FIELD TESTATION OF HYBRID PIG IN COMMERCIAL HERD

M. Šprysl, R. Stupka, J. Čítek

Czech University of Agriculture, Faculty of Agronomy, Prague, Czech Republic

The objective of this work was to verify the performance of two crossbred combinations in a large-scale operation using a field test. The two combinations used were CVM x (LW x L) and PN x (LW x L). For them, reproduction performance was assessed in 44 and 46 litters, respectively, and production performance of these combinations was assessed in 135 finishing pigs of both crossbred combinations. In order to examine more precisely the phenotypic values of reproduction and production performance of the genotypes used, and the effects affecting this performance, linear models with fixed and random effects were used. On the basis of the results one could draw the following conclusions:

- Reproduction performance of the CVM x (LW x L) crossbred combination was significantly higher than that of the PN x (LW x L) combination.
- As regards fattening indicators, the PN x (LW x L) pigs had a lower growth capacity compared to the CVM x (LW x L) pigs with the values achieved being at a very low level, affected primarily by environmental factors.
- PN x (LW x L) combination had significantly better results in carcass value assessment, especially as regards lean meat share. Also here, however, the indicators are first of all affected by the weight achieved.
- From the economic point of view, the genotype of CVM x (LW x L) pigs appears more suitable for the establishment concerned.

pig; testation; reproductive performance; growth and fattening capacity; carcass value; meat quality; profit formula; linear models

INTRODUCTION

In the Czech Republic, pig breeding is based on the testing of animals coming from the operations producing grandparent and parent generations as well as from the fattening operations. There are two testing arrangements for pigs:

- Stations for pig heredity and fattening capacity testing, where pure-bred progeny of boars and sows is tested and where also the crossbred combi-

nations from fattening operations will be tested after the Central Testing Station for Crossbred Pigs was dissolved.

- Field tests of crossbred pigs in fattening operations where usually two crossbred combinations are tested in large-scale operations using a great sample of pigs (Šprysl et al., 1988).

Appropriate selection and ingenious use of breeds and lines in crossbreeding is a necessary prerequisite for achieving an economic effect in pig breeding. To this end, field tests of crossbred pigs in fattening operations are used (Šprysl et al., 1993).

The field tests examine all traits ranging from those related to reproduction to the production ones. From this viewpoint, the field tests are one of the measures that effectively assist to the optimisation of on-farm crossbreeding programmes thus contributing significantly to increasing the profitability of these farms(Šprysl, Stupka, 1990, 1991).

The problems of field tests in fattening operations including the determination of the most important indicators and effects to be monitored were examined, for instance by Smith (1977), Blendl (1978), Schepp (1980), Jakubec et al. (1981), Moskal (1984, 1986), Brandt (1986), Jakubec (1990), Šprysl et al. (1998).

MATERIAL AND METHODS

The objective of this work was to assess the performance of four-crossbred combinations in a large scale operation using a field test. In the mother line genotype sows of genotype LW x L were used and in the sire line Pietrain (PN), resp. Czech Pig Meat (CVM) boars were used, so the genotypes used were PN x (LW x L) and CVM x (LW x L). For them, reproduction performance was assessed in 46, resp. 44 litters, and the following indicators were observed:

- litter size: – all born piglets
  - live born piglets
  - stillborn piglets
  - reared piglets
  - mortality
- litter parity (number of litter in sequence of litters)
- length of farrowing interval (days)
- reproduction indexes – by the Czech National Standard No. 46 6164 (I_{RR})
  - by Moskal (1984b) (I_R).

In the growing and finishing phase, the following production traits were observed:

- number and weight of animals moved in and moved out in individual phases (head, kg)

- duration of individual phases (days)
- mortality and emergency slaughters (head)
- average daily weight gain (g) in phases
- feed conversion (kg) in the finishing phase.

As it was not possible to establish the feed consumption in the growing phase due to technological reasons, the average feed consumption per head was used to calculate the profitability function for both genotypes.

The total of 135 crossbred pigs of both combinations were finished in the test and the following indicators were assessed after they were slaughtered:

- carcass weight in warm state (kg)
- backfat according to the Czech National Standard No. 46 6160
- measured over the last rib in the middle spot (mm)
- lean meat share (%) using the ZP (Zwei-Punkte-Verfahren) method
- pH_1 (45 minutes *post mortem*) for MLT (*musculus longissimus thoracis*) at the last *thoracic vertebra* using a portable WTW pH-meter and ORION 201 probe.

