THE EVALUATION OF NUCLEUS HERDS OF PIGS ON THE BASIS OF THEIR ECONOMIC EFFICIENCY*

L. Houška, J. Fiedler, J. Pavlík

Research Institute of Animal Production, Prague-Uhříněves, Czech Republic

Reproduction, utility traits and breeding measures in the nucleus herds of Czech White Improved (Large White) breed were evaluated by means of program EPOS. Selection intensity in the rearing of breeding gilts differed among herds from 3.1% to 80.6%, with an average of 52.7%. High level (from 84.5% to 98.5%, with the average of 94.2%) reached the selection intensity in the rearing of young breeding boars. The average costs/sow/year 45 118 CZK (from 34 629 to 59 213 CZK), the income/sow/year 47 354 CZK (from 36 742 to 62 615 CZK) and the profit/sow/year 2236 CZK (with range of –5319 to 10 180 CZK) were found. On the basis of the height of profit/sow/year, as an indicator of their economic efficiency, the herds can be ranked.

pig; nucleus herd; breeding measures; economic efficiency

INTRODUCTION

Application of BLUP – animal model as a method to estimate breeding value (Groeneveld et al., 1998; Wolf et al., 1998, 1999; Peškovičová et al., 1999a) put higher demands on individual nucleus herds not only from the point of view of reached yield and breeding value but management which have to establish these demands, too. The model equations embrace random effect of the herd or aggregated effect of herd x year x season (hys). According to Peškovičová et al. (1999b), there is no unambiguous answer, if environmental effect may be used as single effects or aggregated one. They remark, that answer depends on the structure of input data (frequency of subclasses of effects, or random sample of population or stratified sample according to done criteria). According to Wolf et al. (1999), for instance variability of average daily gain in Landrace breed (field test) depends by 18% on additive-genetic effect by 27% on effect of the herd and by 20% on common environment of the litter of origine. Altogether 65% of total variability may be explained by known factors, while the rest depends on unknown factors. Authors continue that for instance in the number of piglets born alive on the 2nd and higher parities the share of additive-genetic variance forms 13%, the share of herd–year–season 1% and permanent effect of the sow 3%. Only 16% of total variability can be explained by known factors, residual effect forms 84%.

Our former papers (Fiedler et al., 1984, 1989) and recent ones (Houška, Fiedler, 1996; Fiedler, Houška, 1998) pointed out high variability so with utility traits as breeding measures among nucleus herds. As nucleus herds are independent economic units in our conditions, it is self-evident that breeding measures must be chosen that way to reach appropriate profit in herds. But individual nucleus herds are approved, evaluated and reexamined by commission.

The objective of this paper was to evaluate appropriate breeding measures realized in individual nucleus herds using computer model of nucleus herd (program EPOS) which was created by Houška et al. (1992). It can be assumed that introduction of more precise estimation of breeding value according to the herds will be evaluated too, will be in consonance with economic efficiency reached in herds.

MATERIAL AND METHOD

Data from utility and heritability recording of the Czech White Improved (Large White) breed as the most spread one in the Czech Republic were used. Data used were from 1997 from database of The Union of Pig Breeders in Bohemia and Moravia. Only herds with stable level of utility traits and those with minimum of 4 classified young breeding boars within a year (performance test and type, constitution and exterior evaluation) and with minimum of 10 animals tested in performance test were included. The set of 40 nucleus herds (44% of total number of nucleus herds) with 5600 sows (65% of the whole breeding population) was then tested.

The herds were characterized by controlled traits of reproduction, i.e. average litter size at weaning, litter weight on 21st day and the length of farrowing interval. Average daily gain from birth till the end of the test (at 90 kg of liveweight in gilts or 100 kg in young breeding boars, respectively), average backfat thickness and lean meat percentage in gilts and young breeding boars recalculated to 100 kg of liveweight as traits of performance (field) test were evaluated then. Average daily gain, consumption of metabolisable energy (ME) per kg of

* Research was sponsored by Ministry of Agriculture of the Czech Republic (Project No. EP7123 of National Agency for Agricultural Research).

liveweight gain, main lean cuts percentage of halfcarcass, ham (bone in) percentage of halfcarcass and average backfat thickness as traits observed in station test were evaluated, too.

