00 ± 1.22	10.00 ± 1.00

a,b,c,: $P \leq 0.05$

IV: *ab. 4: Basic statistical characterization for trait – birth weight of piglets*

Sex	Birth weight (kg)				
	n	Average	S_x	X_{min}	X_{max}
Gilts	324	1.40	0.33	0.52	2.15
Boars	325	1.46	0.32	0.55	2.27

(12.44) and the fourth litter (13.00) and next between the fourth (13.00) and the ninth litter (10.27).

Tab. IV shows determined birth weights of gilts and boars. Among birth weight in both sexes statistical conclusive difference ($P \leq 0.05$) was found. Higher birth weight (1.46 kg) was found in boars in comparison with birth weight of gilts (1.40 kg). Bocian *et al.* (2012) detected in their study higher birth weight in gilts (1.35 kg) in comparison to boars (1.25 kg). Detected difference in birth weight between sexes it was statistical conclusive ($P \leq 0.05$).

According to Magnabosco et all. (2015) because of higher number of piglets in a litter breeders prefer birth weight around 1 kg with a higher risk of mortality and lower growth ability. Beaulieu *et al.* (2010) studied an influence of birth weight of piglets on their growth. They found out that piglets with lower birth weight are reaching lower weaning weight, lower weight in 5th and 7th weeks after weaning so their fattening takes longer time.

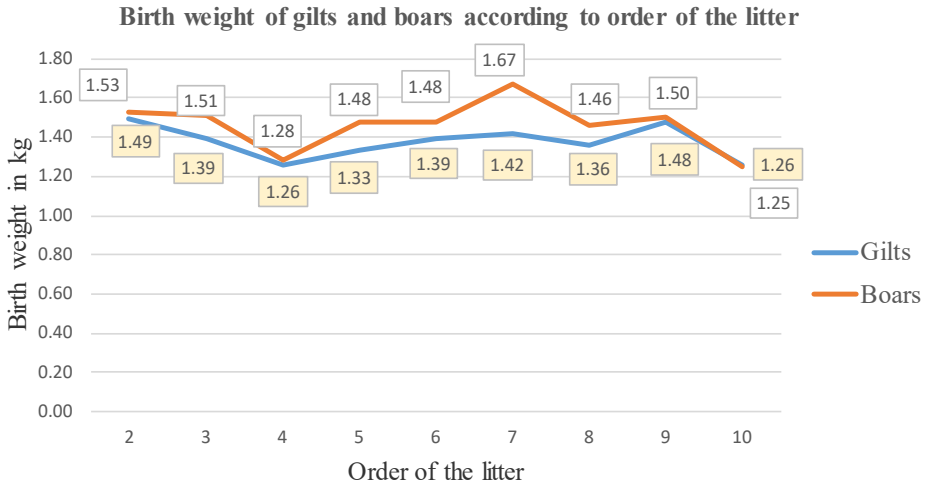
Tab. V and Fig 2 show average birth weight of gilts and boars according to litter order. The highest average birth weight was reached by gilts of sows on the second and the ninth litters – 1.49 kg and 1.48 kg. Following values were determined on productive litters: on the third litters 1.39 kg, on the fourth litters 1.26 kg, on the fifth litters 1.33 kg. On the sixth litter an average birth weight of gilts reached 1.39 kg. Weights 1.36 and 1.48 kg were detected on eighth and the ninth litters. Decrease of weight was detected on the tenth litter – 1.26 kg. Statistically highly conclusive difference ($P \leq 0.001$) was found between the second (1.49 kg) and the fourth (1.26 kg) litter and between the second (1.49 kg) and tenth (1.26 kg) litter. Highly conclusive difference ($P \leq 0.01$) was determined between the fourth (1.26 kg) and the ninth litter (1.48 kg) and between the ninth (1.48 kg) and tenth litter (1.26 kg). Statistical conclusive difference ($P \leq 0.05$) was found between the third (1.39 kg) and the fourth litter (1.26 kg) and between the third (1.39 kg) and tenth litter (1.26 kg).

The highest average birth weight in boars was determined on the seventh litter (1.67 kg), but this result is not objective because only piglets from one sow were weightened. The second highest birth weight was reached on the second litters – 1.53 kg. On the contrary the lowest average birth weight was found on the fourth and the tenth litters – 1.28 and 1.25 kg. Statistical conclusive difference ($P \leq 0.05$) was found between the second (1.53 kg) and tenth litter (1.25 kg). According to Herčík (2003) the lowest ratio of live born piglets with weight over 1.2 kg is reached on the first litters and on that after sixth litter. High participation of the first litters in a commercial breeding is not advantageous from a position of piglet production because with higher number of piglets with low birth weight in a litter mortality is increasing. In boars maximum of average birth weight was reached on the seventh litter (1.67 kg) and in gilts on the second (1.49 kg) and on the ninth (1.48 kg) litter. The lowest birth weight in both sexes was detected on the tenth litter – boars 1.25 kg and gilts 1.26 kg.

V: *Birth weight of gilts and boars according to order of the litter*

Order of the litter	Number of litters	Average birth weight of gilts in kg	Average birth weight of boars in kg
2	9	$1.49^{f,g} \pm 0.31$	$1.53^{e} \pm 0.33$
3	5	$1.39^{a,d} \pm 0.31$	1.51 ± 0.31
4	4	$1.26^{a,d,f} \pm 0.31$	1.28 ± 0.28
5	9	1.33 ± 0.29	1.48 ± 0.29
6	4	1.39 ± 0.27	1.48 ± 0.38
7	1	1.42 ± 0.22	1.67 ± 0.25
8	5	1.36 ± 0.27	1.46 ± 0.30
9	11	$1.48^{d,e} \pm 0.40$	1.50 ± 0.33
10	4	$1.26^{a,e,g} \pm 0.30$	$1.25^{e} \pm 0.21$

a,b,c: $P \leq 0.05$ d,e: $P \leq 0.01$ f,g: $P \leq 0.001$



2: *Birth weight of gilts and boars according to order of the litter*

CONCLUSION

From reached results of reproductive traits in studied hybrid combination (Czech Large White x Czech Landrace) x (Pietrain x Duroc) it is possible to pronounce that very good results were achieved. Average number of all born piglets in a litter reached 13.25 piglets, live born 12.48 and weaned piglets 11.40 per litter. Losses from live born piglets till weaning were on the level of 8.63 %. During evaluation of an influence of litter order on reproductive traits in studied sows it was found out that highest number of live born piglets in a litter is reached on the fourth litters – 14.5 piglets. On the eighth and ninth litter number of live born piglets decreased on 11.6 and 11 piglets. The highest number of weaned piglets was in sows on the second, the third and the fourth litters. Since the fifth litter number of weaned piglets was decreasing. The lowest number of weaned piglets was found on the tenth litter. Statistical conclusive difference was found in birth weight of piglets between sexes when boars reached higher birth weight in comparison to gilts. The highest average birth weight of gilts was recorded on the second and the ninth litter, in boars on the seventh and the third litter. The lowest birth weight of both sexes was recorded on the tenth litter.

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