KRMIVA

THE EFFECT OF CROSSING BETWEEN LANDRACE AND YORKSHIRE IN RELATION TO MATERNAL HETEROZIS

UTJECAJ KRIŽANJA IZMEĐU LANDRASA I JORKŠIRA NA POJAVU HETEROZISA MAJKE

D. Lukač, V. Vidović, Jovanka Krnjaić, Ljuba Štrbac, V. Višnjić, M. Stupar

Original scientific paper – Izvorni znanstveni članak
Received – Primljeno: 12. April – travanj 2012

SUMMARY

The analysis was done at a nucleus and two commercial farms using 1243 purebred Danish Landrace (LL) and Danish Yorkshire (YY) sows and 1344 F_1 produced by reciprocal crossing between them. Selection criteria were the same for DL and DY. So, as expected the reciprocal crosses showed no significant differences between them on reproduction traits. But the differences between purebreds and their product of F_1 sows showed statistically significant effect ($P< 0.05$) named as maternal heterosis. The F_1 sows compared to purebreds, showed superiority of the following traits: age at first fertile mating, number of alive born and stillborn piglets, weight at birth, number of piglets and weight at weaning, daily gain at suckling. All these differences were statistically significant ($P<0.05$). The level of heterosis was measured as the differences of average between DL and DY compared to their F1 sows. Value of heterosis showed variation from 4.7% for age at first fertile mating to 8.72% for number of live piglets. The statistical analysis confirms significant differences between farms. Season effect at both farms showed statistically significant differences. Most of the analyzed traits showed similar tendency in purebred as well as in F_1 during production life.

Key words: reproductive traits of pigs, crossbreeding, heterosis effec

INTRODUCTION

Starting from the knowledge that some important traits found in divergent genetic addiction are not the same selection criteria defined in fertile compared to meat-breed terminal. Knowing the value of genetic parameters used for the study of natural breeders action of genes, primarily additive, modeling selection criteria and selection of breeding direction. Those farmers are divided on the fertile breed, i.e. milk (Landrace and Yorkshire) and meaty, i.e. terminal (Duroc, Hampshire and Pietrain). As a result of this knowledge specialized pig farms were created - the nucleus and commercial farms (Vidović et al., 2011).

In the nucleus farm is located genetically superior perfectly healthy material, and used to produce desirable effects of selection in pure breed and hybrid of both sexes. Hybrid producing animals get different types of heterosis in order to engage non-additive genes, to produce the desired recombination of genes responsible for the genetic variability of traits, without which selection would not be effective (Bass et al., 1992; Vidović and Lukač, 2010). Many estimates of breed and heterosis effects on reproductive traits of pigs have been reported, but estimates of recombination or epistatic effects are scarce. Recombination loss, hereafter referred to as recombination, is the breakup of epistatic effects

MSc Lukač Dragomir, Assistant, Dr. Vidović Vitomir, Professor, MSc Štrbac Ljuba, Dr. Stupar Milanko, Scientific Adviser, Faculty of Agriculture, Novi Sad, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia.
Dipl. ing Krnjaić Jovanka, DELTA Agrar, 22300 Stara Pazova, Golubički put bb., Serbia.
Dipl. ing Višnjić Vladislav, Carnex Ltd, Meat industry,Vrbas, Kulski put 26, 21460 Vrbas, Serbia

during meiosis forming un-parental interlocus combinations of alleles in gametes of crossbred parents (Vidović and Lukač, 2010). Maternal heterosis is usually manifested in regular oestrus females reaction, increased fertility, a larger number of weaned piglets per sow per year and higher milk production, increased resistance to disease and stable constitution (Vidović, 2009). In sows from F1 generation there is maximum heterozygosis. In case of a cross of L x Y, F_1 sows manifest maximum maternal heterosis. As for the health status of animals they must be healthy, with no treatment, with selective vaccination (Parvo, Vrbanac and Klostridia). Basic criteria are that breeding-seed material must be healthy. To achieve this it is necessary to apply the new knowledge in the field of sows feeding technology, insemination technology, and to optimize some important parameters, e.g.: humidity, air velocity, temperature and light, which significantly affect the development of the genome (Vidović and Šubara, 2011).

The newer genotypes of pigs are far more sensitive than the older traditional genotypes, and therefore attention must be paid to the proper upbringing of pigs on the farm (Young and Aherne, 2005; Foxcroft and Aherne, 2001; Radojković et al. 2005). Age and body weight of gilts at puberty and the occurrence of fertile estrus were subjected to stronger interaction between the genetic basis (Krnjaić et al., 2012; Cotton, 2001; King, 2002) and numerous factors and paragenetic (Evans and O'Doherty, 2001; Peltoniemi et al., 2005). A particularly important aspect in pig production is an adaptation of modern aspects of managers in farm production.