All the traits were analysed by the method of least square means using the GLM procedure (SAS, 1997).

To assess reproduction, linear model with fixed effects was used (Jakubec, 1993):

$$y_{ij} = \mu + a_i + b_j + (ab)_{ij} + e_{ijk}$$

where: y_{ij} – observed variable
μ – population average
a_i – effect of i-th genotype (combination)
b_j – effect of j-th litter in sequence
$(ab)_{ij}$ – effect of interaction between i-th genotype and j-th litter in sequence
e_{ij} – residual error

To compare the fattening and carcass value indicators, linear model with random effects was used (Jakubec, 1993):

$$y_{ij} = \mu + a_i + bx_{ij} + e_{ijk}$$

where: y_{ij} – observed variable
μ – population average
a_i – effect of i-th genotype (combination)
b – regression coefficient
x_{ij} – carcass weight (independent variable)
e_{ij} – residual error

Basic statistical values have been calculated for all the traits for the entire sample (x, s_x, s, v).

Economic assessment of the crossbred combinations was carried out using the profit function of Sellier (1976), as adjusted by Poděbradský and Jakubec (1982):

$$Z_c = [c_1 y_1 - \{n_1 x_1 + a_2 x_2 + (n_3 : x_3) + A\}]\ r$$

$$r = 365 : (x_2 + k)$$

$$x_2 = (y_1 - y_0) : x_2'$$

$$Z_c = Z \,.\, r$$

where: Z_c – annual profit per capacity unit
Z – profit per head
r – annual speed of turnover
c_1 – average sales price per unit of production
n_1 – unit cost of compound feed
n_2 – fixed costs per feeding day (in growing and finishing phase)
n_3 – costs per sow and litter
A – costs of piglet treatment and feeding
y_1 – carcass weight
y_1' – live weight of slaughter pig
y_0 – initial live weight of fattened pig
x_1 – quantity of consumed compound feed
x_2 – duration of fattening
x_2' – average daily weight gain from live weight y_0 to live weight y_1 of the slaughter pig
x_3 – number of reared piglets per sow and litter
k – number of days between two rounds of fattening

RESULTS AND DISCUSSION

Table I summarises the reproduction indicators observed, Table II assesses the reproduction performance from the viewpoint of the significance of the effects that affect it.

Table II documents that the sow fertility expressed in terms of all piglets and live born piglets per litter reaches a peak in the fifth litter. The CVM x (LW x L) genotype gives a better reproduction performance than the PN x (LW x L) combination.

The reproduction performance of sows in the operation concerned is significantly affected by genotype. It means that the environmental conditions there are at such a level that they allow to take advantage of the genetic progress achieved in the breeding sphere. The insignificance of the effects examined with respect to mortality suggests that mortality is affected by non-genetic, i.e. environmental factors.

Results of the growing and finishing phase are given in Table III. Both phases took place in the same pig house to ensure the same environmental conditions.

I. Reproduction indicators of the tested sows

Indicator	PN x (LW x L)			CVM x (LW x L)		
	x_1	s_1	v_1	x_2	s_2	v_2
Number of sows and gilts (head)	46			44		
Number of all piglets / litter (head)	10.76	2.60	24.16	11.82	2.94	24.87
Number of live piglets / litter (head)	9.46	2.33	24.63	10.21	2.47	24.19
Number of stillborn piglets/ litter (head)	1.30	1.47	113.10	1.61	1.30	81.25
Mortality / litter (head)	1.33	1.56	117.29	1.43	1.58	110.48
Number of reared piglets / litter (head)	8.13	1.94	23.86	8.78	1.93	21.98
Farrowing interval (days)	158.78	6.53	4.11	160.07	6.64	4.14
Average litter parity	3.48	0.94	27.01	3.20	0.98	30.65
I_{RR}	50.63	22.72	44.87	58.10	22.96	39.18
I_R	95.84	25.31	26.40	104.34	25.77	24.69

II. Least square means of the reproduction traits

Trait	Number of all piglets	Number of live born piglets	Number of stillborn piglets	Number of reared piglets	Mortality	Farrowing interval
Genotype						
PN x (LW x L), n = 46	9.97	8.72	1.29	7.59	1.13	161.39
CVM x (LW x L), n = 44	12.65	10.98	1.67	9.60	1.37	159.68
Litter parity						
II	10.63	9.48	1.15	8.40	1.08	158.73
III	11.31	10.02	1.28	8.39	1.62	158.47
IV	11.03	9.45	1.58	8.19	1.26	159.95
V	12.60	10.30	2.40	9.00	1.30	162.02
VI	11.00	10.00	1.00	9.00	1.00	163.50
Significance of effects						
Combination	A	A	C	A	C	C
Litter parity	C	C	C	C	C	C
Combination x litter parity	C	C	C	B	C	C