Breeding measures by which practised selection work may be characterized were evaluated in every nucleus herd. The most important one is selection intensity in rearing of young breeding animals or percentage of gilts and young breeding boars, respectively, not included into rearing and consequently destinated for fattening. In program EPOS this date is expressed as the share of the number of weaned animals of corresponding sex. As not all performance tested animals are permitted to classification according to the type, constitution and exterior, the total number of culled animals is determined, embracing both animals not introduced into rearing and performance tested animals that were not evaluated according to the type, constitution and exterior. Even in this case the share of culled gilts and young breeding boars is expressed as the percentage of the number of weaned animals of corresponding sex. Selection intensity when animals are classified according to the type, constitution and exterior (percentage of the number of breeding gilts and young breeding boars permitted to classification) have been evaluated, too. It should be noticed that this way of selection intensity determination may be used only in the herd where changes in breeding work arrangement are not too high within several years. There is some temporal shift (17–19 weeks) between the piglet rearing period and field test. So that changes for instance in the number of controlled sows or in herd replacement may cause inaccuracy of estimation. Adequate software is not used for more precise determination of selection intensity in rearing of young breeding animals, yet. Groeneveld's (1999) paper concerning processing of database systems may be noticed in this context.

Two other breeding measures are closely related. These are average number of parities in sow's lifetime and percentage of primiparous sows of the total number of controlled sows per year. Both these measures characterize longevity of sows and consequently herd replacement, too. First one has been stated on the basis of the number of weanings in sows that established "lifetime production" related to 31st of December of a current year. As well the size of the herd can be taken as breeding measure. Above-mentioned breeding measures need to be defined more precisely with herds evaluation and recording of them must be improved.

Economic efficiency of nucleus herd has been stated by means of bioeconomic model (EPOS) according to Houška et al. (1992), also referred in Fiedler, Houška (1998) with Large White, Landrace and Czech Meat breeds. Bioeconomic model allows to calculate total profit in individual herds according to reached efficiency and used breeding measures. Total profit/sow/year was used as a criterion of economic efficiency of the herd. The herds can be ranked according to this criterion, from the best to the worst.

RESULTS AND DISCUSSION

Table I shows the level of utility traits in 40 nucleus herds included into observation, Table II presents selection intensity in successive periods. It can be said, that range of values in observed utility trait is essentially lower than in breeding measures. Highest variability in utility traits was found in backfat thickness. Breeding measures did not show normal distribution due to prevailed production of gilts detrimental to production of young breeding boars in some nucleus herds. Due to this reason we did not calculate coefficient of variability in

I. Utility indices in the nucleus herds of Large White breed

Trait		$\bar{x}$	Min.	Max.	CV
Reproduction					
No. of weaned piglets/litter		9.7	8.6	11.6	6.05
Litter weight on 21st day		54.94	49.90	60.85	5.87
Farrowing interval		171	158	212	6.39
Field test					
Average daily gain in gilts	(g)	559	496	603	5.14
Average daily gain in boars	(g)	627	563	676	4.84
Backfat thickness in gilts	(cm)	1.09	0.90	1.37	9.43
Backfat thickness in boars	(cm)	1.10	0.76	1.46	11.75
Lean meat percentage in gilts		58.29	56.10	60.10	1.58
Lean meat percentage in boars		59.27	56.10	62.30	1.91
Station test					
Average daily gain	(g)	895	797	972	4.68
Consumption of ME	(MJ)	35.48	32.60	40.10	4.06
Main lean cuts percentage of halfcarcass		52.44	49.19	54.18	2.39
Ham percentage of halfcarcass		21.30	19.31	22.66	3.31
Average backfat thickness	(cm)	1.91	1.47	2.59	11.57

II. Breeding measures in the nucleus herds of Large White breed

Indices	$\bar{x}$	Min.	Max.
Selection intensity in gilts			
Not included into rearing[1)]	52.7	3.1	80.6
Total number of culled animals at the end of rearing[1)]	71.0	39.1	90.6
Discarded in classification[3)]	38.6	11.7	61.7
Selection intensity in young boars			
Not included into rearing[2)]	94.2	84.5	98.5
Total number of culled animals at the end of rearing[2)]	98.6	95.7	99.6
Discarded at classification[4)]	70.6	28.0	92.2

[1)] number of weaned gilts = 100%
[2)] number of weaned young boars = 100%
[3)] number of gilts permitted to classification = 100%
[4)] number of young boars permitted to classification = 100%

III. The evaluation of nucleus herds in Large White according to costs, income and profit recalculated per sow and year

Economic indices	$\bar{x}$	Min.	Max.	CV
Costs	45 118.2	34 628.6	59 212.9	11.53
Income	47 354.4	36 742.2	62 614.6	12.85
Profit	2 236.2	–5 318.7	10 179.6	39.94

breeding measures, but it is evident that the range of values is in most cases substantially more extensive than in utility traits.