As stated above, the aim of this study was to determine the level of heterosis and hybrid superiority obtained by mating Landrace and Yorkshire females for basic reproductive parameters in relation to the pure breed.

MATERIAL AND METHODS

Research was done on 1.243 purebreds in a nucleus farm (L = 652, Y = 591) and 1.344 F_1(LY = 632, YL = 712) sows in two commercial farms. Both purebreds L and Y wee selected applying the same selection criteria. The data are from a nucleus farm that produces pure breeds and a commercial farm that uses hybrid gilts obtained from the nucleus farm, including 2 years (8 seasons). To optimize analysis LSQ (least squares equation), mixed model equation and maximum likelihood equation were used. Maternal heterosis effect was been measured as differences between averages of purebreds to F_1 contemporaries in reproductive traits.

Mixed Model Equation was used, model 1:

$$\mathbf{Y_{ijklm} = \mu + A_i + FS_{ij} + R_{ijk} + S_{ijkl} + E_{ijklm}}$$

$\mathbf{Y_{ijk}}$ – observed traits

$\boldsymbol{\mu}$ **-** average mean of traits

$\mathbf{A_i}$ – fixed effect of age

$\mathbf{FS_{ij}}$ **-** fixed effect of farms and seasons

$\mathbf{R_{ijk}}$ – fixed effect of breeds (genotypes)

$\mathbf{S_{ijkl}}$ – sire random effects

$\mathbf{E_{ijklm}}$ – "error"

RESULTS AND DISCUSSION

In Tables 1 to 4 reproductive performances are presented up to the third parity Landrace, Yorkshire and F_1 gilts obtained by crossing them. In intensive commercial pig production use of crossbred sows is desirable and economically viable to exploit heterosis effect of reproductive traits. Hybrid sows were superior in all studied traits related to pure breed. Number of alive born and weaned piglets was significantly higher in F_1 compared to the tested pure breed. F_1 sows had more than one live born piglet per litter, and had one more weaned piglet in relation to the purebred Landrace and Yorkshire. Similar results were recorded by Bass et al., 1992; Rothschild, 1996; Veljić et al., 1997; Bizelis et al., 2000; Savić et. al., 2012.

From the aspect of management at the farm, the difference is very important, especially for farms with several thousands of farrowing during the year. Piglets of hybrid sows had higher daily weight gain, which automatically resulted in a higher body weight at weaning.The current strategy of selection and cross-breeding showed significant improvement when it comes to litter size at birth and weaning. The selection obtained Landrace and Yorkshire, particularly in Denmark produce 11-15 and more weaned piglets per sow per year compared to the existing ones. New selections in our conditions showed al-

Table 1: Reproductive parameters of Landrace sows

Tablica 1. Reprodukcijski pokazatelji landras krmača

Age at 1st insemination, days - Dob kod prve inseminacije, dana	Parity - Paritet	Alive born - Živih	Stillborn - Mrtvih	Weight at birth, kg - Masa pri prašenju,g	Weaned - Odbijenih	Lactation length, days - Trajanje laktacije, dana	Weight at weaned, kg - Masa kod odbića, kg	Daily gain at suckling, g - Dnevni prirast na sisi, g
280	1	14.0	2.3	1.260	11.5	28	6.700	0.190
	2	14.5	2.5	1.370	12.3	28	7.200	0.207
	3	12.0	3.0	1.380	11.2	28	7.100	0.206
Average - Prosjek		13.5	2.6	1.336	11.6	28	7.000	0.201

Table 2: Reproductive parameters of Yorkshire sows

Tablica 2. Reprodukcijski pokazatelji jorkšir krmača

Age at 1st insemination, days - Dob kod prve inseminacije, dana	Parity - Paritet	Alive born - Živih	Stillborn - Mrtvih	Weight at birth, kg - Masa pri prašenju, kg	Weaned - Odbijenih	Lactation length, days - Trajanje laktacije, dana	Weight at weaned, kg - Masa kod odbića, kg	Daily gain at suckling,g - Dnevni prirast na sisi g
275	1	13.3	2.7	1.270	11.4	28	6.380	0.180
	2	13.5	1.8	1.250	12.6	28	7.280	0.208
	3	14.3	1.9	1.300	11.3	28	8.200	0.230
Average - Prosijek		13.7	2.2	1.273	11.7	28	7.280	0.206