A – $P < 0.01$; B – $P < 0.05$; C – insignificant

III. Assessment of the growing (G) and finishing (F) phase of the tested crossbred combinations

Indicator		PN x (LW x L)		CVM x (LW x L)	
		G	F	G	F
Number of pigs moved in		80	72	82	76
Total initial weight	(kg)	410	1794	437	2045
Average initial weight	(kg)	5.12	24.92	5.33	26.91
Number of pigs moved out		72	62	76	73
Average final weight	(kg)	24.92	97.12	26.91	100.98
Duration of the phase	(days)	74	121	74	121
Total gain per phase	(kg)	1384	4227	1608	5327
No. of feeding days		5711	7839	5911	8823
ADWG	(g)	268	597	291	612
Mortality	(head)	8	6	6	2
Emergency slaughter	(head)	–	4	–	1
Feed conversion	(kg)	–	3.68	–	3.52

When assessing the fattening capacity of the crossbred combinations tested using the average daily weight gain (ADWG) and the feed conversion in the finishing phase, we may conclude that the CVM x (LW x L) achieved much better values. Nevertheless, these values are very low, especially in the growing phase (268 g and 291 g, respectively). This may be caused by the following:

Firstly, the tested piglets were weaned at 21 days of age, which is complicated in the conditions of our large-scale operations. The second cause of the low weight gains is the low initial weight of the piglets starting the growing phase (5.12 kg and 5.33 kg, respectively). According to the recommendations of various EU companies, the weight should be some 1.0–1.5 kg higher. This fact has significant implications for the growth intensity and costs of pig production. In our case, the experimental pigs should reach the live weight of 41–52 kg at the age of 95 days regardless of their genotype. Their live weight at the end of fattening in the age of 216 days should be at least 122 kg (Guyokrma, 1994).

From this perspective, there are serious shortcomings in the zootechnical work in the operation concerned, especially as regards the growing phase. The effects of the environment are such that they suppress the manifestation of the genotype as documented by the significance of the effects observed (see Table IV).

IV. Assessment of the fattening indicators of the crossbred combinations tested

Indicator	Total weight gain per phase	
Combination	growing	finishing
PN x (LW x L)	20.71	72.44
CVM x (LW x L)	20.68	74.27
Significance of effects		
Combination	C	C
Final weight	AA	AA

AA – $P < 0.001$; C – insignificant

V. Carcass value indicators of the crossbred combinations tested

Indicator		PN x (LW x L)		CVM x (LW x L)	
		$x_1 \pm sx_1$	s_1	$x_2 \pm sx_2$	s_2
Carcass weight in warm state	(kg)	$78.85^{A} \pm 1.803$	14.20	$81.94^{A} \pm 1.316$	11.24
Last rib backfat depth (Czech National Standard – mm)		$18.50^{B} \pm 0.662$	5.21	$20.68^{B} \pm 0.568$	4.68
Average backfat	(mm)	$19.99^{A} \pm 0.670$	5.28	$22.52^{A} \pm 0.573$	4.89
Lean meat share – ZP	(%)	$55.41^{A} \pm 0.425$	3.35	$52.69^{A} \pm 0.318$	2.72
pH_1 MLT		6.17 ± 0.036	0.28	6.14 ± 0.315	0.27

A – $P < 0.01$; B – $P < 0.05$

In order to examine carcass value and meat quality, 135 pigs were tested. Table V gives a summary of basic production indicators.

Table V shows that the difference of 3.09 kg in carcass weight is statistically significant with a higher weight reported for the CVM x (LW x L) combination. It means that the other carcass value indicators of the crossbred combinations tested are not comparable, as they are affected by the carcass weight value.

Therefore, the indicators examined were converted to a common carcass weight, as shown in Table VI.

The above table shows that in terms of the carcass value indicators the crossbred combination using the PN boars in C position gives better results. The significance of the effects examined indicates that the carcass value is not affected by genotype in this operation, which may suggest some shortcomings in the zootechnical as well as breeding work in the operation concerned.