Nucleus herds' task is, besides improving of utility traits level, the production of gilts for use in multiplier herds, too. Selection intensity in the rearing of breeding gilts averaged 52.7%, with distinctive differences among the herds (from 3.1 to 80.6%). Further 18.3% of gilts were culled after performance test, i.e. totally 71% of gilts (of the number of weaned gilts) were culled at the end of rearing (from 39.1 to 90.6%). On average 29.0% of gilts were permitted to classification. From this number of gilts 38.6% (from 11.7 to 61.7%) were discarded classifying them for type, constitution and exterior evaluation.

There was substantially high intensity of selection in the rearing of young breeding boars. On average 94.2% of the number of weaned male piglets were not included into rearing (from 84.5 to 98.5%) and further 4.4% were culled after performance test (from 95.7 to 99.6%). Totally 98.6% of young boars were culled at the end of rearing. Only 1.4% of young boars were permitted to classification. From this number of boars 70.6% were discarded classifying them for type, constitution and exterior evaluation. Also in this case high variability among the herds was found. Only 8 herds (20%) reared more than 10% of young breeding boars. High differences among the herds were found when classifying boars. Even herds with more than 92% of young boars discarded in classification were observed.

The size of the nucleus herd or the number of controlled sows, respectively, may be considered (in some sense) for breeding measure, too. In observed set the herd size, expressed as the number of controlled sows within a year, moved from 46 to 471 pieces, while the share of the herds with less than 100 sows was 37.5%, the share of the herds with 101 to 200 sows was 47.5% and only 15% of the herds exceeded 200 sows.

The share of primiparous sows from the total number of controlled sows showed high variability (from 16.7 to 81.8%), with average of 42.2%. Average number of weanings per sow's lifetime (3.5 weanings) established distinctive variability, too (from 2 to 5.5 litters).

The efficiency of the herds as from the point of view of reached level of utility traits, as appropriate breeding measures chosen, have been evaluated by means of bioeconomic model of the nucleus herd (program EPOS). As mentioned above, average profit reached per sow and year has served as a criterion of economic efficiency of the herd. Table III brings average costs, income, profit and variability range. Brought values confirm high variability in observed set of nucleus herds. It is surprising that 20% of the herds sustained a loss.

The results of economic efficiency evaluation allow to determine the rank of the herds according to profit reached. In the frame of selection programme within the whole population it can serve a decision of subsequent acting of inefficient herds in the field of breeding.

Suitability of the use of bioeconomic model is illustrated by indices of performance and breeding measures in the worst, average and the best herds (Tables IV and V). It can be concluded from the differences between the performance of the worst and the best herds, that profit is influenced the most by the number of weaned piglets and by all traits of fattening capacity and carcass value with except of percentage of main lean cuts of halfcarcass weight.

Indices of selection intensity in the rearing of gilts indicate advantage of rigorous preselection in the choice

IV. The evaluation of nucleus herds of Large White breed according to utility level

Herd	No. of weaned piglets		Performance test						Progeny test	
			average daily gain (g)		lean meat percentage		backfat thickness (cm)		average daily gain (g)	main lean cuts %
	per litter	total	gilts	boars	gilts	boars	gilts	boars		
The worst	9.3	178	546	600	56.1	57.0	1.37	1.45	948	51.51
Median	9.8	171	582	646	59.3	60.2	1.02	1.03	899	52.55
The best	11.6	168	577	673	59.1	59.5	0.92	1.02	967	50.18