Table 3: Reproductive parameters of F_1 sows (Landrace x Yorkshire)

Tablica 3. Reprodukcijski pokazatelji F_1 krmača (landras x jorkšir)

Age at 1st insemination, days - Dob kod prve inseminacije, dana	Parity - Paritet	Alive born - Živih	Stillborn - Mrtvih	Weight at birth, kg - Masa pri prašenju, kg	Weaned - Odbijenih	Lactation length, days - Trajanje laktacije, dana	Weight at weaned, kg - Masa kod odbića, kg	Daily gain at suckling,g - Dnevni prirast na sisi, g
268	1	14.5	3.4	1.300	12.3	28	7.120	0.210
	2	15.2	2.3	1.390	13.3	28	8.230	0.230
	3	16.0	3.5	1.490	14.2	28	7.350	0.250
Average- Prosijek		15.23	3.06	1.393	13.2	28	7.560	0.230

Table 4: Reproductive parameters of F_1 sows (Yorkshire x Landrace)

Tablica 4. Reprodukcijski pokazatelji F_1 krmača (jorkšir x landras)

Age at 1st insemination, days - Dob kod prve inseminacije, dana	Parity - Paritet	Alive born - Živih	Stillborn - Mrtvih	Weight at birth, kg - Masa na rođenju, kg	Weaned - Odbijenih	Lactation length, days - Trajanje laktacije, dana	Weight at weaned, kg - Masa na odbiću, kg	Daily gain at suckling,g - Dnevni prirast na sisi, g
260	1	13.9	2.3	1.310	12.0	28	7.430	0.220
	2	14.8	3.1	1.410	12.4	28	8.350	0.230
	3	15.4	2.8	1.620	13.8	28	7.250	0.250
Average- Prosijek		14.7	2.73	1.446	12.73	28	7.676	0.233

Table 5: The level of maternal heterosis

Tablica 5. Razina heterozisa majke

Traits - Osobine	Maternal heterosis, % - Heterozis majke, %
Age at first farrowing, days - Dob kod prvog prašenja, dana	4.7
Alive born piglets - Živooprašene prasadi	8.72
Stillborn piglets - Mrtvooprašene prasadi	17.2
Weight at birth - Masa pri prašenju	7.44
Weaned piglets - Odbijene prasadi	10.1
Weight at weaned- Masa kod odbića	14.00
Daily gain at suckling- Dnevni prirast na sisi	12.12

most the same roles. In practical production conditions in the nucleus farm one sow is expected produce 10 daughters. From these 10 the next year are 100, and 100 of these next year give 1000 peers (Vidović i Šubara, 2011, Vidović et al., 2011). This high fertility provides a high intensity of selection and rapid genetic progress (Vidović, 2009).

CONCLUSION

The obtained results indicate that the differences in fertility between pure breeds can be successfully used in crossing to obtain one of three types of heterosis. Heterosis effect is manifested in all the studied reproductive traits. All differences were statistically significant. Statistical analysis confirmed that there were no significant differences between the management of the farm, while the effect of season

on the farms showed statistical differences. Selection breeds combined production ability can not be more efficient than selection of specialized breeds (fertile and meaty), because the selection limit is achieved at a lower level, and the genetic variance of individual properties remain unused. Therefore, selection and crossing can be an alternative to the realization of the breeding program. On the contrary, the genetic improvement of breeding methods should greatly contribute to reducing the production cost of pig's meat. Choice of crossing schemes and selection criteria of specialized breeds of pigs with successive testing of potential parents to the appropriate quantitative traits and the correct choice of the selection criteria of the index will lead to maximizing genetic progress per unit time, and proportionally reduce the production costs of the farm.