VI. Carcass value indicators after conversion to a common carcass weight of 80.52 kg and assessment of significance of the effects examined

Indicator Combination	Backfat (CNS)	Average backfat	Lean meat share	pH_1 MLT
PN x (LW x L)	18.94	20.39	55.32	6.17
ČVM x (LW x L)	20.27	22.12	52.80	6.14
Significance of effects				
Combination	C	C	C	C
Carcass weight	AA	AA	A	C

AA – $P < 0.001$; C – insignificant

VII. Economic assessment of the field test by crossbred combinations

Indicator		PN x (LW x L)	CVM x (LW x L)
Costs in CZK per:	1 pig	615.10	659.10
	1 pig in growing phase	672.90	695.10
	1 feeding day in growing phase	8.48	8.48
	1 kg of weight gain in growing phase	35.00	35.20
	1 pig	1509.20	1519.30
	1 feeding day in finishing phase	11.90	12.60
	1 kg of weight gain in finishing phase	22.10	20.80
Sales in CZK per:	1 head	2 789.10	2 962.80
	1 kg of live weight	28.80	29.50
	1 kg of carcass weight	35.40	36.20
Profit per pig		–8.10	188.70
Profitability (%)		–0.30	6.80

Based on the assessment of reproduction and production performance a comprehensive economic assessment of the crossbred combinations tested was carried out using a profit function. Results of the assessment are given in Table VII.

The above table shows that the difference in profit per slaughter pig between the crossbred combinations examined is substantial. The CVM x (LW x L) combination gave a per pig profit of CZK 188.70 per pig what was by CZK 196.80 more than the other combination with a loss of CZK 8.10 per pig. Considering the annual turnover of the 2.87 fattening rounds, the PN x (LW x L) combination would result in a loss of CZK 24.30 per capacity unit while the ČVM x (LW x L) combination gives a profit of 565.90 CZK per capacity unit.

The CVM x (LW x L) combination appears more suitable for the operation concerned as its profitability is better.

CONCLUSION

The experiment examines the performance of two crossbred combinations in a large-scale operation using a field test. The two combinations examined were CVM x (LW x L) and PN x (LW x L). For them, reproduction performance was assessed in 44 and 46 litters, respectively, and production performance was assessed in 135 pigs. Finally, an economic assessment was carried out using profit functions. Linear models with fixed and random effects were used to analyse the significance of effects affecting the reproduction and production performance.

The following conclusions may be drawn from the experiment:

- Reproduction performance of the CVM x (LW x L) crossbred combination was significantly higher than that of the PN x (LW x L) combination. It was also confirmed that the reproduction performance is affected by genetic effects, which allows the production sphere to take advantage of the genetic progress achieved in the breeding sphere.
- As regards fattening indicators, the PN x (LW x L) pigs had a lower growth capacity compared to the CVM x (LW x L) pigs with the values achieved being at a very low level, affected primarily by environmental factors.
- PN x (LW x L) combination had significantly better results in carcass value assessment, especially as regards lean meat share. Also here, however, the indicators are not affected by the crossbred combination (genotype), but only by the weight achieved.
- From the economic point of view, the genotype of CVM x (LW x L) pigs appears more suitable for the operation concerned.
- The usefulness of field tests which are capable of optimising the selection of crossbred combinations with minimum costs as well as to reveal the effects that significantly affect the performance in the given operation was confirmed.

References

BLENDL, H. M.: Stichprobentest mit Hybridschweinen. Schweinez. u. Schweinemast, *26*, 1978: 16–18.