V. The evaluation of nucleus herds in Large White breed according to breeding measures

Herd	Selection intensity						First parity gilts (%)	No. of weanings per lifetime	No. of controlled sows
	gilts			young boars					
	not included into rearing[1)]	not permited to class.[1)]	discard. in class.[3)]	not included into rearing[2)]	not permited to class.[2)]	discard. in class.[4)]			
The worst	30.0	19.4	27.7	97.6	0.9	37.5	56.5	3.26	46
Median	40.7	25.7	43.4	84.5	13.6	88.0	51.2	2.65	129
The best	78.1	4.3	19.6	98.4	0.4	28.0	37.0	3.80	146

[1)] number of weaned gilts = 100%
[2)] number of weaned young boars = 100%
[3)] number of gilts permitted to classification = 100%
[4)] number of young boars permitted to classification = 100%

of gilts for rearing and milder selection intensity in classification of reared gilts. Selection intensity of young breeding boars seems not to participate expressively in the height of profit in the dam breed. Further, it can be mentioned that herds with lower herd turnover, i.e. with lower share of sows on 1st and 2nd parity and consequently higher age reached by sows, will have lower costs. It appears, neither herd size does influence the height of profit significantly.

It can be concluded that evaluation of herds need to include information about breeding measures, particularly selection intensity in the rearing of young breeding animals, but methodology must be defined more precisely. Further it can be recommended to evaluate the herds also on the basis of their economic efficiency, for instance by means of bioeconomic model of the nucleus herd. It can induce pressure on lowering the variability among the herds and conceivably allow to eliminate unsuccessful herds from the breeding sphere.

REFERENCES

FIEDLER, J. – HOUŠKA, L.: Hodnocení šlechtitelských chovů prasat pomocí bioekonomického modelu (Evaluation of breeding pig rearings using bioeconomic model). In: XVIII Genetic Days, České Budějovice, 8.–10. 9. 1998.

FIEDLER, J. – ŠILER, R. – KLUSÁČEK, J.: Struktura populace prasat bílé ušlechtilé (The structure of the pig population Large White breed). Živoč. Výr., *29*, 1984: 909–915.

FIEDLER, J. – HOUŠKA, L. – PULKRÁBEK, J. – PRAŽÁK, J.: Vliv velikosti chovu na užitkovost prasat (The effect of size of breeding on pig efficiency). In: Proc. Current Issues of Pig Breeding in the Slovak Socialist Republic, Banská Bystrica, 18.–19. 5. 1989: 93–98.

GROENEVELD, E.: Obecně adaptovatelný systém pro management dat ve šlechtitelských programech u prasat (Generally adaptable system for management of data in breeding programmes in pigs). In: Proc. Estimate of Breeding Value in Pigs in the Czech and Slovak Republics – Current Situation and Prospects of Further Development, VÚŽV Prague-Uhříněves, 26. 4. 1999: 3–14

GROENEVELD, E. – WOLF, J. – WOLFOVÁ, M. – JELÍNKOVÁ, V. – VEČEŘOVÁ, D.: Schätzung genetischer Parameter für tschechische Schweinerassen mit einem Mehrmerkmals-Tiermodell. Züchtungskunde, *70*, 1998: 96–107.

HOUŠKA, L. – FIEDLER, J.: Posouzení ekonomické efektivnosti šlechtitelských chovů prasat bílého ušlechtilého plemene (Evaluation of economic efficiency of breeding pig rearings of the Large White breed). In: Proc. Current Problems of Breeding, Health, Growth and Production of Pigs, JU České Budějovice, 6.–7. 2. 1996: 63–65.

HOUŠKA, L. – FIEDLER, J. – PULKRÁBEK, J.: Bioekonomický model šlechtitelského chovu prasat (Bioeconomic model of breeding pig rearing). Živoč. Výr., *37*, 1992: 1009–1015.

PEŠKOVIČOVÁ, D. – WOLF, J. – GROENEVELD, E.: Stabilita odhadov genetických parametrov ošípaných (Stability of estimates of genetic indicators of pigs). In: Proc. Current Problems of Breeding, Health, Growth and Production of Pigs, JU České Budějovice, 9.–10. 2. 1999a: 28–29.

PEŠKOVIČOVÁ, D. – GROENEVELD, E. – KUMIČÍK, M. – WOLF, J. – ŘEHÁČEK, P.: Odhad plemennej hodnoty

ošípaných v Slovenskej republike – aktuálny stav a perspektívy (Breeding value estimates of pigs in the Slovak Republic – current situation and prospects). In: Proc. Breeding Values Estimates in Pigs in the Czech and Slovak Republics – Current Situation and Prospects of Further Development. VÚŽV Prague-Uhříněves, 26. 4. 1999b.