REFERENCES

1. Baas, T.J., Christian, L.L., Rothschild, M.F. (1992): Heterosis and recombination effects in Hampshire and Landrace swine: I. Maternal Traits. J. Anim. Sci, 70: 89–98.
2. Bizelis, A., Kominakis, E., Rogdakis, F. (2000): Genetic parameters of production and reproductive traits on a farm tested Danish Large White and Landrace swine in Greece Arch. Tierz. Dummerstorf, 43: 287–297.
3. Cotton, B. (2001): Reproductive Development in Gilts. Manitoba Agriculture and Food (Livestock), May,1-2.
4. Evans, O.C.A., O'Dohert, V.J. (2001): Endocrine changes and management factors affecting puberty in gilts. Livestock. Prod Sci., 68(1): 1-12.
5. Foxcroft, G., Aherne, F. (2001): Rethinking Management of the Replacement Gilt. Advances in Pork Production, 12: 197-210.
6. King, G. (2002): Reproductive Management of Pigs Points to Consider: The Importance of Reproductive Performance. Anim Sci.1-8.
7. Krnjaić, J., Vidović, V., Lukač, D., Višnjić, V., Vučenov, D., Bilić, S. (2012): Intenzitet porasata nazimica plodnih rasa u dedovskoj generaciji i veličina legla. X međunarodni znanstveno-stručni skup: Poljoprivreda u zaštiti prirode i okoliša, 04.-06. lipnja, Vukovar. 108-113.
8. Peltoniemi, O.A.T., Tas, T.A., Virolainen, J.V., Karkamo, V., Heinonen. M., Andersson, M.A. (2005): Nighttime Melatonin Secretion and Seasonally Delayed Puberty in Gilts. Reprod Dom Anim.,40: 224-227.
9. Rothschild, MF. (1996): Genetics and reproduction in the pig. Anim. Reprod. Sci., 42:143–151.
10. Savić, M., Vidović, V., Lukač, D., Višnjić, V., Stupar, M., Brčin, D., Jugović, D. (2012): Heterozis individue F1 generacije između landrasa i jorkšira. 5th International scientific/professional conference agriculture in nature and environment protection, 4-6 June, Vukovar, Croatia. 125-129.
11. Young, M., Aherne, F. (2005): Gilt development: a review of the literature. In: Proceedings of the 2005 American Association Swine Veterinarians, Seminar 1, Toronto, Ont, 1–10.
12. Veljić, M., Vidović, V., Marković, M., Adžić, N. (1997): Heterosis effects of reproductive traits of sows in two and three-crossbreeding schemes. Poljorivreda i šumarstvo. 43 (3): 107-116.
13. Vidović, V., Lukač, D. (2010): Genetika životinja. Poljoprivredni fakultet, Novi Sad. 361 pp
14. Vidović, V., Višnjić, V., Jugović, D., Punoš, D., Vuković N. (2011): Praktično svinjarstvo. Asocijacija proizvođača svinja i mesa-APROSIM, Novi Sad, 285 pp.
15. Vidović, V., Šubara, V. (2011). Farmski menadžment - ključ uspeha. Univerzitet u Novom Sadu, Poljoprivredni fakultet, Novi Sad, 146 pp.
16. Vidović, V. (2009): Principi i metodi oplemenjivanja životinja. Poljoprivredni fakultet, Novi sad, 348 pp.

SAŽETAK

Analiza podataka je urađena na jednoj nukleus i dvije komercijalne farme, i to na 1243 krmače čistih pasmina danskog landrasa (LL) i danskog jorkšira (YY), te 1344 križanki dobivenih uzajamnim križanjem između ove dvije čiste pasmine. Kriteriji selekcije za danskog landrasa i jorkšira su isti. U obrađenim podacima, kao što se i očekivalo, između uzajamnih križanja nije ustanovljena razlika u promatranim reproduktivnim osobinama. Međutim, između čistih pasmina i njihovih F_1 hibridnih

krmača, ustanovljena je statistički signifikantna razlika ($P< 0,05$), zbog pojave heterozisa majke. F_1 krmače u usporedbi s krmačama čistih pasmina, pokazale su se superiornije u slijedećim osobinama: dobi kod prve fertilne oplodnje, broju živooprašene i mrtvooprašene prasadi, masi pri prašenju, broju odbijene i masi odbijene prasadi, kao i dnevnom prirastu prasadi na sisi. Sve ove osobine su imale statistički signifikantne razlike ($P<0,05$). Razina heterozisa je dobivena kao razlika između prosjeka danskog landrasa i jorkšira s jedne strane, i F_1 krmača sa druge strane u svim promatranim osobinama. Razina ovog tipa heterozisa je pokazivala promjenljivosti od 4,7% za dob kod prve fertilne oplodnje do 17,2% za broj mrtvooprašene prasadi. Također, razina heterozisa za broj živooprašene prasadi je iznosio 4,7%. Statističkom analizom je potvrđeno da postoji značajna razlika između farmi. Utjecaj sezone na sve tri farme imao je statistički značaj. Većina analiziranih osobina pokazuje sličnu tendenciju kod čistih pasmina i hibridnih F_1 krmača tijekom životne proizvodnje.

Ključne riječi: reprodukcijske osobine svinja, križanje pasmina, heterozis efekt