GUYOKRMA, s.r.o.: Tabulka růstové schopnosti prasat, firemní materiál (Table of growth capacity of pigs, business material). 1994.
JAKUBEC, V.: Uplatnění biometrické genetiky ve šlechtění hospodářských zvířat (Application of biometrical genetics in livestock breeding). Sbor. ČSAZ, *133*, 1990.
JAKUBEC, V.: Obecný model pro genetické efekty v šlechtění živočichů (General model for genetic effects in animal breeding). Živoč. Výr., *38*, 1993: 861–873.
JAKUBEC, V. – PODĚBRADSKÝ, Z. – ČERNÁ, M. – VÍTEK, M.: Testace hybridních prasat v provozních podmínkách (Testing of hybrid animals in farm-scale conditions). [Final Report.] Praha-Uhříněves, VÚŽV 1981.
MOSKAL, V.: Metodika testace prasat při hybridizaci v provozních podmínkách (Methodology of pig testing in hybridization in farm-scale conditions of commercial breedings). Praha-Uhříněves, VÚŽV 1984a.
MOSKAL, V.: Index reprodukční užitkovosti prasnic. Praha-Uhříněves, VÚŽV 1984b: 1–5.
MOSKAL, V.: Prováděcí metodika testace hybridních prasat v provozních podmínkách užitkových chovů. Praha-Uhříněves, VÚŽV 1986.
PODĚBRADSKÝ, Z. – JAKUBEC, V.: Ekonomika zemědělství, *10*, 1982: 471–474.
SAS/STAT. Users Guide (Release 6, 11). SAS Inst. Inc., Cary, NC, USA, 1997.
SELLIER, P.: The basis of crossbreeding in pigs. Livest. Prod. Sci., *3*, 1976: 203–226.
SCHEPP, W.: Der British Warentest an Deutscher Schicht. Schweinez. u. Schweinemast, *8*, 1980: 254–255.
SMITH, D. T.: Warentest von Hybridschwein in Grossbritanien. Tierzüchter, *29*, 1977: 381–387.
ŠPRYSL, M. – STUPKA, R.: Provozní testace v užitkovém chovu. (Farm-scale testing in commercial breeding). [Final Report.] Praha, AF VŠZ 1990.
ŠPRYSL, M. – STUPKA, R.: Polní testace – racionální opatření v chovu prasat (Field testing - rational measurements in pig breeding). Zeměd. Ekon., *37*, 1991: 479–491.
ŠPRYSL, M. – MOSKAL, V. – POUR, M.: Vyhodnocení testace hybridních prasat v provozních podmínkách SZP Sychrov (Evaluation of the testing of hybrid animals in farm-scale conditions of SZP Sychrov). [Final Report.] Praha, AF VŠZ 1988.
ŠPRYSL, M. – STUPKA, R. – BEER, J.: Provozní testace prasat – zdroj ekonomické úspěšnosti v chovu (Farm-scale testing of pigs – source of economic successfulness in breeding). Zeměd. Ekon., *44*, 1998: 557–562.
ŠPRYSL, M. – STUPKA, R. – POUR, M.: Uplatnění plemene duroc v pozici C v užitkových velkochovech v rámci polních testací (The use of the Duroc breeding in C position in commercial large-scale breedings within field testing). In: Proc. Conf. VŠVaF Brno, 1993: 30–35.

Received for publication on March 15, 2000

ŠPRYSL, M. – STUPKA, R. – ČÍTEK, J. (Česká zemědělská univerzita, Agronomická fakulta, Praha, Česká republika):

Polní testace hybridních prasat v užitkovém velkochovu.

Scientia Agric. Bohem., *31*, 2000: 209–219.

Práce se zabývá hodnocením užitkovosti dvou kombinací křížení prasat z užitkového velkochovu pomocí polní testace. Byly hodnoceny genotypy ČVM x (LW x L) a PN x (LW x L). Reprodukční užitkovost byla vyhodnocena na podkladě 44, resp. 46 vrhů a produkční užitkovost na 135 jatečných prasatech obou kombinací.

V práci byla rovněž stanovena významnost fixních a náhodných efektů ovlivňujících reprodukční a produkční vlastnosti sledovaných genotypů pomocí lineárních modelů. Na základě dosažených výsledků lze konstatovat tyto závěry:

- Reprodukční užitkovost kombinace ČVM x (LW x L) dosáhla průkazně lepších výsledků v základních ukazatelích ve srovnání s kombinací PN x (LW x L). Pro chov to znamená uplatnění realizace genetického zisku, vzniklého ve šlechtění, v produkční sféře.
- Vlastnosti charakterizující výkrmnost, které nejsou ovlivňovány genetickými efekty, byly v daném chovu negativně ovlivněny efekty prostředí. Přesto lze konstatovat, že prasata kombinace PN x (LW x L) vykázala nižší intenzitu růstu než prasata genotypu ČVM x (LW x L).
- U kombinace PN x (LW x L) byla prokázána významně lepší úroveň jatečné hodnoty, zejména u procentuálního zastoupení svaloviny. V tomto případě byla jatečná hodnota ovlivněna především hmotností.
- Na základě ekonomického zhodnocení výsledků lze pro tento chov z uvažovaných genotypů doporučit kombinaci křížení ČVM x (LW x L).

prase; testace; reprodukce; výkrmnost; jatečná hodnota; kvalita; zisková funkce; lineární modely

Contact Address:

Ing. Michal Šprysl, Česká zemědělská univerzita, Agronomická fakulta, katedra chovu prasat a drůbeže, Kamýcká 129, 165 00 Praha 6-Suchdol, Česká republika, tel.: 02/20 92 22 51, fax: 02/20 92 03 12, e-mail: sprysl@af.czu.cz