WOLF, J. – PEŠKOVIČOVÁ, D. – GROENEVELD, E. – JELÍNKOVÁ, V. – ADÁMKOVÁ, Š.: Stability of breeding value estimates for production traits in the Czech Republic. In: XVIII Genetic Days, České Budějovice, 8.–10. 9. 1998.

WOLF, J. – GROENEVELD, E. – PEŠKOVIČOVÁ, D. – WOLFOVÁ, M. – JELÍNKOVÁ, V. – PRAŽÁK, Č. – FIEDLER, J.: Odhad plemenné hodnoty u prasat v České republice aktuální stav a perspektivy dalšího vývoje (Breeding value estimate in pigs in the Czech Republic and in Slovakia). In: Proc. Breeding Value Estimate in Pigs in the Czech Republic and in Slovakia - current situation and prospects of further development. In: Proc. Breeding Values Estimates in Pigs in the Czech and Slovak Republics – Current Situation and Prospects of Further Development. VÚŽV Prague-Uhříněves, 26. 4. 1999: 15–39.

Received for publication on November 6, 2000
Accepted for publication on November 5, 2001

HOUŠKA, L. – FIEDLER, J. – PAVLÍK, J. (Výzkumný ústav živočišné výroby, Praha-Uhříněves, Česká republika):

Hodnocení šlechtitelských chovů prasat na základě jejich ekonomické výkonnosti.

Scientia Agric. Bohem., *33*, 2002: 25–29.

Pro posouzení vhodných plemenářských opatření realizovaných v jednotlivých šlechtitelských chovech pomocí tzv. bioekonomického modelu ŠCH (EPOS), který vypracovali H o u š k a et al. (1992), bylo využito nejrozšířenějšího plemene chovaného v ČR, tj. bílého ušlechtilého. Do sledování bylo zařazeno 40 šlechtitelských chovů s 5 600 prasnicemi v kontrole užitkovosti, což činí 44 % z celé populace šlechtitelských chovů a 65 % z počtu prasnic v kontrole užitkovosti. Pro charakteristiku užitkovosti chovů byly vybrány znaky reprodukce, znaky z testu vlastní užitkovosti (polního testu) a znaky ze staničního testu. Z plemenářských opatřeních byla hodnocena intenzita selekce při odchovu plemenných zvířat, velikost chovu, podíl prasniček na prvním vrhu a počet vrhů za dobu působení prasnic v chovu. Intenzita selekce při odchovu prasniček se v jednotlivých chovech pohybovala od 3,1 do 80,6 % s průměrem 52,7 %. Vysoká intenzita selekce byla při odchovu kanečků, a to 94,2 % (od 84,5 do 98,5 %). U sledovaného souboru se velikost chovů pohybovala v rozmezí 46 až 471 prasnic. Vysokou variabilitu vykazoval i podíl prasnic na prvém vrhu z celkového počtu prasnic v kontrole užitkovosti, a to od 16,7 do 81,8 %, kdy průměrný chov dosahoval 42,2 %. Rovněž průměrný počet vrhů na prasnici po dobu jejího působení v chovu (3,5 vrhů) vykazoval výraznou variabilitu (od 2 do 5,5 vrhů). Za kritérium ekonomické efektivnosti daného chovu byl považován zisk dosažený na prasnici a rok. Celkové náklady v chovu přepočtené na prasnici a rok dosahovaly 45 118 Kč (od 34 629 do 59 213 Kč), příjmy 47 354 Kč (od 36 742 do 62 615 Kč) a zisk 2 236 Kč (od –5 319 do 10 180 Kč). Výsledky z bioekonomického modelu umožňují určit pořadí chovů podle výše dosaženého zisku, což by bylo možné využít v další šlechtitelské práci.

prase; šlechtitelský chov; plemenářská opatření; ekonomická efektivnost

Contact Address:

Ing. Lubor H o u š k a, CSc., Výzkumný ústav živočišné výroby, 104 00 Praha 10-Uhříněves, Česká republika, tel.: 02/67 71 17 47, l. 276, fax: 02/67 71 07 79, e-mail: houska@vuzv.cz